

# VTA's BART Silicon Valley Phase II Extension Project



VTA Board of Directors  
November 3, 2022

# Agenda

- APTA Independent Peer Review
- FTA Funding Update
- Upcoming December Board Items

# Peer Review Background

As a follow up to May Board Direction:

- VTA, in partnership with the American Public Transportation Association (APTA), commissioned an independent review (Peer Review/Exchange) to support the ongoing project delivery efforts of the BART Phase II Project
- Over the last few months, APTA conducted this effort with a peer review team consisting of experts in tunneling, station architecture and project management
- These independent subject matter experts reviewed existing documentation, engineering records and conducted technical sessions considering:
  - review of the single-bore and twin-bore tunneling methodology
  - customer access and customer service with the current underground station design



# BART Silicon Valley Phase II Extension

Tunneling Approach

APTA PEER REVIEW

November 3, 2022

# What is an APTA Peer Review?

- Provides transit agencies expert advice, industry best practices, and recommendations from highly experienced and respected transit professionals
- Not intended as a comprehensive assessment or engineering analysis of the BART Silicon Valley Phase 2 Extension.
- Goal: respond to specific questions regarding the feasibility and appropriateness of the tunneling approach based on international tunneling experience.

# Questions Posed to the Experts

1. What are the trade-offs between single- and twin-bore tunnels, including safety, passenger experience, cost and delays
2. Is use of a single-bore tunnel for the BART extension:
  - Feasible
  - Appropriate
  - Safe
  - Efficient
3. How much delay would be required for a change in design?
4. What are the major risks that must be mitigated?

# APTA's Tunneling Experts

## – 100 Large Tunnels Across the World

### **Anthony Burchell**, Project Director, Chennai Metro Phase 2

- Underground metro projects in: Hong Kong, Tel Aviv, Dubai, Cairo, Singapore, London, Madrid, New Delhi , Chennai and Qatar
- Single Bore (Dubai, Madrid and Cairo) and Double-Bore Tunnels ( London, Hong Kong, Singapore, New Delhi , Qatar , Tel Aviv, Chennai)

### **Donald Richards**, Retired

- Extensive tunneling experience in the US, Canada and 21 countries
- Metro experience in Taipei, Cairo, Toronto, Singapore, LA, SF, DC, Seattle, NYC, Baltimore, Austin
- Large bore tunnel experience in Seattle, Istanbul and Miami; studies in Dublin
- Tunnel work includes rail, highways, underground metro projects, wastewater and sewer, mines, underground oil storage, and underground defense-related project facilities

# Peer Review Activities

- Review of project documents and other project-related materials
- Review of recent global tunneling projects
- Presentation from KST on proposed design innovations
- Peer exchange with staff on risks and global lessons-learned





# Metro Tunneling Options

- Until recently, most metro/heavy rail tunnels built using twin-bore tunnels
- Recent technology has facilitated larger, single-bore tunnels
  - Increasingly used for transit in Europe/Asia and for highways/water projects in US
    - Transit: Paris & most French Metros, Madrid, Dubai, Netherlands;
    - Canada: Metrolinx Scarborough Extension first single-bore transit in North America
    - In US: Alaskan Way highway (57.3'); Hampton Roads Bridge/Tunnel (46'); under review in Los Angeles for multiple projects

# Key Factors Impacting Selection

## 1. Surface Disruption

– Twin-Bore tunnels cause more surface disruption due to:

- Cross-overs
- Cross passages
- Stations: cut & cover stations
- Utilities relocations
- Traffic diversions

## 2. Soil Variation

## 3. Water Table

## 4. Experience of the Contractors



# Trade-Offs Between Twin-Bore and Single-Bore

Attributes	Twin Tunnel /single track	Single tunnel - 2 tracks	Single Tunnel – 2 tracks w/ platform inside the tunnel
Prevalence	Many twin-bore tunnels across the world	Over <b>40 large</b> (over 45-foot diameter) road/transit/water tunnels in Europe and Asia. Barcelona is the largest two-track rail tunnel to date with an internal diameter of 39.7 feet (in construction)	
Examples	London; Munich; Copenhagen; Tel Aviv; Qatar; Tokyo; Shangha; Delhi	Milan; Toronto; Cairo; Paris Athens, Madrid, Dubai;; Netherlands; Metrolinx Scarboro Extension (in construction)	Barcelona Line 9
Typical Internal Diameter	20 feet	27-32 feet	Barcelona = 40 feet
Typical Depth to platform	Min usually 50 feet	Minimum usually 65 feet	

# Trade-Offs Between Twin-Bore and Single-Bore

Attributes	International Experience
Passenger Safety	No difference in safety from the passenger perspective; fire code requires center wall between tracks or Annex structures in single-bore tunnel
Passenger Experience	<ul style="list-style-type: none"> <li>• Single-bore tunnel will be deeper, requiring longer vertical access.</li> </ul>
Efficiency/Ease of Construction	<ul style="list-style-type: none"> <li>• Twin-bore requires special structures for cross-overs</li> <li>• Single-bore uses a large TBM, which must be deeper to control settlements.</li> <li>• Cut and Cover stations, while easier to build, create significant surface disruption, traffic &amp; utility relocation issues</li> <li>• Single-bore require large adit connections to stations. Risk is reduced with diaphragm walls (or equivalent) from the surface ( as in Barcelona)</li> </ul>
Cost	<ul style="list-style-type: none"> <li>• Twin-bore tunnels with cut &amp; cover stations typically are less expensive initially, but traffic mitigation, surface disruption and utility relocation costs can reduce or eliminate this margin.</li> </ul>

# VTA/BART Rationale For Single-Bore Approach

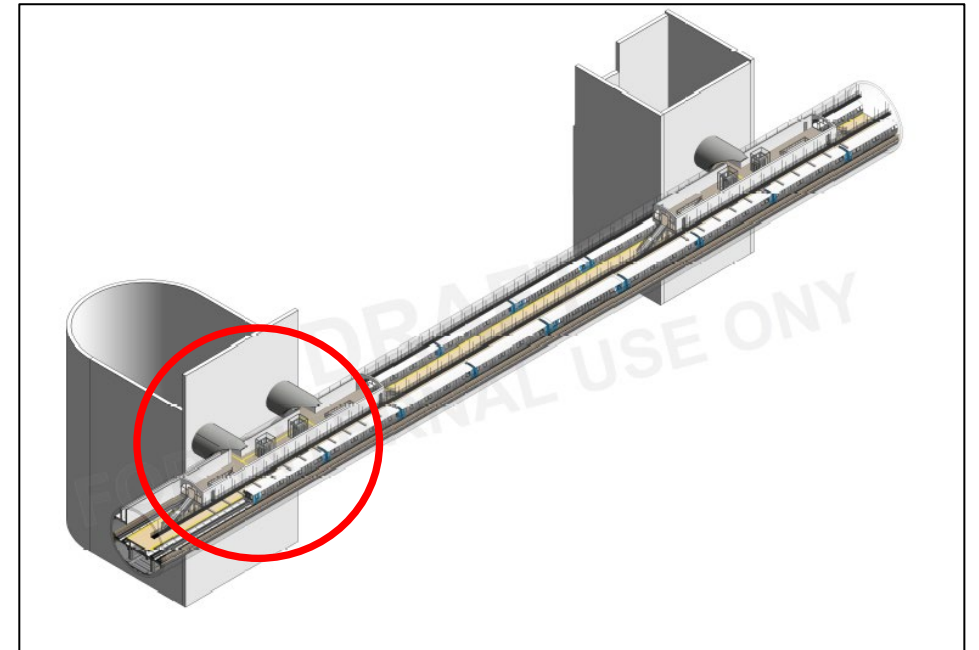
The 2017 SVSX Single Bore Feasibility Study found the following benefits for a single-bore versus a twin-bore tunneling approach:

- Smaller station footprint
- Less right-of-way acquisitions
- Reduced environmental impact during construction
- Smaller station footprint permits greater opportunity for joint development of the station sites

# KST's Proposal for Side-By-Side Tracks Reduces Risks

KST has proposed using side-by-side tracks at stations instead of the stacked-track plan

- Facilitates smaller adits, reducing construction risk and extent and cost of ground treatment
- Slight increase in tunnel diameter, but no appreciable risk increase
- Enhances passenger experience by reducing vertical access and providing an Island platform



# Questions Posed to the Experts

## 1. Is A Single-Bore Tunnel Feasible?

**Yes.** Requires mitigation to address the following risks:

- Settlement
- Cover: Requires increased cover (*or other functionally equivalent blow out resistant structural arrangement*)
- Soft ground below the water table
- Unforeseen conditions: Wells or boulders, if encountered, are more difficult to address using a large TBM
- Adit construction: Requires extensive soil treatment or ground freezing



# Questions Posed to the Experts

## 2. Is a Single-bore Tunnel Appropriate for the BART Extension?

- Both tunneling approaches would work
- Each approach brings different risks that must be mitigated by a highly skilled and experienced contractor.

## 3. Does the Tunnel Approach Impact Passenger Safety?

- No. Must meet same federal and state safety requirements regardless of approach
  - **Safety during construction:** Deeper depth and construction of large adits pose more risk. However, a skilled contractor can safely construct either tunnel type.



# Questions Posed to the Experts

## 4. Is One Approach More Efficient?

- Less surface disruption with single-bore
- Both smaller and larger TBMs pose similar mechanical and operational problems
- Internationally, twin bores typically are cheaper and quicker; with different regulatory requirements, may not apply to the US

## 5. What is the Impact of a Decision to Change Tunnel Approach?

- Design: 6-12 months to revise the design
- NEPA: amendment of the EIS would have to await engineering and then review/public engagement, resulting in as much as **2-year delay**.
- Cost: Increased cost for design and for time delay

# Summary & Observations

1. Single-bore tunnel is feasible and appropriate
2. Single-bore tunnel will reduce above-ground and street disruption
3. Regardless of which tunnel option is selected, construction risk cannot be eliminated, but measures can be taken to account for it.
  - Adit construction requires certainty that the ground is safe for excavation
  - The island platform proposal is a significant improvement and risk mitigation measure
4. KST has assembled a highly experienced and skilled team
5. A design change to twin tunnels at this stage will cause a significant delay and cost to the project

# Major Risks and Recommended Mitigation

Risk	Mitigation
Adit Construction	Consider a perimeter slurry/ diaphragm wall with ground treatment and dewatering prior to TBM arrival. If not possible, freezing is a good option. Recommend hand mining of the adit with multi-drift method and highly experienced crew.
Excessive settlement in TBM drive	<ul style="list-style-type: none"> <li>• Contractor must control ground stability (soil conditioning), face pressures, grout mix, sufficient tail void grout lines, tail seal greasing , and emergency redundant tail seal mechanism.</li> <li>• TBM design should be reviewed by experienced independent experts.</li> </ul>
Geotechnical and unforeseen conditions ( e.g., wells , boulders , foundations)	Identify and locate any obstructions in advance of tunnel construction. Consider having discrete zones of pre- treated ground where the TBM can stop and the cutterhead inspected

# Major Risks and Recommended Mitigation

Risk	Mitigation
Low Cover Above TBM	Apply a surcharge load and/or ground improvement at TBM launch and exit points with a detailed evaluation of the factor of safety of the proposed schemes to be used
Abrasivity of Subsurface Soils	<ul style="list-style-type: none"> <li>• Deeper tunnel likely to encounter more abrasive sand.</li> <li>• Use hardened steel cutters and hard facing on TBM</li> <li>• Maintain wear detectors.</li> <li>• Increasing the lab abrasion tests</li> </ul>
Tail Seal failure	<ul style="list-style-type: none"> <li>• TBM design should permit replacement of at least one row of tail seal brushes.</li> <li>• Provide an emergency seal in the design.</li> <li>• Initial grease packing then continuous grease injection</li> <li>• Strong TBM steering control to maintain clearance</li> </ul>

# Major Risks and Recommended Mitigation

Risk	Mitigation
Failure of Main Bearing	<ul style="list-style-type: none"><li>• TBM design should ensure bearing seals are protected</li><li>• Ensure excellent Quality Control during manufacture and initial testing</li></ul>
Risk of a Blowout	Identify and seal any wells or boreholes in advance
Face Interventions to check for damage, blocking, high torques, overheating	<ul style="list-style-type: none"><li>• Face interventions are very difficult in a large TBM as compressed air cannot hold such a large face.</li><li>• Provide locations for intervention. Provide advance ground treated areas or, if adits are built with Diaphragm walls, the TBM can stop there.</li></ul>

# FTA Funding Update

- VTA has submitted a request to FTA to transition the project into CIG (New Starts) allowing a higher federal funding contribution
- Letter of No Prejudice (LONP) requested to allow for continued pre-award authority and uninterrupted project activities
- Discussions with FTA continue developing a roadmap to a Full Funding Grant Agreement (FFGA)

# Key Differences between CIG and EPD

TOPIC	CIG	EPD
<b>Rating</b>	An overall project rating of Medium or higher. Project is evaluated in Project Justification and Financial Assessment	No rating process in EPD. Project justification is evaluated in five areas based on Sponsor's submittals- no specific format is required
<b>Funding</b>	CIG share not to exceed 60 percent for New Starts project, total federal share not to exceed 80 percent	Total federal share not to exceed 25 percent
<b>Financial Assessment</b>	<ul style="list-style-type: none"> <li>• Criteria by Statue as described in CIG Policy Guidance and Reporting Instructions</li> <li>• Projects must have an “acceptable degree of local financial commitment including evidence of stable and dependable financing sources”</li> <li>• All non-CIG funds fully committed prior to the Grant Agreement</li> <li>• A 20-year cash flow and financial plan are required</li> <li>• FTA evaluates current capital and operating condition; commitment of capital and operating funds; and reasonableness of capital and operational cost estimates and planning assumptions</li> </ul>	<ul style="list-style-type: none"> <li>• Criteria in NOFO</li> <li>• Private/public partnership (P3) required to qualify</li> <li>• Time period for financial review is condensed</li> <li>• Sponsor submission includes budget, evidence of capital and operating funds, the most recent audited financial statement</li> <li>• FTA conducts a limited review on level of funding commitment</li> </ul>
<b>Pre-award Authority</b>	<ul style="list-style-type: none"> <li>• Varies by project phases and NEPA completion status</li> <li>• Construction is allowed on approved LONP</li> </ul>	<ul style="list-style-type: none"> <li>• Full pre-award authority on project selection including construction</li> <li>• Letter of Intent documents additional conditions sponsor must meet, should an FFGA have been awarded</li> <li>• No LONP is required in EPD process</li> </ul>

# EPD to CIG: Path Forward

ACTION	DESCRIPTION
<b>VTA:</b> Complete remaining PD activities	<ul style="list-style-type: none"> <li>• Submits materials for FTA to conduct project rating and evaluation</li> <li>• Completed activities: Select an LPA; LPA in fiscally constrained transportation plan (Complete); Complete NEPA (Complete) and</li> <li>• Incomplete activities: Develop rating information*</li> </ul>
<b>VTA:</b> Submit formal request for Entry into New Starts Project Development (PD) and Letter of No Prejudice (LONP)	<ul style="list-style-type: none"> <li>• Letter to transition from EDP Pilot Program to New Starts (PD) in FTA’s CIG Program</li> <li>• LONP to incur project costs for final design, enabling works, long lead procurement, and limited construction activities</li> </ul>
<b>FTA:</b> Approve VTA’s request for entry to PD and issue an LONP	<ul style="list-style-type: none"> <li>• Project formally in CIG</li> <li>• Project activities continue under LONP, EPD LOI gets null and void</li> <li>• Existing EPD allocations are not transferrable to CIG</li> </ul>
<b>FTA:</b> Notify VTA the project rating (prior to Annual Report release)	<ul style="list-style-type: none"> <li>• Project must receive an overall rating of Medium or higher*</li> </ul>
<b>FTA:</b> Publish rating in FY2024 Annual Report	<ul style="list-style-type: none"> <li>• With an overall Medium rating or better, project is eligible for FY2024 appropriation from Congress</li> <li>• FTA has provision to allocate funds from existing appropriations</li> </ul>
<b>VTA:</b> Submit request to enter into Engineering. Application can be submitted any time after project receives an overall Medium rating or better	<ul style="list-style-type: none"> <li>• Submit materials for FTA to initiate review for engineering</li> <li>• PMOC reviews the submittals and initiate a formal risk refresh</li> <li>• FMOC reviews updated financial plan and cash flow</li> <li>• LONP submitted during PD application continues</li> </ul>
<b>FTA:</b> Approve project into Engineering	<ul style="list-style-type: none"> <li>• Project enters New Starts Engineering phase after satisfying FTA criteria</li> </ul>
<b>VTA:</b> Submit request to execute FFGA	<ul style="list-style-type: none"> <li>• Submit materials for FTA to initiate Readiness Report, FFGA development, approvals and execution</li> </ul>

\*Steps not required in EPD Pilot Program



# Upcoming December Board Items

- **Information Item:** Update on Station Refinement Work
- **Action Item:** Authorize the GM/CEO to issue Contract Amendments up to \$460,000,000 for Early Work Packages related to Contract Package 2 Tunnel/Trackwork including:
  - Purchase of Tunnel Boring Machine (TBM)
  - Associated TBM works
  - West portal construction activities

