



CONNECT Beyond

A Regional Mobility Initiative

Transit Standards and Performance Measures

May 12, 2021



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Abbreviations

BRT – Bus Rapid Transit

HCT – High Capacity Transit

HOV – High-occupancy vehicle

iNTD - Urban Integrated National Transit Database

LRT – Light Rail Transit

NTD – National Transit Database

OTP – On Time Performance

ROW – Right of Way

TAM – Transit Asset Management

TDM – Transportation Demand Management

TSP – Transit Signal Priority

TSPM – Transit Standards and Performance Measures

Terms

Early/late night hours – the timeframe for early/late night hours varies by agency/city, but generally corresponds to the hours of service before and after off-peak hours. This is commonly defined as before 5 AM and after 10 PM.

End-of-line vehicle turnaround – the operating pattern for buses at the end of a route’s line. Preferred patterns should target transit facilities (park and ride, transit hub) whenever possible and avoid long circuitous routing or routing through residential areas.

Layover – when a bus waits at a stop location for a certain period to either give the operator a break, improve transfer opportunities between services, and/or allow an electric bus to charge (given the appropriate infrastructure).

Off-peak hours – hours of the day when transportation system is least utilized and delays are seldom experienced. The timeframe for off-peak hours varies by agency/city, but generally corresponds to the hours in between peak hours, as well as some hours before and after peak hours.

Peak hours – hours of the day when transportation systems are most heavily utilized (both roadway and transit use). Specific hours vary by city but are generally defined as 6 AM–9 AM and 4 PM–7 PM.

Roadway type – a classification system for roadways based their travel speed, use, and access.

Route deviation – a branch from a route’s main operating corridor designed to serve a major trip generator or destination.



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Route directness – refers to the operating pattern between terminal points. Route directness influences how a traveler chooses a transportation mode; transit operations between terminal points should be designed to serve terminals in the most efficient routing pattern possible.

Route duplication – the placement of parallel routes within proximity to one another. Not desirable for transit if capturing the same rider market.

Route length – the distance the bus travels (one-way).

Service frequency – the number of trips per hour (often varies by peak, off-peak, and early/late night hours).

Service types – a specific classification structure for transit services. Service types are often broken down by mode (vehicle type), frequency of service, and/or operating pattern.

Short turn – refers to trips that do not serve the full route length. These trips are often implemented in early/late night hours where ridership clearly drops off at a certain location along the route.

Span of service – the number of hours per day a service is in operation.

Transfer point – a location where at least two bus routes cross paths allowing riders to connect from one route/service to the other.

Two-way service – the operation of buses in opposite directions within the same corridor or operating pattern.



Introduction

Transportation is critical for keeping a region moving. Providing a variety of transportation options helps enhance the quality of life for area residents and visitors by providing greater access to education, healthcare, and recreational activities. These options impact economic development and the availability of goods and services by bringing more jobs within reach of the greater region. Areas seamlessly interconnected by a variety of transportation methods are far more likely to attract people, business, investment, and new opportunities.

To help address the issue of seamless transportation connections, the greater Charlotte region embarked on a project called CONNECT Beyond—a two-state, 12-county regional mobility initiative coordinated by the Centralina Regional Council and the Metropolitan Transportation Commission. The goal of CONNECT Beyond is to create a unified regional transit vision and plan.

Purpose

The necessity of developing a performance-based public transportation system, specifically for fixed-route services, is consistent with federal and state requirements. The Fixing America's Surface Transportation (FAST) Act advanced several important transportation goals, including safety, state of good repair, performance and program efficiency. The Act established performance-based planning requirements that align federal funding with key goals and track progress towards those goals.

Transit service standards and performance measures (TSPM) could be guidelines or policies by which the performance of the region's transit system may be implemented and/or evaluated, and decisions regarding transit investments may be prioritized and measured. In order to provide high quality transit service that is attractive and affordable to passengers and taxpayers in the CONNECT Beyond study area, tradeoffs are required between the costs and benefits of providing the service.

Establishing well-defined TSPM will provide a formal mechanism for making these tradeoffs in an objective and equitable way and provide both decision-makers and the public with the necessary data and evidence when discussing routing, scheduling, and service change decisions.

Based on a review of the five fixed-route transit providers' web pages in the CONNECT Beyond study area, there are no published or easily accessible TSPM documents. The Charlotte Area Transit System (CATS) does have an internal TSPM document which was adopted in November 2018. Four of the five agencies have long range transportation plans available on their website. Publishing and reporting on TSPM increases agency transparency and demonstrates the effectiveness of transit investments, which can improve financial sustainability and enhance long range transportation planning efforts.



All regional agencies are beneficiaries of grants from the Federal Transit Administration (FTA) under the Urbanized Area Formula Program (§5307) or Other than Urbanized Area (Rural) Formula Program (§5311) and are required to submit certain performance metrics to the National Transit Database (NTD). Data can be accessed through the NTD site; however, querying and retrieving such data is not easy for the general public.

The following performance measures are reported by all agencies per federal requirements:

- Operating and capital expenses
- Annual ridership
- Fare revenue
- Revenue miles
- Revenue hours
- Average passenger miles per trip

In addition to the FTA required metrics, 6 of the 17 agencies in the CONNECT Beyond study area report on-time performance, an indicator of how well service is adhering to the posted scheduled. Without published TSPM; however, it is unclear how the agencies use the data collected for NTD reporting for their own planning purposes.

This memorandum reviews three peer transit agencies with adopted TSPM; Valley Metro (Phoenix, AZ), Sound Transit (Seattle, WA), and Capital Metro (CapMetro) (Austin, TX). The peer review identifies best practices for setting service standards and describes how to create a performance-based system for the benefit of the customer.

Peer Agency Selection

Peer agency reviews have been required for several elements of the CONNECT Beyond project. Where possible and appropriate, the project team attempted to be consistent with the peer agencies analyzed. For the TSPM peer review, the project team reviewed the list from the Transportation Demand Management (TDM) peer agency review, which included the following list of peers based on system and network design: Raleigh, Madison, Phoenix, Seattle area, and Houston.

After careful review for this fixed-route provider TSPM review, only Valley Metro (Phoenix) and Sound Transit (Seattle) had published TSPM policies readily available. Additional peers were identified using the Urban Integrated National Transit Database (iNTD)¹ Peer Finder tool and a review

¹ https://ftis.org/urban_iNTD.aspx?AspxAutoDetectCookieSupport=1



of best practice reports published by the Florida Department of Transportation (FDOT) (2009², 2014³). From this review, Austin, Jacksonville, Tampa, Chicago, San Antonio, and York (Ontario Canada) were selected for consideration. Of these areas, Jacksonville, Tampa, and San Antonio do not have published TSPM materials; Austin, Chicago and York do have published TSPM materials. Austin's Capital Metro (CapMetro) was ultimately selected as the third peer because the characteristics of the region and system services provided are most comparable to the CONNECT Beyond study area.

Peer Agency Review

This section outlines the TSPM elements identified in each of the peer agencies' policies.⁴ Specific definitions and details of the elements are described in the following sections. In general, however, standards relate to the planning and design of services. Service standards are intended to create a consistent and logical network design that is easy for users to navigate, serves major activity centers, and operates efficiently. Performance measures are the metrics used to analyze whether the system meets the standards. Performance measures can be applied at the route, corridor, or system level, depending on how the agency wants to evaluate the network.

Planning Principles & Service Goals

CapMetro, Valley Metro, and Sound Transit all have overarching service planning principles and goals guiding their TSPM. Planning principles facilitate the creation of performance-based systems, define the urban environments in which services should operate, and outline the service change process. Examples of guiding planning principles and goals include:

1. Implement services in consideration of a performance-based system.
2. Promote expansion that builds on existing services to meet standards and focuses new services in key areas.
3. Provide transit that is desirable as an alternate mode to automobile travel

² <https://www.nctr.usf.edu/pdf/77720.pdf>

³ <https://www.fdot.gov/docs/default-source/transit/Pages/PerformanceMeasuresExecutiveSummary.pdf>

⁴CapMetro TSPM is available at: https://www.capmetro.org/docs/default-source/plans-and-development-docs/service-changes/capital-metro_service-guidelines-and-standards.pdf?sfvrsn=df9fdacb_2

Valley Metro TSPM is available at:

https://www.valleymetro.org/sites/default/files/tspm_procedures_guide_final_10.04.19.pdf

Sound Transit TSPM is available at: <https://www.soundtransit.org/sites/default/files/2018%2520Edition%2520-%2520Service%2520Standards%2520and%2520Performance%2520Measures.pdf>



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4. Implement service changes that direct the agency toward accomplishing voter-approved plans.
5. Implement services that meet approved budgets.
6. Give high priority to services that focus on the transit-dependent population (elderly (65+), children (<18), low-income households (<50% median income), and zero or one auto households).
7. Implement services in corridors with supportive land densities and uses (mixed use, commercial, institutional, high-density residential).

Notably, the impacts of COVID-19 on tax and fare revenues used to finance transit service operations have brought to light the importance of defining service planning principles and goals as agencies across the country have been forced to reduce service. Service principles and goals, along with baseline service standards established by an adopted TSPM document, can provide a guiding framework by which agencies can make strategic service reductions while still providing quality service; this is true for any emergency situation that may impact funding such as economic recessions, budget cuts, and more. Such principles also help to formalize a process to add effective service rather than being reactive to service requests.

Service Basics

Defining Types of Service

Transit service types are used to define and classify the different modes of transit service operated in the region. By classifying transit services into different types, routes can be more equitably compared to one another within the same service type and performance expectations can be better managed. For example, a commuter express bus route that operates a limited number of peak-period one-way inbound and outbound trips would not be expected to perform similarly to a local bus route that operates in densely populated areas with moderate to high frequency service throughout the day. Transit service types also serve as a tool for understanding what type of service may be most appropriate for a specific area or location.

Valley Metro, Sound Transit, and CapMetro all operate a range of defined services. The agencies generally define services based on frequency of service, operating corridor profile, activity centers and market served. **Error! Reference source not found.** provides examples of service descriptions by peer agency and **Error! Reference source not found.** provides a list of services offered by each peer agency and CONNECT Beyond fixed-route operators. A full list of services operated by each CONNECT Beyond agency is provided in Appendix A.



TABLE 1: EXAMPLE OF SERVICE DESCRIPTION BY AGENCY

City - Agency	Service	Service Description
Austin - CapMetro	Crosstown	Local stop service on primary corridors that bypass downtown Austin
Phoenix - Valley Metro	Key Local Bus	Similar to local bus service but located in corridors that are expected to meet a higher level of performance based on proximity to transit dependent populations (low-income and low-auto ownership) and demonstrated performance. New local routes should be classified as a local bus, until performance at the Key Local Bus level is demonstrated. Please see an expanded description in the Key Local Bus Qualifications Section.
Seattle - Sound Transit	ST Express	ST Express offers fast, frequent two-way service on 28 routes connecting Snohomish, King, and Pierce Counties. Sound Transit provides this bus service via service agreements with transit partners: King County Metro, Pierce Transit, and Community Transit. ST Express provides service to over 50 transit centers and park-and-ride lots.

TABLE 2: PEER AGENCY SERVICES OFFERED

Services Offered	Cap Metro	Valley Metro	Sound Transit	CATS	City of Gastonia	City of Salisbury	Rider Transit	My Ride
Vanpool	x	x		x				
Demand response	x	x		x	x		x	
On demand taxi	x							
Rural connector		x						
Community circulator	x	x		x				
Local bus	x	x		x	x	x	x	x
Key local bus	x	x						
Limited stop peak		x						
Limited stop all-day	x	x						
Crosstown	x							
Commuter express	x	x	x	x				
Light rail transit (LRT)	x	x	x	x				
Streetcar		x						
Bus Rapid Transit (BRT)	x	x		x				
Commuter rail			x					

Span and Frequency of Services

With services defined by type, a standard set of operating characteristics for each service should be established. The two most basic operating characteristics are frequency and span of service; stop, or station spacing, is a third. These three operating characteristics are also the most basic service standards an agency can establish.

By standardizing operating characteristics for each service type, agencies can create a consistent and reliable transit system for passengers. Standardized operating characteristics also serve as key performance measures for system evaluation. Operating characteristics should be based on anticipated demand (ridership), markets served (e.g., all-day travel market versus commuter market), and proven industry practices. **Error! Reference source not found.** outlines the service standards by mode for each peer agency.



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TABLE 3: PEER AGENCY SERVICE STANDARDS BY MODE

Agency	Service Type	Minimum Frequency			Span of Service (Hours)		
		Peak Hours	Midday	Late Night	Weekday	Saturday	Sunday
CapMetro	Radial	30	60	60	16	15	12
	Frequent	15	15	20	16	16	14
	Limited/Flyer	20			4 hours (6-8 AM, 5-7 PM)	based on demand	based on demand
	Feeder	40	60		13	based on demand	based on demand
	Crosstown	30	60	60	16	14	12
	MetroRail	40	60		12	7	N/A
	MetroRapid (BRT)	15	15	20	19	18	17
	Express	20			4 hours (6-8 AM, 4-6 PM)	N/A	N/A
	MetroAirport	30	30	30	17	17	15
	Night Owl	60			27	27	27
UT Shuttle	20	20	40	16	N/A	9	
Valley Metro	Rural Connector	4 inbound / 4 outbound trips			-	NA	NA
	Community Circulator	30	30	60	12	0	0
	Local Bus	30	30	30	16	14	12
	Key Local Bus	15	30	30	16	14	12
	Limited Stop Peak	4 trips AM / 4 trips PM			-	NA	NA
	Limited Stop All-Day	Headways same as LRT, up to 2x Peak			16	14	12
	Commuter Express	4 trips AM / 4 trips PM			-	NA	NA
	LRT	12	20	20	18	14	12
	Streetcar	12	20	20	18	14	12
BRT	12	20	20	18	14	12	
Sound Transit	ST Express	30 min peak / 60 min base			15	0*	0*
	Sounder Commuter Rail ⁵	2 inbound / 2 outbound trips			-	0	0

⁵ <https://www.soundtransit.org/sites/default/files/documents/schedule-sounder.pdf>



Agency	Service Type	Minimum Frequency			Span of Service (Hours)		
		Peak Hours	Midday	Late Night	Weekday	Saturday	Sunday
	Link Light Rail ⁶	6	10	15	20	20	18

*While no service is required on weekends, most ST Express routes operate approximately 18 hours on Saturday and Sunday.

Stop Spacing

Stop spacing is the balance between network access (transit rider markets) and travel speed. For example, commuter routes serve a specific market and should only make a limited number of stops at the origination and destination sites, with very limited or no stops between those two locations. On the other hand, a local route should have stops placed every one-quarter to one-third mile⁷ to increase network accessibility. Stop spacing should be designed to balance coverage and access with targeted operating speeds. Figure 1 depicts Sound Transit’s bus stop spacing standard for ST Express commuter service.

Stop spacing by area type may be appropriate for certain regions or as an overarching standard for an agency. For example, it would be appropriate for a local route to have more frequent stops in a downtown or more densely populated area and stops spaced farther apart in suburban districts. For Valley Metro, the stop spacing standard is set by service type. For CapMetro, the stop spacing standard is based on the surrounding land uses. For Sound Transit, the stop spacing standard is based both on service type and surrounding land use.

⁶ <https://kingcounty.gov/depts/transportation/metro/travel-options/rail.aspx#:~:text=Service%20is%20available%20from%205,midnight%20on%20Sunday%20and%20holidays.&text=Sounder%20trains%20travel%20between%20Lakewood,stops%20in%20Mukilteo%20and%20Edmonds>.

⁷ FTA notes the balance between closely spaced stops to improve access and further distanced stops to improve travel speed. Local routes serving higher-density areas typically have closely spaced stops to increase network access. <https://www.transit.dot.gov/research-innovation/stops-spacing-location-and-design>

FIGURE 1: SOUND TRANSIT ST EXPRESS COMMUTER ROUTE SPACING STANDARD

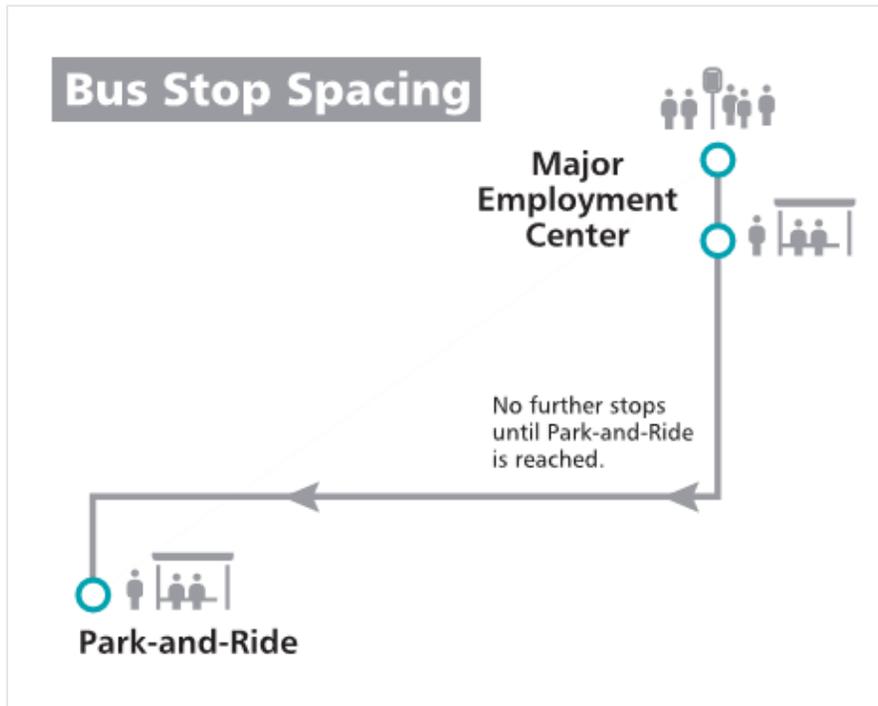


Image source: Sound Transit Service Standards and Performance Measures (2018)

All peers also note preferred locations for bus stop placement. While not a metric usually used to evaluate a system, the placement of bus stops can have a great impact on travel time, customer access, and customer safety. Placing stops at the far-side of intersections and avoiding mid-block stops are placement preferences for both CapMetro and Valley Metro. Far-side stops are particularly preferred for intersections where there is a high volume of vehicles turning right or where transit signal priority (TSP) allows buses to pass through the intersection before the light turns red. Mid-block stops, unless directly serving a major trip generator or near a safe mid-block crossing, should be avoided because of the low safety and accessibility they generally provide. Other factors such as route transfer opportunities, driveways, land use (destinations), sidewalk availability, landscaping, or utilities also impact where bus stops can be located.

Finally, the performance of bus stops may be used to determine whether amenities such as a bench, shelter, trash bin, bike rack, system map, or real time information display is warranted at a stop. The peers note priority for amenities at high ridership stops (threshold varies) and commuter or low frequency routes where passengers may be required to wait longer between trips.



Network Design

Network design standards are used to maintain the integrity of a regional transit system’s grid architecture and optimize route and system-level performance. Table 4 summarizes the peers’ adopted network design standards, subsequent text provides additional explanation.

TABLE 4: PEER AGENCY NETWORK DESIGN STANDARDS

Design Standard	CapMetro	Valley Metro	Sound Transit
Two-way service	x	x	x
Roadway	x	x	x
Deviations	x	x	x
Route Duplication	x	x	x
End-of-Line Vehicle Turnarounds/Route Anchors	x	x	x
Transfer points		x	x
Directness of Travel	x		x
Short Turns	x		x
Route Length	x	x	
Layover			x

Two-Way Service

Operating two-way service on the same street is fundamental to planning a transit network that minimizes passenger confusion and maximizes rider travel time and service effectiveness. Where one-way streets exist, routes should operate on parallel one-ways in as close proximity as possible. All three peers have adopted a two-way service standard. Figure 2 depicts a roadway with two-way service.



FIGURE 2: EXAMPLE ROADWAY WITH TWO-WAY SERVICE



Image source: <https://streetmix.net>

Roadway

Certain roadway configurations should be utilized to help accomplish the frequency standards established by service type. For example, community circulators are shorter routes meant to collect residents from different neighborhoods and bring them to local destinations (i.e., community center, town center, etc.) or connect to the larger transit network. They therefore can, and should, run on collector or even local roads. On the contrary, express and commuter services should use occupancy vehicle (HOV) lanes on express/freeways and arterial roadways, ideally with dedicated bus lanes or transit priority treatments, when leaving the origination or approaching the destination site. Table 5 summarizes the roadway hierarchy from smallest to largest.

TABLE 5: ROADWAY HIERARCHY

Roadway Type	Definition
Local	Lowest speed limits, typically residential neighborhoods
Collector	Collect traffic from local roads and distribute to arterials. Often a core road running through a neighborhood
Arterial	Major through roads that are expected to carry large volumes of traffic. Can be categorized as major or minor arterials
Freeway	Largely uninterrupted travel using partial or full access control and are designed for high speeds

Relatedly, street and sidewalk characteristics are another important consideration, even in high density employment or residential areas. Interconnected streets have higher potential for transit use.



Frontage roads or winding and circuitous streets limit pedestrian access and make transit less desirable, unsafe, or unfeasible. Two of the three peer agencies specifically include which roadway types services should operate on in their definition of transit services. One peer agency included street and sidewalk characteristics in their service guidelines.

Route Deviation Standard

A route deviation is defined as any departure from the primary corridor of a route's operation. All three peer agencies report deviations should be minimized as much as possible, but a route deviation may be warranted if:

- It is no more than 1-mile or 5 minutes one-way, results in no more than a total of two deviations per route
- Deviations do not negatively impact overall performance or add to service and/or capital requirements
- Ridership gains outweigh additional travel time for other passengers

Error! Reference source not found. Figure 3 is an example of an acceptable reason for a route deviation set by Sound Transit standards.



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FIGURE 3: EXAMPLE OF ACCEPTABLE ROUTE DEVIATION FOR SOUND TRANSIT

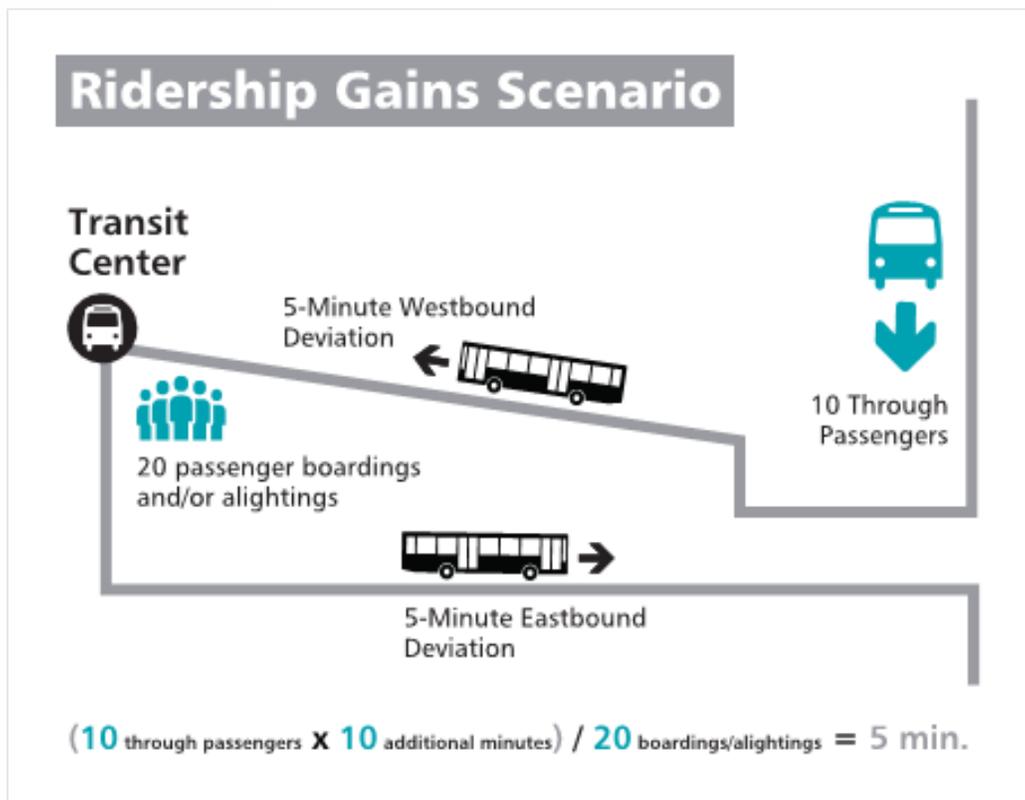


Image source: Sound Transit Service Standards and Performance Measures (2018)

Route Duplication Standard

Route duplication is defined as the operation of two or more routes or services along the same street segment or on closely parallel streets (within one-quarter mile or a defined proximity of each other). All three peer agencies have adopted a route duplication standard and all peers indicate the following exceptions when route duplication may be warranted:

- Routes with high demand, and HOV lane, or special transit priority/designated treatment, with potential to split service demand
- Service headways, performance, stop spacing, and walking distance are optimized

Figure 4 depicts an example of route duplication from Valley Metro's TSPM.



FIGURE 4: VALLEY METRO ROUTE DUPLICATION EXAMPLE

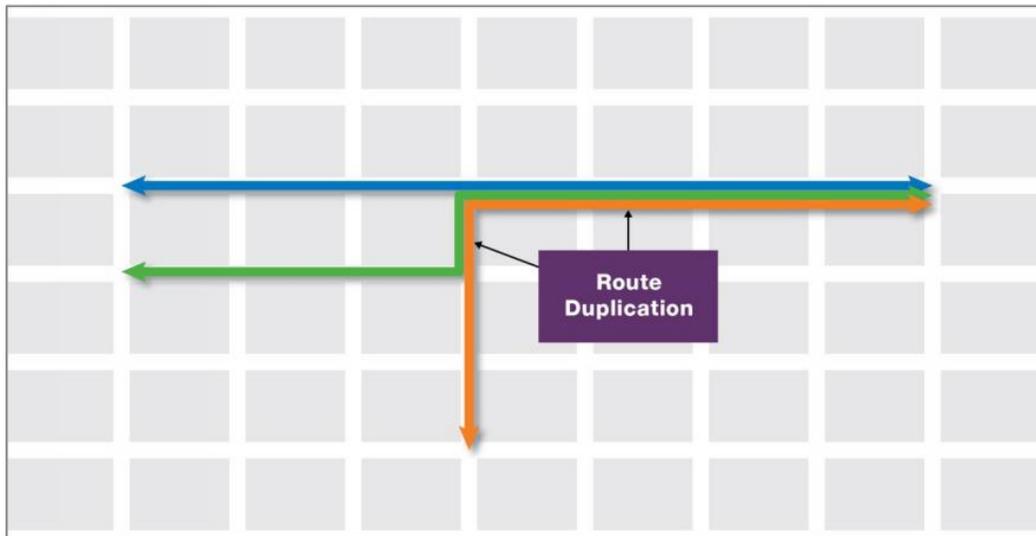


Image source: Valley Metro Transit Standards and Performance Measures (2019)

End-of-Line Vehicle Turnaround

Revenue-service vehicle turnarounds occur when circulations or turnarounds at a route's terminus are necessary to maneuver vehicles into the proper position/location for return trips. The following recommendations are reported by the peers to avoid operating inefficiencies and impacts on adjacent land uses from vehicle turnarounds:

- Use the shortest path to dedicated transit facility. If there is no nearby facility, operate on arterial and collector streets and avoid circulating through non-compatible private properties
- Anchor route terminal at major trip generating locations to maximize ridership and account for safety, security, and operator restroom availability

All three peers have an end-of-line vehicle turnaround standard. Figure 5 depicts end-of-line scenarios with and without a turnaround.



FIGURE 5: EXAMPLE OF END-OF-LINE TURNAROUND

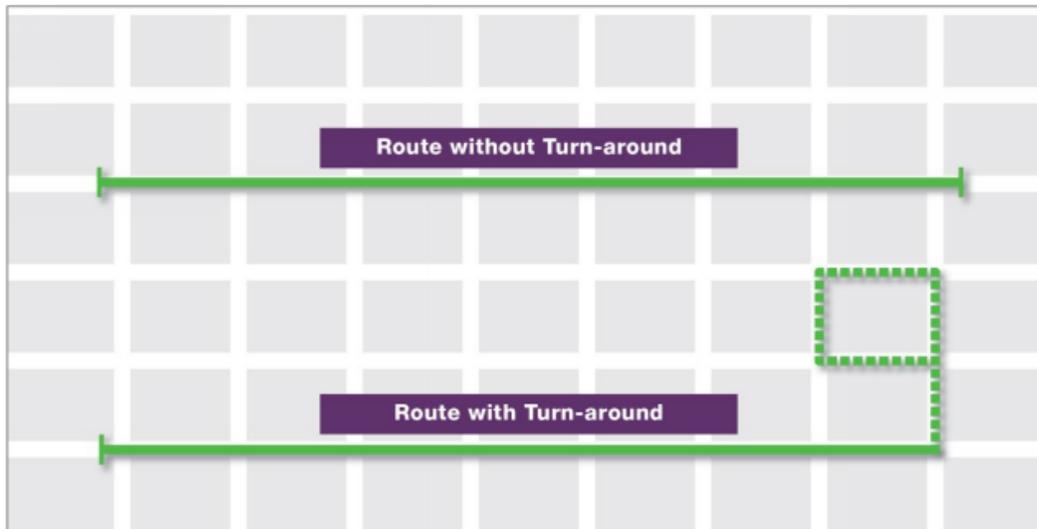


Image source: Valley Metro Transit Standards and Performance Measures (2019)

Transfer Points

Transfer points are the locations where riders make connections from one route or service to another route or service. These often occur at transit hubs where many routes and services converge, but they regularly occur throughout a given network as well. While they vary in specificity, Valley Metro and Sound Transit's transfer point guidelines aim to create a network of services that offer reliable travel times and transfer connections. Strategies to minimize wait time at transfer points include prioritizing locations based on ridership, offsetting schedules, providing more frequent service at key times when transfer volumes are greatest. Figure 6 depicts CATS' Rosa Parks Place Community Transit Center which has capacity for 8-10 buses and facilitates transfers between Routes 7, 26, 30, and 201.

FIGURE 6: CATS' ROSA PARKS PLACE COMMUNITY TRANSIT CENTER



Image source: <https://charlottenc.gov/cats/bus/transit-centers/Pages/default.aspx>

Route Directness Standard

Route directness refers to how a traveler chooses a mode, and the coefficient of directness for a route is defined as the ratio of a transit mode's travel time between terminal points, to that of a single-occupancy private vehicle. A range for the coefficient of directness of 1.25 to 1.75 is reported by two of the three peers, which indicates that transit should only take 25-75 percent longer than driving. CapMetro and Sound Transit have route directness standards. Figure 7 depicts CapMetro's route directness standard.

FIGURE 7: CAPMETRO ROUTE DIRECTNESS STANDARD

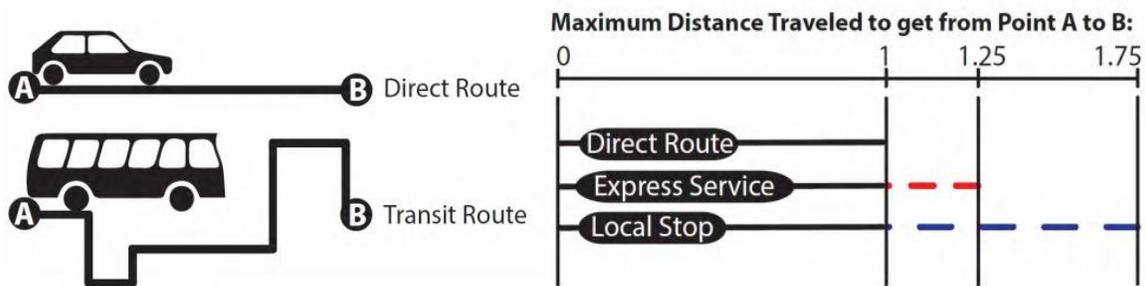


Image source: *CapMetro Service Guidelines and Standards (2015)*

Short Turns

Short turns are trips that do not operate for the entire length of the route; instead they end at a selected point where the route experiences a significant drop in demand. The ridership threshold for

what warrants a short trip are not defined. CapMetro and Sound Transit have short turn guidelines. Valley Metro also operates short turn trips, though they do not have guidelines in their TSPM related to those operations. Figure 8 demonstrates an example of a short operation.

FIGURE 8: EXAMPLE OF SHORT TURN OPERATION

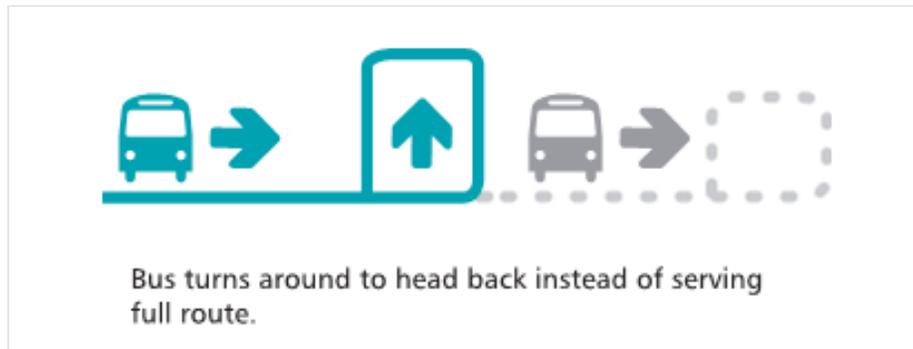


Image source: CapMetro Service Guidelines and Standards (2015)

Route Length

Routes should be the appropriate length to maximize ridership potential and minimize operational issues. For example, a community circulator should be approximately ten miles or less in length since it has lower boardings per revenue mile than local service. This allows it to build a future market for transit while efficiently serving the existing community. Though not necessarily standards, CapMetro and Valley Metro have route lengths associated with each service type. Figure 9 compares the length of Valley Metro's commuter Route 535 to their Venus circulator route.

FIGURE 9: VALLEY METRO COMMUTER ROUTE COMPARED TO CIRCULATOR ROUTE



Image source: remix.com



Layovers

Layover areas, also called layover bays or zones, should be created for operator breaks and coordinated with available comfort stations (bathrooms). The size of the layover bay is generally determined by the frequency and number of routes utilizing the space. Though CONNECT Beyond service providers currently use 40-foot or smaller vehicles, layover bays should be designed, or at least enough right of way (ROW) should be reserved, to accommodate two buses or one 60-foot articulated buses. This reserves space for the system to grow and be able to use larger vehicles in the future. It also reserves space for the installation of electric vehicle charging stations should fleet electrification be pursued. Sound Transit was the only peer agency to have a layover design standard. **Error! Reference source not found.** denotes Sound Transit's ST Express layover standard, which is designed based on the frequency of service. Figure 10 provides an example of a 60-foot articulated bus, used by Sound Transit's ST Express service.

TABLE 6: SOUND TRANSIT ST EXPRESS LAYOVER STANDARD

Route Frequency	Layover Space
More than 30 minutes	One 60-foot articulated bus vehicle
15-30 minutes	Two 60-foot articulated bus vehicles
7.5-15 minutes	Three 60-foot articulated bus vehicles
Less than 7.5 minutes	Four 60-foot articulated bus vehicles

FIGURE 10: ST EXPRESS 60-FOOT ARTICULATE BUS



Image source: <http://mlklabor.org/weekly-update/weekly-update-march-22/>

Performance Measures

Transit service performance measures assess operational effectiveness in achieving the adopted service standards. Agencies define and track performance measures over time for transparency and accountability, which helps garner public buy-in on commitment to safe and reliable services. The evaluation of performance also helps identify whether performance improvement actions to enhance productivity are effective. Service performance measures should be applied separately to each transit service type to allow for a comparable analysis of performance. **Error! Reference source not found.** outlines the adopted performance measures by agency.

TABLE 7: ADOPTED PERFORMANCE MEASURES BY AGENCY

Metric Category	Performance Measures	CapMetro	Valley Metro	Sound Transit
Productivity	Boardings per Trip		x	x
	Boarding per Revenue Hour	x		x
	Boarding per Revenue Mile**		x	
	Farebox Recovery Rate		x	
	Subsidy per Boarding	x		x
	Operating Cost per Passenger	x		
	Passenger Mile per Platform Mile			x
Service Quality	Passenger Load (and standing time*)	x		x*
	On Time Performance (OTP)	x	x	x
	Customer Complaints			x
	Directness of Travel			x

Data Requirements

Available and reliable data are required for evaluating performance measures. Ridership, travel time, and operating costs are the three primary data sets needed to calculate most performance metrics. Agencies in the CONNECT Beyond study area all report ridership data to NTD. Boardings per trip, noted in the table above, are a more specific breakdown of ridership data. The more specific the agency can be about collecting and organizing ridership by route, the day of the week, or even hour of the day, the more beneficial it is to the agency in knowing how to make service adjustments.

In-depth demand and performance analyses can be conducted if origin and destination boarding/alighting data (requires geolocation devices) is available. Such data will reveal average daily boardings and alightings by stop, resulting in a foundation for route-level boarding and alighting analysis and uncovering opportunities to improve services and connectivity. Stop-level data should be available to the general public and stakeholders as well, as it can be used to support efforts such as research or community grant applications looking to make improvements near stops.



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Applying Performance Measures

Each of the three peer agencies reviewed uses a quartile-based framework for evaluating transit service performance measures. The thresholds rely on a numerical ranking of each performance measure for each route or service within their respective service type category. Routes in the top quartile may require additional service or capacity, while routes in the lowest quartile require corrective action to improve performance. Figure 11 depicts Valley Metro's service performance thresholds.

FIGURE 11: VALLEY METRO TRANSIT SERVICE PERFORMANCE THRESHOLDS

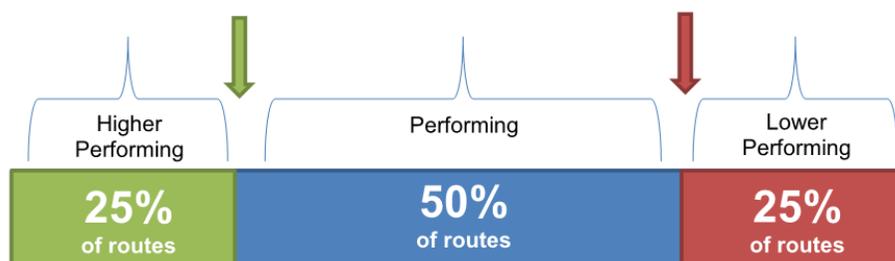


Image source: Valley Metro Transit Standards and Performance Measures (2019)

For under-performing routes, performance improvement actions may include targeted marketing, schedule adjustments, frequency, service span and days of operation adjustments, and rerouting (including route extensions and route segment terminations). The duration of time for routes receiving improvements to demonstrate actual ridership growth was not specified by the agencies; since new transit services are usually granted one to three years to reach maturity, a similar evaluation timeframe should be used for a route receiving improvement actions. Unsuccessful performance improvement actions should be evaluated for potential reinvestment of resources into other services.

Service Modification Tools

For routes in the top or bottom performing quartile, there are tools available, or which can be developed, to further evaluate routes and corridors to understand where service improvements would be most beneficial. For example, Valley Metro developed the Frequency Assessment Standards for Transit (FAST) tool. FAST offers a set of thresholds and guidelines to assess individual transit corridors which are the best candidates for frequent service. The tool also provides a snapshot of how a set of corridors with improved frequencies could function together. The model considers a range of locally calibrated variables correlating with ridership on a route level, such as total population, jobs, network connectivity, minority population, and zero vehicle households. The inputs are normalized, and the resulting percentage ranks the routes amongst each other, highlighting



which routes in the top quartile would see the greatest ridership increases as a result of frequency increases. Since it may not be appropriate to increase frequency on the entire length of a route, the FAST model can also be used for a corridor analysis to identify segments where frequency increases are most beneficial. The full FAST methodology is available in Valley Metro’s Transit Standards and Performance Measures – Procedures Guide.⁸

CapMetro and Sound Transit also noted evaluation requirements to assist in the service modification process, though specific tools and analysis methodologies are not outlined in their TSPMs. Adopting or creating a service modification analysis tool helps ensure strategic and effective investments in transit.

Frequency of Evaluation

The frequency of evaluation ranged from tri-annually to annually; Valley Metro and Sound Transit specifically coordinate the evaluation of services with the agency’s budget process and timeline. Aligning the performance evaluation and budget process enables a smoother planning process and ensures service changes are appropriately managed and approved in the budget approval process. The frequency of evaluation for each fixed-route provider in the CONNECT Beyond region should be coordinated and conducted simultaneously; doing so will enable the region to better align service changes to maintain or improve connections.

Coordinating Changes

Valley Metro holds monthly Service Planning Working Group (SPWG) meetings to address numerous topics including transit technology, fares, service standards, service performance, bi-annual service changes, and the short-range transit plan. The SPWG is made up of Valley Metro staff, as well as local service providers and representatives from each of the surrounding jurisdictions. The monthly coordination discussions ensure the agency is providing effective service and convenient transfers to the greatest extent possible. The meetings also build lasting relationships among transit staff across the region, improving trust and the collective knowledge about operating transit in the region.

The CONNECT Beyond fixed-route providers, as well as community transit providers, would benefit from implementing a similar working group to discuss the findings of TSPM evaluations, modifications to routes, opportunities for improving connections, and any short- and long-term plans which may impact the region. Discussing short- and long-term plans could even garner regional support of ideas and facilitate an expedited implementation process if resources are coordinated appropriately.

⁸ https://www.valleymetro.org/sites/default/files/tspm_procedures_guide_final_10.04.19.pdf



Implementing New Transit Services

CapMetro, Valley Metro, and Sound Transit all have implementation guidelines for new services. CapMetro and Sound Transit do not outline specific thresholds or criteria for introducing new services but require a one-year and two-year trial period, respectively, to allow for full market development and ridership potential. The evaluation of new services requires ridership and cost projections, at a minimum. A Board approval process is also required by all agencies prior to implementing new services.

New Transit Service Implementation Tools

Valley Metro utilizes a transit propensity tool to model performance of new transit services. The multivariate linear regression model estimates ridership by comparing total population, low income population, and no-car household counts to ridership in a corridor. Estimates from this system inform efforts to improve underperforming routes, rank proposals for funding, and establish new service.

CapMetro and Sound Transit also noted proposed new services must be analyzed, though like service modification, the specific criteria and variables used for analysis are not outlined in their TSPMs. Adopting or creating a transit propensity tool helps ensure strategic and effective investments in transit are taking place.

Thresholds

Valley Metro has implementation thresholds established for each service type. New services must be consistent and meet the requirements of the metropolitan planning organization, other agency financial and transit lifecycle plans, and any other regional transportation plans. New services must also be evaluated for their potential performance using TSPM planning tools. **Error! Reference source not found.** provides examples of Valley Metro's new service implementation thresholds by service type.

FIGURE 12: EXAMPLES OF VALLEY METRO THRESHOLDS FOR NEW SERVICE⁹

Service Type	Thresholds for New Services
Vanpool	<ul style="list-style-type: none"> Serves groups of 6 to 15 persons with a common destination Provides a commuter express-type option for limited-demand worksites not necessarily located within one of the top 10 regional employment centers
Demand Response/Flex Route	<ul style="list-style-type: none"> Serves low-density (4 DU/Acre or lower) areas without fixed-route transit service or other available transit service options Can help build future demand for local transit market
Rural Connector	<ul style="list-style-type: none"> Connect a rural community into the regional transit network Based on market demand
Community Circulator	<ul style="list-style-type: none"> Based on market demand Routing structure connects neighborhoods to local or regional activity centers and resources Proposed new routes that are generally less than 10 miles in length that fall below the projected boardings per revenue mile for local service would be a candidate for community circulator standard of service, to help build a future market for transit use
Local	<ul style="list-style-type: none"> Projected boardings/revenue mile > 90% of bottom quartile threshold

Image source: Valley Metro Transit Standards and Performance Measures (2019)

CapMetro’s TSPM does not have thresholds for implementing new service but specifies all new services should meet minimum standards within one year. Sound Transit does not have identified thresholds, except for stops, which should achieve 15 boardings per day. Setting thresholds, even simply “based on market demand” establishes a consistent framework for expanding a transit network system and implementing the appropriate type of service to do so.

Evaluating and Reporting on the Existing Network

As noted, none of the CONNECT Beyond five fixed-route providers have TSPM published on their website; CATS has an internal TSPM document. The three peer agencies TSPM documents were all easily accessible online and clearly outline the baseline services they provide and the established means for delivering those services. The TSPMs also set the framework for evaluating system performance and determining how effectively they are delivering service, where investments are proving worthwhile (or not), and how they are fulfilling FTA requirements as funding recipient agencies. Refer to Table 3 in the Service Basics section of this report for the peer agencies core span

⁹ The threshold for new local service



of service and frequency standards and refer to Table 7 in the Performance Measures section for the full list of performance metrics used by each peer agency.

Regional Transit Inventory and Performance Analysis

A *Regional Transit Inventory and Performance Analysis Report* was developed for the CONNECT Beyond study to analyze the performance of urban, fixed-route service providers and rural, human services providers. The data collected was used to complete a region-wide performance analysis as well as to identify areas for further analysis that can help integrate the service providers into a seamless regional system.

The performance analysis included information from urban, fixed-route service providers (referred to as Urban Services Providers) as well as Community Transportation Providers of rural and human services. The report made the following observations about all providers in the region which fixed-route providers should address through the development and adoption of TSPM:

- On-time performance (actual and goal) is not a standard metric consistently defined or tracked across the region
- There is need for a structured and coordinated approach to collect, store, validate, and manage data pertinent to regional transit planning in order to successfully develop a seamless transit system for the region.
- Establishing a means for knowledge transfer between agencies can improve the understanding of regional transit performance, including performance over time, which can inform the planning process. This information, as well as lessons learned from pilot programs, service modifications, implementing new services, and capital projects, could be put into a repository for all regional agencies to gain insights from.
- If related services are provided by multiple agencies, it is important to establish a clear and separate service data reporting process to avoid double counting of fare revenue and ridership numbers.
- It is important to improve service effectiveness and efficiency through stop-level performance analysis or other performance measures.
- It is difficult to differentiate the performance of express services from local bus service because the data are combined in the NTD.
- There is growing mobility demand in rural areas. If this trend is sustainable, it is important to incorporate these projections into future transportation planning.

During the inventory process it was discovered that not all agencies collect and report the same information consistently, making it challenging to develop recommendations for the entire region that could help improve future transit operations. It's also important that the region continues to



review capital reinvestment backlog and ensure that assets are maintained in a state of good repair; while this is more directly related to Transit Asset Management (TAM) requirements, the condition of buses and facilities affect service efficiency and the user experience as well.

Given the regional context of the exercise, it is evident there is a need for a structured and coordinated approach to collect, validated, and manage data pertinent to regional transit planning. This aligns with the fact that none of the 17 agencies in the study area have adopted TSPM.

Recommendations

As reported in the *Regional Transit Inventory and Performance Analysis Report* there is a need for a structured and coordinated approach to collect, validate, and manage data pertinent to regional transit planning. Without reliable data for each of the service providers, it is impossible to understand the effectiveness of the services provided, make appropriate adjustments to service to improve productivity and efficiency, and plan new services. Implementing TSPM would formally establish a need for collecting data.

Equally as important, creating and adopting TSPM sets clear and consistent expectations for riders about when the system operates and at what frequency they can expect different services. A consistent and reliable network improves the customer experience for transit-dependent riders and paves the way for creating a convenient system which attracts choice-users too. In order to create the foundation of a regional TSPM, it is recommended that the agencies:

1. **Create data gathering protocols.** Invest in staff and equipment needed to plan, develop, and manage a performance-based system.
2. **Establish a governing structure and process for data gathering and analysis.** This same governing structure and process should be used to modify and develop transit services.
3. **Develop regional transit service goals.**
4. **Define regional transit service types.** Establish baseline service standards by transit service type. This should include frequency and span of service by type.
5. **Adopt core network design standards.** At a minimum, this should include providing two-way service, limiting route deviations, avoiding route duplication, and defining an end-of-line turnaround policy.
6. **Develop regional performance metrics.** At a minimum, this should include passengers per revenue hour (or mile; per trip for commuter routes), operating cost per passenger, and on time performance.



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Developing and adopting TSPM appropriate for the region is a key component of the overall strategy to facilitate regional coordination. The agencies in the CONNECT Beyond study area will need to hold a series of workshops to develop regional transit standards and performance measures. Should this not be feasible, the agencies should coordinate and align their standards to the greatest extent possible.



Appendix A – CONNECT Beyond Services Operated by Agency

Agency	Bus	Commuter Bus	Demand Response	Demand Response Taxi	Light Rail	Streetcar Rail	Vanpool
Urban Services Providers							
Charlotte Area Transit System	x	x	x		x	x	x
City of Gastonia Transit	x		x				
City of Salisbury Transit	x						
Rider Transit	x		x				
Rock Hill My Ride	x						
Community Transportation Providers							
Anson County Transportation System			x				
Cabarrus County Transportation Services			x				
Gaston County ACCESS Central Transportation	x		x				
Iredell County Area Transportation System	x		x				
Lancaster Area Ride Service (zone 5)			x				
Mecklenburg Transportation System			x	x			
Rowan Transit System	x		x				
Stanly County Transportation Services – Stanly County Umbrella Services Agency			x				
Transportation Administration of Cleveland County	x		x				
Transportation Lincoln County	x		x				
Union County Human Services' Transportation Division (Union County Transportation)			x				
York County Access Public Service			x				