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 Current Meeting: December 7, 2017
 Board Meeting: December 7, 2017

BOARD MEMORANDUM

TO: Santa Clara Valley Transportation Authority
 Board of Directors

THROUGH: General Manager, Nuria I. Fernandez

FROM: Chief Engineering & Program Delivery Officer, Carolyn M. Gonot

SUBJECT: VTA's BART Silicon Valley Phase II Extension Status: Environmental Clearance and Tunneling Methodology Review

FOR INFORMATION ONLY

Phase II of VTA's BART Silicon Valley extension would extend BART from the San Jose Berryessa station into downtown San Jose and then into the City of Santa Clara. In 2014, planning efforts were renewed for Phase II and VTA staff identified as a viable option in delivering the next six miles of track a single-bore tunneling methodology, a configuration made practical by recent advancements in the use of large bore tunnel boring machinery. This memorandum summarizes further steps VTA will undergo to fully explore the single-bore design following input by a panel of its peers and the modification in the environmental clearance schedule to provide for the additional review of the tunneling options.

BACKGROUND:

Twin-bore tunnels, with a single track running in each tunnel and in opposite directions, are used in many subway systems, including the existing BART system. In a single-bore configuration, a single tunnel would house two tracks, each running within separate compartments and in opposite directions.

VTA staff spent the past two years engaging BART staff in exploring and undergoing a complete study of the viability of operating the BART system through a single-bore tunnel configuration for a section of Phase II of the BART Silicon Valley extension into downtown San Jose. VTA also engaged a number of third party consultants to conduct a comprehensive analysis of the single-bore tunneling configuration. During that analysis, evaluation criteria were established, with BART, to provide a qualitative and quantitative assessment of the single-bore option, and conduct further review of the twin-bore configuration. The draft environmental documents released for public review included an analysis of impacts related to both single-bore and twin-bore construction methodologies. Under consideration and study were the following: the feasibility to build and operate a single-bore tunnel design; specific fire/life/safety elements of each

configuration with respect to most recent codes and standards; and, the costs, schedule and risks associated with each tunnel configuration.

The various studies conducted by VTA indicate that the single-bore configuration can provide substantial advantages over the twin bore configuration in key areas, including safety, operational flexibility, passenger experience, and construction impacts. Attachment A includes information about the single-bore configuration that describes key benefits and advantages that VTA has identified for the single bore configuration, making it a viable option for the Phase II Extension.

Once the studies were complete, VTA and BART agreed to engage a panel of peers from public transit agencies currently operating heavy rail subway systems with deep stations to review the single-bore concept with a focus on operations and safety. The peer review panel met the week of November 13, 2017, and included current and retired managers from Los Angeles Metropolitan Transportation Authority (LAMTA), Washington Metropolitan Area Transit Authority (WMATA), Metropolitan Atlanta Rapid Transit Authority (MARTA), New York City Transit (NYCT), New York Metropolitan Transportation Authority (NYMTA), and San Francisco Municipal Transportation Agency (SFMTA). The key question asked was what are the risks and/or challenges associated with the single-bore option; and, can it be operated and maintained safely as an extension of the BART system?

After three days of meetings where VTA and BART staff presented relevant aspects of the single-bore and twin-bore options, the panel opined that with some adjustments to address BART's operational safety concerns: *the single-bore tunnel can be operated safely as an extension of the BART system.*

However, due to timing constraints related to the current federal funding schedule combined with BART's strong preference for operating what it is familiar with, the panel advised that at this time, twin-bore would be a preferred option for Phase II of VTA's BART Silicon Valley Extension.

DISCUSSION:

As the County of Santa Clara's Transit Agency and Congestion Management Agency and as the owner and builder of the BART Silicon Valley Extension, VTA has a responsibility to fully explore options that will result in the safest and most efficient system being built with the least amount of impact on its customers, businesses and the community.

As noted above, the peer review panel concluded that while the single-bore design could be safely operated as part of the BART extension, the twin-bore design was preferred. However, after noting that the panel's conclusions were based on the time constraints imposed by the timeline for a federal project to make its way into the federal funding process and thereby be eligible for federal grant funds, VTA decided to extend the project development timeline. This would allow VTA to fully embrace the conclusions of the peer review panel and demonstrate more thoroughly how the single-bore configuration can satisfy BART's operational safety

concerns. It would also allow VTA to further explore construction impact mitigation strategies for the Downtown San José stations.

VTA estimates the process to refine the relevant aspects of the single-bore design will take approximately three months. As such, VTA will request from the Federal Transit Administration, the federal oversight and funding agency, an extension of the time within which to proceed through the federal funding process. This extension will assure exhaustive due diligence has been made before recommending a tunneling methodology. As with all activities related to VTA's BART Silicon Valley Extension, VTA will continue to engage BART engineers and operations representatives in this process.

Following a thorough examination of all the foregoing considerations, VTA staff will provide a recommendation regarding tunneling methodology to the VTA Board of Directors and complete the environmental and funding processes for this critical and highly anticipated infrastructure project for Santa Clara County.

The remainder of this memo outlines specific areas for further analysis or consideration highlighted in the peer review findings.

Configuration Consistency

Based on information provided by BART, the peer review panel identified several aspects of the single-bore configuration that could be improved through the design process to better satisfy BART's operational preferences. The most important observation was the desire for a consistent configuration throughout the tunnel length to simplify training for train operators and first responders when implementing emergency procedures in the tunnel.

Although the single-bore tunnel option meets, and in some instances exceeds, all objective and regulatory fire/life safety requirements, the peer review panel acknowledged BART's concern that the trackway variations (stacked, transitions, and side-by-side) throughout the tunnel would result in additional training needed for train operators and first-responders. To address this concern, VTA will undergo additional analysis and characterization of the egress paths for operators, responders, and passengers.

Trackways at two different elevations

In the single-bore approach, some locations within the tunnel, including the stations, include the two trackways being configured one over the other versus side-by-side. Standard protocol for a disabled train in a tunnel is to conduct a train-to-train transfer of passengers from the disabled train to another train in the adjacent tunnel. When tracks are located one above the other in the single-bore configuration, the train-to-train transfer will be up or down and involve stairs. Though different than the side-to-side transfer, this approach is not entirely unprecedented in transit subways. In fact, even in the existing BART system, stairs are involved in train-to-train transfers within the Transbay tube running under the San Francisco Bay, as well as in other tunnels.

Another aspect of having the two trackways configured one over the other is that when evacuating a train in the upper level, passengers may need to go down to reach the non-disabled

train in the trackway below. BART is concerned that going down to evacuate a system may be non-intuitive to its passengers and cause confusion. Although all egress paths and exits will be well designated, VTA will explore the use of ADA-compliant ramps and other egress configurations between upper and lower trackways which may improve the ease and intuitiveness of egress.

Station Evacuation

The panel also identified important aspects of the single-bore configuration that significantly outperformed the twin-bore configuration. In particular, because the entire passenger space inside each ticketing halls (two per station) in the single-bore configuration can be maintained as a point of safety during a train fire emergency, passengers would not need to make their way all the way up to the street level to be safe. This aspect makes the single-bore an option which provides more rapid clearing of the boarding platform, and more rapid arrival to a point of safety than the twin-bore configuration. The panel recommended that if the twin-bore configuration is to be used, these aspects of the single-bore configuration should be adopted in its design.

Depth of the Stations

Although BART raised the depth of the stations as a major concern in various evacuation scenarios, the panel expressed that the depth of the station was not of particular concern for safety or passenger experience. In addition, as stated earlier, the more immediate point of safety offered in the single-bore configuration provided a model that could outperform the twin-bore configuration. The peer reviewers also expressed no particular concerns about the tunnel or station ventilation configurations.

To support its recommendation on tunneling methodologies for its Phase II BART Silicon Valley extension, VTA will examine these and other relevant topics during this extended project development period. VTA and BART are committed to continued cooperative and productive work in these efforts.

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Memo No. 6372

ATTACHMENT A

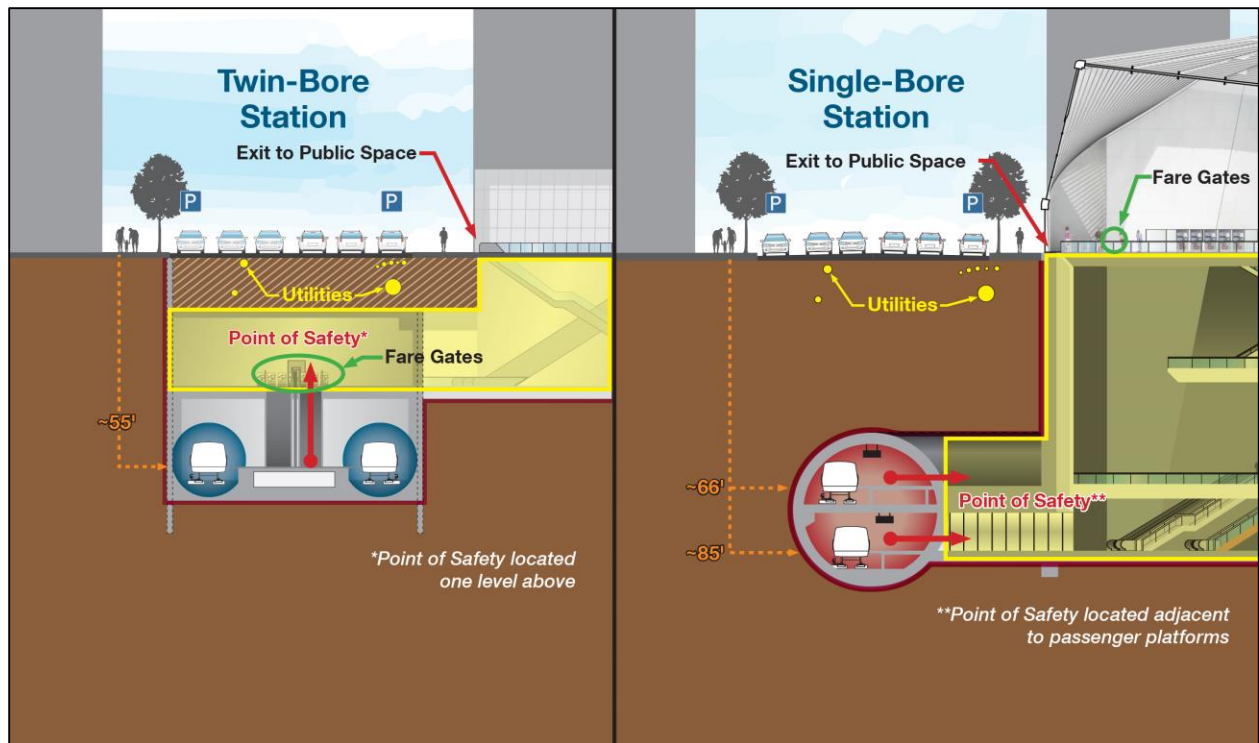
Single-Bore Tunnel Configuration for VTA's BART Silicon Valley Phase II Extension

Phase II of VTA's BART Silicon Valley Extension would extend BART from the future Berryessa/North San Jose Station through downtown San Jose to the City of Santa Clara. This configuration includes approximately five miles of tunnel, with much of the tunnel running beneath Santa Clara Street in downtown San Jose. Twin bore tunnels with a single track running in each tunnel are used in many subway systems including the existing BART system. VTA has done extensive design for the Phase II Extension under the twin bore configuration. As part of renewed planning efforts for the Phase II Extension, VTA staff identified a single bore tunneling methodology as a viable option in delivering the approximately five miles of tunnel. The single bore configuration has been made practical by recent advancements in the use of large diameter tunnel boring machinery. In a single bore configuration, a single, large diameter tunnel would contain two trackways, each running in separate compartments for opposite direction of travel. The figure below shows the twin-bore and single-bore station configurations.

Various studies conducted by VTA indicate that the single bore configuration can provide substantial advantages over the twin bore configuration in key areas, including safety, operational flexibility, passenger experience, and construction impacts. The information below describes key benefits and advantages that VTA has identified for the single bore configuration, making it a viable option for the Phase II Extension.

Safety

- For the single bore configuration, the Point of Safety (areas identified within the station where passengers are essentially safe from an emergency event) is located directly adjacent to the platforms allowing for lower emergency evacuation times. In comparison, for the twin-bore configuration, passengers have to travel up stairways to an upper concourse level to reach the Point of Safety.
- As illustrated in the figure below, the Point of Safety for the single bore configuration is located on the same level as the boarding platform, providing improved access for mobility impaired passengers.
- Station safety and security would be improved as fare gates would be located at the surface level, reducing fare evasion and unauthorized access to underground areas of the station.



- The location of escalator and stairwell landings would be located off of the platforms, allowing for larger unobstructed platform widths, enhancing passenger safety and unobstructed views of exit passageways.
- Under emergency situations within the tunnel (between station locations), more than twice as many locations would be provided to evacuate passengers to safe passageways for rescue from first responders or a rescue train.
- Wider stairwells could be provided allowing for increased passenger capacity and emergency response access during station evacuations.

Operational Flexibility and Maintenance

- A wider diameter single bore tunnel would provide the ability to construct storage tracks within the tunnel to store trains or equipment for special events and other operational and maintenance purposes.
- Crossover tracks provide operational flexibility to switch trains from one track to another. With a single bore tunnel configuration, crossover tracks could be constructed within the tunnel with limited impacts to surface activities, including the potential to construct a crossover between the Diridon and Santa Clara stations. This would provide operational benefits when events occur at SAP Center.
- Allows for track shifting and realignment that may be required as a result of geologic fault movements.

- Ground water intrusion from tunnel cross passages (mined connections between twin-bore tunnels) would be eliminated. The potential for ground water intrusion is a result of areas where cross passages tie-in to the tunnel.
- The single bore tunnel would be simple, stable, and waterproof, without complex structural interfaces.

Construction Impacts

- Single bore stations would not require cut and cover construction in the street right of way. The station would be constructed off-street, which would significantly reduce impacts to downtown:
 - Businesses
 - VTA light rail operations
 - VTA bus operations
 - pedestrians
 - bicyclists
 - automobile traffic
 - Utilities
- As would be required for a twin bore configuration, there would be no major utility relocations on three blocks of Santa Clara Street, which is a high risk activity with potentially severe risks to schedule. The concurrent construction of off-street stations and the tunnel would reduce schedule and risk cost.
- Construction-related traffic due to hauling of muck from the cut-and-cover station would occur for a period of time significantly shorter than twin-bore. Truck traffic estimated to be 50% less due to smaller excavation footprint.
- Based on information released by the USGS in 2010 about the Silver Creek Fault, the twin-bore tunnel configuration does not allow for periodic realigning of tracks after a seismic event involving the Silver Creek fault, including fault creep. With the twin bore configuration, potential changes to the tunnel configuration at this location could result in construction of a cut-and-cover box at this location. The single bore configuration accommodates a clearance envelope to allow for periodic re-aligning of tracks after a seismic event.
- Eliminates the need for, and risk associated with, the construction of twin bore cross passages. In many locations throughout the project alignment, the ground conditions where cross passages would be constructed are not suitable for mining and would require ground treatment (improvements to make the ground suitable for mining).
- Under the twin bore configuration, the Diridon Station would require construction of the station box that would be beneath the Caltrain tracks with Caltrain tracks supported.

Passenger Experience

- The elevator design allows for better access for mobility impaired passengers between paid areas at the surface and boarding platforms. This is made possible with the inclusion of a single elevator, rather than multiple elevators (in the case of the twin bore configuration), to travel between the surface and platform levels.
- The larger unobstructed boarding platform areas would assist in relieving platform crowding and queuing for the station's elevators and stairwells. Twin bore stations include vertical circulation elements such as elevators, escalators, and stairway landings on the platforms.