



SOUND TRANSIT

HCT Planning

Sound Transit Long-Range Plan Update

Issue Paper N.1: BRT on SR 99

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Sound Transit

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FINAL

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Foreword

This issue paper is part of a series of reports designed to inform the Sound Transit Board in its decision-making on the Regional Transit Long-Range Plan update for the Sound Transit service area. Each issue paper provides information about a specific element or area of the Long-Range Plan and potential options. These reports focus on issues such as costs, ridership, engineering feasibility and operations.

The environmental impacts of the updated Long-Range Plan and Options, as well as potential mitigation measures, are examined in the Draft Supplemental EIS for the Regional Transit Long-Range Plan (December 2004). The Draft SEIS supplements the 1993 EIS prepared on the Regional Transit System Plan, and it generally updates that information and analysis through the year 2030. Public and agency comments on the 2004 Draft Supplemental EIS have been received and will be responded to in a final SEIS to be issued in June 2005.

The Sound Transit Board anticipates identifying a draft updated Long-Range Plan in the spring of 2005. There will be an opportunity for public review and comment on the draft Plan. The Board will adopt a final updated Long-Range Plan after public comments are received on the draft plan and the final SEIS is issued.

References in these reports to Sound Transit's existing Long-Range Plan are to the 1996 Regional Transit Long-Range Vision, which functions as the agency's Long-Range Plan. Discussion of the updated Long-Range Plan refers to the Plan being developed by Sound Transit over the coming months.

The following issue papers are being prepared:

East Corridor

E.1 – I-90 Corridor / East King County High Capacity Transit Analysis

North Corridor

N.1 – BRT in SR 99 Corridor

N.2 – I-5 Corridor Northgate to Everett HCT Assessment

N.3 – Seattle Streetcar Options

N.4 – SR 522 Corridor HCT Assessment

N.5 – Convertibility of BRT to Light Rail

South Corridor

S.1 – Tacoma Link Integration with Central Link

S.2 – Potential Rail Extensions to Frederickson and Orting

S.3 – HCT System Development Issues in the South Corridor

S.4 – Potential Tacoma Link Extension – West

S.5 – Rail between Burien and Renton

S.6 – Potential Tacoma Link Extension – East

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1. Introduction and Summary

1.1 *Purpose of this Paper*

As part of the process of updating its Long-Range Plan, Sound Transit is considering whether or not to include Bus Rapid Transit (BRT) on the SR 99 corridor in the Plan. SR 99 is currently designated as a regional express corridor in the Long-Range Plan, but has not yet been implemented. Community Transit and King County Metro are working to develop BRT along SR 99, and this paper explores Sound Transit's roles and responsibilities, if any, in joining in this venture. This issue paper seeks to provide relevant information regarding BRT on SR 99 in the following areas:

- Defining the components of BRT,
- Discussing the available ridership forecasts and their underlying assumptions,
- Identifying the costs associated with elements of BRT, and
- Discussing issues Sound Transit must consider if it is to be involved in implementing BRT in the SR 99 corridor.

The BRT route studied for this paper would follow SR 99 almost exclusively, as shown in Figure 1. Beginning at Everett Station, the route would head west on Pacific Avenue, then proceed south along Rucker Avenue/Evergreen Way, then via SR 99 to the Aurora Village Transit Center, and then continue via SR 99 (Aurora Avenue) to downtown Seattle. The total route length would be approximately 33 miles.

The approach used in this paper was to first review existing planning documents for issues, needs and recommendations in the SR 99 corridor. Existing conditions were inventoried and ridership forecasts that were developed by Sound Transit for the Supplemental Environmental Impact Statement and by Community Transit for the *Community Transit SR 99 Bus Rapid Transit Study* were reviewed. Finally, an overview (at a conceptual level) of the types of services, equipment and infrastructure that would potentially be involved in implementing a BRT system was developed along with estimated costs.

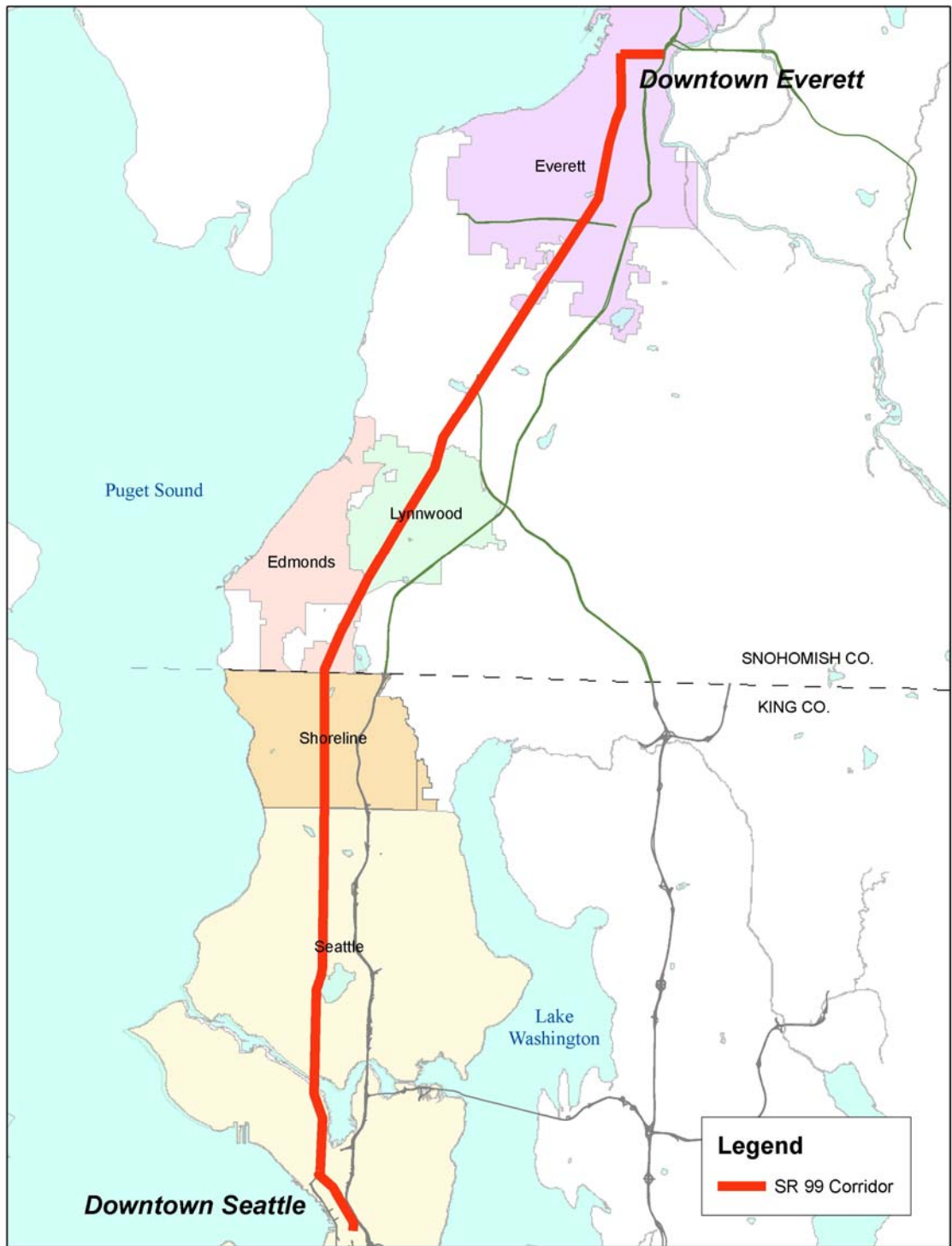


Figure 1. Study Corridor

1.2 Key Findings

- The type of Bus Rapid Transit (BRT) service that is discussed in this paper is different than any bus service currently operated by Sound Transit. While ST Express bus routes generally make use of regional freeways and operate at roughly 30-minute headways, the BRT service discussed in this paper would use Business Access Transit (BAT) lanes in an arterial environment and would operate at 10-minute headways. Significant capital improvements would be needed to implement this service as a true BRT route.
- Transit ridership forecasts for the corridor, which found that a significant number of new riders would be generated by BRT, vary widely depending on the transit network assumptions used. The *Community Transit SR 99 BRT Study*, which forecasted more than 21,000 daily riders on the BRT route in 2030, assumed that Link light rail would not extend north of the Northgate station. In contrast, as part of the Long-Range Plan update process, Sound Transit has forecasted approximately 5,000 to 10,000 daily riders on the BRT route in 2030, assuming that LRT would extend to Everett.
- This study estimated the total capital cost of the BRT system to be in the range of \$237 million to \$282 million. The majority of the cost would be for improving the running ways (transit signal priority and lane widening), including a variety of complex roadway improvement projects involving multiple jurisdictions.
- The annual operating cost for the BRT system is estimated at between \$5.2 and \$6.0 million per year with the service level assumption of 10-minute headways. The of local service currently operated by King County Metro and Community Transit might be reduced if BRT service were added, but this study did not estimate how much that might be, or how much might be used to offset the costs of BRT. The operating cost of the BRT system could increase if more frequent service was needed.
- Implementation of BRT in this corridor could require significant coordination between multiple transit agencies, WSDOT, local jurisdictions, and hundreds of businesses along the 33-mile route. The role of Sound Transit in that implementation raises a variety of issues: 1) operational issues (reliability of single-route service across the county line, ST's role in paying for implementing higher service frequencies); 2) ridership and revenue (potential loss of revenue to partner agencies if ST funds BRT service); 3) capital facilities (ST can contribute to build-out of capital BRT facilities); and 4) branding (options include jointly-branded service or new "combined" brand).

2. Existing Conditions

The SR 99 Corridor travels through five cities (Everett, Lynnwood, Edmonds, Shoreline and Seattle) and two counties (Snohomish and King). The roadway is a Washington State Highway known as State Route 99, a highway of statewide significance, and a major transit corridor. Three different agencies (King County Metro, Community



Source: WSDOT

Transit, and Everett Transit) provide services in the corridor. It is also a significant freight corridor. This corridor is also part of the City of Seattle Transit Priority Network.¹ The average annual daily traffic (ADT) on the corridor ranges from 38,000 to 84,700, dependent on the location.

The corridor has an accident rate higher (and in some cases much higher) than the state average for urban principal arterial highways. According to WSDOT accident data from 01/01/99 to 12/31/01², the SR 99 North corridor is one of the more accident-prone roadways in the Puget Sound, as well as the state. Causes are attributed to heavy traffic, center turn lanes, short on- and off- ramps, multiple driveways, and aggressive drivers.

2.1 Transit Services

Three transit agencies provide service along the SR 99 corridor. Everett Transit provides services within the city limits of Everett, Community Transit provides service along the corridor in Snohomish County outside of Everett, and King County Metro Transit provides service within King County. There is no continuous service from Everett to Downtown Seattle. Each agency's service is summarized in Tables 1 and 2.

- Everett Transit Route 9 operates from Everett Station to Airport Road, Community Transit Route 101 operates from Airport Road to Aurora Village, and Metro Route 358 operates from Aurora Village to downtown Seattle. Community Transit also operates limited weekday peak-period peak-direction overlay service between Aurora Village and Everett Station.
- Up to 12,500 riders use transit each day in this corridor.

¹ Seattle Comprehensive Plan amended November 18, 1996.

² WSDOT SR 99 RDP, p 2.

- A trip from Everett or Snohomish County to Seattle requires a transfer.
- The Aurora Bridge is used by four all-day two-way King County Metro routes (Routes 5, 16, 26 and 358), as well as two peak-period peak-direction express service routes (Routes 5 Express and 28 Express).
- There are more than 100 stops between Everett and Seattle.

On-street parking policies vary throughout the day. In Seattle, parking is restricted between N 38th Street and N 50th Street and between N 72nd Street and N 110th Street in the southbound direction in the morning and in the northbound direction in the afternoon. When parking is restricted, buses use the curb lane (BAT lane) and do not have to merge in and out of traffic. However, where there are no restrictions, bus stops operate as bus pullouts, with the inherent difficulty of pulling back into the traffic flow.

Table 1. Transit Service Characteristics by Classification

Route	Provider	Hours of Service*	Major Destinations
9	Everett Transit	4:26 Am to 11:41 PM	Everett Station, Airport/Hyw 99
100	Community Transit	5:06 AM to 8:43 AM 3:00 PM to 6:54 PM	Aurora Village TC, Edmonds CC, Everett Station
101	Community Transit	4:57 AM to 1:24 AM	Aurora Village TC, Edmonds CC, Mariner P&R
358	Metro	4:25 AM to 2:01 AM	Aurora Village TC, Shoreline P&R, Aurora AVE N, W Green Lake, Downtown Seattle

* First and last time point on route

Table 2. Transit Service Headways by Time Period

Route	Provider	Peak direction	Off-peak direction	Midday	Early Evening	Late Evening	Saturday	Sunday
9	Everett Transit	20 min	20 min	20 min	20 min	30 min	15/40 min	30/60 min
100	Community Transit	20 min	-	-	-	-	-	-
101	Community Transit	15 min	20 min	15 min	15 min	30 min	30 min	30 min
358	Metro	8 min	15 min	15 min	30 min	30 min	30/15/30 min	30 min

2.2 SR 99 Infrastructure Inventory

The SR 99 facilities that support transit service in the corridor include park-and-ride lots, exclusive transit lanes or BAT lanes, transit signal priority system, on-street parking restrictions, and automated vehicle locating systems.

2.2.1 Park-and-Ride Lots

The Aurora Village Transit Center and Shoreline Park-and-Ride are located in the City of Shoreline. Within Snohomish County, the 255-stall Edmonds Park-and-Ride is located close to SR 99, and there is a 500-stall park-and-ride and transit center at the end of the route at Everett Station.

The Aurora Village Transit Center is located a block east of Aurora Avenue off N 200th Street. It is a major transfer point for both King County Metro Transit and Community Transit. The transit center accommodates a park-and-ride with 202 parking spaces and 12 bus bays that allow for local, inter-community and regional bus connections. Community Transit provides connections to the Edmonds-Kingston ferry and the Sounder Edmonds station. Currently, seven King County Metro Transit and five Community Transit serve the transit center.

Located at N 192nd Street and Aurora Avenue, the Shoreline Park and Ride lot has a capacity of 384 parking spaces. King County Metro Transit operates and maintains this lot. Five routes provide connections to downtown Seattle, First Hill, the University District and Renton.

2.2.2 Business Access Transit Lanes

Business Access Transit (BAT) lanes are designed to improve transit service and traffic flow in the through lanes while providing access to adjacent businesses for other vehicles. The typical BAT lane configuration dedicates the curb lane for transit use, but other vehicles are allowed in the lane in order to make right turns from local business driveways and to turn right at intersections.

Sound Transit was a funding partner in the completion of BAT lanes along SR 99 in south Snohomish County, where they now exist between 148th Street SW and Edmonds Way for both directions. In King County, they occur in the northbound direction between N 110th Street and N 145th Street. In the southbound direction, there is a BAT lane between N 40th Street and N 50th Street during the morning peak period only. Plans call for completing the BAT lanes for both directions between N 110th Street to Edmonds Way. Figure 2 shows the locations of existing and planned BAT lanes in the study corridor.

2.2.3 On-Street Parking Management

A key element of BRT service is having the right-of-way to operate vehicles on dedicated roadways or lanes. Parking lanes serve many businesses along the roadway but potentially create friction with through traffic and potential BRT operations. Policies such as restrictive parking during peak periods and/or the

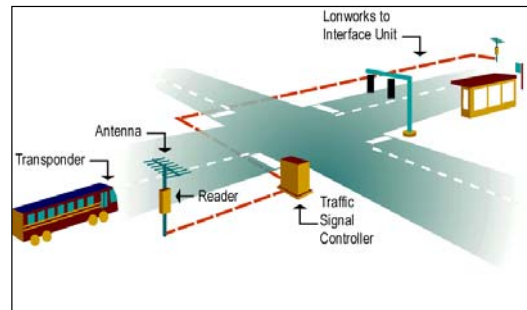
displacement of parking lanes are some potential strategies for on-street parking management.

On street parking in Snohomish county is limited to a few locations north of Lincoln Way for businesses located in Everett. Depending on the location, there are two or three general-purpose lanes where parking is permitted. In King County, parking lanes occur in front of some businesses in the City of Seattle. As shown in Table 4, during peak periods, these parking lanes are restricted depending upon peak traffic patterns. Figure 2 shows the locations of parking restrictions in the study corridor.

2.2.4 Transit Signal Priority

Transit Signal Priority (TSP) is technology that allows specially equipped buses to communicate with an approaching traffic signal and ask it provide additional green light time for bus.

The cities of Seattle, Shoreline and King County Metro have installed TSP at 19 intersections. Community Transit in Snohomish County has made TSP improvements at 18 locations along SR 99. Figure 2 shows the locations of TSP in the study corridor.



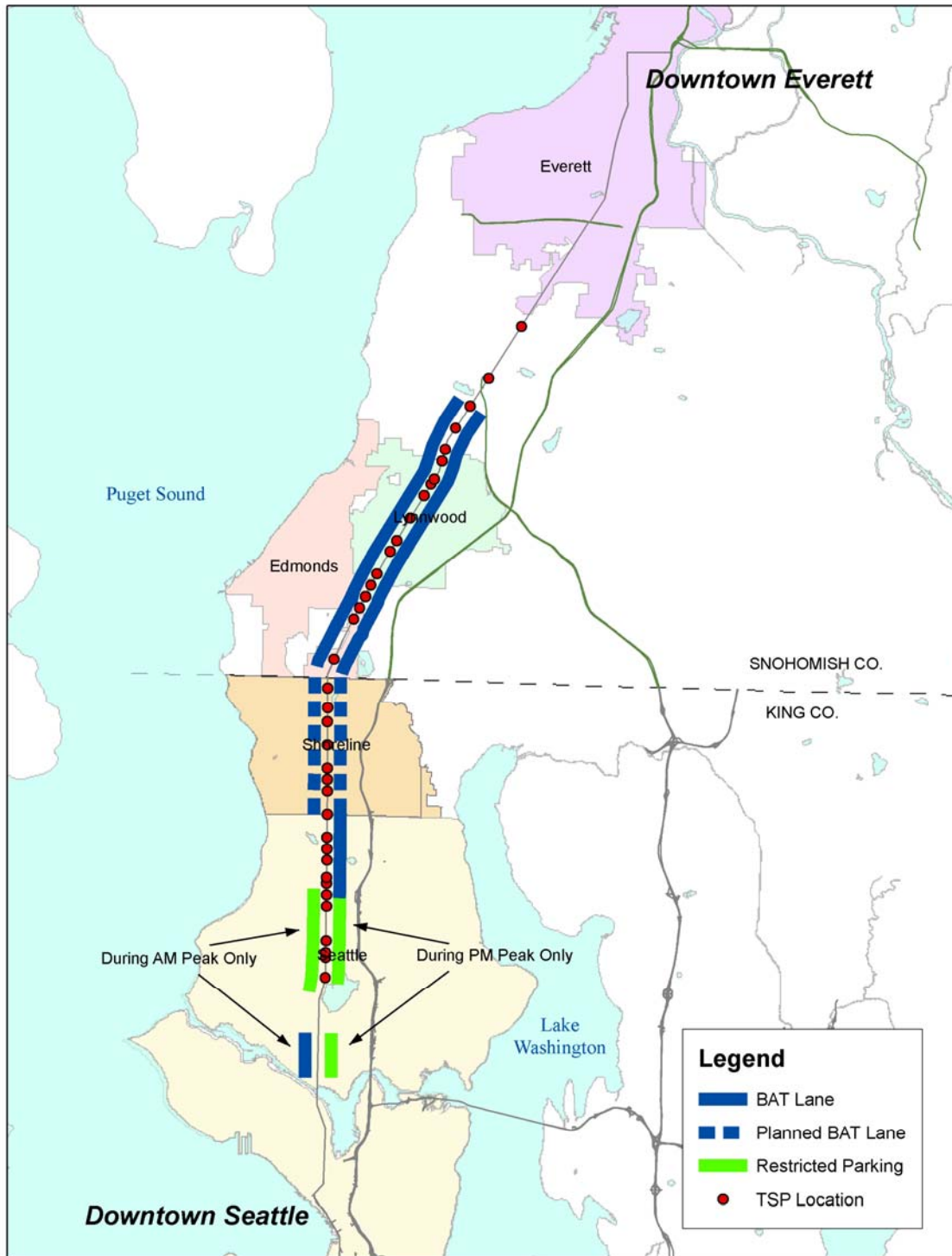
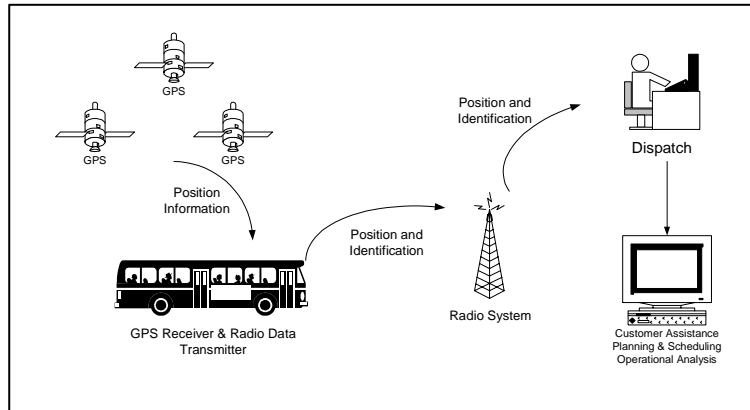


Figure 2. Existing and Planned Infrastructure on SR 99

2.2.5 Vehicle Locating Systems

King County, Sound Transit and the University of Washington ITS Program have implemented an Automatic Vehicle Location (AVL) system for improving transit reliability and information.



A demonstration

project modified the University of Washington's "My Bus" program to provide variable message boards at two stops along the SR 99 corridor in King County. Stops include N 85th Street (northbound and southbound), and at N 46th Street (northbound and southbound). The variable message readers receive updates through a cellular data transmission every five seconds to provide the projected bus arrival times. Arrival times are updated every minute. The data can also be used to assist in travel time analysis and in the adjustment of route schedules.

3. Review of Existing Plans

SR 99 is included in several planning documents prepared by the jurisdictions and agencies operating along the corridor, including:

- *Sound Transit Regional Transit Long-Range Vision*
- *Sound Transit Sound Move (10 year plan)*
- *Sound Transit Regional Transit Long-Range Plan Update*
- *City of Seattle Draft Seattle Transit Plan*
- *Regional Transportation Investment District (RTID) Projects*
- *King County Metro Six-Year Transit Development Plan*
- *WSDOT SR 99 Route Development Plan*
- *City of Seattle Parking Management Study*
- *Community Transit SR 99 Corridor Bus Rapid Transit Planning Study*
- *Seattle Monorail Project Corridor Technical Assessment for the Blue North Corridor*
- *City of Shoreline Aurora Avenue Improvement Project*

3.1 Sound Transit Regional Transit Long-Range Vision (1996)

The *1996 Regional Transit Long-Range Vision* identified the SR 99 Corridor, from downtown Everett to downtown Seattle, as a corridor for regional express bus service. The *1996 Regional Transit Long-Range Vision* was based on the Rail/TSM Alternative analyzed in the *1993 High Capacity Transit FEIS*, which evaluated a range of HCT system alternatives for the Puget Sound region. The Long-Range Vision details a system that would best address the region's mobility needs and support growth management over a 25-year period through 2020. The essence of the long-range vision is to expand the capacity of the region's major transportation corridors by adding HCT system improvements. The Plan describes an approach to develop the future HCT system, over time, in a series of implementation phases.

3.2 Sound Transit Sound Move (1996)

Sound Move, also known as *The Regional Transit System Plan*, is the first phase of implementation of the *Regional Transit Long-Range Vision*, and supports the regional, long-standing strategy to focus growth in urban areas connected by high-quality transportation (VISION 2020, Destination 2030). The system is a combined rail and regional express bus network that includes a mix of light rail, commuter rail, HOV expressway investments (transit centers, HOV lane direct access ramps, park-and-ride lots), and regional express bus service. Regional

express bus service in the SR 99 corridor from Everett to Seattle was identified in this plan, but has not been implemented. Sound Transit investment along SR 99 during *Sound Move* helped fund the completion of BAT lanes through Lynnwood and Edmonds instead.

3.3 Sound Transit Regional Transit Long-Range Plan Update (2004-2005)

The Options studied in the DSEIS issued in December 2004 include BRT service along the SR 99 corridor, with additional speed, reliability, frequency, passenger facilities and amenities. The DSEIS acknowledges that BRT is a new term/concept in the transit industry, emerging since 1996, when the original long-range vision was developed. Those characteristics assigned to the HOV Expressway identified and described in *Sound Move* fit into a BRT system. Furthermore, the DSEIS states that those “. . . regional express bus projects could incorporate BRT concepts that provide exclusive right of ways or priority for buses.”³ The decision to create exclusive right-of-ways on roadways belongs to the local and/or state government. Sound Transit can and has entered partnerships with lead state or local government agencies to develop HOV systems that improve transit efficiency, including on SR 99. Regional express capital projects may include other BRT supportive items such as transit priority, transit/BRT station park-and-ride lots, rider amenities, and grade or barrier separation.

The DSEIS Plan Alternative includes regional express bus service on SR 99 from Seattle to Everett, the same as the service identified in the *1996 Regional Transit Long-Range Vision*. Transit ridership forecasting conducted as part of the Long-Range Update has estimated daily ridership for the SR 99 BRT service to be between 5,000 and 10,000 riders. The difference between this forecast and those conducted for the recent study of the corridor by Community Transit are explained later in this paper.

The DSEIS states that as it was with the *1996 Regional Transit Long-Range Vision* and *Sound Move*, “in some corridors BRT technology may also be considered as a near-term phasing decision while preserving the option for a corridor to be designated as a potential future rail corridor in the updated Long-Range Plan”.⁴

3.4 Draft Seattle Transit Plan, October 2004

The *Draft Seattle Transit Plan* intends to be proactive with future transit actions that coordinates efforts with multiple agencies and is concurrent with city plans and policies. The plan identifies high and intermediate capacity transit corridors along SR 99, as well as on parallel corridors to the east and west.

³ 3-15. The Puget Sound Region has been one of the pioneers for busway treatments (Downtown Seattle Transit Tunnel)

⁴ SEIS, pg 3-18

A key element of the plan to make transit a “real choice” in Seattle is the Urban Village Transit Network (UVTN), shown in Figure 3. This will become the backbone of the Seattle transit network carrying the majority of the Seattle transit system riders. The following are characteristics of the UVTN:

- Connections to Seattle’s Urban Villages
- Longer hours of service (18 hrs/day, 7 days) and shorter headways (15 min or better in both directions)
- Fast and reliable
- Focused on the performance rather than technology; this includes regional high and intermediate capacity and local transit.
- Wide route spacing
- Easy connections between lines
- Has a sense of permanence to support transit supportive and economic development
- Performance monitoring using quality level of service measures.

In the UVTN, SR 99 north of downtown Seattle is specifically designated for bus rapid transit (BRT) service as shown in Figure 2. The Aurora BRT will provide connections to Bitter Lake Hub Urban Village, Aurora-Licton Springs Residential Urban Village, Wallingford Residential Urban Village, Fremont Hub Urban Village, South Lake Union Urban Center, Uptown Urban Center, and Downtown Urban Center.

The envisioned BRT service on SR 99 is classified as an Intermediate Capacity Transit BRT service. It would be provided on articulated transit buses operating in dedicated lanes on City arterial streets. Proposed BRT lanes were assumed to be curbside with stops and stations to be within the sidewalk area. Proposed BRT service would be operated on low-floor clean diesel, rubber-tired vehicles, operating at peak hour headways of 5 minutes and off-peak headways of 7.5 minutes. The average speed of these systems (including dwell time) was estimated to be 11 miles per hour. BRT routes were assumed to have approximately four stops per mile, with variations depending upon route and area served.

The City’s transit street classification identifies where transit needs to operate. In this plan, there are five transit classes: Transit Way; Principal Transit Street; Major Transit Street; Minor Transit Street and Local Transit Street. The Aurora corridor is classified as a Major Transit Street. It is designated to function for transit services for those trips with one or both ends of a trip within a Neighborhood District.

The expected operational characteristics of major transit streets feature:

- Maximum bus speeds in conformance with the limits imposed by the street’s traffic classification, typically 30 to 45 mph. Bus volumes of

16 to 50 vehicles per hour (55 on approval by SDOT) on fixed route transit service.

- Provide frequent intra-city and local transit service with stops approximately every two blocks and frequent limited transit service stopping at transfer points and activity centers approximately every 10 blocks.
- Exclusive transit HOV lanes may be provided by the removal of parking during the peak hours in the direction of the major traffic flow. Full-time transit priority improvements may be provided if compatible with adjacent land uses.
- A Major Transit Street that is part of the Urban Village Transit Network should achieve performance thresholds. It is important to regularly monitor performance of Major Transit streets on the Urban Village Transit Network.



Source: Review Draft Seattle Transit Plan, October 2004; SDOT Chapter 3: Making Good Connections, Figure 1, pg 44.

Figure 3. The Urban Village Transit Network

3.5 Regional Transportation Investment District (RTID) Projects (2004)

King County has proposed to include a project for Transit Arterial Improvements for SR 99 between Denny Way and North 205th Street to be funded in the RTID. Improvements would include exclusive lanes for buses and right-turning traffic (BAT lanes), upgraded bus shelters and lighting, traffic signal improvements, sidewalks, expanded intersections, pedestrian and safety improvements. The status of the RTID is uncertain at this time.

3.6 King County Metro Six-Year Transit Development Plan (2002 to 2007)

Aurora Avenue North was selected as one of three primary candidate corridors for future BRT investment in the *King County Metro Six-Year Transit Development Plan* (2002 to 2007), adopted in September 2002. The *BRT Background Paper* describes the process and schedule Metro used to select that preferred corridor that the agency recommended to the County Executive to be targeted for concept refinement.

The following assumptions were used as part of the decision process to select SR 99 as the BRT corridor for the demonstration project:

- The project would not take-a-lane of general traffic.
- Removal of on-street parking and/or shoulder lanes might be necessary.
- Cities selected for BRT demonstration must be willing to approve bus stop changes.
- Cities must also adopt traffic and transit operations policies that in the aggregate are designed to provide a 25 percent or greater travel time advantage to buses. (TSP, transit queue jumps).

The analysis assumed that for the Aurora Corridor the existing King County Metro Route 358 service would be reduced to operate every 30 minutes and continue to serve all the existing stops. This reduction would create 19,000 annual service hours that would be invested in the BRT route.

3.7 WSDOT Route Development Plan for State Route 99 North/ Aurora Avenue North (March 2003)

The Route Development Plan SR 99 (RDP) is a 25-year plan intended to assist WSDOT, the City of Seattle and King County Metro in making informed decisions on future improvements to the SR 99 corridor. The purpose of the study was to develop a set of recommendations to help reduce accidents and improve mobility for corridor users. The study area included SR 99 from the north end of the Battery Street Tunnel to N. 145th Street.

The Plan recommended improvements for both the near term and long term related to safety and mobility in the corridor. Those most relevant to SR 99 BRT service include the following:

Near Term Improvements:

- Safety improvement recommendations such as removing parking in high accident locations with narrow lanes; where lacking install bus shelters and lighting; improve access management by consolidating driveways.
- Congestion improvements recommendation. The corridor is ‘built up’ with many long-standing, established businesses that does not provide room to add significant new road capacity --- need to maximize the people moving capacity of the corridor northbound and southbound during peak periods of congestion; continue transit speed and reliability improvements to maximize the people carrying capacity of the corridor.
- Security Improvements such as lighting and other improvements are recommended along the corridor.
- Additional law enforcement of speed limits, BAT lane restrictions, and alcohol consumption laws were recommended to reduce the number of accidents occurring on the corridor.
- Improve BAT lane signage; signage for access and exits from SR 99 north; signage for merging traffic.

Long Term Improvements

With the exception of the Aurora Bridge (which would be a specific state and/or city initiated and sponsored project) all the long term recommendations would take place over time as private property redevelopment occurs over the next 25 years. Ultimately a new roadway width would be created as redevelopment occurs, because the curb lines and sidewalk edges would be set to the future cross-section locations. The long-term improvements include:

- Signalization and channelization improvements along the corridor.
- Remove parking from N 39th Street to N 50th Street; widen center median barrier.
- N 50th to N 72nd Street – add center median with barrier.
- N 72nd Street to N 110th St –add 11 foot center raised median along sections with high number of left turn accidents and a center turn lane for other sections.
- N 110th Street to N 145th Street – add SB BAT lanes (currently NB BAT lanes but limited curb, gutter and sidewalks); widen existing lanes (ROW is available); add a raised median with controlled access points; driveway consolidation.

Several comments from the public supported removing parking on SR 99 from N. Aloha Street to N 50th Street; but small businesses on SR 99 were opposed to removing parking from N 50th to 110th Street. Several commented that if parking it is totally removed alternative parking such as public parking lots must be provided for merchants. Some of the public wanted to remove on-street parking and add an additional general-purpose lane for traffic, not a BAT lane.

3.8 City of Seattle Parking Management Study (September 2002)

The study concluded that on-street parking, including SR 99, would continue to be an issue in the future as City of Seattle strives to improve traffic flow through the city's principal traffic corridors and as King County Metro proposes further transit priority improvements.

However existing city policies help to confirm that parking is a lesser priority on a principal arterial than the need to move traffic and transit. (Seattle Comprehensive Plan Policies T16, T20 and T28)

The study called for the City to establish a needs evaluation process and considerations for the City Traffic Engineer to implement arterial parking restrictions related to transit speed and reliability, pedestrian and bicycle travel, and general traffic flow benefits.

3.9 Community Transit SR 99 Bus Rapid Transit Planning Study (January 2005)

Community Transit recently commissioned a study to explore the possibility of implementing a BRT route on SR 99 in Snohomish County. The document evaluated six potential routes, along with 2005, 2015, and 2030 ridership estimates. An example deployment option illustrating the potential costs and time frames associated with implementation of a BRT service in the SR 99 corridor was included. The deployment represented one possible option only in Snohomish County, and was not intended to represent specific service and infrastructure recommendations. Instead, it was intended to provide an overview (at a conceptual level) of the type and cost of services, equipment and infrastructure that would potentially be involved in implementing a BRT service in Snohomish County.

The key assumptions included a limited number of stops and 10-minute peak and midday service. Key findings from the study include:

- Existing transit operators in the SR 99 corridor carry a total of 12,500 riders each day, while the model developed for the study forecasted that transit ridership in the corridor could increase by up to 15,100 riders per day in 2015 and 20,300 riders per day in 2030 with the current route structure.

- Adding BRT service to the existing services would increase SR 99 corridor total ridership – up to 23,000 riders in 2015 and 36,000 riders in 2030. BRT riders would be 53% of the increase in 2015 and up to 77% of the riders in 2030.
- If the BRT line operates from Everett Station to Downtown Seattle with 10 minute service in the peak periods and midday period, the BRT line, excluding local service ridership, is projected to carry about 13,500 riders per day in 2015 and 21,300 riders per day in 2030. The 2015 BRT ridership of 13,500 riders would be about 60 percent of the total transit riders (combined BRT and local services) in the SR 99 corridor. There would be some shifts in transit ridership from those on the local routes to the new BRT route.
- If the BRT system were implemented with high levels of services, enhanced speed and reliability, and other features that would make service for the potential riders more convenient and comfortable, it would generate new transit riders. In 2015, it is projected that a total of 7,300 new riders per day would be using the BRT system in the SR 99 corridor. About three-quarters of these new riders would be located within King County.

3.10 Seattle Monorail Project Corridor Technical Assessment for the Blue North Corridor

The Seattle Monorail Project is currently in its phase 2 planning for additional routes for the system. A published analysis, the *Corridor Technical Assessment for the Blue North Corridor* (November 30, 2004), describes the conceptual alignment, route options, costs and ridership for route along Aurora Avenue (SR 99) between Downtown Seattle and Bitter Lake neighborhood (approximately NE 130th Street) in Seattle. According to SMP, the Blue North Corridor is unlikely to be developed in the near term, but will continue to be considered for future system expansion.⁵ The most likely configuration for the elevated rail would be within the existing right-of-way that may use one lane of the roadway. If this were the case, Monorail would reduce the possibility for northbound and southbound dedicated transit lanes along this segment of SR 99. The paper estimates a potential 29,700 riders along this corridor and estimates a reduction in travel times by 50% over existing transit service. The assessment does not include BRT in the analysis and would likely replace any BRT system, if implemented.

⁵ Telephone conversation with Denna Cline, Director of Phase 2 Planning, Seattle Monorail Project, January 31, 2005.

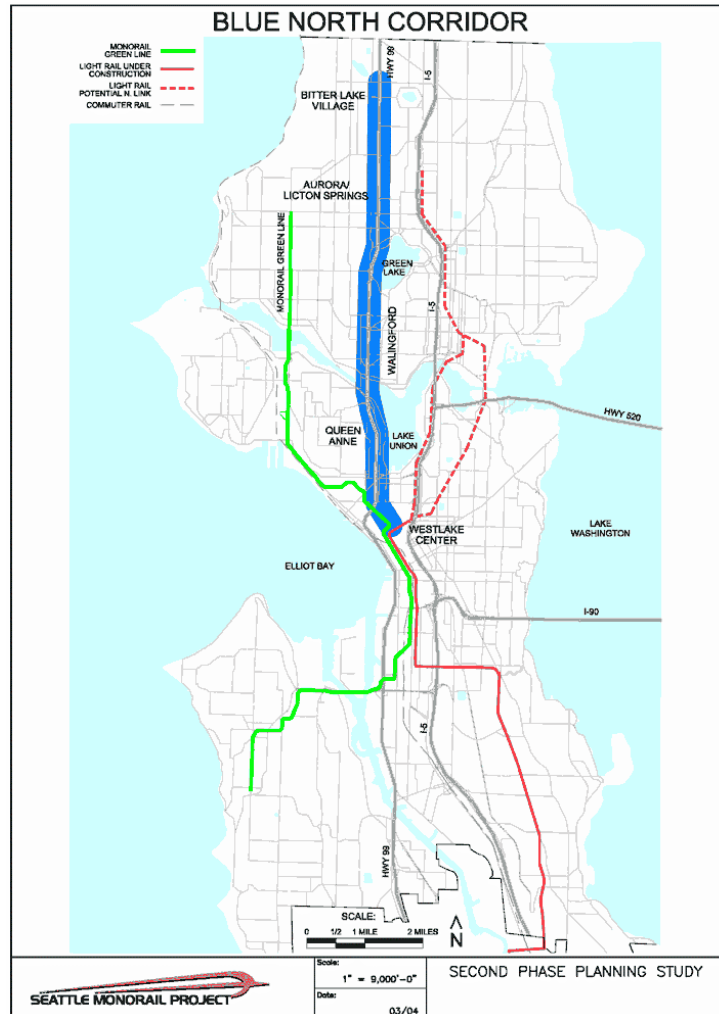


Figure 4. Seattle Monorail Blue North Corridor

3.11 City of Shoreline Aurora Avenue Improvement Project

In 1998, the City of Shoreline adopted the Transportation Element of the Comprehensive Plan, which included a policy that designated Aurora Avenue as a primary transit corridor. To implement this policy, Shoreline has been working to improve Aurora Avenue, including an addition of business-access transit (BAT) lanes. This major capital improvement project is broken down into two phases. The first phase, which is fully funded, consists of Aurora Avenue from North 145th to 165th Street. The second phase of construction, which is only partially funded, stretches from North 165th to 205th Street.

In the first phase, BAT lanes, curbs, gutters, landscaping, street furnishing, and sidewalks will be added on both sides of Aurora. Construction of the landscaped center median safety lane will make provisions for left-turns and U-turns. All traffic signals will be interconnected, include pedestrian crossings and equipped with transit signal priority (TSP). The placement of utility lines underground will

make room for new street lighting. Transit stops will receive new shelters. Upgrading the existing storm water drainage will improve water quality. This phase is projected to cost \$25.0 million, and the completion is set for 2006.

The work in the second phase (North 165th to 205th Street) will be similar in scope as the first phase. Work on this stretch of Aurora will also include the addition of sidewalks, BAT lanes, curbs, gutters, landscaping, street furnishings and sidewalks on both sides. The addition of the landscaped center median safety will also make provisions for left-turns and U-turns. In addition, this phase calls for adding traffic signals at N 182nd and at North 195th. These signals will be interconnected to with existing signals, as well as adding pedestrian crossings and installing TSP. Transit stops will be upgraded with new shelters, and overhead utilities will be put underground while new street lighting will be installed. At major intersections, enhancements will be made to improve east-west traffic flow. In total, it is estimated that this phase will cost \$59.8 million, and this project may be completed by 2009.

4. BRT Components

The FTA's recently published *Characteristics of Bus Rapid Transit for Decision-Making* defines BRT as:

*A flexible, high performance rapid transit mode that combines a variety of physical, operating and system elements into a permanently integrated system, with a quality image and unique identity.*⁶

This definition highlights BRT's flexibility and the fact that it encompasses a wide variety of applications, each one tailored to a particular set of travel markets and physical environments.

4.1 BRT Service

In order to be effective and to attract passengers, BRT service should be frequent, direct, understandable, comfortable, reliable, efficient, and rapid, particularly in comparison to regular bus transit service. Such service is affected by the following elements:

- Route length – the route should be long enough in order to minimize the need for transfers. However, if the route is too long it can affect travel time reliability.
- Route structure – the route structure should be relatively simple so that it is easy for passengers to understand.
- Service span – all-day service (as opposed to peak-only) allows the BRT service to attract a wider market of passengers, rather than only typical commuters who only travel during peak periods.
- Service frequency – service should be frequent (e.g., 10 minutes or less between buses), allowing passengers to feel they can arrive randomly without having to refer to a schedule.
- Station spacing – the stations should be spaced farther apart than stops for local service, allowing vehicles to achieve higher speeds between stations.
- Scheduling – the use of “headway-based scheduling” focuses on maintaining headways, rather than meeting specific schedules. Operators are encouraged to travel their route with maximum speed and have no specified time of arrival at the end of the route. Dispatchers may monitor vehicle locations and issue directions to operators in order to maintain proper spacing between vehicles, minimizing passenger wait times.

⁶ Characteristics of Bus Rapid transit for Decision-Making, FTA August 2004 (Levinson et al, BRT Implementation Guidelines, TCRP Report 90-Volume 2.

4.2 BRT Capital Elements

There are several major capital elements of a BRT system, but five key capital elements, along with service and integration, generally define BRT, according to the FTA: running way, stations, vehicles, fare collection, and Intelligent Transportation Systems (ITS).⁷ The success of a BRT system requires that these elements function in combination with and in support of the service and one another. Various combinations of capital elements and the resolution of planning and design issues associated with their successful integration support BRT performance and maximize benefits. Further detail on these elements is available in the *Community Transit Bus Rapid Transit Planning Study*.

4.2.1 Running Way

Just as rail transit vehicles travel down tracks, BRT vehicles travel on guideways or running ways. In fact, a major defining factor of a BRT system is the running ways. Running ways drive travel speeds, reliability and identity. Options range from general traffic lanes to exclusive transit lanes to fully-grade separated BRT transitways. Transit Signal Priority (TSP) can allow BRT systems to minimize delay at intersections, to recover from delay, and ensure schedule maintenance. Running ways are often the most significant cost item in the entire BRT system. BRT running ways can also incorporate a feature known as lateral guidance. This feature controls the side-to-side movement of vehicles along the running way, similar to how a track defines where a train operates. Guidance systems contribute to a rail-like experience and can reduce right-of-way space needs.



Source: BRT - FTA August 2004

4.2.2 Stations

Stations, as the entry point to the system, are the customer interface, affecting accessibility, reliability, comfort, safety, and security, as well as dwell times, and system image. BRT station options vary from simple stops with basic shelters to complex intermodal terminals with many amenities. Stations are an important



Source: Community Transit SR 99 BRT Corridor

⁷ Characteristics of Bus Rapid transit for Decision-Making Implementation Guidelines, TCRP Report 90-Volume 2.

component of establishing the BRT's identity and often include unique features and amenities such as platforms, passenger information and fare payment systems. The station designs shown are prototypes developed for CT's SR 99 Corridor BRT system.

Some BRT systems incorporate vehicle guidance to facilitate "precision docking" at stations, allowing no-step boarding and alighting. With precision docking technologies, a bus can be stopped at a consistent location on the platform, with a gap small enough for wheel chair passengers to board and alight the vehicle without the use of ramps or lifts.



Source: www.rtcsonthernnevada.com/max

4.2.3 Vehicles

BRT systems can use a wide range of vehicles, from standard buses to specialized vehicles. Options vary in terms of size, propulsion system, internal layout, and horizontal/longitudinal control, all of which impact performance, capacity and service quality. Design factors both inside and outside the vehicle can help brand the service. In response to



Source: www.newflyer.com

the American Disabilities Act, low-floor vehicles have become the norm in conventional transit operations. Vehicles in BRT systems range from low-floor two-axle 40-foot units to 90-foot bi-articulated buses. BRT vehicles often incorporate a high level of technological sophistication such as vehicle GPS systems, automatic passenger counters, and automated stop announcements.

4.2.4 Fare Collection

Fare collection affects customer convenience, accessibility, and passenger security. But it also affects performance in travel times by reducing dwell times and increasing service reliability. Streamlined fare collection eliminates the delays that can result at traditional transit stops during peak hours as passengers queue up to pay fares. These delays can be minimized by requiring passengers to purchase tickets in advance of entering the vehicle or by making on-board fare collection as efficient as possible through the use of pre-paid fare media. A key feature of BRT is



Ticket Vending Machine (TVM)

Source: www.rtcsonthernnevada.com/max

providing streamlined fare collection, either on-board or off-board, in order to ensure the rapid throughput needed to achieve BRT's goal of minimizing travel times. On-board fare collection strategies include the use of prepaid fare media or contactless smart cards that can be read electronically. Such cards will be deployed in the Puget Sound region in 2006-2007 as part of the Regional Fare Coordination Project. Off-board fare collection strategies include stand-alone smart card terminals and cash ticket vending machines provided at stops with random on-board inspections of proof-of-payment or providing staff to collect fares at loading platforms (entry granted only upon fare payment).

4.2.5 Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) includes a variety of technologies that allow transit agencies to collect, process, and disseminate real-time data from vehicles and the roadway in order to increase safety and maximize operational efficiency.

Examples of ITS include Transit Signal Priority (TSP) and Automatic Vehicle Location (AVL), both described earlier.



Another example of ITS is passenger information technologies, which can improve passenger satisfaction, help to reduce wait times, and thus increase ridership. For BRT systems, information about the vehicle schedule can be provided to the rider at the station/stop and/or on the vehicle, reducing uncertainty about when the bus will come and helping passengers decide whether or not to wait for it. Passenger information systems can sell advertising time and space on information screens, creating another source of revenue. These services rely on a communication system able to track vehicles. There are many different cost elements associated with the installation and operation of passenger information systems.

5. Ridership Forecasts

The transit ridership forecasting model developed for the *Community Transit SR 99 Bus Rapid Transit Planning Study* was used to develop ridership forecasts for the study corridor for this paper. As part of the Long-Range Plan update, Sound Transit prepared ridership forecasts for the regional transit system for 2030, including BRT service on SR 99 from Seattle to Everett. These forecasts show that the SR 99 BRT route would generate a total of 5,000 to 10,000 daily boardings. The key difference between these two sets of forecast results is that the forecast from the Community Transit study assumes that light rail would not be extended beyond Northgate, while the forecast from the Long-Range Plan update assumes that light rail would be extended from Northgate to downtown Everett. This light rail service would provide a competitive service on a parallel route that could reduce ridership on the SR 99 BRT line. Additional differences between the forecasts include:

- Model origin – the Community Transit forecasts are based on the Puget Sound Regional Council regional travel demand forecasting model, while the Sound Transit forecasts are based on the transit-only Sound Transit ridership forecasting model.
- Model validation – the model used for the Community Transit forecasts was validated against 2003/2004 count data, while the model used for the Sound Transit forecasts was validated against 2002 count data.

5.1 Existing Transit Ridership

As indicated in the previous section, existing transit services in the SR 99 corridor (from the Everett Station to Downtown Seattle) are provided by three transit operators: Everett Transit, King County Metro and Community Transit. While the four routes (ET 9, KCM 358, and CT 100 and CT 101) are well designed to carry high levels of transit riders, there is no route that continuously provides transit service from one end to the other. The *Community Transit Bus Rapid Transit Planning Study* assumed adding regional BRT service that runs continuously from Everett to downtown Seattle on SR 99.

It is estimated that the transit operators in the SR 99 corridor are carrying a total of 12,500 riders (boardings) per day in 2005. The route specific daily ridership estimates follow.

- ET 9: 950 boardings per day
- CT 100: 450 boardings per day
- CT 101: 2,800 boardings per day
- KCM 358: 8,300 boardings per day

5.2 Modeling Assumptions Underlying Community Transit's Forecasts

In order to prepare the transit forecasts for 2015 and 2030, the following assumptions were made regarding the BRT service and local transit service levels, and the facilities that support the operation of the BRT service in the SR 99 corridor:

- A new BRT line would operate between Everett Station and downtown Seattle with a headway of 10 minutes during both the peak and off-peak periods in both directions.
- The new BRT line would be designed to have a set of specific stations. A total of 28 stations (15 stations in Snohomish County, and 13 Stations in King County) would be provided.
- King County Metro's Route 358 would operate under the current service levels. The added BRT service assumed no service level change for Route 358. (Note that if the BRT service were implemented, Route 358 service levels might be reduced because the ridership on this route might decrease. At King County Metro's request, the Community Transit study did not assume this would happen.)
- Community Transit route 100 would be eliminated.
- The frequency of Community Transit Route 101 and Everett Transit Route 9 would be reduced by 50 percent.
- Transit travel times would be improved in the SR 99 corridor. In the future, the BRT bus travel time would be approximately 15 percent less than the current transit travel time. This would be due to the proposed Business Access Transit (BAT) lanes from 244th St to 148th St SW and the proposed implementation of the transit signal priority systems.
- By 2015, the City of Shoreline's Aurora Avenue Phase 1 and 2 improvements (BAT lanes, sidewalks, and other improvements from N 145th Street to N 205th Street) would be completed.
- The peak period parking restrictions would be in place in Seattle from Winona Avenue to N 105th Street in both directions.
- By 2030, the City of Seattle's Aurora Avenue improvements (a southbound BAT lane from N 145th Street to N 105th Street) would be completed.

5.3 2015 and 2030 Ridership Forecast Results

5.3.2 2015 and 2030 No Action Transit Ridership

Over the next two decades, transit ridership on the existing four routes in this corridor is projected to increase even without substantial transit investments, such as the implementation of the BRT services. The model estimated that there would be 15,100 riders per day in 2015 (an increase of 21 percent over the 10-year period), and that the existing four routes would carry 20,300 riders per day in 2030. Table 3 shows the No Action ridership forecast for each route for 2015 and 2030.

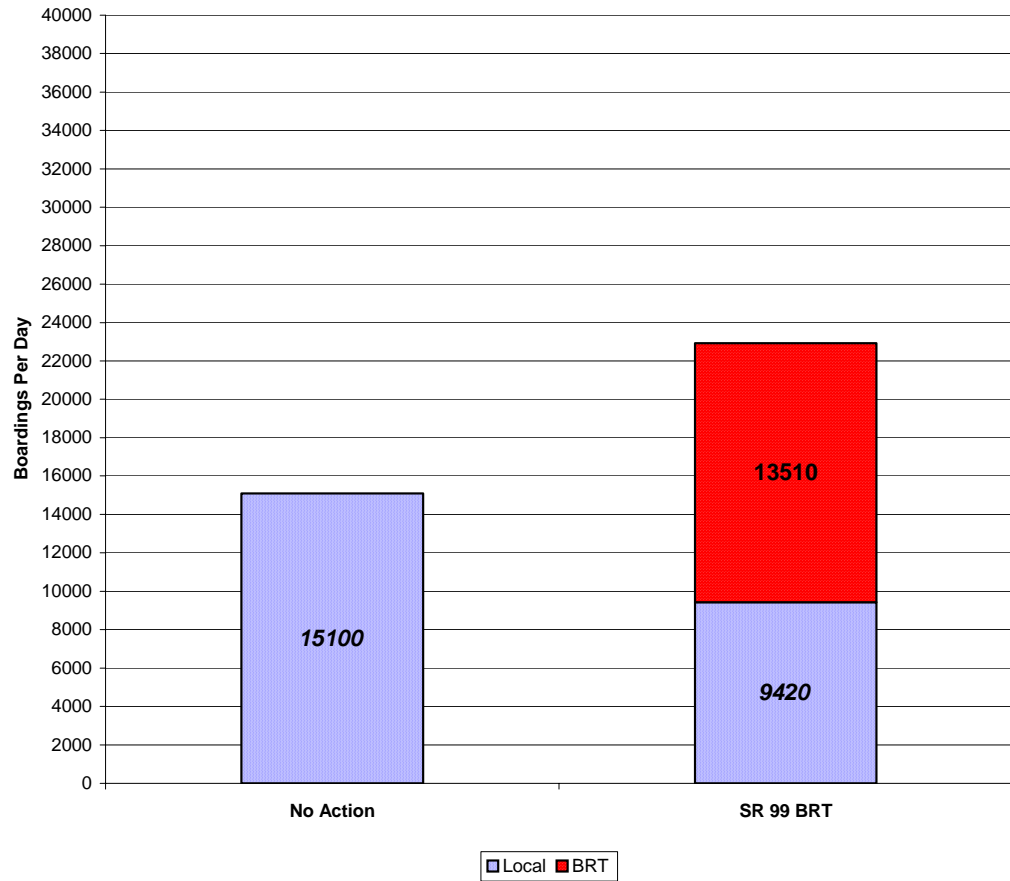
Table 3. Forecasted Daily No Action Boardings

Transit Service Provider	Ridership (Number of Passengers)		
	2005	2015	2030
ET 9	950	1,100	1,500
CT 100	450	550	850
CT 101	2,800	3,000	4,000
KCM 358	8,300	10,450	13,900
Totals	12,500	15,100	20,250

5.3.3 2015 and 2030 Transit Ridership with BRT

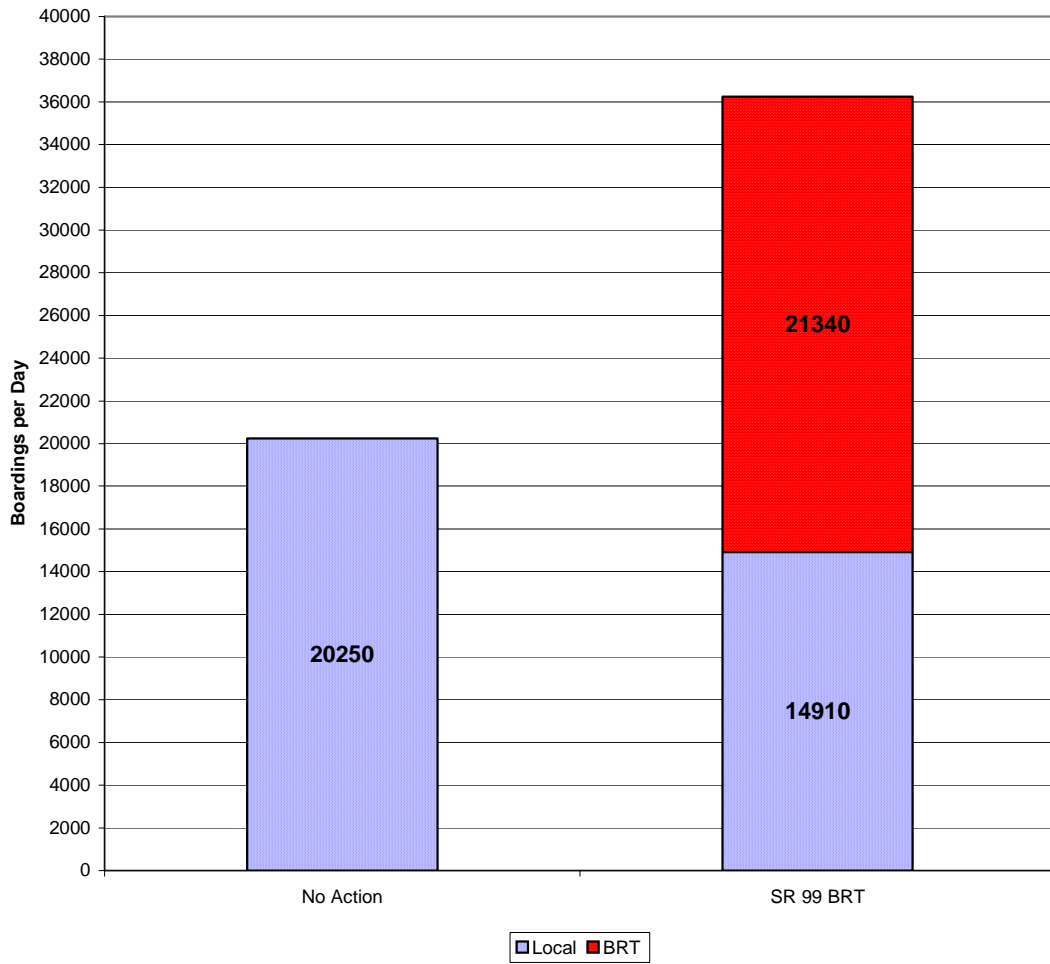
Adding the new BRT transit service to the existing services would substantially increase transit ridership in the SR 99 corridor. The BRT buses would travel on the BAT lanes along major sections of the corridor. With the assumed BRT services in this corridor, the total daily transit ridership (that includes the riders on both the BRT line and local routes), would increase to about 23,000 riders in 2015 as shown in Figure 5 and 36,000 riders in 2030 as shown in Figure 6. The 2015 transit ridership reflects an increase of 84 percent from the 2005 level.

Compared with the No Action ridership levels, the number of transit riders on the local routes would be reduced with the BRT service, while the total riders in the corridor would increase. This indicates that a significant number of the riders on the existing local routes would choose to use the BRT services when the BRT service is implemented. In 2015, the BRT system would contribute 53 percent of the increase in the corridor transit ridership and up to 77 percent of the increase in 2030, compared with the No Action ridership forecasts.



Note: The total boardings on the local routes are shown in blue. The boardings on BRT are shown in red.

Figure 5. 2015 Transit Ridership Forecasts under No Action and with BRT in the SR 99 Corridor



Note: The total boardings on the local routes are shown in blue. The boardings on BRT are shown in red.

Figure 6. 2030 Transit Ridership Forecasts Under No Action and with BRT in the SR 99 Corridor

5.3.4 Conclusions about the BRT Ridership Forecasts

The unique features of a BRT system design such as “branding”, attractive shelter design, enhanced passenger information system, and added passenger security may significantly contribute to the increased ridership figures.

The forecasts of ridership for the SR 99 BRT options evaluated in this study indicate that the corridor has the potential to attract a substantial number of new transit riders. While the riders in the BRT system would include some of those who would be riding a local route, a significant number of new riders would be generated by the BRT system. This ridership potential is directly linked to three factors: land use, frequency of service, and competitive bus travel times compared with those of auto travel times.

6. Cost Estimate

The development of an effective BRT system depends on a strategic combination of infrastructure, service and vehicle improvements, along with advanced operations technologies that enables BRT to approach the speed and efficiency of light rail, at a lower capital cost. Cost estimates for this analysis were largely developed based on information from the *Community Transit Bus Rapid Transit Planning Study*. To illustrate different ways to create BRT along SR 99, estimates are provided for Low-BRT and High-BRT scenarios to provide a range of costs for capital and operating expenditures. Both the low and high estimates include the cost of new vehicles and assume the same level of transit services, but differ in the extent of BRT system technologies and capital elements included. The High-BRT system is identical to the Low-BRT estimate except it includes platform loading with precision docking vehicles at BRT stop locations, and all-door boarding and alighting with on-board ticket inspections.

Vehicle System Costs

The vehicle cycle length, the time required for a vehicle to return to the beginning of the route (including shift changes and bus staging), is assumed to be 170 to 190 minutes. Given this cycle length, 18 to 19 transit coaches are required to meet the ten-minute headways for SR 99 BRT route. Including spares, 21 to 23 vehicles would meet the assumed system level of service.

The most likely vehicle is a 60-foot, low floor coach. Coach attributes could include low floor design for easy boarding, a range of engine options (advanced diesel assumed for costing purposes, but hybrid or other propulsion technology could be assumed a likely future technology), distinctive styling and passenger amenities, and the ability to accommodate precision docking systems. It is assumed that capacity requirements would provide each passenger with a seat. Based on ridership projections, the 60-foot coaches would provide sufficient capacity to meet peak period demands. Tables 4 and 5 show the capital and operating unit costs for the Vehicle Systems.

Table 4. Vehicle Systems Capital Costs Unit Costs

Vehicle Component	Unit Cost
60' Low Floor Diesel Coaches	\$500,000/bus
Smart Card On-board Equipment (reader, DDU, wireless)	\$4,000/bus
AVL On-board Equipment (GPS, VLU, software)	\$9,000/bus
TSP On-board Equipment	\$1,500/bus
APC On-board Equipment	\$2,500/bus
ASA On-board Equipment	\$1,000/bus
Voice and Data Radio	\$4,000/bus
Security Package	\$5,000/bus
Precision Docking Technology	\$50,000/bus

Table 5. Vehicle Systems Operating Unit Costs

Vehicle Component	Unit Cost
Vehicle Operation and Maintenance	\$118/service hour ⁸
Communications Between Vehicle and Dispatch	\$75/month per bus
Data Communications	\$900/year per bus
Vehicle Location Service ⁹	\$1,100/year per vehicle

Stop Systems Costs

For BRT systems, the design of stops and the fare collection method are important elements in streamlining the system operation and reducing delays at stop locations. A fundamental decision is whether to construct platform for passenger boarding or to use an enhanced shelter. Precision docking and platforms would allow direct access from the platform to the bus floor allowing level boarding.

⁸ Estimates are based on current service hour costs including revenue service and layover time. Deadhead time not included.

⁹ Contracted service assumed. Would not be required if the agency implements its own computer aided AVL dispatch system.

Wheelchair lifts would be incorporated into the platforms rather than into the bus. The enhanced shelter would likely be attractive, with tactile edging, but not significantly different from standard bus stops. Wheelchair lifts would be required for special need passengers; however, the low-floor bus design would accommodate greater numbers of passengers without use of lifts. Tables 6 and 7 list the unit costs for a variety of stop components.

BRT systems rely on expediting the boarding and alighting process to improve system reliability and to reduce the time spent at stops. Improved fare collection methods can reduce the amount of time required to collect and verify fares prior to departing a stop. A range of approaches to fare collection could also be used from current fare collections methods (on-board cash and passes), to pre-paid fares purchased at a ticket vending machine (TVM) with either driver verification or “proof-of-payment” verification by a conductor.

Table 6. Stop Systems Capital Unit Costs

Stop Component	Unit Cost
Shelter	\$67,000 per stop
Platform	\$25,000 per stop
Electricity	\$6,000 per stop
Communications	\$1,000 per stop
Ticket Vending Machine	\$45,000 per stop
CCTV Camera	\$5,000 each
Emergency Call Stations	\$5,000 each
Dynamic Message Sign for Real-Time Information	\$2,500 each
Route Maps and Schedules Display	\$300 per stop
Precision Docking Infrastructure	\$4,000 per stop

Table 7. Stop Systems Operating Unit Costs

Stop Component	Unit Cost
Electricity	\$100/month per stop
Route-Wide TVM Maintenance and Operations	\$100,000/year (2 FTE equivalent)
On-board random ticket inspectors	\$80,000/year (2 FTE equivalent)
Communications	\$900/year per stop
Real-Time Traveler Information Service	\$1,100/year per stop

Speed and Reliability Systems Cost

Business Access and Transit (BAT) lanes along with Transit Signal Priority (TSP) systems are two facilities that are appropriate to provide a high degree of certainty to BRT system operations and will provide travel time savings needed for an effective system.

Transit Signal Priority (TSP)

TSP technology allows BRT drivers that are behind schedule to affect the traffic signal by either providing additional green time or shortening opposing cycles.

The TSP allows maintenance of schedules and ensures the reliability of the BRT system. Table 8 provides a unit cost estimate for TSP and for BAT lanes.

Table 8. Speed and Reliability Systems Operating Unit Costs

Speed and Reliability Component	Unit Cost
Transit Signal Priority	\$70,000 each intersection

BAT Lanes

Dedicated BAT lanes allow increased travel speeds while allowing vehicles to cross the lanes to access private businesses. The conceptual arterial improvements and BAT lane costs shown in Table 9 are estimated based on recent improvement studies completed by WSDOT and the City of Shoreline. The costs reflect the entire cost of the roadway improvement project, not just the costs associated with the BAT lane installation. These include pedestrian and urban design amenities, right-of-way, roadway lane restriping, utilities undergrounding, centerline medians, pedestrian crossing, lighting and landscaping, and access ramps serving the facility. The conceptual cost for completing the BAT lanes for the length of the corridor is \$254 million.

Table 9. Cost Estimate for Completing SR 99 BAT Lanes and Arterial Improvements

Segment	Improvement	2004 Estimate (x000s)	Amount Funded (x000s)	Source
Aloha St. to Dexter Way	Amenity zone (sidewalk and planting strip) improvements	\$7,800		WSDOT: SR 99 North Route Development Plan 3/2003
Halladay St. – Raye St.	Staged reconstruction of Raye and Halladay Street intersections and signalization of nearby intersections.	21,900		WSDOT: SR 99 North Route Development Plan 3/2003
Aurora Bridge	Widen existing lanes, add median barrier, construct new pedestrian facilities	32,000		WSDOT: SR 99 North Route Development Plan 3/2003
N. 38th St. vicinity	Add traffic signals to facilitate access to/from on-and off-ramps. Add new acceleration and deceleration lane between N. 38th and N. 39th streets	2,000		WSDOT: SR 99 North Route Development Plan 3/2003
N. 39th St. to N. 50th St.	Widen existing lanes	1,900		WSDOT: SR 99 North Route Development Plan 3/2003
N. 50th St. – N. 59th St.	Widen existing lanes and add center median with barrier.	8,000		WSDOT: SR 99 North Route Development Plan 3/2003
N. 59th St. – N. 63rd St.	Add center median with barrier.	3,800		WSDOT: SR 99 North Route Development Plan 3/2003
N. 63rd St. – N. 110th St.	No modifications are anticipated except in conjunction with large-scale private development.	0		WSDOT: SR 99 North Route Development Plan 3/2003
N. 110 th St. – N. 145 th St.	Widen lanes, add BAT lanes, add median with controlled access, pedestrian crossings	40,900		WSDOT: SR 99 North Route Development Plan 3/2003
N 145th St. - N. 165th St.	Add BAT lanes, pedestrian amenities, underground utilities, urban design components	20,300	20,283	City of Shoreline 2004-2009 CIP - Phase 1 cost estimate
N. 165th St. - N. 205th St	Add BAT lanes, pedestrian amenities, underground utilities, urban design components	59,790	20,000	City of Shoreline 2004-2009 CIP - Phase 2&3 cost estimate
SR 104 Overpass Improvement	Widen bridge	5,500		Estimate of \$5 million
SR 104 - 148th St SW	Complete	-		
148th St SW - Pacific Ave.	Converting existing shoulder and general purpose lane to BAT lane	50,500		Estimate of \$5.3 million per mile
	Total Cost (000s)	\$254,400		
	Total Amount Funded (000s)		\$40,283	
	Net Remaining Cost (000s)	\$214,100		

Central Systems Costs

Central systems costs reflect the investment in new computer, video and other equipment needed to monitor and operate the BRT system. New computer systems would manage the Automatic Passenger Counter (APC) and Automated Stop Announcement (ASA) systems. These would be workstations that would process the data associated with these systems. Other central systems costs would include: video monitors and a video switch for security monitoring at dispatch, costs for licenses and other fees for the automatic vehicle location (AVL) service, and additional staff for monitoring and dispatch. Some of these central system improvements may exist or be desirable for other Sound Transit, King County Metro or Community Transit services, allowing the systems costs to be shared with the other transit agencies. Tables 10 and 11 lists the unit capital and operating costs for central systems improvements.

Table 10. Central Systems Capital Unit Costs

Central Systems Component	Unit Cost
APC Central System	\$62,500 total
ASA Central System	\$57,500 total
Contracted AVL Information Fees	\$11,000 total
Hardware for Security System	\$15,000 total
Integration of Security System with Existing Systems	\$50,000 total
Video Monitor for Security System	\$3,500 each

Table 11. Central System Operating Unit Costs

Central Systems and Dispatch Component	Unit Cost
Additional Dispatch and Security Staff	\$65,000 per FTE

Implementation Costs

The cost estimate assumes one-time implementation costs for consultant services and internal costs within the transit agency as shown in Table 12. These costs would be associated with the design and implementation of the service and the associated systems.

Table 12. Implementation Unit Costs

Implementation Component	Unit Cost
Consultant Services	\$500,000
Internal Costs (5% of capital)	\$600,000

Low-BRT and High-BRT Costs Estimate

The Low-BRT and High-BRT cost estimates both provide the principle elements and technologies of a BRT system. These costs are shown in Tables 13 and 14. The Low-BRT system includes the major elements of a BRT system that will result in improved the efficiency and effectiveness when compared to typical

corridor service. The Low-BRT system includes buses equipped for AVL, signal prioritization, and smart card readers, along with improved station locations, off-vehicle fare payment and real-time traveler information.

The High-BRT system is identical to the Low-BRT estimate except it includes platform loading with precision docking vehicles at BRT stop locations, and all-door boarding and alighting with on-board ticket inspections. The High-BRT does not require wheelchair lifts or ramps on buses due to level platform loading. Operating and maintenance costs are assumed to be similar between the two estimates. Capital costs for the BRT system are estimated between \$236.8 million and \$281.7 million for implementation of the BRT system, including BAT lane construction and associated roadway improvements. Annual operating costs are estimated between \$5.2 million and \$6.0 million.

Table 13. Estimated Capital Costs

BRT System	Low-BRT (000s)	High-BRT (000s)
Vehicles Systems	\$12,700 - 14,600	\$13,900 - 16,000
Stop Systems	\$7,400 - 8,500	\$9,100 - 10,500
Speed & Reliability	\$215,400 - 253,700	\$215,400 - 253,700
Central Systems	\$200	\$200
Implementation Costs	\$1,100 - 1,300	\$1,100 - 1,300
Total	\$236,800 – 278,300	\$239,700- 281,700

Table 14. Estimated Operating Costs

BRT System	Low-BRT (000s)	High-BRT (000s)
Vehicles Systems	\$4,730 - 5,440	\$4,730 - 5,440
Stop Systems	\$260 - 300	\$340 - 390
Central Systems	\$160 - 180	\$160 -180
Total Capital Costs	\$5,150 - 5,920	\$5,230 - 6,010

7. Sound Transit as an Implementer of BRT

If bus rapid transit is pursued as a new transit option in the SR 99 corridor, Sound Transit could be involved in a number of ways. All of them recognize that existing transit services in this corridor are very important to King County Metro, Community Transit and Everett Transit and their customers, that those agencies are already planning bus rapid transit improvement projects of their own, and that depending on the BRT service design that is pursued, Sound Transit would be a partner with some or all of those agencies in any role it might assume. This section outlines some of the opportunities and challenges that partnerships might present in several key issue areas.

7.1 Operational Issues

Though there have been discussions recently, to Sound Transit's knowledge there are no firm current plans by either King County Metro or Community Transit to operate bus rapid transit across the King-Snohomish County line. One of the challenges in operating service across the line is that the routes that currently serve the corridor on either side of the line are already long and sometimes unreliable. Operating an even longer route could magnify reliability problems, especially if further investments to enhance transit speed and reliability are not implemented. However, the package of capital improvements outlined in this paper could significantly improve transit speed and reliability along the corridor, and make operation of longer routes more feasible.

Another significant issue is the operating cost of achieving the service frequencies envisioned as part of a continuous BRT system between Everett and Seattle. Currently, both Community Transit and King County Metro provide base service headways of 15 minutes in both directions on weekdays (Everett Transit 20 minutes), with more frequent peak-period, peak direction service, and less frequent weekend and evening service. The costs of either improving those existing services to 10 minute base service and 15 minutes at other times (if BRT service were to be created by changing current services), or adding BRT service as an overlay at those frequencies, are significant. None of those agencies currently has unused operating funds that they could prioritize on an on-going basis to achieve this level of service improvement without foregoing other service improvement needs throughout their service areas. Sound Transit, through voter-approved operations funding as part of a potential future investment phase, might bring dedicated, on-going operating funds to the corridor. Alternately, Sound Transit might support initial BRT service investment for a defined period of time, with agreement from the other operators that they would assume those operating costs over time as their revenues grow. This approach would free up Sound Transit financing capacity in future phases for additional HCT capital investment. A hybrid approach would have some or all agencies sharing the additional operating costs required to create BRT along the corridor.

7.2 Ridership and Revenue

SR 99 is the highest ridership corridor in both Everett Transit's and Community Transit's systems. It is among the top ten in King County Metro's system. As a result, each service generates significant fare revenue for those agencies, and the ridership carried on each contributes to each agency's ability to compete for grant funds that are prioritized at least in part based on ridership. If Sound Transit were to fund service in the corridor, some riders would end up on Sound Transit service rather than the other operators' services, and the fare revenues they generate would flow to Sound Transit instead of the other operators. It is unclear whether this would result in a net reduction in ridership and fare revenue for those agencies, or whether the addition of new service might generate enough additional demand to offset the movement of riders between the services, or even add riders to existing services as well as Sound Transit service. However, the possibility of lost revenues is a significant concern in this era of tight transit agency budgets. Whatever partnering approach might be selected would need to address how to equitably share credit for ridership and fare revenues among the participating agencies.

7.3 Capital Facilities

As discussed elsewhere in this paper, there are a number of capital improvements that could be made throughout the SR 99 corridor to support provision of bus rapid transit service, such as filling gaps in the BAT lane system, installing transit signal priority at more intersections, upgrading BRT stops to emulate rail stations, buying unique buses and improving customer information and security through intelligent transportation system investments. The other transit agencies' capital budgets must address a wide variety of needs around their systems, and they may not be able to dedicate as much investment to this one corridor as might be necessary to achieve the BRT system that has been defined for SR 99 and performance that is anticipated. However, through the process of prioritizing potential next phase investments, Sound Transit could potentially target specific capital funds to "fill out" the remaining BRT capital needs along the corridor. This could help achieve the full build-out of BRT capital facilities sooner than otherwise might happen if King County Metro, Community Transit and Everett Transit were to prioritize those investments out of their own capital budgets.

7.4 Branding

One of the primary components of successful bus rapid transit systems seems to be that they stand out as "different" from other transit services. This makes it easier to capture current and potential new riders' attention and market the service as something they should try. Development of BRT along the SR 99 corridor provides a unique opportunity for partnerships among Sound Transit and up to three other transit operators, including the branding and marketing of such service. Options apparent at this time include jointly-branded service and/or facilities that showcase each agency's participation with its own brand, or creation of a new "combined" brand that visibly communicates each agency's role in the

partnership while also communicating the distinctiveness of BRT from other services of any of the agencies. As noted, current services along SR 99 are very important to each of the current operators, and maintaining the visibility of their brand to communicate to their riders and taxpayers what their fare and tax revenues are buying will likely be a pre-requisite for any partnership. If Sound Transit were to invest in developing bus rapid transit along SR 99, it's reasonable that Sound Transit should expect its investment to be similarly visible for the same purposes.