

Central Link and Airport Link Project Before-and-After Study (2013)

Seattle, Washington



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Central Link Initial Segment and Airport Link Project; Seattle, Washington

The Central Link Initial Segment and Airport Link project is a 15.6-mile light rail line extending south from downtown Seattle to the Seattle-Tacoma International Airport (Sea-Tac). The project comprises two increments of the longer Central Link line planned for the north-south corridor through downtown Seattle: the Initial Segment from downtown to S. 154th St. and the Airport Link extension from S. 154th St. to Sea-Tac. The accompanying figure provides a map of the project.



Initial Segment and Airport Link

At various points during planning and project development, the two increments were components of a single project while at other points they were defined as separate projects. Both opened to service in 2009 – the Initial Segment in July and the Airport Link in December. Because their planning, development, and outcomes are closely related, the two segments are documented as one project for the purposes of this Before-and-After Study.

Sound Transit planned and developed the Initial/Airport Link project. Sound Transit now operates the light rail line in addition to express bus and commuter rail services in the Seattle metropolitan area.

The project emerged from a complex history of planning, project development, and decision-making in the north-south corridor. Sound Transit completed a major investment study (MIS) in 1997 and a Draft Environmental Impact

Statement in 1998 and adopted a locally preferred alternative (LPA) for the corridor in 1999. The 20-mile LPA extended south from NE 45th St. in the University District, through downtown Seattle and the Rainier Valley, and past Sea-Tea to a southern terminus at S. 200th St. The Final

Environment Impact Statement in late 1999 and the Record of Decision (ROD) issued by the Federal Transit Administration (FTA) in early 2000 completed the environmental process for the LPA with only minor modifications to the project.

Later in 2000, FTA approved entry into final design of both the LPA and a 7-mile minimum operable segment (MOS-1) extending from the LPA's northern terminus to an interim terminus just south of downtown Seattle. Initial work in final design identified engineering and cost difficulties, including unstable soils, higher right-of-way costs, and higher construction costs. In response, Sound Transit increased the project budget and schedule. These changes were included in the Full Funding Grant Agreement (FFGA) for MOS-1 that was executed by FTA and Sound Transit in January 2001.

In April 2001, a review of the project by the Inspector General of the U.S. Department of Transportation concluded with recommendations that: FTA defer funding until Sound Transit had identified all issues that could affect the project's scope, cost, and schedule; FTA and its project management oversight contractor (PMOC) validate the project's estimated cost to complete; and FTA and its financial management oversight (FMO) Contractor validate the sufficiency of local funding sources to complete the project.

In response to the Inspector General's recommendations, Sound Transit reexamined the project and decided not to proceed with MOS-1. In November 2001, Sound Transit instead identified the Initial Segment project as the priority for construction. An Environmental Assessment (EA) (February 2002) and FTA's Amended Record of Decision (May 2002) concluded the environmental review of the Initial Segment project. In October 2003, FTA and Sound Transit executed an FFGA providing \$500 million in New Starts funding for the project.

Sound Transit continued development of the Airport Link extension, completing an EA for the project in May 2005 leading to FTA issuance of a ROD in September 2005. As construction of the Initial Segment project neared completion, it became clear that the project would be completed under budget. FTA and Sound Transit agreed that remaining New Starts funds would be used to help fund the Airport Link extension. The two agencies signed an amended FFGA in 2008 to add the Airport Link to the scope of the FFGA while keeping the New Starts funding at \$500 million. The Initial Segment opened to service in July, 2009, and the Airport Link extension opened in December, 2009.

This complex history poses a challenge for the predicted-versus-actual comparisons in the Before-and-After Study. While the project actually built extends from downtown Seattle to Sea-Tac airport, the LPA at various milestones in project development anticipated a project that extended three miles further north and one mile further south. To make the comparisons meaningful, the analysis Sound Transit extracted from the LPA at each milestone the component that most closely matches the project. Consequently, all predicted-versus-actual comparisons are between the as-built project and the portion of the LPA at each milestone that best corresponds to the as-built project.

Physical scope of the project

The project is a 15.6-mile, double-tracked light rail line that extends from downtown Seattle to the Seattle-Tacoma Airport. The north end of the line is located in the 1.3-mile Downtown Seattle Transit Tunnel (DSTT) where it serves four stations. Project construction included a substantial retrofit of the tunnel to accommodate the light rail line and convert it from bus-only

to mixed bus/train operations. South of downtown, the line runs at grade through an industrial area and then enters a 1-mile tunnel bored through Beacon Hill to the Rainier Valley. The Beacon Hill tunnel includes one underground station. The line is located at grade in the Rainier Valley with four stations. Further south, the line is largely elevated to traverse difficult terrain and then climb the hill to the airport. Over its 15.6 miles and 13 stations, the line is at grade for 6.3 miles with five stations, elevated for 7.0 miles with three stations, and in tunnel for 2.3 miles with five stations. The stations accommodate 4-car trains and have low platforms that provide level boarding with the low-floor vehicles. The project includes 35 light rail vehicles, 95 feet long and double-articulated as well as a 25-acre operations and maintenance facility located in the industrial area just south of downtown Seattle. The single park-and-ride lot is located at the Tukwila station with 600 parking spaces. All stations have adjacent bus-loading zone, mostly on-street.

The facility was expanded in 2008 to accommodate up to 104 vehicles as part of the University Link extension schedule to open in 2016.

The anticipated scope of the project during planning and project development was largely consistent with the actual outcome on the physical scope of the project. At PE-entry, the anticipated scope had five differences from the as-built scope:

- The DSTT was planned to operate with light rail trains only instead of the joint bus and light rail operation of the as-built project; the joint-operations plan was adopted during PE.
- South of downtown Seattle, the planned alignment was at-grade and slightly shorter than the elevated alignment of the as-built project; the as-built alignment was adopted during PE.
- The alignment through Tukwila was in the median of Tukwila International Blvd. and was 1.1 miles shorter than the Tukwila Freeway alignment of the as-built project; the as-built alignment was adopted during PE.
- The scope of the project included two stations – Boeing Access Road and South 144th Street – that were not built; these stations were dropped during PE.
- The planned scope did not include the Beacon Hill station; this station was added to the project scope at the Amended FFGA.

Changes made during PE to the anticipated project scope brought it into close agreement with the as-built scope by the FD-entry milestone. The only significant differences at FD-entry were the continued absence of the Beacon Hill station and the now-deferred Stadium station. No significant scope characteristics changed during FD; so the anticipated scope continued to match the as-built scope quite closely. The addition of the Beacon Hill and Stadium stations at the Amended FFGA brought the planned scope into full agreement with the actual outcome.

Capital cost

The actual cost of the combined Central Link Initial Segment and Airport Link project was \$2.558 billion in year-of-expenditure (YOE) dollars. Physical elements accounted for 60 percent of the cost, including the guideway and track-work (27 percent), systems (12 percent), stations and ventilation (7 percent), utilities and roadway (7 percent), vehicles (6 percent) and other specialty items (1 percent). Costs of services and administration were 20 percent of the total

cost. Right-of-way acquisition required nine percent and financing costs represented seven percent. Miscellaneous other capital expenditures made up the remaining four percent. The average per-mile cost was \$164 million including all capital costs.

In YOE dollars, predicted capital costs for the combined project were low by \$700 million (27 percent) at entry into PE and then high by \$90-130 million (four to five percent) at FD-entry, the FFGA, and the Amended FFGA. (While the Airport Link extension was not advanced into PE or FD along with the Initial Segment, or included within the FFGA scope, its separately estimated cost is included at these milestones to permit meaningful comparisons with the actual capital cost of the combined project.) In constant-dollar terms that remove inflation effects from the comparisons, predicted costs were low by \$560 million (21 percent) at PE-entry and then high by \$410-460 million (15 to 17 percent) at FD-entry, the FFGA, and the Amended FFGA.

The significant underestimate at the PE-entry milestone is attributable to: (1) later changes to an elevated alignment south of downtown Seattle and a longer alignment through Tukwila; (2) later additions to the signaling and communication systems in the DSTT to permit mixed bus and rail operations; (3) some \$400 million in project contingency reserve, financing costs, and DSTT debt service – cost categories not included in the predicted cost at PE-entry; (4) an expected opening year for the project in 2006 rather than the actual 2009 opening, leading to three additional years of inflation in construction costs; and (5) higher than expected annual rates of inflation over the course of project development and construction; actual inflation in construction costs from the entry into PE in 1999 to the opening year totaled 40 percent as the expanding national and world economies, plus weather events in the United States, contributed to rapidly rising prices for steel, concrete, and construction labor.

The overestimates at the later milestones are attributable to: (1) overestimated right-of-way costs because of higher than actual expectations increases in real estate prices; (2) a conservative approach to cost estimation as Sound Transit worked with FTA staff and FTA's project management oversight contractors in the wake of the cost estimating problems encountered for the earlier MOS-1 project; (3) FTA concerns on possible risks associated with the Beacon Hill tunnel; and (4) the \$130 million project reserve required by FTA of which only \$35 million was used. In constant-dollar terms, these differences led to overestimates of actual costs in the range of 15 to 17 percent; in YOE dollar terms, higher than expected inflation reduced the overestimates to four to five percent. The differences between the constant-dollar and YOE-dollar comparisons indicate that, without the high rates of inflation in the mid-2000s that were not anticipated by any project sponsor or by FTA, the cost of the combined project would have come in substantially under the cautiously prepared estimates. In the outcome, the unexpectedly high actual rates of inflation, to a large degree, moderated the extent of the overestimates.

Transit service

The Central Link Initial Segment and Airport Link light rail line provides twenty hours of service on weekdays and Saturdays from 5 a.m. to 1 a.m., and eighteen hours of service on Sundays and holidays from 6 a.m. to midnight. On weekdays, trains run every 7.5 minutes in the peak periods, every 10 minutes during midday and evening hours, and every 15 minutes during early morning and late night hours. On weekends trains run every 10 minutes except during early morning and late night when they run every 15 minutes. The line operates two-car trains at all times. The one-way running time from Westlake Station to SeaTac/Airport Station is 38 minutes including dwell times at stations, an average speed of 24 mph.

Integration of the rail line into the transit system has been guided by a general philosophy that bus service hours saved because of rail would be reinvested in the corridor. Two years after project opening, bus service hours on weekdays and weekends were three percent higher than before opening. This outcome reflects the modest nature and extent of bus changes. The Beacon Hill and Rainier Valley areas of Southeast Seattle have diverse populations of generally lower and lower-middle income families that are served by several of Sound Transit's most frequent and most productive bus routes. These bus routes were largely unaffected by the introduction of rail service – with limited deviations to rail stations, truncations at stations, and adjustments to other routes to replace truncated services. Other bus services were upgraded. In areas further south, Sound Transit eliminated some long routes to downtown Seattle, including the airport-downtown express and introduced new services to light rail stations.

During project development, Sound Transit accurately anticipated the actual service levels on the light rail line in terms of daily hours of service, headways, train length, and end-to-end running time. The only difference is that, throughout project development, Sound Transit planned to operate with 6-minute, peak-period headway on weekdays. Subsequent tests of joint bus-rail operations in the DSTT indicated that the actual 7.5-minute headway would be preferable. In general, adjustments to bus services planned during project development accurately anticipated actual adjustment. Sound Transit established early in project development the governing philosophy of reinvesting bus service hours saved with the introduction of rail service, thereby maintaining consistent aggregate service levels throughout project development. Some planned changes in bus services have not occurred: the planned elimination of direct bus connections between the Rainier Valley and downtown Seattle has not happened, although some reductions have been made in service levels. Sound Transit is gradually completing the planned adjustments to bus service in the corridor, a process slowed to some degree by resistance on the part of current bus riders, particularly in the Rainier Valley.

Operating and maintenance costs

In 2011, the operating and maintenance (O&M) cost of the combined Central Link Initial Segment and Airport Link rail line was \$47.7 million. Labor costs for train operations and maintenance of vehicles and facilities accounted for 44 percent of the total cost. Contracted services, including contracts for maintenance and security with third-party vendors and governmental agencies, represented 24 percent of the total cost. In 2011 dollars, O&M costs for bus service in the corridor remained unchanged from pre-light-rail expenditures.

At the project development milestones, predicted annual O&M costs for light rail in 2011 dollars under-estimated actual costs by \$6-9 million (12 to 19 percent low). At the amended FFGA, the predicted O&M costs were low by \$3 million, or seven percent. The two causes of these underestimates are (1) an unexpected annual charge for Sound Transit's contribution to O&M and debt-service costs of the DSTT and (2) an unexpected increase in security requirements. The DSTT charge (\$5.6 million in 2011) reflects an unanticipated change in Sound Transit accounting procedures that assigns to light rail the payment made annually by Sound Transit to King County, the owner of the DSTT. The increase in security needs reflects new requirements by the U. S. Department of Homeland Security and local police and fire departments after the attacks of 9/11/2001.

Ridership

In the fall of 2011, the combined Central Link Initial Segment and Airport Link project carried 23,400 trips on the average weekday and 7.8 million total trips in calendar year 2011. Rail ridership is somewhat higher than the average during summer months when more sporting and community events occur in downtown Seattle. The tourist and cruise-ship seasons also add to ridership between the airport and downtown Seattle. This seasonality is different from the seasonal character of the bus system where ridership is highest in the fall months when universities and colleges are in session.

Compared to the bus system, light rail riders come from households with significantly higher incomes and marginally higher auto-ownership, and are somewhat more likely to drive and park at their boarding location (even though the project includes only one park-and-ride lot).

Between 2008 and 2011, overall transit ridership in the corridor appears to have increased on weekdays by approximately 7,000 origin-to-destination trips, suggesting that the 23,400 trips on rail are roughly one-third new transit trips and two-thirds former bus riders.

Throughout project development, forecasts for opening-year ridership on light rail consistently overestimated actual ridership. Predicted weekday ridership ranged from 34,900 (high by 11,500 or 49 percent) at PE-entry to 37,800 (high by 14,400 or 62 percent) at FD-entry, the FFGA, and the amended FFGA. Because actual weekend ridership is higher than anticipated in the opening-year forecasts, however, differences are smaller in annual terms: 7.8 million annual light rail trips in 2011 compared to opening year forecasts of 10.6 million (high by 36 percent) at PE-entry and 11.5 million (high by 47 percent) at the later milestones.

These overestimates are caused largely by a problematic forecast of employment in downtown Seattle that was developed by the regional planning agency in 2001 and used by Sound Transit in subsequent ridership forecasts for the project. The employment forecast anticipated rapid growth that located 80,000 more jobs in downtown than were actually there in 2011. This difference by itself accounts for 11,000 light rail trips – 76 percent of the overestimates at the later milestones. Some of the over-prediction of downtown employment is attributable to optimism about downtown growth by the planning agency and the city of Seattle. Some is attributable to the effects of the severe recession starting in 2008 on employment throughout the Seattle metropolitan area. Higher unemployment also reduced economic activity through the area, and with it, ridership on transit, including light rail.

Other contributors include Sound Transits adoption of a distance-based light-rail fare not anticipated in the ridership predictions; light rail fares average \$1.53 per trip compared to the \$1.08 assumed in the predictions. Further, light rail trips made within the DSTT must pay a fare while DSTT bus trips are free, in contrast to the assumption made in the ridership predictions that all DSTT services would be free-fare. Mixed bus and rail operations in the tunnel cause some schedule-adherence difficulties and light rail headways are 7.5 minutes rather than the planned 6.0 minutes. Finally, Sound Transit is making planned changes to bus services gradually and shifts of bus riders to light rail are consequently happening more slowly than expected.