APPENDIX E
Alternative PA-1X Elimination Memo

Technical Memorandum

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SUBJECT: PATCO Philadelphia Waterfront Transit Expansion Alternative Analysis – Fatal Flaw Analysis Draft for Alternative PA-1 Extended

The purpose of this Technical Memorandum is to detail the reasons why Alternative PA-1 Extended should be eliminated from further consideration as a build alternative as part of the PATCO Philadelphia Waterfront Transit Expansion Alternatives Analysis.

Introduction

Build Alternative PA-1 Extended would provide a connection between SEPTA's Subway-Surface Line trolley tunnel under City Hall and the Philadelphia Waterfront transit service being evaluated in this Alternatives Analysis via tunnel connection at the northeast corner of the SEPTA City Hall trolley route. The alternative would create a linkage, either through a direct track connection or a pedestrian transfer between the existing SEPTA system and proposed Waterfront transit system.

The connection would occur in the line segment between the existing Juniper Street Subway-Surface station and the proposed Arch Street subway. At this point, the new trolley tunnels would pass beneath the 4-track Center City Commuter Connection (CCCC) tunnel. Both of these trolley tunnels would be located under Juniper Street in the block between Arch Street and JFK Boulevard.

The alignment envisaged for the PA-1 Extended Alternative would be in a relatively shallow subway under Arch Street between the vicinity of 9th Street and Juniper Street. These tunnels would necessarily have to pass beneath the CCCC tunnel. It has been determined that the top-of-rail elevation under the CCCC tunnel would need to be -24.0 feet. The lowest elevation of existing track in the Juniper Street station is 0.0. This would require significant gradients on the connecting tracks.

The Center City portion of the routing reference in this technical memorandum is shown in Figure 1.

Figure 1. Alternative PA-1 Extended – Center City Portion

WESTBOUND CONNECTION

From its elevation under Arch Street the new westbound trolley tunnel would slope downward to a depth sufficient to pass under the CCCC tunnel. From there it would curve westward, pass under the shallower existing trolley tunnel beneath JFK Boulevard and then slope upward to reach the grade of that tunnel at a point just east of the 15th Street/Dilworth Plaza Subway-Surface station.

The gradient of this upward slope would be in the range of 7%, which is steeper than any on the surviving local trolley network. There were comparable gradients on some lines no longer operated with trolleys (e.g. Wayne Avenue south of Lincoln Drive) and there are even steeper gradients elsewhere. Contemporary LRT systems have gradients in this range and traditional streetcar systems had gradients as steep as 12%. Consequently, a possible gradient of 7%, or even 8%, for the westbound connection is not viewed as a fatal flaw.

The downward slope in the westbound tunnel from Arch Street to the low point under the CCCC tunnel would not be critical. The descent could begin as far upstream as necessary to produce a desired gradient.

EASTBOUND CONNECTION

The west end of the new eastbound trolley tunnel would be constructed along the horizontal alignment of the spur track that diverges from the existing Subway-Surface track at the north end of the Juniper Street station. This spur track tunnel ends at the south wall of the CCCC tunnel.

The main portion of the Juniper Street station platform and the adjacent operating track, which are directly under the 13th Street station of the Market Street Subway, are flat and level. However, in the north wing of the station, past the north side of the 13th Street subway station above, the track and platform begin to curve upward. For purposes of this memorandum, and for reasons discussed below, the beginning (south end) of this vertical curve will be referenced as “Point A”.

This vertical curve leads into an upward slope on the operating track of 2%. That gradient has been determined from an examination of As-Built drawings of the CCCC tunnel which show 100-foot stationing and elevations along the existing Subway-Surface track beneath JFK Boulevard in the zone where it was impacted by the CCCC project.

As explained above, the new eastbound trolley tunnel would follow the horizontal alignment of the spur track but not its vertical profile. At some location in the Juniper Street station area the track would need to begin its descent to pass beneath the CCCC tunnel.

It is assumed that lowering the track and platform in the main portion of the Juniper Street station would alone represent a fatal flaw due to the construction complexity and potential disruptions to the existing service on SEPTA's Subway-Surface Line service. However, given that the track and platform in the north wing of the station are already on a vertical curve, it may be deduced that a straight and level profile is not essential there. Consequently, the concept evaluated in this analysis would include the replacement of the existing sag vertical curve that begins at Point A and leads into an ascending gradient with a crest vertical curve that would lead into a descending gradient.

The top-of-rail elevation in the level section is 0.0. The distance from the north end of the level track section to the south wall of the CCCC tunnel is 252 feet. Within this distance the connecting track would have to descend a vertical distance of 24.0 feet. The resulting descending gradient would be 13.6%.

Descending gradients detract from braking capability. Contemporary light rail car and streetcars have a service (non-emergency) braking rate of about three miles/hour/second (mphps). Each one percent of descending gradient reduces the effective braking rate by about 0.22 mphps. A gradient of 13.6% would utilize essentially the entire service braking capability, requiring routine use of emergency braking. The unacceptability of such a practice is obvious.

CONCLUSION

According to the evaluation criteria developed for this Alternatives Analysis and endorsed by the project's Technical Advisory Committee, build alternatives are to be evaluated against a fatal flaw screen to potentially eliminate build alternatives are inoperable, not constructible, or that violate the project's goals and objectives. Engineering analysis shows that Alternative PA-1 Extended cannot be safely operated resulting from the gradient needed to clear the CCCC tunnel in the eastbound direction. In addition, to achieve the gradient necessary, the disruption to the existing SEPTA Subway-Surface trolley service would violate the project objective to minimize disruption to the existing regional transportation system.

It is recommended that Alternative PA-1 be eliminated from further consideration or study.