Appendix B: Articulated Buses

Whatcom Transportation Authority
2017 Strategic Plan

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ARTICULATED BUSES

OVERVIEW

As part of the Six-Year Strategic Plan, WTA is examining a variety of strategies to position the agency for future success across all aspects of operations. Potential strategies under consideration involve determining if there are ways to manage demand and/or reduce emissions, such as diversifying the fleet to include articulated or electric vehicles.

In terms of vehicle size, WTA has investigated the use of articulated vehicles to help alleviate demand issues on high demand routes serving WWU. When overloads occur on these routes, WTA operates "shuttle" trips to provide additional capacity. Shuttle trips are usually only used to cover the part of the route where they are needed. However, shuttle trips can be expensive because they require additional vehicles and operators at the times of highest system demand. An alternative to operating some of these shuttle trips is to operate articulated buses with greater capacity on regular trips. This chapter evaluates the costs and benefits of this strategy to manage demand and mitigate the use of shuttle trips.

VEHICLE TYPES

In fixed-route service, three vehicle types are most commonly seen at transit agencies across the U.S. Heavy-duty small buses are essentially a shortened 29 to 35-foot version of the standard 40-foot transit bus. In addition to use of heavy-duty small buses and standard buses, articulated buses provide a high-capacity option for routes with significant ridership demand. Outside of the six-year timeframe of this strategic plan, WTA may begin to consider implementation of high-capacity transit options such as Bus Rapid Transit (BRT), and articulated vehicles would provide a likely option for this type of service.

In fixed-route operations, WTA currently uses a small number of 29-foot and 35-foot vehicles, but the majority of the fleet is made up of standard 40-foot vehicles. These buses are well-suited for operations in Whatcom County and have served the agency well. One consideration with articulated buses is that they are less capable in snow compared to standard buses and can be prone to jackknifing, particularly on streets with a significant grade. For this reason, if WTA were to introduce articulated buses, it may need to substitute standard buses in snow conditions due to the topography of the area.

Figure 1 Vehicle Types

Heavy-Duty Small Bus

Typical Uses: Low demand fixed-route services

Cost: $401,431 (30 ft)

Length: 29-35 ft

Seats: 22 to 31

Maximum Capacity: 45

Standard Bus

Typical Uses: Fixed-route urban transit service

Cost: $413,581

Length: 40 ft

Seats: 35 to 38

Maximum Capacity: 57

Articulated Bus

Typical Uses: High-use fixed-route transit service, bus rapid transit

Cost: $675,702

Length: 60 ft

Seats: 50 to 55

Maximum Capacity: 82

Note: The costs listed are base costs from the WSDOT state contract and do not include additional features required by WTA that can add $100,000 or more to the price.

FUEL CONSUMPTION AND MAINTENANCE COSTS

National experience shows that there are additional costs associated with articulated buses compared to standard buses (Figure 2).[1] Compared to standard 40-foot vehicles, articulated vehicles are estimated to cost approximately 33% more in terms of fuel consumption and 43% more in terms of maintenance. Additional fuel consumption and maintenance costs associated with operating articulated vehicles can translate to significant additional costs per hour, as shown in Figure 3.[2] It is estimated that articulated buses would cost $11.47 per hour more than existing WTA buses (an 8% increase). This is significantly lower than the cost increase associated with fuel and maintenance because these costs make up only a small portion of overall operating costs, with other costs such as personnel wages and benefits comprising the majority of costs.

[1] Values include diesel vehicles only

[2] The costs shown were developed as part of an analysis conducted for Metro Transit in Madison, WI to consider the costs and benefits of diversifying their fleet

Figure 2 Operating Cost Differential Compared to Standard Vehicles

Vehicle Type	Length	Additional Fuel Consumption	Additional Maintenance Cost
Standard	40’	-	-
Articulated	60’	33%	43%

Source: Transit Cooperative Research Program and the Center for Urban Transit Research (CUTR)

Figure 3 Estimated Hourly Operating Cost by Vehicle Size

	Existing WTA Costs	Estimated Articulated Bus Costs
Fuel	$6.05	$9.00
Maintenance	$19.71	$28.23
Other operating costs (includes personnel wages, benefits, administration, and other costs)	$106.18	$106.18
Total Cost per Revenue Hour	**$131.94**	**$143.41**

ARTICULATED BUS OPERATING SCENARIOS

Two scenarios were developed to assess the costs and benefits of introducing articulated buses into the WTA fleet. Articulated buses are typically deployed on routes with high demand, often on trips where all seats on a standard bus are filled and riders must stand. On WTA routes, this happens most frequently on service to WWU, where many shuttle trips operate to provide enough capacity so that riders are not left at the curb due to overloaded buses.

Route 190 Existing Service

The first articulated bus operating scenario examines the 12-year aggregate cost savings of replacing one of the existing Route 190 shuttle buses with an articulated bus and reducing an additional afternoon peak vehicle. It is estimated that this combination would save $2,401,895 in operating costs over the 12-year lifespan of a bus. The additional cost of five articulated buses compared to standard buses is calculated to be $1,310,605. As shown in Notes:
A. Takes into account additional operating and maintenance costs associated with articulated buses as well as cost savings from operating fewer shuttle trips. Cost per hour increase each year is based on WTA long-range financial model.
B. Based on assumption that capital cost of articulated buses is an additional $262,121 compared to standard buses.

, this leads to a 12-year aggregate savings of $1,091,290 in operating costs.

Route 190 Proposed Service

As proposed under the short-term service recommendations of this study, Route 190 would become a Go Line and operate every 15 minutes. It is assumed that Route 190 would operate with articulated buses instead of standard buses, providing additional capacity on the route.[3] To offset this additional capacity, trips on the proposed 190 Shuttle and Billy Frank Jr Shuttle would be reduced.

Based on an analysis of passenger loads, it is estimated that shuttle service could be reduced by approximately 10 daily revenue hours (approximately 45 shuttle trips) and one peak bus while still providing adequate capacity. It is estimated that this combination would save $1,996,596 in operating costs over the 12-year lifespan of a bus. The additional cost of four articulated buses compared to standard buses is calculated to be $1,048,484. As shown in Figure 5, this leads to a 12-year aggregate savings of $948,112 in operating costs.

Figure 4 Route 190 Existing Service Articulated Bus Operating Scenario 12-Year Cost Savings

Category	Cost
12-year operating cost savings by using 5 articulated buses[A]	$2,401,895
Additional vehicle cost of 5 articulated buses compared to standard buses[B]	$1,310,605
12-year aggregate savings	**$1,091,290**

Notes:
A. Takes into account additional operating and maintenance costs associated with articulated buses as well as cost savings from operating fewer shuttle trips. Cost per hour increase each year is based on WTA long-range financial model.
B. Based on assumption that capital cost of articulated buses is an additional $262,121 compared to standard buses.

[3] It is assumed that Route 190 would operate with standard buses when WWU is not in session.

Figure 5 Route 190 Proposed Service Articulated Bus Operating Scenario 12-Year Cost Savings

Category	Cost
12-year operating cost savings by using 4 articulated buses[A]	$1,996,596
Additional vehicle cost of 4 articulated buses compared to standard buses[B]	$1,048,484
12-year aggregate savings	**$948,112**

Notes:
A. Takes into account additional operating and maintenance costs associated with articulated buses as well as cost savings from operating fewer shuttle trips. Cost per hour increase each year is based on WTA long-range financial model.
B. Based on assumption that capital cost of articulated buses is an additional $262,121 compared to standard buses.

FACILITIES NEEDS

In addition to operating and vehicle cost considerations, facility improvements would be necessary to accommodate articulated vehicles in the system.

MOAB and Bus Stop Improvements

All WTA buses are stored and maintained at the Maintenance, Operations, and Administration (MOAB) facility at 4111 Bakerview Spur Road. The existing facility does not have the ability to lift and maintain 60-foot articulated buses; construction of a new lift would be required to accommodate articulated buses. Additionally, a series of bus stops along Lincoln Street and Bill McDonald Parkway have been identified for expansion to accommodate articulated vehicles. Cost estimates for improvements to the MOAB facility and bus stops are provided in Figure 6. The total estimated cost is $1.9 million.

Figure 6 MOAB and Bus Stops Facilities Improvement Costs

Improvements to Accommodate Articulated Vehicles	Estimated Cost
New 82’ x 20’ Maintenance Bay at MOAB Facility	$703,093
Lincoln Street Bus Stop Improvements	$271,635
Bill McDonald Parkway Bus Stop Improvements	$414,042
Fees & Permits	$529,374
Total	**$1,918,144**

Source: WTA

Bellingham Station Expansion

Additionally, WTA would need to conduct a retrofit of the existing Bellingham Transit Station to allow for circulation of articulated vehicles within the existing site. The proposed station improvements would incorporate existing station architecture and are shown in Figure 7. Station improvements would be achieved by expanding the station onto Railroad Avenue and by absorbing one row of on-street parking. The new concourse would handle four 40-foot buses or two articulated buses plus one 40-foot bus. Costs for this expansion have not been estimated and the expansion has benefits beyond accommodating articulated buses, so the costs for this have not been included in the cost comparison.

Figure 7 Bellingham Station Expansion

Source: WTA

RECOMMENDATION

Based on the operating scenarios presented above, introducing articulated buses into the WTA fleet is projected to lead to operating cost savings by reducing the number of shuttle trips that would need to be operated to WWU. However, costs associated with upgrading facilities to accommodate articulated buses would completely offset those cost savings. Therefore, deploying articulated buses is not recommended at this time.

As WTA expands and upgrades existing facilities, the agency will plan improvements to accommodate articulated vehicles. As such, articulated vehicles may become a more cost-effective option for future implementation and should continue to be evaluated.