Comprehensive Plan for Public Transportation

Fixed-Route Service Design Guidelines: Principles, Policies and Performance Standards

As Adopted by:
Board of Directors

FINAL

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Spokane Transit

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Introduction

Over a century of urban transportation system planning reveals the challenges and opportunities faced by those involved in the field. Economic efficiency, operating conflicts with the private automobile and other roadway users, and serving the general public versus responding to individual needs have made the logical assessment and improvement of fixed-route transit a difficult endeavor.

To illustrate this point, in 1919 the Federal government appointed an eight-member panel to the Federal Electric Railways Commission to investigate the challenges then facing operators of streetcars in American cities. The creation of the commission was preceded by several very difficult years for private companies whose transit systems carried millions of Americans each day. Inflation in energy prices, labor shortages, deferred maintenance, and fixed fares were among the many symptoms of these difficult years. While these more notable symptoms seem unrelated to good service design, the findings of the Commission are startling in their applicability to today's planning problems. Some of the findings and recommendations for streetcar companies include: reduction of stops to improve speeds; elimination of service in low-density areas; consolidation of competing lines; adjustments to fare structures to reflect cost variations that can exist between routes, and so forth.[1]

In 1958 a National Committee on Urban Transportation assembled what is likely the first comprehensive standards for transit services and facilities in North America. This document recognized "that [standards, warrants and objectives] must be directly related to the economical feasibility of providing services." Furthermore, it provided standards for routing which list desirable routing characteristics such as: offering directness of travel with respect to origins and destinations; being free of duplication, except where routes converge; including a minimum number of turning movements; and so forth.

In 1982 Spokane Transit adopted its first Service Standards for fixed-route service. The standards included minimum frequencies, hours of service (span), loading, stop spacing and access. Service Planning Guidelines adopted by the STA Board in February 2000 made some modifications to these standards while adding additional guidance on service change procedures and service allocation.

The following document draws from documents highlighted above as well as numerous samples of service guidelines and standards documents from other transit authorities. This document is intended to both express ideals and establish expectations for the design, quality and performance of Spokane Transit's fixed-route system. Ultimately, this document will be subsumed into the Comprehensive Plan for Public Transportation in the relevant plan elements.

The process of creating good transit service is probably new to most readers. However, the practice is similar to that of building a good house. For example, first a builder must ask, "What makes for a good house?" Most people generally agree that a good house should be energy efficient, comfortable, aesthetically pleasing, and protect its inhabitants from adverse weather. These are the principles of

[1] Wilcox, Delos F; Analysis of the Electric Railway Problem; Published by the Author; 1921

building a good house. Second, they ask, "How do I build a good house?" There are many ways to build a house, but construction of good houses must meet important regulations and standards to ensure safety, utility, consistency and proper urban form. These are the policies to follow when building a good house. Finally the builder asks, "Did I build a good house?" This can be measured by calculating energy efficiency, looking for leaks in the roof or analyzing the market value. These are the performance standards used to evaluate the need for remediation. If they didn't build a good house, the builder must revisit the principles and follow the process again. This "understanding, implementing, and evaluating" analogy illustrates the similar process used to create and maintain first-rate fixed-route transit service.

There are three major sections in this document:

Principles-What makes for good service?

This section describes basic principles that affect the design of service, its utility to the public, and ultimately the performance of the route on many different levels. It is not meant to be policy; rather, it is information prepared to communicate to decision makers, customers and other groups interested in transit service the concepts that should be considered to ensure the most benefit is derived from investment in operating fixed-route service.

Figure 1 - Principles

Policies-What guidelines do we follow to create good service?

This section articulates draft policy, based on principles and impending discussion by policy makers, that defines transit network architecture, extent and service levels for fixed-route transit service. Issues of frequency of service, span (hours of operation), public input and geographic extent are determined in policies to ensure consistency in service modifications, enhancements and reductions.

Figure 2 - Policies

Performance Standards-Did we build good service?

This section proposes three primary standards that when not met result in evaluating alternatives for remediation. This may include routing changes, service reductions, or adjustments to related routes. The performance standards measure route performance based on ridership productivity, farebox recovery, and vehicle loads as it relates to the energy consumed for transporting passengers.

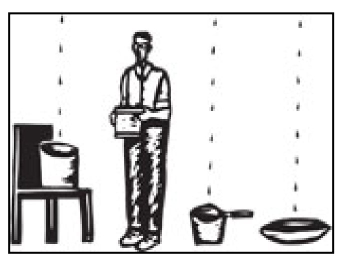

Figure 3 - Performance Standards

Service Design Principles

The principles listed below provide guidelines for ensuring the most benefit is derived from investment in operating fixed-route service. Adherence to these principles grows in importance as demand and service expand. Smaller transit systems can afford, with relatively little risk, to design systems outside of the recommended principles below. Larger systems, such as STA, cannot afford the same luxury.

1. Network

Routes should be designed in the context of other routes and transit facilities.

No route is an island. Designing routes within the context of other routes and transit facilities provides for sound transit networks.

2. Independent Utility

Routes should be designed to access a mix of uses and have utility independent of transfers.

While route design should reflect network integration, each route should be developed to have utility independent of transfers. For instance, the notion of trunk and feeder suggests that feeders are dependent upon a trunk for utility and therefore taking people to a transit center or park and ride is adequate. STA's experience with such route has shown that they are suboptimal. While in most cases riders will transfer, a route that "feeds" a major line should access a mix of uses so that there are trips that could be served on the line without a transfer.

3. Generalized Service versus Specialized Service

Route design should focus more on generalized service, rather than specialized service, for greater ridership gains based upon equivalent capital investments.

Generalized service is that service which provides service for most of the day and can be folded into the travel patterns of a multitude of users for many different purposes. Specialized service seeks to go out of its way to reach the front door of a specific employer or housing facility; is scheduled around specific work shifts; or, is limited to peak travel times. In most cases, the more specialized a service, the less capital intensive it should be. In the majority of cases, capital and operating investments in generalized service will result in greater ridership gains over comparable major capital investments in specialized service.

4. Multiple Destinations

Generalized service routes should be designed to serve multiple origins and destinations.

A generalized service route should serve multiple origins and destinations. While a downtown area will produce higher trip demand than many other destinations, ensuring a route has intermediate destinations allows for greater seat turnover and utility to riders.

5. Route Terminals

Routes should be designed with anchors in activity centers with healthy mixes of jobs and housing.

Routes should be anchored in activity centers, ideally with a mix of jobs and housing. As much as possible, routes should not end in low density environments. Without proper anchors a route will chronically be empty at the end of the route and serve fewer people.

6. Interlining of Routes

Routes should be designed to interline with other routes, rather than terminating in major activity centers, such as a central business district (CBD).

It is common practice to radiate routes from a CBD. While it may support defining a route's destination, it provides less mobility than continuing through downtown, either after a pause and/or route number change, or as a singular route. Interlines should reflect utility to the rider; routes that are interlined and serve the same general geography or quadrant of the city (so the bus is effectively turning around downtown) are generally not useful to riders.

7. Route Length

Routes should be designed to be as long as practicable without being wasteful, unreliable, or inoperable due to the lack of recovery opportunities.

The longer a route, the more opportunities there are to match origins with destinations without requiring a transfer. This results in a higher load at any given point on a route. Ideally, no route should be less than two miles in length.

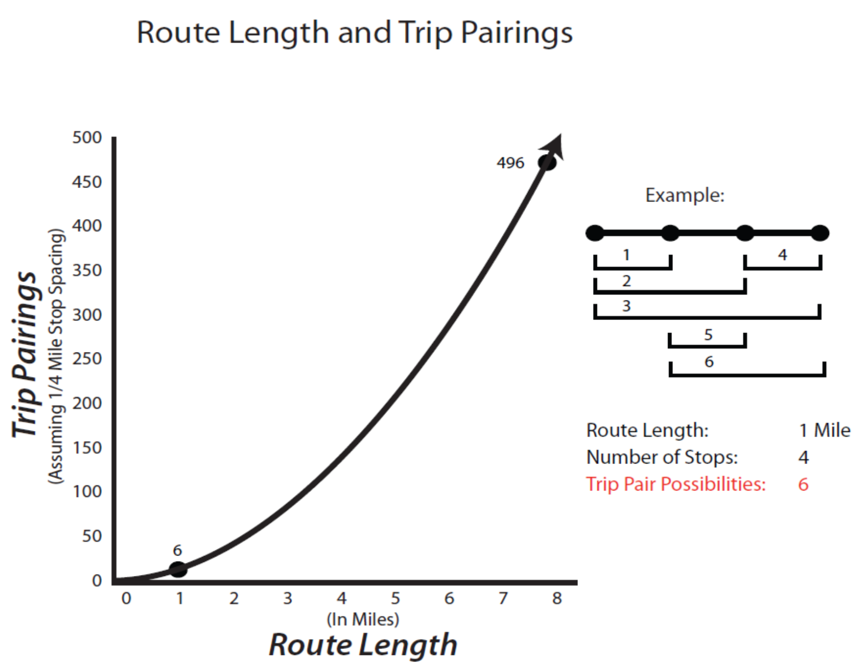

Figure 4 - Route Length and Trip Pairings

8. Arterial Travel

Under most circumstances, routes should be designed to travel on arterials.

Travel on arterials generally provides a good balance between speed and access. Appropriate exceptions include the following: to accommodate route terminals where off-arterial travel is necessary to turn around; an alternative to a segment of arterial where grades or other inherent conditions prohibit regular transit operations; or, where a non-arterial street has been designated as a special transit corridor with enhanced and/or exclusive infrastructure that is amenable to transit operations.

9. Speed versus Access

Routes should be designed specific to the speed and access needs of the areas/populations they serve.

While people may prefer the fastest way between two points, point to point (non-stop) service is not available at a scale that would match the ubiquity of the automobile. Adding more access (i.e. pick-ups and drop-offs) can increase utility but can also reduce the service utility for some riders. Generally, access must decrease in order to increase speed.

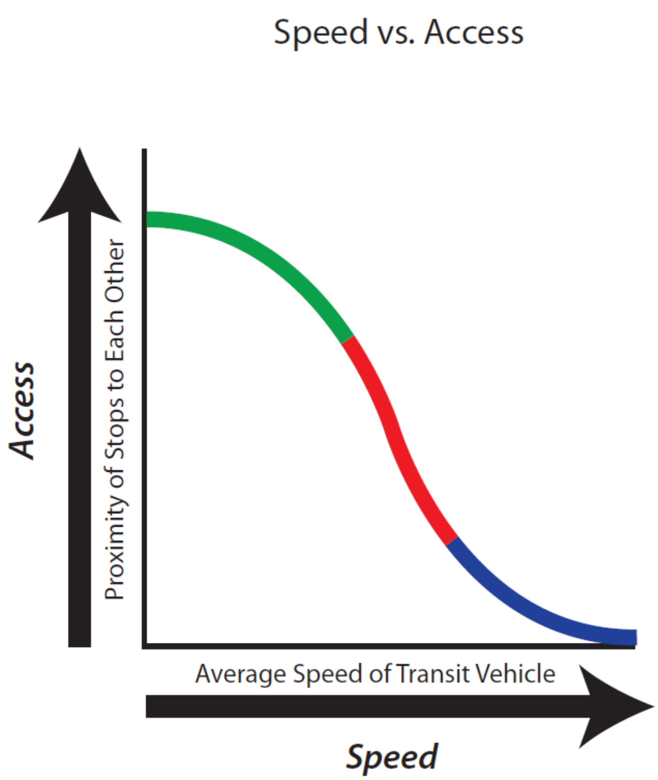

Figure 5 - Speed vs. Access

10. Convergence of Routes

Routes should be designed to converge on higher density centers and corridors to increase frequency and facilitate short, spontaneous trips.

When approaching on higher density centers and corridors, such as a CBD or university campus, it is appropriate for routes to converge such that the combined frequency increases the capacity and quality of service. Focusing service on a common pathway can allow for very high frequencies that facilitate short, spontaneous trips that would otherwise not opt for transit as a preferred mode.

11. Route Spacing

Parallel routes should be spaced far enough apart so that service is not duplicative.

Numerous transit studies have shown that people will walk up to ¼ to ½ mile to catch a bus or train. In most cases spacing of a minimum of ½ mile eliminates unnecessary duplication of service and simplifies the decision-making process for riders. It also tends to enable higher frequencies on a single corridor rather than a dilution of service over many streets.

12. Loops and Circles

Under most circumstances, routes should be designed to avoid loops and circles.

People generally prefer the most direct path between any two points. Providing a circular path, especially in a one-way fashion, can add cost and reduce the attractiveness of service. Some small loops that operate at route terminals or very large two-way loops where the circumference is sizable so that most riders will travel in a straight line or only a medium-sized arc about the loop may be appropriate.

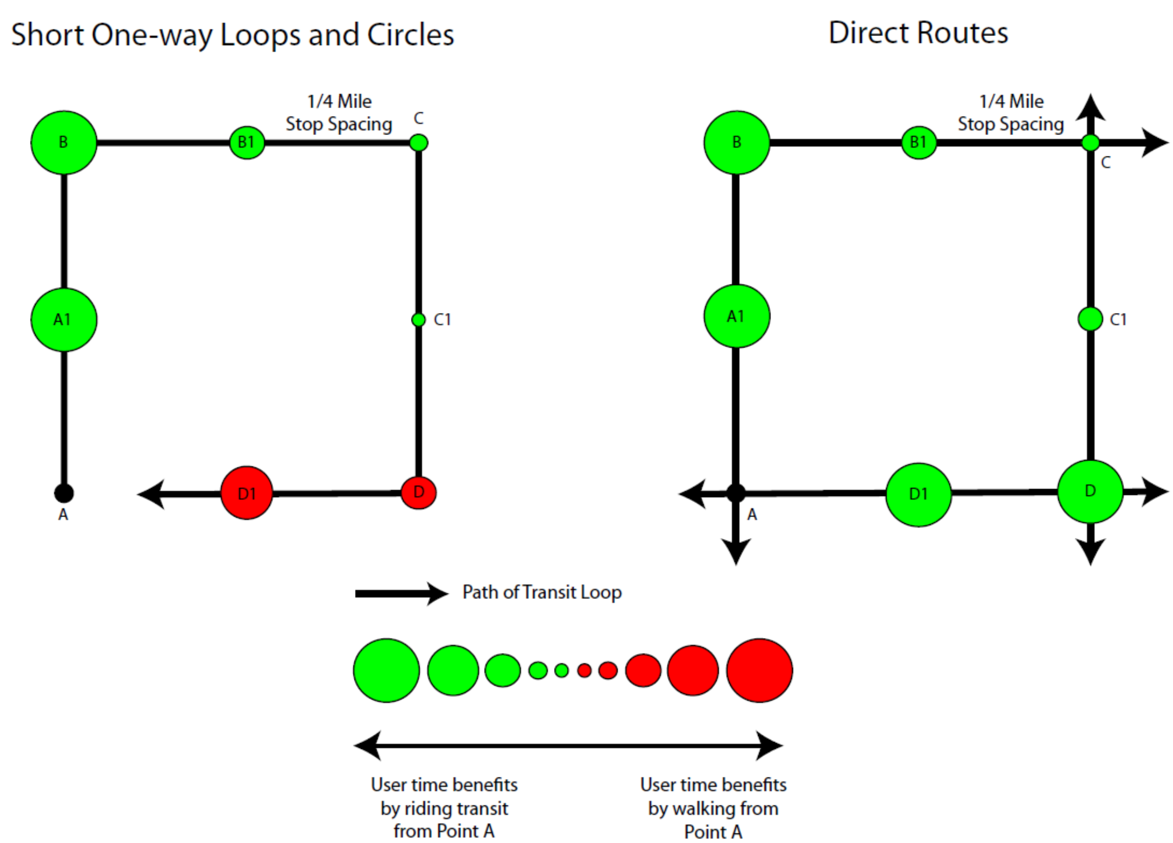

Figure 6 - Loops and Circles

13. Opportunity Cost and Change

Route design should focus more on providing good service and network design, rather than ridership preservation, to increase overall ridership.

Reallocation or restructuring of service to better fit good service and network design will without fail result in increases in ridership. Despite this opportunity, there will always be pressure to maintain current service in order to preserve current riders' travel habits. Hence, ridership growth will always be pitted against ridership preservation.

Service Design Policies

Introduction

This section articulates policy, based on principles, that defines transit network architecture, extent and service levels for fixed-route transit service. These policies are intended to ensure consistency of existing service and for service modifications, enhancements and reductions as well. The policies may be used by citizens, staff and elected officials for the purposes of decision making, maintaining consistency, and network/route building Guidelines. The following policies can be classified in two categories. The first set of policies can be applied to the system as a whole. The second set of policies is route specific. The existing network, routes, and all proposed route changes should be in compliance with all of the policies to the greatest extent practicable.

Table 1-Policy Summary

Policy Summary	
System-wide Policies	
P-1.0 Major Service Types	These policies define the types of service found in the fixed-route network.
1.1 HPTN	This is a network of routes selected for higher capital and operating investment.
1.2 Basic	This is the basic service level STA provides.
1.3 Commuter Peak	This service is focused on peak demands for specific travel markets.
1.4 Basic Service in Transition	Incremental investments in basic service that overlays proposed HPTN routes may take place over time.
P-2.0 Service Allocation	These policies identify targets for the allocation of service across service types and geography.
2.1 Geographic Extent	This policy defines the necessity of geographically extending service to serve the urbanized areas.
2.2 Service Type Allocation	This policy defines the minimum and maximum percentage of revenue service hours allocated to each service type.
2.3 Geographic Allocation	This policy defines the minimum requirements for serving each travel shed within the PTBA.
2.4 Service Partnerships	This policy defines the reimbursement requirements of contracted service requests.
P-3.0 Service Span	The Service Span policies identify target hours of operation during each day of the week.
3.1 Basic System Hours	This policy defines the system operating hours requirements for regular basic service.
3.2 Extended System Hours	This policy defines the system operating hours requirements for the HPTN.
Route-Specific Policies	
P-4.0 Headway	This policy defines the maximum headways for service by type.
P-5.0 Stop Spacing and Placement	This policy states guidelines for stop placement and defines the maximum and minimum distances for stop spacing by service type.
P-6.0 Route Numbering	This policy defines the standard numbering system for all routes.
P-7.0 Service Change Decision Making	This policy outlines the staff, board, and public involvement for policy changes.

P-1.0 – Major Service Types

Spokane Transit has three major types of fixed-route service: High Performance Transit Network (HPTN) Service, Basic Fixed Route Service, and Commuter Peak Service. HPTN and Basic service types are generalized service that are designed to serve the greatest number of people within the region's geographic area and STA's financial limitations. Commuter Peak is a specialized service focused on attracting and accommodating peak demand travelers to employment and education centers. The following descriptions describe a basic policy framework on which the attributes of each service type is constructed.

1.1 – High Performance Transit Network Service

This generalized service is intended to be considered full-time service, operating in two directions. Frequency generally supports spontaneous travel because of relatively high frequencies. The HPTN routes are in major corridors where there is sufficient ridership to justify significant investments in passenger amenities and information. At this stage, three service sub-types – Green, Red, and Blue(See P-5.0 and P-6.0) – have been identified to reflect appropriate distinctions in speed, service frequency, and access (distance between stops) for each route or family of routes. At some stage, these service sub-type names may be replaced with more descriptive branding names. A specific route in the HPTN service typology is considered an HPTN Corridor.

1.2 – Basic Fixed Route Service

This is the basic service level STA provides as general purpose service. It is intended to be sufficient enough to meet basic demand that exists in an area served while still being robust enough to meet many purposes throughout each day. For the purposes of service attributes of frequency and stop spacing, Basic Fixed Route Service is classified into two types: Basic Urban and Basic Interurban.

Basic Urban meets travel needs in urbanized areas where the average passenger trip length is less than or equal to three miles long. Basic Interurban provide service between urbanized or suburban areas, possibly traveling through semi-rural areas, where the average passenger trip length is more than three miles in length. The rationale for this distinction at three miles is based on the premise that service should generally be more frequent than a walking alternative. That is, if the average passenger can arrive at their destination within the same time as the full wait time in between trips by walking, the service becomes substantially less attractive. This distinction also reflects the financial aspects of basic service: 1) longer routes typically require more operating cost to achieve the same frequency as shorter routes and 2) at an equal fare for all basic routes, the longer a passenger trip, the more favorably transit compares to the operating costs of the automobile.

1.3 – Commuter Peak Route Service

This is a service that is focused on premium/express service to a major employment/education center on weekdays at periods that are considered peak for the destination. Such routes are typically one-way in each peak. It may be anchored by a park and ride facility or have a collection segment through residential areas before traveling limited stop to the employment/education center.

Commuter Peak routes should provide no less than five trips per peak in order to be adequate enough to provide for a range of start and quit times for various employees. The exception to this rule would be peak routes that are provided by using buses that would otherwise be out of service (deadheading routes). These routes should provide at least three trips per peak and are considered “Commuter Peak – Subordinate” routes for purposes of performance standards. Service headway for all Commuter Peak routes should be no more than every 30 minutes.

1.4 – Basic Service in Transition

Basic Service routes that coincide with identified High Performance Transit Network Corridors for the majority of route miles should be the focus of incremental investments in increased frequency and hours of service (span) as well as investments in reliability treatments and enhanced passenger amenities to provide an incremental investment in the High Performance Transit Network. At such time a Basic Service route is more like the HPTN corridor than Basic Service, route branding and communications should transition to reflect to the user the higher quality and quantity of service provided.

P-2.0 – Service Allocation Policies

Transit agencies generally provide a service allocation policy to guide transit planning and support the agency’s mission and goals. Common policies in other communities relate to geographic extent of service, spatial distribution of service among geographic partitions of an agency’s service area, and distribution of operating outlays among service types. The Spokane Transit service allocation policy will include a hybrid of these three methods.

2.1 – Geographic Extent

Proposed Policy: Basic or HPTN service should be available within no more than ½ miles distance of at least **85%** of the PTBA population residing within urban areas. Urban areas are defined as the Spokane “urbanized area” (UZA) and “urban clusters,” as defined by the last available US Census.

Discussion: This policy recognizes the need to be geographically extended in order to be accessible and functional for the traveling public. It also highlights the position that fixed-route is a service made functional because it serves urban areas. While rural areas will likely have some service, this service is incidental to a route’s design. Using census data and geographical definitions, this policy can be measured.

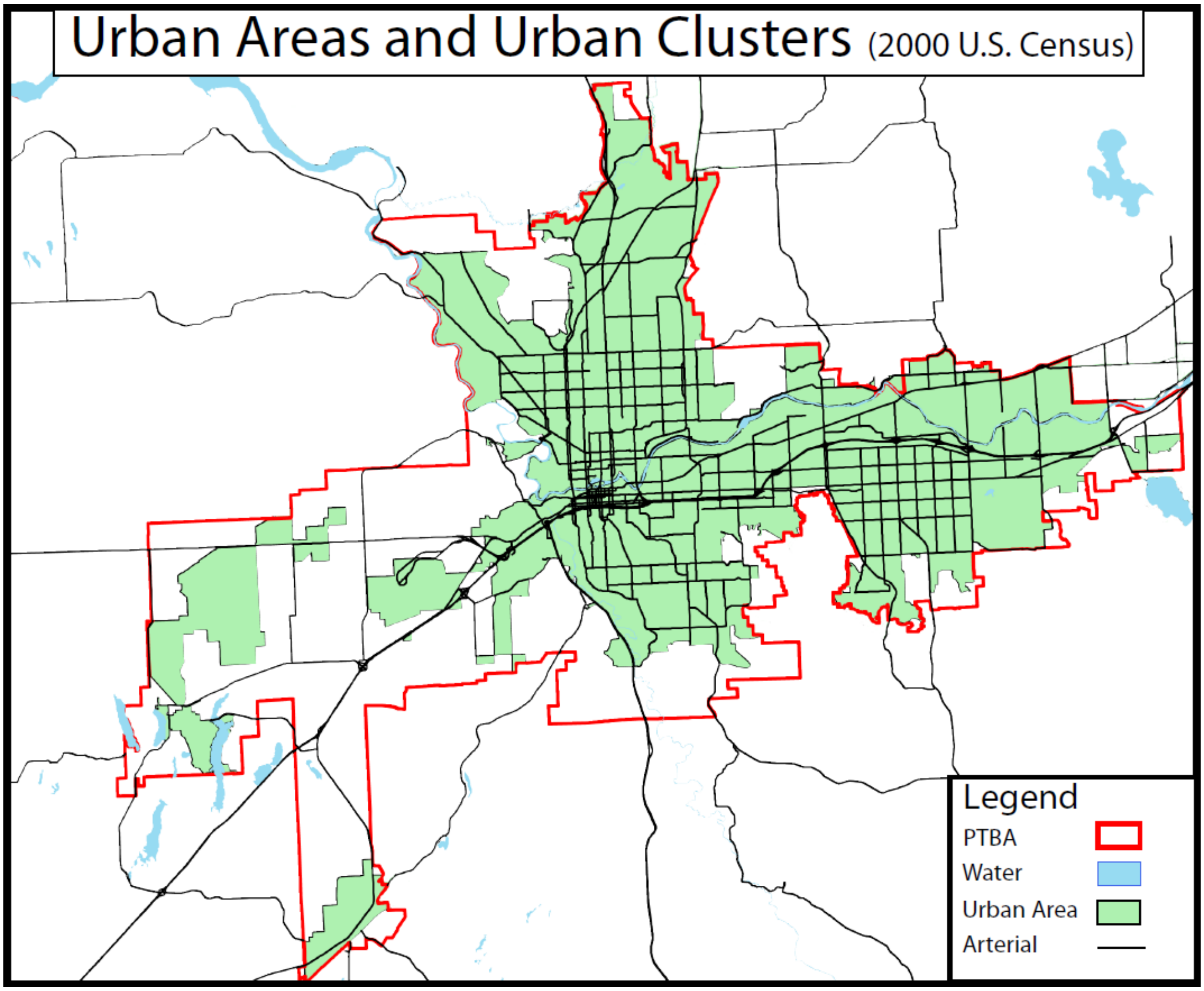

Figure 7 - Urban Areas and Urban Clusters within the PTBA

2.2 – Service Type Allocation

Proposed Policy: The following minimum and maximum allocation rates are considered ideal:

1) No more than **15%** of annual fixed-route revenue service hours should be allocated to Commuter Peak service.
2) No more than **50%** of annual fixed-route revenue service hours should be allocated to HPTN service.
3) At least **35%** of annual fixed-route revenue service hours should be allocated to Basic Service.

Discussion: Past practice has included "blend formulas" that specified a precise percentage distribution among service types of "productivity, coverage and equity." This sort of policy is neither practicable nor desirable. Rather than being a strict formula for distribution among service types, the proposed policy is intended to provide checks and balance to service planning and implementation. Constraining the extent of Commuter Peak and HPTN service types is reasonable given their higher capital investment requirements compared to Basic service. Maintaining at least 35% of the service as Basic Service ensures coverage to areas that do not justify HPTN or Commuter Peak service. While current routes have not been developed with the three major service types in mind, existing service reflects the following make-up: 93.8% Basic Service; 5.7% Commuter Peak; and, 0.5% undefined service.

2.3 – Geographic Allocation

Proposed Policy: The following allocations of service should be observed in allocating service among Travel Shed Partitions:

1) Each Travel Shed Partition should have at least **one** Commuter Peak route originating within the partition so long as it meets service performance standards.
2) Within **10 years** of implementation of the first HPTN corridor service, HPTN service should operate within each travel shed partition.

Discussion: Travel Shed Partitions will be defined as a service design tool in meeting this criteria. Conceptually these will be defined as North, South, East and West Plains. The intent of the partitions is to ensure a geographic distribution among high quality service types. Partition boundaries should not be defined by municipal boundaries; neither should tax revenues raised in a partition determine service provision. Rather, the partitions are merely for grouping component travel needs in order to ensure a minimum level of need satisfaction.

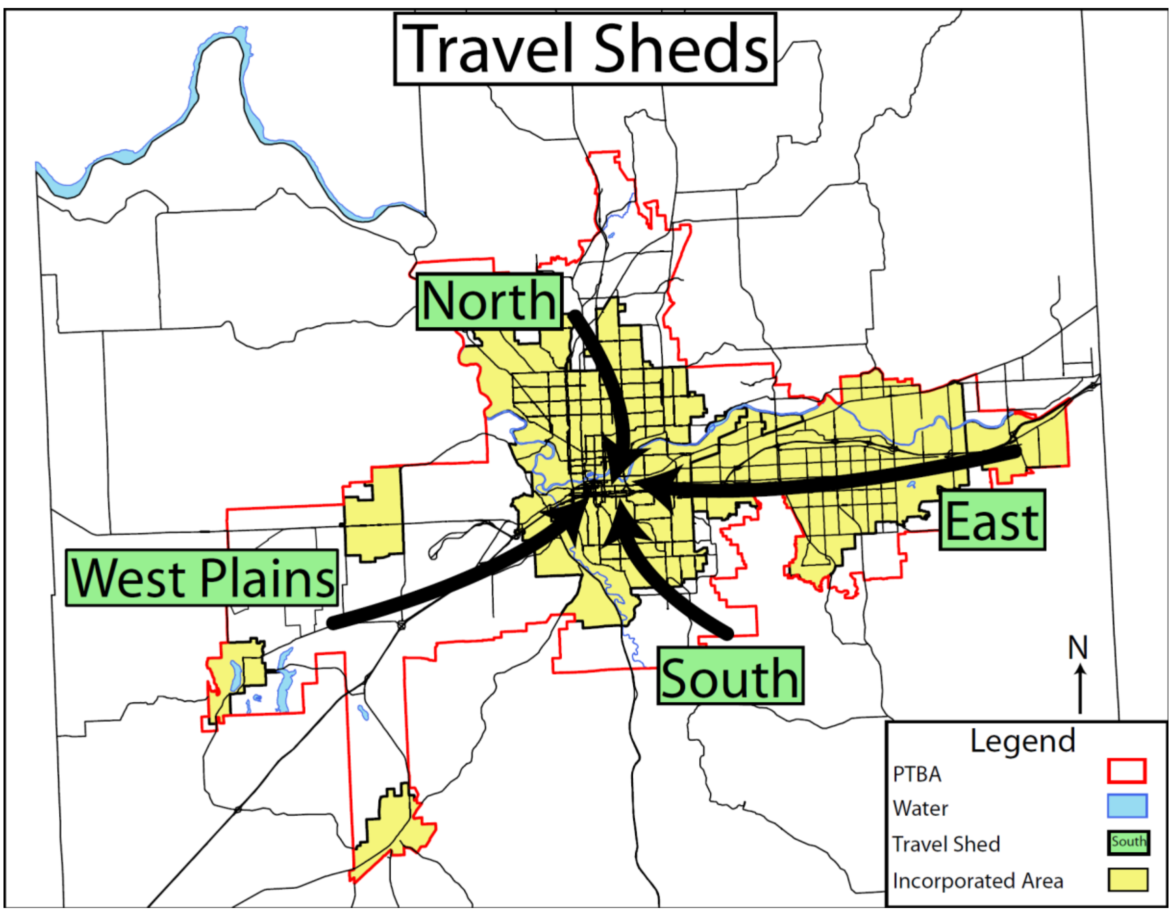

Figure 8 - Spokane Transit Travel Sheds

P-3.0 – Service Span Policy

3.1 – Basic System Hours of Service (Span)

Proposed Policy: The extent of each day in which the basic system is in operation is as follows:

Table 2- Basic System Span

Day	Span
Weekdays	6 am to 11 pm
Saturdays	6 am to 10 pm
Sundays/Holidays	8 am to 9 pm

3.2 – HPTN System Hours of Service (Span)

Proposed Policy: The extensive period of each day where service is provided which is greater than the Basic System Span for the purposes of the HPTN is as follows:

Table 3 - HPTN System Span

Day	Span
Weekdays	5 am to 1 am
Saturdays	6 am to 12 am
Sundays/Holidays	6 am to 10 pm

P-4.0 – Headway Policies for HPTN Service/ Basic Service

The following headways are maximum intervals considered acceptable for the various general purpose fixed-route service types. The definition of Peak, Base and Sub-base periods are relative to the travel demand, but generally Peak is between 6:30 am and 8:30 am and 4:00 pm and 6:30 pm on weekdays; Base is the period between weekday peaks as well the outside shoulders of Peak travel times; and Sub-base is late-nights and weekends.

Table 4 - Headway Policies

Service	Maximum Headways (minutes)			
	Span	Peak	Base	Sub-base
HPTN – Green	Extended	10	12	15
HPTN – Red	Extended	12	15	30
HPTN – Blue	Extended	15	30	60
Basic Urban	Basic	30	30	60
Basic Interurban	Basic	60	60	120

P-5.0 – Stop Spacing and Placement Policies

The fixed-route service stop defines whether service is provided in a geographic area. The optimal placement of stops plays a critical role in customer access, service reliability and system performance. Past practice has encouraged the proliferation of stops with the view that the biggest hurdle to increased transit patronage was that people lacked access to transit within a convenient walk. The result is that there are instances in STA's service area where one bus in service may stop more than once on the same block face. The proposed stop spacing policy recognizes the influence access has on speed and ridership. Research and service design changes in other transit markets have taught the following lessons: 1) people are willing to walk greater distances (1/2 mile or more) for higher quality service and 2) stops closer than one-quarter mile generally don't provide more ridership; in most applications, ridership has grown after stops have been eliminated to meet a greater average distance between stops.

Table 5 - Stop Spacing Policies

Service	Average Stop Spacing	Minimum Stop Spacing	Maximum Stop Spacing
HPTN – Green	¼ mile	1000'	1500'
HPTN – Red	½ mile	1300'	8000'
HPTN – Blue	2.5 miles	5000'	N/A
Basic Urban	¼ mile	800'	1500'
Basic Interurban	½ mile	800'	N/A

Placement of a stop should consider the following:

1) Relationship to high demand destinations
2) Proximity to intersecting routes and transit facilities
3) The ability for users to safely access the stop from both sides of the street
4) The ability for the bus to efficiently and safely re-enter general purpose traffic

Where considerations 3 and 4 negatively impact the ability to place a stop considered due to 1 and 2, STA will work with the appropriate jurisdiction to provide a solution.

P-6.0 – Route Numbering Policy

The following policy provides Guidelines on a numbering system for all fixed-routes. A survey of various transit systems suggests that organizing route numbering series by service types and common geography (destination-based or travel-shed-based) are the most prevalent numbering logics outside of simple sequential numbering. A clear numbering system helps users to make effective travel choices based on the service characteristics which are most important for their particular transportation needs.

STA routes are grouped in series with the first digit reflective of either common geographical attribute or common service characteristic (service type). As a policy, HPTN routes, Basic Service in Transit, and

Commuter Peak service should be in series reflecting service type while Basic Service can be grouped by common geography. To avoid confusion, no route number should conflict with a numbered Washington State highway passing through the PTBA. Any reintroduction of a route number on a substantially different route than its prior identity should occur after no less than two years of non-use.

Colors and letters can also be used to distinguish HPTN or specialized routes. The use of colors and numbers, when introduced, should fit within a systems-approach to service communication and branding.

Service Performance Standards

Standards imply accountability, comparison and remediation in the event of non-compliance. Standards should be straight-forward and derived from a rational, transparent basis. The performance standards set forth herein are directly related to the effectiveness and sustainability of STA's fixed-route system. These performance standards reflect a triple bottom line (TBL) approach that seeks to improve the system's performance as it relates to its riders, the environment and the tax payers. Literature on the subject of triple bottom line refers to People (social), Planet (environmental) and Profit (economic) as the primary metrics for evaluating agency performance.

Performance Standard 1: Ridership (Social)

Ridership is a basic indication of a transit route's effectiveness in serving people. There may be a great community dialogue about serving a particular facility, geography or community, but if the result is a route that has little or no ridership, clearly this goal is not met. It may be that the service is designed poorly or that densities don't justify fixed-route bus service. Only by having a minimum performance standard can these routes be fairly evaluated and remediated.

Productivity is a measure of riders per revenue hour and is used as the framework for the ridership standard.

Basic Routes Proposed Ridership Standard

For Basic Fixed-Route Service in Spokane the best indicator of potential performance is a route's relation to the CBD. A route that ties into downtown has more connectivity than other routes. Furthermore, it must meet a higher expectation due to the fact that the downtown Plaza has a finite number of bus bays and overall capacity. Accordingly it should be focused on routes with a higher level of effectiveness in terms of ridership. The annual performance standard is produced based on the most up-to-date actual annual riders per annual revenue hours figure. For routes traveling into the CBD, the performance standard is **one-half the standard deviation below** the average of the basic routes traveling into the CBD. For all other routes, the standard is precisely one-half this number. By necessity this standard will need to change after substantial changes to the system have been such that one-half the standard deviation is less than 10% of the average ridership productivity. At this time, routes traveling into the CBD that are **one standard below the standard deviation** will be considered inconsistent with this performance measure.

HPTN Ridership Standard

The High Performance Transit Network has only a slightly higher standard level since the increased frequency should result in greater frequency but may not necessarily rise to a productivity level significantly greater than the entire system. As a starting point, the high performance transit network routes should be **one-half standard deviation above** the average basic route productivity of similarly situated routes (i.e. that travel to the CBD). For routes that do not travel in the CBD, the standard is one-half the productivity rate for HPTN routes that travel in the CBD.

Commuter Peak Ridership Standard

From a performance evaluation perspective, Commuter Peak Routes have the benefit of not being in operation in off-peak times when travel demand is lighter. However, peak routes are very capital consumptive in terms of rolling stock and facilities because they only operate six to seven hours per day, increasing the capital cost per passenger. A bus that carries passengers for 12 hours in a day amortizes the capital costs of that bus over more hours of service are spread to many users over 12 years of such use. For this reason the productivity expectation for Commuter Peak routes should be equal to the HPTN. For routes that operate as a function of what would otherwise be out-of-service time on a route ("Commuter Peak Route – Subordinate") the standard is equal to one-third the productivity of other Commuter Peak Routes. This reflects the reality that a bus serving passengers in the opposite direction of peak demand will have lower ridership and yet is typically better than operating out of service and providing no transportation benefit.

The performance standards for 2007 and 2008 are illustrated below. Please note that the HPTN standard is developed on system-wide data not yet applicable for 2007 and 2008 since no HPTN service is in existence.

Table 6 - Standard Riders per Revenue Hour by Service Type

Service Type	Grouping	2007	2008
Basic	Intersects CBD	22.08	25.45
Basic	No CBD intersection	11.04	12.73
HPTN	Intersects CBD	29.84	33.95
HPTN	No CBD intersection	14.92	16.97
Commuter Peak	Dominant	29.84	33.95
Commuter Peak	Subordinate	9.95	11.32

Performance Standard 2: Equivalent Energy Consumption (Environmental)

Since the 1970s, there has been recognition of the value of mass transit as it pertains to environmental sustainability and energy conservation. Often missing from this recognition are any measurable outcomes other than car trips avoided. Because they are larger and heavier, transit vehicles actually consume more energy per vehicle mile traveled than private automobiles. In order to reap any benefit as it pertains to energy consumption, looking at energy consumed per passenger mile is the easiest to obtain and likely the most effective in measuring outcomes. British Thermal Units (BTUs) are commonly used for similar metrics and will be used here.

A minimum standard for BTUs per passenger mile is useful in evaluating the performance of routes in a different way than the previous standard. While productivity measures gross riders, the "BTUs per passenger miles" metric speaks to the duration of passengers' time on the vehicle. BTUs per passenger miles speaks to energy consumed for a particular vehicle type given a particular trip pattern.

At the very minimum, a bus route should perform equally to the private automobile in terms of energy consumed per mile traveled for each passenger. Assuming a load factor of one person in an automobile and current fuel economy (http://cta.ornl.gov/data/download28.shtml), there are 5,500 BTUs consumed for every single-passenger mile traveled in a car. While routes will have trips that can exceed this consumption rate, no route should be worse than an automobile when judged from the cumulative service provided. Translating these consumption rates to buses by size of bus requires looking at average fuel consumption of each major vehicle type in STA's fixed-route fleet as opposed to actual consumption on a route-by-route basis.

The performance standard for energy expressed in passenger miles over platform miles is found below. The numbers are for diesel vehicles. The numbers below are established given fuel economy of the existing fleet and its comparison to private automobiles. Average load factor, or passenger miles divided by platform (vehicle) miles provides information on how many people are served for every mile of travel. As new propulsion sources come online this table should be amended to reflect those sources. Carbon-based fuel sources have different concentrations of energy. Electrified systems use generally less energy and therefore may have a different ratio which would be a minimum standard in the event that such vehicles are added to the STA fleet.

Table 7 - Energy Standards Expressed in Passenger Miles over Platform Miles (Load Factor)

Vehicle Size	Basic	Commuter Peak (Dominant Only)	HPTN
Cutaways	2.84	4.45	4.45
30'	5.35	8.39	8.39
35'	5.16	8.10	8.10
40'	5.48	8.60	8.60
60'	6.65	10.45	10.45

Performance Standard 3: Fares (Economic)

An important performance indicator for medium-sized to large-sized transit systems is fare revenues. While small agencies often find that the cost of collecting fares is equal to or exceeds the fares potentially collected, STA collects millions annually from its riders for services rendered. Farebox recovery for this performance standard is the total fixed-route revenue collected as a percentage of the total fixed-route operating cost. It is valuable as a metric since both fares per passenger and cost per hour are not equal for every route. Two routes may have exactly the same ridership but have different farebox recoveries. Routes using larger vehicles traveling longer distances in an hour will cost more to operate. Without a corresponding increase in fares per passenger, farebox recovery is likely to be lower than the comparable route.

As a minimum standard of performance, routes shall have a farebox recovery no less than one-half the system average.

Performance Reporting

By April of each year, the Planning Department will report on the performance of each route for the previous two years along with the standards that applied for those years. Any route that falls below the minimum standard for any one of the three performance standards for two years consecutively will be considered out of compliance with the standards. A partial year of operation (e.g. if a route begins operation in September) will not be counted against a route’s compliance with these standards. This provides for at least two and not more than three years for a route to mature before any corrective action is required.

The annual report will offer reasons why the route may be below standard and offer preliminary concepts for remediation.

Remediation

Remediation is not simply about eliminating poor performing routes, but instead considering the routes relationship to the network as well as other possible network changes that will ultimately improve the entire network. Remedial actions should take place no less than 18 months following a performance report indicating non-compliance.

Non-compliance of routes with respect to performance standards is typically an indication of a route being designed inconsistent with the design principles or adopted service design policies. There may also be changes in land use (e.g. a major mall closes indefinitely) or changes in the network which unintentionally deteriorated service or demand. Remedial efforts should identify how proposed improvements will better align with design principles, adopted policy and provide a rough projection of the relationship to performance standards.

Glossary of Terms

Access: The opportunity to board a transit vehicle.

Alighting: A single passenger getting off of a transit vehicle.

Anchor: The end of a transit route.

Arterial: A main road with controlled access.

Boarding: A single passenger getting on a transit vehicle.

British Thermal Unit (BTU): The amount of energy required to raise the temperature of 1 lb. of water 1 degree Fahrenheit.

Deadhead Time: The scheduled time spent driving to and from the vehicle's base or between trips on different routes. During this time, the transit vehicle does not allow new passengers to alight.

Feeder: A route or part of a route that brings passengers to a significant transit line.

Frequency: The number of transit vehicle trips in the same direction of travel within a specified time period. Frequency is referred to as the number of trips per hour or by the number of minutes between single trips.

Headway: The time between two vehicles passing the same point traveling the same direction on a transit route.

Inbound/Outbound: Every bus trip is classified as an "inbound" or "outbound" trip depending upon the direction the bus is heading. Generally, inbound trips head toward the major market being served by the route. Outbound trips head away from the major market being served.

Interline: A transit route that continues on as a different numbered route after reaching a transit hub.

Layover/Recovery Time: The scheduled time spent at a route's terminal between consecutive trips by a single bus.

Load: Number of passengers on a transit vehicle.

Load Factor: The ratio of the number of passengers in a vehicle to the capacity of that vehicle. For example, if a transit vehicle has 100 seats and 40 seats are filled, the load factor is 0.40 or 40%.

Passenger Mile: One unit is equal to one mile traveled per rider.

Platform Hour: The number of hours buses are on the road for a given route. This includes revenue time, layover time and deadhead time.

Platform Mile: The distance a bus travels for a given route. This includes revenue miles and deadhead miles.

Revenue Hour: The number of hours buses are operating scheduled trips for a given route. This time does not include layover or deadhead time.

Revenue Mile: The number of miles buses travel during scheduled trips for a given route. This does not include deadhead miles.

Ridership: The number of passengers who ride on a particular transit route or the entire system.

Terminal: The location where a transit route begins or ends.

Transfer: Occurs when a passenger must change buses in order to complete their trip.

Trip: A single passenger movement from their origin to their destination, possibly including several rides.

Trunk and Feeder: A trunk and feeder system uses resources to bring riders from weaker transit markets to a strong transit corridor.