Adopted October 19, 2021

CITIES OF SANDY SPRINGS AND DUNWOODY

TRANSIT SIGNAL PRIORITY IMPLEMENTATION PLAN

pin partnership for inclusive innovation

Georgia Tech CREATING THE NEXT

City of Dunwoody Georgia

ARC Atlanta Regional Commission

SANDY SPRINGS GEORGIA

Prepared by: Kimley»Horn

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The conclusions developed in this project reflect the research and analysis conducted in August 2020 to May 2021. Generally, this data reflects the local and national economic conditions prior to the widespread external economic shock caused by the COVID-19 pandemic and its dramatic shifts in transportation and commuting patterns. The assumptions reported herein do not account for a drawn-out economic downturn. These assumptions should be considered valid under a reasonably likely scenario in which transportation and commuting patterns stabilize and largely return to a normalized state within the 2021 calendar year. The data and the corresponding conclusions and recommendations herein should be reviewed and adjusted should any major changes in the above occur.

1 Introduction

The Atlanta Region – particularly the Cities of Sandy Springs and Dunwoody – have embraced the challenge of continuing to innovate and integrate technology for the purposes of managing, operating, and enhancing the existing multi-modal transportation system. The City of Sandy Springs has a long history of being on the forefront of emerging technologies. For example, the City was one of the first municipalities to adopt next generation wireless vehicular detection technology in the Southeast and is now seen as the technology leader when it comes to deployment of advanced technology.

The Cities of Sandy Springs and Dunwoody have maintained this forward-thinking approach to implement state-of-the-art Intelligent Transportation Systems (ITS), connected and automated vehicle, smart city, and internet of things applications. In addition, the focus on collaboration internally with City stakeholders and externally with partner agencies and the public, will continue to gain support for transportation technology, present opportunities for partnership, and be on the forefront of the industry.

The Cities' mature foundation and commitment to innovative solutions has led to the award of the Georgia Smart Communities Challenge 2020 (GA Smart) grant. The purpose of the GA Smart grant is to study the integration and implementation of a Transit Signal Priority (TSP) system and the impact of that system. TSP is the process by which an advantage is given to transit vehicles operating along the corridor through communication with the traffic signals; this can be accomplished through a variety of architectures and configurations depending on the goal of the deployment.

The purpose of this document is to develop a TSP implementation plan based on the results of the TSP Pilot Project, as well as national best practices, expected benefits, stakeholder outreach, and an understanding of existing conditions, potential partnership opportunities, and public support.

1.1 Georgia Smart Communities Challenge

The Georgia Smart Communities Challenge Program provides support for local governments to explore, plan, and implement "smart" technologies to achieve their community's goals. Communities throughout the State of Georgia are eligible to apply for funding. Selected communities are provided resources, a partnership with Georgia Institute of Technology (Georgia Tech) research team, networking opportunities, and access to additional, unique partnerships to execute their projects over the course of a year. The program is funded by the Atlanta Regional Commission (ARC).

Sandy Springs partnered with Metropolitan Atlanta Rapid Transit Authority (MARTA), Georgia Tech, and the City of Dunwoody to seek Georgia Smart Communities Challenge Program funding for the purposes of streamlining suburban transit. The application included a project vision, motivation, overview, partnerships, financial support, and letters of support from community

partners. In 2020, the City of Sandy Springs was one of four communities awarded this opportunity.

1.2 Sandy Springs and Dunwoody Transit Signal Priority Pilot Project

The City of Sandy Springs, in partnership with MARTA, Georgia Tech, and the City of Dunwoody, conducted a proof-of-concept study ("The TSP Pilot Project") for the use of innovative TSP technologies along MARTA Bus Route 5. The TSP Pilot Project leveraged the City's existing infrastructure used for emergency vehicle preemption (EVP) and MARTA bus location data published through an application program interface (API). The MARTA API gives access to transit vehicle tracking information without requiring an on-board unit (OBU) to communicate with the City's traffic signal infrastructure, which is different than other methodologies for TSP deployment. Additionally, the TSP functionality and interoperability across Sandy Springs and Dunwoody jurisdictions was tested. Transit on-time performance (OTP) along Route 5 was measured as well as additional operational impacts to the transportation network.

The TSP Pilot Project included the following goals:

- Test effectiveness of TSP using MARTA API
- Understand TSP impacts on transit, local signal equipment and other roadway travelers
- Understand TSP impact between different signal systems
- Identify next steps for implementation

The TSP Pilot Project is the first step to understanding how the Cities may consider implementing TSP. The Sandy Springs and Dunwoody TSP Pilot Project will inform how communities throughout the metro region and the State will implement TSP to support transit ridership and improve reliability and efficiency. Additionally, the project has led to conversations with MARTA and other regional partners about further opportunities for collaboration. Based on the results of the TSP Pilot Project, a review of best practices, and public feedback, the TSP Implementation Plan will guide the future deployment of TSP in Sandy Springs and Dunwoody.

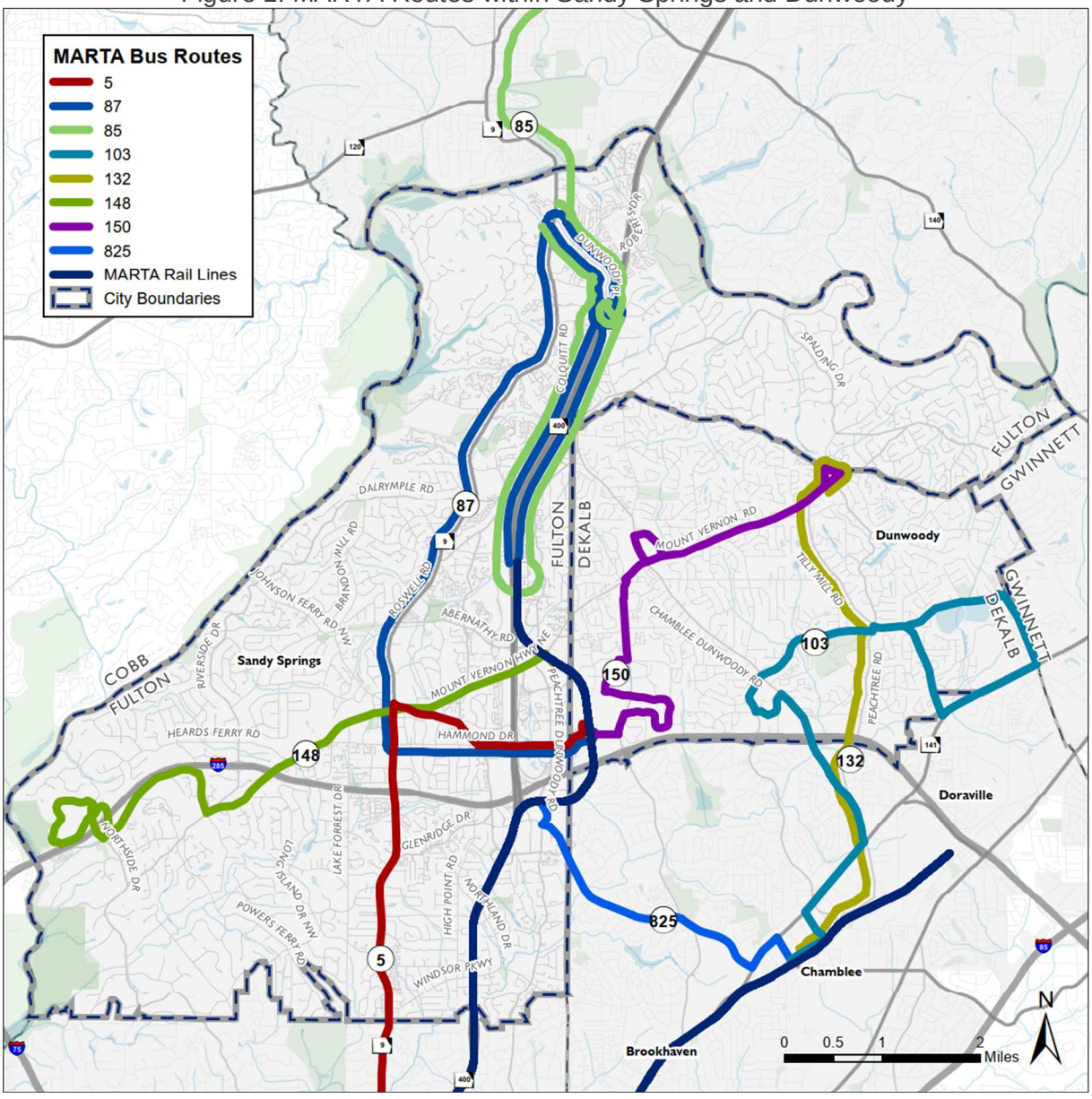
2 Existing Transit Environment and Engagement

The TSP Implementation Plan development process included a review of existing ITS technologies and solicitation of stakeholder and public input. Review of the existing transit environment, seven partner agency interviews, an online survey, and one stakeholder workshop were conducted to understand the TSP vision and needs of the Cities, investigate interagency collaboration potential, and refine high-level recommendations.

2.1 Existing Transit Routes

MARTA routes within Sandy Springs and Dunwoody include: Route 5, 85, 87, 103, 132, 148, 150, and 825 as shown in **Figure 1**.

Figure 1. MARTA Routes within Sandy Springs and Dunwoody



Existing Transit Route 5 Inventory

The City of Sandy Springs performed an inventory of MARTA Route 5 transit stop locations and conditions. Along Route 5, sixty (60) transit stop locations were inventoried. From the data collected, fourteen (14) stop locations that are currently near-side stops at signalized intersections have the potential to be relocated to the far-side of the signalized intersections. Far-side transit stops allow the transit vehicle to leverage TSP to traverse the intersection prior to stopping. Fourteen (14) stop locations along Route 5 currently have an existing shelter, and fifteen (15) stop locations have seating provided. MARTA has plans to replace one (1) existing shelter and add seven (7) new shelters along Route 5.

Existing Plan Review

The table below provides a brief summary of plans and documents completed in the City of Sandy Springs and City of Dunwoody that have been reviewed for transportation technology and transit relevant information. Chronologically organized, the inventory summarizes the planning efforts from 2017 to current and includes comprehensive plans, corridor studies, and transit plans.

Table 1. Existing Plan Review

Name	Description	Major Transit Related Recommendations
Last Mile Connectivity Study, March 2017 (Perimeter CID)	Study provides recommendations for improving last mile connectivity and increasing transit usage in the Cities.	– Implementing Complete Street Treatments – Improve transit facilities
The Next Ten Comprehensive Plan, Sandy Springs, February 2017 (City of Sandy Springs)	Long range plan that lays out framework and goals for future development in the City.	– Improve traffic operations and safety – Increase transit – Enhance public spaces
Comprehensive Transportation Plan Update, Adopted September 18, 2017 (City of Dunwoody)	Long range transportation plan that lays out goals and investment locations in the City as well as identifies short term plan for how budgets will be spent for the next 5 years.	– Prioritize multi-modal transportation options
North Fulton Comprehensive Transportation Plan, January 2018	Short term regional transportation plan for how budgets will be spent in the next 5 years as it relates to the long-range transportation plan.	– Improve traffic operations and safety – Increase transit
Fulton County Transit Master Plan, Update June 2019	Regional transportation plan that lays out framework and goals for investment in transit across the region.	– Improve transit bus stops – Implement transit technologies
City of Sandy Springs ITS Master Plan, November 2019 (City of Sandy Springs)	Long range intelligent transportation systems plan that lays out goals and investment locations in the City.	– Implement ITS initiatives – Improve and increase ITS devices and technology deployments – Implement TSP technologies and transit curbside management programs
Sandy Springs Transportation Master Plan, April 2021 (City of Sandy Springs)	Long-range transportation plan that lays out goals and investment locations in the City.	– Improve regional transit connectivity – Implement TSP technologies – Improve traffic operations and safety

2.2 Existing Transit Technology Environment

The City of Sandy Springs and the City of Dunwoody operate and maintain extensive ITS networks. The current communications networks support each of the Cities' ITS devices including, traffic signals and equipment, vehicle and pedestrian detection devices, closed circuit television (CCTV) cameras, and Bluetooth readers.

Communications Network

Through their respective Traffic Management Centers (TMCs) the Cities operate and maintain their ITS networks. Each TMC features an operations room where the CCTV camera images, signal operations, and ITS devices are monitored and managed for each respective City. To further enhance operations across jurisdictional borders the City of Sandy Springs and the City of Dunwoody have direct center-to-center fiber communications between their TMCs, and with Georgia Department of Transportation (GDOT). The current communications networks are made up of fiber optic cable, wireless radios, and cellular modems. These communications networks support the Cities' ITS devices including, traffic signals and equipment, vehicle and pedestrian detection devices, CCTV cameras, Bluetooth readers, and Field Monitoring Units (FMU) which support EVP and TSP.

Traffic Signals

The City of Sandy Springs traffic signal system currently includes one-hundred thirty-six (136) signalized intersections, all of which are maintained by the City. The traffic signal system uses two (2) Siemens traffic controller software programs and central software programs that work together to provide users with a safe and efficient travel experience. The majority of the existing traffic signals currently operate using Siemens adaptive signal timing system Split, Cycle, and Offset Optimization Technique (SCOOT) and is monitored with the SCOOT central software. The remaining traffic signals operate using Siemens SEPAC 2070 local controller software monitored with Siemens TACTICS central system software. These controllers support fixed time, actuated, adaptive, and traffic responsive operations.

The City of Dunwoody traffic signal system currently includes sixty-six (66) signalized intersections, most of which are maintained by the City with assistance through GDOT. The traffic signal system uses Q-Free Intelight MaxTime traffic controller software program and Q-Free Intelight MaxView central software to monitor and control their network. These controllers support fixed time, actuated, adaptive, and traffic responsive operations.

The Cities of Sandy Spring and Dunwoody are currently part of the GDOT Signal Operations Program (SigOps), which focuses on regional traffic operations. The SigOps team works closely with the Cities to actively monitor and manage the signalized intersections during peak periods, providing signal timing support, upgrading/installing equipment, and monitoring communications.

Emergency Vehicle Preemption

The City of Sandy Springs has deployed connected vehicle (CV) FMU devices (Applied Information Glance devices), at all traffic signals, which are used for EVP for the Fire Department. EVP devices are installed on the emergency vehicles and provide information to the traffic signals to streamline signal timing along the route of the emergency vehicle reducing response time and increasing safety. **These existing FMU devices were leveraged for the TSP Pilot Project.**

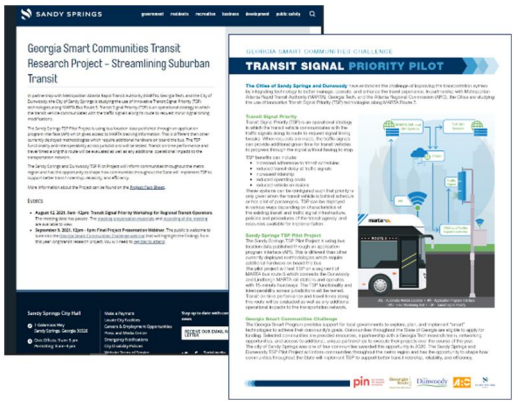
Dunwoody Fire Department currently utilizes a traffic signal preemption system at three (3) fire station locations. The current traffic signal preemption systems are push button activated, which initiate signal timing changes to allow the emergency vehicles to exit the station and route quickly through nearby traffic signals by providing green signals. The City of Dunwoody does not have additional CV or TSP equipment installed at their traffic signals at this time.

2.3 Engagement and Collaboration

Collaboration and partnership between transit agencies and jurisdictions which maintain the traffic signals is important to successfully implement TSP. In the Metro Atlanta region, there are many different transit agencies which operate across many different jurisdictions. Collaboration with stakeholders is important to determine opportunities for investment in TSP technologies within and across jurisdictions. Reaching a diverse group of stakeholders, interagency interviews, a stakeholder workshop, transit operator interviews, and a transit usage survey were conducted to solicit feedback to guide the development of the TSP Implementation Plan.

Outreach

Sandy Springs developed a project website to provide information to stakeholders and the public about the TSP Pilot Project and related upcoming events. Included on the website was a fact sheet that was developed to provide additional information. The fact sheet, shown in the **Appendix**, aims to provide a basic description of the purpose and benefit of TSP in the Cities of Sandy Springs and Dunwoody, engaging a broader audience and demonstrating the value of the current and continued investments of the City.



Interagency Interviews and TSP Workshop

The interagency interviews were conducted and focused on current TSP technologies, future opportunity for collaboration, and improvement within the realm of transit operations through the use of transportation technology. These interviews served as an opportunity for each agency to provide input and ideas specific to what was most relevant to their current needs and experience with TSP.

Interagency coordination interviews were held with the following agencies:

- MARTA Technology and Customer Experience
- MARTA Planning
- MARTA Operations
- Atlanta-Region Transit Link Authority (ATL)/Xpress
- Perimeter Connects
- Gwinnett County Transit
- CobbLinc

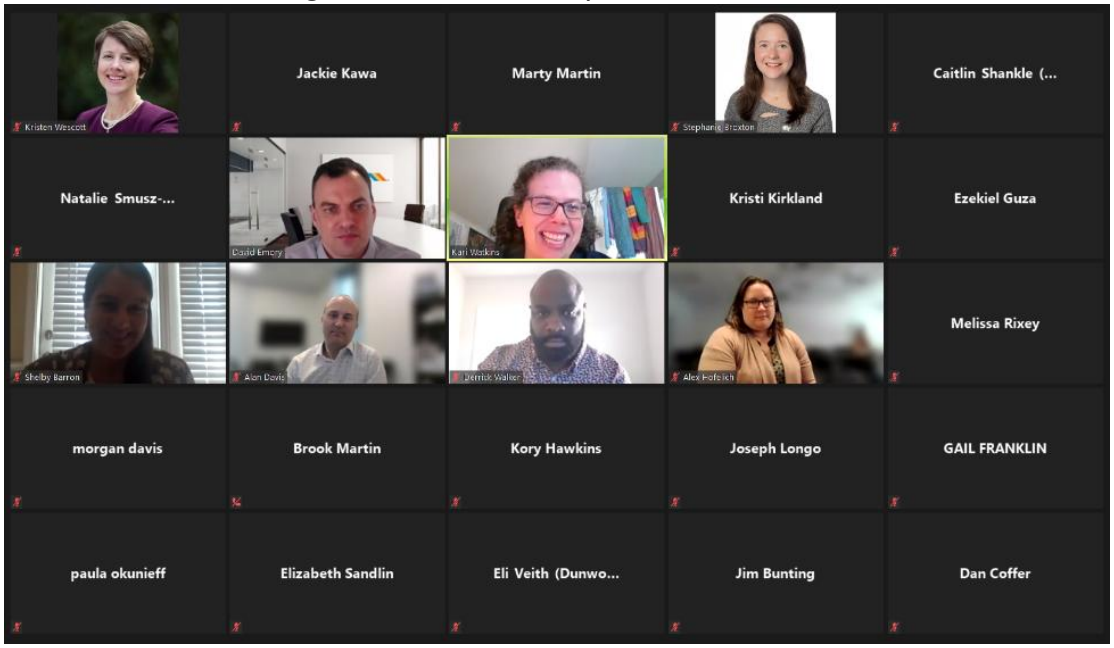
Each stakeholder participated in a thirty (30) minute interview. During the interview each participant was asked the following questions:

- What are your general thoughts pertaining to TSP as a deployment?
- What do you consider the existing strengths and challenges related to coordination, collaboration, and implementation within the realm of TSP?
- What are your current plans and considerations for implementing TSP from a technology perspective?
- What are the greatest opportunities for implementing TSP?
- What is your agency's current plan for considering or implementing TSP?
- What is your vision for the on-going partnership with the City of Sandy Springs and Dunwoody? How can this partnership be leveraged to make best use of TSP?

The responses from the interviews were summarized into themes: 1) Existing needs and challenges; 2) TSP opportunities; and 3) Collaboration opportunities. The major takeaways from the stakeholder interviews informed the direction of the panel discussion of the TSP workshop, where consistent topics were discussed further. The summary of the interviews is included in the **Appendix**.

An interagency TSP Workshop was held virtually on August 12, 2021 with stakeholders and regional agencies as part of the Georgia Smart Program site visit. The goal of this meeting was to discuss TSP, share initial pilot project findings, and identify potential interoperability between partner agencies.

Figure 2. TSP Workshop Panel Discussion



During the workshop, representatives from GDOT, MARTA, Gwinnett Transit, CobbLinc, and Atlanta-Region Transit Link Authority (ATL) engaged in discussion about past experiences and

opportunities with TSP, limitations of TSP, and cross-jurisdictional collaboration opportunities, shown in **Figure 2**. The panel discussion was facilitated by Dr. Kari Watkins who has extensive experience in the field of transit research and served as a research partner for the Georgia Smart Program. The major takeaways from the discussion and interagency interviews are presented below.

Needs and Challenges

Agency stakeholders discussed in more detail the needs and challenges of implementing TSP. First, it is important that the traffic signal infrastructure system can support TSP along with the technology of the transit systems. Second, collaboration between the transit agencies and local jurisdictions is critical to ensure the TSP technologies are compatible from one system to the next. The transit agencies have routes that cross many jurisdictions, so they must coordinate to be able to provide TSP along all routes. One of the challenges is that there are many different methods for TSP deployment – different technologies and architectures – it is difficult for an agency to invest in a particular solution without regional coordination. There are also challenges related to network connectivity and security issues that can arise when connecting different technologies and networks.

Staffing resources and expertise are limited for implementing TSP. Each agency is limited by the number and size of projects their staff are able to coordinate which can make TSP implementation, operations, and maintenance challenging.

Lastly, TSP is only one tool that can be implemented to improve transit performance and reliability. There are complementary improvements to make TSP most effective. There are many factors which impact transit efficiency, such as scheduling, fare collection, congestion, signal timing, etc. Additionally, the traffic network supports many modes of travel (vehicles, bicycles, pedestrians) and balancing the needs of all users can be challenging.

Collaboration Opportunities

TSP and cross-jurisdictional operability was a primary discussion topic for all the stakeholders. There is an opportunity to discuss TSP at a regional level. A regional TSP plan could provide the following benefits:

- Ensure regional jurisdictions and partner transit agencies are informed of TSP plans and initiatives within different jurisdictions
- Cross-jurisdictional collaboration to build infrastructure
- Cost and technology sharing opportunities
- Ensure inoperability of technologies and practices across the region

In addition to the TSP-focused discussion, interviewees and workshop participants discussed the opportunity to create a regional transit application which could be used by transit riders to provide fare collection for multiple transit agencies, route planning, and real time information. The ATL is currently working on development of the ATL RIDES which is a complete trip planning application; fare collection has been discussed but is not within the scope of development for ATL RIDES at this time.

Perimeter Connects expressed interest in collaborating with Sandy Springs to develop a TSP pilot project for their private shuttles. Perimeter Connects provides last mile connectivity from MARTA

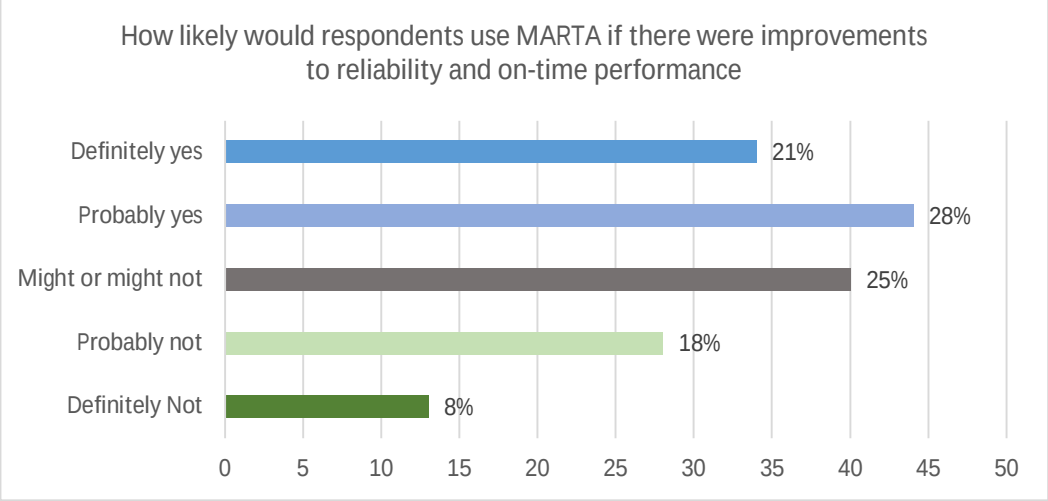
transit stations to a variety of employers and commercial properties within the Perimeter Community Improvement District (CID).

Non-Transit Rider Survey

To understand why residents and commuters in Sandy Springs do not currently use transit, specifically buses, the City of Sandy Springs developed an online survey which was released on June 28, 2021 and closed July 16, 2021. The goal of the survey was to understand existing transit usage and if improvements in reliability and reduced travel time from TSP technologies would encourage respondents to use transit in the future. The results of the survey are included in the **Appendix**.

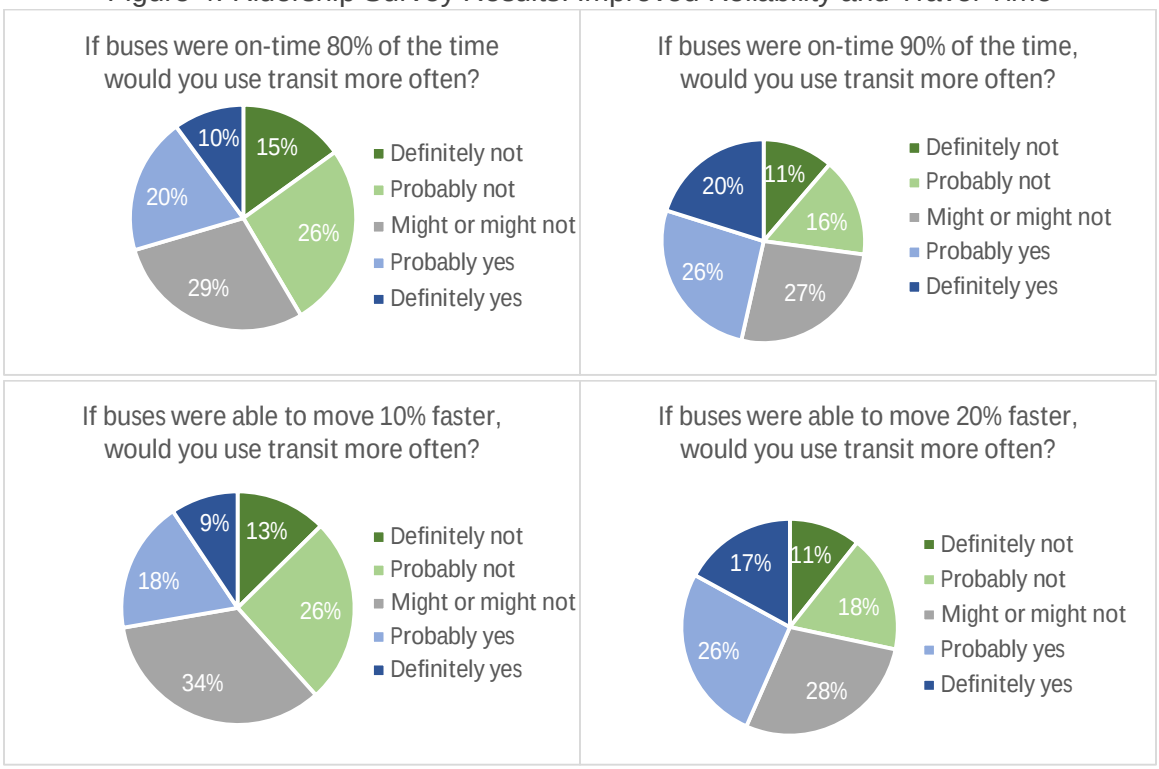
The City received approximately one-hundred sixty (160) completed survey responses with most of the respondents indicting they use transit at least occasionally. The survey respondents were asked the main reasons why they do not take transit more regularly. The majority of the respondents indicated long travel times, proximity to transit, and reliability as the main reasons for not taking transit. The survey asked additional questions to determine if respondents would be more likely to use transit if improvements in reliability and OTP were improved. The results of the survey indicated that 49% of the respondents said they would use transit if there were improvements to reliability and OTP. The results are shown in **Figure 3**.

Figure 3. Transit Usage Survey Results: MARTA Use with Improvements



To better understand the necessary magnitude of improvements needed for respondents to use transit, the survey asked if they would use transit more often in the following scenarios: 1) if buses were on time 80% of the time compared to 75% today; 2) if buses were on time 90% of the time compared to 75% today; 3) if buses were able to move 10% faster (save 3 minutes on a 30 minute trip compared to today); and 4) if buses were able to move 20% faster (save 6 minutes on a 30 minute trip compared to today). The results of these questions are shown in **Figure 4**.

Figure 4. Ridership Survey Results: Improved Reliability and Travel Time



Based on the results of the survey, improvements to reliability and travel times could encourage Sandy Springs travelers to take transit more often. The results of the survey identified several other factors that impact the decision for residents to use transit, such as transit stop proximity, which would not be improved by TSP technology. Investments in transit technologies and other methods to improve the transit reliability and mobility in Sandy Springs may encourage more residents to utilize transit rather than single-occupancy vehicles.

MARTA Operator Interviews

The City of Sandy Springs conducted interviews with MARTA bus operators of Route 5 to provide supplemental information to the data analysis from the TSP Pilot Project. The interviews were conducted on July 15, 2021 at MARTA's Perry Garage. A total of six (6) bus operators were interviewed with driver operating experience ranging from eleven (11) months to twenty-five (25) years. During the interview the operators provided insight regarding operating procedures, potential improvements for Route 5, and TSP operations during the TSP Pilot Project. A complete summary of the bus operator interviews is included in the **Appendix**.

The bus operators identified congestion as the main source of delay along Route 5 due to high traffic volumes and construction. The operators identified common times of congestion between 2:30PM and 6:00PM on weekdays. Additionally, the operators identified locations where they are delayed due to high traffic volumes, vehicles not allowing the buses to merge back into traffic, where they see frequent crashes, and stops with high number of boardings. The operators discussed additional delay can be caused from helping customers buy bus fares and arriving late to the start of the route due to congestion delays traveling from the bus garage.

With many interruptions to the route, the operators discussed operational procedures they use to stay on time. For example, when running behind schedule some operators allow riders to board

while they are still finding their fare instead of requiring payment right away. The operators also discussed how being ahead of schedule was also a challenge as the operators do not want to wait at time check points and impede traffic. Some operators drive slower so they do not arrive early at a time check point.

During the interviews, the operators were asked if they were familiar with TSP and the TSP Pilot Project. Most of the operators were unfamiliar with the current TSP Pilot Project but a few operators did notice there may have been changes to the traffic signals along Route 5 during the pilot time period. The participants thought the TSP technology would be valuable to the operators and riders. All participants approved of TSP and its efforts to improve reliability and travel times for riders and operators who drive the route.

Commitment to Transit

Sandy Springs strives to enhance safety, mobility, connectivity, and efficiency throughout all modes of travel to improve the quantity of life for all residents. The goal of "maximizing the potential of the city's transit infrastructure by managing transit systems, concentrating development around existing and future MARTA stations, and providing better access to these transit assets" has been formally adopted in the City's 2017 Next Ten Comprehensive Plan. To achieve these goals, the City is committed to improving transit and transportation technologies. The information and guidance provided by the TSP Pilot Project, workshop, and interviews supported the continued investment in TSP technologies as one component of improving transit operations.

3 Transit Signal Priority Background and Best Practices Review

TSP is an operational strategy that facilitates the prioritized movement of transit vehicles through signalized intersections. By adjusting traffic signals to extend green indications or shorten red indications when transit vehicles are present, transit travel times are improved. The objectives of TSP are to increase transit reliability, improve schedule adherence, and reduce delay for transit vehicles and their customers while minimizing impacts to normal traffic operations.

TSP is different from preemption; preemption terminates normal traffic operations to provide service to a special task. Typical applications of preemption are at railroad crossings and for emergency vehicle passage. EVP is currently operating in the City of Sandy Springs and the City of Dunwoody. EVP facilitates the movement of emergency vehicles to improve response times. Normal traffic operations can be disrupted by EVP. TSP provides preferential treatment to transit vehicles and is typically accomplished with limited disruption to coordinated and adaptive traffic signal operations. Active TSP uses detection and subsequent priority request activation to alter traffic signals by extending green time for buses approaching an intersection, advancing green time for buses waiting at the red phase, or more advanced options such as transit activated phases, phase insertion, or phase rotation.

3.1 TSP Operational Conditions and Descriptions

The following are some of the potential TSP operational conditions that should be considered for Sandy Springs and Dunwoody.

Passive Priority

Passive signal priority provides an advantage to transit vehicles traveling along a corridor without the vehicle communicating with the traffic signal to acquire priority. This priority is typically provided through improvements in signal timing to provide better progression for the buses, accounting for the differences in travel speeds between cars and buses and providing preference to buses instead of cars. Passive timing changes can be accomplished on an intersection-by-intersection basis or for an entire corridor, depending upon the extent of priority needed. Advantages can also be gained through the coordination or retiming of signals to accommodate bus travel patterns. Because it involves adjusting the typical signal timing parameters, passive priority will occur every cycle for the time period it is programmed. This timing gives the bus a priority over general traffic, reducing delays for the bus and improving travel time for the passenger. It is recommended that Sandy Springs and Dunwoody consider adjusting timing parameters at intersections along bus routes to improve coordination for buses. It may be possible to adjust the timing parameters to improve bus coordination without negatively impacting coordination for all vehicles.

Active Priority

Active TSP is the process by which an advantage is given to transit vehicles operating along the corridor through communication with the traffic signals. The advantage can be received through the extension of green time for buses approaching an intersection or advancing green time for buses waiting at the red phase. The use of TSP can be scheduled for all-day, during peak hours, or some other defined time-period of the day. Signal priority can be implemented at single

intersections or throughout an entire corridor. Active TSP is not likely to occur every cycle during its programmed time period since it is activated only by the presence of a transit vehicle. More advanced signal priority systems can be tied to the bus schedule, only giving priority when a bus is behind schedule. One other option includes headway consistency, where transit priority is granted if buses are behind a pre-defined headway. Other systems provide the benefit to the bus every time it approaches an intersection regardless of schedule. The latter ensures that buses not only remain on schedule, but also improves overall travel times. For this TSP Pilot Project, priority was requested if the buses were at least one (1) minute behind the schedule. A number of active priority TSP conditions are described in the following paragraphs. It is recommended that Sandy Springs and Dunwoody consider the use of Active TSP and its associated operational conditions in implementing TSP.

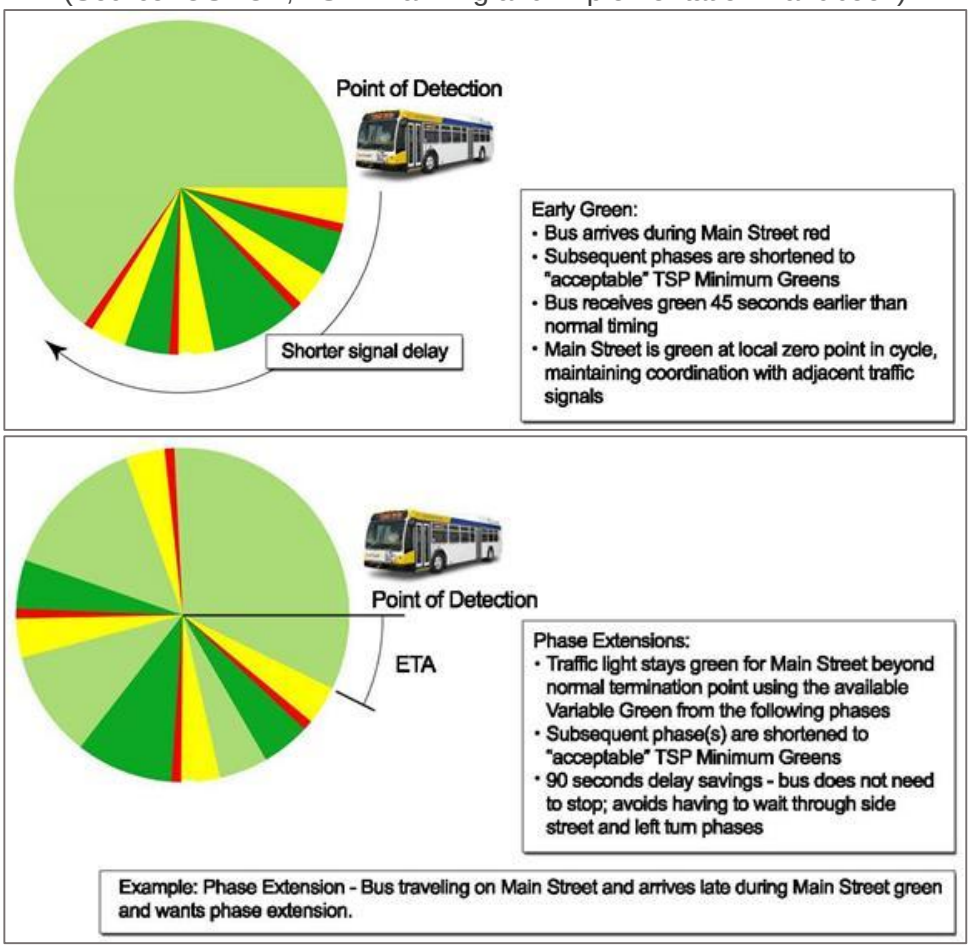
Early Green and Extension of Green

An early green shortens the green time of preceding phases to expedite the return to green (i.e., red truncation) for the movement where a TSP-capable vehicle has been detected and the priority logic has been satisfied. This strategy only applies when the signal is red for the approaching TSP-capable vehicle. The early green interval is set to a maximum threshold to prevent unnecessary congestion along other approaches. Depending on the typical queue length, this amount may be changed to allow more or less vehicles to get the advantage of the early green, and clear the intersection, including the transit vehicle.

A green phase extension strategy extends the green time for the TSP movement when a TSP-capable vehicle is approaching and the priority logic has been satisfied. This strategy only applies when the signal is green for the approaching TSP-capable vehicle. The extension of green is set to a maximum threshold to prevent unnecessary congestion along other approaches and will be truncated once the bus leaves the intersection.

Figure 5 shows examples of early green and green extension.

Figure 5. Example of Early Green and Green Extension
(Source: USDOT, TSP: Planning and Implementation Handbook)



Phase Insertion and Phase Rotation

Phase Insertion is when a special priority phase is inserted within the normal signal sequence. The phase is only inserted when a transit vehicle is detected and requests priority for this phase. An example would be an exclusive transit phase or when there is an insertion of a leading left-turn-only phase for transit vehicles entering an off-street terminal on the opposite side of the street. The controller must possess the ability to process that additional phase, beyond the normal eight-phase limitation (if needed).

Phase Rotation refers to the order of signal phases to provide TSP. For example, a northbound left-turn phase could normally be a lagging phase, meaning it follows the opposing southbound through signal phase. A northbound left turning bus requesting priority that arrives before the start of the green phase for the through movement could request the left-turn phase. With the phase rotation concept, the left-turn phase could be served as a leading phase in order to expedite the passage of the transit vehicle.

Queue Jump Operation

Queue jump operation allows the transit vehicles to bypass regular traffic, through either a separate turn-bay, through a right-turn lane, or at a transition lane between exclusive transit lanes and mixed flow lanes, through the use of special bus phasing operation. The bus bay allows the

bus to proceed straight through the intersection, bypassing traffic at the intersection to access a far-side bus stop or to continue without waiting at the intersection. The use of a queue jump and signal priority treatments can provide a means for transit to gain an advantage over general traffic when used in conjunction with a near-side bus stop or at a transition point. Queue jumps and signal priority can also be an effective way to provide time savings to buses in corridors in which it is not feasible to dedicate the entire corridor as exclusive transit lanes. The bus would travel in mixed traffic until it reaches the queue jump and bypasses traffic before proceeding through the intersection.

While not providing the level of priority an exclusive transit lane does, the queue jump provides a certain level of time savings the bus would not otherwise receive. Queue jumps are particularly effective in providing time savings at locations where the transit vehicle experiences the most delay, such as known and consistent bottlenecks at signalized intersections. The queue jump operation, however, requires either a dedicated bus bay or a shared right-turn lane. Due to the advantage of a queue jump operation, it should be considered wherever there is an appropriate right-turn lane, room for an additional lane, or at a transition point between dedicated and mixed flow lanes.

Always-On

The always-on operation will grant priority at all times, when a bus is in operation, independent of schedule or headway. This option provides maximum benefit to the transit vehicles. It provides an advantage to a bus vehicle, regardless of its schedule (on, ahead, or behind schedule). The always-on operation can be programmed on a time of day or day or week basis as well. In such an operating condition, TSP will be granted during certain times of day or days of week. For example, a TSP can be granted during non-peak hours. The advantage of always-on system is simplicity in operation and the advantage that it can provide to transit vehicles.

If the always-on logic is selected, that decision can be made locally at the controller level, with firmware capability added. If the TSP firmware does not already exist in the traffic signal controller, there is a license and integration cost to enable this capability.

Headway Based

In a headway-based operation, the priority logic will be granted based on a pre-defined headway between buses. The headway parameter can be user defined and can be variable based on time of day, day of week, or any other desired parameters. The bus transmits its priority request to the intersection, and the priority request server will manage the priority activity to maintain the desired headways between buses. Buses that arrive sooner than the headway will not receive priority and those that arrive later will get the benefit of priority.

The headway-based priority is not dependent on the bus schedule. Once the first bus travels along the corridor, subsequent buses, independent of direction, will set an established headway. This headway, as described earlier, can be changed during the day, based on the bus schedule or priority request importance. A headway-based system manages to provide an advantage to the buses that are behind schedule (indirectly) by maintaining a consistent headway among the bus fleet. It also tends to reduce “bunching” of the buses and improve system operation. Buses which are running faster than anticipated are “penalized” by denying the priority request as the goal is to maintain a consistent headway among the buses.

Schedule Based

In a schedule-based operation, the priority logic will be granted based on the actual, real-time location of the buses. A priority will be granted if a bus is behind a pre-defined schedule, based on the Automatic Vehicle Location (AVL) system. The AVL system must receive information from scheduling software / databases to compare actual bus location to the bus's schedule. This comparison is a key portion of the conditional priority system because only late buses should receive signal priority. This condition will create a more efficient use of the signal priority modifications at the intersection, where priority is granted only if a bus is behind schedule. This system requires a robust communications system and an updated schedule database of the bus operation.

Adaptive Transit Signal Priority

Adaptive TSP provides priority while simultaneously optimizing general traffic progression and vehicular delays. Adaptive signal control systems continuously monitor traffic conditions and adjust control strategies. When using an adaptive system, it is possible to take into account person delay, transit delay, vehicle delay, or a combination of these criteria.

To take advantage of adaptive signal control systems, TSP would typically require early detection of a transit vehicle in order to provide more time to adjust the signals to provide priority while minimizing traffic impacts. Adaptive systems combined with TSP also may require the ability to update the transit vehicle's arrival time, which can vary due to the number of stops and traffic conditions. The updated arrival time can then be fed back into the process of adjusting the signal timings.

Typically, an adaptive TSP needs to have the following components:

1. A detection means that allows accurate prediction of bus time-to-arrival to the intersection in real-time when vehicle is within a specified range
2. A traffic detection system
3. A signal control algorithm that adjusts the signals to provide priority while explicitly considering the impacts on the rest of the traffic and ensuring pedestrian safety
4. A vehicle to infrastructure communications links; priority request generator (PRG), a priority request server (PRS), and a control system with real-time signal timing strategies to facilitate adaptive TSP

3.2 Transit Signal Priority Architecture Types

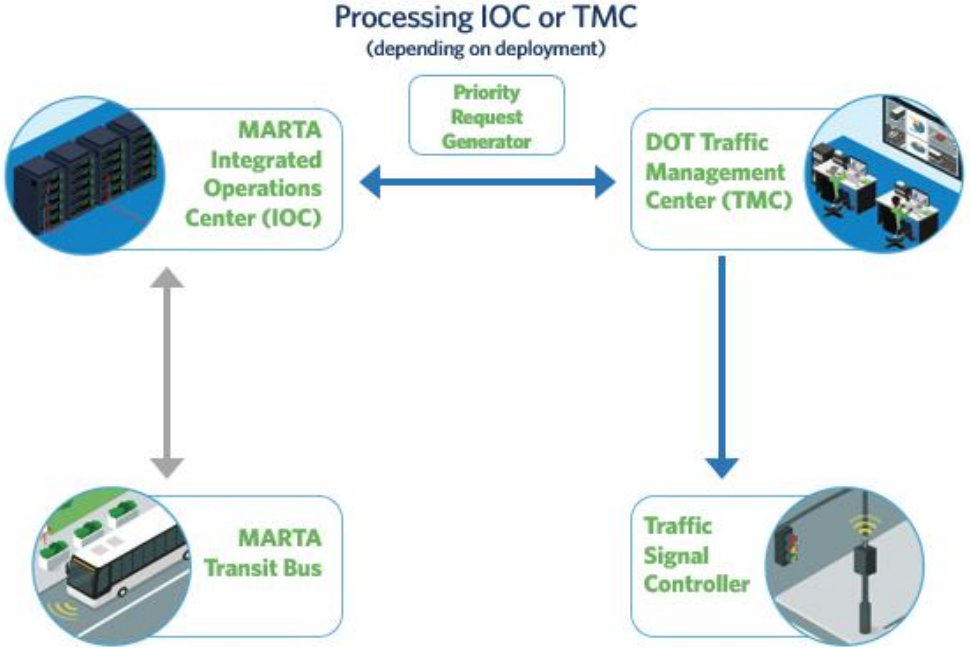
TSP systems consist of four primary components: the transit vehicle detection system, the PRG (a priority generator based on the detection device), the PRS (signal controllers and embedded priority logic), and the support systems that allow the agencies access to data for management of the system (transit and traffic monitoring systems). Architecture types vary based on physical configuration of equipment, hardware, and processing of logic. The following architecture types have been generally categorized as distributed or centralized systems. Both systems have possible variations in the architecture that can allow for additional options based upon these TSP systems. The following is a general description of several options, using MARTA as an example transit partner agency.

Centralized System

The centralized priority system is where the priority request is generated either at the MARTA Integrated Operations Center (IOC) or at a TMC. The decision regarding the location for the centralized system should be made through discussions between MARTA and the TMC.

Priority is granted on the local controller level based on direction from either operations center. This system is advantageous in situations where the local jurisdictions have their signal controllers connected to a centralized system with real-time communication, and the central system has the capability to determine whether to grant priority based on predefined conditions – schedule adherence, headways, conflicting calls, ridership, etc. Another advantage of a centralized system is that all records of the system operation can be maintained centrally, and changes can be easily implemented across all systems from the central location. An example of a centralized system TSP architecture is shown below in **Figure 6**.

Figure 6. Centralized System

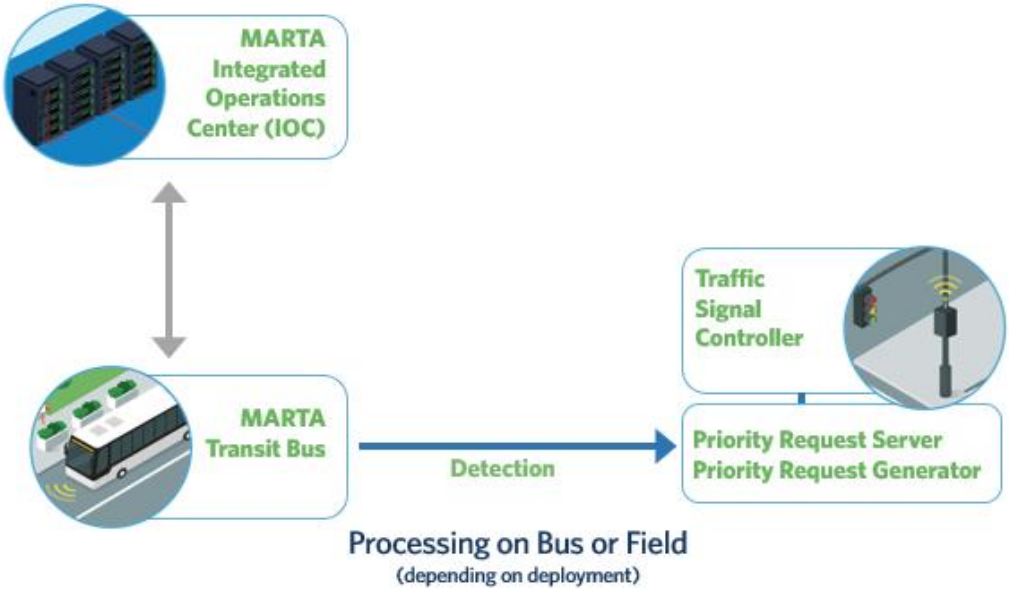


Distributed System

A distributed priority system does not involve a centralized location in the decision-making process. All decisions to request and grant priority are made at the local intersection level. A distributed priority system is where the priority request is produced by the transit vehicle and is detected and served at the local traffic signal controller. The signal controller software contains the priority logic and serves the request locally. Also, regardless of which system is used, the controller software must be capable of processing low priority.

For this project, a distributed priority system would not involve the MARTA IOC nor a TMC in the decision-making process. A graphic illustrating a distributed architecture as it pertains to this project is included in **Figure 7**.

Figure 7. Distributed System

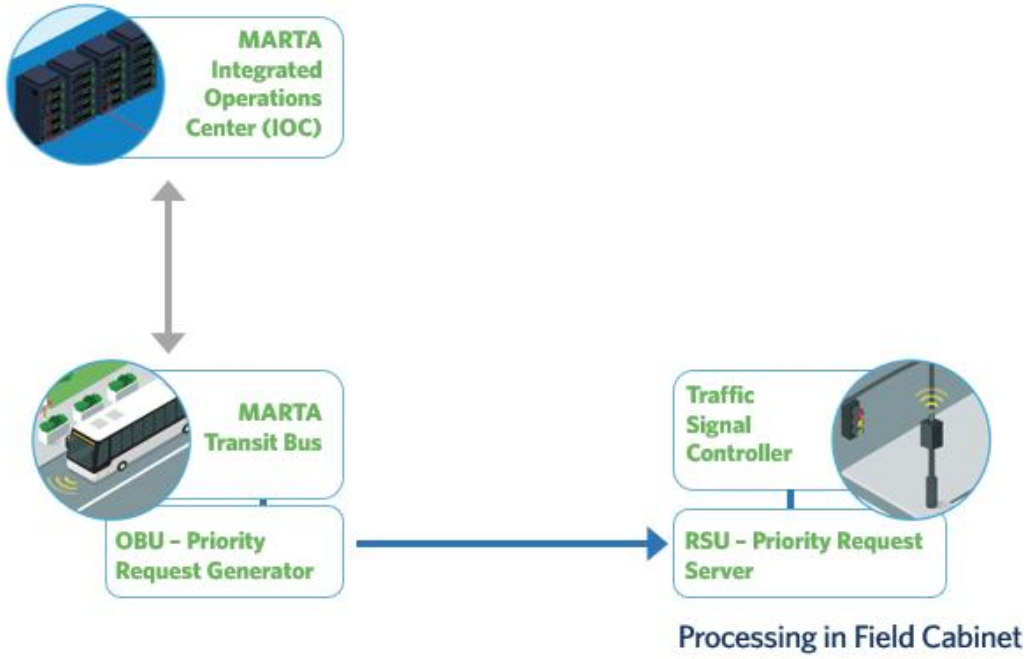


Distributed – Connected Vehicle Concept

The CV concept is a variation of a distributed system that utilizes CV technology to request and grant priority. In this system, the TSP logic resides on the bus that determines whether to request priority. The fleet vehicle contains the information necessary to determine whether to request priority based on predefined conditions, which will consider schedule adherence, location, route, doors closed, etc. In order for the vehicle to meet the schedule adherence condition and request priority, the on-board AVL system is integrated with the scheduling system. This processing is accomplished on-board the vehicle with the AVL system comparing its location to time points in the schedule. The schedule is uploaded to the vehicle daily. Once the vehicle is behind its schedule by a predefined threshold, the priority system is activated. The equipment for TSP is integrated with the schedule status within the AVL or duplicates that information by using the existing data flows within the system. The system does not require a center-to-center connection between the MARTA IOC and the TMC. **Figure 8** displays a graphical representation of the CV concept.

An OBU resides on each fleet vehicle to communicate priority requests to the individual intersections. The individual traffic controllers would receive the priority message from the fleet vehicle via a Roadside Unit (RSU) located at the intersections. The priority message would be transmitted from the RSU to the signal cabinet where the priority request is processed, and the signal timing parameters are adjusted.

Figure 8. Connected Vehicle Concept



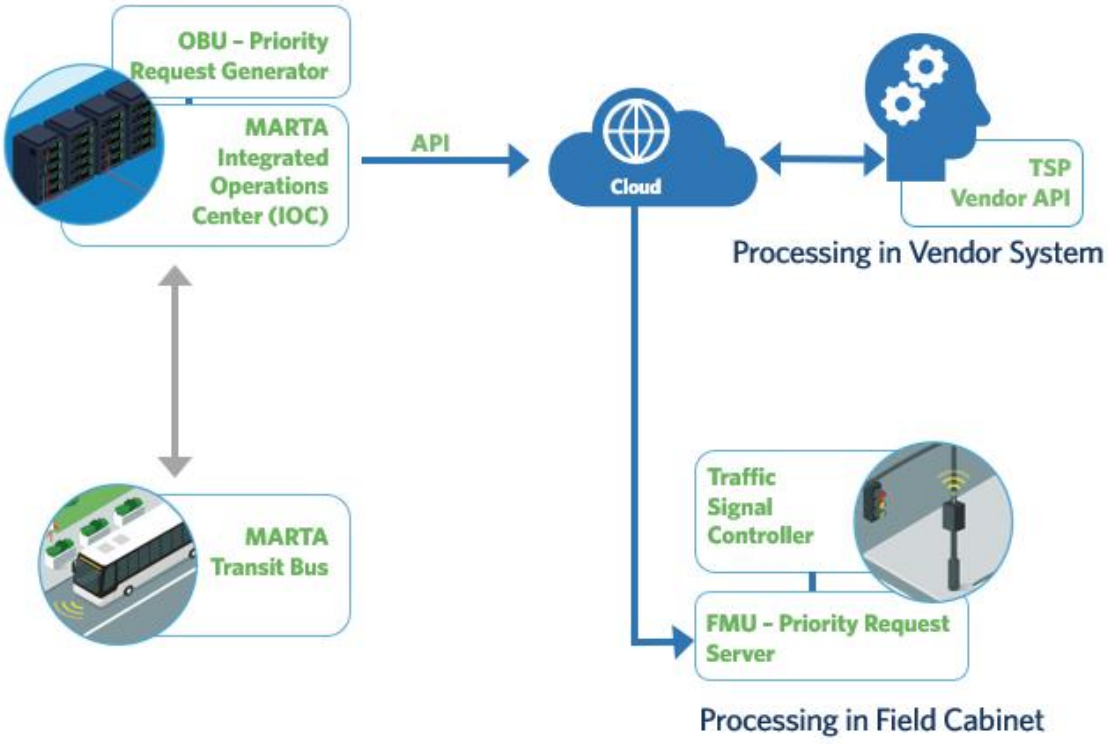
Hybrid Pilot Concept

The hybrid pilot concept is a system that uses components of both centralized and distributed systems. This architecture was developed and deployed for the Sandy Springs and Dunwoody TSP Pilot Project. The hybrid pilot operates as a centralized system because the transit bus does not communicate directly with the field equipment. Instead, the decision priority request is generated from the vendor system based on a transit agency API. However, similar to a distributed system, field hardware is required in the form of CV FMUs located at each intersection. The hybrid pilot concept process is as follows:

- MARTA bus transmits AVL data to the MARTA sever where it is placed in a real time database.
- MARTA's computer aided dispatch (CAD) system uses the AVL data to determine transit vehicle location, speed, heading, and schedule adherence.
- MARTA AVL/CAD data is processed and published in the form of MARTA API.
- TSP Vendor then subscribes to MARTA AVL/CAD API through a web server.
- TSP Vendor processes the data and transmits a TSP Vendor API to the FMU.
- FMU processes the TSP Vendor API and places a call for priority with the traffic signal controller.

Figure 9 displays a graphical representation of the hybrid pilot concept.

Figure 9. Hybrid Pilot Concept



Although the hybrid pilot was tested for the TSP Pilot Project, other architectures could be implemented depending on the desired direction of the transit agencies. Some of these architectures will provide better functionality and interoperability with existing infrastructure and reduce the need for additional coordination and cost. For example, if MARTA chose to install OBUs on all buses, Sandy Spring's current signal system could implement TSP by leveraging a CV architecture.

3.3 National Best Practices

TSP has been implemented with regularity across the nation and internationally with some systems operating continuously for decades. These deployments vary in scale, architecture type, TSP technology, and timing strategies and were among the systems reviewed for best practices and compiling lessons learned to aid in the implementation of TSP in the Cities of Sandy Springs and Dunwoody. **Table 2** provides examples of some of the documented national TSP deployments. This list demonstrates a sample of the variety of individual systems referenced in the search for best practices.

- King County Metro – In King County, Washington, King County Metro operates TSP for buses at two hundred (200) intersections along nine (9) routes. Utilizing distributed, conditional priority, this system was reconfigured in 2010 to use more reliable vehicle-to-infrastructure (V2I) communications. King County Metro coordinates with various state, county, and city governments that operate and maintain the traffic signals throughout the system. The agency stated that their benefits include improvements in bus speed, travel times, travel time variability, intersection approach delay, and headway adherence. Recommendations from this deployment include ongoing system optimization and ensuring that evaluation of the TSP system is based on standardized data. This allows for an accurate evaluation of the performance of the system and its benefits, along with keeping the parameters up to date as traffic conditions change.

- Pace Suburban Bus/Chicago Transit Authority (CTA) – In Illinois, Pace Suburban Bus and the CTA are operating and expanding TSP for buses to hundreds of signalized intersections along fourteen (14) corridors throughout the Chicago region. Utilizing distributed, conditional priority, this system began implementation in 2016. Pace and CTA coordinate with Chicago Department of Transportation (CDOT) and Illinois Department of Transportation (IDOT) who own and maintain the traffic signals along the corridors. The agencies stated that their benefits include improvements in bus travel times and reliability. Recommendations for system improvement include collection of second-by-second AVL data to measure the effectiveness of TSP. This second-by-second data should allow for a more accurate calculation of performance measures such as signal delay and the number of stops when doing before and after comparisons.

- Toronto Transit Commission (TTC) – In Toronto, Canada, the Transit Commission operates TSP for streetcars and buses on approximately two hundred (200) intersections including four (4) bus routes. This system utilizes distributed, unconditional priority architecture. TTC collaborates with Transportation Services, which owns and maintains the traffic signals throughout the system. The agency has seen improvements in bus speed and reliability. Lessons learned include that TSP success is dependent upon the signal controller and the timing parameters chosen. The signal controller and the timing

parameters are responsible for the final step of TSP activation and determine the time savings that can be gained from TSP and how it impacts other vehicles.

- San Francisco Municipal Transportation Agency (SFMTA) – In San Francisco, California, the Municipal Transportation Agency operates TSP for buses on four-hundred fifty (450) intersections that covers eleven (11) routes. Utilizing distributed, unconditional priority, this system has been in operation since 2013. SFTMA manages the entire TSP system included the traffic signals and their timing, so no coordination with other agencies is required. The agency has seen improvements in bus travel times, travel time variability, and delay at intersections. Lessons learned include the need for adjusting TSP parameters to account for operator behavior and the importance of baseline data collection for benefit analysis. If operators are not aware of how TSP impacts or changes the signal timing, the unexpected timing changes may result in the TSP benefits being wasted.
- San Diego Metropolitan Transit System (MTS) – In San Diego, California, the MTS operates TSP at fifty (50) intersections along four (4) bus routes. Utilizing distributed, unconditional priority, this system has been in operation since 2014. MTS coordinates through formal agreements with local governments that operate and maintain the traffic signals throughout the system. The agency has seen benefits in bus travel times, schedule adherence, headway adherence, bus travel time variability, headway variability, and delay at intersections. Their lessons learned include the importance of having a responsive and proactive system maintenance to troubleshoot issues when part of the system fails.
- TriMet - In Portland, Oregon, TriMet has been operating TSP for buses along three-hundred seventy (370) intersections on eight (8) plus corridors. Utilizing distributed, conditional priority, this system has been operating since approximately 2004. TriMet coordinates with the City of Portland who operates and maintains the traffic signals throughout the system. The agency stated that their benefits include a reduction in recovery time and increased reliability. Their lessons learned include the need to adjust bus schedules gradually and stop once variability starts to increase. Adjusting the bus schedules in response to TSP improvements assists in travel time reduction, however the proper adjustments must be determined to find the optimal travel time reliability.

Table 2. National TSP Deployments

Agency	Vendor/ Technology	Architecture	Scale	Priority Timings	Measures of Effectiveness	Lessons Learned
King County Metro	Custom using V2I	Distributed Conditional	200 intersections 9 routes	Green Extension Early Green	Speed Travel Time Delay Headway Adherence Reliability	Ongoing System Optimization Standardized Evaluation
Pace/CTA	Novax	Distributed Conditional	200+ intersections 14 routes	Green Extension Early Green	Travel Time	High-resolution AVL Data
TTC	Novax	Distributed Unconditional	200 intersections 4 routes	Green Extension Early Green	Speed Reliability	Choosing proper TSP parameters
SFMTA	Opticom GPS	Distributed Unconditional	450 intersections 11 routes	Green Extension Early Green	Travel Time Reliability Delay	Impact of Operator Behavior Baseline Data Collection
San Diego MTS	Infrared Detection	Distributed Unconditional	50 intersections 4 routes	Green Extension Early Green Phase Insertion Phase Rotation Phase Skipping	Travel Time Schedule Adherence Headway Adherence Reliability Delay	Importance of Responsive and Proactive System Maintenance
TriMet	Opticom	Distributed Conditional	370 intersections 8+ routes	Green Extension Early Green Queue Jump	Recover Time Reliability	Adjusting Schedules after TSP Implementation

3.4 Local Existing and Planned TSP Technology Deployments

There are several existing technologies in the Atlanta Metro Area that should be considered in the TSP system evaluation process. It is important to note what types of existing technology have been previously installed, where they are operating, and how this equipment is being used. There is potential to easily scale future TSP operations and maintenance and provide interoperability by having consistent TSP systems and equipment throughout the area.

Within the Metro Atlanta Area, MARTA, the City of Atlanta, GDOT, and the City of Marietta have existing equipment that currently serve priority calls.

- Atlanta Streetcar (Opticom) – The Atlanta Streetcar operates in downtown Atlanta along a 2.6-mile route of predominantly mixed flow travel lanes. There are twenty-eight (28) signals along this route with the Global Traffic Technologies (GTT) Opticom Global Positioning System (GPS) system installed at ten (10) signalized intersections. The GTT system at these ten (10) intersections are utilized to detect when a streetcar is approaching an intersection to generate a priority request at signals along the route. By using peer-to-peer communications and controller logic in the signal system software Q-Free Intelight MaxTime, priority can be served at intersections with installed detection and at adjacent intersections.

- Midtown TSP Pilot Project (DSRC/Cohda) – In Midtown Atlanta, West Peachtree and Spring streets have TSP capabilities at twenty-six (26) of the twenty-seven (27) signalized intersections along ATL Xpress Bus Route 431. Vehicles along this route are equipped with the Cohda MK5 OBU while signalized intersections have the Cohda MK5 RSU installed. Buses utilize Dedicated Short-Range Communication (DSRC) to send the request for TSP to the Q-Free Intelight MaxTime CV Module installed on the traffic signal controller. Buses are also equipped with schedule adherence data so that a request is only sent if the bus is more than five (5) minutes behind schedule.

- Marietta TSP (Applied Information) – In the City of Marietta, fifty-two (52) signals are currently operating with TSP. Future expansion is planned to include seventy (70) additional adaptive signals in Cumberland CID and Town Center CID. All CobbLinc local buses are equipped with the technology to request signal priority. This system uses Applied Information's Glance technology to request and grant priority via an In-Vehicle Unit in the bus and a FMU in the cabinet.

Table 3 provides a summary of the known existing or future programs and projects related to TSP Technology Deployments within the Atlanta region. Information on the involved agencies, equipment vendors, TSP architecture, and scale of deployment have been compiled for comparison and informative purposes.

Table 3. Existing and Planned Local TSP Technology Deployments

Existing or Future Programs/Projects	Agency	Vendor	Architecture	Scale
Sandy Springs TSP Pilot	CoSS, MARTA	Applied Information	Hybrid Pilot	Route 5 – Pilot
Atlanta Streetcar	MARTA	Opticom	Distributed	28 signals
Midtown TSP Pilot	GDOT, ATL	Cohda (DSRC)	Distributed – CV	27 signals
Downtown Bus Corridor Study	ATL, Central Atlanta Progress (CAP)	TBD	Distributed – Smart Bus	Downtown Atlanta
Summerhill BRT	MARTA, COA, GDOT	TBD	Distributed – TBD	28 signals
Campbellton Corridor	MARTA, COA	TBD	TBD	13-18 signals
Marietta TSP	Marietta, Cobb County	Applied Information	Distributed – CV	52 signals
CobbLinc	Cobb County	TBD	Distributed – CV	TBD
Gwinnett County Transit	Gwinnett County Transit	Danlaw RSU Kapsch OBU	Distributed – CV	Countywide
CV1K	GDOT, ARC	Danlaw RSU Kapsch OBU	Distributed – CV	Regional

3.5 Lessons Learned

In determining the potential benefits of TSP and compiling lessons learned from previous deployments, a variety of literature was reviewed. Deployments ranged from a single signal to a region-wide area covering hundreds of signals. Key among these documents were previous compilations by the U.S. Department of Transportation (USDOT) and Transportation Research Board (TRB) Transit Cooperative Research Program (TCRP). The USDOT *Transit Signal Priority Handbook* and the TRB Transit Cooperative Research Program's *TCRP Synthesis 149: Transit Signal Priority: Current State of the Practice* contained surveys from transit systems throughout North America that provided a wealth of information.

Lessons Learned

Lessons learned were compiled from the reviewed literature and summarized into groups of topics. The following topics were common themes found from the implementation of TSP:

- Involve stakeholders early and ensure good communication and interjurisdictional partnerships amongst all involved agencies. Coordinating responsibility and aligning priorities among transportation agencies are critical to TSP implementation and success.
- Perform an extensive technology evaluation to select a reliable technology that is suited for the agencies' existing systems.

- Keep the project moving forward with one or more champions when problems occur.
- Keep the project and TSP objectives simple at the beginning and increase goals over time.
- Successful TSP systems are dependent upon the signal controller hardware and software systems. An upgraded traffic control system will yield the best results.
- Consider the maintenance of the TSP hardware and software onboard vehicles and in the field. There is more than the initial cost of the system to consider in ensuring TSP will work over time.
- Keep security in mind when configuring the system architecture. Due to security concerns, not every device may be allowed to connect to the network, so that needs to be a primary consideration when looking at solutions.

The following recommendations were common themes throughout literature reviewed or documented local experience regarding the successful operations of a TSP system. These practices are recommended for the successful implementation of TSP in Sandy Springs and Dunwoody.

- TSP works best when stops are far-side and it is recommended to relocate near-side stops to the far-side where possible. Far-side stops provide easier capability for estimating the arrival of the transit vehicle through the intersection and allow the vehicle to leverage TSP to traverse the intersection prior to stopping.
- Accurate and high-resolution transit vehicle location data is critical for efficient TSP operation. The location and configuration of transit vehicle detection is key in efficient TSP operation.
- TSP works best when signal timing is optimized for transit vehicles. A traffic engineer needs to design the TSP system appropriately so that it is effective. This includes considering the effect on the entire network and balancing out demands from all modes. Some signals along a route may not be suitable for TSP.
- It is important to select proper TSP business rules that match the goals of the project and tweak them over time. Refining the parameters that determine how TSP calls are served is critical for system success.
- Communicate the timing plan changes and expected system results with transit vehicle operators. TSP works best when drivers know what to expect from the system. Unexpected feedback from field devices can negate improvement gained from new priority timings.
- Evaluate system performance with measurable and quantifiable benefits to support system optimization, maintenance, and support. Perform before and after studies that can produce evidence of system benefits and evaluate them early and often.
- Adjust bus schedules once TSP has been implemented. Pre-existing schedules may include estimated or expected delay from prior signal timing. Adjusting bus schedules for changes in signal coordination will improve OTP and impact systems with schedule adherence TSP parameters.

In consideration of this guidance provided by the lessons learned, the requirement of a proper dataset for data collection and system evaluation is apparent. TRB Transportation Cooperative Research Program's *TCRP G-18: Improving Access and Management of Transit ITS Data* gives guidance on the type of data to be collected for the evaluation of fixed-route transit systems. This project states that the scope of ITS data elements include the following core datasets:

1. AVL data that includes stop and time-point arrival and departure times, intermediate vehicle location observations, and other vehicle event data;
2. Automated Passenger Counter (APC) data that includes boarding and alighting counts by trip and stop; and
3. Automated Fare Collection (AFC) data that includes individual fare transactions.

The literature states that where possible, these data elements should be matched with schedule service information. The data management approach should allow expansion in the future to accommodate other transit operational data.

3.6 Benefits of TSP

In documenting the benefits of TSP, most data were acquired through before and after studies or by modelling results. A range of results were experienced by transit agencies that implemented TSP and there are many factors that can contribute to the variance in benefits observed. Variables such as implementation scale, TSP business parameters, signal timing coordination, amongst others, influence the resulting TSP benefits. Results also vary by time of day for data points at the same location, as traffic conditions and timing parameters change throughout the day. Additionally, many of the TSP deployments also included other improvements for the transit system such as signal coordination or dedicated lanes. Many agencies qualified their benefits by stating that these improvements likely had impact on the measured results of TSP. The following metrics were commonly listed as contributing to the benefits of TSP from the reviewed literature and had associated ranges of improvement:

- Corridor Travel Time Reduction – Reviewed literature documented reductions in corridor travel times up to 25%. In one example of qualifying these savings, the Los Angeles County Metropolitan Transit Authority estimated that 1/3 of their travel time reduction is due to the TSP, while 2/3 of the savings is due to the change in headway-based service with fewer stops and shorter dwell times. Other studies were able to obtain reductions up to a similar percentage when analyzing time periods where TSP was turned on vs. those where TSP was turned off.
- Increased Reliability – Reported improvements in reliability were documented to be up to 40% when comparing a signal system optimized without TSP to one with TSP.
- Intersection Approach Delay Reduction – Reductions in approach delay up to 50% were observed along segments by the SFMTA. However, TSP implementation occurred at the same time as other improvements that complicate the benefit assessment. Other studies documented wide ranges in delay reductions at traffic signals in comparing time periods with TSP turned off vs. turned on.

- Headway Adherence Improvement – Improvements in headway adherence up to 30% were found in the reviewed literature. In this case, improvement was determined by comparing time periods where TSP was turned on vs. turned off.

Calculating Benefits

Decision makers are increasingly seeking data-driven approaches to better understand their return on investment (ROI). While research has shown that ITS strategies typically have much higher returns than traditional roadway projects, agencies still struggle to demonstrate the benefits of these strategies. TSP deployments are comprised of multiple systems working together to provide more efficient transit progression along signalized corridors; analyzing benefits gained specifically from TSP deployments can be challenging to isolate and analyze. As described above, the benefits of TSP deployments include increased reliability; travel time savings which leads to bus operator time savings, gas savings, reduced environmental impact; improved headway adherence; etc., all of which require elements of objective and subjective analysis to calculate.

The USDOT ITS Joint Program Office's (JPO) hosts and solicits ITS deployment data, research, and lessons learned information on their website (ITS Deployment Evaluation Databases – Benefits Database). In addition, benefit-cost analysis (BCA) guidance, including a TSP use case example is forthcoming from USDOT and will be available on the ITS Deployment Evaluation Databases website.

The general methodology for performing BCA for TSP include the following steps:

Step 1 – Establish Framework. First a framework for analysis must be established. This includes establishing the specific TSP deployment area, priority treatments, timeframe, and all key assumptions that guide the BCA.

Step 2 – Identify Resources. Secondly, based on the established framework, resources should be identified that will be leveraged for use within the BCA. Resources may include:

- Research and data shared on the ITS Deployment Evaluation Databases website.
- Data, including site-specific data such as corridor transit travel times, existing transit service routes, ridership, headways, and schedules, OTP, etc. It is recommended that local data be utilized where practical.

Step 3 – Estimate Benefits. The framework will guide the benefits that are analyzed for each deployment. It would be expected that TSP benefits will include analysis of mobility and environmental benefits. Mobility benefits would likely be in the form of reduced travel time savings and increased reliability.

Step 4 – Monetize Benefits. Using the estimated benefits from Step 3, the monetary value of the TSP benefits can be estimated by applying state and national monetary values of the following:

- Mobility - Transit vehicle-hour value of time; value of reliability per estimated transit rider.
- Energy and Environmental - Value of CO2 emissions and fuel reduction.

Step 5 – Estimate Costs. Costs specific to the TSP deployment being analyzed should be estimated. Assumptions of TSP deployment costs in Sandy Springs can be found in the **Appendix**.

Step 6 – Conduct BCA and ROI. Various methods of evaluation and reporting are used based on the information available, and/or requirements for funding. BCA commonly includes a consideration of Benefit-Cost Ratio (BCR) and/or ROI, where:

- BCR = $benefits \div costs : costs$
- ROI = $(benefits - costs) \div (costs) \times 100\%$

The estimated monetized mobility and environmental benefits are extrapolated over ten (10) years. The capital, operations, and maintenance costs are estimated for the same ten (10) year horizon. The BCR and/or ROI for the TSP deployment are calculated and demonstrate a positive impact is expected where the benefits are found to be greater than the costs.

4 Georgia Smart Route 5 TSP Pilot Project Results

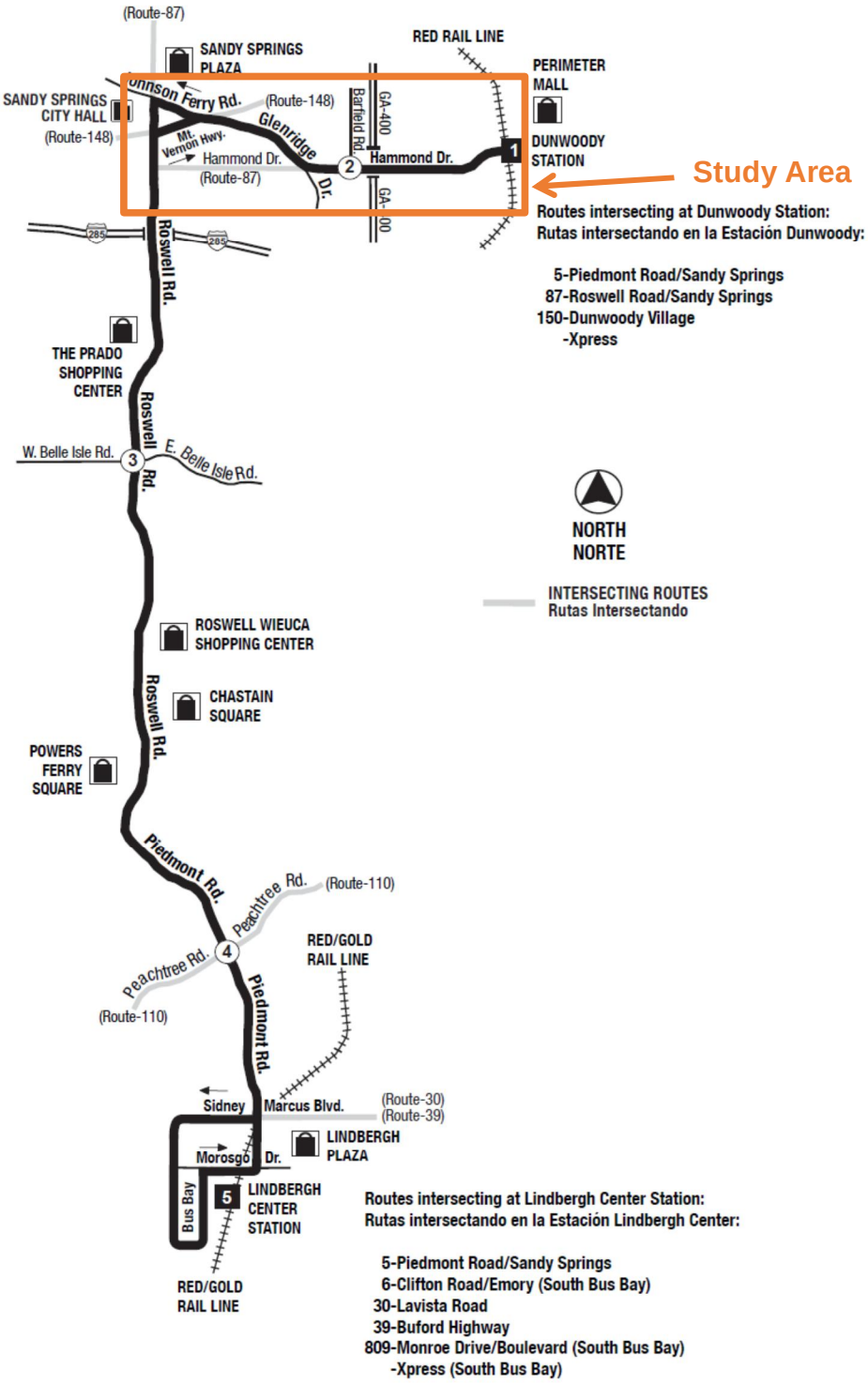
The purpose of the GA Smart grant is to study the deployment of the TSP Pilot Project to verify functionality and impact of the system. As mentioned previously, the TSP pilot deployment leverages existing infrastructure currently being used for emergency preemption in Sandy Springs and MARTA bus location data published through API. **Figure 9** provides an image of the TSP Pilot Project hybrid concept architecture. The Georgia Tech research team led the design, testing, and analysis of the TSP Pilot Project Study.

4.1 Study Design

To test the performance of the TSP system, a with and without TSP study design was utilized. In this design the TSP system was turned on (TSP-With) and off (TSP-Without) over alternating weeks in April, May, and June of 2021. This approach to alternating TSP on-off allowed for a testing with and without TSP under similar user and traffic demand conditions. It is noted that during the system initial deployment, issues were identified and resolved pertaining to transitioning the TSP system on and off as well as ensuring the data collection streams were operating correctly. Data collected while resolving these issues are not utilized in the final analysis. These issues were resolved after the first few weeks of testing.

The study was conducted over a portion of MARTA's Route 5 within Sandy Springs and Dunwoody. The study area is limited to the portion of the route north of I-285 and the Dunwoody MARTA Station as shown in **Figure 10**. For this study, a priority request was placed if the bus was at least one (1) minute behind schedule, the bus was in an established zone (set up within the signal system) and within forty (40) seconds of the intersection, and based on the calculated bus speed and location, the bus would not arrive on green. Depending on phase on the cycle, the signal system could either extend the green signal or it would allow an early return to green. A priority request would not be granted if it was overridden by an EVP request or if the roadway segment exceeds 100% saturation.

Figure 10. Study Area shown on Route 5 Map (source: MARTA)



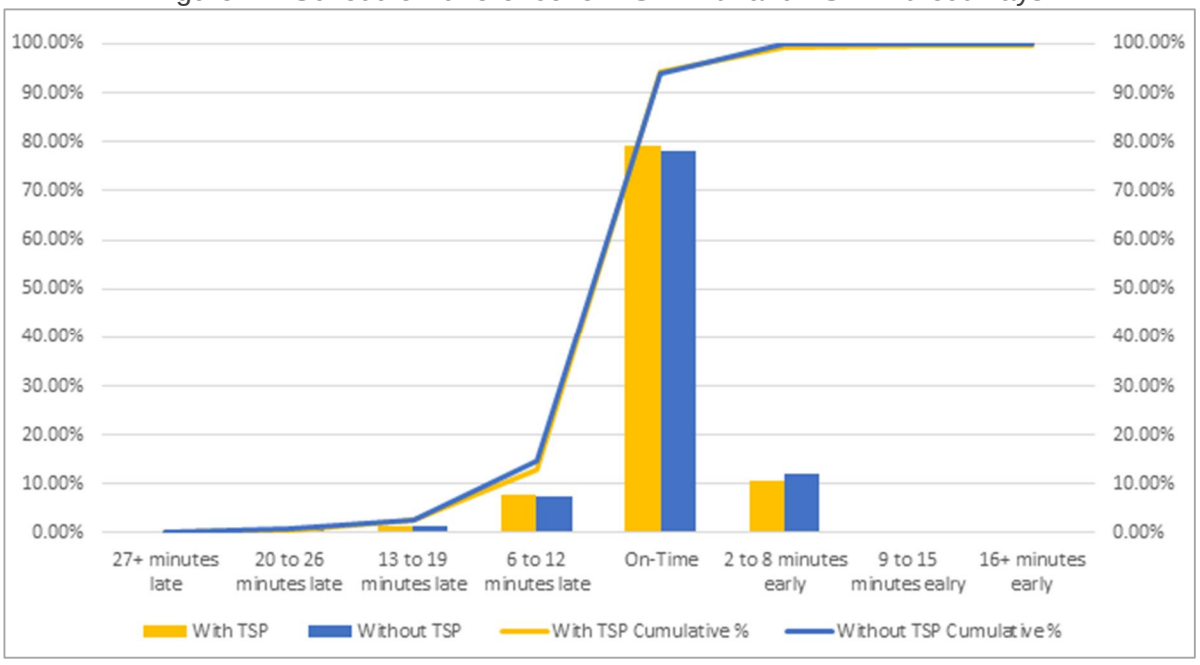
4.2 Data Description

The data analyzed in this study consists primarily of the AVL/CAD API data received from the Route 5 MARTA buses. The AVL/CAD API data included the schedule adherence values (i.e., minutes ahead or behind schedule), as well as the GPS location trace data as the bus traversed the corridor. The AVL data stream is updated approximately every five (5) to thirty (30) seconds. However, the adherence values are updated by MARTA every two (2) minutes. Therefore, the data collection time of an AVL adherence value associated with a GPS point lags the timestamp of the GPS data point ranging from a few seconds up to two (2) minutes. The length of the lag for any given point is not known. The AVL/CAD API data is supplemented with a log of the dates and times the TSP service is turned on and off at the signal controllers.

4.3 TSP Impact Analysis

To isolate the impact of TSP on schedule adherence, the trips were broken down into small segments close to the intersection. The adherence value for each bus immediately after it passed through an intersection was determined. The post-processed AVL/CAD API data was utilized to identify this adherence data. For this analysis, a zone from the center of the intersection to three hundred (300) feet downstream of the intersection was utilized. The median adherence value within this zone was used for each bus trip through each intersection. Utilizing a single adherence value at each intersection reduced potential bias from over-sampling slower moving buses. The per-trip adherence values were labeled as TSP-With and TSP-Without depending on whether the trip occurred on a TSP "on" day or "off" day. The distribution of the adherence values for all bus trips and all intersections for the TSP-With and TSP-Without days are shown in **Figure 11**. For this analysis, thirty-four (34) TSP-With and forty-nine (49) TSP-Without days are utilized. The extra TSP-Without days were needed to ensure that the number of trip-segments in the on and off groups were balanced.

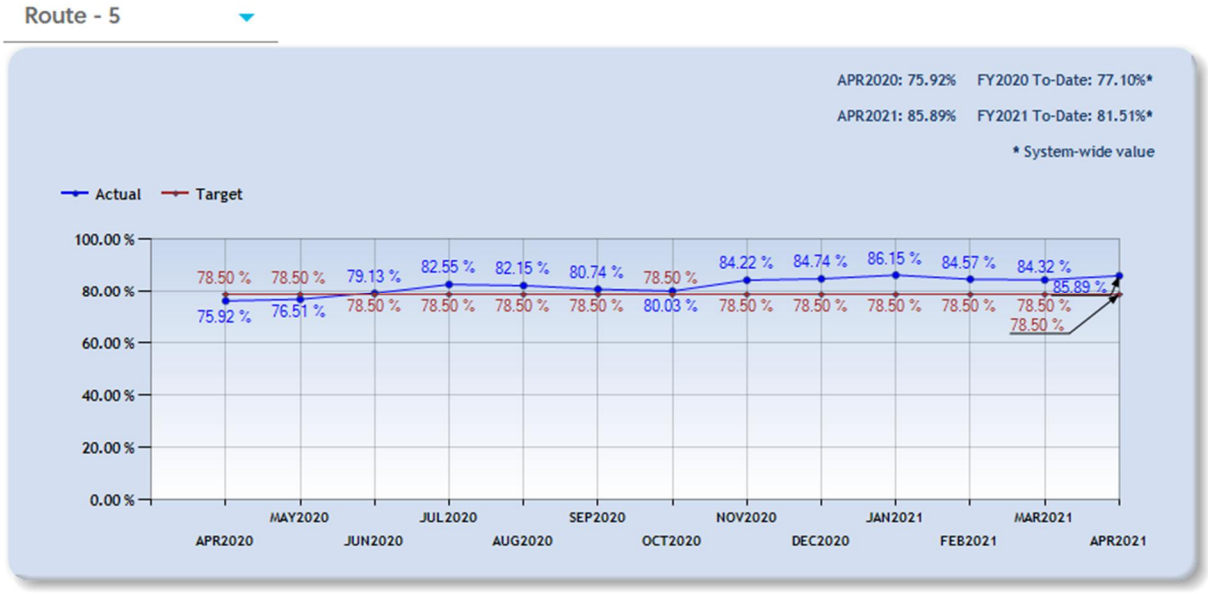
Figure 11. Schedule Adherence for TSP-With and TSP-Without Days



The analysis considers the adherence data in six (6) minute bins, where OTP is taken to be from five (5) minutes behind schedule to one (1) minute ahead of schedule. This approximates the MARTA on-time definition of five (5) minutes and thirty (30) seconds behind to thirty (30) seconds ahead of schedule (the exact MARTA on-time definition was not used as the adherence data is given to the nearest minute).

As seen, overall the impact on performance is not significant, with a slight improvement in the OTP of approximately 2%. At the inception of the project (early 2020) it was expected to see more significant improvements in adherence. However, according to MARTA route performance data, the Route 5 OTP improved from approximately 76% in April of 2020 to 86% in April 2021, shown in **Figure 12**. During the scoping phase of the TSP Pilot Project there was a higher percentage of behind schedule trips; however, prior to implementation, the OTP improved to 86%. This left minimal flexibility for TSP to improve adherence. This on-time improvement over the prior year has several potential underlying sources. First, given COVID-19, MARTA overall ridership has decreased approximately 50%. This results in shorter passenger boarding and alighting times, reducing a potential source of delay along a trip. In addition, over this time period MARTA made a concerted effort with drivers to improve OTP. Finally, underlying roadway traffic congestion has also seen a reduction during COVID-19, although on arterials these improvements are fading. These underlying factors have resulted in higher OTP prior to TSP implementation, likely also resulting in slack in the current schedule. This TSP deployment has primarily focused on schedule adherence, and specifically has avoided causing buses to arrive early, thus, the opportunity for TSP to improve service on the corridor was minimized.

Figure 12. Route 5 On-Time Performance, April 2020 to April 2021
Source: https://www.itsmarta.com/bcs_Bus_OTP.aspx



4.4 TSP Pilot Project Results

The primary objective of the TSP Pilot Project was to determine if the hybrid pilot architecture could be implemented to provide TSP along MARTA Route 5 – this objective was proven to be successful.

In addition, the TSP Pilot Project was an opportunity to learn and study the impact of deployment. The following lessons were learned during the pilot deployment and have guided the recommendations for future deployment:

- Buy in from all partners is essential.
- There is potential to better optimize signal system parameters (Glance, SCOOT, avoid calls from buses not on route/in service).
- Bus location and schedule adherence data needs to be updated more frequently than every two (2) minutes.

The initial TSP Pilot Project findings indicate positive operability. The impact of the TSP deployment is recommended for further study.

5 Route Screening

High-level recommendations have been developed based on a screening of the potential highest areas of need along each route. Access to current data and an understanding of those needs with the potential to be impacted with TSP drove the route screening methodology. Need was determined by considering current reliability, mobility, and accessibility along MARTA Routes 5, 85, 87, 148, and 825 within Sandy Springs. Dunwoody MARTA Routes 103, 132, and 150 were not considered with the same approach because mobility data is not available at this time. However, the following approach for considering high-need areas can be applied by the City when access to the data is available.

Reliability

OTP is the primary way that transit agencies determine reliability. Current, April 2021, reliability along the MARTA routes throughout Sandy Springs and Dunwoody range from 81.87% to 94.19%. **Table 4** provides a summary of OTP by route for April 2021.

Table 4. On-Time Performance by Route (Source: MARTA, April 2021)

MARTA Route	On-Time Performance (April 2021)
Route 5	85.89%
Route 85	88.77%
Route 87	87.44%
Route 103*	92.22%
Route 132*	86.24%
Route 148	84.26%
Route 150*	81.87%
Route 825	94.19%

*Dunwoody MARTA Route

It should be noted that COVID-19 has impacted ridership and traffic patterns throughout the country. It is expected that the OTP data is higher than would be expected during typical conditions. However, it was determined that a relative comparison of current OTP is more accurate to consider need rather than leveraging pre-COVID-19 data because of concern for influences that were found during the TSP Pilot Project. MARTA routes within Sandy Springs were ranked and assigned a score based on their respective ranking: High, Medium, Low. The relative comparison score of OTP was weighted by 50%, added to determine the total score and used to guide the identification of high-need routes within Sandy Springs.

Table 5 provides a summary of the OTP for the highest need signalized intersections along Sandy Springs MARTA routes.

Mobility

Regional Integrated Transportation Information System (RITIS) data was leveraged to understand the relative mobility along MARTA routes within Sandy Springs. RITIS is *a data-driven platform for transportation analysis, monitoring, and data visualization*. The RITIS platform is widely used throughout the industry to assess mobility and reliability on freeways and arterials. Mobility data can be a general guide for identifying locations for potential TSP deployment, however, it should be noted that TSP will not be activated if congestion is such that a transit vehicle will not be able to traverse the intersection even with additional green time. Mobility data can indicate where general mobility needs are located and can also be used to identify locations where queue jumps may be located to by-pass congestion.

The Bottleneck Ranking is one of several tools in the RITIS Probe Data Analytics Suite. This tool analyzes segments of roadway to determine where bottlenecks occur, and which have the greatest impact. MARTA routes within Sandy Springs were ranked by Total Delay within April 2021 and assigned a score based on their respective ranking: High, Medium, Low. The relative comparison score of Total Delay was added to determine the total score and used to guide the identification of high-need routes within Sandy Springs.

The Speed for each roadway segment was analyzed for the month of April 2021. The lowest average speed observed throughout the day for each roadway segment was recorded. Bottlenecks along MARTA routes within Sandy Springs were ranked and assigned a score based on their respective ranking: High, Medium, Low. The relative comparison score of Speed was added to determine the total score and used to guide the identification of high-need routes within Sandy Springs.

Table 5 provides a summary of the total delay and speed for the highest need signalized intersections along Sandy Springs MARTA routes.

Sandy Springs High Priority TSP Locations

The OTP, delay, and speed data was scored based on their relative distribution within each dataset. Locations that were identified along multiple routes were removed. The OTP data was weighted by half to decrease the influence of this dataset due to the concern of COVID-19 impact on ridership. In the future, it is anticipated that OTP will be a primary driver in determining which routes have the highest potential to be positively impacted by the deployment of TSP. It is recommended that OTP, delay, and speed data continue to be monitored as travel patterns are likely to continue to shift after COVID-19 has subsided.

These scores were combined to determine a cumulative need score. **Table 5** provides a summary of the cumulative need score for the top thirty (30) intersection locations. **Figure 13** provides a map of the highest cumulative need score intersection locations.

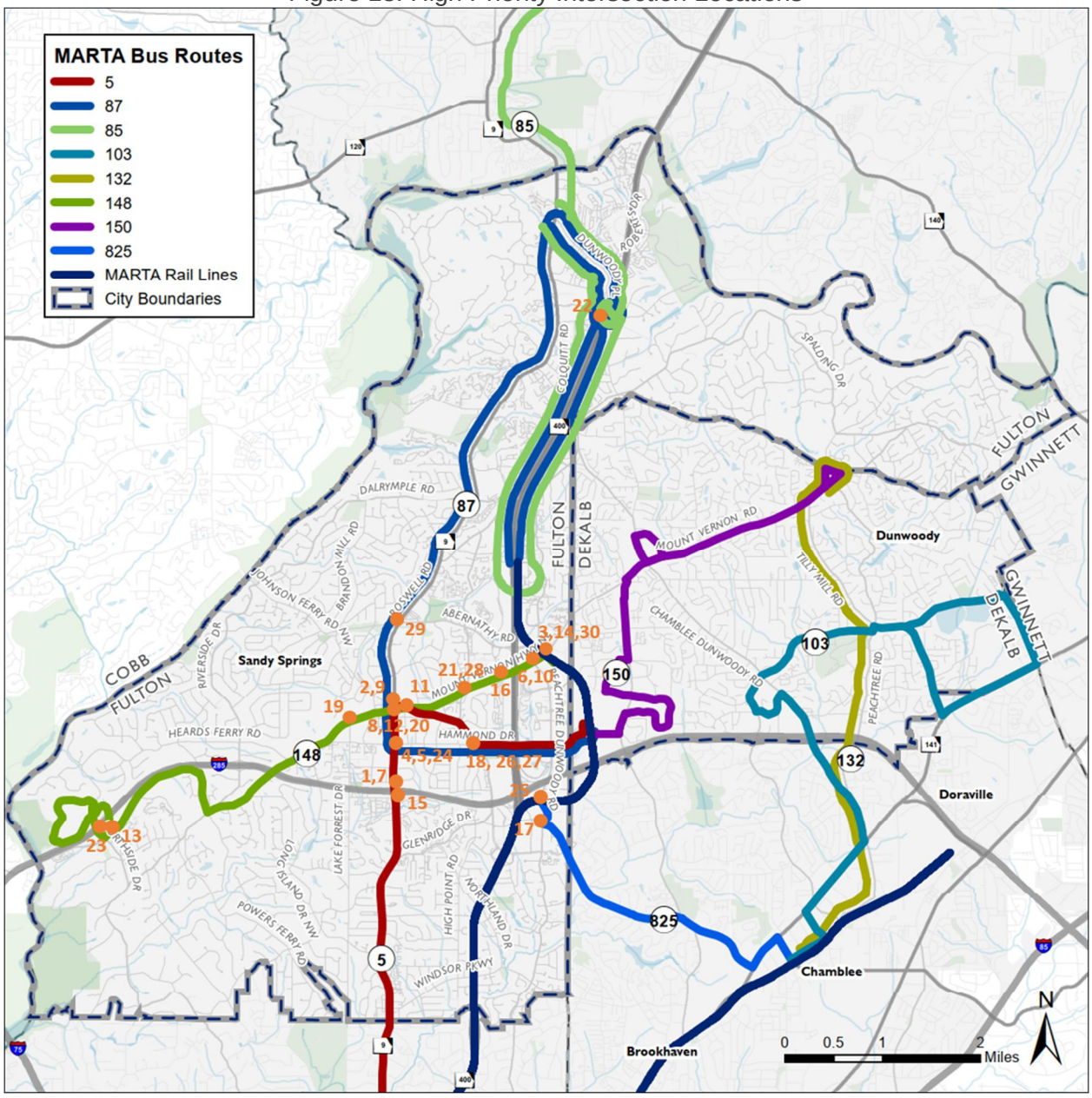
Table 5. High Priority Intersection Locations (April 2021)

Intersection	Approach	Route	Total Delay	OTP (%)	Speed (mph)	Delay Rank	OTP Rank	Speed Rank	Total Score
GA-9 S @ I-285	SB	5	12,608,526	85.89	7.6	High	Medium	High	9
GA-9 N @ Johnson Ferry Rd	NB	5	4,093,710	85.89	8.4	High	Medium	High	13
Mt Vernon Hwy NE E @ Perimeter Ctr W	EB	148	1,040,930	84.26	10.8	High	High	High	13.5
GA-9 N @ Hammond Dr	NB	5	1,368,730	85.89	11.6	High	Medium	High	19
GA-9 S @ Hammond Dr	SB	5	827,063	85.89	7.9	High	Medium	High	20
Mt Vernon Hwy NE W @ Peachtree Dunwoody Rd	WB	148	416,461	84.26	7.7	Medium	High	High	21.5
US-19/GA-9 N @ I-285	NB	5	3,363,677	85.89	14.5	High	Medium	High	23
Mt Vernon Hwy NE E @ GA-9/ Roswell Rd	EB	148	630,864	84.26	13.5	High	High	High	24.5
Johnson Ferry Rd N @ GA-9/ Roswell Rd NE	NB	5	551,170	85.89	8.6	High	Medium	High	27
Mt Vernon Hwy NE E @ Peachtree Dunwoody Rd	EB	148	621,898	84.26	14.8	High	High	High	27.5
Mt Vernon Hwy NE E @ Johnson Ferry Rd NE	EB	5	596,793	85.89	12	High	Medium	High	30
GA-9 N @ Mt Vernon Hwy	NB	5	909,969	85.89	15.1	High	Medium	High	32
Powers Ferry Rd E @ New Northside Dr NW	EB	148	322,517	84.26	12.4	Medium	High	High	32.5
Perimeter Ctr W @ Mt Vernon Hwy NE	WB	148	952,352	84.26	18.5	High	High	Medium	34.5
US-19/GA-9 S @ I-285	SB	5	441,656	85.89	12.5	Medium	Medium	High	35
Mt Vernon Hwy NE W @ Barfield Rd	WB	148	436,578	84.26	17.9	Medium	High	Medium	43.5
Peachtree Dunwoody Rd NE S @ Johnson Ferry Rd NE	SB	825	1,121,416	94.19	15.7	High	Low	High	44
Hammond Dr W @ Glenridge Dr NE	WB	5	334,557	85.89	16.1	Medium	Medium	High	47

Intersection	Approach	Route	Total Delay	OTP (%)	Speed (mph)	Delay Rank	OTP Rank	Speed Rank	Total Score
Mt Vernon Hwy W @ Lake Forrest Dr NW	WB	148	316,022	84.26	17.3	Medium	High	Medium	47.5
GA-9 S @ Mt Vernon Hwy	SB	5	152,319	85.89	10.1	Low	Medium	High	48
Mt Vernon Hwy NE E @ Glenridge Dr	EB	148	256,829	84.26	16.2	Medium	High	High	48.5
Dunwoody Pl S @ US-19/ Northridge Rd	SB	85	918,895	88.77	16.8	High	Medium	Medium	50.5
Northside Dr NW/ New Northside Dr NW S @ I-285	SB	148	139,448	84.26	14.8	Low	High	High	50.5
Hammond Dr W @ GA-9/ Roswell Rd NE	WB	87	450,164	87.44	17.1	Medium	Medium	Medium	56
Peachtree Dunwoody Rd NE N @ Lake Hearn Dr NE	NB	825	411,636	94.19	15.8	Medium	Low	High	60
Glenridge Dr NE S @ Hammond Dr NE	SB	5	155,459	85.89	16.2	Low	Medium	High	61
Hammond Dr E @ GA-400/ Barfield Rd NE	EB	5	291,435	85.89	20.5	Medium	Medium	Medium	63
Mt Vernon Hwy NE W @ Johnson Ferry Rd NE	WB	5	208,379	85.89	18	Medium	Medium	Medium	63
GA-9 N @ Abernathy Rd	NB	87	730,177	87.44	23.2	High	Medium	Low	67
Perimeter Ctr W E @ Perimeter Center Pkwy NE	EB	148	133,894	84.26	19.8	Low	High	Medium	68.5

*Intersections within the vicinity of I-285 are likely to have been impacted by the Transform 285/400 construction.

Figure 13. High Priority Intersection Locations

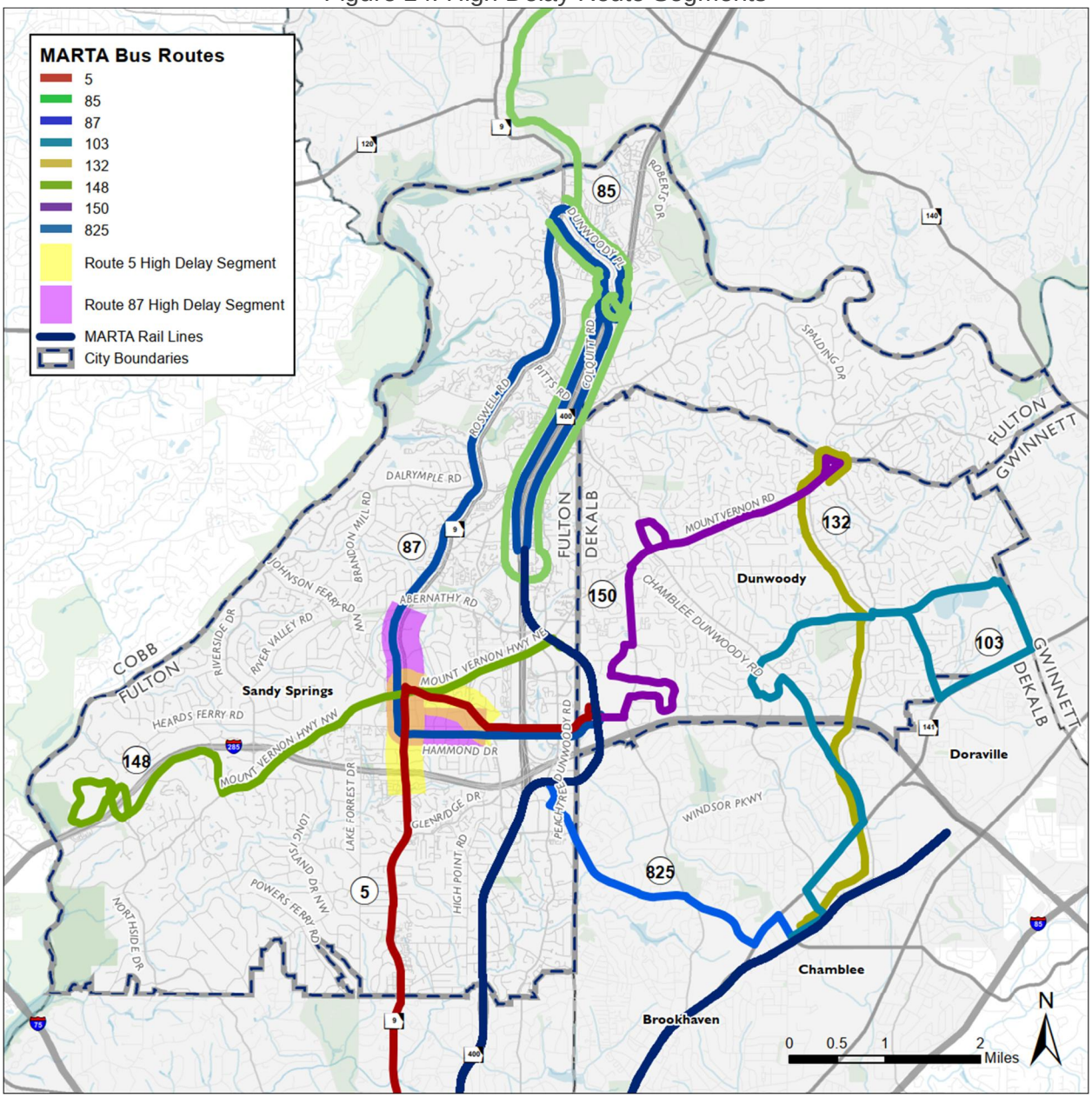


Upon identification of the highest cumulative need score intersection locations, current MARTA route headways were considered. Locations identified along Route 148 and Route 825 were removed from TSP deployment recommendations at this time due to their greater headways, i.e. the bus does not traverse the route with frequency. Route 148 currently operates during peak periods with approximately one-hour headways. Route 825 currently operates from 6:05AM to 9:52PM with approximately one-hour headways. Routes 5, 85, and 87 currently operate generally from 5:00AM to 1:00AM and offer a range of headways from fifteen (15) minutes to forty (40) minutes depending on time of day.

It is recommended that Routes 148 and 825 be monitored such that if service is expanded or OTP declines significantly, TSP deployments may be considered in the future.

Routes 5, 85, and 87 were then considered more closely based on the high priority intersection locations and it was determined that Routes 5 and 87 were the highest priority for TSP deployment. **Figure 14** provides a summary of the highest delay route segments within Sandy Springs.

Figure 14. High Delay Route Segments

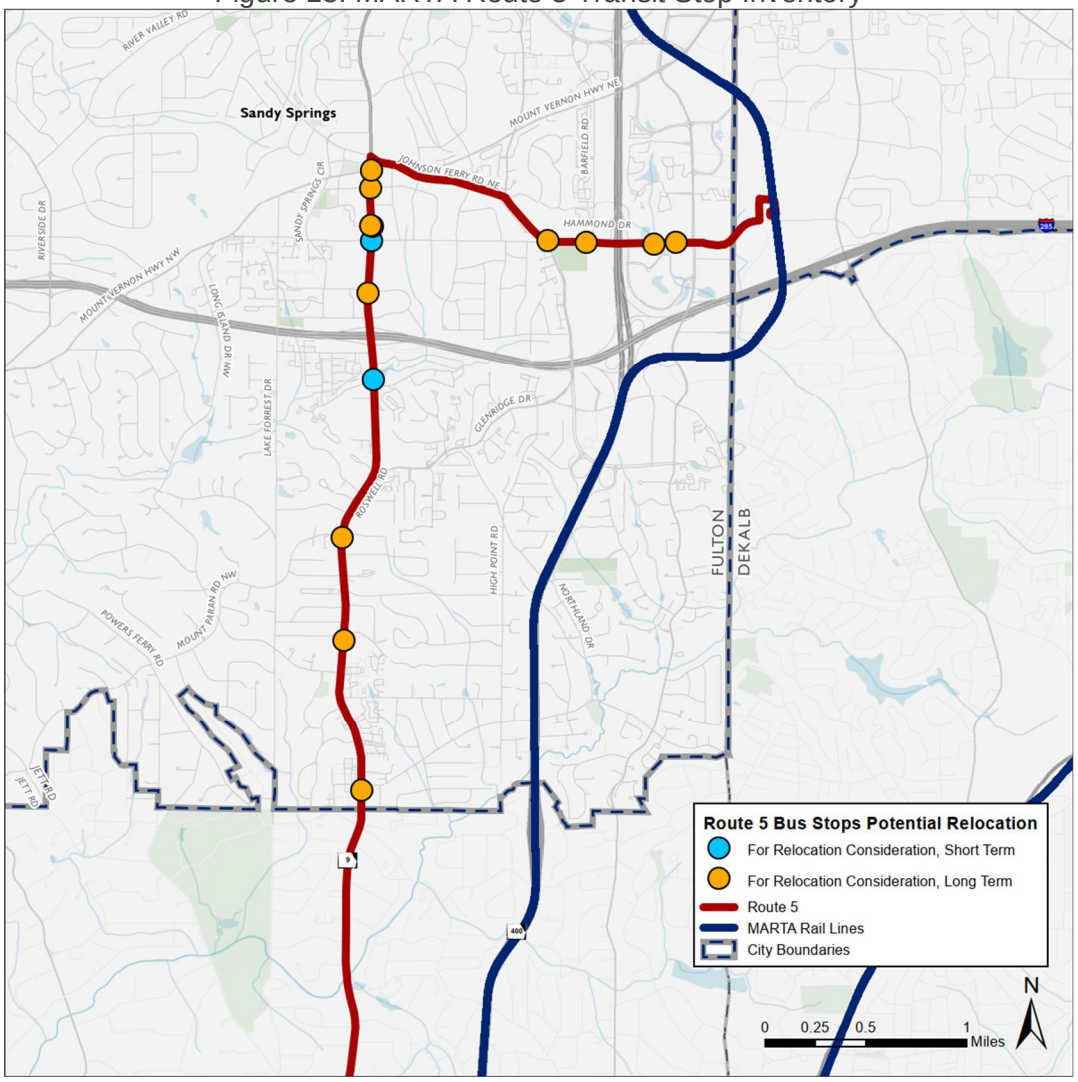


Accessibility

As discussed in **Section 2.1**, the City of Sandy Springs performed an inventory of Route 5 transit stop locations. Based on the inventory findings and an estimation of 10% of stops requiring American Disabilities Act (ADA) upgrades, it is recommended that two (2) transit stops are relocated to the far-side of the signalized intersection and one (1) stop is upgraded to provide ADA compliant access initially. In the longer term, it is recommended that twelve (12) transit stops

are relocated, and three (3) locations are improved with ADA compliant access. The twelve (12) bus stops would likely be more beneficial to transit operations if moved to the far side, but due to right-of-way constraints and other factors, would need to be moved in conjunction with redevelopment of the adjacent parcels. **Figure 15** presents the information collected for potential transit stop relocations.

Figure 15. MARTA Route 5 Transit Stop Inventory



Transit stop inventory data is not available for other routes currently. Recommendations for relocations and upgrades are based on the findings from the Route 5 inventory. Half of the independent signalized locations along the route were assumed to require transit stop relocations and 10% of independent signalized locations were assumed to represent transit stop locations that require upgrades. It is recommended that Sandy Springs perform an inventory of transit stop locations along each route to determine need, feasibility, and timeline for specific relocations and upgrades required.

6 Recommendations

High-level dependencies and recommendations have been defined based on an assessment of the existing system, information gathered through interviews, best practices review, and the TSP pilot deployment project results. This section provides an overview of partner transit agency dependencies (PTAD), system recommendations, and TSP route segment recommendations for implementation.

These recommendations are primarily focused on Sandy Springs due to their ability to leverage existing field deployment to implement TSP. It is recommended that the City of Dunwoody continues to leverage and monitor opportunities for collaboration and partnership to determine efficient methods of TSP deployment. Opportunities may include: similar initiatives to the GA Smart grant, specific requests from partner transit agencies for support along high need transit routes, potential opportunities with GDOT and the CV1K program, or future city hardware deployments able to be leveraged similarly to Sandy Springs (i.e. CV deployments).

6.1 Partner Transit Agency Dependencies and Collaboration Recommendations

The Cities of Sandy Springs and Dunwoody do not operate transit services. The Cities rely on MARTA regional transit services as well as the ATL Xpress service to support their communities' transit needs. The Cities depend on their partner transit agencies to provide data, processing, and schedule optimization to support effective TSP deployments.

The experience gained during the TSP Pilot Project further demonstrated the importance of transit agency support and dependencies. The following initiatives are identified as PTAD critical to the successful deployment of TSP. These dependencies need to be accomplished prior to deploying TSP within Sandy Springs and Dunwoody. The recommendations focus on improvements needed based on implementing TSP along MARTA routes using the Hybrid Pilot architecture, but other transit partners would need to provide the same parameters for Sandy Springs to consider a future deployment with them as well.

PTAD-1: AVL-CAD TSP API Refinement. The AVL-CAD TSP API is published to provide the transit schedule adherence and location data which is used to generate the priority request within the system. MARTA developed this API during the deployment of the pilot project. It is recommended that the AVL-CAD TSP API be refined to address data inaccuracies discovered during evaluation of the pilot project.

PTAD-2: CAD System Upgrade. The CAD system provides schedule adherence data within the AVL-CAD TSP API. This schedule adherence data is currently published every two (2) minutes which leads to a potential lag in data. For example, if a particular bus is within on-schedule parameters, but has an unexpected delay, the system will not recognize the delay for up to two (2) minutes after delay has occurred leading to a lag in priority requests. MARTA is currently in the process of upgrading their CAD system and anticipates a significantly enhanced system with minimal data lag. It is expected that this upgrade will be completed over the following twelve (12) to twenty-four (24) months.

PTAD-3: Automated System Monitoring. During the TSP Pilot Project, it was found that MARTA experienced several server outages during the period of TSP evaluation. TSP relies on the data provided by partner transit agencies; when this data is not available, TSP cannot function. It is

recommended that partner transit agencies implement automated system monitoring such that system outages or degradations are recognized and reported through alerts or notifications to increase response time and minimize system downtime.

PTAD-4: General Transit Feed Specification (GTFS) and GTFS Realtime Data Streaming. Transit agencies publish their data, including fixed-route schedules, routes, and bus stop data, such that third parties can leverage the information to provide applications, assessment, or analysis for various reasons. Standard data feeds that are used throughout the industry are referred to as General Transit Feed Specification (GTFS) and come in the form of static and Realtime. MARTA currently publishes GTFS data and is in the process of refining that dataset. MARTA is working to be able to also publish GTFS Realtime data. This data can then be used by Sandy Springs and others to support the assessment and optimization of TSP[1].

PTAD-5: Fixed-Route Schedule Optimization. Fixed-route transit schedules are developed to provide riders with a reliable expectation of when they can board and alight the vehicle. To be able to provide acceptable OTP, transit agencies need to provide additional time, or slack, within the fixed-route schedule to ensure the vehicle can arrive on-time. The deployment of TSP allows more efficient operations and enhanced reliability. Therefore, agencies can reduce the amount of slack within the schedule, reducing transit travel times. It is recommended that Sandy Springs and Dunwoody work with their partner transit agency prior to deployment of TSP to coordinate schedule optimization along the TSP route such that riders are able to realize increased reliability as well as reduced travel times from the deployment.

Interagency Collaboration

The need for consistent collaboration at a regional level was identified during the interviews and TSP workshop. Fostering a culture of collaboration is essential for integration and coordination of TSP technology deployments. Regional collaboration to provide opportunities for sharing of project information, cross-jurisdictional infrastructure, and technology can lead to standardized TSP practices across the region such that cross-jurisdictional interoperability is possible.

6.2 System Recommendations

System recommendations are intended to support the effective deployment of TSP such that optimal value can be realized from the investment. The following system recommendations are required to support optimal TSP performance.

System-1: Partner Agency Agreement. An informal agreement was developed for the deployment of the TSP Pilot Project but was intended to be short-term. It is recommended that partner agencies collaborating to deploy TSP develop a formal agreement that identifies operational and maintenance responsibilities, communications protocols and security, and coordination criteria. This agreement will provide a framework for successful TSP deployment and demonstrate the partners' commitment to collaborative investment.

System-2: Route 5 Pilot Further Study. As discussed in **Section 4**, the GA Smart Route 5 TSP Pilot Project demonstrated the successful deployment of TSP with the hybrid architecture approach which leveraged existing Sandy Springs deployments and MARTA data. Georgia Tech is planning to further analyze the data associated with the pilot study to better understand the

[1] More information about GTFS and GTFS Realtime standards can be found at GTFS Static Overview | Static Transit | Google Developers and GTFS Realtime Overview | Realtime Transit | Google Developers

potential impact of the deployment on traffic operations. It is recommended that the results of this further study be considered prior to future TSP deployment. Online survey respondents would also be supportive of transit improvements if it causes minimal or no delay to traffic, so it will be critical to understand the impact to other vehicles and pedestrians prior to moving forward.

System-3: Staff and Technology Resources for Support. Maintaining the TSP field equipment and monitoring of the TSP system are important to continue to provide TSP. It is recommended that the City plan for the additional staff hours and resources needed for the monitoring of operations and maintenance of TSP deployments. It is anticipated that this effort will account for approximately 10% of a full-time equivalent employee on an annual basis during the initial deployment and expansion phases of the system.

System-4: TSP Performance Measure Monitoring. As mentioned in **Section 3**, it is important to monitor and analyze key indicators to evaluate system performance. Effective performance monitoring is dependent upon the collection of appropriate, accurate, and high-resolution datasets. TRB TCRP's *G-18: Improving Access and Management of Transit ITS Data* gives guidance on the development of a common, practical approach to storing, accessing, and managing fixed-route transit ITS data. This project states that the scope of ITS data elements should include the following core datasets:

1. AVL data that includes stop and time-point arrival and departure times, intermediate vehicle location observations, and other vehicle event data;
2. APC data that includes boarding and alighting counts by trip and stop; and
3. AFC data that includes individual fare transactions.

Additionally, TRB Transit Cooperative Research Program's *TCRP Synthesis 153: The Transit Analysis Toolbox: Analysis and Approaches for Reporting, Communicating, and Examining Transit Data* details existing data, performance measures, data governance, and data management procedures adopted by transit agencies within the United States. This synthesis details that while the best practice of data management tools in the industry has yet to be researched extensively, they are necessary for integration and archiving of the increasing amount and variety of data being collected by transit agencies. It finds that a data governance framework that built upon enterprise approaches, controls, and rules for data management is recommended as observed in other industry groups. Additionally, executive leadership support for data governance is referenced as a critical element of data governance compliance.

It is recommended that guidance from these two sources be considered in the collection and management of data, and in the determination of performance measures used in system evaluation. It is recommended that Sandy Springs and Dunwoody work with transit agency partners to collect and monitor performance measures, including AVL data, GTFS and GTFS Realtime data, APC, AFC, headway adherence, OTP, and other metrics as needed. In addition, it is recommended that the cities continue to monitor mobility data including, bottleneck delay and speed as a resource to guide future deployments. Cities should refer to TCRP Synthesis 153 Toolbox to select appropriate data management tools, develop a data governance framework, and identify best methods for communicating data to leadership.

System-5: Route 5 TSP Parameter Traffic Signal Adjustments. The TSP parameters programmed within the traffic signal system are determined based on traffic volumes and transit operations. These parameters include, but are not limited to, amount of early green or extension of green that can be provided, at what level of congestion TSP is undesirable, and recovery needs. It is recommended to further study these parameters to optimize the system using information from the TSP Pilot Project and performance metrics of the system.

System-6: Route 5 Deployment Evaluation. It is critical to measure and evaluate the performance of a system to be able to optimize operations, implement lessons learned, and verify responsible investment initiatives. It is recommended that the Route 5 TSP deployment be evaluated after Georgia Tech completes further study, TSP parameters have been adjusted, and route TSP modifications have been implemented. The evaluation will verify anticipated benefits are being realized, recommend potential opportunities for optimization, and demonstrate fiscal responsibility.

System-7: Route 87 TSP Parameter Traffic Signal Adjustments. The TSP parameters programmed within the traffic signal system are determined based on traffic volumes and transit operations. These parameters include, but are not limited to, amount of early green or extension of green can be provided, at what level of congestion TSP is undesirable, and recovery needs. It is recommended to further study these parameters to optimize the system using information from the further TSP Pilot Project and performance metrics of the system.

System-8: Route 87 Deployment Evaluation. It is recommended that the Route 87 TSP deployment be evaluated after TSP parameters have been adjusted and route TSP has been deployed. The evaluation will verify anticipated benefits are being realized, recommend potential opportunities for optimization, and demonstrate fiscal responsibility.

System-9: Additional Transit Priority Treatment Study. It is recommended that high priority (high delay, low speed, low OTP, etc.) routes be studied to identify appropriate and feasible locations for additional transit priority treatments, such as queue jumps, bus lanes, and other operational improvements. Anticipated design and construction recommendations from this study are not estimated herein and will need to be developed as part of the Additional Transit Priority Treatment Study.

6.3 Recommendations by Route

Recommendations have been developed by route based on the methodology described in **Section 5**. It is recommended that PTAD, reliability, mobility, and headways be monitored and guide the deployment of route recommendations. As stated above, PTAD should be completed prior to further deployment of TSP. The cities should also work with MARTA to optimize route schedules and monitor OTP. Transit agencies generally have an 85% OTP goal; it is recommended that TSP only be considered for deployment if the optimized route schedules fall below 85% OTP. In addition, mobility indicators such as bottleneck delay and speed should be monitored to identified priority need areas which may initiate consideration of additional transit priority treatments such as queue jumps. Headways should be monitored and used to guide deployment; consideration should be given to determine if the investment would be expected to be greater than potential return of TSP deployment (i.e. number of buses traversing the route per day and expected benefit is worth the investment of TSP deployment).

Route 5

Based on Route 5 priority intersection locations and route segments, the following TSP deployment projects are recommended:

- **Route-5A: Route 5 Bus Stop Upgrades Short Term.** The Route 5 bus stop inventory identified two (2) transit stops which should be considered for relocation to the far-side of the intersection and one (1) transit stop to be upgraded in the short term. The City should coordinate with MARTA and review the results of additional TSP study to determine if and when the improvements should be made.
- **Route-5B: Route 5 Modification to Existing and Full TSP Deployment (COSS).** Based on the results of the Route 5 Pilot Further Study, performance metrics, and analysis of the TSP parameters, it is recommended to modify the TSP parameters and business rules in the existing fourteen (14) TSP Pilot Project deployment locations along Route 5. It is recommended to deploy TSP at the additional eight (8) traffic signals along Route 5 that were not included within the TSP Pilot Project.
- **Route-5C: Route 5 Modification to Existing TSP (COD).** Based on the results of the Route 5 Pilot Further Study, performance metrics, and analysis of the TSP parameters, it is recommended to modify the TSP parameters and business rules in the Dunwoody traffic signal system along Route 5. In addition, it is recommended that the GPS accuracy issue found during the TSP Pilot Project in the vicinity of Perimeter Center Pkwy and Hammond Dr intersection be further considered prior to deployment of the TSP hybrid architecture. It is possible that a solution such as strategically placing WiFi beacons may resolve this issue in an efficient manner; however, other deployment architectures within this area may also need to be considered.
- **Route-5D: Route 5 Bus Stop Upgrades Long Term.** The Route 5 bus stop inventory identified twelve (12) transit stops which could be relocated to the far-side of the intersection and three (3) transit stop to be upgraded in the short term.

Route 85

Based on Route 85 priority intersection locations and route segments, the following TSP deployment projects are recommended:

- **Route-85A: Route 85 Full TSP Deployment.** Route 85 operates on the north end of Sandy Springs along Roswell Rd and GA 400 to the North Springs MARTA station. The route includes seven (7) traffic signals in Sandy Springs; all the traffic signals are common with Route 87. It is recommended to deploy TSP along Route 87 prior to Route 85.

Route 87

Based on Route 87 priority intersection locations and route segments, the following TSP deployment projects are recommended:

- **Route-87A: Route 87 Bus Stop Upgrades.** Relocation of bus stops to the far-side of signalized intersections and upgrades of stops to provide ADA accessibility, after a complete inventory of stops along Route 87 has been completed.
- **Route-87B: Route 87 Initial TSP Deployment.** Initial deployment of TSP along Route 87 is recommended from GA 9/Roswell Rd at Abernathy Rd to the Dunwoody MARTA station.

This section includes sixteen (16) traffic signals; of those traffic signals twelve (12) are common with Route 5.

- **Route-87C: Route 87 Full TSP Deployment.** Full deployment of TSP along Route 87 is recommended to complete the northern section of Route 87 from the North Springs MARTA station to GA-9/Roswell Rd at Abernathy Rd. This section of includes fourteen (14) traffic signals; of those traffic signals seven (7) are common with Route 85.

Route 148

Based on Route 148 priority intersection locations and route segments, the following TSP deployment projects are recommended:

- **Route-148A: Route 148 Bus Stop Upgrades.** Relocation of bus stops to the far-side of signalized intersections and upgrades of stops to provide ADA accessibility, after a complete inventory of stops along Route 148 has been completed.
- **Route-148B: Route 148 Initial TSP Deployment.** Initial deployment of TSP along Route 148 is recommended from the Sandy Springs MARTA station to Mt Vernon Hwy at Lake Forest Dr. This section includes twelve (12) traffic signals; of those traffic signals one (1) is common with Route 5 and one (1) is common with Route 5 and 87.
- **Route-148C: Route 148 Full TSP Deployment.** Full deployment of TSP along Route 148 is recommended to complete the western section of Route 148 from Mt Vernon Hwy at Lake Forest Dr. This section includes thirteen (13) traffic signals; none of those are common traffic signals along TSP routes in Sandy Springs.

Route 825

Based on Route 825 priority intersection locations and route segments, the following TSP deployment projects are recommended:

- **Route-825A: Route 825 Bus Stop Upgrades.** Relocation of bus stops to the far-side of signalized intersections and upgrades of stops to provide ADA accessibility, after a complete inventory of stops along Route 825 has been completed.
- **Route-825B: Route 825 Full TSP Deployment.** Route 825 operates at the southeastern area of Sandy Springs from the Medical Center MARTA station along Peachtree Dunwoody Rd and Johnson Ferry Rd. In Sandy Springs, the route includes four (4) traffic signals; none of those are common with traffic signals along TSP routes in Sandy Springs.

City of Dunwoody – Route 103, Route 132, and Route 150

Based on future priority intersection locations and route segments and future TSP deployment decisions, the following TSP deployment projects are recommended:

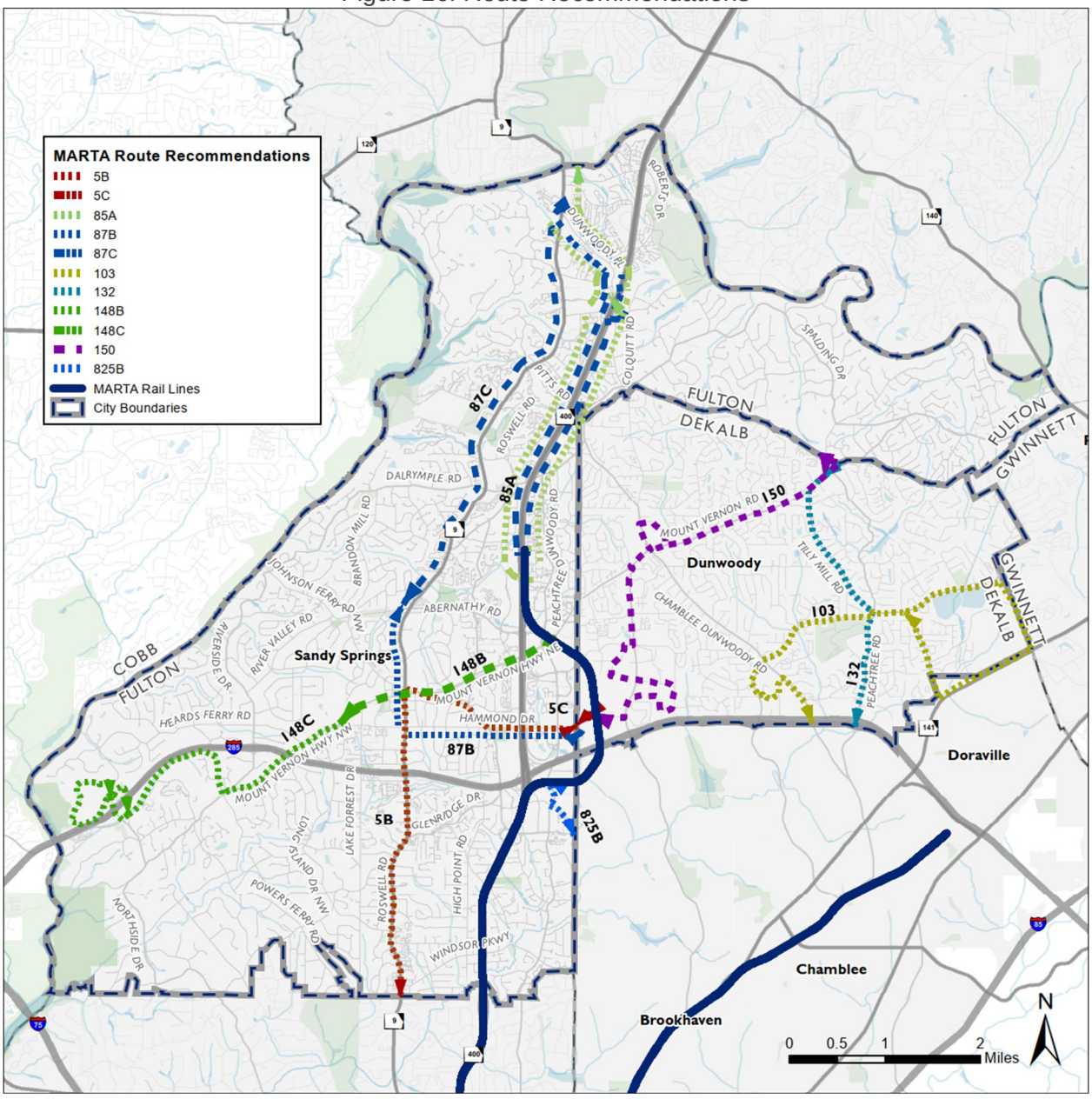
- **Route-103: Route 103 Full TSP Deployment.** Route 103 operates from the Chamblee MARTA station to Peeler Rd and Winters Chapel Rd. In Dunwoody, the route includes eleven (11) traffic signals; of those traffic signals two (2) are common with Route 132.
- **Route-132: Route 132 Full TSP Deployment.** Route 132 operates north/south from the Chamblee MARTA Station to Dunwoody Club Dr. In Dunwoody, the route includes nine (9) traffic signals: of those traffic signals two (2) are common with Route 103 and two (2) are common with Route 150.

- **Route150: Route 150 Full TSP Deployment.** Route 150 operates from the Dunwoody MARTA station to the northeast to Chamblee Dunwoody Rd and Dunwoody Village Pkwy with select weekday trips to Jett Ferry Rd. The section of the route from Dunwoody station to Chamblee Dunwoody Rd and Dunwoody Village Pkwy includes seventeen (17) traffic signals. The select weekday trip trips to Jett Ferry Rd includes five (5) traffic signals; of those traffic signals two (2) are common with Route 132.

7 Implementation Plan

The system and route recommendations described in the previous sections have been developed based on an assessment of the existing system, information gathered through interviews, best practices review, and the TSP pilot deployment project results. **Figure 16** provides a map of recommended TSP route recommendations.

Figure 16. Route Recommendations



7.1 Cost Development

TSP deployment recommendations and estimated costs are based on the assumption that Sandy Springs continues to operate and maintain the FMU, Glance, devices at traffic signal locations along transit corridors as part of their EVP program. In addition, the recommended route project estimated costs have been developed based on the assumption that traffic signals associated with multiple routes will be configured to accommodate TSP along each route that traverses the signal. Therefore, should the phasing of deployment differ than what is recommended, estimated costs should be reconsidered. The high-level cost estimates and assumptions are included in the **Appendix**.

7.2 Implementation Plan

Table 6 provides a summary of recommended TSP projects, deployment priority, associated high-level estimated costs, and key dependencies. As mentioned previously, PTAD, reliability, mobility, and headways should be monitored and guide the deployment of route recommendations identified below. In addition, this TSP implementation plan is based on the assumption that existing EVP hardware will be leveraged to deploy the hybrid TSP architecture. However, it should also be noted that if a transit partner agency decides to pursue a distributed CV approach to TSP utilizing an OBU, it should be possible for Sandy Springs to integrate with the partner agency system to provide TSP in that manner.

Table 6. TSP Implementation Plan

Project ID	Priority	Project Name	Lead	Estimated Cost	Dependencies
PTAD-1	1	AVL-CAD TSP API Refinement	Transit Agency	N/A	
PTAD-2	1	CAD System Upgrade	Transit Agency	N/A	
PTAD-3	1	Automated System Monitoring	Transit Agency	N/A	
PTAD-4	1	GTFS and GTFS Realtime Data Streaming	Transit Agency	N/A	
PTAD-5	1	Fixed-Route Schedule Optimization	Transit Agency	N/A	
System-1	1	Partner Agency Agreement	CoSS	$ -	None
System-2	2	Route 5 Pilot Further Study	GATech	$ -	None
System-3	3	Staff and Technology Resources for Support	CoSS	$ 30,000 (annually)	None
System-4	4	TSP Performance Measure Monitoring	CoSS	$ 25,000	System-3

Project ID	Priority	Project Name	Lead	Estimated Cost	Dependencies
System-5	5	Route 5 TSP Parameter Traffic Signal Adjustments	CoSS/CoD	$ 10,000	System-1, System-2, System-3
Route-5A	6	Route 5 - Bus Stop Upgrades Short Term	CoSS	$ 10,000	None
Route-5B	7	Route 5 - Modification to Existing TSP and Full TSP Deployment (CoSS)	CoSS	$ 48,000	System-1, System-2, System-3, System-4, System-5
Route-5C	8	Route 5 - Modification to Existing TSP (CoD)	CoD	$ 7,000	System-1, System-2, System-3, System-4, System-5
System-6	9	Route 5 Deployment Evaluation	CoSS	$ 30,000	Route-5A, Route-5B, Route-5C
System-9	10	Additional Transit Priority Treatment Study	CoSS	$ 60,000	System-1, System-2, System-3, System-4, System-5, System-6
System-7	11	Route 87 TSP Parameter Traffic Signal Adjustments	CoSS	$ 8,000	System-1, System-2, System-3, System-5, System-6
Route-87A	12	Route 87 - Bus Stop Upgrades	CoSS	$ 33,000	System-3
Route-87B	13	Route 87 - Initial TSP Deployment	CoSS	$ 16,000	System-1, System-2, System-3
System-8	14	Route 87 Deployment Evaluation	CoSS	$ 30,000	Route-87A, Route-87B
Route-5D	15	Route 5 - Bus Stop Upgrades Long Term	CoSS	$ 45,000	None
Route-87C	16	Route 87 - Full TSP Deployment	CoSS	$ 50,000	Route-87B
Route-85A	17	Route 85 - Full TSP Deployment	CoSS	$ 3,000	Route-87B, Route-87C
Route-825A	18	Route 825 - Bus Stop Upgrades	CoSS	$ 10,000	None
Route-825B	19	Route 825 - Full TSP Deployment	CoSS	$ 16,000	Increased Headways
Route-148A	20	Route 148 - Bus Stop Upgrades	CoSS	$ 45,000	None

Project ID	Priority	Project Name	Lead	Estimated Cost	Dependencies
Route-148B	21	Route 148 - Initial TSP Deployment	CoSS	$ 36,000	Increased Headways
Route-148C	22	Route 148 - Full TSP Deployment	CoSS	$ 43,000	Increased Headways
Route-103	23	Route 103 - Full TSP Deployment	CoD	$ -	To be determined based on future need and interest by CoD.
Route-132	24	Route 132 - Full TSP Deployment	CoD	$ -	To be determined based on future need and interest by CoD.
Route-150	25	Route 150 - Full TSP Deployment	CoD	$ -	To be determined based on future need and interest by CoD.

APPENDIX

List of Abbreviations

List of Abbreviations	
ADA	American Disabilities Act
AFC	Automated Fare Collection
APC	Automated Passenger Counter
API	Application Program Interface
ARC	Atlanta Regional Commission
ATL	Atlanta-Region Transit Link Authority
AVL	Automatic Vehicle Location
BCA	Benefit-Cost Analysis
BCR	Benefit-Cost Ratio
BRT	Bus Rapid Transit
CAD	Computer Aided Dispatch
CAP	Central Atlanta Progress
CCTV	Closed Circuit Television
CDOT	Chicago Department of Transportation
CID	Community Improvement District
COA	City of Atlanta
CoD	City of Dunwoody
CoSS	City of Sandy Springs
CTA	Chicago Transit Authority
CV	Connected Vehicle
DSRC	Dedicated Short-Range Communication
EVP	Emergency Vehicle Preemption
FMU	Field Monitoring Unit
GA Smart	Georgia Smart Communities Challenge 2020
GDOT	Georgia Department of Transportation
Georgia Tech	Georgia Institute of Technology
GPS	Global Positioning System
GTFS	General Transit Feed Specification
GTT	Global Traffic Technologies
IDOT	Illinois Department of Transportation
IOC	Integrated Operations Center
ITS	Intelligent Transportation Systems
JPO	Joint Program Office
MARTA	Metropolitan Atlanta Rapid Transit Authority
MTS	Metropolitan Transit System
OBU	On-Board Unit
OTP	On-Time Performance
PRG	Priority Request Generator
PRS	Priority Request Server
PTAD	Partner Transit Agency Dependencies

List of Abbreviations	
RITIS	Regional Integrated Transportation Information System
ROI	Return on Investment
RSU	Roadside Unit
SCOOT	Split, Cycle, and Offset Optimization Technique
SigOps	Signal Operations Program
SMFTA	San Francisco Municipal Transportation Agency
TCRP	Transit Cooperative Research Program
TMC	Traffic Management Center
TRB	Transportation Research Board
TSP	Transit Signal Priority
TTC	Toronto Transit Commission
USDOT	U.S. Department of Transportation
V2I	Vehicle-to-Infrastructure

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Fact Sheet

TRANSIT SIGNAL PRIORITY PILOT

The Cities of Sandy Springs and Dunwoody have embraced the challenge of improving the transportation system by integrating technology to better manage, operate, and enhance the travel experience. In partnership with Metropolitan Atlanta Rapid Transit Authority (MARTA), Georgia Tech, and the Atlanta Regional Commission (ARC), the Cities are studying the use of innovative Transit Signal Priority (TSP) technologies along MARTA Route 5.

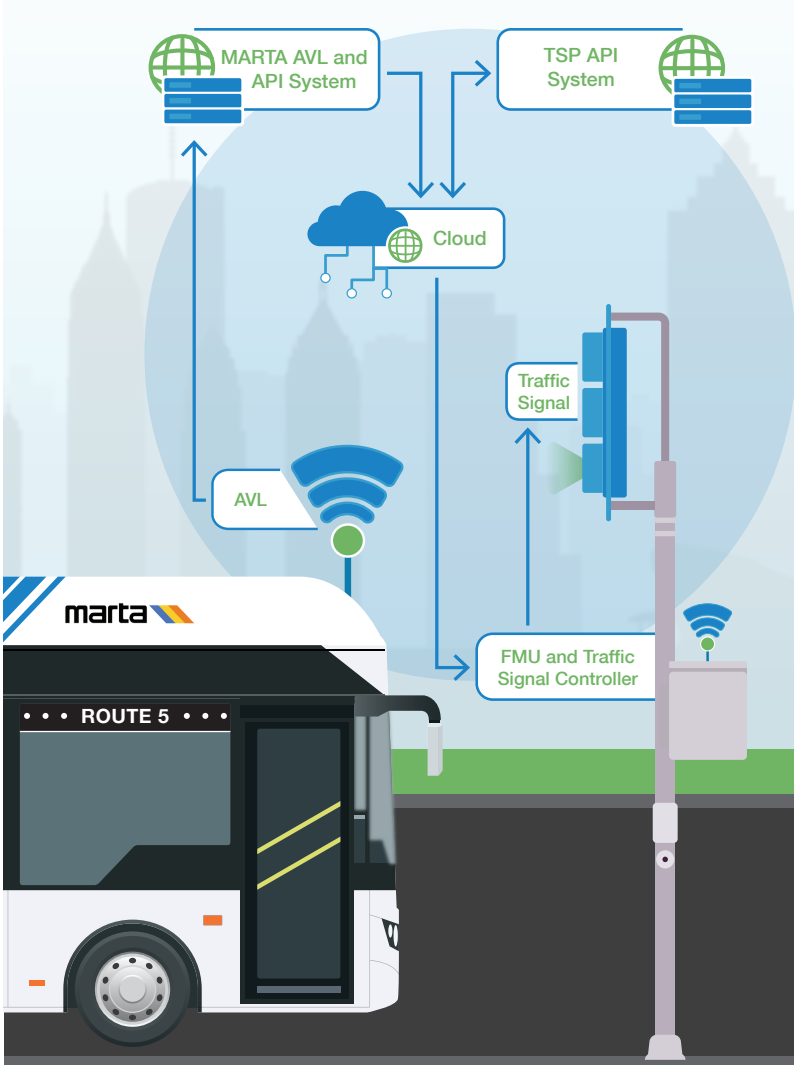
Transit Signal Priority

Transit Signal Priority (TSP) is an operational strategy in which the transit vehicle communicates with the traffic signals along its route to request signal timing tweaks. When requests are made, the traffic signals can provide additional green time for transit vehicles to progress through the signal without having to stop.

TSP benefits can include:

- increased adherence to transit schedules
- reduced transit delay at traffic signals
- increased ridership
- reduced operating costs
- reduced vehicle emissions

These systems can be configured such that priority is only given when the transit vehicle is behind schedule or has a lot of passengers. TSP can be deployed in various ways depending on characteristics of the existing transit and traffic signal infrastructure, policies and procedures of the transit agency, and resources available for implementation.



Sandy Springs TSP Pilot Project

The Sandy Springs TSP Pilot Project is using bus location data published through an application program interface (API). This is different than other currently deployed methodologies which require additional hardware on board the bus.

The pilot project will test TSP on a segment of MARTA bus route 5 which connects the Dunwoody and Lindbergh MARTA rail stations and operates with 15-minute headways. The TSP functionality and interoperability across jurisdictions will be tested. Transit on-time performance and travel times along this route will be evaluated as well as any additional operational impacts to the transportation network.

Georgia Smart Communities Challenge

The Georgia Smart Program provides support for local governments to explore, plan, and implement “smart” technologies to achieve their community’s goals. Communities throughout the State of Georgia are eligible to apply for funding. Selected communities are provided resources, a partnership with a Georgia Tech research team, networking opportunities, and access to additional, unique partnerships to execute their projects over the course of the year.

The city of Sandy Springs was one of four communities awarded this opportunity in 2020. The Sandy Springs and Dunwoody TSP Pilot Project will inform communities throughout the metro region and has the opportunity to shape how communities throughout the State will implement TSP to support better transit ridership, reliability, and efficiency.

Interagency Interview Summary

Cities of Sandy Springs and Dunwoody TSP Implementation Plan - Interagency Interview

Date / Time:	6/21/2021 10:00am	
Partner Agency:	ATL/SRTA/GRTA	
Interviewee(s):	Gail Franklin (SRTA) David Brown (SRTA)	gail.franklin@srta.ga.gov

Brief Introduction of TSP Implementation Plan: scope, schedule, and status. Discuss how their information will be used.

Question:	Answer:
General thoughts pertaining to TSP as a deployment (technology agnostic).	TSP has been on their radar for some time. Impacts on traffic needs to be more controlled. Ultimate desire is to improve performance across the areas where they know they have bottleneck and impacts to performance.
What do you consider the existing strengths and challenges related to coordination, collaboration, and implementation within the realm of TSP?	
Traffic Signal Systems	Challenge of technologies and the number of players that are involved in any given region. Partnered with GDOT which gives them access to the State Road but vehicles traverse through different cities and counties which could have different systems. Different areas are looking at TSP opportunities so there needs to be compatibility with the different systems in the different cities and counties. Marking sure the technologies are complementary and need to work seamlessly between the different jurisdictions.
Transit Systems	Trying to determine benefits of integration with CAD AVL system. If connected to CAD AVL they can trigger signals based on runtime. This will allow them to get better data with the integration.
Transit Routes	Not all corridors have on-time performance challenges. Would like to run TSP on routes that are lit and are safe.
Transit Operators	
Transit Users	TSP is a great way to provide better performance. Improving on time performance to meet riders expectations.
Non-Transit Users	They have done some outreach regarding TSP but it was a soft outreach that was similar to what they did for Managed Lanes. There are opportunities to educate and promote TSP.
What are your current plans and considerations for implementing TSP from a technology perspective?	They are doing a pilot using OBUs and RSUs with DSRC communications. They are looking at using their current AVI system but have not made a decision either way with TSP technology yet.
TSP Methodologies (Distributed / Central / Smart Bus)	
TSP Technologies (OBU / AVL / Combination / Other)	Working with GDOT to determine their level of commitment to DSRC technology to ensure that whatever they adopt can work seamlessly with the 12 counties and 3 CIDs they service. Figure out all the technologies and how they can interface with them.
Where are the greatest opportunities for implementing TSP?	Ultimate desire is to improve performance across the areas where they know they have bottlenecks and impacts to performance. It is working with their contracting to make sure they are getting as much opportunity to be successful which trickles down to their riders so they get the most appealing ride and finding ways to leverage technology. TSP is a great way to provide a better performance. TSP is a great way to provide better performance. Improving on time performance to meet riders expectations.

What is your agency's current plan for considering or implementing TSP?	Prior to pandemic working with GDOT on a small pilot project using OBUs on 10 of their buses in the Arts Center. Having stared collecting data over a 30 day period. Current installation is jut a stand alone pilot and did not bring in the CAD AVL system to send information about on time performance with the cabinet. Interested in connected vehicle technologies vs their existing equipment. They are working with GDOT to get the equipment and have it installed on their buses. Probably going to move forward with it but there have not made a decision on which way they are leaning. They are doing this independently but meeting with Cobb and Gwinnett Counties to see if there is synergy between agencies. MARTA is looking at TSP but behind on their roll out. Last technology meeting (about a month ago) looking at what MARTA was doing and they are looking at going from their AVI system and not onboard units
What is your vision for the on-going partnership with COSS and COD? How can this partnership be leveraged to make best use of TSP?	

Cities of Sandy Springs and Dunwoody TSP Implementation Plan - Interagency Interview

Date / Time:	6/21/2021 12:00pm
Partner Agency:	MARTA Technology and Customer Experience
Interviewee(s):	David Emory demory@itsmarta.com

Brief Introduction of TSP Implementation Plan: scope, schedule, and status. Discuss how their information will be used.

Question:	Answer:
General thoughts pertaining to TSP as a deployment (technology agnostic).	Very interested in using TSP. Interested in the potential for customer information as well. Tracking buses, locating buses, doing some sort of bus arrival information on apps, estimated arrival times, predictive analytics.
What do you consider the existing strengths and challenges related to coordination, collaboration, and implementation within the realm of TSP?	
Traffic Signal Systems	
Transit Systems	Having flexibility to assign any bus to any route (router based approach) and challenge of using on-board units that correct buses are being assigned to the correct routes. Due to the size of their fleet installing additional TSP on-board units can be a major challenge. Challenge of first time using specific type of technology keeping everything up and running and fully maintained is a challenge. Issues with some GPS cards and ff a GPS isn't working on a specific vehicle it is considered lower priority to maintenance for it to be operational. Challenge to upgrade firmware for on-board units and getting entire fleet online.
Transit Routes	Need to work with planning if TSP improves operations and how that affects run times and schedules moving forward and the communication moving forward.
Transit Operators	Any additional things for bus drivers that they need to turn on/off can be challenging. Staffing is a challenge. Bus operations to prioritize this.
Transit Users	There isn't a big agitation piece the bus will run more smoothly and won't need to communicate with riders too much. Regional App: Plan interagency trips, formatting/naming of stops needs to be consistent, gps location of stops could be off, lots of coordination needed.
Non-Transit Users	
What are your current plans and considerations for implementing TSP from a technology perspective?	Waiting to see how the COSS pilot is to consider further steps. Also looking at all options for deploying TSP. Have pilots which are testing different technologies.
TSP Methodologies (Distributed / Central / Smart Bus)	Routers have been installed on buses for years which support CCTVs, fare payment, etc.
TSP Technologies (OBU / AVL / Combination / Other)	MARTA is replacing its CAD AVL system over the next year or two. Once that is in place they will have the high-quality real-time information. Router system is considered different than the CAD AVL system. Current CAD AVL system gives information every 2 minutes but does link the information to the schedule that helps determine adherence. Their public facing system also uses CAD system.

Where are the greatest opportunities for implementing TSP?	Would like to get more updated adherence information along corridors. Potential to include some sort of logic predictions: looking at historical trends and congestion speeds along segments. Software could include information on buses, communicate if bus is stopped at stop with bus with door open. Regional coordination around data and information sharing: Regional App.
What is your agency's current plan for considering or implementing TSP?	Pilot projects on many different corridors: Summer Hill BRT Project in Downtown Atlanta type of TSP system is to be determined. North Avenue enhanced bus service talk. Looking at options for OBU/RSU type of system. Router/software based approach - Plan to have it working on every bus and will simplify things. Project with GDOT and Cisco along Route 39 on Buford Hwy. Doing project with Pascal on demand-responsive pilot.
What is your vision for the on-going partnership with COSS and COD? How can this partnership be leveraged to make best use of TSP?	MARTA wants to move ahead with the deployment of TSP. Want to learn from this pilot project to see what challenges to implementation that can be improved moving forward. GDOT coordination with some regional efforts with ATL.

Cities of Sandy Springs and Dunwoody TSP Implementation Plan - Interagency Interview

Date / Time: 6/22/2021 11:00am	
Partner Agency: CobbLinc	
Interviewee(s): Andrea Foard	andrea.foard@cobbcounty.org

Brief Introduction of TSP Implementation Plan: scope, schedule, and status. Discuss how their information will be used.

Question:	Answer:
General thoughts pertaining to TSP as a deployment (technology agnostic).	Currently have TSP deployed at 1 intersection in the City of Marietta and looking to expand TSP throughout the City
What do you consider the existing strengths and challenges related to coordination, collaboration, and implementation within the realm of TSP?	
Traffic Signal Systems	What else is needed for them to expand TSP in the City limits of Marietta using the same OBU/RSU system.
Transit Systems	Getting good data, tracking service changes and how they affect the system
Transit Routes	
Transit Operators	
Transit Users	
Non-Transit Users	Education of drivers on how to use the TSP and queue jump system. May have done an initial push with DOT or City with then signal of Cobb Pkwy. and Windy Hill was first implemented but not aware of a large TSP education effort.
What are your current plans and considerations for implementing TSP from a technology perspective?	Testing their current system but looking at other projects to analyze data and seeing how TSP continues to roll out across the country
TSP Methodologies (Distributed / Central / Smart Bus)	Have 1 location with RSU. Looking to move forward with additional deployments
TSP Technologies (OBU / AVL / Combination / Other)	Have Glance on-board units on 70 fleet vehicles
Where are the greatest opportunities for implementing TSP?	
What is your agency's current plan for considering or implementing TSP?	Existing TSP/queue jump lane at the intersection of Cobb Pkwy and Windy Hill. Working internally to expand transit service in Marietta using project submitted through ATL. Would like to see what else is needed to expand TSP in city limits using the same system. Working to determine if TSP will be implemented across all City traffic signals or just along determined routes. County is looking at CV1K which may change a little about deployments moving forward
What is your vision for the on-going partnership with COSS and COD? How can this partnership be leveraged to make best use of TSP?	

Cities of Sandy Springs and Dunwoody TSP Implementation Plan - Interagency Interview

Date / Time: 6/23/2021 1:00pm	
Partner Agency: Perimeter Connects	
Interviewee(s): Amy Johnson	johnsona@urbantrans.com

Brief Introduction of TSP Implementation Plan: scope, schedule, and status. Discuss how their information will be used.

Question:	Answer:
General thoughts pertaining to TSP as a deployment (technology agnostic).	Have shuttles that connect to MARTA stations and to employment destinations and would like to do a TSP pilot.
What do you consider the existing strengths and challenges related to coordination, collaboration, and implementation within the realm of TSP?	
Traffic Signal Systems	
Transit Systems	Need appropriate equipment to provide the correct AVL information. They currently work with the PCID and large corporations to provide shuttles to clusters of employers. Shuttles run on certain schedule focused on peak period connections. The shuttles are maintained and operated by multiple providers.
Transit Routes	
Transit Operators	Have various shuttle providers. Coordination between all providers and the cities could be a challenge for equipment compatibility, schedule information, and creating one place for tracking vehicles
Transit Users	Level of ridership is currently pretty low but they do track the information. Few of the routes provide over one hundred routes per day.
Non-Transit Users	Perception that congestion is so bad and shuttles do not adhere to a schedule. They are already communicating with employers which could be a good time to promote more ridership with TSP as well as have independent list of commuters. They currently have outreach programs such as "try transit". Challenge of non-transit riders not understanding why transit is getting priority over motor vehicles when congestion is already bad.
What are your current plans and considerations for implementing TSP from a technology perspective?	Do not have a preference for type of technology to implement TSP. Is looking for direction from cities/PCID to communicate to shuttle providers
TSP Methodologies (Distributed / Central / Smart Bus)	
TSP Technologies (OBU / AVL / Combination / Other)	
Where are the greatest opportunities for implementing TSP?	Providing AVL information to promote schedule adherence
What is your agency's current plan for considering or implementing TSP?	Would like to do a pilot project with a certain shuttle provider and evaluate the technology and make sure they have the right equipment to expand to other shuttle providers. Would like to have an app that tracks the different shuttles across the different providers.
What is your vision for the on-going partnership with COSS and COD? How can this partnership be leveraged to make best use of TSP?	The PCID will help support getting the correct equipment for the shuttles but would need additional partnership from COSS and COD. Some of the shuttles have the ability to track but are unaware if the technology is compatible. Would like to pursue a partnership with the cities to help influence and support pilot. May need additional hardware for the existing RSU to support the shuttle OBUs or equipment.

Cities of Sandy Springs and Dunwoody TSP Implementation Plan - Interagency Interview

Date / Time:	6/23/2021 3:00pm	
Partner Agency:	Gwinnett County Transit	
Interviewee(s):	Karen Winger	karen.winger@gwinnettcounty.com

Brief Introduction of TSP Implementation Plan: scope, schedule, and status. Discuss how their information will be used.

Question:	Answer:
General thoughts pertaining to TSP as a deployment (technology agnostic).	Would like to implement TSP for routes that take riders into heavily congested areas which would help increase ridership.
What do you consider the existing strengths and challenges related to coordination, collaboration, and implementation within the realm of TSP?	
Traffic Signal Systems	Technologies pilots. Gwinnett County Transit is apart of the DOT which has direct coordination with signal system and has less jurisdictional oversight as other transit partners. Challenge of technologies communicating across jurisdictions.
Transit Systems	Latency on schedule adherence is about 30 seconds. API is available now GTFS-RT is almost available through google. Currently have 4 time points on their schedules. During the school schedules they have a lot of time built into the schedule but with TSP they can control those time points, and need to shift time points and/or add additional time points, build in better breaks for their drivers. Look at bus operations costs with the improvements with TSP. Challenge of technologies communicating across jurisdictions.
Transit Routes	Reconsider schedules to gain efficiency around routes based on improvements from TSP.
Transit Operators	Improved time point controls/schedule adherence would improve operator experience
Transit Users	Improved time point controls/schedule adherence would improve ridership experience
Non-Transit Users	Have not yet done any outreach/communications. Will talk about doing education like they did with DDI implementation. Need to help tell the story of Transit
What are your current plans and considerations for implementing TSP from a technology perspective?	
TSP Methodologies (Distributed / Central / Smart Bus)	
TSP Technologies (OBU / AVL / Combination / Other)	Current pilot using OBU/RBU and Connected vehicle technology. Have an API available to TTFS real time. Peachtree corners has AVI imbedded in their App.
Where are the greatest opportunities for implementing TSP?	If they can get commuter buses to get through downtown Atlanta traffic sooner. If it helps them get through downtown quicker and not sitting in traffic it could help increase ridership. Bus can be held up to get a few passengers and talk to signals downstream to get back on schedule to keep efficiency. Diverting trips to service additional customers. Customers are able to coordinate transfers and the drivers can be notified ("see") riders getting off one bus and wait for them to get onto theirs: a complete trip App.

What is your agency's current plan for considering or implementing TSP?	Smart Corridor Project using on-board units and roadside units using connected vehicle path. Focused on local routes for now and have not yet figured out what TSP may look like for Express and Commuter routes
What is your vision for the on-going partnership with COSS and COD? How can this partnership be leveraged to make best use of TSP?	Regional coordination: This is a new space for everyone and anything they can do to help keep things seamless to coordinate real time bus to bus transfers and figure out how to work concurrently or together to make systems work together. Very open to partnerships and collaboration to whatever will support customers better.

Cities of Sandy Springs and Dunwoody TSP Implementation Plan - Interagency Interview

Date / Time:	6/30/2021 12:00pm	
Partner Agency:	MARTA Planning	
Interviewee(s):	Natavis Harris	nharris@itsmarta.com
	Corentin Auguin	cauguin@itsmarta.com
	Ezekiel Guza	eguza@itsmarta.com

Brief Introduction of TSP Implementation Plan: scope, schedule, and status. Discuss how their information will be used.

Question:	Answer:
General thoughts pertaining to TSP as a deployment (technology agnostic).	Pro technology and speeding buses up. Is it possible to have unconditional signalization? If they schedule well they the buses wouldn't need TSP, incentivized to run a tight schedule to use the system. If they can increase the service span being able to service additional customers.
What do you consider the existing strengths and challenges related to coordination, collaboration, and implementation within the realm of TSP?	
Traffic Signal Systems	
Transit Systems	TSP implementation will have many moving parts because they need to consider scheduling with TSP and how that changes departure times, faster schedules, slack time, etc. Need to put more stops on the far sides of the intersection. Been doing things with TSP in made to use more in the future.
Transit Routes	Putting more stops on the far side of the intersection
Transit Operators	
Transit Users	
Non-Transit Users	
What are your current plans and considerations for implementing TSP from a technology perspective?	Jurisdictional corporation is needed.
TSP Methodologies (Distributed / Central / Smart Bus)	
TSP Technologies (OBU / AVL / Combination / Other)	
Where are the greatest opportunities for implementing TSP?	
What is your agency's current plan for considering or implementing TSP?	Currently developing a tool to identify where TSP could be deployed. Looking at bus stop location, safety, headway enhancements, and other smaller projects that could be completed for TSP implementation
What is your vision for the on-going partnership with COSS and COD? How can this partnership be leveraged to make best use of TSP?	Jurisdictional coordination is critical.

Cities of Sandy Springs and Dunwoody TSP Implementation Plan - Interagency Interview

Date / Time:	8/5/2021 11:00am	
Partner Agency:	MARTA Operations	
Interviewee(s):	Thomas Gaskin	tgaskin@itsmarta.com
	Brentnom McCalmon	bmccalmon@itsmarta.com
	Larnell Stephens	lstephens@itsmarta.com
	Barbara Williams	bwilliams@itsmarta.com

Brief Introduction of TSP Implementation Plan: scope, schedule, and status. Discuss how their information will be used.

Question:	Answer:
General thoughts pertaining to TSP as a deployment (technology agnostic).	
What do you consider the existing strengths and challenges related to coordination, collaboration, and implementation within the realm of TSP?	
Traffic Signal Systems	
Transit Systems	During the Route 5 TSP Pilot Project there were some issues found that the AVL server had gone down and the API stream wasn't accurate. Would recommend that there is automated monitoring to notify if AVL system is down.
Transit Routes	
Transit Operators	Operators have a running board that gives them a schedule and MDT (device that talk to the AVL) which indicates if the bus is running early or late to the second. This will also let them know if they will continue to be early or late based on their speed and location. The operators are trained on what to do if they are early or late. They are trained on how to get people on safely but quicker if running behind and if early how to pull over and wait, hold up and wait longer at bus stops.
Transit Users	
Non-Transit Users	
What are your current plans and considerations for implementing TSP from a technology perspective?	
TSP Methodologies (Distributed / Central / Smart Bus)	
TSP Technologies (OBU / AVL / Combination / Other)	
Where are the greatest opportunities for implementing TSP?	There was a recent effort to remove operator behavior from the on-time performance equation. They did a better job explaining to the operators what it means to be on-time and what time points mean. They are now looking at schedules and how the system is working with these improvements to operator behaviors
What is your agency's current plan for considering or implementing TSP?	
What is your vision for the on-going partnership with COSS and COD? How can this partnership be leveraged to make best use of TSP?	

Non-Transit Rider Survey Results

Non-Transit Rider Survey

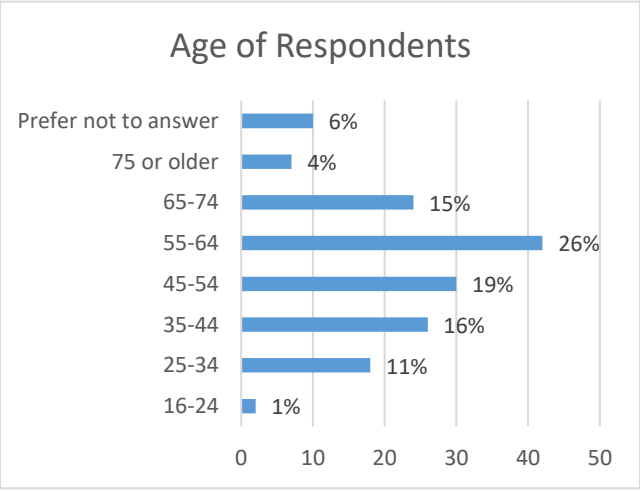
Background
The City of Sandy Springs is conducting a pilot project testing transit signal priority (TSP) technology on a segment of MARTA Route 5 within the City. This technology is intended to improve reliability of the bus route. As part of a future deployment, TSP can also be used to re-time the route and reduce the amount of time needed to travel the entire route.

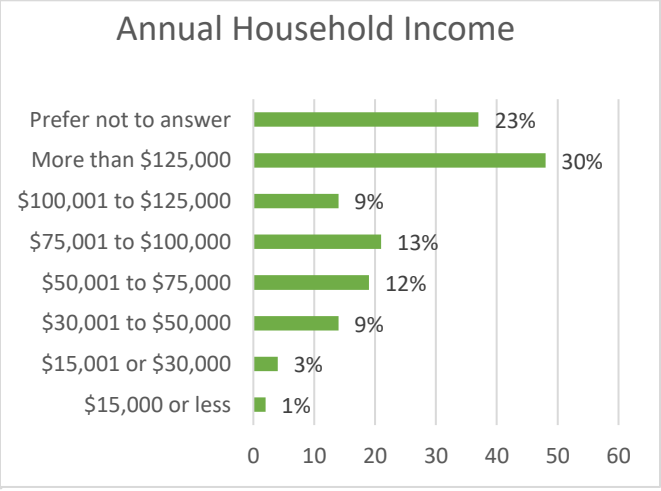
To supplement the study, an online survey was developed to understand why residents and commuters in Sandy Springs do not currently use transit, specifically the bus routes, and to understand if improvements from Transit Signal Priority technology (improved reliability and reduced travel time) would encourage them to use transit in the future. The City would like to understand if TSP improvements would help shift single occupancy drivers to take transit within the City.

Development and Distribution
To develop the survey questions, similar surveys were reviewed. This survey reused several questions from other surveys in order to be able to compare the responses to other surveys. The survey include questions about demographics of participants to better understand who was taking the survey, questions related to transit improvements, questions about reasons why riders didn't currently take transit, and questions related to COVID-19's impact on transit use.

The survey was released on June 28th and closed on July 16th. The survey was advertised by the Sandy Springs Perimeter Chamber of Commerce, the Perimeter Community Improvement District, and Sandy Springs Economic Development Department to reach employers and commuters in Sandy Springs. It was also advertised in the Sandy Springs July newsletter which was shared with Sandy Springs residents.

Respondent Demographics
The City received 159 completed responses to the survey. Over 45% of respondents (73 people) were 55 years old or older, although this age group only makes up 31% of City residents (ACS 2018). Over 23% of respondents chose not to report their annual household income before taxes, and of those 122 respondents that did report, 50% of them reported an annual household income of greater than $75,000 – slightly higher than the median income for Sandy Springs, $71,000 (ACS 2018).





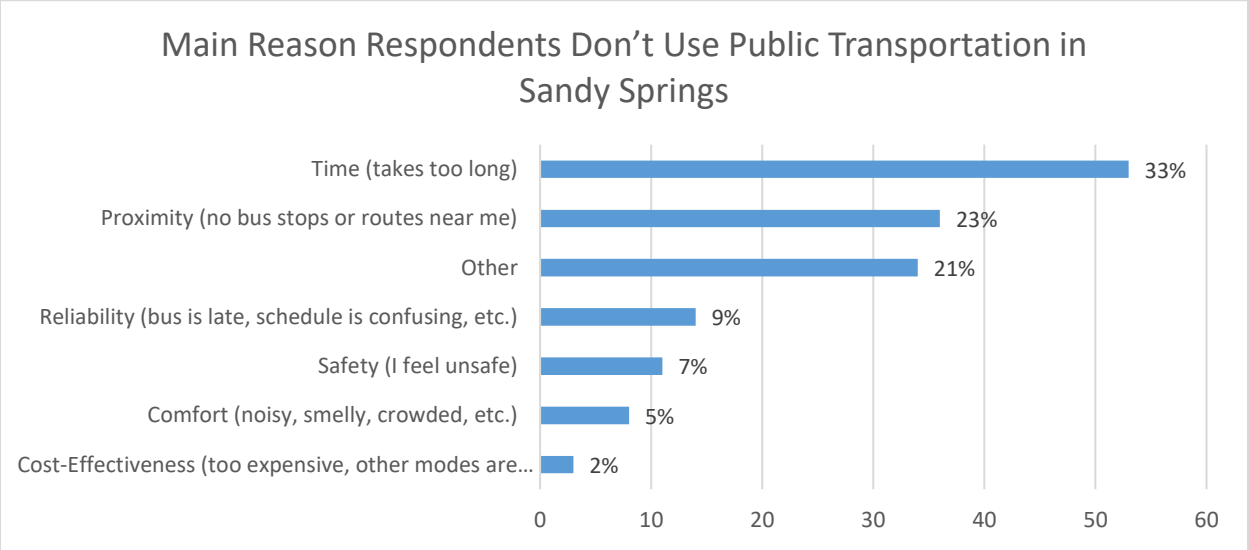
Increasing Transit Usage

Existing Transit Usage

Almost all respondents (95%) had used transit service within the region before (MARTA, CobbLinc and/or Xpress), and 94% had specifically used MARTA bus or rail service. About 46.5% of respondents had used both MARTA bus and rail service, 46.5% had used only MARTA rail system, and 1% had used only the MARTA bus system. With that said, respondents did not use MARTA system regularly. Only 20 (13%) respondents used rail at least once a week to commute to work or school and only 16 (10%) of respondents use the bus at least once a week to commute to work or school. Fewer respondents used rail or bus transit for non-work/school purposes (such as shopping, dining, attending events, errands, visiting others, doctor, or hobbies). Just over 40% of respondents did use rail and/or bus less than once a month, indicating that they many more respondents were occasional transit users, than regular users.

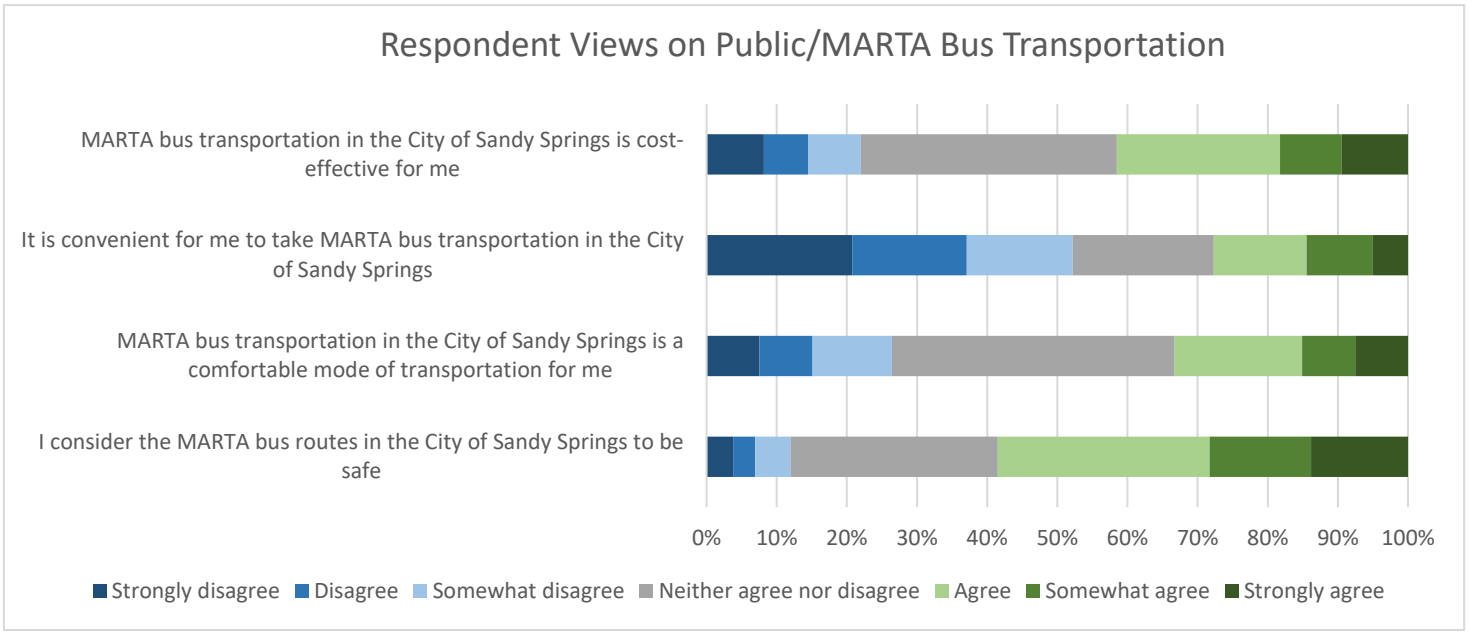
Potential for Mode Shift

Since many respondents indicated they have used transit before, and many of the respondents use it to some frequency for work/school trips and non work/school trips, it is likely that they are open to the idea of using transit. Therefore, it is important to consider what changes can be made for respondents to use transit as their mode more frequently. Survey respondents were asked the main reasons they didn't take transit. Over 33% of respondents noted the main reason they don't use public transportation in Sandy Springs is because it takes too long, 23% cited proximity (no bus stops/routes near them), 9% reliability, 7% safety, 5% comfort and 2% cost-effectiveness. Transit signal priority has the potential to improve reliability by helping buses stay on schedule, and shortening the travel time by re-timing the corridor since TSP can help a bus move through a corridor faster.



*Of those that answered "Other", the major reasons were related to not needing transit/not wanting to use it or that they do use public transportation so the question wasn't relevant to them. Other responses were related to travel time, inconvenience, and proximity to destinations.

Regarding other issues, less than 15% of respondents thought of public/MARTA bus transportation as unsafe and over 40% thought public/MARTA bus transportation was cost effective for them, but less than 30% thought public/MARTA bus transportation was a convenient option for them. Convenience can be related to both proximity of bus stops and travel time, which were the two main reasons cited for not taking public transportation in Sandy Springs.

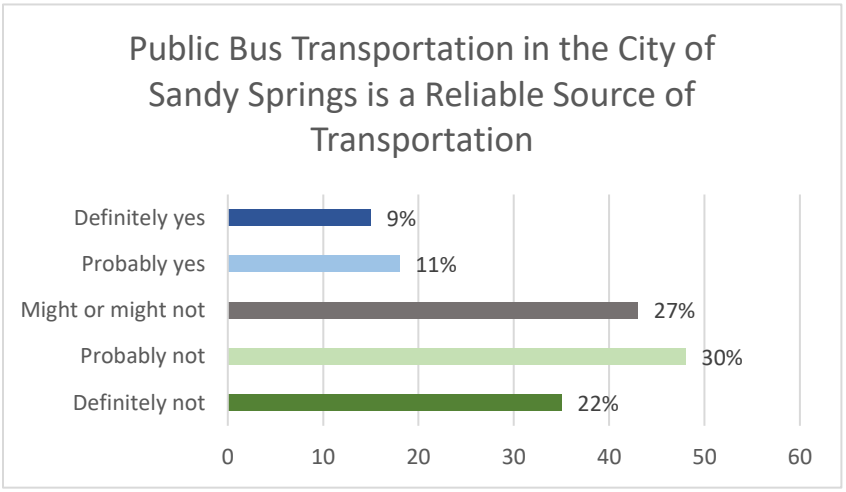


Can Transit Signal Priority help?

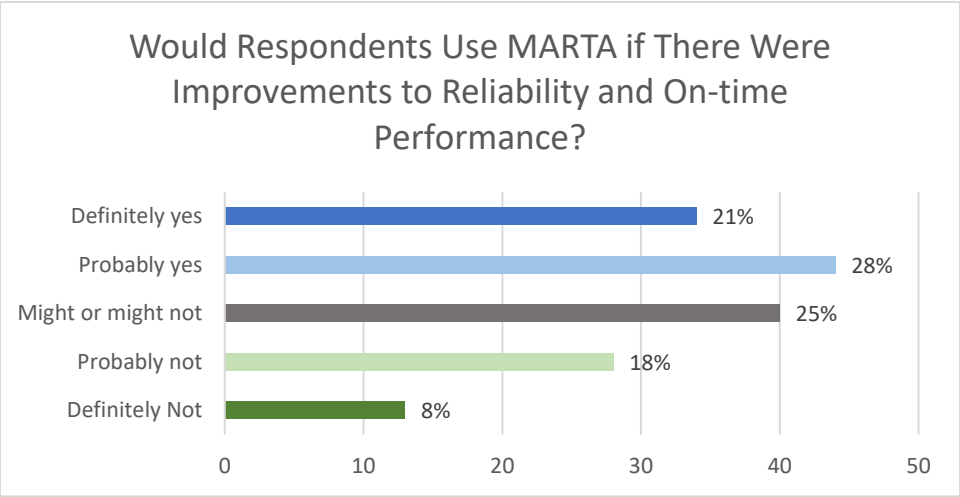
As mentioned above, TSP can improve reliability and shorten travel time. The next sections dive into additional questions related to respondent's perspectives on reliability and travel time.

Reliability

When asked specifically about reliability, less than 20% of respondents (36 people) thought that public bus transportation was definitely or probably a reliable source of transportation for them. While reliability is not the main reason most respondents do not take public transportation, it is clear that for that it is an issue for over 50% of them.

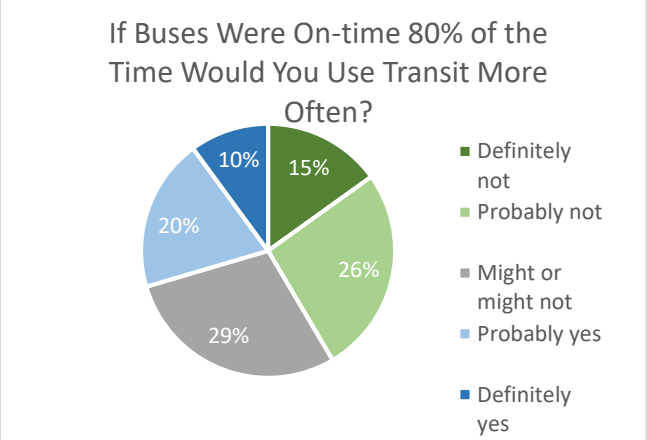


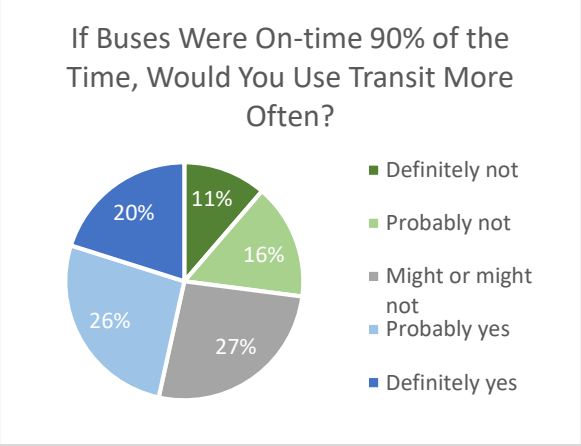
In regards to mode shift, 49% of respondents responded that they would probably or definitely use MARTA if there were improvements to reliability and on-time performance, indicating there is some potential to increase MARTA usage with an increase in reliability.



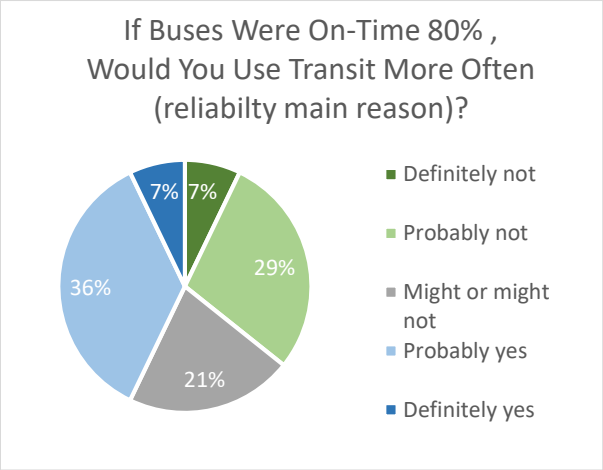
To understand the necessary magnitude of the improvement for respondents to use MARTA, respondents were asked if they would use transit more often in two scenarios 1) if buses were on time 80% of the time (late one day out of 5 days they take the bus) compared to 75% today, and 2) if buses were on time 90% of the time (late one day out of 10 days they take the bus) compared to 75% today.

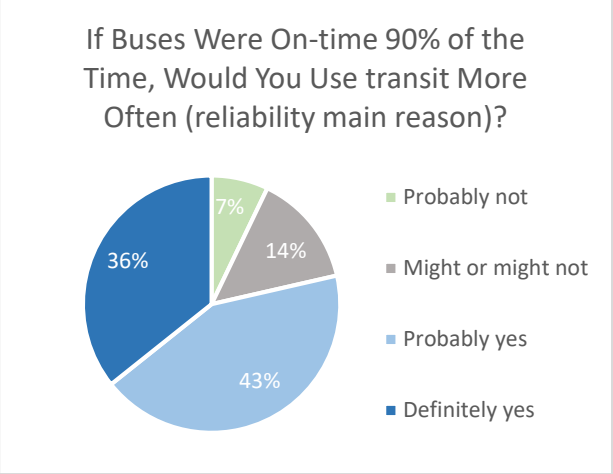
In the scenario where buses were on time 80% of the time, 30% of respondents selected that they would definitely or probably use transit more often, and if buses were on time 90% of the time, 46% of respondents would definitely or probably use transit more often. In order to encourage people take the bus more often, the bus will likely need to be on time 90% of the time.





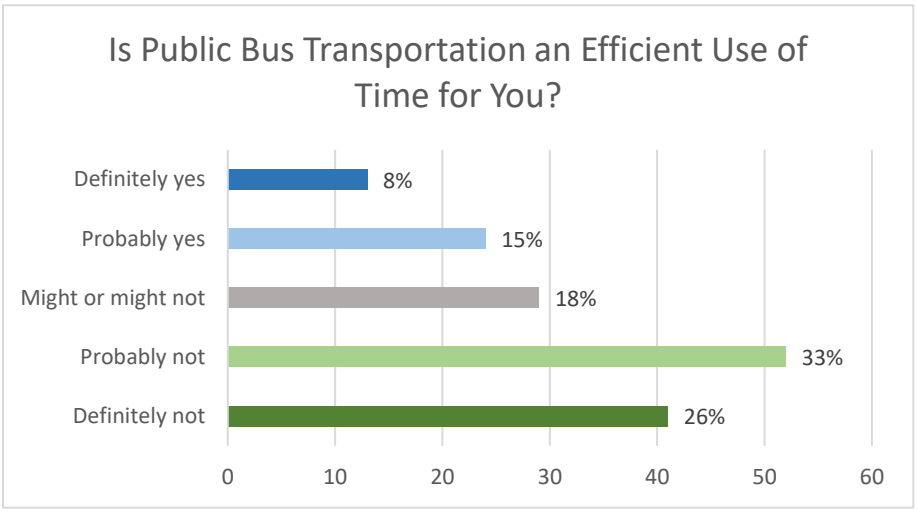
Diving deeper into the data, there were 14 respondents who identified reliability as the main reason they do not take public transportation. For these participants, an increase in on time performance to 80%-90% was more important than to the respondent group overall. For this group, if buses were on time 80% of the time, 43% of respondents would definitely or probably use transit more often, and if buses were on time 90% of the time, 79% of respondents would definitely or probably use transit more often.





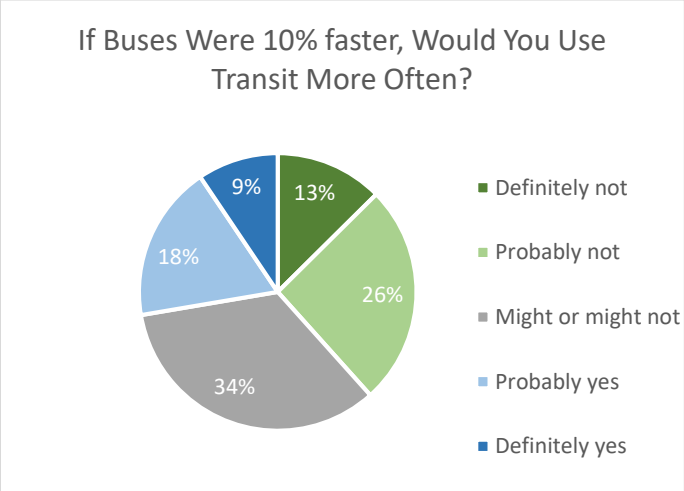
Travel Time

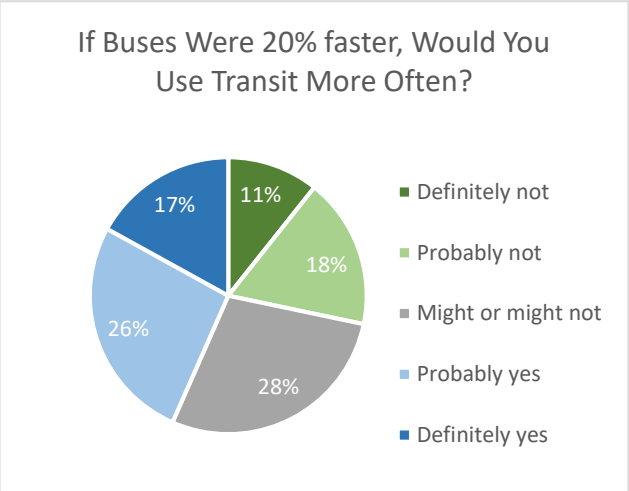
When asked specifically about travel time, less than 25% of respondents (37 people) thought that public bus transportation is definitely or probably an efficient us of time for them; and 59% (93 people) thought it was definitely or probably not an efficient use of time. This finding is consistent with the 33% of respondents who identified that "transit takes too long" as the main reason they do not use public transportation.



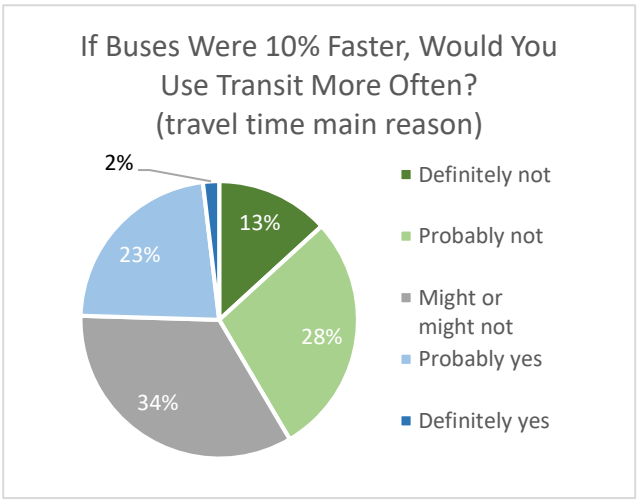
To understand the necessary magnitude of the travel time reduction for respondents to use MARTA, respondents were asked if they would use transit more often in two scenarios 1) if buses were able to move 10% faster (save 3 minutes on a 30 minute trip compared to today), and 2) if buses were able to move 20% faster (save 6 minutes on a 30 minute trip compared to today).

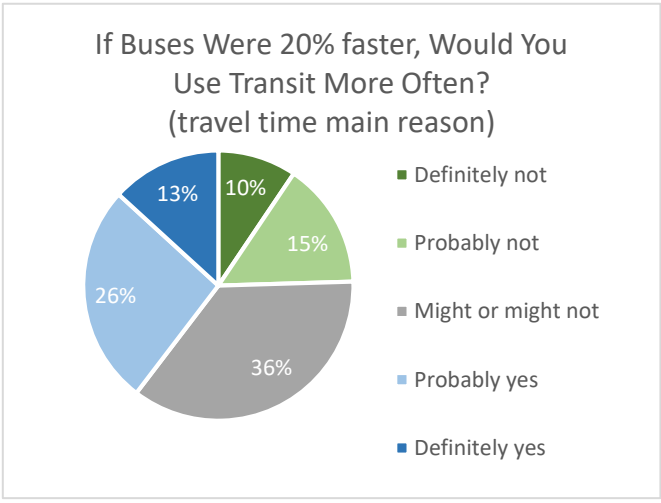
In the scenario where buses were 10% faster, 27% of respondents selected that they would definitely or probably use transit more often, and if buses were 20% faster, 43% of respondents would definitely or probably use transit more often.





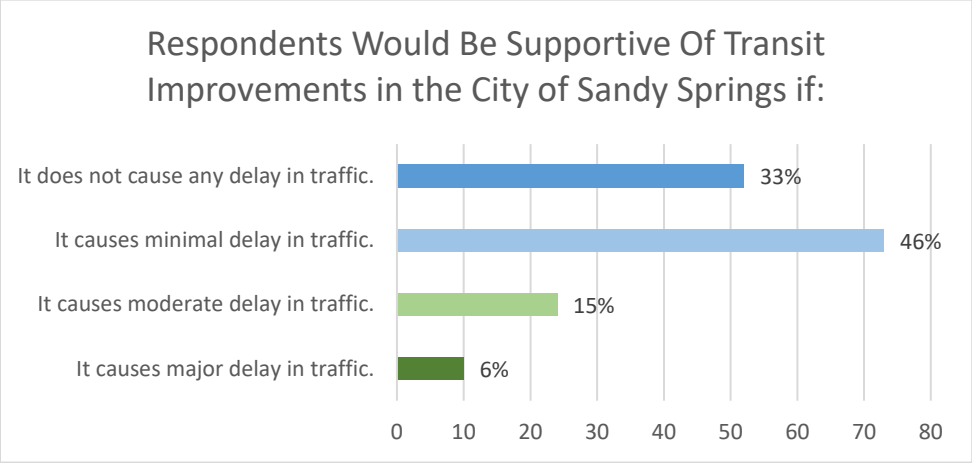
There were 53 respondents who identified travel time (takes too long) as the main reason they do not take public transportation. For these participants, faster travel time by 10%-20% was slightly less important than to the respondent group overall. For this group, if buses were 10% faster, only 25% of respondents would definitely or probably use transit more often, and if buses were 20% faster, 39% of respondents would definitely or probably use transit more often. In order to encourage people take the bus more often, the bus will likely need to be 20% faster.





Negative Impacts of Technology

All respondents were also asked whether or not they would be supportive of improvements depending on how it affected vehicular travel. About one third of respondents would only be supportive if the TSP didn't cause any delay to traffic, 46% would be supportive if it only caused minimal delay and 21% would still be supportive if it caused moderate or major delay to traffic. If the technology causes only minimal delay, then most respondents would be supportive of the investment.



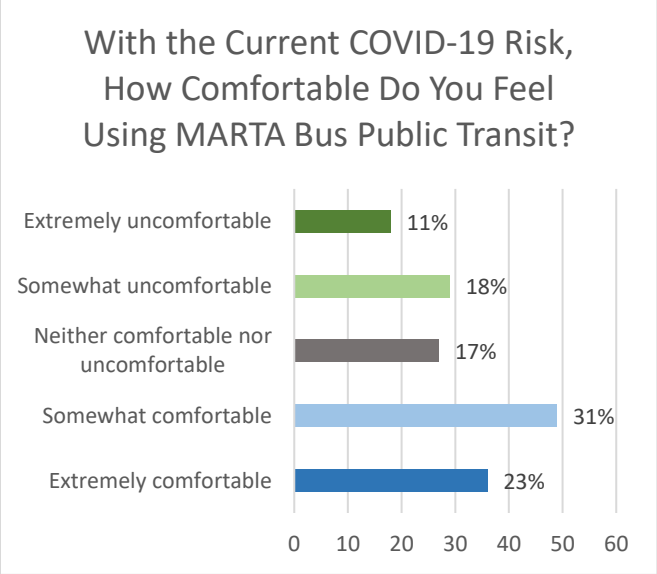
Why does improving transit matter?

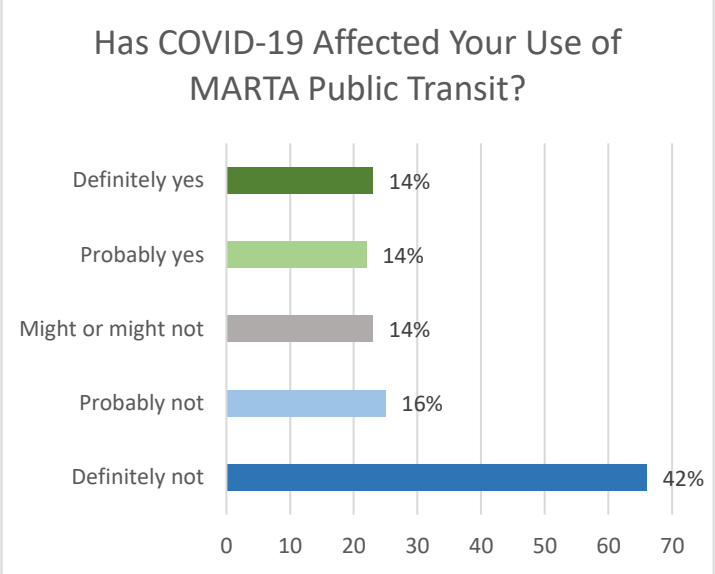
Transit is a more sustainable travel option and reduces congestion if travelers use transit instead of driving alone in vehicles. Respondents were also asked why they value transit. The answers have been reduced to a few categories and are shown in the word bubble below. Their responses are similar to transportation professionals – reducing environmental impacts, equity, and access. Their responses also include reasons specific to their needs – avoiding driving in traffic, more convenient, less stressful.

2021 COVID-19 Pandemic Context

It is important to note that this online survey was distributed during the summer of 2021 when the COVID-19 pandemic reduced ridership on buses and rail due to the increase in telecommuting and the emphasis on social distancing. All passengers were also required to wear a mask while using MARTA transit during this time period. As such, the online survey did include questions related to travel patterns during the COVID-19 pandemic.

About 29% of respondents reported feeling somewhat or extremely uncomfortable using MARTA bus transit during COVID-19, but it has only affected 28% of respondent's use of MARTA public transit.





Conclusion

Improvements to reliability and travel time could encourage those in Sandy Springs to choose to take the bus more often. The magnitude of the mode shift will likely be based on the amount of improvements to these measures by TSP technology. In order to secure buy-in from the community, it will be important to track the delay to vehicles as a result of TSP – based on this survey, the community will likely only be supportive of the technology if it causes minimal delay.

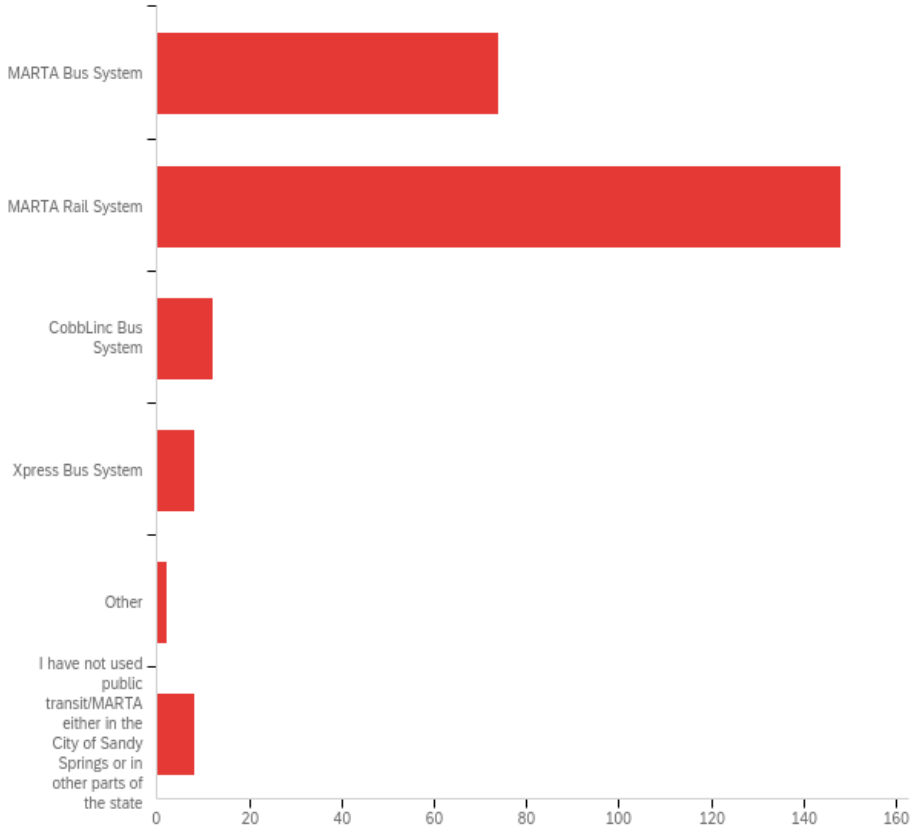
There are several other factors, such as transit stop/station proximity, that affects the level of transit usage. TSP technology does not address these issues, so there will be a need for continued evaluation of other methods to improve the transit system in Sandy Springs. Transit is seen as valuable to the community, so addressing these issues may also contribute to a shift from single occupancy vehicles to transit. There will always be uncontrollable situations, such as the COVID-19 pandemic, which will change ridership, but as demonstrated during the current pandemic, transit is still a vital necessity and many people will continue to use it despite these conditions.

APPENDIX - All questions, all data

Sandy Springs MARTA Non-transit Rider Survey

September 8th 2021, 6:00 am MDT

Q1 - Which forms of public transit systems have you used before? (Check all that apply)

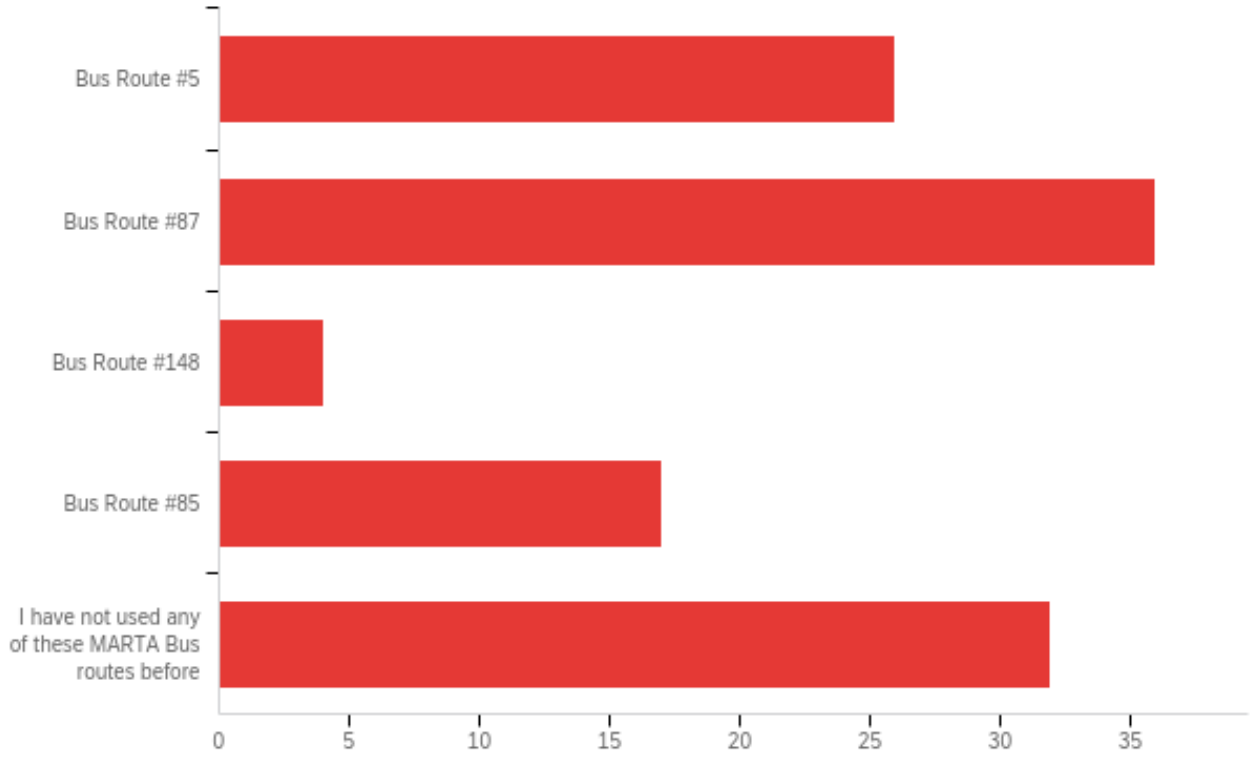


#	Answer	%	Count
1	MARTA Bus System	29.37%	74
2	MARTA Rail System	58.73%	148
3	CobbLinc Bus System	4.76%	12
4	Xpress Bus System	3.17%	8
5	Other	0.79%	2
6	I have not used public transit/MARTA either in the City of Sandy Springs or in other parts of the state	3.17%	8
	Total	100%	252

Q1_5_TEXT - Other

Other - Text
Metro in DC
Atlantic Station Shuttle

Q2 - Have you ever used any of these MARTA bus routes in Sandy Springs before? (Check all that apply)



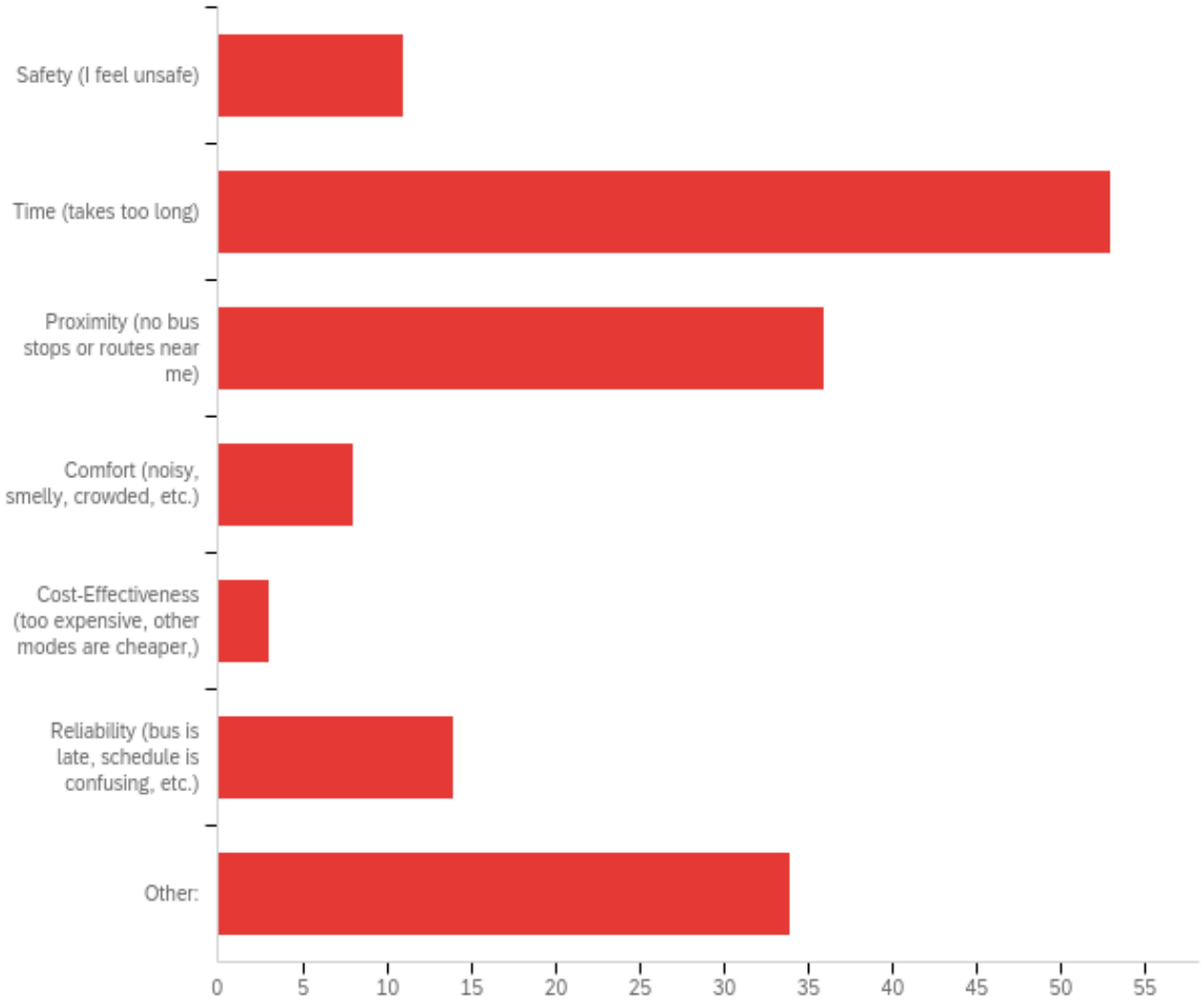
#	Answer	%	Count
1	Bus Route #5	22.61%	26
2	Bus Route #87	31.30%	36
3	Bus Route #148	3.48%	4
4	Bus Route #85	14.78%	17
5	I have not used any of these MARTA Bus routes before	27.83%	32
	Total	100%	115

Q3 - Please select the answer that best fits your views on Public/MARTA bus transportation.

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I consider the MARTA bus routes in the City of Sandy Springs to be safe	1.00	7.00	3.06	1.50	2.24	159
2	MARTA bus transportation in the City of Sandy Springs is a comfortable mode of transportation for me	1.00	7.00	3.82	1.60	2.55	159
3	It is convenient for me to take MARTA bus transportation in the City of Sandy Springs	1.00	7.00	4.59	1.84	3.40	159
4	MARTA bus transportation in the City of Sandy Springs is cost-effective for me	1.00	7.00	3.61	1.67	2.78	159

#	Question	Strongly agree		Agree		Somewhat agree		Neither agree nor disagree		Somewhat disagree		Disagree		Strongly disagree		Total
1	I consider the MARTA bus routes in the City of Sandy Springs to be safe	13.84%	22	30.19%	48	14.47%	23	29.56%	47	5.03%	8	3.14%	5	3.77%	6	159
2	MARTA bus transportation in the City of Sandy Springs is a comfortable mode of transportation for me	7.55%	12	18.24%	29	7.55%	12	40.25%	64	11.32%	18	7.55%	12	7.55%	12	159
3	It is convenient for me to take MARTA bus transportation in the City of Sandy Springs	5.03%	8	13.21%	21	9.43%	15	20.13%	32	15.09%	24	16.35%	26	20.75%	33	159
4	MARTA bus transportation in the City of Sandy Springs is cost-effective for me	9.43%	15	23.27%	37	8.81%	14	36.48%	58	7.55%	12	6.29%	10	8.18%	13	159

Q4 - What is the main reason you don't use public transportation in Sandy Springs?

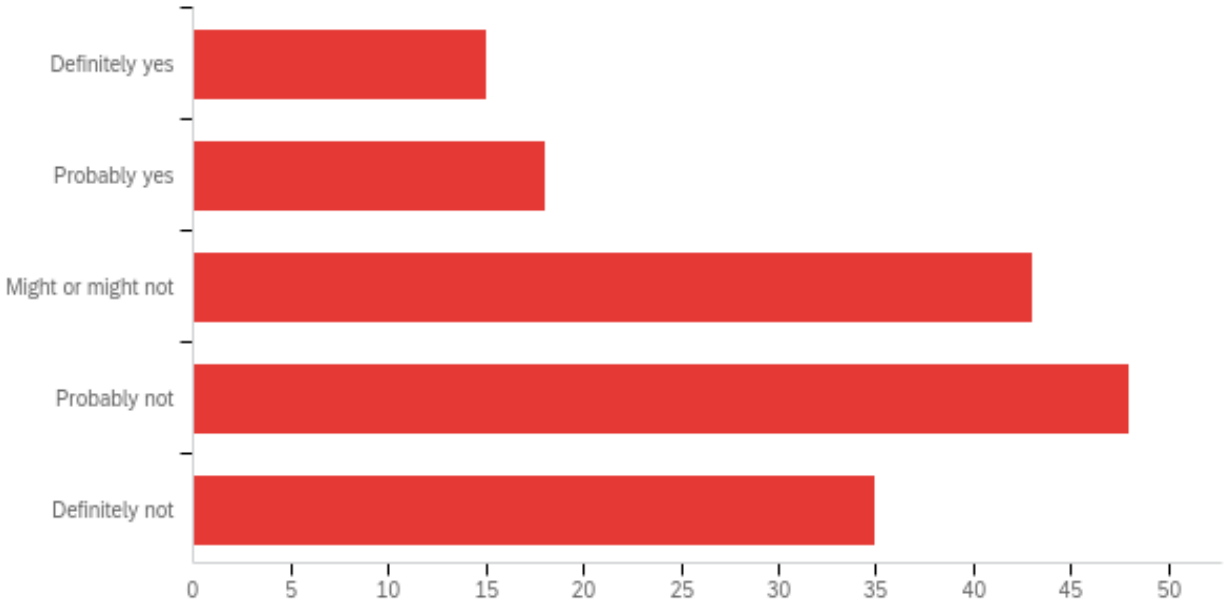


#	Answer	%	Count
1	Safety (I feel unsafe)	6.92%	11
2	Time (takes too long)	33.33%	53
3	Proximity (no bus stops or routes near me)	22.64%	36
4	Comfort (noisy, smelly, crowded, etc.)	5.03%	8
5	Cost-Effectiveness (too expensive, other modes are cheaper,)	1.89%	3
6	Reliability (bus is late, schedule is confusing, etc.)	8.81%	14
7	Other:	21.38%	34
	Total	100%	159

Q4_7_TEXT - Other:

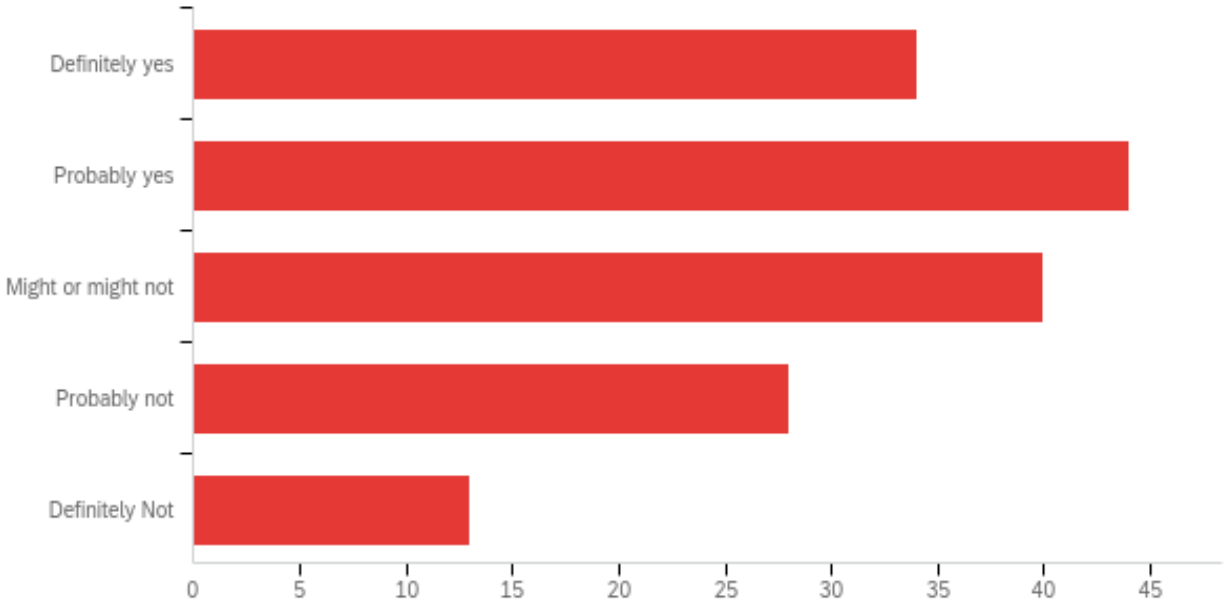
Other: - Text
Train experience only
Easier and quicker to take my car
Not applicable
I do not use it on a regular basis.
I live less than 2 miles from work. I would like to see a short ride shuttle service to frequently visited facilities in and near SS (grocery stores, mall, hospitals…)
TO go from my residence at 7500 Roswell Road to my office in Roswell requires a bus change at Dunwoody Place -- I can drive there in 10 minutes - would take the bus if it was direct.
Except for traveling to the airport, MARTA isn't very convenient for me for shopping/errands in the City Center.
Car is more convenient
too infrequent and proxmmity to me
So far, I drive.
I have a personal vehicle but wouldn't use PT due to the time it takes. I would have to leave 2 hours early and get home 2 hours late.
I used the subway
I am an advocate for public transit
I ride Marta all of the time because, it is my only transportation
None of these apply to me
I have no need for the bus system currently
My only need for MARTA is airport trips, which is rare. Otherwise I bike or walk to work.
I don't live in Sandy Springs.
No need to do so
I DO USE IT....
Prefer privacy of my car, particularly with COVID to go to work
All the above plus it"s just not my cup of tea
I use marta
Buses don't go places I need to go.
I don’t have the need/don’t want to
I take MARTA train, your questions were about MARTA bus
Car is more convenient
no need to use it

Q5 - Is public bus transportation in the City of Sandy Springs a reliable source of transportation for you?



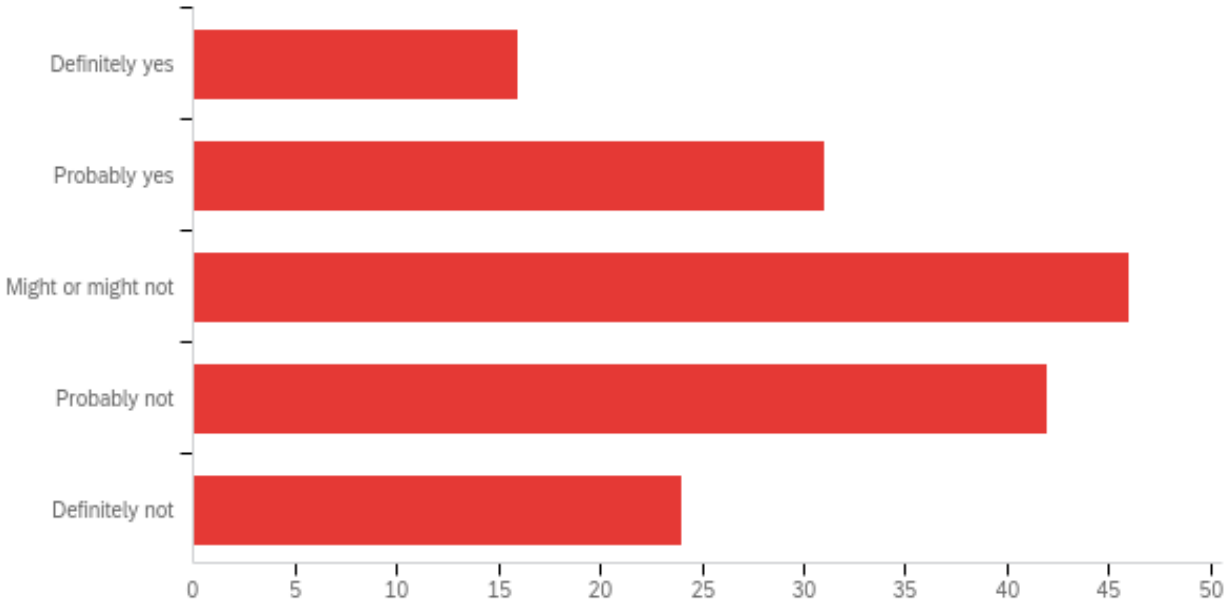
#	Answer	%	Count
1	Definitely yes	9.43%	15
2	Probably yes	11.32%	18
3	Might or might not	27.04%	43
4	Probably not	30.19%	48
5	Definitely not	22.01%	35
	Total	100%	159

Q6 - If you knew that MARTA was making improvements to better reliability and on-time performance, would you be more likely to use it?



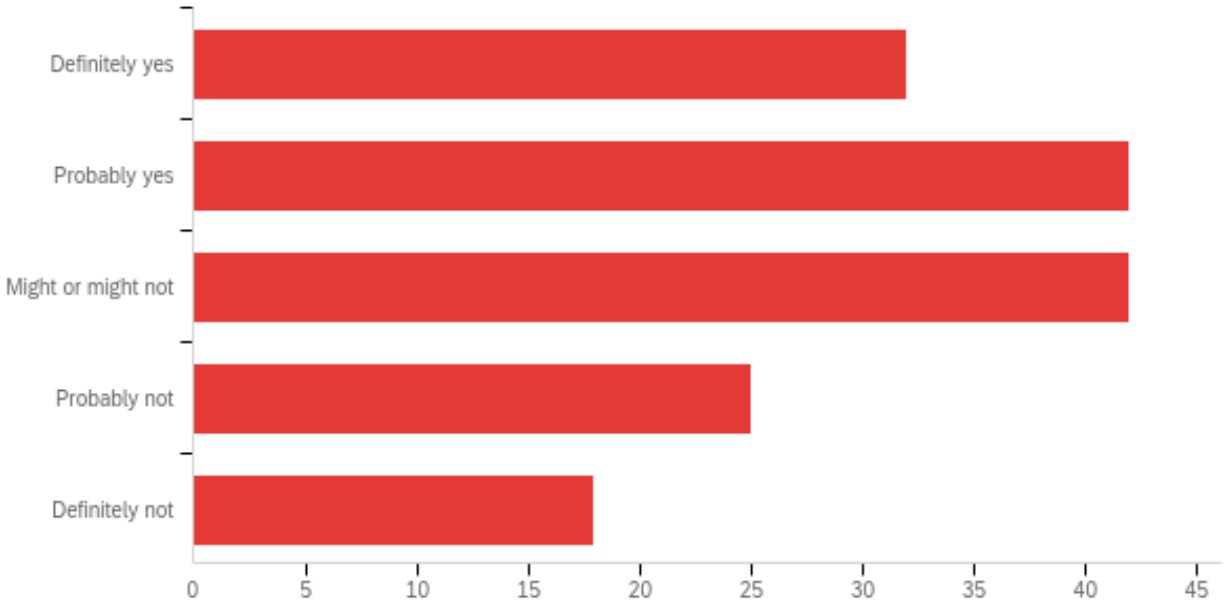
#	Answer	%	Count
1	Definitely yes	21.38%	34
2	Probably yes	27.67%	44
3	Might or might not	25.16%	40
4	Probably not	17.61%	28
5	Definitely Not	8.18%	13
	Total	100%	159

Q7 - If buses were on-time 80% of the time (late one day out of 5 days you take the bus) compared to 75% today, would you use transit more often?



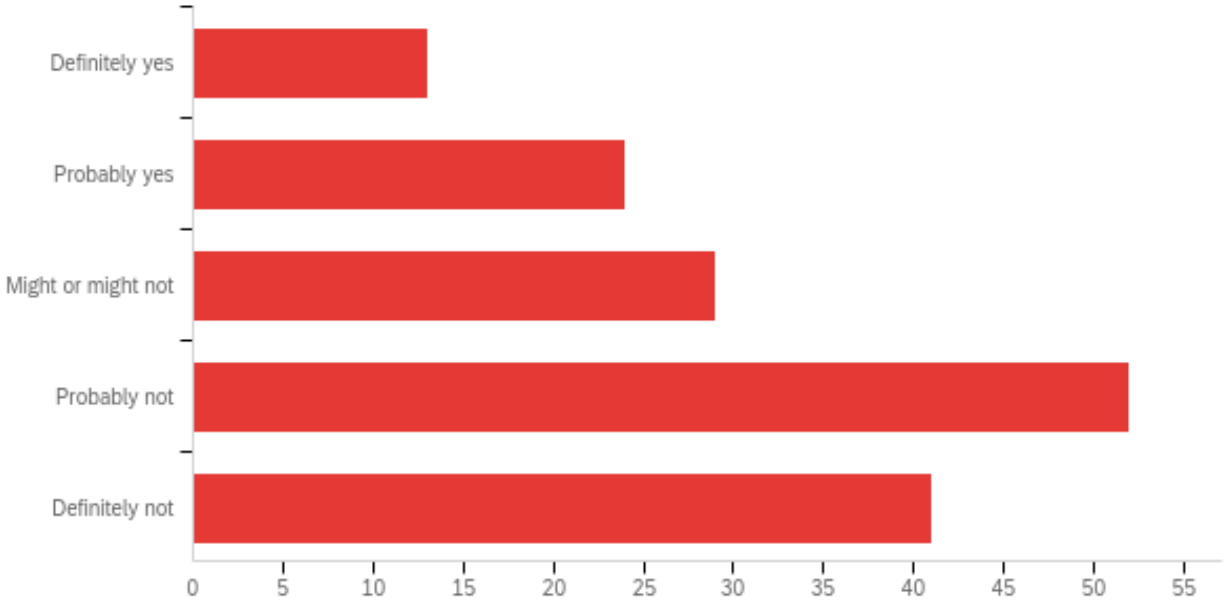
#	Answer	%	Count
1	Definitely yes	10.06%	16
2	Probably yes	19.50%	31
3	Might or might not	28.93%	46
4	Probably not	26.42%	42
5	Definitely not	15.09%	24
	Total	100%	159

Q8 - If buses were on-time 90% of the time (late one day out of 10 days you take the bus) compared to 75% today, would you use transit more often?



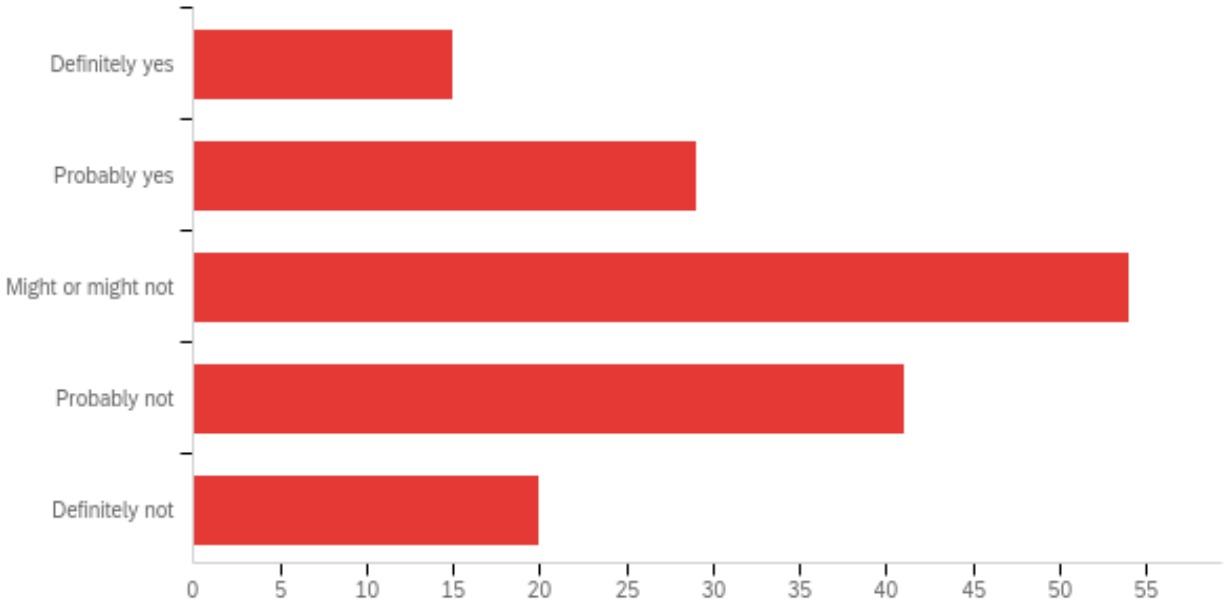
#	Answer	%	Count
1	Definitely yes	20.13%	32
2	Probably yes	26.42%	42
3	Might or might not	26.42%	42
4	Probably not	15.72%	25
5	Definitely not	11.32%	18
	Total	100%	159

Q9 - Is public bus transportation an efficient use of time for you?



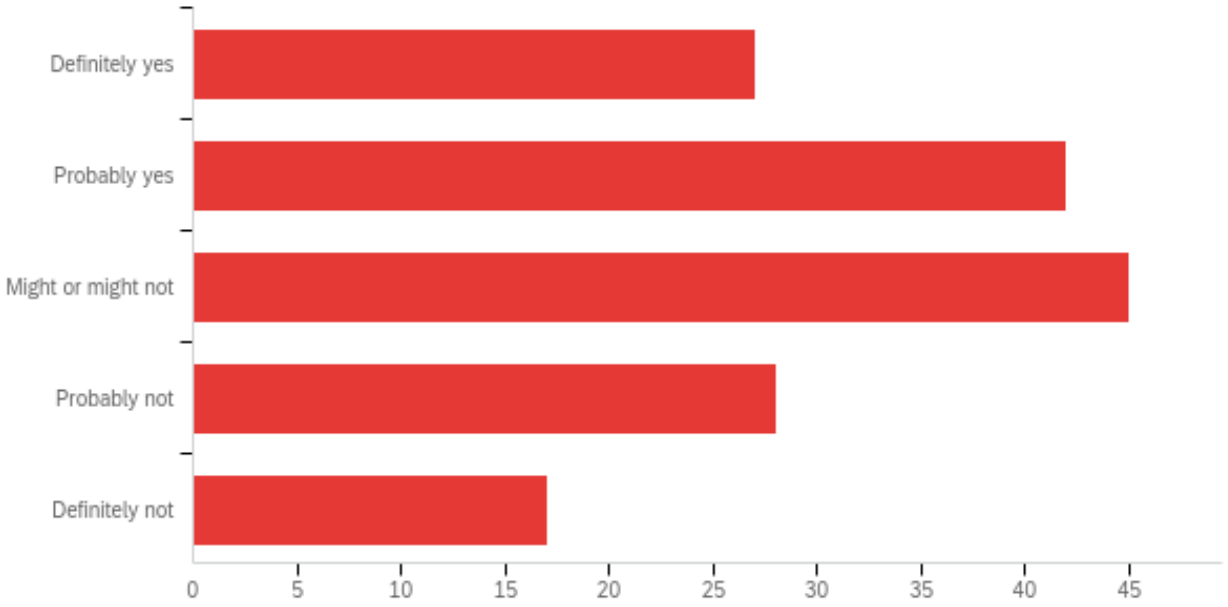
#	Answer	%	Count
1	Definitely yes	8.18%	13
2	Probably yes	15.09%	24
3	Might or might not	18.24%	29
4	Probably not	32.70%	52
5	Definitely not	25.79%	41
	Total	100%	159

Q11 - If buses were able to move 10% faster (save 3 minutes on a 30 minute trip compared to today) than they currently do, would you use transit more often?



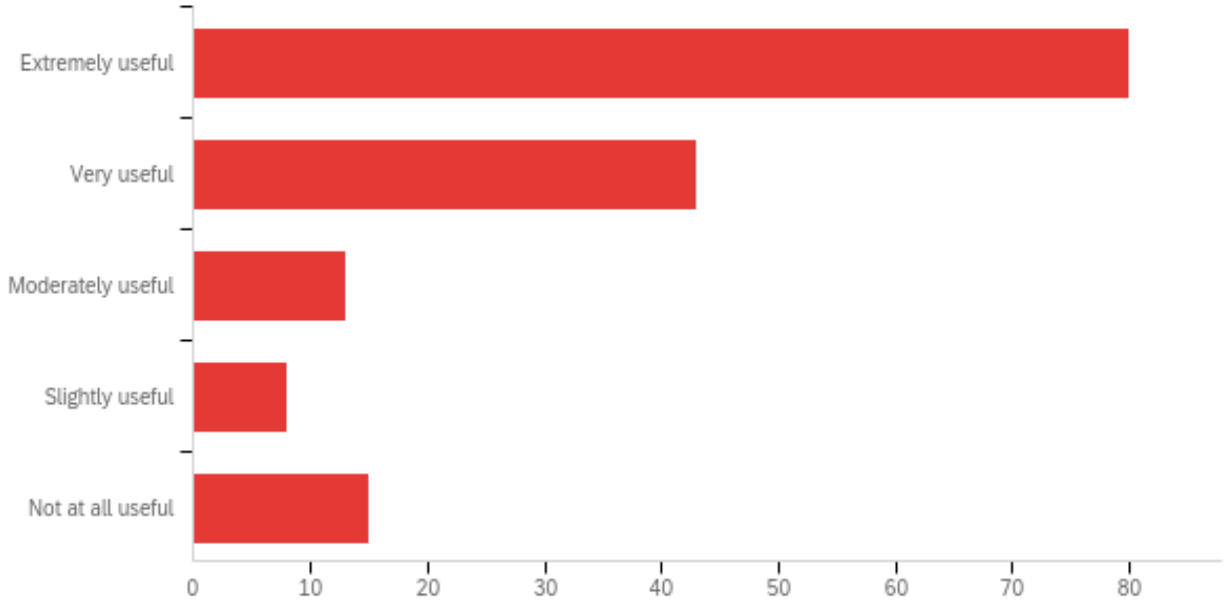
#	Answer	%	Count
1	Definitely yes	9.43%	15
2	Probably yes	18.24%	29
3	Might or might not	33.96%	54
4	Probably not	25.79%	41
5	Definitely not	12.58%	20
	Total	100%	159

Q12 - If buses were able to move 20% faster (save 6 minutes on a 30 minute trip compared to today) than they currently do, would you use transit more often?



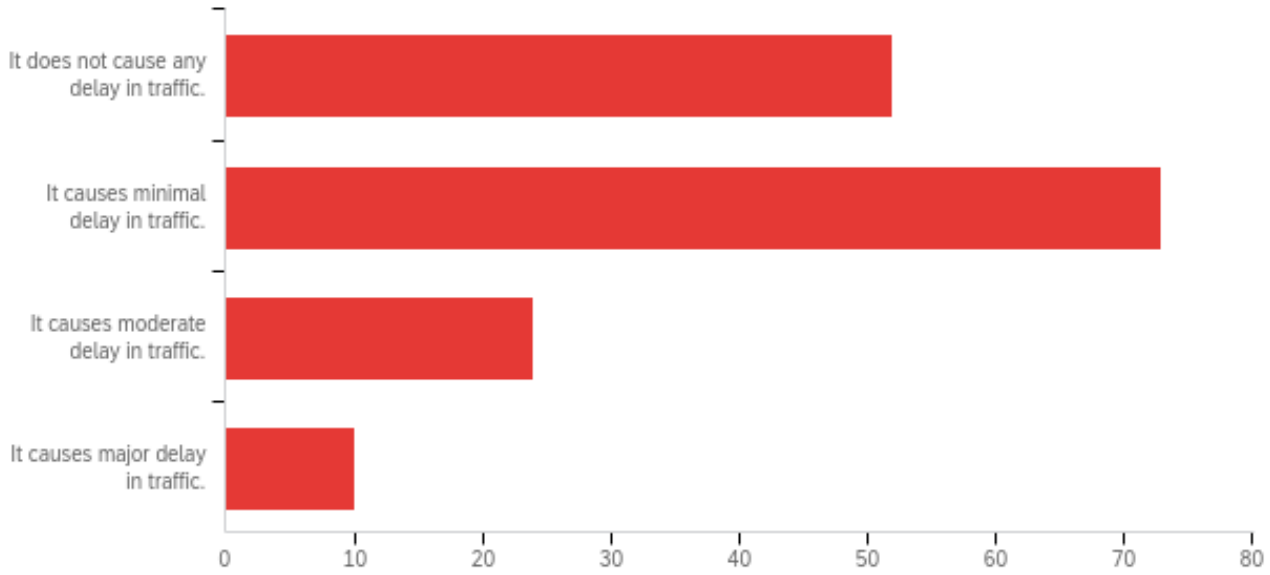
#	Answer	%	Count
1	Definitely yes	16.98%	27
2	Probably yes	26.42%	42
3	Might or might not	28.30%	45
4	Probably not	17.61%	28
5	Definitely not	10.69%	17
	Total	100%	159

Q13 - How useful is knowing how far away the bus is from your bus stop in real time?



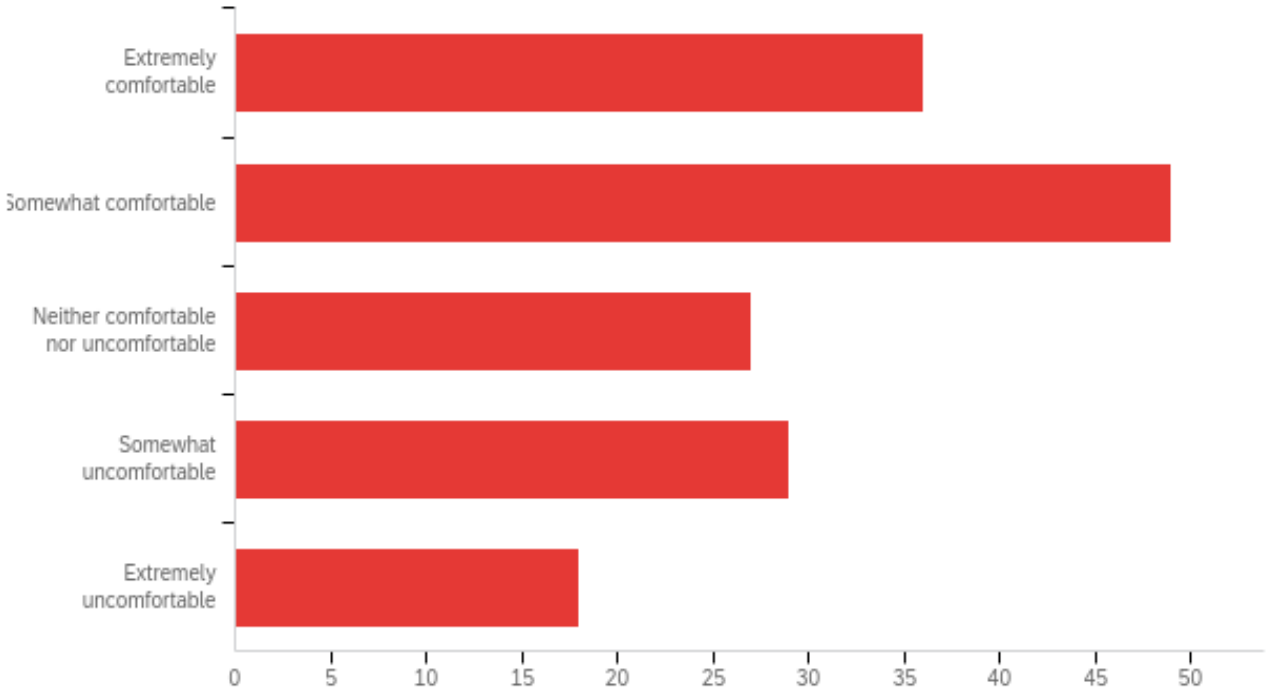
#	Answer	%	Count
1	Extremely useful	50.31%	80
2	Very useful	27.04%	43
3	Moderately useful	8.18%	13
4	Slightly useful	5.03%	8
5	Not at all useful	9.43%	15
	Total	100%	159

Q14 - I would be supportive of transit improvements in the City of Sandy Springs if:



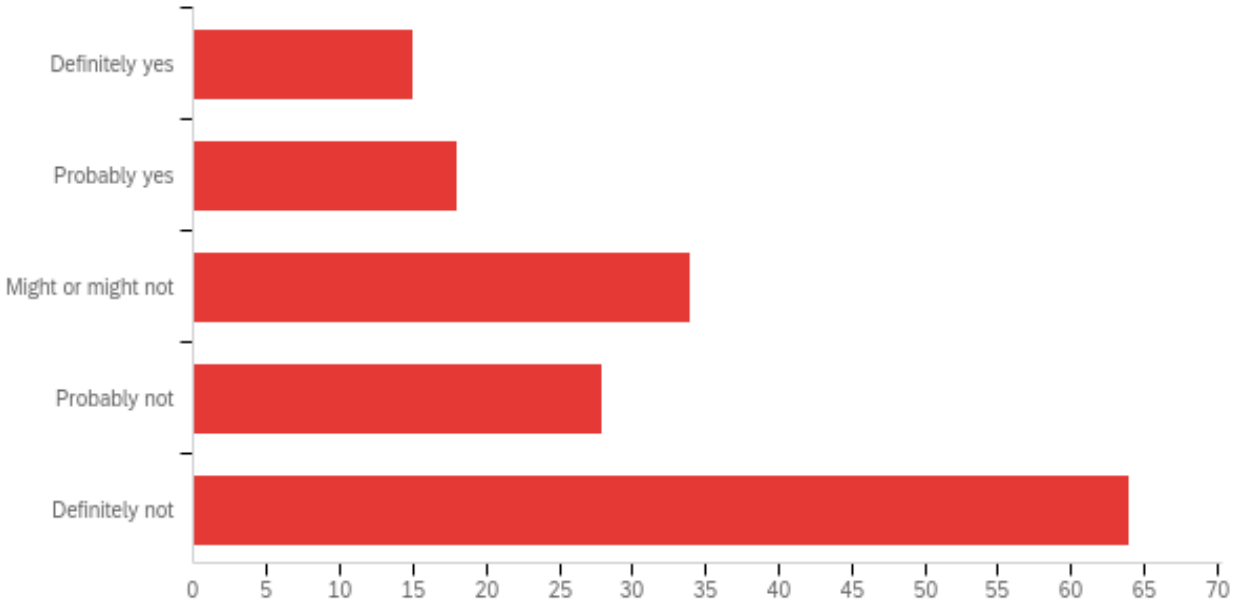
#	Answer	%	Count
1	It does not cause any delay in traffic.	32.70%	52
2	It causes minimal delay in traffic.	45.91%	73
3	It causes moderate delay in traffic.	15.09%	24
4	It causes major delay in traffic.	6.29%	10
	Total	100%	159

Q15 - With the current COVID-19 risk, how comfortable do you feel using MARTA bus public transit?



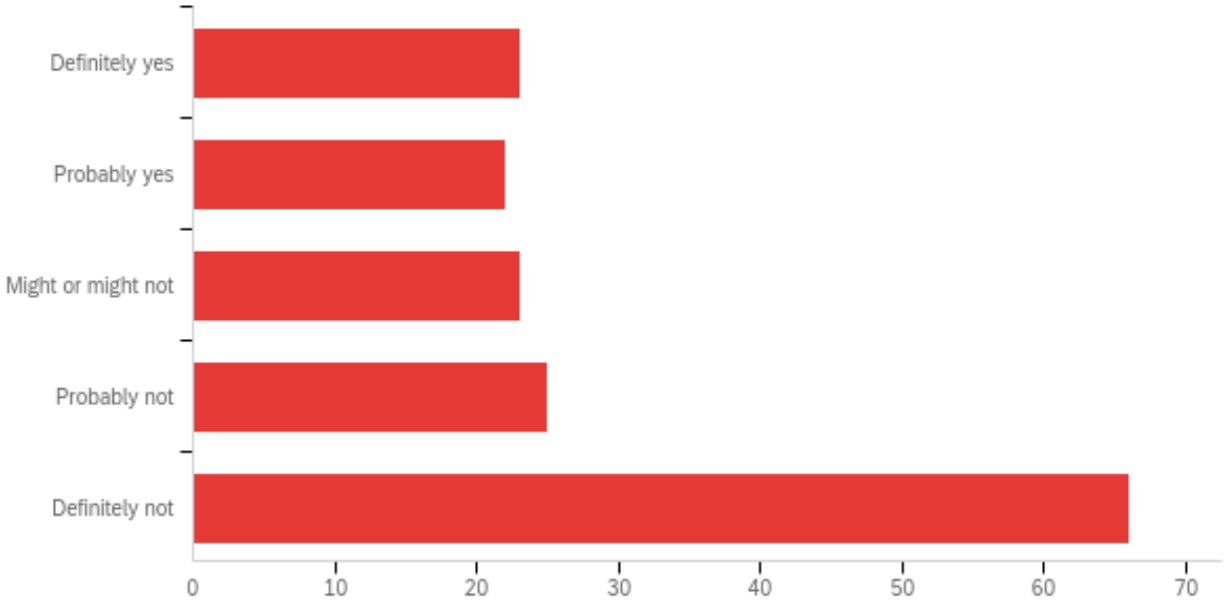
#	Answer	%	Count
1	Extremely comfortable	22.64%	36
2	Somewhat comfortable	30.82%	49
3	Neither comfortable nor uncomfortable	16.98%	27
4	Somewhat uncomfortable	18.24%	29
5	Extremely uncomfortable	11.32%	18
	Total	100%	159

Q16 - Do you prefer not to use public bus transportation because of COVID-19 mask requirements?



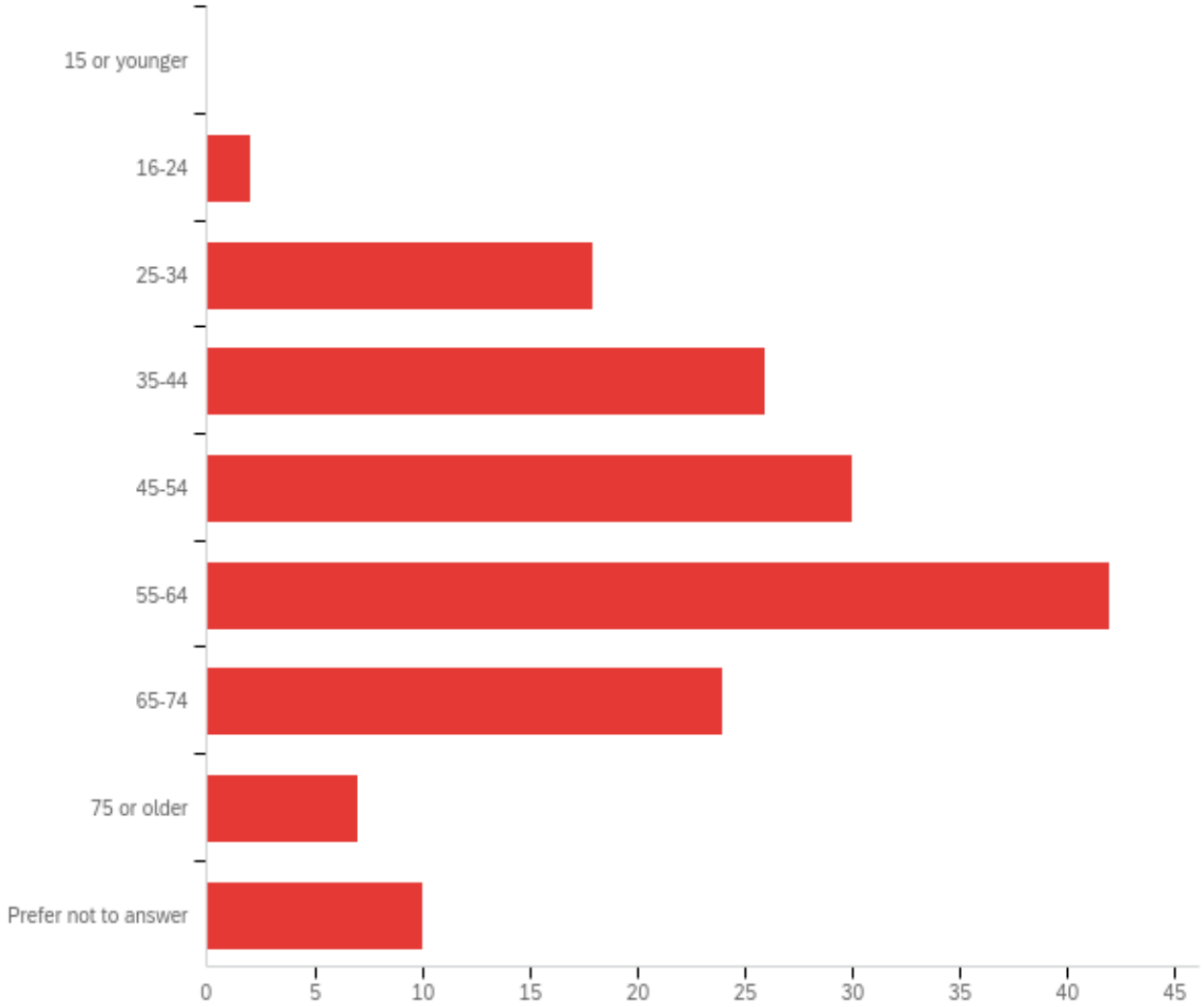
#	Answer	%	Count
1	Definitely yes	9.43%	15
2	Probably yes	11.32%	18
3	Might or might not	21.38%	34
4	Probably not	17.61%	28
5	Definitely not	40.25%	64
	Total	100%	159

Q17 - Has COVID-19 affected your use of MARTA public transit?



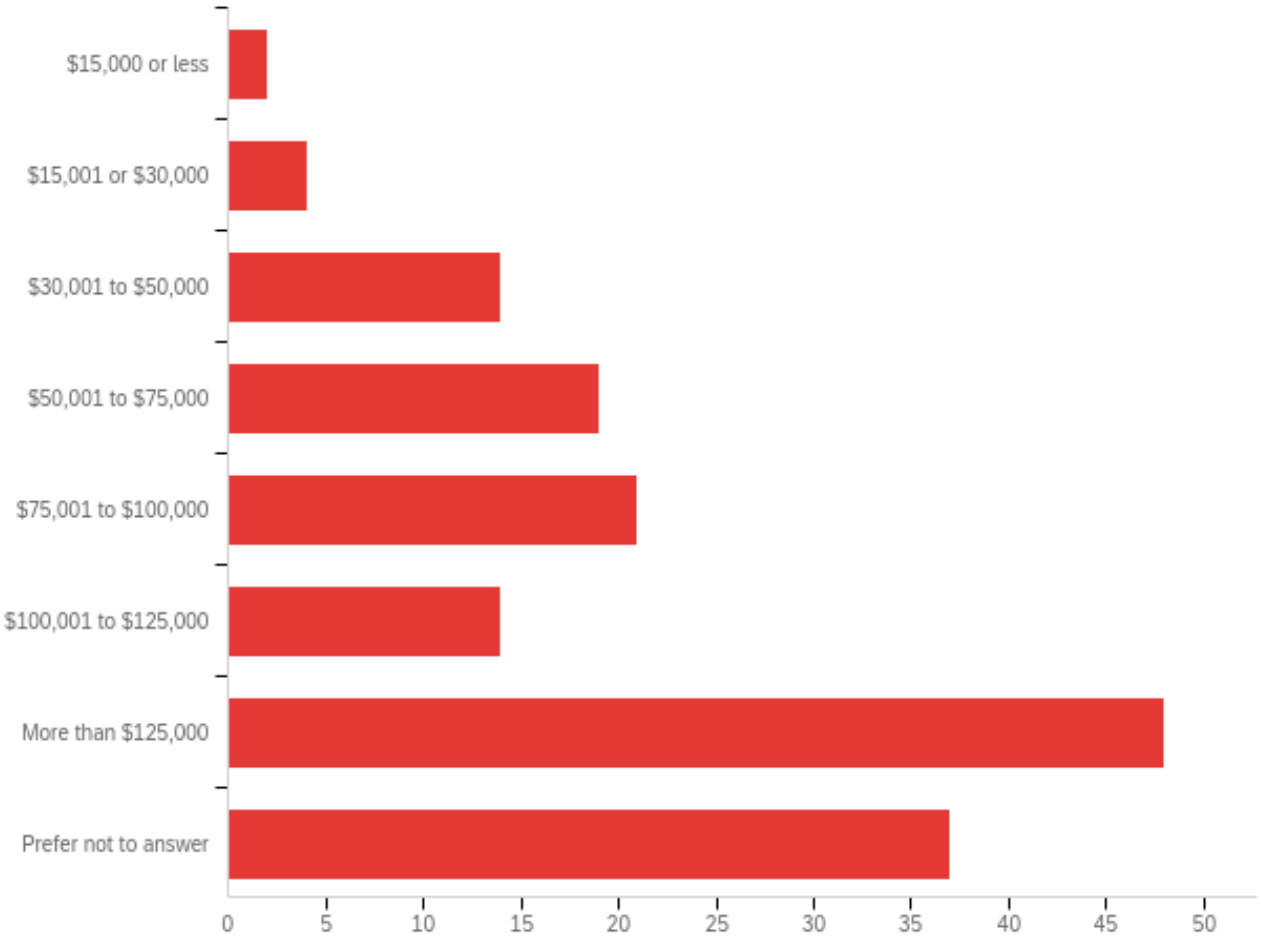
#	Answer	%	Count
1	Definitely yes	14.47%	23
2	Probably yes	13.84%	22
3	Might or might not	14.47%	23
4	Probably not	15.72%	25
5	Definitely not	41.51%	66
	Total	100%	159

Q18 - How old are you?



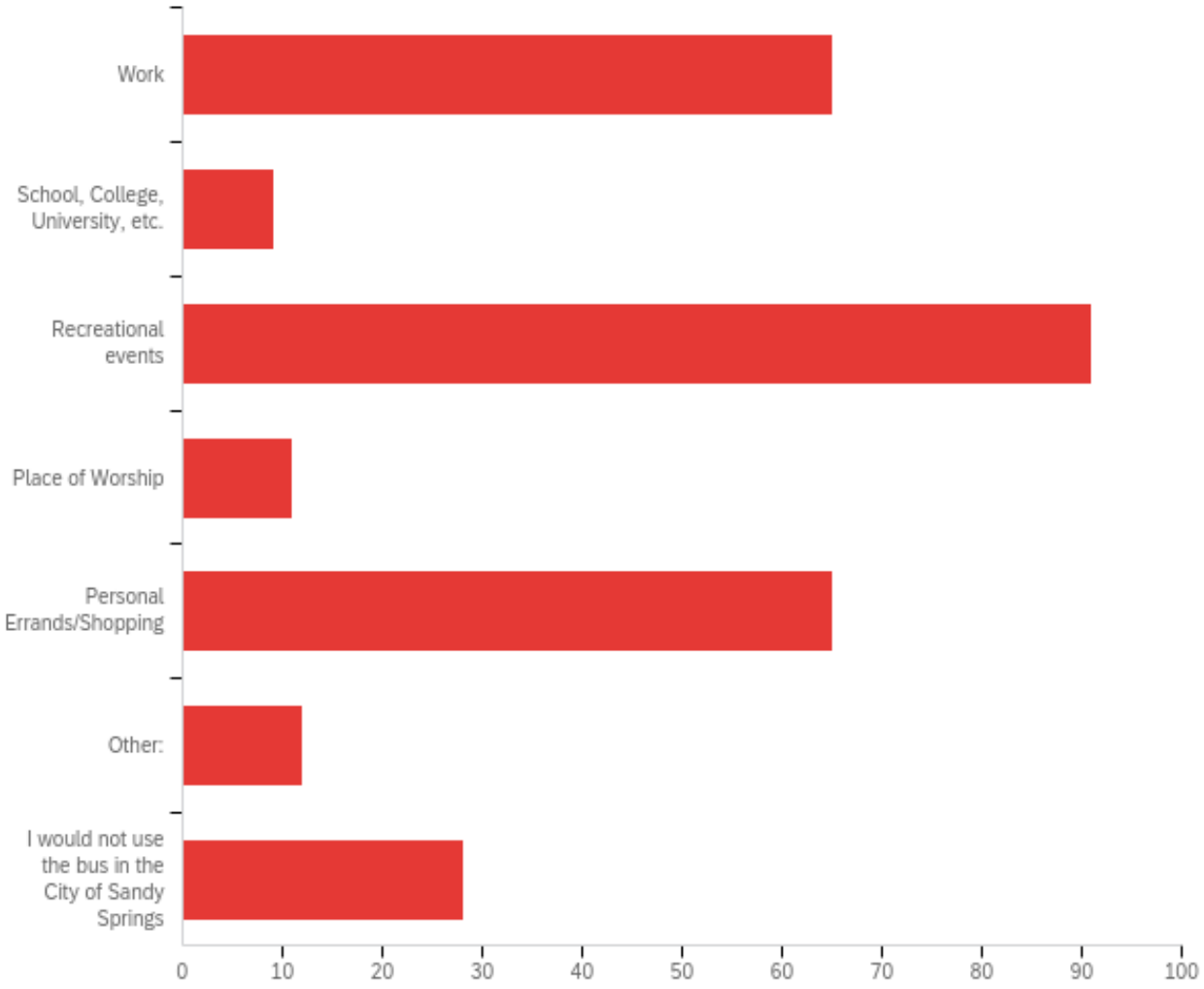
#	Answer	%	Count
1	15 or younger	0.00%	0
2	16-24	1.26%	2
3	25-34	11.32%	18
4	35-44	16.35%	26
5	45-54	18.87%	30
6	55-64	26.42%	42
7	65-74	15.09%	24
8	75 or older	4.40%	7
9	Prefer not to answer	6.29%	10
	Total	100%	159

Q19 - Please check the category that contains your approximate annual household income before taxes:



#	Answer	%	Count
1	$15,000 or less	1.26%	2
2	$15,001 or $30,000	2.52%	4
3	$30,001 to $50,000	8.81%	14
4	$50,001 to $75,000	11.95%	19
5	$75,001 to $100,000	13.21%	21
6	$100,001 to $125,000	8.81%	14
7	More than $125,000	30.19%	48
8	Prefer not to answer	23.27%	37
	Total	100%	159

Q20 - If you were to use the bus in the City of Sandy Springs, where would you most likely go? (Check all that apply)

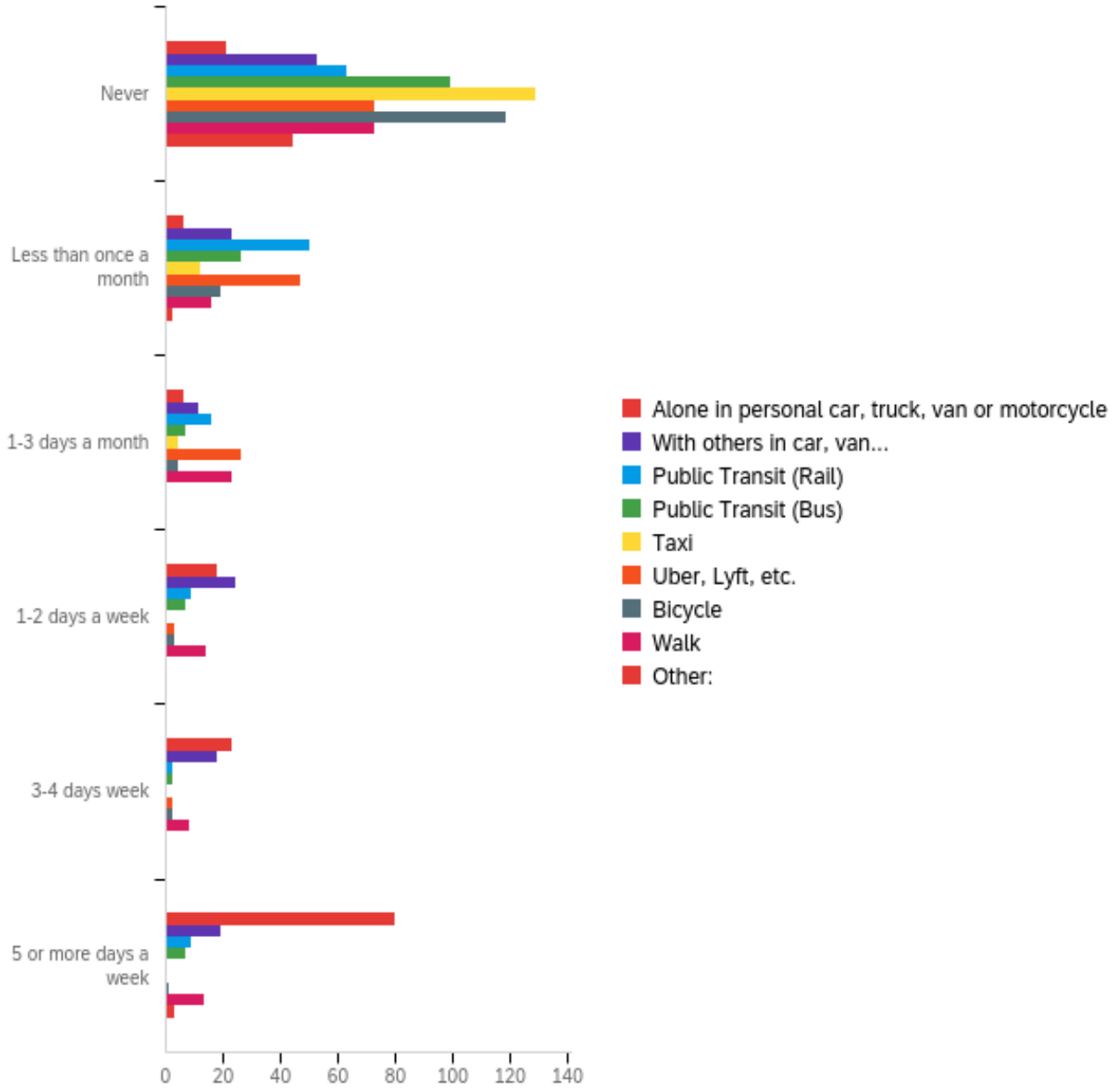


#	Answer	%	Count
1	Work	23.13%	65
2	School, College, University, etc.	3.20%	9
3	Recreational events	32.38%	91
4	Place of Worship	3.91%	11
5	Personal Errands/Shopping	23.13%	65
6	Other:	4.27%	12
7	I would not use the bus in the City of Sandy Springs	9.96%	28
	Total	100%	281

Q20_6_TEXT - Other:

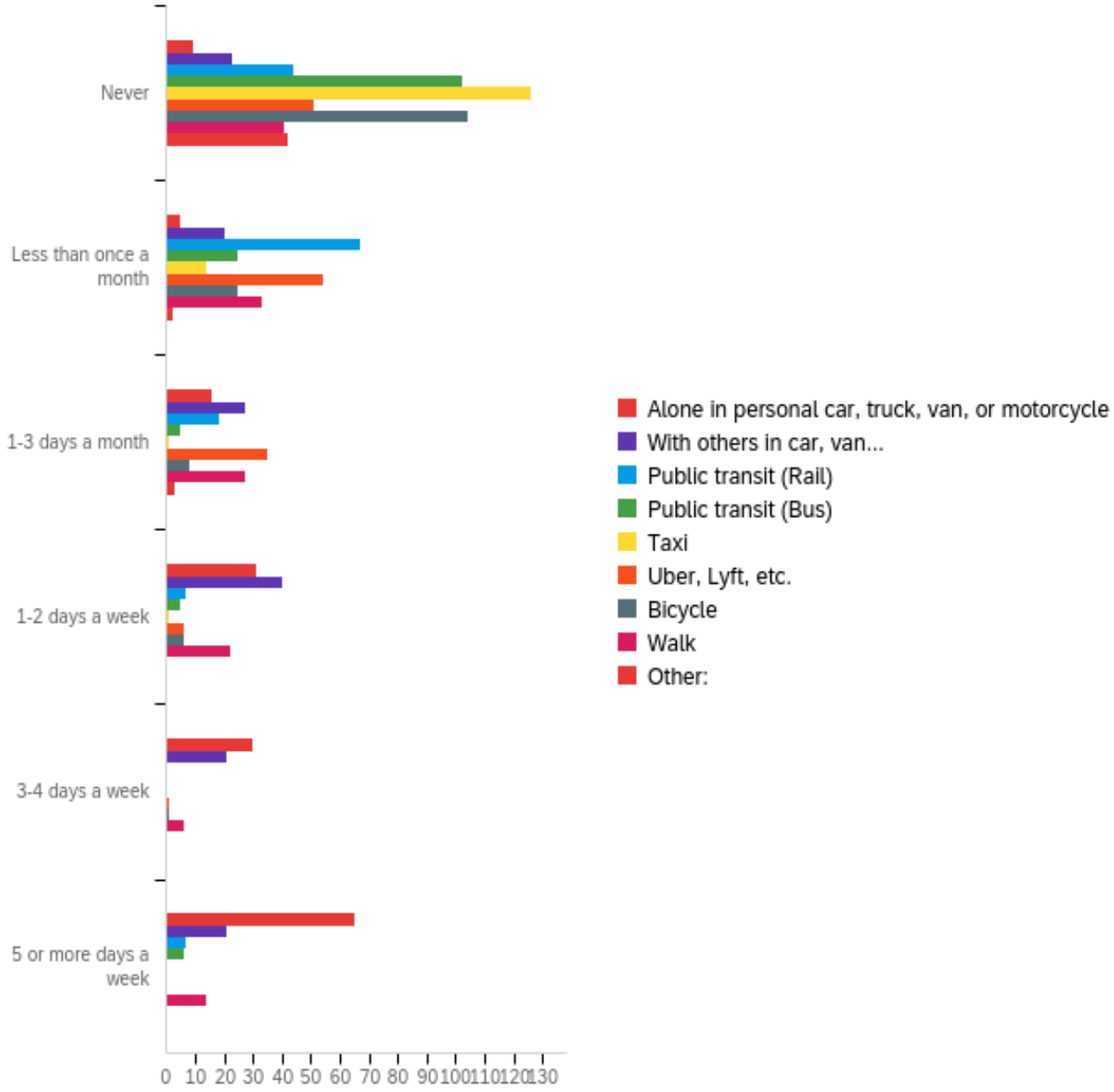
Other: - Text
all activities
Sandy Springs MARTA station
The car is still faster for me.
Parks, Library
Doctor
Airport
midtown/downtown/connect to MARTA train.
airport
Recreational, maybe
Airport

Q21 - Considering your trips to work/school, please indicate how often you use each of the following means of transportation for such trips:



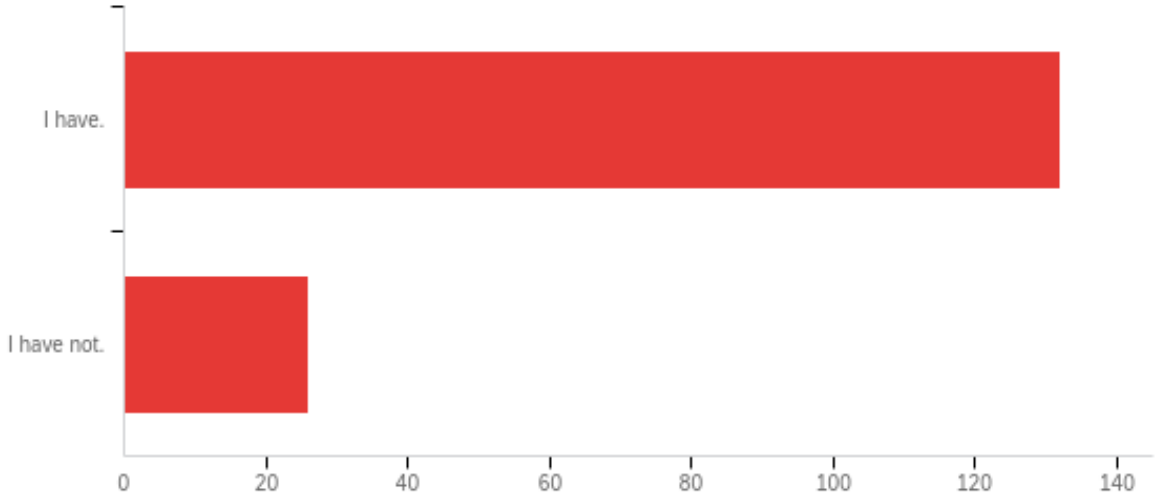
#	Question	Never		Less than once a month		1-3 days a month		1-2 days a week		3-4 days week		5 or more days a week		Total
1	Alone in personal car, truck, van or motorcycle	13.64%	21	3.90%	6	3.90%	6	11.69%	18	14.94%	23	51.95%	80	154
2	With others in car, van...	35.81%	53	15.54%	23	7.43%	11	16.22%	24	12.16%	18	12.84%	19	148
3	Public Transit (Rail)	42.28%	63	33.56%	50	10.74%	16	6.04%	9	1.34%	2	6.04%	9	149
4	Public Transit (Bus)	66.89%	99	17.57%	26	4.73%	7	4.73%	7	1.35%	2	4.73%	7	148
5	Taxi	88.97%	129	8.28%	12	2.76%	4	0.00%	0	0.00%	0	0.00%	0	145
6	Uber, Lyft, etc.	48.34%	73	31.13%	47	17.22%	26	1.99%	3	1.32%	2	0.00%	0	151
7	Bicycle	80.41%	119	12.84%	19	2.70%	4	2.03%	3	1.35%	2	0.68%	1	148
8	Walk	49.66%	73	10.88%	16	15.65%	23	9.52%	14	5.44%	8	8.84%	13	147
9	Other:	89.80%	44	4.08%	2	0.00%	0	0.00%	0	0.00%	0	6.12%	3	49

Q22 - Considering your trips for other (non-work / school) purposes (e.g. for shopping, dining, attending events, visiting others, errands, doctor, or hobbies), please indicate how often you typically make such trips, using each of the following means of transportation:



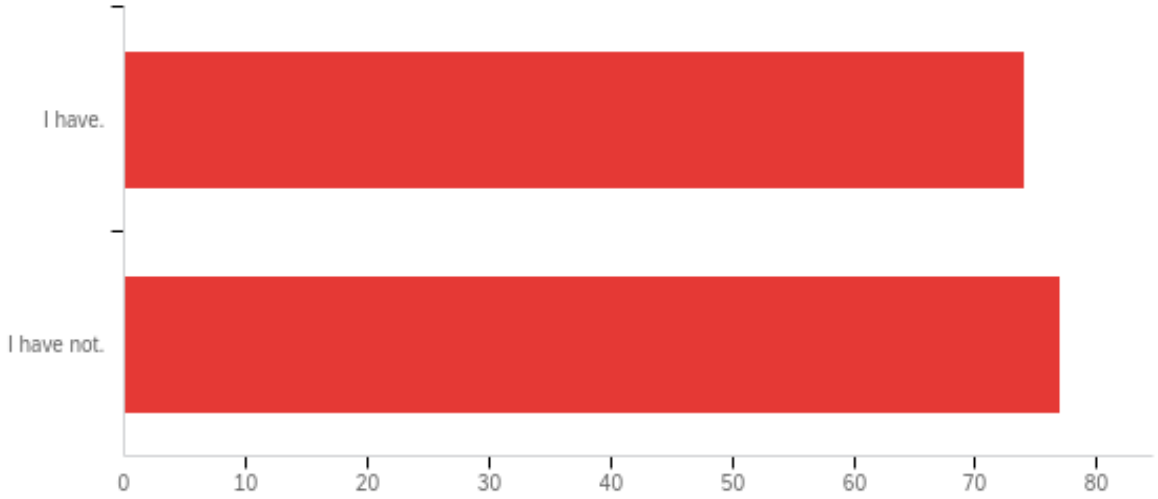
#	Question	Never		Less than once a month		1-3 days a month		1-2 days a week		3-4 days a week		5 or more days a week		Total
1	Alone in personal car, truck, van, or motorcycle	5.77%	9	3.21%	5	10.26%	16	19.87%	31	19.23%	30	41.67%	65	156
2	With others in car, van...	15.13%	23	13.16%	20	17.76%	27	26.32%	40	13.82%	21	13.82%	21	152
3	Public transit (Rail)	30.77%	44	46.85%	67	12.59%	18	4.90%	7	0.00%	0	4.90%	7	143
4	Public transit (Bus)	71.33%	102	17.48%	25	3.50%	5	3.50%	5	0.00%	0	4.20%	6	143
5	Taxi	88.73%	126	9.86%	14	0.70%	1	0.70%	1	0.00%	0	0.00%	0	142
6	Uber, Lyft, etc.	34.69%	51	36.73%	54	23.81%	35	4.08%	6	0.68%	1	0.00%	0	147
7	Bicycle	72.22%	104	17.36%	25	5.56%	8	4.17%	6	0.69%	1	0.00%	0	144
8	Walk	28.67%	41	23.08%	33	18.88%	27	15.38%	22	4.20%	6	9.79%	14	143
9	Other:	89.36%	42	4.26%	2	6.38%	3	0.00%	0	0.00%	0	0.00%	0	47

Q27 - I have had a positive experience with public transportation



#	Answer	%	Count
1	I have.	83.54%	132
2	I have not.	16.46%	26
	Total	100%	158

Q23 - I have had a negative experience with public transportation.



#	Answer	%	Count
1	I have.	49.01%	74
2	I have not.	50.99%	77
	Total	100%	151

All questions, all data

Sandy Springs MARTA Non-transit Rider Survey

September 8th 2021, 6:14 am MDT

Q34 - If public bus transportation is not a reliable source of transportation, how could it be?

If public bus transportation is not a reliable source of transportation, how could it be?
Make it safer
Train use only
Stops closer to my home
Safer, more frequent runs, better transportation grid to places I want to go ---- shopping, entertainment, errands, etc. Not sure it's cost effective to do this, though.
I can get to work faster by walking. The buses are usually late by traffic accidents or Rush hour ROAD CONSTUTIONsh hour
more frequent buses at closest stops
Need more rail line access to places from outlying suburban areas and easily accessible.
I have never used the bus.
Less time between busses.
More stops, more frequent pick up
buses simply do not show up at times, or are late, cancelled you cannot rely on it as your primary means of getting to work
Increasing routes and stops
more reliable and efficient
Go to more destinations.
Would have to be pervasive
More stops
make it safe - cameras, guards onboard
auto
If there were more bus stops - none close to my residence. Also if I knew it would be on time.
Reliability
More buses running up and down Roswell Rd.
More stops and more routes

Better software integration, better stops and stations, more frequent service
n/a
Be more convient
I will be using marta mobility soon.
More publicized routes and stops
Stick to the schedules and cover more areas
I’m concerned about safety and cleanliness
GDOT put BRT lanes in and we are not funding the bus system. Shameful
?
Dedicated bus lanes. Busses should never have to sit in traffic
Several factors. Traffic is so bad at times in Sandy Springs and the routes take too long to complete. Shorter commute times will help. Also, MARTA doesn’t have enough police officers either on trains or buses and many people don’t feel safe. Homeless people also ride the buses and trains all day, there is panhandling, and MARTA buses and trains always smell bad. Lite rail from stations such as North Springs to city center maybe would entice people more since traffic is so bad.
...
I dont know. Maybe more stops closer to my home.
Arrivals at various stops to be more timely. Look at the tokyo and other international public transits, a clock can be set off public Transit but not in Atlanta
Bus stops with covered canopies
Make riders obwy the law. Punish those who do not to the fullest extent of the law.
Doesn't go where I need to go without going out-of-way.
Easier access
More convenient bus stops
Bus should be more frequent and schedule should work with the train.
it would need to be more frequent and less north-south oriented
I don't feel safe using the bus system.
run more frequently
Smaller bus with more routes
All depends on the routes.
many many more stops, covered and protected bus stops
Not possible in this current climate
by being private transpostation

Need bus stop closer to my home

put buses on Johnson ferry and Abernathy.

Would need frequent bus stops along side roads not just Roswell Rd, but Dalrymple, etc.

More diverse routes. It just doesn't go where I need to go.

Better route info. A Roswell Bus that travels the length of Roswell in Sandy Springs instead of a bus only to city springs and then have to transfer to get to Hammond or Target

Bus stop I could get to more easily

MARTA is HUGE waste of money. Get rid of it.

I do not think I would be using it unless I were unable to drive

we live back in a neighborhood - perhpas if a shuttle ran frequently down Roswell Road we would get to the front of the neighborhood and could take it to City Springs do some light shopping or grab a meal or attend meeting or event - then catch the shuttle back up North.

extended routes

na

More routes closer to the west side, reliable schedules

Not sure

Clean and safe units are a good start.

better service with time

It doesn’t go anywhere and it’s useless if you are going to more than one place. Sandy Springs isn’t big enough for public transportation

Just significantly easy to use my car.

Very frequent, fast, and goes to places I want to go. You would be better at getting commuters from cobbb and points north directly through sandy springs and to their work

I'm not really a bus person. There's not anywhere in Sandy Springs I would take a bus... Marta is useful because of North Springs and Airport stations

If there was a Marta rail line not a bus line

More routes and buses, and safety

Make it 100 percent safe and with no people wanting money from me.

If buses could bypass car traffic

not sure

I don't know

I just don't think we have high enough density for a public transportation option that would benefit me.

It's a waste

I don’t/won’t use public transportation in Sandy Springs

It can't.

More routes and stops
not sure
Bus stops too far from my house
Make it safer

Q10 - If public bus transportation is not an efficient use of time for you, how could it be?

If public bus transportation is not an efficient use of time for you, how could it be?
Bus stops ON main rds; be on time
When it takes less than an hour for a 30minute drive in a car
Safety is my issue
more frequently available
More train rail
More frequent bus arrivals. More routes.
It would need to go to places I frequent --- shopping, entertainment, etc., without a lot of downtime waiting for connnections. Not sure that there would be enough people riding the buses to make this cost effective.
It's just easier to get my car and go to work.
more stops close by my home and destinations
more frequent buses
Use rail lines instead of bus lines. Inner city locations for open rail transportation as in Portland, OR.
Faster
More frequent buses
Need short distance (10 mile radius) quick routes.
More routes
If I could board a get-on-get off shuttle near me (Roswell @ Mt. Paran NE) and get to businesses in the core of the City Center, I would probably be much more interested in and inclined to use public transit.
More bus stops throughout instead of just on the main roads.
More routes to more places
Free wifi, more convenient stops, more clear scheduling details
more reliable
more rail lines going up 400
Having more direct routes.
Non stop routes
Prefer convenience of private vehicle
Takes too long to get anywhere.
I cannot walk much. It is a matter of bus stop location.

More “shuttle” type options between train stations and destinations
Cut down on the time on punctual
Expand the rail system up 400
If it showed up on time reliably. That would be great. Also I wish the bus and train timings were coordinated. So many times the bus pulls Into the station and then the train leaves .. have to wait about 20 minutes for the next train
more buses
?
Busses have to skip traffic to be more efficient than driving
Dedicated bus lanes, more buses on routes.
...
More stops, routes,, less wait time in traffic
frequent routes to the places I start and stop
Be safe and reliable 95% of the time.
If a bus ran down Heards Ferry Road on schedule, I would probably use it. Need a bus stop at Cameron Ridge Drive.
more direct routes
More convenient stops
Add the BRT Northridge station back to the 400 expansion plan.
see prior answer about frequency
Less traffic
does not run often enough
More routes
i dont see myself using public bus transportation
Not possible. Public transportation should shift to a Lfyt/Uber model. Smaller vehicles than buses. Shorter routes.
na
Need bus stop closer to home
?
If I were to take it to work, I would have to walk 20 minutes to the stop to catch the bus, ride the bus and transfer (taking at least another 40 minutes,) then walk from the stop to my office for at least 15 minutes. This is a 10 mile route if I'm driving, and takes me an average of 15 minutes.
If the buses came more frequently, and few transfers to my destination
Bus stop near me
Unsafe and a waste of money.

Not applicable

BRT on expressway would help

frequent shuttles

more dense route network, with smaller, more frequent vehicle arrivals

I do not live in Sandy Springs and Marta would be inefficient to get me to Douglasville, regardless of an improvements.

more buses per hour

no need

I mostly avoid public transportation, EXCEPT when I take the train to the ATL airport, or sometimes to an event downtown.. I appreciate the train for those 2 purposes!

reliable, closer to me, more routes

Not sure

I am not an expert on this matter.

time

Takes too long and doesn't go where I need to be.

Can't

Direct to work, shopping, frequent and fast - why these huge mostly empty buses- use smaller more frequent. Means more reliable transit employees with work ethic - heard that 25% plus of Marta employees don't show up on any given day. Can't run an efficient business that way

It's kind of hard to beat the convenience of a personal vehicle. I would say the bus service would have to be ubiquitous (always available everywhere to jump on), but I wouldn't want that, as it would be an eyesore.

only use Marta rail lines, bus lines in traffic are less appealing to me

Routes as frequent as The University of Georgia bus system. Be safe, keep people from jumping from bus to bus all day pandering and assaulting passengers.

Faster service

I'm going to drive

more widely available routes more frequent buses, dedicated lanes that don't have to sit in traffic.

Make it safe with no one asking me for money

If it could bypass car traffic it could help

if buses were able to move faster

Cannot compete with my car

I don't know

A trolley type system where you could get on a stop at anytime and not have to wait more than 10 minutes.

The use of transit requires two transfers (train, train, bus) so it takes longer than a car (most of the time)

It's a waste

I don’t/won’t take public transportation in Sandy Springs
It can't.
More stops and routes
couldn't
I have a car and I work at home. Why would I take the bus?
not sure
Na
Small buses throughout big neighborhoods which would take you to bigger buses
I do not feel safe

Q36 - If you have had a positive experience please explain below.

If you have had a positive experience please explain below.
Before the Pandemic, I always took the train to & from the airport.
I have been riding marta for 49 years and its been good and bad.
To airport
frequent trains that are on time, thank you!
Clean, cost-efficient, and mostly on time
I used to commute in town regularly. Park-and-ride at North Springs was convenient for this.
I was about to use the service to get to my destination on time in a clean and safe environment.
Knowing that I am reducing my carbon footprint.
Efficient
Marta rail works just fine between our stop North Springs and the airport. Always has.
free bus rides during pandemic
Have used Marta on occasion (not during pandemic).
I love taking the rail to the airport and back! It beats downtown traffic and parking!
Convenient if work is on MARTA rail line or for trips to sporting events, airport
I've never used public transportation in Sandy Springs. We have utilized public transportation multiple times with our children for events, weekend shopping- public transportation is great when you don't want to get your kids in and out of car seats over and over.
I prefer it to driving - but only when it is on direct routes - not to stand and change busses on a short trip
Since living in Sandy Springs (25 years), I have primarily used MARTA, including long term parking, as a safe and cost-effective way to access the Atlanta Airport. As a retiree, I no longer commute, but used to ride MARTA rail from the Medical Center to 5 Points. I always enjoyed riding the train.
When I didn't have a car it got me to where I was suppose to be. I never had bad incidents. My only problem is its slow and doesn't go everywhere
I could just sit back and relax.
MARTA is efficient, cost effective and stress free means to get to events and places in Atlanta.
Ride is comfortable
When buses and trains are plentiful, clean, on-time, and not heavily crowded like it was pre-pandemic at rush hours — that is when I have my best experiences riding public transportation. When those public resources also include room for people who also bike, that is AWESOME. By room, I mean not only physical space on train cars and on buses. I also mean PROTECTED BIKE LANES! Sandy Springs can be more walkable and safer for cyclists and families who cycle together. Investing in public transportation IS investing in our families and in connecting our great communities.

Convenience.
Efficiency
On time rail
riding rail to airiport
I've had many rides where people were kind, I've gotten to events fast, etc.
I love helping the environment.
Easy and time efficient during high traffic times
Use of Marta rail to travel to airport
I take Marta rail to go downtown Atlanta and to the airport. I love the convenience of that.
Public transit is great for events and not having to deal with traffic
I like taking the trains.
Marta rail service to the airport and anywhere on the line is great.
MARTA rail is fast and not impacted by TRAFFIC
Good way to get to airport
During the snow storm in 2014 I used the Marta Rail system to get home.
Efficient
It's environmentally friendly.
Drivers are friendly and courteous. Let you know about things that are available
Got me where I needed to go
much less stressful than driving
Convenience of travel from North Springs to the Airport on multiple occasions. Not to say I haven't had as many negative experiences too. However, skipping downtown Atlanta traffic is a bonus.
Going to airport is.nice
Before retiring i used the rail system to go downtown and to the airport. Rare delays and felt completely safe.
The drivers for the most part are friendly and courteous.
Rail system works when it goes somewhere close to your destination.
Less wear and tear on car
Taking the train from the St. Joe's stop to airport has been useful and vice-versa. Occasionally took train to High Museum. Wish I could take train or bus to Six Flags or Stone Mountain.
comfortable and on-time rail to airport
i used to take the train to the airport
It got me where I need to go. Even though it took a long time

i took marta to GA state for years. In DC, we relied almost entirely on the Metro trains

The MARTA Train is very convenient to get to the airport.

I have taken it to oncerts, events

Lately because of Covid always find A seat

Took Mats to Georgia Pacific for a year

Safety cleanliness

convenient for taking rail to airport

I use Marta rail to downtown Atlanta and sometimes to the airport.

Like the rail system, not as sold on bus

I feel The Marta system (bus or rail) gets bad reviews from people who rarely if ever use the system. I do think there is room for improvement, but any public system of transportation can be improved. RAIL LINES NEED TO BE EXTENDED!!

I appreciate Marta Rail. The station upgrades have been fantastic

In my lifetime, yes-- transit in other cities is great, and in Atlanta is has been mostly okay, but I mainly take transit to the airport.

Marta to airport

Airport trips by rail a couple times a year ped-COVID. Always reliable.

Efficient

No issues with Marta

I like to park at the Medical Ctr station and take the train to the airport

efficient way to get to airport if not checking bags.

taking Marta to Airport

I like being able to read and relax while traveling.

For years, it was my primary way to work. I was very rarely late.

MARTA is great for getting in town during rush hour

I have used the rail system to get to and from Atlanta Hawks games, after driving into Atlanta. It was quick, easy and so much cheaper than finding parking near the venue.

Most rides are pleasant enough. They just take longer than jumping in the car and driving directly to the destinations.

marta train

No safety problems; the train was timely and cost ep

Use it to get to sporting events in atlanta

It’s been ok - going downtown or to the airport.

Washington DC to public museums- still did lots of walking.

I sometimes use Marta to get to and from the airport. I would consider it for downtown Atlanta concerts or other events.

Marta rail is fast and mostly reliable. Would be even better with more trains/hour

I generally support public transportation for environmental purposes.

Easy

Generally was terrific (MARTA) for years ago when I had to go to GA State for school

NOT in Atlanta, but in NYC, Mexico City, Montreal, Vancouver, etc.

MARTA is the best way to get to ATL Airport

Marta to airport

marta rail is good system.

I love to ride with Marta, the drivers are so polite and normally the buses are clean and at good temperature

Train usually is ontime, reasonably clean, and goes where I need to go

MARTA can be great when it is on time

When I worked downtown, it was very nice to ride the bus and train to work and not have the stress of traffic in my daily commute.

travel to GSU while in college

Sometimes train is on time.

I enjoy riding the Marta rail to the airport

Only ride Marta to airport

Marta train is good for getting to the airport

I like the rail to the airport

Quick way to the airport

Q24 - If you have had a negative experience please explain below.

If you have had a negative experience please explain below.
Rude drivers, dirty busses, behind schedule
A very drunk man & a man who was vaping were on the train for the full ride.
bus not running during covid so I can get the work.no supervisor letting riders now when buses are late
People approaching asking for money, people fighting, drug addicts. I used to feel safer, but it has gotten way worse.
infrequent buses that are not on time
Waiting for the bus and the scheduled trip never showed up; there was no notification on why either.
Late trains/buses. Limited routes.
pandhandlers on MARTA trains, trains delayed enroute, lack of extra trains for large events, lack of public safety officers on trains and in stations
I don't like being late to work.
There are weirdos (cat calls, homeless using it to "move", overly chatty people, etc.)
Delays, panhandling, delays due to homeless, persons with weapons onboard
In other cities long delays have scared me away from using it for any purpose that requires an on time arrival.
when I didn't have a car and relied on the 85/87 bus, it was often late or simply didn't show up
Train or bus being significantly late or no termination where I am trying to go
aggressive panhandlling
We need more buses and they need to be on time. More buses and more trains on every route so that passengers don’t have to wait for up to an hour at times for a connecting service. Cleanliness is also an issue. Particularly on City of Atlanta buses and train cars. The restriction of availability of public restrooms is inhumane and must end! The un-housed population deserves respect and basic human dignity.
Slow
too unreliable, I don't feel safe
I've someimese encountered rude (usually kids) being noisy or loud on phones.
Sometimes it takes too long.
Trying to find parking at the Marta stations is the worst, nothing but vehicles from counties that don't have Marta!!!
Buses travel is so slow and confusing.
I've been on the rail when it's broken down and taken forever to get restarted.
Bus never came, the next bus never came, this was before uber/lyft so we were stranded for a couple of hours
Delays. Buses not showing up at all, long waits at train station. Rude passengers. Sometimes filthy.

Cleanlinessy

Waited a long time. Breakdowns. Not convenient to where I was going

delays

Specifically in rail, pan handlers, aggressive riders, loud music, the smell, people loudly talking on their phones, excess time wasted, kids running from train to train, police are not visible enough.

Unwanted comments, smells, drunks asleep on cars,

Rider for 13 years so seen alot

Homeless on oublic transport. Some are sick and a health risk to paying riders. Crime is high, especially against certain groups from black riders.

Lack of Security and Cleanliness on Trains, especially with the current state of things with COVID, has become an issue.

Drunk Passenger on Marta rail coming from airport late in the evening

3 hour commute to work in Duluth

Not feeling safe

encounters with person under the influence of drugs/alcohol, panhandlers

Train stuck or delayed

Urine on ground

Sometimes the transit riders can be unpredictable, transit can smell.. late.. sometimes the train will stop on the tracks for an unknown amount of time..

Criminals

Safety people on bus, no Marta officer patrol

I am sick and tired of panhandlers and bums who abuse the train system.

disruptive/scary people on the train. Train stopped for 15 minutes for no obvious reason.

trying to get from SS over to Decatur

Lack of bathroom access, lack of social skills from some riders, use of elevators by some to urination, unreliable timetables

One of the few times I was late, a bus broke down and they didn't send a timely replacement. I had to wait 45 minutes for the next bus and was almost an hour late.

Dirty, unsafe and unreliable.

timing for bus and Martha not good

Waiting hours after an event to get home

MARTA - dirty, later at night have to stop at Lindbergh and Chang. Takes to long due to stops to get to airport. Workers unfriendly, not helpful. Hate the card refill (paying for card) and then expiring the card. Shall I go on? Horrid company

People jumping train to train assaulting passengers. Nearly every time I go to the airport from Sandy Springs. Would not suggest my family use it. Feel unsafe. No presence of security.

Homelessness and other aggressive people on Marta

People playing music at full volume on their cellphones
For the third time make the bus safe and with no one asking for money
MARTA trains stopping before my destination due to repairs - both at Lindberg and College Park, and always when I was in a hurry
trains late or delayed during route
Social deviants jumping turnstiles, smoking, etc.
Too crowded at times
Too many panhandlers, lax enforcement of rules
Issues with significant delays
Too slow. And very expensive.
Train is late and it would have been quicker to drive.
Beggars. Preachers.
Seats not clean; bus interior smells
It is unsafe

Q25 - What do you value most about public transportation?

What I value: - Text
Not having to find parking
convenience & price
the bus is clean
The ease of getting to places especially the airport
dont have to drive
Ease of use
Convenience
That Atlanta has a heavy rail system
Not having to drive in traffic.
efficiency
Ease of use, saves time
Well it's okay going downtown.
efficiency and cost and environmental health
the cost compared to owning a vehicle
fast means of transportation
speed, destination, accessibility for all
Copnvienence, reliability, not sitting in traffic
Not having to drive in traffic; used Marta trains a Lot pre- Covid
Less cars on road, less traffic, less pollution, less stress for me. I can read or relax while not needing to drive
The ability to positively impact the environment, and the ease of seeing multiple things with children
Less stressful than driving when the service is direct point to point
Reduced traffic/environmental impact
Cost effectiveness
Transportation other than personal vehicle
Efficient
convenient when driving/parking is a challenge
It’s crucial for physical and economic mobility for many residents, more environmentally friendly
takes stress out of travel

On time
Lowering carbon footprint and reducing the amount of cars on the road
Better for the environment. Not driving in traffic. Getting to view the city from a better perspective.
Environmental
Reliability
Ability to skip traffic
easy to get around, avoid driving
Environmental
it is less expensive than using a car
Speed and efficiency, being green
Saving money and the environment.
convenience
The convenience of having someone else do the driving.
Gives freedom and mobility to those without the means for personal transporyatjon
Getting to downtown, but would like to get around Sandy springs much more too
not having to drive to the airport
convenience
It gets traffic off the roads
It's the right thing to do as far as carbon footprint
That it is there for anyone who is in need of transportation and affordable.
not paying parking at the destination
Getting to downtown Atlanta without much traffic and having it available for people who do not have cars
Access, affordable
Environmentally friendly,
Safety and cleanliness
We need our communities connected, especially when our service industry workers, teachers, emergency staff cannot afford to live in Sandy Springs. 67% of traffic on our roads comes from outside SS. Soon we won't be able to staff our businesses and schools if we don't provide innovative alternatives to cars.
environmentally friendly
Ease of access via rail to downtown and to the airport on high traffic days and for events.
Safety, convenience, time & easy to use

Eases traffic, environmentally friendl, low cost for those unable to afford a car
Access
skipping traffic and parking
Reading books
Convenience, good for the environment
I appreciate the green utility of the system, but have never found the bus system to be accessible from our SSprings residence. If the bus ran down Heards Ferry and connected to MARTA train, that would be great.
The opportunity to lower my carbon footprint.
mass transit
That it’s an option
it is necessary
do not have to worry about parking
the environment
Everything! It's my only transportation.
Senior citizen fare
It’s environmental impact
Not having to park at airport or downtown venues
rail service to airport
Avoiding traffic on I85
Fast, frequent, takes me to relevant locations
Getting cars off the road
Efficiency of time.
It’s generally economical and clean
It's environmental impact is less
The ease of getting to my destination, safely and at a reliable time.
Benefits environment
On time every time to airport
Cost savings, getting cars off of road ways
nothing. waste of tax payer money and only good for criminals
Cost
Cheaper than parking at the airport

Less driving abd tradfic

not having to park

decrease in traffic, avoid parking

Low cost, resource savings, less congestion

It allows my to get to events and appointments downtown, avoiding the horrible parking.

takes cars off road, provides more urban density,

efficiency

Access for those who don't or can't drive. That may one day be me.

equality

I value the train.

Better for environment, miss hassle of traffic

It helps some people.

time and efficientcy

Less pollution.

Speed and efficiency

having the ability to get somewhere without operating the vehicle

getting somewhere without parking a car

Efficiency

Environamental

It gives me time to relax on the way to my destination

Helps out a wide range of people in different income levels

THE CONVIENCE

reduce pollution and congestion

Less stressful than driving. On the train, ability to sit down and read.

environmentally friendly

Efficient use of travel

going to airport

Keep traffic off roads. Reliable time to airport

comfort

Good for the environment, helps address traffic problems.

On time service
Being a passenger instead of a driver.
traffic efficiency
Not in traffic
not having to drive
Speed
Helps people who don't have cars

Q26 - If you could make a suggestion to improve the likelihood of your use of the public transportation system, what would it be?

I would suggest: - Text
Convenient bus stops, adequate seating and lighting at stops
MAKE IT SAFER on &off the train
put riders on your board who have been riding for years
Having more security on trains.
more buses to more places
Expanding the train rail system further north n400
More coverage
More direct routes with more frequent service and longer service hours
Increase train/bus frequency/routes
more frequent MARTA trains, particularly in the evenings and weekends
More timely schedule
Look at places like Portland and Minneapolis
more frequent buses during the daytime
better lines and cross county access lines.
I liked the idea of tracking the bus to see how close it is (like Lyft).
Have Covid approved air filtration system
Create the most user friendly app with up to date numbers on delays and how many people are using the system at that time. An app that could tell you if using public transportation or driving would be faster. The app could tell you how much carbon you would save by taking public transportation in a month. You could partner with local businesses that included bus/rail fare with reservations or in store purchase. Reach out to the local Braves/Hawks/Falcons fanclubs in Sandy Springs to offer free GameDay transit with a railcard.
have a bus that goes all the way down Roswell Rd without having to change busses
dedicated lanes/broader availability/faster service
Low-cost intra-City Shuttle service for accessing businesses in and near the City Center.
Faster and routes all over
Making bus routes more available
improving timeliness and routes to encourage usage
More routes and stops, expand the rail line
more employees around

More routes
More buses
More accessibility, more routes, basically a general expansion
Bicycles, bicycles, bicycles. Build it and they will come! We need safe, well-funded bicycle programs which include protected bike lanes, tire air pumps stations at all rail stations and major bus depots, many more bike racks, and added security for those racks. Bikes can be our last mile solution, and bicycle infrastructure saves communities money when compared to increased motor vehicle infrastructure.
Make it efficient and safe
Pay on QR code
More accessibility throughout the city.
Simpler ways to get to and from rail. Need better rail options
make it safe and reliable
security personnel on each bus and rail car
Bus schedules that show when the next bus will arrive, like they do in other cities. And more trains - I would use that a lot if it went more places.
More direct trips.
More routes, more bus stops, longer coverage times.
More rail locations, direct shuttle type services to specific areas like parks and shopping centers
More infrastructure in Sandy springs
reliability
Educate on how to use it and where it goes
buses without steps
Easy connection “shuttle” type services to top destinations
connect to where I have to go
Expanding the rail system and making sure buses are reliable
More routes/range
Reliability. Reminder that people are going to work and places to get to in a timely manner.
BRT
Express options
dedicated bus lanes and more rail stops
Express rail. Instead of stopping at every station, have high profile stations on an express line. An example: leave North Springs and stop at Lindburgh, then stop at Five Points, etc., to the airport. Still having local trains that stop at every station, but express trains to minimize the travel time. Having lived in Japan, I have seen very effective and efficient rail, subway, and bus systems. Perhaps MARTA management can look into communicating with professionals from JR EAST or other transit figures from Japan on efficiency improvements.

More readily available
Timely schedules
That they run more frequently on weekends for rail and bus!
extended rail lines
On schedule and more police
Have more police and get rid of bad actors
A Sandy Springs MARTA bus running down Heards Ferry that stopped in the turn lane at Cameron Ridge Dr so as not to block the two lane traffic would be GREAT! Bus stops on a two lane road need to have a right of way carve out bus stop lane created so as not to block traffic.
More Bus Routes, Reliability, and Scheduling. Ex: I live 2 miles south of Downtown Roswell, but can only access the area via car because the closest route to Roswell (85) only goes down Dunwoody Place.
Safety Officers
Making it easier to switch between bus lines and weekly or monthly passes that cross systems
Re-add the Northridge station to the 400 BRT expansion plan.
more routes and more frequent trips
operate more often
more bus stops throughout Sandy Springs, especially in the neighborhoods!
Have bus routes to the Sandy Springs station
Putting service on Glenridge Ave
Adding more east and west routes..pill hill, Perimeter etc
extensive expansion of rail service throughout city and into suburbs
put buses on abernathy and Johson ferry
More frequent rail trips
More, more varied, and more diverse bus routes that actually will take me from one place to another in a timely manner and not tack on an hour or more versus if I were driving my vehicle.
It would be nice if there was a local bus/shuttle for the SS area. Maybe two, one from City Springs on North and one from CIty Springs on South given the area/shape of SS. The other issue is crossing the street if the stop is on the opposite side of the street from where you want to be. There either needs to be more frequent stops at each (which could be solved by a local type shuttle) or similar to Buford Hwy and farther South on R Rd, crosswalks in the middle of the street between lights. Often the idea of having to walk up and around to get where I'm going (especially in GA summers) is enough of a deterrent.
Rail Service down Georgia 400 to Alpharetta. It would significantly shrink traffic on GA. 400 and would be a faster way to travel.
Instructional video on how to use the bus. How to pay and how to tell the driver to stop at the next stop
Make the bus stops more hospitable (shelters) and have buses run more frequently.
Dedicated loops for targeted shopping areas with smart stops at apartment complexes and concentrated single family areas. A stop at Abernathy and Johnson Ferry for example.

Put a sidewalk on Hammond Dr so standing at the bus stop is safe
DEFUND MARTA
More Marta Police present
Arrest the vagrants on the trains and prohibit their access
needs to be closer to my area and have good park/ride lots
frequent shuttle service along main corredors
I would use a bus along Johnson Ferry connecting Fulton to Cobb, which used to exist but now seems defunct.
Run buses more often. The wide gap between buses is the main reason I don't ride them that often.
more routes that make north-south travel faster on the eastside, and options to get from Buckhead to Truist Park
State funding for MARTA so that the system can afford better access.
expand train services
Make more reliable, frequent and have more routes
Make it cleaner, safer and more efficient.
better time for service and more often busus
Overall the entire system and focus on moving workers from their job sites fast , cheaply and effivientlu
If it was a luxurious experience--limo-style--I would consider it, but this is not useful to you. Do not invest to court potential passengers like me, spend more time on logistics, don't be late, don't be unclean, don't cause traffic.
more marta lines, increased schedule
Add tons of unarmed low level security guards. There is no presence. Team up and beat this safety issue. I will use Marta bus/rail/tram whatever.. but has to feel safe. Scariest places to be sometimes. Marta on the EAST west line alone.
More safety and busses/trains
More lines, more rail
REOPEN PUBLIC RESTROOMS
More buses, dedicated lanes, more widely dispersed routes.
Expansion of the rail system. I hate waiting on the bus and then stopping at every street corner
Lowering fares for short bus rides. A 1 mile bus ride should not cost the same as a 25 mile train ride.
Countdown message board at bus stops,, real time web display of bus location, travel time and arrival times
Hard to think how it would be useful given the sprawl.
More routes so we can leave the car
Expand rail service to serve more areas.
Focus on on time service delivery. Get bus system out of traffic

Cleanliness (and no water leaks on rainy days)
Much lower prices
Make reliability as good as the Japanese train system.
real time app
More stops and routes
Build MARTA train stop at Northridge
improve the rail
Make it a safer environment

MARTA Operator Interviews Summary

SANDY SPRINGS
GEORGIA

2021 Bus Operator Interview Summary

City of Sandy Spring staff conducted interviews with MARTA bus operators of Route 5 on July 15, 2021. These interviews provided supplemental information to the data analysis from the 2021 Transit Signal Priority (TSP) pilot, which tested TSP technology along a segment of the Route 5 corridor. The findings from the data analysis and bus operator interviews will inform recommendations for the Sandy Springs and Dunwoody TSP Implementation Plan.

Background

The interviews were conducted on July 15, 2021 at MARTA's bus garage, Perry Garage. Bus operators were interviewed for 30 minute periods about their perspectives on Route 5 and opinions of transit signal priority (TSP).

A total of six bus operators were interviewed, each with a different amount of experience ranging from 11 months to 25 years. One of the bus operators had only driven the route for two months, while there were a few that had been driving the route for over 10 years. Operators interviewed drove Route 5 during shifts between 4:00 a.m. to 7:37 p.m. The majority of the bus operators interviewed drove Route 5 in the morning to early afternoon, but had some experience driving it other times of the day.

Perspectives on Route

Operators were asked about delays and potential improvements for the route. They identified congestion as the main source of delay due to high traffic volumes and construction. Due to high traffic volumes, it was noted that Roswell Road near I-285 has some of the worst congestion on the route, especially on Fridays and during the weekend. Operators mentioned that weekdays have the greatest variance in delay due to construction impacts.

Other common sources of delay include:

- The bus pull-off at Hammond Drive/Peachtree Dunwoody Road, near the Arby's and Publix. Buses are delayed, especially during congested times, because cars do not let them merge back into the travel lane after picking up/dropping off passengers.
- Crashes near the Chick Fil-A at 5925 Roswell Road. This location is a common spot for crashes.
- Near Roswell Road/W. Belle Isle Road in the mid to late afternoon, due to increase in traffic volume.
- Hammond Drive near State Route 400 ramps in the afternoon due to high traffic volume.

- Lane closures due to construction. (no specific location given)
- Common times for congestion are 2:30 p.m. - 6:00 p.m. with traffic volumes declining around 5:15 p.m.
- Bus stops with high number of boardings such as Roswell Road/Lake Placid Drive.

Operators were asked how they manage system interruptions in order to stay on time. One operator noted that some interruptions were easy to maneuver such as driving around a crash along a corridor. Others found it hard to detour on a route when all lanes were blocked since there are no parallel streets for the length of Roswell Road in Sandy Springs. A few operators shared examples of where it was difficult to manage falling behind schedule when they would start their routes late for reasons such as 1) helping a customer buy a ticket at a ticket machine and 2) arriving to the start of the route late due to heavy traffic in the afternoon between the route start and the bus garage. When running late, many operators mentioned they would allow riders to board while they found their fare instead of requiring payment right of way in order to keep the buses moving. Being ahead of schedule was also a problem because operators did not want to wait at the time check points and impede traffic. If an operator was ahead of schedule, they would drive slower, “drag the line”, so they would not arrive early to time points.

Interviewees had a variety of suggestions to offer for other route improvements. Several operators identified locations where trees and poles blocked the view of the bus stop. Others made suggestions around route management and operations such as reducing the number of time points to improve fluidity and pace of the route and shorten travel time. It was also recommended to add an extra bus during congested times. One operator suggested modifying striping at an intersection to better enable the left turn movement for the bus.

Transit Signal Priority

Most of the operators interviewed were unfamiliar with the current TSP pilot project and concept of TSP technology, but two operators had heard of the pilot project in passing and one was familiar with the TSP concept from a different route in the region. Upon asking if the operators noticed a change in the traffic signals in the past few months, operators initially responded that they did not notice a change, but once the Transit Signal Priority Project was explained, a few operators did think there may have been changes in traffic signals along Route 5 during the pilot time period.

The operators all thought the TSP technology was valuable to riders since they would arrive on-time, but did not think riders would notice the difference because many riders are typically on their phones and do not pay attention to their surroundings while on board the bus. One operator suggested to not publicize the project because it would be better for riders to not be aware of the technology. Operators suggested that TSP would be most beneficial on Roswell Road and when the bus is running 5-6 minutes late. One operator mentioned that operators can relax if they knew that they could catch up when running late. All operators interviewed approved of TSP and its efforts to improve reliability and on-time performance for the riders and operators who drive the route.

Attachment – Interview Questions

1. How long have you been a bus operator?
2. What bus routes have you driven before?
3. How often are you in charge of operating MARTA Bus Route 5?
4. Have you noticed in differences in the traffic signals on your routes?
5. Do you know of or what Transit Signal Priority (TSP) is?
6. How do you deal with system interruptions (accidents on route, multiple delays in traffic, delays in boarding on and off, etc.)? Do you run into these problems often?
7. Do you think that TSP is of value to the riders? Why or why not?
8. Do you think that this improvement via TSP will be noticed by the riders? Why or why not?
9. Have you noticed any specific places in the city where there is traffic or bottlenecks that might benefit from TSP?
10. What are your initial thoughts on (the concept of) TSP?
11. What other improvements can MARTA or the City of Sandy Springs make to the bus routes that you would like to see/consider helpful?

High-Level Cost Estimates and Assumptions

Route Recommendations and High-Level Estimated Cost Assumptions

Project ID	Project Name	Agency Lead	Route Signals	Independent Signals	Bus Licenses	Bus Stop Relocation	Bus Stop Upgrades	Estimated Cost	Assumptions
Route-5A	Route 5 - Bus Stop Upgrades Short Team	CoSS				2	1	$ 10,000	Based on CoSS inventory data.
Route-5B	Route 5 - Modification to Existing TSP (CoSS)	CoSS	22	8				$ 48,000	Assumed 50% of SCOOT modification costs will be necessary for modified deployment at existing TSP locations.
Route-5C	Route 5 - Modification to Existing TSP (CoD)	CoD	2	2				$ 7,000	Assumed 50% of SCOOT modification costs will be necessary for modified deployment.
Route-5D	Route 5 - Bus Stop Upgrades Long Team	CoSS				12	3	$ 45,000	Based on CoSS inventory data and 10% of total route signal locations would require upgrades.
Route-87A	Route 87 - Bus Stop Upgrades (Relocations and ADA Improvements)	CoSS				9	2	$ 33,000	Assumed 50% of total independent route signals would be relocated and 10% of total independent route signal locations would require upgrades.
Route-87B	Route 87 - Initial TSP Deployment	CoSS	16	4	4			$ 16,000	Route 87 and 5 have 12 common signals along this section.
Route-87C	Route 87 - Full TSP Deployment	CoSS	14	14				$ 50,000	Route 87 and 85 have seven common signals along this section. Six signals are not on SCOOT.
Route-85A	Route 85 - Full TSP Deployment	CoSS	7	0	4			$ 3,000	Six signals not on SCOOT (same as Route 87 signals). Route 87 and 85 have seven common signals.
Route-825A	Route 825 - Bus Stop Upgrades (Relocations and ADA Improvements)	CoSS				2	1	$ 10,000	Assumed 50% of total independent route signals would be relocated and 10% of total independent route signal locations would require upgrades.
Route-825B	Route 825 - Full TSP Deployment	CoSS	4	4	4			$ 16,000	Only recommended if Route 825 begins to run on increased headways.
Route-148A	Route 148 - Bus Stop Upgrades (Relocations and ADA Improvements)	CoSS				12	3	$ 45,000	Assumed 50% of total independent route signals would be relocated and 10% of total independent route signal locations would require upgrades.

Project ID	Project Name	Agency Lead	Route Signals	Independent Signals	Bus Licenses	Bus Stop Relocation	Bus Stop Upgrades	Estimated Cost	Assumptions
Route-148B	Route 148 - Initial TSP Deployment	CoSS	12	10	4			$ 36,000	Only recommended if Route 148 begins to run on increased headways. Route 148 has one common signal with Route 5 and one common signal with Route 5 and Route 87.
Route-148C	Route 148 - Full TSP Deployment	CoSS	13	13				$ 43,000	Only recommended if Route 148 begins to run on increased headways. Six signals are not on SCOOT.
Route-103	Route 103 - Full TSP Deployment	CoD	11					-	Cost estimates to be determined based on future deployment decisions and study.
Route-132	Route 132 - Full TSP Deployment	CoD	9					-	Cost estimates to be determined based on future deployment decisions and study.
Route-150	Route 150 - Full TSP Deployment	CoD	24					-	Cost estimates to be determined based on future deployment decisions and study.