

# North Shore Connector Project Before-and-After Study (2016)

Pittsburgh, Pennsylvania



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## **North Shore Connector; Pittsburgh, PA**

The North Shore Connector project is a 1.2-mile extension of the Pittsburgh light rail system from the existing Gateway station in downtown, under the Allegheny River, to the North Shore district. Figure 3 is a map of the project and its connection to the existing light rail system in downtown Pittsburgh.

The Port Authority of Allegheny County (Port Authority) developed and built the project. Port Authority now operates light rail service on the extension along with bus and light rail services throughout metropolitan Pittsburgh

Planning for an extension of the downtown subway to the North Shore neighborhood of Pittsburgh began in the late 1980s with the Spine Line Study of transit options in a corridor reaching from the North Shore through downtown Pittsburgh and to Oakland and other areas east of downtown. The study examined light rail extensions to the North Shore via an existing highway bridge, an existing railroad bridge, and a new bridge, all with at-grade alignments north of the Allegheny River. That study concluded in 1993 and Port Authority deferred further attention to the corridor while the agency focused on the planning, development, and construction of the Airport Busway. That facility, since renamed as the West Busway, broke ground in 1994 and opened to service in 2001.

Focus on North Shore connections resumed in 1997 with the initiation of a Major Investment Study (MIS) sponsored by the City of Pittsburgh and the Southwestern Pennsylvania Commission. The motivation for the study was to connect the North Shore to downtown as part of the City of Pittsburgh's plan to redevelop and expand its Central Business District beyond the traditional boundaries of the Golden Triangle into both the North Shore and South Shore. The MIS recommended a new rapid transit link between the Golden Triangle and the North Shore. The MIS evaluated many different alignments and three different rapid transit technologies (light rail transit, people mover and low-speed MAGLEV). Two potential alignments and all three technologies were recommended for further analyses.

Port Authority assumed responsibility for the corridor in January 1999 with the initiation of the North Shore Connector Draft Environmental Impact Statement (DEIS) to consider the remaining alternatives. The DEIS effort identified as the Locally Preferred Alternative (LPA) a 1.2-mile light rail extension from a reconstructed Gateway Center Station via a new tunnel under the Allegheny River to an at-grade alignment with three new stations on the North Shore. The LPA also included a 0.3-mile Convention Center extension of the rail spur already in place from Steel Plaza Station to Penn Station.

The proposed project entered into Preliminary Engineering (PE) in January 2001, entered into Final Design (FD) in April 2003, received a Full Funding Grant Agreement (FFGA) in 2006. After the FFGA was awarded, costs escalated and FTA required the development of a Recovery Plan to identify a path to project completion. FTA approved the Recovery Plan in 2009 and the project opened to service in 2012.



Figure 3. The North Shore Connector from Gateway Station to Allegheny Station

During Final Design, escalating costs led to the downsizing of the proposed project and the elimination of the Convention Center extension and other elements of the LPA. Consistent with other Before-and-After Studies of projects with similar histories, this study focuses on the project that was built and the accuracy of the predicted costs and impacts of that project. Consequently, while the study provides context regarding the difficulties that led to downsizing and identifies the elements that were dropped from the project, it considers only the as-built project in the comparisons predicted and actual outcomes.

### **Physical scope**

The North Shore Connector is a 1.2-mile double-tracked LRT extension of the light-rail line in downtown Pittsburgh. The extension is physically and operationally compatible with the existing light rail system -- electrically powered by the same overhead catenary system, outfitted with the same signal and communication systems, and served by the same light rail vehicles. The line is completely grade separated from street traffic and adjacent land uses. The first 0.52 miles of the alignment from Gateway Station are below grade, while the remaining 0.68-miles are on elevated structure. The line transitions from subway to elevated structure approximately midway between the two stadiums on the North Shore.

The project includes the reconstruction of Gateway Station, formerly the terminus of the light-rail subway alignment through downtown, and two new stations on the North Shore. Reconstruction of the underground Gateway Station converted it from a loop turn-around station with east-west oriented side platforms to a through station with a north-south-oriented center platform.

North of the river, the North Side Station is located within the underground segment of the extension and has a center platform. At street level above the station is a high-capacity parking garage that was funded separately from the project, developed by the Pittsburgh Parking Authority, and owned by the Stadium Authority of the City of Pittsburgh. It provides 1,321 spaces in ten floors of parking and includes 25,000 square feet of currently vacant retail space, a transit center lobby, and accommodations for bicycles.

Allegheny Station, the terminus, is on the elevated segment, has a center platform, includes a bus-transfer platform at street level, and has tail tracks for the staging of light-rail vehicles.

The project did not include new light rail vehicles because Port Authority had a sufficient number of spares in the existing 83-vehicle fleet to add trains necessary to provide service on the extension. Consequently, the project did not include any expansion of existing maintenance and storage facilities for light rail vehicles. The project scope also did not include park-ride lots or structures because existing nearby parking facilities – particularly those providing parking for the baseball and football stadiums – have sufficient parking for transit riders.

(As noted above, the scope at PE-entry also included the 0.3-mile extension of the Steel Plaza spur from its current terminus at Penn Station to a new station at the Convention Center. This major element is not part of the project that was built and is therefore not included in this study's comparisons of predicted and actual costs and impacts of the project.)

At entry into PE, the anticipated scope of the project was different from the actual outcome in several ways. First, the anticipated alignment on the North Shore was at-grade with three stations. During PE, however, community concerns about at-grade operations amidst heavy traffic and pedestrian movements during stadium events led to the as-built design with an underground segment transitioning to an elevated segment. Because the grades of the transition do not allow the placement of a station near the transition, Port Authority eliminated one of the three anticipated North Shore stations. Second, the anticipated scope included the purchase of 10 new light rail vehicles. Further analysis during PE determined that only four new vehicles would be needed to provide service with the short extension of the rail system. Finally, the anticipated scope included a new mid-day storage facility for light rail vehicles. With the later elimination of new vehicles from the project scope, Port Authority reduced the storage facility to two tail tracks at the Allegheny Station.

At entry into FD, the anticipated scope was different from the actual as-built project only in the anticipated purchase of four light rail vehicles. (The scope at FD-entry also continued to include the extension of the Steel Plaza spur to Penn Station that was later dropped from the project.) During FD, Port Authority began to solicit construction bids and, given the complexity and risks associated with the tunnel segment underneath the river, included the tunnels among the first solicitations. When the bid prices for the tunnels came in well above the budgeted amounts, Port Authority undertook a comprehensive analysis to determine which elements of the project could be deferred. The analysis led to a decision to drop the four vehicles (and the Convention Center extension) from the project scope.

At the FFGA, the anticipated scope of the project matched the actual as-built project. Costs continued to escalate after the FFGA and FTA required the development of a Recovery Plan to identify a path to project completion. The Recovery Plan detailed the specific risk mitigation measures that were taken by Port Authority to mitigate cost and schedule issues. It focused on changes to the project schedule, budget performance, financial management, and capacity to complete the project. The Recovery Plan produced an updated cost for the project but made no changes to the project scope as defined in the FFGA.

### **Capital cost**

The actual capital cost of the project was \$510.4 million in year-of-expenditure (YOE) dollars. Construction costs represented 76 percent of the total. Construction of the guideway, including both the tunnels and the elevated segment, was the most costly component (31 percent of the total cost), followed by construction of the stations (24 percent), site-work (13 percent), and systems (8 percent). The costs of all non-construction items were limited to 24 percent of total project costs including real estate (2 percent) and professional services (22 percent). The relatively large share of project costs associated with stations reflects the scale of the reconstruction of the underground Gateway Station and the construction of relatively costly North Shore stations – one underground and one elevated. The small shares for site-work and real estate reflect the underground alignment of approximately one half of the project length, the use of public rights-of-way where possible, and the limited at-grade footprint of the elevated segment.

Under-estimates of project costs were a persistent problem throughout the development of the North Shore Connector. (The following comparisons exclude the predicted cost of the Convention Center extension because it was dropped from the as-built project.) At PE-entry, the predicted cost in YOE-dollars (that includes both the baseline cost estimate in constant dollars and the effects of anticipated annual rates of inflation in construction costs over the anticipated construction schedule) was \$326.7 million, an underestimate of \$183.7 million (36 percent) compared to the actual cost of \$510.4 million. Two-thirds of this under-estimate was the result of underestimated baseline unit costs and an understated scope: the anticipated scope had the North Shore alignment and stations at-grade rather than the actual outcome in tunnel and on elevated structure. This difference was offset somewhat by the 10 new light rail vehicles and their new maintenance facility in the anticipated scope that were not part of the actual outcome. The remainder is attributable to schedule delays (21 percent) and higher-than-anticipated rates of inflation in construction costs (13 percent).

At entry into Final Design, the predicted YOE cost was \$326.8 million, an underestimate of \$183.6 million (36 percent). Because the anticipated project scope at this milestone was much closer to the actual outcome, most (80 percent) of the under-estimate was because of underestimated unit costs. The remaining 20 percent occurred because of schedule delays. None of the difference was the result of anticipated rates of construction inflation as projected inflation rates aligned closely with actual inflation rates.

At the FFGA, the predicted YOE cost was \$435.0 million, an underestimate of \$75.3 million. All of this under-estimate occurred because of underestimated unit costs in baseline-year dollars. Predicted costs of inflation matched the actual outcomes closely. The Recovery Plan produced a revised estimate for total project costs of \$538.7 million, an overestimate of \$28.4 million (5.6 percent).

### **Transit service**

Service on the North Shore Connector is provided by the Red and Blue Lines that originate from various points in southern Allegheny County, pass through downtown Pittsburgh, and cross the Allegheny River to the North Shore. All trains entering downtown proceed to the Allegheny Station terminus on the North Shore. The combined frequency of the Red and Blue Lines in the morning and afternoon peak periods is 15 trains per hour – averaging 4-minute headways between trains. Headways lengthen to 7.5 minutes mid-day, 10 minutes in the evenings, and 7.5-minute headways on Saturdays and Sundays. All trains have 2-car consists in the peak periods and for special events and one-car consists mid-day, evenings, and weekends. The runtime from the Wood Street Station in downtown Pittsburgh to Allegheny Station in the North Shore averages nine minutes (an average operating speed of 8.6 mph).

Two bus routes connect to light rail at Allegheny Station. The #14 extends northwest, serving communities along the Ohio River. The #18 serves the nearby Manchester section of the North Shore. Both routes terminate at Allegheny Station.

The principal changes to the existing transit system that were made with the opening of the project were the conversion of the #18 and #14 bus routes into feeder routes to Allegheny Station. Before project opening, both routes crossed the Allegheny River into downtown. Now,

all riders destined for downtown on these two routes must transfer at Allegheny Station in order to continue their trips. The additional transfer and waiting times increased travel time by three minutes for riders traveling from Manchester and Ohio Valley destinations to downtown Pittsburgh. None of the 10 other bus routes serving the North Shore was similarly affected.

The service plans prepared during project development anticipated accurately the actual service levels for both light rail and bus routes in the North Shore area. Those plans did not foresee the system-wide service reductions made by Port Authority in 2007 and 2011 in response to budget constraints. While these reductions did not affect service on the project or North Shore bus routes, they eliminated 27 percent of all Port Authority transit service. The consequence was a four percent reduction in ridership and a more efficient transit system.

### **Operating and maintenance (O&M) costs**

Port Authority estimates that the share of system-wide light rail O&M costs attributable to service on the North Shore Connector was \$4.0 million in 2013 – an increase of 17 percent in system-wide light rail costs compared to 2011, before the extension opened to service. The savings in bus O&M costs attributable to the rerouting of the #14 and #18 bus routes from downtown to Allegheny Station is estimated to be \$2.5 million.

At PE-entry, predictions of the O&M costs of the extension of the light rail system anticipated an increase of \$4.7 million, an overestimate of actual costs by 17 percent.

### **Ridership**

Actual ridership on the North Shore Connector in March 2016 was 11,100 trips per average weekday. Of this total, 7,400 trips were made to jobs, shopping, and other activities in downtown Pittsburgh. Sixty percent of these trips to downtown came from the immediate North Shore area and other areas of Allegheny County further north and northwest. However, trips on the project originated in other neighborhoods throughout the greater Pittsburgh area – including southern areas of the City of Pittsburgh and Allegheny County. This pattern occurs because travelers to downtown find it convenient to use a less costly parking facility near one of the North Shore stations and then use light rail to complete their trips into downtown.

Another 1,500 trips were made to jobs, education, entertainment, and other activities on the North Shore. These trips originated throughout areas to the south of the Allegheny River.

Trips between home and work represented 64 percent of all trips on the project; trips between home and non-work activities were another 22 percent; and trips between two non-home locations were 14 percent of all project trips. Some 56 percent of all trips on the project relied on park-ride to access the transit system and then, later in the day, to return home. For project trips destined for downtown Pittsburgh, the park-ride share was 67 percent. A direct walk from and back to home provided access to the project for 20 percent of all project trips while 5 percent of all trips on the project used a bus from and back to home. Travelers from 0-car households comprised 15 percent of all trips on the project but just 6 percent of project trips destined for downtown Pittsburgh.

Port Authority predicted that 14,300 trips would use the North Shore Connector in 2025. Because no opening-year forecast was prepared, a direct comparison with actual ridership in 2016 is not possible. However, reaching the 2025 forecasts from current levels would require average annual ridership growth of 2.85 percent. The likelihood of that outcome depends on a host of influences including the continuation of the fare-free zone for trips between the North Shore and downtown, the health of the downtown economy, continued development of the North Shore, the availability of operating funding sufficient to maintain current service levels, gasoline prices, and other factors.