

RAIL ALIGNMENT AND BENEFITS STUDY

Executive Summary Report
September 2018



Source: Flickr user Joey Parsons



San Francisco
Planning

CONTENTS

Acronyms and Abbreviations	C
Glossary	D
Introduction	1
Component #1: Rail Alignment to Salesforce Transit Center	5
Rail Alignment Option 1: Future with Surface Rail: DTX + Trenched Streets	8
Rail Alignment Option 2: Pennsylvania Avenue: DTX + Extended Tunnel	12
Rail Alignment Option 3: Mission Bay: Modified DTX + 3rd Street Tunnel	18
Component #2: Railyard Reconfiguration / Relocation	26
Component #3: Urban Form and Land Use Considerations	32
Component #4: Transit Center (SFTC) Extension/Loop	36
Component #5: Boulevard I-280	40
Preliminary Findings and Recommendations:	43
Next Steps	45
End Notes	46

LIST OF EXHIBITS

Exhibit 1: Rail Connections in California and the Bay Area	2
Exhibit 2: Population and Employment Growth	2
Exhibit 3: RAB Study Components	3
Exhibit 4: Three Rail Alignments to Salesforce Transit Center in Component #1	7
Exhibit 5: Future with Surface Rail: DTX + Trenched Streets Alignment (Option 1)	8
Exhibit 6: Future with Surface Rail: DTX + Trenched Streets Alignment (Option 1) Cross Sections	9
Exhibit 7: Pennsylvania Avenue: DTX + Extended Tunnel Alignment (Option 2)	12
Exhibit 8: Pennsylvania Avenue: DTX + Extended Tunnel Alignment (Option 2) Cross Sections	13
Exhibit 9: Elements of the DTX evaluated in the TJPA SEIS/EIR	14
Exhibit 10: Location of Tunnel Stub Box in DTX Plans	15
Exhibit 11: Mission Bay: Modified DTX + 3rd Street Tunnel Alignment (Option 3)	19
Exhibit 12: Mission Bay: Modified DTX + 3rd Street Tunnel Alignment (Option 3) Cross Sections	20
Exhibit 13: Location of SFTC throat in DTX	21
Exhibit 14: Construction Timeline for Rail Alignments	23
Exhibit 15: Preliminary Estimates of Probable Costs - Rail Alignments	25
Exhibit 16: Existing 4th/King Railyard	26
Exhibit 17: Turnback Track as identified in DTX SEIS/R	27
Exhibit 18: Railyard Conceptual Level Layout Design	29
Exhibit 19: Urban Form and Land Use Considerations for Railyard Site (Component #3)	32
Exhibit 20: Salesforce Transit Center Cross Section	36
Exhibit 21: Extension/Loop Options (Component #4)	37
Exhibit 22: Landing Sites for Potential Second Tunnel in San Francisco Bay	38
Exhibit 23: Boulevard I-280 (Component #5)	40

ACRONYMS AND ABBREVIATIONS

CCSF	City and County of San Francisco
CGS	California Geological Survey
CHSRA	California High Speed Rail Authority
CWG	Citizen Working Group as conveyed for the RAB study
CalSTA	California State Transportation Agency
Caltrans	California Department of Transportation
DTX	Downtown Rail Extension
I	Interstate
HSR	High Speed Rail
MTC	Metropolitan Transportation Commission
PCJPB	Peninsula Corridor Joint Powers Board (Caltrain)
PUC	Public Utilities Commission
RAB	Rail Alignment and Benefits Study (previously known as Railyard Alternatives and I-280 Boulevard Feasibility Study)
SCL	Sprayed Concrete Lined – a type of construction of tunnels
SEIS/SEIR	Supplemental Environmental Impact Statement/Report
SEM	Sequential Excavation Method – a type of construction of tunnels
SFCTA	San Francisco County Transportation Authority
SFMTA	San Francisco Municipal Transit Agency
SFTC	Salesforce Transit Center – formerly known as Transbay Transit Center (TTC)
TBM	Tunnel Boring Machine
TJPA	Transbay Joint Powers Authority
TTC	Transbay Transit Center now called Salesforce Transit Center (SFTC)
USGS	United States Geological Survey
WGCEP	Working Group on California Earthquake Probabilities

GLOSSARY

DTX – Downtown Rail Extension

Under the direction of TJPA; the DTX is an underground rail connection from the vicinity of 7th/Townsend to Salesforce Transit Center (SFTC) for use by both Caltrain and CHSRA.

Caltrain (PCEP) Electrification

The electrification of the Caltrain corridor from San Jose to San Francisco and purchase of 75% electrical multiple unit fleet. To be completed and operations to begin in 2022. The cost of this project is \$1.9 Billion.

Blended Service Operations Plan

Under the direction of CHSRA, and in coordination with Caltrain; the plan of how Caltrain and CHSRA trains will operate on the same tracks from Gilroy to San Jose and on to San Francisco. Includes shared stations in San Jose, Millbrae and San Francisco (4th/King initially and SFTC when DTX is built).The Blended Service Operations plan will be used as the starting point for the Caltrain Business Plan (anticipated 2019) and CHSRA draft environmental impact statement (San Jose – San Francisco segment– anticipated 2020/2021)

CHSRA Business Plan

Updated biannually. The most recent version was adopted in June 2018. An overarching policy document used to inform the State Legislature, the public, and stakeholders of the project's implementation, and assist the Legislature in making policy decisions regarding the project. The schedule and cost estimate are updated and provided in each revision.

Turnback track

Included in the DTX SEIS/R. This track provides a way for trains stored at 4th/King railyard to access SFTC and vice versa. It is located south of 16th Street adjacent to the existing operational tracks. To move to or from one to the other (e.g., from storage and into operations),

SEIS/R – Supplemental Environmental Impact Statement/Report

Federal (NEPA) and State (CEQA) environmental process completed for projects that previously went through and received environmental clearance. A Supplemental is completed when changes are made to the original project that may change the impacts from previously anticipated levels. Example: the DTX received a Record of Decision (ROD) for the SEIS/R (2018) for the items included in Exhibit 9 within the Executive Summary

INTRODUCTION

The Rail Alignment and Benefits Study (RAB) (previously known as the Railyard Alternatives and I-280 Boulevard Feasibility Study) is a multi-agency study of transportation and land use alternatives in southeast San Francisco. The RAB study is comprised of five components: 1) Rail alignment into the Salesforce Transit Center; 2) Railyard reconfiguration/relocation; and 3) Urban form and land use opportunities; 4) Salesforce Transit Center extension/loop; and 5) Assessment of a boulevard replacing the north end of I-280.

This Executive Summary is a companion to the Final Consultant Technical Report¹ and provides the material points for the five components as well as a summary of the Planning Department's preliminary findings and recommendations. This Executive Summary provides high-level information that may be critical to decision-making, such as cost estimations and cross sections of alignment options. The Executive Summary is designed to be a stand-alone summary of the complete study and process. The Final Consultant Technical Report provides more technical discussion around the scope of work of the five components as well as the additional quantitative and qualitative analysis requested as part of the study.

Background

The RAB study has focused on helping the city, region, state, and nation realize the goal of bringing High Speed Rail and Caltrain service to the Salesforce Transit Center (SFTC – Previously known as the Transbay Transit Center). In 2014, the City and County of San Francisco recognized that if the projects went forward as planned, additional impacts to the city would need to be addressed if this regional vision were to become a reality. The RAB study is a comprehensive look for solutions – unbounded by jurisdictional boundaries and budget(s) that limited previously approved projects. This unconstrained approach, while difficult and sometimes controversial, is now pointing to concrete solutions that could solve for needed grade separation while delivering a better project encouraging local and regional economic development.

The Rail Alignment and Benefits Study (RAB) began in mid-2014 to gain better understanding of the transportation and land use changes at the city, region, and state level. The RAB study has looked at the southeast quad-

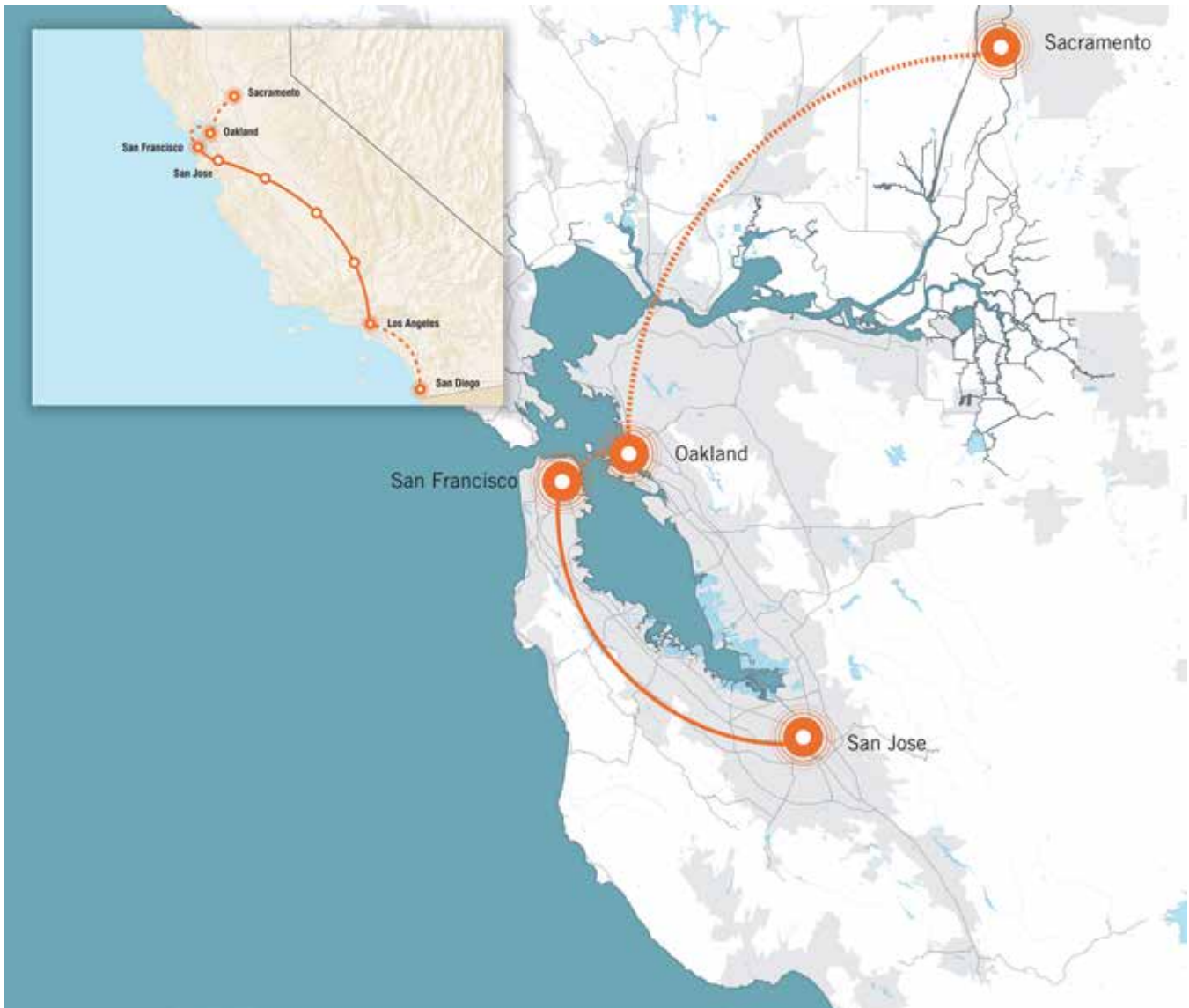
rant of the city, inclusive of both known and potential projects, to fully understand the impacts and benefits to the city and its residents in the most rapidly growing area of San Francisco.

Transportation systems throughout the city, region, and state are about to change. Under construction now, the California High Speed Rail Authority (CHSRA) is building the Central Valley to San Francisco link (expected completion date 2029 with possible early service in 2027) (See Exhibit 1), Caltrain is electrifying the rail corridor from San Jose to San Francisco (4th/King – expected completion date 2022), the SFMTA is nearing completion on the Central Subway (opening in 2018), and Transbay Joint Powers Authority (TJPA) opened the Salesforce Transit Center (SFTC) in August 2018. At the same time that transportation is transforming, the city is also changing and growing. Central SoMa and Mission Bay neighborhoods are growing (See Exhibit 2), with major development approved for the coming decade. Fully understanding these transportation and land use changes in concert is essential to maximizing this major tax-payer investment most effectively and to fulfilling the vision of high speed regional connections to/from the City.

The magnitude of the infrastructure investment demands that we not only understand immediate needs, but that we also plan for the next 100+ years of need in San Francisco, the region, and the state.

After decades of low density industrial activity east of the current alignment, the southeast quadrant of San Francisco is on track to receive 75% of the City's planned growth over the next 30 years, including San Francisco's largest hospital and indoor entertainment venues along with an anticipated 20,000 new households and 35,000 jobs just in the Southern Bayfront area. Without good transit connections, this growth cannot be achieved.

Exhibit 1: Rail Connections in California and the Bay Area



While this Executive Summary compiles a list of specifics related to the RAB Final Consultant Technical Report, it should be noted that the Final Consultant Technical Report is based on the scope of services (including the project area, as well as identified alternatives for further development, etc.), as determined at the outset of the project. This Executive Summary provides an overview of the Final Consultant Technical Report but goes beyond the report to provide staff analysis and preliminary findings by the Planning Department to identify a preferred policy direction of the City and County and to further regional conversations.

Exhibit 2: Population and Employment Growth

		2015	2065	GROWTH
California	Population	39M	52M	+33%
	Employees	16M	28M	+77%
Region	Population	7.6M	10.7M	+41%
	Employees	4.0M	5.8M	+44%
City	Population	0.86M	1.43M	+66%
	Employees	0.70M	0.99M	+44%

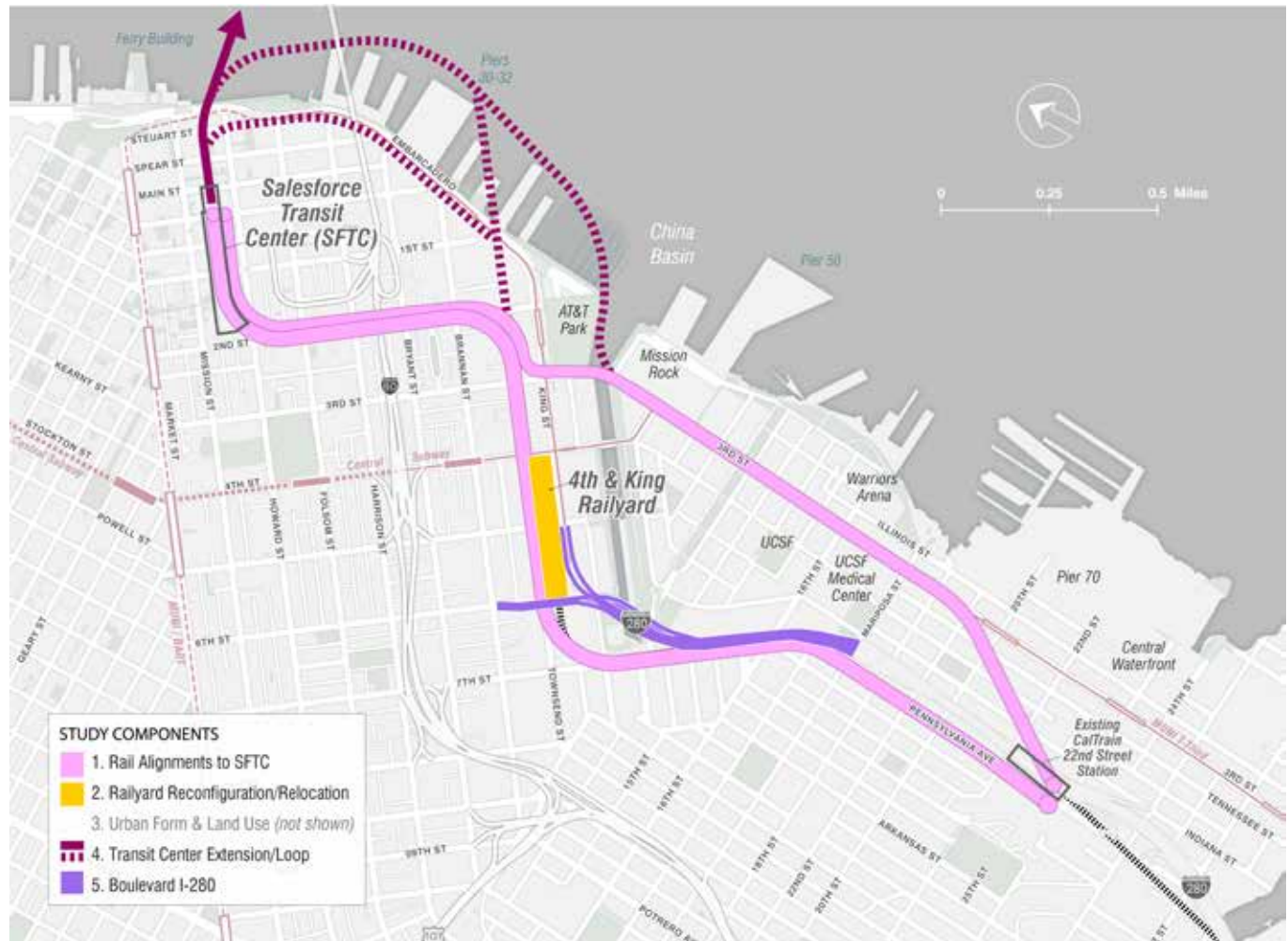
Components

There are five components to the RAB study – each representing a major transportation and/or land use decision that must be determined in the next 1-15 years (See Exhibit 3). Each decision will likely affect the performance of both the state and regional transportation system, and San Francisco itself for the next century. These five components are:

1. **Rail Alignment to Salesforce Transit Center (SFTC)** – This component seeks to answer the most time sensitive question of the RAB: how to bring both Caltrain and High Speed Rail from the county line into the Salesforce Transit Center (SFTC).
2. **Railyard Reconfiguration/Relocation** – This component considers re-knitting the fabric of the city by modifying or relocating some or all of the activities at the current 4th/King surface railyard and station.

3. **Urban Design and Land Use Considerations** – Relocating part of all of the Caltrain Railyard and/or other infrastructure changes could make new land available for the restoration of the street grid, improved bike/pedestrian connections, elimination of rail hazards and noise, and construction of housing, commercial development, and open space.
4. **Transit Center (SFTC) Extension/Loop** – This component explores future scenarios for train connections and operations beyond the initial connection to the SFTC to improve station capacity and/or rail connections beyond SFTC to the East Bay or back down the Peninsula.
5. **Boulevard I-280** – This component analyzes the interaction between proposed rail alignments and the I-280 structure to ensure that the rail alignment does not preclude the possibility of future changes to I-280 north of Mariposa.

Exhibit 3: RAB Study Components





Source: Flickr user throgers

As shown in the Final Consultant Technical Report, I-280 did not conflict with any of the alignments under further consideration. As the project progressed, the effort focused more on the potential rail alignment, railyard reconfiguration/relocation and related implications to urban design and land use (Component #1, #2, and #3). Once it was determined that rail alignments were not dependent upon either the continued use of I-280 or the removal of I-280 north of Mariposa, the Boulevard and I-280 work scope became subordinate to the RAB's primary objectives. To be clear, any future decision about I-280 would require much more analysis and coordination with Caltrans, CalSTA, and federal partners at a minimum. Because that work was outside of the RAB scope, it was not further pursued.

While each component of the RAB has its own time frame and is independent of each other, the Rail Alignment to Salesforce Transit Center (SFTC) is the most time sensitive and the immediate focus of the RAB Study.

In the pages that follow, each component is examined and a summary of work completed is provided including the options under consideration for each component and an assessment of each option. The last section provides the preliminary findings and recommendations of the RAB Study.

COMPONENT #1:

RAIL ALIGNMENT TO SALESFORCE TRANSIT CENTER

Description

Component #1 of the study sought to answer the most time sensitive question of the RAB: how to bring both Caltrain and High Speed Rail from the county line into the Salesforce Transit Center (SFTC).

Common Issues Across All Rail Alignment Options Considered

The following issues and considerations are relevant to all alignments discussed in this report. These common issues and considerations are organized into two categories: (1) maximizing public benefit and public investment for a growing population and (2) managing train conflicts.

MAXIMIZING PUBLIC BENEFIT & PUBLIC INVESTMENT FOR A GROWING POPULATION:

- » Fast, frequent, and reliable Caltrain and High Speed Rail (HSR) service to and within the city are essential to the Bay Area today and in the future.
 - » The Downtown Rail Extension (aka “the DTX” which provides underground rail from the vicinity of the 4th/ King surface railyard to the Salesforce Transit Center) was selected in 2004, prior to the construction of, and plans for, thousands of new homes and jobs along the current Caltrain route.
 - » High Speed Rail (HSR) operations in the city will begin within 15 years.
 - » With the passage of Proposition H (1999), San Francisco established that High Speed Rail will terminate at the Transbay Transit Center (now known as the Salesforce Transit Center – SFTC).² Although the Salesforce Transit Center opened to bus service in August 2018, the train levels will not be in operation until after the DTX is built in 2027 or later (See Exhibit 20 later in this report for a cross section of the SFTC).
 - » To maintain full functionality of the SFTC as designed and built, only rail alignments that provided access at the constructed throat location (southwest corner of SFTC) were selected for further analysis. Any other rail access location would cause significant impacts to the safety, cost, building integrity, and construction of the SFTC.
- » To maximize operations and flexibility of rail service, all platforms within the SFTC (and potentially the DTX underground 4th/Townsend station) will be constructed to one platform height.
 - » No alignment option under consideration requires Caltrain or HSR to be out of service for any significant duration during construction.
 - » The CHSRA’s “Blended Service” Operations Plan and Caltrain’s Business Plan (anticipated 2019), and future regional and state plans are expected to account for the recommendations from the RAB study.
 - » All rail alignment options include elements whose costs are not currently estimated. The DTX is the last mile of rail on the rail corridor and is estimated to cost \$4 billion dollars. Each alignment under RAB would tunnel rail beyond the DTX and modify infrastructure as appropriate, and therefore incur additional costs.
 - » To maintain access and integrate Mission Bay with the City, the RAB studied rail alignments and elements that will preserve and expand access on existing and potential new streets and paths.

MANAGING TRAIN CONFLICTS

- » There are currently two at-grade Caltrain intersections (Mission Bay Drive and 16th Street) that serve east/west traffic between Mission Bay and the rest of the City. These are the only two east/west connections for more than a mile. Each time intersections on these streets close for trains, traffic is stopped.
- » When Caltrain electrifies in 2022, the number of trains will increase by 20% during peak commute hours.³
- » When High Speed Rail (HSR) begins operations in 2027, the number of trains will increase by another 66% during peak commute hours.⁴
- » Both Caltrain and CHSRA anticipate the possibility of adding more and or longer trains in the future.
- » Each time a train moves across the two at-grade intersections, east/west traffic is blocked for 60-100 seconds. This will equate to more than 20 minutes in any peak hour in the future when both Caltrain and

High Speed Rail operate on the corridor, unless grade separations are built.

- » Conflicts at the at-grade Caltrain intersection of 16th Street would be particularly impactful as this street serves as 1) a Bus Rapid Transit line for the 22-Fillmore, 2) a primary ambulance route to UCSF Hospital, and 3) a vehicle path for more than 19,000 vehicles every weekday.
- » Continued Caltrain operations during construction of all alignments can occur with minimal disruption for any alignment option under consideration.
- » In this section, discussion of the railyard will occur relative to the fact that there is no direct connection between the surface railyard at 4th/King and the Salesforce Transit Center, yet trains will be expected to move from the railyard to the SFTC in the future.⁵ While this movement of trains from a railyard to the SFTC will be cumbersome and time-consuming for all alignments, certain alignment options will have greater impacts than others. Further discussion regarding the current 4th/King surface railyard is included in Component #2.

Analysis

The following analysis is relevant to all alignments discussed in this report. Again, this section is organized into two categories: 1) maximizing public benefit and public investment for a growing population and 2) managing train conflicts.

MAXIMIZING PUBLIC BENEFIT & PUBLIC INVESTMENT FOR A GROWING POPULATION

The final rail alignment into San Francisco must meet regional needs. Additional train service to and from San Francisco is essential to support expected city, regional, and state population and employment growth. Maximizing train service and flexibility to one of California's major economic centers is crucial for both the region and the rail operators. The ability to move to and through the city is also a vital consideration. Careful consideration of these issues related to rail alignment will ensure that full potential of rail investments in the city, region, and state can be realized.

In the short-term, the current project to fully electrify the Caltrain fleet is essential.⁶ Without a fully electrified fleet for Caltrain, future Caltrain service to SFTC is limited as ventilation requirements would preclude the use of

diesel trains in any tunnel option (including the DTX) under consideration.

MANAGING TRAIN CONFLICTS

When Caltrain and HSR operate in San Francisco as planned, there will be significant impacts to the two at-grade Caltrain intersections at Mission Bay Drive and 16th Street. Currently, Caltrain trains interrupt east/west traffic between 60 and 100 seconds per train movement. This means that, after electrification, east/west travel of all kinds would be stopped for more than 20 minutes every peak hour.⁷

If the planned projects, as currently designed and environmentally cleared, move forward, it is the City's position that the closure of the two at-grade Caltrain intersections at Mission Bay Drive and 16th Street for 20 minutes or more during the peak hours leads to an unacceptable condition. To maintain access and integrate Mission Bay with the City, the RAB studied rail alignment and elements that improve, rather than degrade, these conditions.

After a review of the existing Caltrain rail alignment and the planned Downtown Rail Extension (DTX), the RAB study explored other alignment options and the varied benefits of each alignment to the City, region, and state. While numerous possible alignments were reviewed and analyzed at some level, four alignments were found to have merit for deeper analysis. During further study, one option (Tunnel under Existing Caltrain Tracks/I-280 alignment) was deemed infeasible.⁸

The remaining alignment options that were further analyzed, are shown in Exhibit 4, and presented in the pages below. They are:

1. Future with Surface Rail: DTX + Trenched Streets
2. Pennsylvania Avenue: DTX + Extended Tunnel
3. Mission Bay: Modified DTX + 3rd Street Tunnel.

Exhibit 4: Three Rail Alignments to Salesforce Transit Center in Component #1



Platform Heights at SFTC

While the city determines how to meet future rail demand, the platform heights of the SFTC are of great importance and can significantly affect the number of trains that can access San Francisco. The currently published SFTC plans include two separate platform heights, permanently dedicating some platforms to Caltrain and others to HSR.⁹ This separation limits the train operating capacity of the SFTC. It could also limit the planned DTX underground 4th/Townsend station, which currently include plans for a center platform height that would only serve Caltrain, not CHSRA.

All platforms should be constructed at the higher platform height, since future Caltrain cars will have two sets of doors - designed for both traditional Caltrain and future HSR platform heights. This uniform height would maximize the operational capacity and flexibility of both the SFTC and the 4th/Townsend stations. Accordingly, the TJPA adopted Resolution Number 15-023 in 2015, which "strongly encourages CHSRA and JPB to reach an agreement that would allow the Transbay Transit Center's [SFTC's] three rail platforms to be designed and constructed with a common, level, boarding height ... such that each platform is capable of being used by Caltrain and High-Speed Rail trains."

RAIL ALIGNMENT OPTION 1: FUTURE WITH SURFACE RAIL: DTX + TRENCHED STREETS

Description

The Future with Surface Rail alignment option (shown in green in Exhibit 5) reflects the conditions in 20 years, if current plans move forward when DTX is built and the city must trench it's current at-grade intersections with the Caltrain tracks. This option includes existing surface rail south of Mission Bay Drive that would connect into either (1) 4th/King surface railyard or (2) the Downtown Rail Extension (DTX) tunnel. The DTX tunnel then extends from the SW corner of the Caltrain yard to the Salesforce Transit Center (SFTC). Specific elements of the Future with Surface Rail alignment option include:

- » Use of the DTX tunnel as designed and environmentally cleared.
- » Assumed new underground 4th/Townsend station as part of the designed and environmentally cleared DTX. Includes continued use of the 4th/King surface station as well.

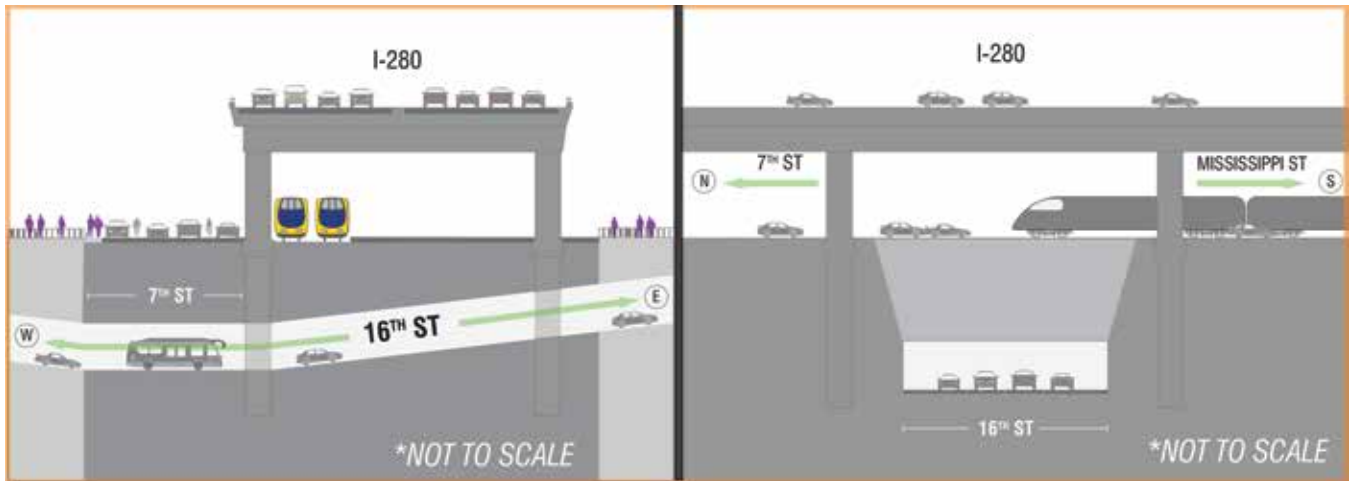
- » Use of existing surface Caltrain tracks under I-280 south of 4th/King surface railyard connection.
- » Assumed two grade separated roadways (Mission Bay Drive and 16th Street) that are currently at-grade intersections with the Caltrain tracks. These roadways would be trenched to run below the Caltrain tracks to maintain vital east/west connections between the city and Mission Bay.
- » Assumed Caltrain Electrification consistent with current plans, including electrifying the Caltrain line from San Jose to San Francisco and electrifying Caltrain 4th/King surface railyard for passenger operations, staging, storage, and maintenance.
- » Assumed 3 tracks in the DTX tunnel and predominantly 2 tracks south of 16th Street, as is provided today, with crossovers as needed for safety and operational flexibility.

Exhibit 5: Future with Surface Rail: DTX + Trenched Streets Alignment (Option 1)



Exhibit 6: Future with Surface Rail: DTX + Trenched Streets Alignment (Option 1)

Cross sections of the 16th/7th street intersection with 16th Street moved underground, below the rail operations. This produces a trench of 0.6 miles in length.



Looking North

Looking East

Issues and Considerations

In addition to the common issues and considerations for all alignments identified above, the following are specific to the Future with Surface Rail alignment option.

- » To address the intermittent closures of the at-grade Caltrain intersections of Mission Bay Drive and 16th Street for more than 20 minutes in the peak hours, this option trenches these two streets. Without these grade separations, these vital intersections would be closed for 20+ minutes during peak hours. Such delays were deemed unacceptable and therefore were not further studied.
- » While the trenched streets assumed in this option would solve for intersection closures, at double the depth of the Cesar Chavez or Geary underpasses (4-5 stories deep) and over one-half mile in length (due to the required grades and distances from underground, gravity-driven utilities) they would create additional issues for pedestrians and neighborhood connectivity. These trenched streets would also be vulnerable to sea level rise and/or flooding.
- » There is no direct connection between the surface-level 4th/King railyard and the underground Salesforce Transit Center. For all rail alignment options under consideration, train movements between these destinations will be cumbersome and time-consuming.
 - Unique to this alignment, trains needing to travel from the surface railyard to the SFTC will need to travel backwards (south) for approximately 1.2 miles and across the two intersections before going north, across the two intersections to access the DTX tunnel and SFTC (See Exhibit 9, Item 12) in order to enter the DTX tunnel to access the SFTC.
 - Use of the turnback track described above from the surface railyard at 4th/King to SFTC would take approximately 10 minutes.

Analysis

This section analyzes the issues and considerations within four categories: 1) managing train conflicts, 2) change management, 3) maximizing public investment in the Salesforce Transit Center, and 4) interactions with other RAB components.

MANAGING TRAIN CONFLICTS

To solve for the issue of intermittent closures of the at-grade Caltrain intersections of Mission Bay Drive and 16th Street for more than 20 minutes in the peak hours, this option requires the trenching of these two streets. In this alignment option, preventing significant conflicts across the two intersections is achieved by depressing the two streets into approximately 45-foot deep, 0.6 mile long trenches (See Exhibit 6).¹⁰ Any north/south street currently intersecting these two streets in this stretch would either need to be severed, or the intersecting street would need to be depressed. That could result in buildings on corners where two sides are bounded by walls approximately 50 feet in height, increasing the visual separation between the Mission Bay district and the city at large.

Trenching 16th Street will affect operations and connections for the 22-Fillmore BRT, ambulance access to UCSF hospitals, and access to thousands of new homes and jobs in Mission Bay. The 22-Fillmore BRT is anticipated to run on 16th Street providing faster and more convenient transit access along the 16th Street corridor. For riders within the trench limit, additional vertical components (stairs/ramps) will be required to access the BRT stops. In addition, for an ambulance, directly connecting patients to UCSF hospital services is vital. Today, an ambulance patient can be delayed approximately 60 seconds when a train is crossing 16th Street. If the trench is put in place, the ambulance would travel under the rail and would never be stopped. However, an ambulance user coming from the north or south would require a 6-12 block additional trip (including at least three additional left turns) to access UCSF depending on the street grid that is put in place.

CHANGE MANAGEMENT

As this rail alignment option represents the current plans, no change management would be needed for train operators.

- » The DTX remains as currently designed and environmentally cleared. The DTX is a 1.3 mile underground

extension of the Caltrain tracks connecting the surface Caltrain tracks at 7th Street to the SFTC and includes a new underground station at 4th/Townsend (See Exhibit 9 Item 10).

- » Caltrain electrifies its corridor, as well as the 4th/King surface railyard. There would be no change in the connections provided to the existing Caltrain tracks.
- » CHSRA operates on the Caltrain tracks.

The city would need to develop plans for the intersection grade separations to lower these streets 35-50 feet below current elevations. This work would include additional design development, completion of environmental clearance, securing funding, and construction of two grade-separated intersections.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Under current operations plans, not all Caltrain trains will complete their trip at San Francisco's central transit hub, the SFTC. Current plans show some Caltrain trains originating and terminating at the 4th/King surface railyard. Caltrain and CHSRA are currently developing a plan for their joint service operations which may change these service plans.¹¹ With the proposed underground 4th/Townsend station, those traveling on to the SFTC would essentially make a mid-line station stop at this new station. Ideally, all trains to San Francisco would have the SFTC as the final destination. This would be in keeping with the designation of the SFTC as a multi-modal station connecting to BART, MUNI Metro, MUNI buses, AC Transit, bike share, and the downtown core of employment in San Francisco.

If current plans do not change, the 4th/King station would also act as an end-terminal essentially making San Francisco a two-terminal city. Creating two terminals less than one-mile apart that serve the same stations and operators increases the potential to confuse the occasional rider without significant improvement to the overall system.

Given the transportation system connectivity and the density of hotels, jobs and homes near the SFTC, the City and County of San Francisco prefers that future service plans maximize the number of trains to the SFTC. Turning trains back at 4th/King potentially leaves thousands of rail passengers short of their desired destination (connection) each day and requiring at least a change in location or mode to reach their final destination.

INTERACTIONS WITH OTHER RAB COMPONENTS

- » **Component #2 Railyard Reconfiguration/Relocation** – This option provides minimal possibility for relocation or reconfiguration on the 4th/King surface railyard. Under this option the railyard remains as is for operations, staging, and storage and maintenance, although these activities could remain, or could be completed on a smaller footprint, moved underground, moved south, or certain combinations of the above.
- » **Component #3 Urban Form and Land Use Considerations** – This option does not increase nor reduce a significant amount of developable land. This option, assuming deep trenches underneath the rail corridor, would create extensive stretches of concrete retaining walls and inactive facades along Mission Bay Drive and 16th Street. This option does not allow for new connections between Mission Bay and the rest of the city.

- » **Component #4 Extension/Loop** – This option does not affect the possibility of creating an extension/loop out of the east end of the SFTC.
- » **Component #5 I-280** – This option likely requires the elevated I-280 structure and touchdown ramps to 4th/King and 6th/Brannan to remain in place indefinitely; surface rail tracks will likely continue to run directly under the freeway due to the difficulty of removal of the elevated freeway segment(s) over an active railroad/yard.

Cost Considerations

The current cost estimate for the DTX portion is \$4 billion. This rail alignment would incur additional costs for the construction of two grade-separated (trenched) streets at Mission Bay Drive and 16th Street to maintain east/west movement across the City. For a summary of costs see *Preliminary Estimate of Probable Costs* (Exhibit 15) later in this component.

Summary: Option #1 Future with Surface Rail Alignment

PROS	CONS
<ul style="list-style-type: none"> » Provides for additional capacity along the Caltrain corridor for increased future rail service. » Allows Caltrain to continue phasing towards full electrification of their fleet. » Provides rail access to SFTC. » Has approved environmental clearance for the DTX. » Provides access and mobility for critical life-safety connections to the hospital via a trenched 16th Street. » Allows rail providers to proceed on their schedule and could allow the city to pursue a phased construction schedule with trenching streets to follow. » Requires the least amount of reassessment by the partner agencies and jurisdictions. » Remains the least expensive option. 	<ul style="list-style-type: none"> » Uses a plan that was determined when land use in the area was more industrial. With the more intense and dense uses that exist now and will be built in the future, there will be more impacts. The surface rail: <ul style="list-style-type: none"> • precludes new east/west crossings and access points; • limits access points east/west to two (2) locations. » Requires approximately \$1 billion in trenching to solve for the issue of intermittent closures of the at-grade intersections. The trenches would: <ul style="list-style-type: none"> • be four to five stories deep, or double the depth of the Cesar Chavez and Geary underpasses. • disrupt circulation and further isolate Mission Bay, Dogpatch, Potrero Hill, and other communities. • create more disjointed environments for pedestrians, bicyclists, and drivers. • be susceptible to sea level rise and/or flooding at any time. » Potentially provides two rail facilities near each other but without direct rail connections (4th/King and the new underground 4th/Townsend stations). » Does not allow all trains to terminate at SFTC.

RAIL ALIGNMENT OPTION 2: PENNSYLVANIA AVENUE: DTX + EXTENDED TUNNEL

Description

The Pennsylvania Avenue alignment: DTX + Extended Tunnel option (shown in orange in Exhibit 7 and referred to as Pennsylvania Avenue alignment throughout this summary) moves the trains underground near the 22nd Street Caltrain station. All trains then travel via an underground tunnel beneath Pennsylvania Avenue. The rail travels north, adjacent to and underneath the current tracks up 7th Street connecting to the DTX tunnel stub box (see Exhibit 10, Item 11). Trains use the Downtown Rail Extension (DTX) to pass through the new underground 4th/Townsend station towards a final destination at the SFTC. The the Pennsylvania Avenue alignment option:

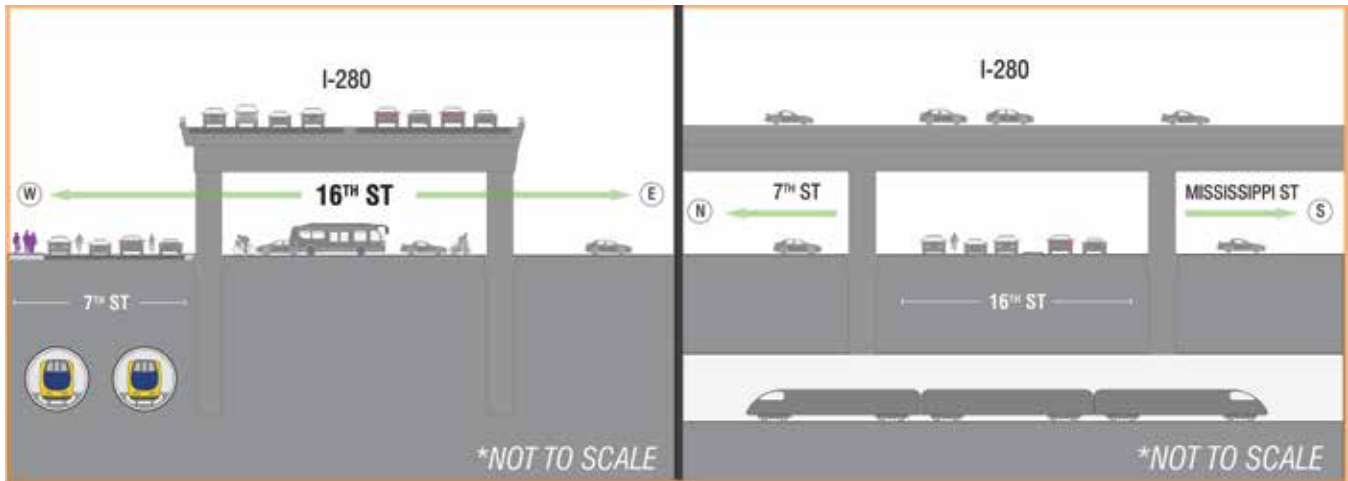
- » Includes the DTX as designed and environmentally cleared.
- » Allows for operation of the DTX as designed and environmentally cleared, while Pennsylvania Avenue extension is being constructed. Does not delay DTX design and/or construction.
- » Assumes Caltrain electrification. Requires 100% electrification of fleet servicing San Francisco.
- » Proposes that current 4th/King passenger operations move to the new underground 4th/Townsend station.
- » Assumes the rail is moved underground in the area around the 22nd Street Caltrain station using a tunnel boring machine. The existing surface tracks could be removed after tunnel is operational.

Exhibit 7: Pennsylvania Avenue: DTX + Extended Tunnel Alignment (Option 2)



Exhibit 8: Pennsylvania Avenue: DTX + Extended Tunnel Alignment (Option 2)

Cross sections of the 16th/7th street intersection with trains moved underground, below the streets



Looking North

Looking East

- » Assumes long-term removal of rail access to the 4th/ King surface railyard and relocation of storage and maintenance facilities to a new location. While the continued use of the 4th/King surface railyard was not fully studied under RAB, the railyard could ultimately remain in its current location, be reconfigured to a smaller footprint, be moved underground or south, or certain combinations of the above. See Component #2 for more information on potential changes to the current railyard.
- » Removes conflicts at rail crossings of Mission Bay Drive and 16th Street, as rail moves underground.
- » Provides opportunity for new pedestrian, bike, and vehicular connections east/west between the Mission Bay neighborhood and the west and north/south across existing tracks and railyard.
- » Assumes 3 tracks in the DTX tunnel and predominantly 2 tracks south of the 4th/Townsend underground station, with crossovers as needed to allow for flexibility in operations.

Issues and Considerations

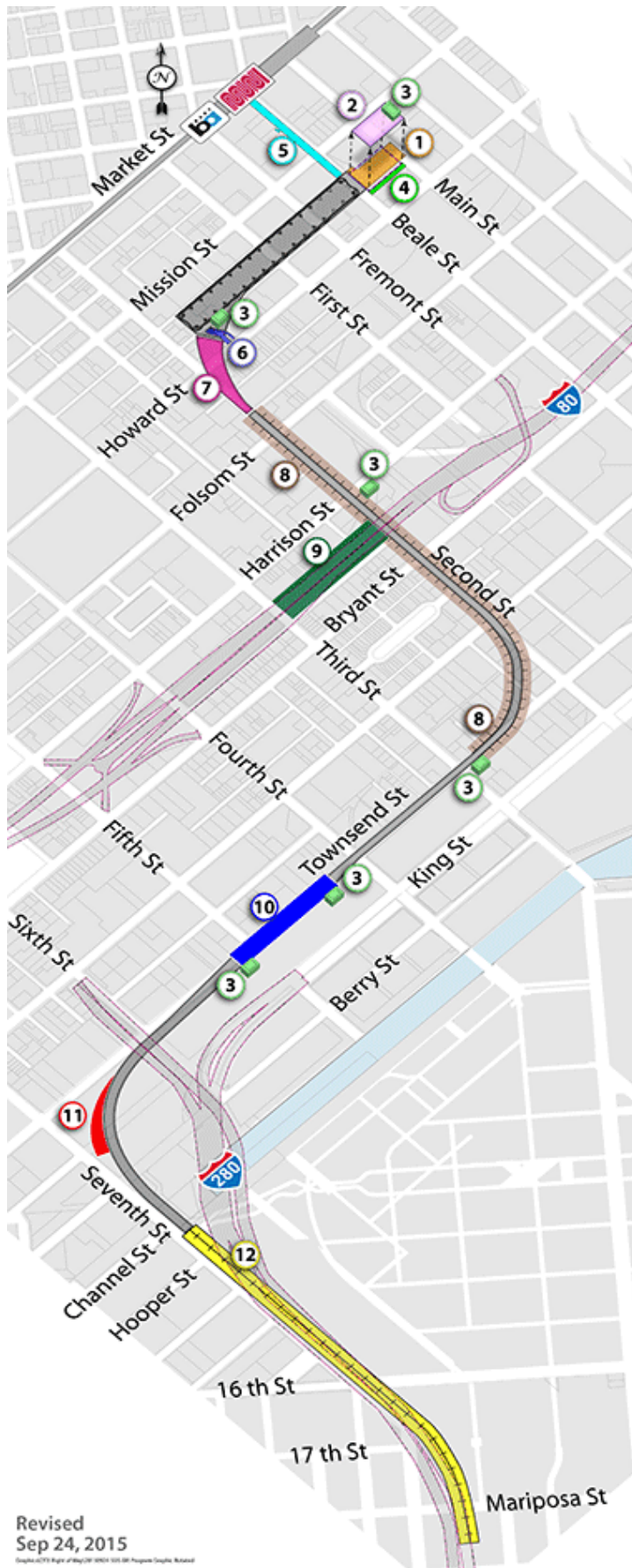
In addition to the common issues and considerations for all alignments identified previously, the following are specific to the Pennsylvania Avenue alignment option:

- » To avoid the outcomes of the Future with Surface Rail alignment of either intermittent closures of the

at-grade intersections or significant trenching, this option moves the trains underground. (See Exhibit 8).

- » Requires 100% electrification of Caltrain.
- » Allows for a phased construction where DTX is built and Pennsylvania Avenue extension could be designed and environmentally cleared separately and connected to the DTX with minimal service impacts.
- » Assuming a new location(s) for Caltrain storage and maintenance and all passenger service moves underground to the 4th/Townsend station, the following are fully realized:
 - Allows for many new east/west connections in the area.
 - Allows all trains to serve the SFTC.
 - Maintains rider access to the 4th/King area via the underground DTX station at 4th/Townsend, next to the Central Subway MUNI Metro station.
 - Separates passenger operations (at 4th/ Townsend) from storage and maintenance (at a new railyard location(s) (underground, south, or some combination)).
 - Potentially repurposes the 4th/King surface railyard for improved urban design and land use considerations.
- » Requires the determination of an appropriate location for a tunnel boring machine launch pit.

Exhibit 9: Elements of the DTX evaluated in the TJPA SEIS/EIR



Revised
Sep 24, 2015
Source: TJPA, 2015

1. **Train Box Extension** – The underground train box could be extended east one block to Main Street.
2. **Intercity Bus Facility** – A new bus facility would be constructed above the extended train box between Beale and Main streets. It would serve operators such as Amtrak and Greyhound.
3. **Ventilation and Emergency Egress Structures** – Six emergency ventilation/evacuation structures would be co-located with emergency tunnel exits at various locations along the DTX alignment.
4. **Taxi Staging Areas** – Curbside passenger loading and unloading spaces for taxis would be provided on Natoma Street alongside the new intercity bus facility.
5. **BART/Muni Underground Pedestrian Connector** – A pedestrian connection would link the Embarcadero BART/Muni Metro Station to the Transit Center.
6. **Bicycle/Controlled Vehicle Ramp** – A bicycle ramp would lead to below-grade bicycle facilities within the Transit Center. A separate controlled-access vehicle ramp (for use by emergency and approved maintenance vehicles) would run parallel to the bicycle ramp.
7. **Widened Throat Structure** – The proposed widened throat structure provides the connection between the underground tracks and the train box below the Transit Center. It will conform to design specifications required for High-Speed Rail service.
8. **Rock Dowels** – Rock dowels are approximately 15-foot-long rods that would be installed along the mined tunnel segment.
9. **Parking at AC Transit Bus Storage Facility** – The AC Transit bus storage facility would be used for off-hours/nighttime or special event parking when not in use by AC Transit for regular operations.
10. **Fourth and Townsend Underground Station Realignment** – The underground station would be realigned to parallel Townsend Street.
11. **Tunnel Stub Box** – A new below-grade train box at the west end of the Caltrain railyard near Townsend and Seventh streets would be constructed to accommodate future grade separations and expedite future arrival of below-grade Caltrain and High-Speed trains.
12. **Additional Trackwork** – A turnback track and maintenance of way storage track would be constructed within the existing Caltrain right-of-way between Hooper Street and Mariposa Street, immediately east of Seventh Street.

- » Requires additional environmental clearance for tunnel portion south of the DTX tunnel stub box.
- » Potentially increases tunnel boring efficiency by using the same boring machine for both the Pennsylvania Avenue alignment¹² and possibly a portion of the DTX alignment¹³.
- » Provides increased possibility of relocating the 22nd Street station for greater accessibility.
- » Removes rail use in up to two of the four Caltrain tunnels in San Francisco. These existing tunnels are over 100 years old and eligible for the national historic register, are susceptible to sea level rise and flooding, and are currently difficult to maintain.

Analysis

This section analyzes the issues and considerations within four categories: 1) managing train conflicts, 2) change management, 3) maximizing public investment in the Salesforce Transit Center, and 4) interactions with other RAB components.

MANAGING TRAIN CONFLICTS

With the movement of trains underground, and the storage and maintenance activities moved to new locations as discussed above, this rail alignment avoids the 20 minute intersection closures identified in the Future with Surface Rail alignment option. The two current at-grade intersections could operate as regular four-way intersections – without the train operations interrupting traffic flow. In addition, north of the tunnel portal location, the surface tracks and the 4th/King surface railyard could be removed. With the removal of train operations at the surface, up to six (6) new east/west roads could connect Mission Bay and its adjoining neighborhoods to the rest of the city north of 18th Street. These changes would also enable up to two (2) new north/south connections across the existing railyard.

CHANGE MANAGEMENT

The Pennsylvania Avenue alignment minimizes disruptions in train service. Compared to current plans, the operational changes to Caltrain and HSR are balanced with improved urban design outcomes and increased potential for more intense urban land uses. Specifically, change management associated with this alignment includes the following considerations:

- » Connection of the Pennsylvania Avenue extension would be made through the use of the DTX tunnel stub box, as included in the DTX current design and environmental clearance documents (See Exhibit 10, item 11).
- » This alignment would allow a phased construction whereby the DTX would be completed and could start operations with a later connection to the Pennsylvania Avenue extension section. This

Exhibit 10: Location of Tunnel Stub Box in DTX Plans



Source: TJPA, 2015

would enable train operations to start within the DTX and continue without major interruptions while the Pennsylvania Avenue extension is completed. Connections between the Pennsylvania Avenue extension portion and the operating DTX could be completed with a limited number of weekend service impacts.

- » Additional environmental clearance would be required for the underground portion of Pennsylvania Avenue extension outside of the DTX. This additional environmental work is anticipated to be simpler than the DTX environmental clearance, as surface impacts under the Pennsylvania Avenue alignment outside of the environmentally cleared DTX segment would be minimal.
- » A 22nd Street station study would be required.¹⁴ This proposed study would provide a full analysis of connections to existing and future transit lines, bicycle and pedestrian routes, and complete ADA accessibility.
- » New storage and maintenance facilities could add operating expenses for Caltrain to move trains into and out of service.
 - This change could eliminate the need for the required turnback movement as provided under Future with Surface Rail alignment (Exhibit 10, item 12). The travel time associated with the turnback is roughly equal to the travel time from a southern railyard into the SFTC.
 - To allow for additional storage or event staging of trains, there are possibilities (not included in the cost estimates provided, and not fully engineered) for an expanded DTX underground 4th/Townsend station.¹⁵
- » Changes to Caltrain electrification schedule would not be necessary, as both CHSRA and Caltrain can use the Caltrain tracks. But as noted, Caltrain would be required to fully electrify its fleet to use the Pennsylvania Avenue alignment.

MAXIMIZING PUBLIC INVESTMENT IN SFTC

With the removal of the surface tracks north of the 22nd Street station for the new Pennsylvania Avenue alignment tunnel, all trains traveling to and from San Francisco would terminate at SFTC. This maximizes the immense public investment in the new transit center, which has one of the highest modal connection opportunities and job densities in the western United States.

INTERACTIONS WITH OTHER RAB COMPONENTS

- » **Component #2 Railyard Relocation/Reconfiguration**
 - Under this option, the surface railyard is expected to be removed and repurposed for improved urban design and land use more compatible with high-density neighborhood.¹⁶
- » **Component #3 Urban Design and Land Use Considerations** – Provides opportunity for new east/west pedestrian, bike, and vehicular connections between the Mission Bay neighborhood and adjacent neighborhoods to the west, as well as new north/south connections across the existing railyard. Adds land use opportunities. Avoids the need to trench streets.
- » **Component #4 Extension/Loop** – this alignment maintains the potential for future connections out of the east end of the SFTC.
- » **Component #5 I-280** – Assumes continued use of elevated I-280; compatible with the potential future removal of I-280.

Cost Considerations

Costs will exceed the current DTX estimate (\$4 billion). This alignment would include the design, environmental clearance, and construction of an additional 1.6 miles of underground rail tunnel, and a new location for storage and maintenance activities.¹⁶ For a summary of costs see *Preliminary Estimate of Probable Costs* (Exhibit 15) later in this Component.

Summary: Option #2 Pennsylvania Avenue Alignment

PROS	CONS
<ul style="list-style-type: none"> » Avoids a long, deep trenching of the street network to maintain east/west connections to Mission Bay. » Provides access and mobility for critical life-safety connections along 16th Street to hospitals in Mission Bay. » Improves neighborhood connectivity and safety by eliminating conflicts with trains. » Provides opportunity to re-knit over one mile of the city longitudinally with up to six additional east/west connections across existing surface rail. » Improves urban design and creates land use opportunities at 4th/King surface railyard; provides up to two additional north/south connections across existing railyard. » Provides dedicated right-of-way for operating trains, resulting in safer surface streets. » Provides for nominally faster rail travel times over the Future with Surface Rail alignment and current conditions. » Allows for more direct train movement from storage into operations for trains than the Future with Surface Rail alignment option by creating a new storage and maintenance location. » Allows possibility of expanding 4th/Townsend underground for additional storage and staging opportunities. » Includes flexibility of construction phasing by allowing the construction of the Pennsylvania Avenue extension after the DTX is in operation with minimal disruptions to Caltrain/HSR. » Provides for all trains to utilize SFTC. 	<ul style="list-style-type: none"> » Increases project costs. » Requires additional environmental review on the underground segment south of 7th/Townsend. » Assumes relocation of storage and maintenance functions at surface 4th/King railyard to new location(s). » Likely requires the relocation of a substantial number of underground utilities. » May impact overall station capacity of 4th/King area. Future analysis to be completed and 4th/Townsend underground station may be revised to improve capacity if needed.

RAIL ALIGNMENT OPTION 3: MISSION BAY: MODIFIED DTX + 3RD STREET TUNNEL

Description

The Mission Bay alignment: Modified DTX + 3rd Street Tunnel proposes a tunnel from the vicinity of 23rd Street below the existing I-280 elevated freeway (shown in blue in Exhibit 11 and referred to as Mission Bay alignment throughout this summary). From there, the tunnel would veer east traveling below 3rd Street, across China Basin to the southwest corner of AT&T Park and then into the existing DTX alignment. This alignment would travel at a deeper depth¹⁷ than the approved DTX and climb to the DTX elevation at the throat of the SFTC near 2nd Street. Notably, this alignment would require abandoning the DTX alignment which has completed preliminary design and is environmentally cleared. Specifically, the Mission Bay alignment option:

- » Forges a new alignment that largely falls east of the Downtown Rail Extension (DTX) alignment. Only the last segment along 2nd Street would follow the DTX into the SFTC. Even here, the depth would be different than the approved DTX.
 - » Assumes Caltrain electrification. Requires 100% electrification of fleet servicing San Francisco.
 - » Proposes a new underground Third Street station to serve the Mission Bay community. This would operate as a replacement to 4th/King station and/or 4th/Townsend station for passenger operations.
 - » Assumes surface rail is removed north of 22nd Street station and thereby removes 4th/King surface railyard access.¹⁶
 - » Removes rail conflicts at Caltrain intersections with Mission Bay Drive and 16th Street, as rail moves underground.
 - » Relocates 4th/King storage and maintenance activities to a new location.¹⁶
 - » Provides for opportunity for new pedestrian, bike, and vehicular connections east/west between the Mission Bay neighborhood and the west.
- » Provides the opportunity for new north/south connections across existing railyard.
 - » Assumes two to three tracks throughout the entire new alignment section with crossovers as needed for operations flexibility.

Issues and Considerations

In addition to the common issues and considerations for all alignments shown above, the following are specific to the Mission Bay alignment option:

- » To avoid the outcomes of the Future with Surface Rail alignment of either intermittent closures of the at-grade intersections or significant trenching, this option moves the trains underground. (See Exhibit 12).
- » Requires 100% electrification of Caltrain fleet.
- » Placement of trains underground allows for many more east/west connections in the area.
- » Assuming the construction and use of new locations for Caltrain storage and maintenance and all passenger service moves underground to the Third Street station, the following are fully realized:
 - Allows for more east/west connections in the area.
 - Allows all trains to serve the SFTC.
 - Separates passenger operations (at a new Third Street station) from storage and maintenance (at a new railyard location (underground, south, or some combination)).
 - Requires additional travel time on foot/bike/transit to access the 4th/King area for train users who would use the new underground station at 3rd Street instead of 4th/King or 4th/Townsend.
 - Potentially repurposes the 4th/King surface railyard for improved urban design and land use considerations.
- » Requires the determination of an appropriate location for a tunnel boring machine launch pit.
- » Requires additional environmental clearance for tunnel portion south of the DTX throat including

impacts to major substructures (e.g., 3rd Street Bridge, AT&T, and I-280), poor and unknown soil conditions, impacts from construction and operation of a new, underground, deep station, and potentially use of the largest tunnel boring machine used in the United States to date.

- » This tunnel cannot be phased and the work and time spent on the DTX design and environmental clearance would be a loss.
- » Although this alignment is a straighter shot into the SFTC, there is not significant time savings over the other alignments due to 1) traveling to the depth needed to travel under Mission Creek and climbing back to the SFTC depth, and 2) the likelihood of a required double reverse curve around AT&T Park to minimize impacts to the substructure of the ballpark.
- » Provides increased possibility of relocating the 22nd Street station for greater accessibility.

Analysis

This section analyzes the issues and considerations within four categories: 1) managing train conflicts, 2) change management, 3) maximizing public investment in the Salesforce Transit Center, and 4) interactions with other RAB components.

MANAGING TRAIN CONFLICTS

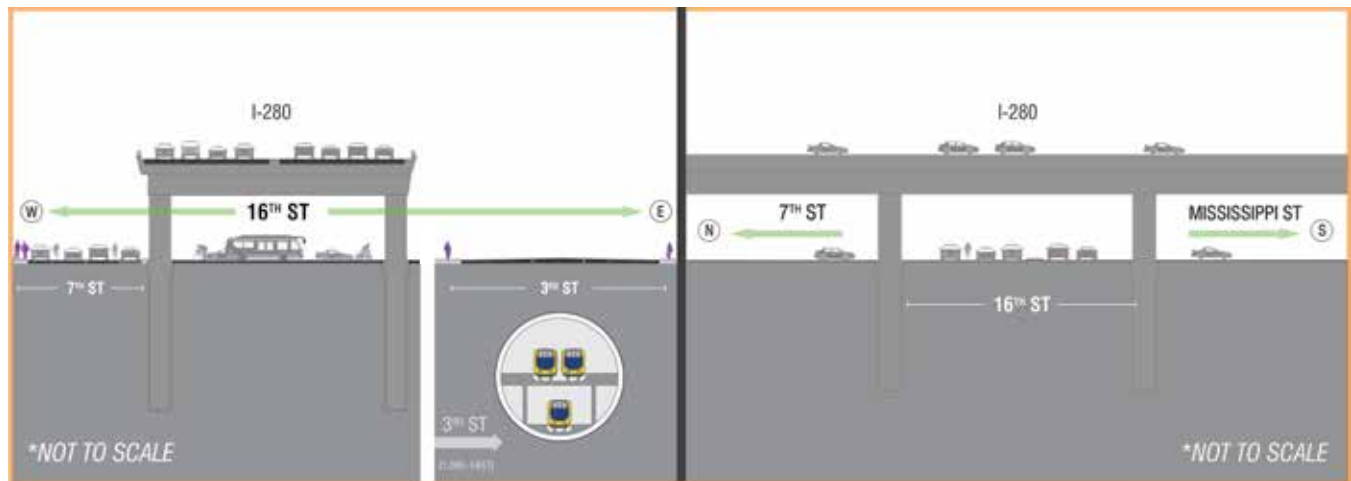
As the trains are moved underground south of 16th Street, the possibilities of train conflicts are removed. In addition, the issues identified in the Future with Surface Rail alignment option around the two at-grade intersections are also removed. The two intersections could operate as regular four-way intersections – without the train operations interrupting traffic flow. In addition, north of the tunnel portal location, the surface tracks and the 4th/King railyard are anticipated to be removed.¹⁶ With the removal of train operations at the surface, up to six (6) new east/west roads could be reconnected in the area. In addition, with the movement of storage and maintenance activities to a new location two (2) north/south connections across the existing railyard could be constructed.

Exhibit 11: Mission Bay: Modified DTX + 3rd Street Tunnel Alignment (Option 3)



Exhibit 12: Mission Bay: Modified DTX + 3rd Street Tunnel Alignment (Option 3)

Cross sections of the 16th/7th street intersection with trains moved underground, below 3rd Street



Looking North

Looking East

While the lack of conflict just described is the final state of this alignment, there is an interim condition of the Mission Bay alignment where the train conflicts with surface traffic will continue (after Caltrain electrifies and HSR is operating but the Mission Bay alignment is not constructed/in operation as yet¹⁸). Unlike the Pennsylvania Avenue alignment, the Mission Bay alignment cannot be constructed in a phased manner. Trains would continue to run at surface until the Mission Bay tunnel is complete and trains are operating underground. The interim state would disrupt the 16th Street Bus Rapid Transit (22-Fillmore) line, emergency access to the hospital, and general travel conditions for all in the neighborhood.

This interim period of conflict could continue as the potential for delays is difficult to estimate. This tunnel utilizes 2nd Street but would be at a different elevation than previously cleared under the DTX, so additional environmental study would be needed. Further, the impacts to major substructures (e.g., 3rd Street Bridge, AT&T Park, and I-280), poor and unknown soil conditions, impacts from construction and operation of a new, underground, deep station, and potential use of the largest tunnel boring machine used in the United States to date all contribute to the possibility that delays will add time and money to the design, environmental clearance, and construction costs.

CHANGE MANAGEMENT

The Mission Bay alignment requires the most change for execution with the following items impacted:

- » This alignment cannot use the vast majority of the DTX alignment, with the only common element being at the throat of the SFTC (Exhibit 13, item 7). Further, the portion of the Mission Bay alignment at 2nd Street is at a different elevation than the current DTX. The tunnel would be constructed while Caltrain remained in service to 4th/King with a limited number of weekend service impacts as the connection is made to the new tunnel.
- » Additional environmental clearance would be required for the underground portion outside of the DTX throat. The environmental clearance of this tunnel would include more impacts than the Pennsylvania Avenue alignment tunnel including not only vent structures but also a new, likely deep, underground station somewhere along 3rd Street¹⁹ and negotiation around the 3rd Street Bascule (Swing) Bridge and AT&T Park substructures, all of which need to be analyzed. Therefore, the environmental clearance process for the Mission Bay alignment is anticipated to be more lengthy and in-depth than other options.
- » A 22nd Street station study would be required.²⁰ This proposed study would provide a full analysis of connections to existing and future transit lines, bicycle and pedestrian routes, and complete ADA accessibility.

- » Changes to Caltrain functionality would include separating passenger loading operations which would occur at the new Third Street station from storage and maintenance which would occur at a new location.
 - This change would eliminate the need for a turn-back track as provided under Future with Surface Rail alignment (see Exhibit 10, item 12). The operations time associated with the movement utilizing the turnback track is equitable to the operations time from a southern railyard into the SFTC.
 - There is the possibility of double-berthing for staging but likely not storage at the new underground Mission Bay station. Logistics and costing of providing additional staging or storage in the Mission Bay alignment was not included in the cost estimates and the Blended Service Operations Plan would need to be completed before additional work is undertaken.
- » No change needed to Caltrain electrification schedule as both CHSRA and Caltrain both can use the Caltrain tracks, but as noted. Caltrain would be required to fully electrify its fleet.

Exhibit 13: Location of SFTC throat in DTX



Source: TJPA, 2015

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

With the removal of the surface tracks north of the 22nd Street station for the new Mission Bay alignment tunnel, all trains traveling to and from San Francisco would terminate at SFTC. This maximizes the immense public investment in building the new transit center, which has one of the highest modal connection opportunities and surrounding job densities in the western United States.

INTERACTIONS WITH OTHER RAB COMPONENTS

- » **Component #2 Railyard Reconfiguration/Relocation** – This option assumes that the railyard is removed and repurposed in order to improve urban design and enable land use more compatible with high-density neighborhoods.¹⁶
- » **Component #3 Urban Design and Land Use Considerations** – Provides opportunity for new pedestrian, bike, and vehicular connections east/west between the Mission Bay neighborhood and the rest of the city. Adds land use opportunities. Avoids the need for trenching of streets. The Third Street station would serve the growing Mission Bay neighborhood; however, ridership would be somewhat reduced from other alignments because the capture area includes a portion of San Francisco Bay.
- » **Component #4 Extension/Loop** – this alignment maintains the potential for future connections out of the east end of the SFTC.
- » **Component #5 I-280** – Assumes continued use of elevated I-280; compatible with the potential future removal of I-280.

COST CONSIDERATIONS

Costs will exceed the current DTX estimate (\$4 billion). This alignment would include the design, complicated environmental clearance and construction of a new 2.6 mile underground rail tunnel in an area with many unknowns as well as construction costs associated with a new location for storage and maintenance activities.

¹⁶ For a summary of costs see *Preliminary Estimate of Probable Costs* (Exhibit 15) later in this Component.

Summary Option #3: Mission Bay Alignment

PROS	CONS
<ul style="list-style-type: none"> » Avoids a long, deep trenching of the street network to maintain east/west connections to Mission Bay. » Provides access and mobility for critical life-safety connections along 16th Street to hospitals in Mission Bay. » Improves neighborhood connectivity and safety by eliminating conflicts with trains. » Provides opportunity to re-knit over one mile of the city longitudinally with up to six additional east/west connections across existing surface rail. » Provides for nominally faster rail travel times. » Allows for more direct train movement from storage into operations for trains than the Future with Surface Rail alignment option by creating a new storage and maintenance location.¹⁶ » Improves urban design and creates land use opportunities at 4th/King surface railyard, provides up to two additional north/south connections across existing railyard. » Provides a direct connection to Caltrain and HSR for Mission Bay. » Provides for all trains to utilize SFTC. 	<ul style="list-style-type: none"> » Requires additional environmental review on the entire new segment from the Caltrain alignment to the throat of the SFTC. » Assumes relocation of storage and maintenance functions to new location(s).¹⁶ » Constrains space for underground storage tracks at Mission Bay station. » May require the largest tunnel boring machine (TBM) used in US to date, depending upon how many tracks are required. » Likely increases in costs for design, difficulty of environmental review, and costs of construction due to poor soils and in some cases unknown soil conditions. » Increases engineering unknowns and potential difficulties due to alignment's interaction with substructures such as the 3rd Street Bascule (Swing) Bridge, AT&T Park, and potentially I-280. » Eliminates the potential for phased construction. Trains would continue to run to/from 4th/King until the new tunnel to SFTC is completed and operational. » Results in the longest schedule for completion of alignments under consideration. » Costs the most out of the three alignments further analyzed.

Comparative Analysis Between Rail Alignment Options

CONSTRUCTION TIMELINE

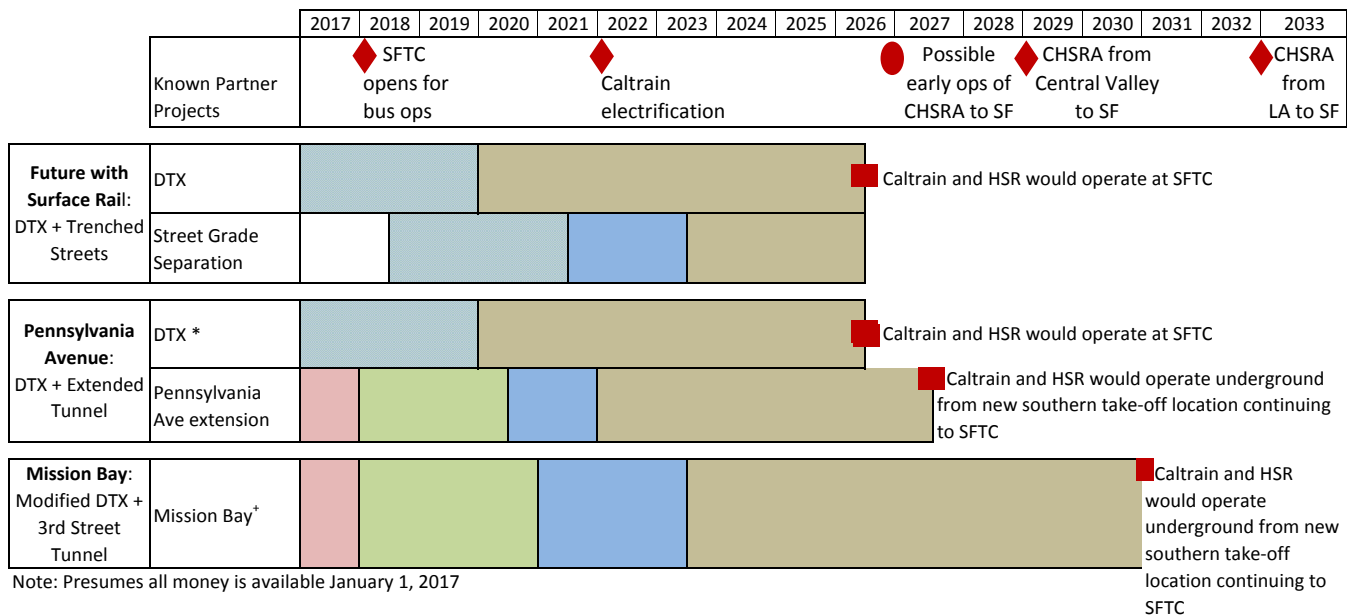
To provide comparison of construction timeline for each of the rail alignments under consideration, the analysis looked at how quickly each could be constructed if all the money became available (when needed) starting in January 2017. The three rail alignments would still be constructed and opened on different timelines. The Future with Surface Rail alignment has completed its environmental clearance (SEIS/R, 2018) for the DTX tunnel while the two trenched streets would still need to have environmental clearance completed prior to their construction. Similarly, both the Pennsylvania Avenue alignment and the Mission Bay alignment would need additional environmental work prior to construction for the tunnel portions outside of the DTX (See Exhibit 14).

PRELIMINARY ESTIMATES OF PROBABLE COSTS

The preliminary estimates of probable costs were completed to allow for a preliminary financial comparison of the rail alignment options. Please note:

- » These estimates were based on between 5-10% design documents and represent the comparative costs based on the TJPA's estimates of the DTX, and validated costs of similar projects.
- » These estimates were expressed in 2016 dollars and have been escalated on a 5% per year basis to mid-construction year.
- » These estimates are not meant to be a line-by-line cost estimate that would be available when 30% design is complete. These estimates are intended to provide decision-makers with an order of magnitude analysis.²¹

Exhibit 14: Construction Timeline for Rail Alignments



* Project approach of the DTX should be revisited to take advantage of potential efficiencies in boring parts of the DTX in combination with the Pennsylvania Avenue Extension. These efficiencies could have beneficial schedule implications

* Example of big bore in bad soil conditions: Bertha (Seattle) 57 feet in diameter. 1.7 miles - rate of 1 year

LEGEND

- Selection of Rail Alignment
- ▨ Additional Engineering & Property Acquisition
- ▨ Additional Design & Environmental Clearance (if needed)
- ▨ Property Acquisition
- ▨ Construction

- » All alignment option cost estimates included the DTX elements²², with some variations²³. In addition, specific alignment elements were added including but not limited to:
 - New locations for storage and maintenance activities (see Component #2 for more information) are included in both the Pennsylvania Avenue and Mission Bay alignments.¹⁶
 - Grade separation of the two at-grade intersections is included in the Future with Surface Rail alignment.
 - Rail alignment elements and construction costs vary under each alignment.
- » The estimates provided below are all inclusive. They include all elements for each rail alignment as identified below. (e.g., Future with Surface Rail includes both the DTX and the cost for trenching the city Streets; Pennsylvania Avenue includes the DTX, environmental and construction of extending the tunnel underground, and providing for a southern railyard to replace 4th/King; Mission Bay includes environmental and construction of a new tunnel, as well as providing for a new southern railyard.)

Development Opportunities

The Pennsylvania Avenue and Mission Bay alignments make land available that is more compatible with a growing population and job base. Additional space for more urban land uses could off-set some of the costs of construction. The largest opportunity for reuse is the 4th/King surface railyard. Looking only at the 4th/King surface railyard, and utilizing the zoning in the surrounding Central SoMa area, an estimation of the potential increased land opportunity is included. Not included in the estimates provided is any increased property values associated with the removal of heavy industrial rail yards and improved street connectivity.

Unlike other development opportunities, such as the land around the Salesforce Transit Center that was owned by Caltrans and transferred to the city, the land under the 4th/King surface railyard is owned by a private developer who has provided Caltrain with an operating lease on that land. While the 4th/King surface railyard may become available for future development, the value increase available to the city would not include the sale of the land as was the case in the Transbay Transit Center District. Value from the 4th/King surface railyard would potentially be captured from: bonding potential, property value conferred, transfer taxes, and one or more Community Facilities Districts (CFDs or “Mello Roos districts”).

Grade Separation Cost Estimation

The two current at-grade Caltrain intersections (Mission Bay Drive and 16th Street) under the Future with Surface Rail alignment option would be depressed into trenches within the city. San Francisco Department of Public Works provided preliminary estimates of probable costs for each of these two intersections based on known utility conflicts and city standards. Those estimates are included in the larger alignment estimate separately.

While there are other costs that were identified and estimated within the report, given the magnitude of this type of construction, private sector costs and benefits including disruption costs, property impacts, and rider travel time savings, while significant (on the order of millions), were excluded from the summary calculations. Specifics on the preliminary estimates of probable costs can be found in Appendix D and Appendix E of the Final Consultant Technical Report.

Exhibit 15: Preliminary Estimates of Probable Costs - Rail Alignments

Estimated Probable Construction Costs

	Option 1: Future with Surface Rail: DTX + Trenched Streets (2026)	Option 2: Pennsylvania Avenue: DTX + Extended Tunnel (2027)	Option 3: Mission Bay: Modified DTX + 3rd Street Tunnel (2030)
Alignment Construction Probable Cost	-\$4,075	-\$6,842	-\$10,196
Grade Separation (escalated to mid-year construction 2024, completion 2026)	-\$1,116	\$0	\$0
TOTAL (\$millions, escalated to mid-year of construction 2023, 2024, 2027)	-\$5,191	-\$6,842	-\$10,196

City Revenue Bonding Potential

	Option 1	Option 2	Option 3
Railyard Site Development Fiscal Benefit Bonding Potential ¹	\$0	\$235	\$235
Adjacent Property Value attributable to rail: Tax Increment Bonding Potential	\$214	\$214	\$147
Railyard Site Land Secured Financing Bonding Potential - CFD on area 0.1% Assessed value	\$0	\$32	\$32
Diminished Bonding Potential from Trenching	-\$8	\$0	\$0
TOTAL BONDING POTENTIAL (millions of 2026 \$)	\$206	\$481	\$414

¹ Assumes 25% of revenues dedicated to costs associated with development (e.g., increased sewer costs, etc)

Private Sector Benefits(+)/Costs(-)

	Option 1	Option 2	Option 3
Railyard Land Value Conferred	\$0	\$352	\$352
Diminished Property Value from Trenching intersections at Mission Bay Dr and 16th St	-\$114	\$0	\$0
Potential Rail Passenger Travel time Savings over 50 years	\$0	\$0	\$82
TOTAL PRIVATE SECTOR BENEFITS/COSTS (millions of 2026\$)	-\$114	\$352	\$434

Overall Benefit/Cost Summary

	Option 1: Future with Surface Rail: DTX + Trenched Streets (2026)	Option 2: Pennsylvania Avenue: DTX + Extended Tunnel (2027)	Option 3: Mission Bay: Modified DTX + 3rd Street Tunnel (2030)
Estimated Project Costs (escalated to estimated mid-year of construction 2023, 2024, 2027)	-\$5,191	-\$6,842	-\$10,196
City Bonding Potential	\$206	\$481	\$414
Private Sector +Benefits/-Costs (estimated to 2026\$ millions)	-\$114	\$352	\$434
TOTAL (millions)	-\$5,099	-\$6,010	-\$9,349

COMPONENT #2: RAILYARD RECONFIGURATION/RELOCATION

Description

The current 4th/King surface railyard provides multiple services that are essential to Caltrain. Today, this railyard operates as a station for boarding Caltrain riders. It performs important staging tasks so that multiple trains may come into service quickly after a big event such as a Giants baseball game. The railyard also provides space for storage and light maintenance of Caltrain trains.

As the city, region, and state consider how to best bring HSR and Caltrain to the Salesforce Transit Center (SFTC), the future of the railyard should be carefully considered. While the analysis of the railyard considered either the railyard remaining (e.g., Future with Surface Rail alignment), or relocating (e.g., Pennsylvania Avenue and Mission Bay alignments), ultimately the 4th/King surface railyard could remain, be reconfigured at surface to a smaller footprint, be moved underground, moved south, or certain combinations of the above. As noted below, the continued use of the surface railyard at 4th/King will limit or negate the benefits related to re-knitting the city (both east/west and north/south) and creating transit oriented development.

The continued use of the 4th/King surface railyard was not fully studied under the RAB. The RAB studied scenarios which included full relocation of the 4th/King surface railyard to a southern location (biggest impact to train operations) and the 4th/King surface railyard remaining at surface (smallest impact to train operations). The study also determined that it may be possible to distribute train storage among various locations (more on this below). At this time, no decision can be made about modifying, or relocating the yard and/or its functions until a full analysis of the needs of Caltrain and CHSRA are completed. This analysis work is underway through the Caltrain Business Plan and the Blended Service Operations Plan. Both efforts are anticipated to be completed in 2019. In the future, any proposed yard relocation would be required to have its own environmental process where alternatives will be analyzed, and public input sought.

As noted above, the RAB study found that it may be possible to distribute train storage among various locations. For example, expanding the underground



Source: Flickr user Joey Parsons

Exhibit 16: Existing 4th/King Railyard

4th/Townsend station further south (under 4th/King surface railyard) is one option that would allow for additional dead-end tracks for staging or storage, and allowing for transit-oriented development to be built above. In addition, there is the possibility to allow for overnight storage at the Salesforce Transit Center (SFTC) on all six tracks including double-berthing the trains on five tracks. Some combination of the above could also be deployed with or without a southern railyard. Until the Caltrain Business Plan and the Blended Service Operations Plan efforts are completed, and we have a better understanding of the needs required to operate future service, we must have potential alternative railyard sites. Of note, the Pennsylvania Avenue alignment and potential yard relocation can be seen as independent projects. Even after the Pennsylvania Avenue or Mission Bay alignment is built, Caltrain could continue using the surface railyard (or a smaller footprint) for some to-be-determined amount of time. Since most trains would be traveling to/from the SFTC, train volumes on the surface would be significantly lower than present, but the ability to reconnect the street grid in both the east/west and north/south directions would not be possible as long as surface tracks remain at-grade.

There are some rail alignments which would create more opportunity for reuse of part or all of the railyard. To help explore the potential issues and opportunities, the RAB study considered how the current functions of the railyard could be adapted to require less space. For example, Caltrain could separate passenger operations from staging needs, and storage and maintenance

Exhibit 17: Turnback Track as identified in DTX SEIS/R



Source: TJPA, 2015

activities. Separation of these functions could enable relocation of some or all of the functions to free up space at the railyard, assuming a replacement location is secured as discussed in Component #1: Rail Alignment to Salesforce Transit Center (SFTC). There are additional benefits to considering how the function of the railyard would change under the current plan to bring rail to the SFTC. As discussed in Component #1 of this report, the current planned alignment requires a cumbersome turnback movement to connect trains at the 4th/King surface railyard to the SFTC. (See Exhibit 17, item 12) This nine-step movement will take approximately 10 minutes (LTK, 2015).²⁴ To understand alternatives to this movement and examine the potential benefits of reducing the space needs of the current railyard, the RAB conducted a reconfiguration and/or relocation study.²⁵

Five sites for potential relocation of the 4th/King surface railyard were originally studied without consideration of jurisdictional boundaries. After preliminary analysis, two (2) locations were found to have had serious flaws, and one (1) was less desirable as it produced a "stub-end" yard rather than a run-through yard. After applying

Caltrain's minimum requirements for relocation, two locations remained for further study.

Issues and Considerations

It is important to consider the following issues when evaluating potential Railyard Reconfiguration/Relocation options: 1) the needs of rail operators, 2) efficiency of movements, 3) potential impacts and benefits to the wider public.

THE NEEDS OF RAIL OPERATORS

- » If the functions are moved from the 4th/King surface railyard (either onto a smaller footprint, underground, to a southern location or a combination of the above), there may be additional operating costs to move trains into/out of service.
- » Operations analysis based on the Blended Service Plan and a storage and maintenance plan are required before further consideration of either reconfiguration or relocation of the 4th/King surface railyard. The Blended Service Operations Plan and the Caltrain Business Plan are both anticipated in 2019.
- » Caltrain will need to update its facilities to account for the new electrified and larger fleet of train cars. A movement of storage and maintenance functions to a new location(s) could address future needs via a ground-up design to account for the fleet and possible shared operations/facility with CHSRA.

EFFICIENCY OF MOVEMENTS

- » The movement of Caltrain trains in and out of service currently occurs up to six (6) times per weekday.²⁶ If the current 4th/King surface railyard remains with the Future with Surface Rail alignment this would require six time-consuming turnback track use periods per weekday.
- » Caltrain and HSR wish to provide more trains in the peak hours which would require more turnback track usage from the 4th/King surface railyard in the future.
- » Each use of the turnback track requires a temporary suspension of opposing track usage at least twice during the movement limiting the capacity of the main line.

- » A turnback track movement from the 4th/King surface railyard to the SFTC was calculated to take approximately 10 minutes (Caltrain 2013).
- » A southern railyard would reduce the need for track closures as trains move between storage and the SFTC.²⁷ In addition, both potential southern railyard locations are within the 10 minute runtime from 4th/King.

POTENTIAL IMPACTS AND BENEFITS TO THE WIDER PUBLIC

- » One site under consideration is located in San Francisco while one is south of the city. Coordination with a second jurisdiction would be required if that site is chosen.
- » If a southern location could be utilized, the 4th/King surface railyard could be repurposed for improved urban design and land use considerations that could be more compatible with high-density neighborhoods.
- » If a southern location cannot be utilized, other conversations with Caltrain (and other stakeholders) will be needed including potential continued use of 4th/King surface railyard, movement to a smaller footprint on the surface, moving underground, or a combination of the above.

Analysis

This section analyzes the issues and considerations within seven categories: 1) opportunities at the 4th/Townsend underground station, 2) the needs of train operators, 3) potential impacts and benefits to the wider public, 4) managing train conflicts and potential connections to the 4th/King Surface Railyard, 5) change management, 6) maximizing public investment in the Salesforce Transit Center, and 7) interactions with other RAB components.

OPPORTUNITIES AT THE 4TH/TOWNSEND UNDERGROUND STATION

In both the Future with Surface Rail and Pennsylvania Avenue alignment options, there is the possibility to expand the underground 4th/Townsend station. Such expansion would allow for additional storage and staging opportunities for Caltrain underground and decrease the need for this activity to be provided at the 4th/King surface railyard or at a southern railyard

location. Expanding the proposed new underground 4th/Townsend station could affect the height of future development on the surface of 4th/King, but to what degree is unknown. Although more study is needed, it is likely not possible to fully replace the 4th/King surface railyard underground and also provide significant development on the surface because of structural requirements for the buildings and train operations would conflict.

THE NEEDS OF RAIL OPERATORS

If the railyard is moved from the 4th/King surface railyard location, there may be additional operating costs to move trains into/out of service. Added operational costs are not unique to using a southern railyard. There would also be additional operational costs associated with trains moving from storage at the 4th/King surface railyard and into operations at SFTC²⁸ using the turnback track as described above in Efficiency of Movements.

Both potential southern railyard locations further analyzed would meet requirements as outlined by Caltrain in 2016.²⁹

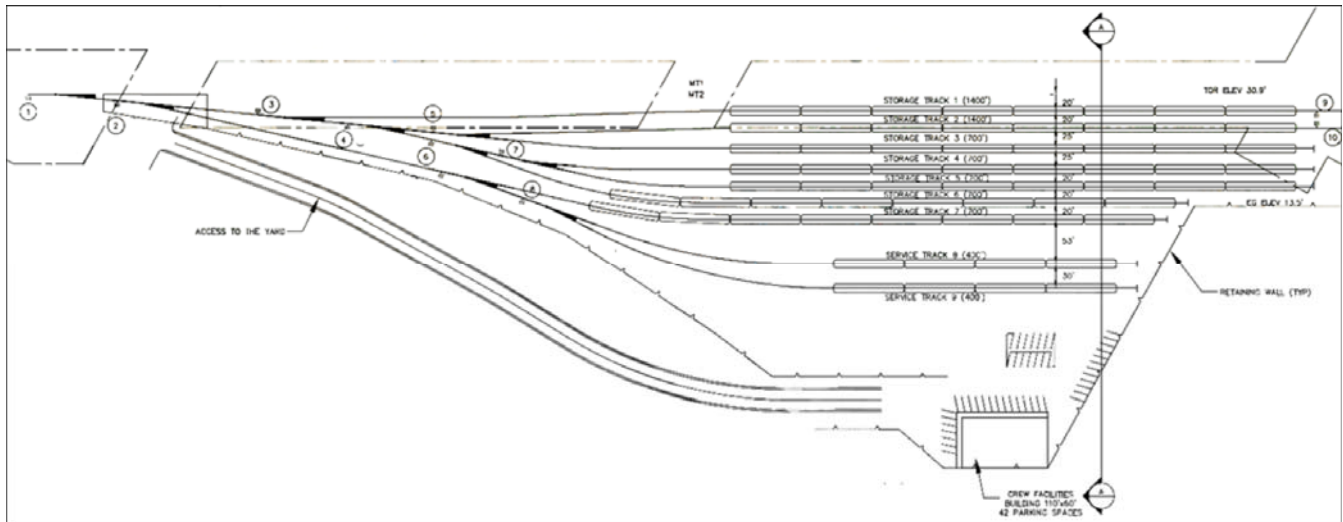
Exhibit 18 below is an example of a sketch-level conceptual design proposed for one of the sites further studied. The example site laid out below would accommodate up to 10 Caltrain eight-car trains and includes required maintenance tracks. In addition, the two tracks at the top of the site could be used as run-through tracks providing for direct connection (in this case in the southbound direction) to the Caltrain mainline tracks.

POTENTIAL IMPACTS AND BENEFITS TO THE WIDER PUBLIC

The current Caltrain tracks and the 4th/King surface railyard result in a barrier across the city both in the east/west direction (across the Caltrain at-surface tracks) and north/south (across the railyard between 4th and 7th Streets). As the region grows in both population and employment in the coming years it will be essential to allow for additional connections by all modes to get to and through the city. Reconfiguring/relocating the railyard could provide up to 20+ acres of land to:

- » Restore the street grid in the east/west direction connecting Mission Bay and the city.
- » Restore the street grid in the north/south direction through the 4th/King surface railyard and potentially across Mission Creek.

Exhibit 18: Railyard Conceptual Level Layout Design



- » Improve bicycle and pedestrian connections including the 5th Street bicycle/pedestrian bridge planned across Mission Creek).
- » Eliminate rail hazards and noise.
- » Create land for housing, open space, and office/retail opportunities.

This reconfiguration/relocation of the surface railyard would only be possible with the creation and construction of a satisfactory alternative (either onto a smaller footprint, underground, to a southern location or a combination of the above).

MANAGING TRAIN CONFLICTS AND POTENTIAL CONNECTIONS TO THE 4TH/KING SURFACE RAILYARD

Both the Pennsylvania Avenue and Mission Bay alignments move trains underground and anticipate the removal of the surface tracks and railyard at some time in the future. Both alignments would require a satisfactory alternative (e.g., smaller footprint, underground, southern yard, or some combination of the above) to be used for storage and maintenance, and potentially staging.

CHANGE MANAGEMENT

A reconfiguration or relocation of the 4th/King surface railyard would affect Caltrain operations and require additional environmental study.

- » Caltrain Operations. Caltrain functionality may be changed from a single location to separate locations for passenger service, staging, and storage/maintenance activities. This may cause some additional operational costs. While this is a different, and possibly more expensive, way of operating for Caltrain, it may serve Caltrain and the city better in the future. Some specific improvements could be:
 - If a partial reconfiguration and relocation were completed, the movement into operations from the remaining storage at 4th/King would require a turnback track as provided under the Future with Surface Rail alignment. Utilizing a turnback track closes the tracks to operations in the opposite direction twice for each train movement. This movement limits capacity of the rail corridor and, due to the usage of the turnback track, can be slower than point-to-point (see below) movements.
 - If a full relocation of the railyard is completed (e.g., to a southern location), the movement from storage into operations would be from point-to-point from a new location into SFTC or vice versa.
 - If any tracks remain at the 4th/King surface railyard, the use of a turnback track to move trains from storage into operations would be required. The turnback movement would restrict move-

ment along the tracks in both directions, affecting capacity along the entire corridor.

- To allow for additional storage or event staging of trains, there are possibilities for an expanded DTX underground 4th/Townsend station in both the Future with Surface Rail and Pennsylvania Avenue alignments.³⁰ While an expanded DTX underground 4th/Townsend station would provide some additional tracks, it is likely that the 12 tracks currently at the 4th/King surface railyard could not be fully replaced. It is likely that up to three (3) storage/staging tracks could be provided underground.³¹ The remainder of the storage needs and likely all maintenance needs for Caltrain would be completed at another location. It is anticipated that replacing all surface railyard tracks with underground tracks will not be necessary.

» Environmental Study. Additional environmental review would be required for any reconfiguration or relocation of the railyard or some combination of options as listed above.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Rail users benefit from significantly more multi-modal connections if all trains terminate at the SFTC. It is important to maximize train use of the SFTC as this station is intended to serve as the multi-modal connection point in San Francisco. The SFTC has direct connections to BART, MUNI Metro Stations, AC Transit and other regional transit agencies. Furthermore, the SFTC has direct access to more jobs, housing and retail, attracting travelers from across the state and the globe.

INTERACTIONS WITH OTHER RAB COMPONENTS

» **Component #1 Rail Alignments** – Under the Future with Surface Rail alignment, partial or full relocation/reconfiguration of the surface railyard would be possible. With both Pennsylvania Avenue and the Mission Bay alignments a new storage and maintenance location (either onto a smaller footprint, underground, to a southern location or a combination of the above) is assumed and the 4th/King surface railyard would be repurposed as appropriate.

» **Component #3 Urban Design and Land Use**

Considerations – Provides for various opportunities for partial reconfiguration or full relocation of the 4th/King surface railyard. Depending upon decisions made, new pedestrian, bike, and vehicular connections could be made between the Mission Bay neighborhood and the west as well as and across the existing railyard.

» **Component #4 Extension/Loop** – Under this component, there is no impact on either option for a potential future SFTC extension/loop.

» **Component #5 I-280** – This component is compatible with I-280 either remaining “as is” or with future removal of the overpass. It should be noted that if the removal of I-280 moves forward sometime in the future, the demolition of the two off-ramps at 6th/Brannan that extend over the existing railyard would greatly impact operations of the yard.

Cost Considerations

Costs for the Pennsylvania Avenue or Mission Bay rail alignments included an estimate for acquiring land, engineering, environmental clearance, and construction of a new location for storage and maintenance activities.¹⁶ As the amount of relocation possible under the Future with Surface Rail alignment was not known, no additional cost was included in the analysis. For a summary of costs see the section of the report titled Preliminary Estimate of Probable Costs is provided in Component #1 (see Exhibit 15).

Summary: Component #2: Railyard Reconfiguration/Relocation

PROS	CONS
<ul style="list-style-type: none"> » Improves neighborhood connectivity and safety by eliminating conflicts with trains if relocation to an underground station, southern railyard or some combination for storage and maintenance is achieved.³² » Both the Pennsylvania Avenue and Mission Bay alignment options provide an opportunity to re-knit over one mile of the city with up to 6 additional east/west connections and up to 2 additional north/south connections, if an underground station, southern railyard or some combination is achieved. » Provides potential for improved opportunities for urban form and land use considerations. » Potentially builds new state-of-the-art railyard facility. <p>FOR FUTURE EVALUATION</p> <ul style="list-style-type: none"> » Potential for more efficient movement from storage into operations for trains using a new storage/maintenance location to the south. 	<ul style="list-style-type: none"> » Requires additional environmental clearance on any reconfiguration or relocation of the 4th/King surface railyard. » Requires a change in Caltrain operations with the storage and maintenance at a new location or locations. » Adds potential operating costs for Caltrain. » May result in longer waits for event specific trains as currently they are handled with staged trains at 4th/King. » Impacts the surrounding community if a new southern railyard is utilized. <p>FOR FUTURE EVALUATION</p> <ul style="list-style-type: none"> » Full analysis of the Blended Service Plan and Caltrain Business Plan are required to understand impacts of the 4th/King surface railyard reconfiguration/relocation (draft plans anticipated 2019).

COMPONENT #3: URBAN FORM AND LAND USE CONSIDERATIONS

Description

After a rail alignment to the DTX has been chosen, parcels of land could become available for development, repurposing, and public uses. Such changes could help pay for some of the transportation improvements needed in the area. The largest of these is the 4th/King surface railyard which has more than 20 acres of contiguous land. Part of this acreage could potentially become available under the Future with Surface Rail alignment. The potential for reuse increases under both the Pennsylvania Avenue and Mission Bay alignments. If these alignments are used, the railyard site could be fully reprogrammed with improvements to the existing street network, and alternative land uses (See Exhibit 19). Of course, any change in use of the railyard would be predicated upon Caltrain's assessment of how such change would affect the viability, efficiency, and effectiveness of their service.

As with all aspects of this study, this consideration of alternative uses of the railyard is provided for decision-

makers. Any decisions regarding the balance of land uses, building intensity and public amenities would require an extensive community planning process. The RAB study assumed zoning comparable to that in the area to estimate possible land value changes. The RAB study did not determine specifically how the land should be developed or when that development should occur. If this reuse of the site moves forward, further studies and public input would be needed to fully explore the possibilities. The RAB study provides a baseline for future considerations. Public benefits, including affordable housing, open space, and other community facilities, would be needed and would offset financial benefits for transportation uses.

Using nearby zoning as guideline for Component #3, the railyard site could accommodate:

- » Over 1.4 million square feet of residential space and
- » Over 2.4 million square feet of commercial space.

Exhibit 19: Urban Form and Land Use Considerations for Railyard Site (Component #3)



Issues and Considerations

The following issues are specific to the Urban Form and Land Use component:

- » A rail alignment option must first be chosen before changes to the railyard could be further considered.
- » Analysis of Caltrain's operations would be required before further consideration of reconfiguration or relocation of the 4th/King surface railyard. The Blended Service Operations (CHSRA and Caltrain) Plan and the Caltrain Business Plan are both anticipated in 2019.
- » Caltrain has an operating lease on the 4th/King surface railyard. The land is privately owned. If the railyard is reconfigured or relocated, the private entity would retain the ownership and could sell the property as one unit, subdivide it, or develop it. The city would establish the zoning regulations and remain involved in the development as occurs with any major development project.
- » Additional analysis, including environmental analysis, would be needed for any development of the site.
- » If Caltrain did not need the site for train operations, staging, and/or storage and maintenance, there is the possibility of creating up to two (2) north/south connections at 5th and 6th Streets through the railyard. Similarly, up to six (6) east/west streets connections could be made across the Caltrain tracks from Mission Bay Drive to 18th Street that currently do not exist because of the surface tracks. This would result in several new connections between Mission Bay, the waterfront, and the rest of the city.

Analysis

This section analyzes the issues and considerations within four categories: 1) managing train conflicts, 2) change management, 3) maximizing public investment in the Salesforce Transit Center, and 4) interactions with other RAB components.

MANAGING TRAIN CONFLICTS

The current Caltrain tracks create a barrier in the east/west direction between 18th and 7th Streets. The current 4th/King surface railyard creates a barrier in the north/south direction across the railyard. As San Francisco grows in population and employment in the coming

years it will be essential to create additional connections by all modes to get to, and through, the city.

Reconfiguring/Relocation of the railyard¹⁶ could create those connections and significantly improve the neighborhood design by:

- » Restoring the street grid in the east/west direction to/from Mission Bay.
- » Extending the street grid in the north/south direction through the 4th/King surface railyard and potentially across Mission Creek.
- » Improving bicycle and pedestrian connections including the 5th Street bicycle/pedestrian bridge (planned across Mission Creek). Currently it is difficult to get to/from this proposed bridge location.

In addition, if the railyard isn't needed for trains, approximately twenty (20) acres of land could be repurposed for new uses, thereby:

- » Creating opportunity for open space, libraries, schools, housing, office/retail opportunities, and more.
- » Eliminating industrial externalities such as rail hazards and noise.
- » Offering design features consistent with a high-density, urban environment.

Under the Future with Surface Rail alignment, the surface rail corridor remains and the 4th/King surface railyard remains. Still, there may be the possibility of some reconfiguration of the 4th/King surface railyard. A full analysis of Caltrain and HSR operations can further inform this possibility. Under this alignment, a reduced railyard would not change to potential train conflicts from the description under the Future with Surface Rail alignment.

Under both the Pennsylvania Avenue and Mission Bay alignments, trains would be relocated underground. At a minimum, the 4th/King surface railyard could be reconfigured to a smaller footprint, moved underground, moved off-site to a new southern railyard location, or a combination of the above. If moved from the surface, there would no longer be surface rail access to the 4th/King railyard. In both alignments, the entire 4th/King surface railyard and the conflicts at Mission Bay Drive and 16th Street would be removed and up to six (6) east/west and two (2) north/south roadways could be connected.

CHANGE MANAGEMENT

Any modification to the Caltrain tracks including potential reconfiguration/relocation of the railyard would result in significant changes to Caltrain as identified under Component #1 - Rail Alignment to SFTC and Component #2 - Railyard Reconfiguration/Relocation. Urban form and land use changes such as those contemplated in this component would require extensive community and stakeholder dialog.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Since the urban form and land use changes contemplated in this component necessitate alteration of the 4th/King surface railyard, these changes would increase the likelihood that all trains would terminate at the SFTC. If all trains terminate at the SFTC, rail users will have many more opportunities for transfers and multi-modal connections through San Francisco.

INTERACTIONS WITH OTHER RAB COMPONENTS

- » **Component #1 Rail Alignment** – Under the Future with Surface Rail alignment, partial or full relocation/reconfiguration could be possible. With both Pennsylvania Avenue and the Mission Bay alignments a new storage and maintenance location (either onto a smaller footprint, underground, to a southern location or a combination of the above) is assumed and the 4th/King surface railyard would be repurposed.
- » **Component #2 Railyard Reconfiguration/Relocation** – Amount of land available for re-use would depend on the extent of the railyard that could be relocated.
- » **Component #4 Extension/Loop** – There is no impact on either option for a potential future SFTC extension/loop.
- » **Component #5 I-280** – this component is compatible with I-280 remaining or future removal.

Cost Considerations

As stated, Caltrain has an operations lease for the 4th/King surface railyard. The land under the lease is owned privately. If the 4th/King surface railyard were reconfigured or relocated,¹⁶ allowing development to occur, the city could employ funding mechanisms such as parcel transfer costs, a community facilities district (“CFD” also known as “Mello Roos” district) funding, and bonding. A summary of these potential revenues for each rail alignment is provided in the *Preliminary Estimates of Probable Costs* (see Exhibit 15). The sale of the land to developers would not be available as part of the revenue stream to the city or Caltrain because the land is privately-owned. Since development impact fees are typically required in San Francisco as mitigation, they are not considered here as potential city revenue.

Summary: Component #3: Urban Form and Land Use Considerations

PROS	CONS
<ul style="list-style-type: none"> » Provides pros as identified in Component #2 related to reconfiguration/relocation of 4th/King surface railyard including: <ul style="list-style-type: none"> • improves neighborhood connectivity and safety by eliminating conflicts with trains if full relocation to a southern yard is achieved. • provides opportunity to re-knit over one mile of the city longitudinally with east/west connections and north/south connections, if full relocation to a southern yard is achieved. » Increases potential funding mechanisms to support needed infrastructure. » Enables potential for public uses such as open space, libraries, schools and more, as well as housing and retail/commercial space. » Eliminates industrial externalities such as rail hazards and noise. » Offers design features consistent with a high-density, urban environment. 	<ul style="list-style-type: none"> » Results in cons as identified in Component #2, related to reconfiguration/relocation of 4th/King surface railyard, including: <ul style="list-style-type: none"> • additional environmental clearance, • a change in Caltrain operations, and • potential additional operational costs for any change at the 4th/King railyard. » Full analysis of the HSR and Caltrain operations and service needs are required to understand impacts of reconfiguration/relocation.

COMPONENT #4: TRANSIT CENTER (SFTC) EXTENSION/LOOP

Description

The Salesforce Transit Center (SFTC) is a stub-end station using one access point for trains to go both in and out. It is the planned terminus for Caltrain and High Speed Rail (HSR) trains. It is important to maximize the number of trains that use the SFTC as it was designed to serve as the multi-modal connection point in downtown San Francisco in the heart of the financial district. The SFTC has direct connections to BART, MUNI light rail and bus, AC Transit, SamTrans, Golden Gate Transit, and other transit agencies; bike share; taxis; and transportation network companies (e.g. Lyft or Uber). It is a short walk to thousands of jobs and homes, as well as high concentrations of hotels and tourist destinations. To accommodate these connections and future riders, the SFTC will be constructed with three (3) platforms and six (6) tracks (See Exhibit 20).

In terminus stations, there are activities that must occur while the train is occupying the platform including not only loading/unloading of passengers and luggage, but also cleaning, stocking, and security checks (at a minimum) for the trains. Each of these activities adds time to how long the train occupies the platform reducing the number of trains that can serve the SFTC on an hourly and daily basis.

Because of these terminus activities, and the expected demand for train service to the SFTC, an expansion of capacity will be needed in the future. As the SFTC cannot accommodate additional platforms, the only way to expand capacity is to extend the underground trainbox to the east and either 1) extend from the current trainbox across the Bay into either Alameda or Oakland, aka “extension”³³ or 2) return to the south, via a “loop” (See Exhibit 21) . With either the extension or loop option, the terminus activities would move to another location (at a new terminus) and the SFTC would operate like a through station with only unloading and loading of passengers.

Issues And Considerations

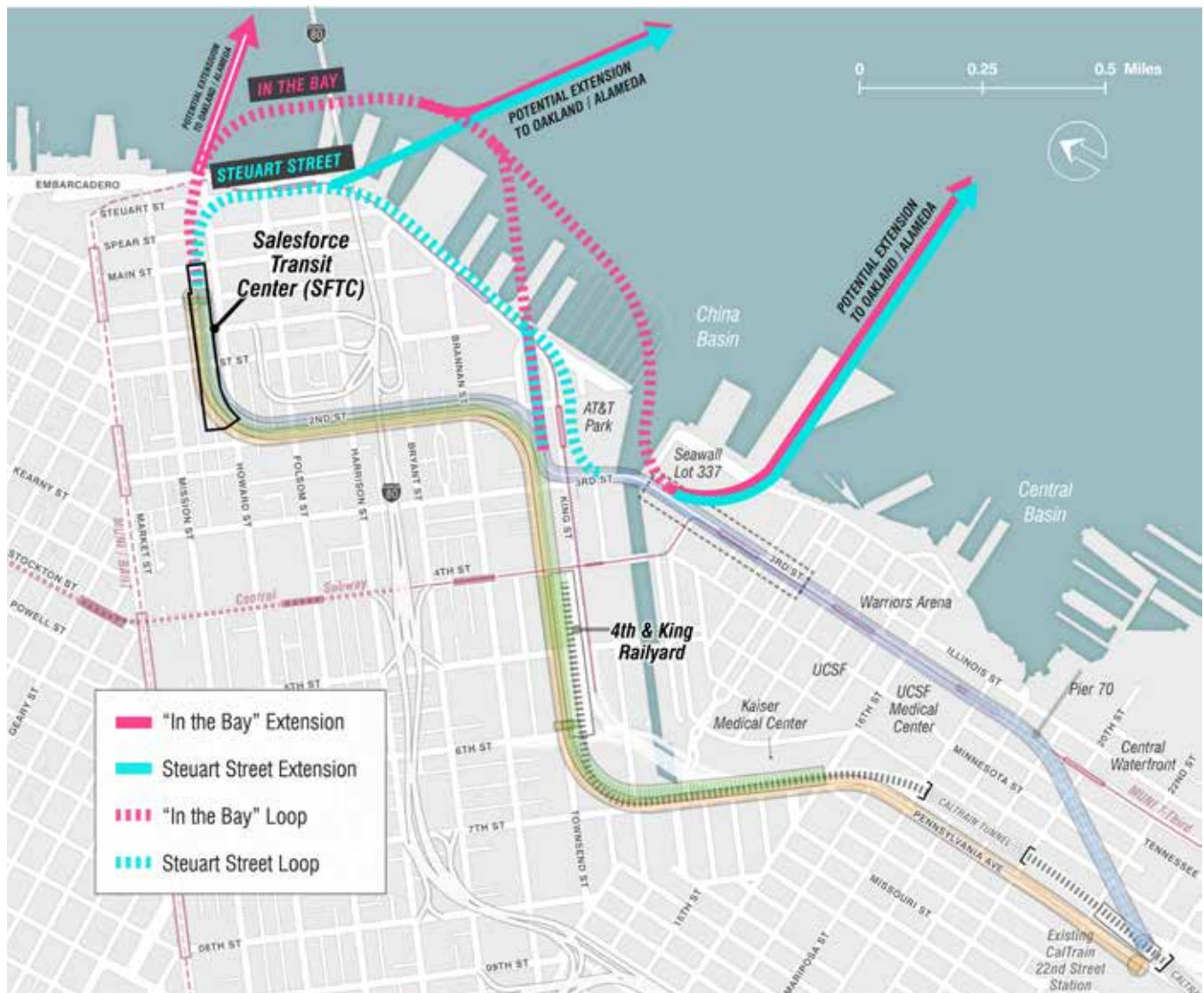
The following issues and considerations are relevant to construction of either the extension or loop out of the east end of the SFTC:

Exhibit 20: Salesforce Transit Center Cross Section



- » Continued population and employment growth in San Francisco, the region, and the state will require more rail service than currently planned.
- » Caltrain and CHSRA would like to run more frequent service. The Blended Service Operations Plan and Caltrain Business Plan (both anticipated in 2019) will provide more information about the amount and timeframe(s) of anticipated additional rail service on the Caltrain corridor.
- » Only 5 of the 6 tracks at the SFTC could be extended. The sixth is limited by substructure supports of a neighboring building.
- » Requires 100% electrification of Caltrain; due to funds needed, the current Caltrain Electrification plan includes purchasing vehicles to replace 75% of the fleet and electrifying the corridor from San Jose to San Francisco.³⁴ Diesel trains do not operate in tunnels beyond a certain length³⁵ as adequate ventilation is required. Stations are not allowed in tunnels with diesel trains (such as the SFTC or the 4th/Townsend station designed in the DTX). In addition, diesel trains do not accelerate/decelerate easily. The current plan is to continue to use the remaining diesel fleet on the baby bullet service from Gilroy to San Francisco (must terminate at 4th/King) until such time as Caltrain can obtain the funds to fully electrify their fleet (TBD). No diesels could use either the DTX

Exhibit 21: Extension/Loop Options (Component #4)



or the extension/loop out the east end of the SFTC as both travel significant distance underground.

» The rail service at the SFTC is limited by three factors:

- First, the potential number of trains served is limited by design as a terminal station. The activities necessary at the terminal station (not only passenger unloading/loading but also stocking of materials, security check, cleaning, etc.) require a certain amount of time to complete which keeps a train at a platform for this period of time affecting turnaround times between northbound arrivals and southbound departures.
- Second, the potential number of trains serving the SFTC is limited by the number of trains (Caltrain and HSR) that the rail corridor can

accommodate (predominantly a two-track system).

- Third, the currently published TJPA plans include dedicated platforms at different heights for Caltrain and HSR trains. As stated previously, to maximize the capacity of the SFTC, all platforms must be constructed to one height.³⁶ Access to all platforms allows train operators to maximize the available capacity at SFTC and would allow for both Caltrain and HSR to utilize a future extension/loop if built.
- » Today, there is not a conventional rail connection across the San Francisco Bay. BART operates on a unique rail gauge that is not compatible with standard gauge trains (e.g., Caltrain and HSR).

- » If a seawall rehabilitation or new seawall project moves forward, it would be beneficial to design a “breakout” panel in the seawall for a future “In the Bay” extension.
- » Does not preclude or determine any additional heavy rail and/or BART Bay crossings in the future.

Analysis

Current designs provide the capacity to handle initial operations at SFTC³⁷ and an extension/loop is not necessary at the time of opening service. Knowing when the SFTC will reach capacity and will limit additional capacity for the Peninsula will be essential. The Blended Service Operations, the Caltrain Business Plan (both anticipated 2019), and modeling work being completed for the DTX will identify when an expansion to the SFTC will be needed. Understanding that timeline will allow for sufficient planning, design, and financing to be in place before capacity is exceeded.

All rail alignments under consideration (Component #1) enter the SFTC at the SW corner to accommodate the structural layout as designed for the SFTC. The selec-

tion of any one rail alignment would not preclude the future construction of an extension or loop.

While only 5 of the 6 tracks in the SFTC could be extended to the east, those tracks would pare down to two (2) in a tunnel to return south or to continue under the Bay. A transbay tunnel would be of considerable length and, it would require that Caltrain fully electrify.

A similar expansion of Union Station in Los Angeles is transforming that stub-end station to a through station by extending tracks south over US-101. This transformation is anticipated to increase capacity at Union Station by at least 40%.

BART is currently beginning a study to further the work completed under MTC called the “Core Capacity Project” which identified four promising departure/landing points in San Francisco connecting to Alameda/Oakland for a new BART tube (See Exhibit 22, promising landing points are shown with red circles). In all cases, the possibility of combining both BART and conventional rail (Caltrain/HSR) tracks in the same tunnel are expected to be studied.

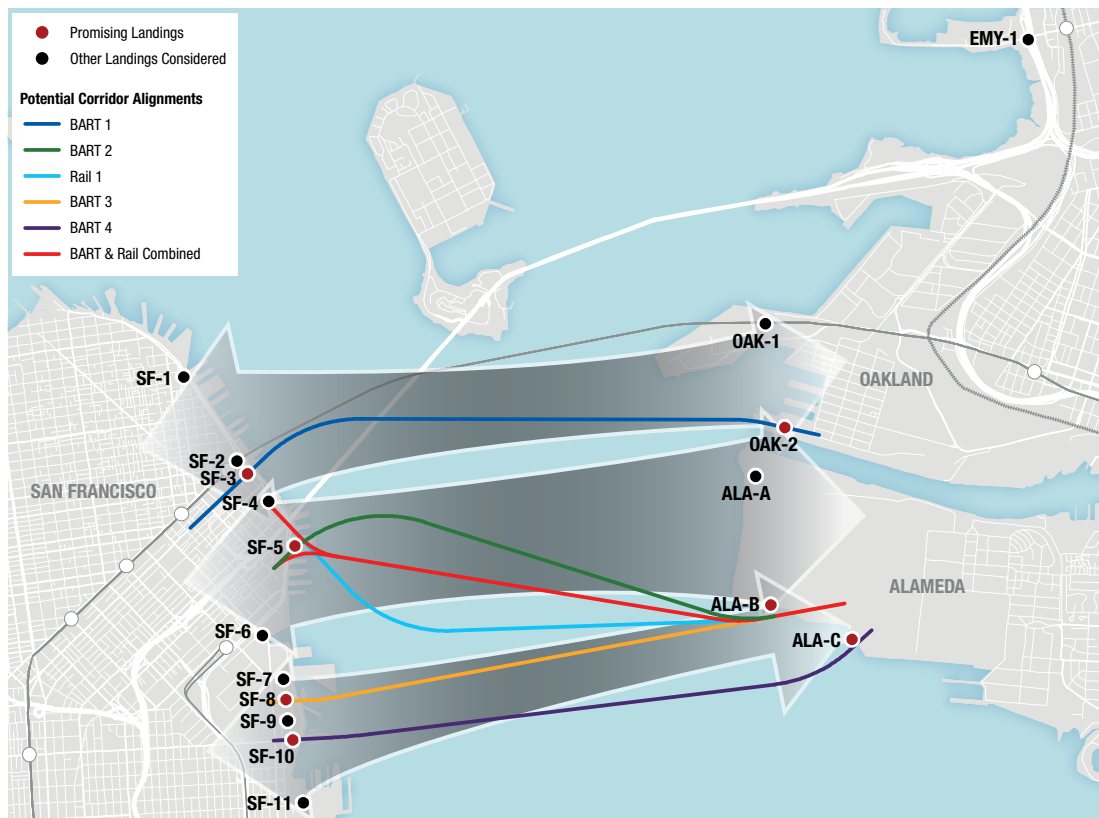


Exhibit 22: Landing Sites for Potential Second Tunnel in San Francisco Bay (Source: MTC, 2017)

Because there is not a conventional rail connection across the Bay for Caltrain/HSR use, persons currently traveling by train and wishing to access San Francisco from the East Bay must switch to other modes.

The analysis for an Extension/loop was focused on concept development and operations analysis rather than engineering specifications. Therefore, while these alignments are feasible, additional study would be necessary to determine 1) final alignment, 2) construction timeline, and 3) cost estimates. If future work on the San Francisco Seawall is to be completed, analyzing where a break-through panel could exist would maximize potential for future expansion of BART and Caltrain/HSR while also minimizing impacts and retrofit costs in the future.

This section further analyzes the issues and considerations within four categories: 1) managing train conflicts, 2) change management, 3) maximizing public investment in the Salesforce Transit Center, and 4) interactions with other RAB components.

MANAGING TRAIN CONFLICTS

No train conflicts are anticipated.

CHANGE MANAGEMENT

No additional change management is needed at this time as any future extension or loop would not disrupt existing rail services or impede any known rail plans.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Transforming SFTC from a stub-end station to a through station would allow for many more trains to utilize the platforms, as dwell times will be greatly shortened by

moving terminal activities such as stocking and cleaning to another location. Providing for more capacity at SFTC could provide a direct transbay connection where currently a mode change is required – there would be a seamless route from San Francisco to Oakland and possibly Sacramento by train rather than the train to bus/ferry/BART connection that is required now.

INTERACTIONS WITH OTHER RAB COMPONENTS

- » **Component #1 Rail Alignment** – Future construction of any extension/loop option does not affect any of the three rail alignments under consideration.
- » **Component #2 Railyard Reconfiguration/Relocation** – There is no impact to the 4th/King surface railyard in any extension/loop option under consideration.
- » **Component #3 Urban Form and Land Use Considerations** – Minimal to no possibility for improvement to urban form and land use capacity.
- » **Component #5 I-280** – Either an extension or loop would be compatible with I-280 remaining as is or future removal.

Cost Considerations

Since the necessary timing of an extension/loop is currently unknown, costs were not included in this study. Once the Blended Service Operations Plan and the Caltrain Business Plan are completed (anticipated 2019), planning and operations analysis should begin to ensure there is enough time to plan, engineer, and environmentally clear future infrastructure needed for expanded rail service to and from San Francisco.

Summary: Transit Center (SFTC) Extension and Loop

PROS	CONS
<ul style="list-style-type: none"> » Provides for additional capacity along the Caltrain corridor essential for future additional rail service. » Potentially provides rail access to/from Alameda/Oakland and beyond. » Provides enough time to plan, engineer, and environmentally clear the project. 	<ul style="list-style-type: none"> » Requires additional planning, engineering, and environmental clearance. » Costs are not known. » Funding could likely be secured only after Caltrain operates a fully electrified fleet (TBD) and HSR is in operation in the city.

COMPONENT #5: BOULEVARD I-280

Interstate-280 runs along the eastern side of the city on approach to Interstate-80, without making a final connection. The initial design would have connected I-280 to I-80, the Embarcadero Freeway, and the Bay Bridge, ultimately creating a ring road around the city as it connected to the Golden Gate Bridge.

Between the freeway revolt and the Loma Prieta earthquake, I-280 never completed these connections and is now a long off-ramp terminating at 4th/King and 6th/Brannan intersections (See Exhibit 23). There is a decades-long, recurring discussion about whether the touch-down of this off-ramp should be changed, and what effect any change might have on the neighborhood and the city.

Specific changes to I-280 are not the primary focus of the RAB study. What is pertinent to the RAB study is an understanding of evolving traffic patterns and predicted traffic volumes that will help inform decisions made now regarding the major investment of rail infrastructure. The significant decisions about investing in rail infrastructure should also be informed on how these decisions might allow, or preclude, the possibility of future changes to I-280 north of Mariposa.

For this reason, even though no specific boulevard designs have ever been proposed in the RAB, high-level traffic flow models were used to consider how traffic might flow if moved off of the current freeway and onto a theoretical surface boulevard.

Issues and Considerations

The following issues and considerations are relevant to a potential future removal of I-280 north of Mariposa:

- » Both the Embarcadero Freeway and the Central Freeway segments were removed following the Loma Prieta earthquake for safety reasons.
- » The former freeway rights-of-way have been reclaimed for improved urban form and land uses more compatible with an urban city.
- » Even with a force of nature acting as the impetus, both freeway removals were time-consuming and controversial. Removal of each freeway included three separate ballot measures and required the city

Exhibit 23: Boulevard I-280 (Component #5)



to fund removal of the structure in exchange for the land under it.

- » I-280 today is a functional and safe freeway, carrying over 61,000 vehicles per day in the area (Source: Caltrans, 2016).

Analysis

In the Future with Surface Rail alignment, there would not be sufficient right-of-way to accommodate both Caltrain and a surfaced I-280. In both the Pennsylvania Avenue and the Mission Bay alignments, the rail moves underground creating sufficient right-of-way for a theoretical surface boulevard.³⁸ A surface boulevard would still result in a large street footprint and additional congestion within the city street grid beyond just peak hours.

I-280 is a usable freeway and is expected to remain viable for the foreseeable future. To continue development of this boulevard component, future analysis with Caltrans is required including:

- » Determining the total impacts of taking down this segment to the overall interstate system and the city intersecting streets.
- » Building understanding and support of those impacts among decision-makers and the public.
- » Discussing with Caltrans the usable life of the greater I-280 corridor.
- » Determining how to pay for the delta between unsafe usable life and zero usable life as the city would be responsible for the tear-down costs of the elevated section.

None of the rail alignment options under consideration in Component #1 would require the continued use or removal of I-280. The RAB findings did not further pursue the potential to remove I-280 once it was determined that the freeway segment has considerable useful life remaining. However, the potential for removal should be included in the city's future analysis.

This section further analyzes the issues and considerations within four categories: 1) managing train conflicts, 2) change management, 3) maximizing public investment in the Salesforce Transit Center, and 4) interactions with other RAB components.

MANAGING TRAIN CONFLICTS

The I-280 freeway segment would be very difficult to transition to a boulevard under the Future with Surface Rail alignment option for four reasons:

- » There is not sufficient space to accomplish both a surface boulevard to replace the freeway segment and the surface rail tracks needed by Caltrain and HSR. The available land for a boulevard is currently being used for rail.
- » If there were enough room to collocate both rail and a surface boulevard, surfacing I-280 would not allow for sufficient intersection flow. There would be significant delays resulting from train closures of the two existing at-grade Caltrain intersections of Mission Bay Drive and 16th Street. All traffic from the freeway would have to be directed through these intersections and would complicate travel patterns.

- » The I-280 corridor is directly above the Caltrain tracks from Mariposa to Mission Bay Drive. A temporary structure would need to be constructed over the Caltrain tracks but under the I-280 structure to protect the train tracks from any falling debris. Necessary equipment for removal could impact train movements along the corridor for what could be months or years.
- » The I-280 existing off-ramps at 6th/Brannan fly-over the existing 4th/King surface railyard. During removal, necessary equipment would greatly impact the operations of the 4th/King surface railyard for what could be months or years.

CHANGE MANAGEMENT

No additional change management is needed at this time. Further discussion of the potential impacts, timing and funding of taking down I-280 can only begin after additional study and agreement by Caltrans, CalSTA, and San Francisco residents.³⁹ The RAB study does not provide enough information to determine if the I-280 freeway segment should be removed. The RAB does conclude that future analysis should be pursued at a later date.

MAXIMIZING PUBLIC INVESTMENT IN THE SALESFORCE TRANSIT CENTER

Retaining or removing the I-280 does not affect the SFTC.

INTERACTIONS WITH RAB COMPONENTS

- » **Component #1 Rail Alignments** – The Future with Surface Rail alignment does not provide enough land area for both a surface running rail line and a surfaced freeway or boulevard. In this alignment option, the I-280 freeway would likely remain. Under both the Pennsylvania Avenue and Mission Bay alignments, the rail is moved underground and the I-280 segment north of Mariposa could be retained or removed in the future.
- » **Component #2 Railyard Reconfiguration/Relocation** – Options for changes to the railyard are not specifically tied to the retention or removal of the I-280 freeway north of Mariposa. Instead, changes to the railyard are tied to the rail alignment choice. That said, the demolition of the I-280 freeway segment above the railyard would impact railyard operations for several months and possibly years. Under both the Pennsylvania Avenue or Mission Bay alignments,

the rails are moved underground and the 4th/King surface railyard is assumed to be reconfigured or relocated.¹⁶ Under either of these alignments, the freeway could be retained or removed in the future much more easily. If development on the 4th/King surface railyard were completed prior to future removal of I-280, there may be some impacts to future development during demolition.

- » **Component #3 Urban Design and Land Use Considerations** – A surface boulevard is more compatible with a dense, urban city than an elevated freeway. Opportunities for creating room for additional, urban land uses are not specifically tied to the retention or removal of the I-280 freeway. If the Future with Surface Rail alignment is chosen, I-280 will likely remain as there is not enough physical space to collocate a surface rail adjacent to a surfaced boulevard. If either the Pennsylvania Avenue or the Mission Bay alignment is chosen, I-280 could remain or be removed in the future. Due to having Caltrain underground, the existing operating easement at the surface (under the freeway) could be relinquished, and could provide some urban form and land use potential.
- » **Component #4 Extension/Loop** – A surface boulevard does not impact any extension/loop option.

Cost Considerations

Due to the independent nature of the decision and remote date of when I-280 changes could be seriously considered, costs for the removal and replacement of I-280 north of Mariposa with a surface boulevard were not included in the RAB study. The I-280 freeway is still a usable freeway so there are many more considerations and costs as associated with removal.

Summary: Boulevard I-280 (Component #5)

PROS	CONS
<ul style="list-style-type: none"> » May provide for better overall traffic flow in the area but with some roads experiencing higher flows than currently. Specifically, improvement may be seen at the intersections around 6th/Brannan. » Removing an elevated freeway could achieve aesthetic improvements. 	<ul style="list-style-type: none"> » Only a very preliminary study has been completed to date. Removal of the I-280 segment would require significant additional planning, engineering, and environmental clearance. Costs are not known and funding is not, and would not be, secured until much more analysis and preliminary assessment and consideration by Caltrans is completed. » I-280 remains a usable freeway segment. » Some roads would experience higher traffic volumes under the boulevard option.

PRELIMINARY FINDINGS AND RECOMMENDATIONS

Based on a careful analysis of trade-offs, implementation considerations, and needs known in the study area, San Francisco staff recommends the following for each component under the RAB study. For in-depth data on any of these components, their analyses, or preliminary recommendations/findings, please see the Final Consultant Technical Report.

1. RAIL ALIGNMENT:

PRELIMINARY RECOMMENDED ALIGNMENT: PENNSYLVANIA AVENUE: DTX + EXTENDED TUNNEL

The Pennsylvania Avenue Alignment: DTX + Extended Tunnel:

- » Solves the significant conflicts that currently exist at the at-grade Caltrain intersections of Mission Bay Drive and 16th Street. This alignment unites Mission Bay with the city, removes the barrier of the Caltrain line as well as the anticipated 20+ minute closures of these two essential intersections during the peak hour, avoids a long, deep trenching of streets to maintain east/west connections and maintains access and mobility for critical life-saving services.

With the relocation of the 4th/King surface railyard (either underground, to the south, or some combination)¹⁶, the Pennsylvania Avenue alignment:

- » Provides the opportunity to re-knit over one mile of the city with up to six additional east/west street connections across existing surface rail.
- » Provides the opportunity to increase access north/south with up to two additional north/south street connections with the removal of the 4th/King surface railyard.
- » Maximizes the public investment in the Salesforce Transit Center (SFTC), by ensuring that all Caltrain and High Speed Rail trains utilize the SFTC as the terminal station.
- » Creates the opportunity to improve the design of the 22nd Street Caltrain station. It allows for further study of a potentially more accessible station location so as to achieve improved performance for both Caltrain and San Francisco.

- » Provides for potential underground expansion of the 4th/Townsend station to allow for additional storage opportunities for Caltrain and relieving the continued need for the 4th/King surface railyard.
- » Minimizes the need for additional environmental work that would need to be completed to only the portion from 7th/Townsend south.
- » Maximizes flexibility during construction and improves opportunities for future rail expansion. This is achieved through the options for phasing the project (DTX first, Pennsylvania Avenue extension opening quickly after).
- » Minimizes any duplicative efforts or throw-away money on projects in the area.
- » Provides the opportunity to connect conventional rail (Caltrain and HSR) from San Francisco to Oakland/Alameda via the east side of the SFTC through a future additional Transbay Crossing.
- » Maximizes the potential land for available development and public benefit opportunities at the 4th/King surface railyard.
- » Provides maximum public benefit for the amount of cost and time required to realize the project.

Preliminary estimates of probable costs & estimated timing of the three rail alignment options is as follows:

ALIGNMENT OPTION	COST	EXPECTED COMPLETION DATE ²
Future with Surface Rail: DTX + Trenched Streets	\$ 5.1 Billion	2026
Pennsylvania Avenue: DTX + Extended Tunnel	\$ 6.0 Billion ¹	2027
Mission Bay: Modified DTX + 3 rd Street Tunnel	\$ 9.3 Billion ¹	2031

1. Includes costs of construction and moving railyard, as well as value capture and impact costs associated with each alignment.

2. Date for completion based on if all money were available on January 1, 2017

2. RAILYARD RECONFIGURATION/RELOCATION

If the Pennsylvania Avenue alignment is built, the 4th/King passenger operations could be accommodated in the underground 4th/Townsend DTX station and the storage and maintenance requirements could be moved to an underground station, new southern location, or some combination thereof. If the underground 4th/Townsend station were expanded to allow for additional storage/staging underground, this could limit the ability to develop on the 4th/King site.

3. URBAN DESIGN AND LAND USE CONSIDERATIONS

Preliminary analysis shows that the railyard site alone could accommodate over two million square feet of commercial and over one million square feet of residential space, based on current zoning in the nearby area. As the land is owned by a private entity with an operating lease for Caltrain on the land, the value capture of this estimated land use could exceed \$830M (\$480M in city bonding potential and \$350M in land value conferred; see Exhibit 15). Further, the site provides the opportunity for much needed public facilities; increased pedestrian, bicycle, transit and vehicle connections; and connecting Mission Bay to the rest of the city.

4. TRANSIT CENTER (SFTC) EXTENSION/LOOP

Either of the two extension/loops described will provide significant benefits by both increasing capacity along the rail line and by potentially providing a conventional rail extension to the East Bay. The extension/loops could be achieved with any of the rail alignment options. An extension/loop is not required at this time. But by having these two extension/loop alignment options identified, even in rough form, the city can prevent substructures from being placed in direct conflict with proposed extension paths.

5. BOULEVARD I-280

This element is substantially more speculative than the other components of the study. While preliminary analysis shows removal is feasible, such dramatic change will require future analysis with Caltrans and other regional and city partners. Further, the immediate RAB components do not require the removal or continued use of I-280.

NEXT STEPS

There are still many unknowns and studies underway, or to be completed, that may affect any of the recommendations above. The items that should be further explored include but are not limited to:

Ongoing projects:

- » Blended Service Operations Plan — As stated previously, CHSRA and Caltrain will complete the Blended Service Operations Plan in 2019 which details what the rail service will look like at any given time of day and what is necessary to maintain operations.
- » Caltrain Business Plan — Understanding how Caltrain would like to grow in the future, including fully electrifying their fleet (anticipated 2019).
 - Caltrain Storage and Maintenance Plan — this plan is needed for Caltrain to fully understand their needs along the corridor and should be consistent with the Caltrain Business Plan (anticipated 2019/2020).
- » CHSRA EIS/R for the San Jose to San Francisco section — this environmental documentation will take into account the Blended Service Operations (see above) and identify additional improvements needed. (Draft anticipated Winter 2020).
- » DTX Final Design — With the Record of Decision (ROD) on the SEIS/R anticipated in the fall 2018, TJPA is authorized to continue to 30% design in preparation for a design/bid/build contract in approximately 2 years (2020).

New and expanded efforts:

- » Project Delivery Method — Currently DTX is planned to be Design/Bid/Build which takes the longest construction time but least risk on the contractor. Other delivery methods should be explored with the expansion of the work for Pennsylvania Avenue including Design/Build or a Public Private Partnership (P3).
- » Pennsylvania Avenue Preliminary Design and Environmental Clearance — TJPA, in partnership with the City and County of San Francisco, would start analysis and preliminary design on the extension of the DTX using the Pennsylvania Avenue alignment as conceptually analyzed in the RAB documents. This would include additional work completed under the

22nd Street Station Study as well as other studies underway including the Blended Service Operations, Caltrain Business Plan, etc. Work would commence late 2018 with a 2-5 year completion horizon.

- » 22nd Street Station Study — SF Planning, in coordination with Caltrain, TJPA, and city agencies, would study the potential to relocate the 22nd Street Caltrain station for better accessibility, in association with the Pennsylvania Avenue alignment and tunnel launch pit location (TBD). Anticipated to start in 2019 with a 2-year process.
- » Continued study on an alternative railyard location (either onto a smaller footprint, underground, to a southern location or a combination of the above) — building on the work completed under the RAB study and after the Blended Service Plan and Caltrain Business Plan are completed (2019), an analysis of the needs of Caltrain to utilize an alternative railyard location for some or all of its current activities performed at 4th/King will begin. Anticipated to start in 2019 with a 3-4 year process anticipated.
- » Continued conversations about a Transbay Crossing — A second Transbay rail crossing would be studied. Included will be an analysis of whether it will contain BART and/or conventional rail (HSR/Caltrain). BART is currently furthering the conversation that MTC began in the Core Capacity Project (completed in 2017). Work began in 2018, with a 2-5 year process anticipated.
- » 4th/King District Land Use Plan — SF Planning (in coordination with others) would undertake a land use study to further understand the possibility of development in and around the 4th/King surface railyard location. This would begin after the Blended Service Plan and the Caltrain Business Plan are completed to ensure the maintenance and operating needs of the rail operators are met. Anticipated to begin in 2020 with a 2-5 year process anticipated.
- » Seawall Coordination — coordination between the City and County of San Francisco various departments and others as appropriate, to ensure that a breakout panel is located within the vicinity of a potential extension to the East Bay that could carry conventional rail (Caltrain/HSR), BART, or both. By providing a breakout panel within the wall, minimal disruption to existing structures can be achieved in the future. Ongoing.

ENDNOTES

- 1 CH2MHill provided consultant support on the RAB project. The Final Consultant Technical Report can be found at: www.sf-planning.org/rab.
- 2 Proposition H (1999) extended the Caltrain tracks to the Transbay Terminal (now known as Salesforce Transit Center - SFTC).
- 3 In the electrification project Caltrain is currently undertaking, the Caltrain line would be electrified from San Jose to San Francisco (including the 4th/King railyard) and 75% of the Caltrain fleet would be converted to electrical multiple units (EMUs which pull electricity from overhead wires and have a driver's cab in either end. As current plans do not include the electrification of the Gilroy to San Jose portion of Caltrain (served only by baby bullet service) and as diesels do not accelerate/ decelerate as easily as EMU's, the diesel fleet will not be retired after electrification, but will be used on the baby bullet service, co-mingling with the EMU's (providing more of the express and local service), to/from 4th/King. It is the plan to operate, store and maintain the Caltrain dual fleet at 4th/King into the future. There is not a current plan to fully electrify the Caltrain fleet. This would mean that even after the DTX is built (under the Future with Surface Rail and Pennsylvania Avenue alignment options presented below), diesels would remain at 4th/King as they are prohibited from operating in these tunnels (not enough ventilation).
- 4 CHSRA plans to run four (4) High Speed Rail (HSR) trains per peak hour per direction (total of 8 train movements) upon completion of Phase I from San Francisco to Los Angeles. CHSRA may operate less than that during the portion between early operations (2027/2029) and full service in Phase I (2033).
- 5 Specifically, trains moving between these two stations will require a 9-step movement "turnback" movement affecting rail service on the main line and the two at-grade intersections twice for each train. See Component #2 or Endnote 24 for description of 9-step movement.
- 6 In the electrification project Caltrain is currently undertaking, the Caltrain line would be electrified from San Jose to San Francisco (including the 4th/King railyard) and 75% of the Caltrain fleet would be converted to electrical multiple units (EMUs, which pull electricity from overhead wires and have a driver's cab in either end). As current plans do not include the electrification of the Gilroy to San Jose portion of Caltrain (served only by baby bullet service) and as diesels do not accelerate/ decelerate as easily as EMU's, the diesel fleet will not be retired after electrification, but will be used on the baby bullet service, co-mingling with the EMU's (providing more of the express and local service), to/from 4th/King. It is the plan to operate, store and maintain the Caltrain dual fleet at 4th/King into the future. There is not a current plan to fully electrify the Caltrain fleet. This would mean that even after the DTX is built (under the Future with Surface Rail and Pennsylvania Avenue alignment options presented below), diesels would remain at 4th/King as they are prohibited from operating in these tunnels (not enough ventilation).
- 7 20 minute calculation is based on 6 trains/peak hour/direction for Caltrain (12 trains total) and 4 trains/peak hour/direction for HSR (8 trains total). That totals 20 trains. Each train closing the intersection at a minimum of 60 seconds equates to a minimum of 20 minutes of the peak hour where east/west traffic is impeded by train movements.
- 8 The Tunnel Under Existing Caltrain T racks alignment option would require Caltrain to be taken out of service north of the 22nd Street Caltrain station for two or more years, And it would also require significant structural work to I-280.
- 9 Platform requirements are respectively 24-inches above top of rail for Caltrain and 48-51 inches above top of rail for HSR.
- 10 For 16th Street, this trench would run approximately from Wisconsin Street to 3rd Street.
- 11 This joint operation plans is known as "the Blended Service Operations Plan." The proposal is currently for 4 high speed rail and 4 Caltrain trains to/from SFTC and 2 Caltrain trains to/from 4th/King each peak hour.
- 12 The location of a tunnel boring machine launch pit will need to be determined.

- 13 Currently the DTX is to be constructed using a cut-and-cover method but TJPA is looking at options for tunneling at least a portion of the DTX alignment.
- 14 The 10% design drawings show that the tunnel would likely not have a common boundary with the existing 22nd Street station. Currently the 22nd Street station is not easily accessed and does not provide ADA accessibility.
- 15 If the 4th/King surface railyard is eliminated, it is likely that the number of tracks currently at the 4th/King Railyard (12) could not be fully replaced underground.
- 16 The continued use of the 4th/King surface railyard was not fully studied under RAB. To understand the range of possibilities, the relocation of all storage and maintenance activities to a new southern location was studied. Alternatively, the railyard could remain in its current location, be reconfigured to a smaller footprint, be moved underground or south, or certain combinations of the above. See Component #2 for more information on potential changes to the current railyard. (Note: this endnote is referenced multiple times in this document.)
- 17 The increased depth is needed so that the tunnel would be below the navigable Mission Creek. The depth of Mission Creek is around 80 feet in depth so the top of the tunnel would need to be below that depth, and then climb at the maximum grade to match the DTX throat location.
- 18 This interim condition is approximately at a minimum of 3 years in length but depends on the timing of design, environmental clearances, and funding.
- 19 For purposes of the study the Third Street station was located just south of Mission Creek. The final location would require further study and analysis.
- 20 The 10% design drawings show that the tunnel would likely not have a common boundary with the existing 22nd Street station. Currently the 22nd Street station is not easily accessed and does not provide ADA accessibility.
- 21 The estimates here were developed using general categories, industry norms, and similar projects throughout the United States. An independent analysis of the DTX was completed and validated the MTC updated cost estimate of the DTX completed in December 2015 which calculated the cost of construction of the DTX at \$4 billion (see Appendix D & E of the Final Consultant Technical Report). The validated DTX cost estimation was then used as the basis for the same type of work for the other two alignments taking into account risks and unknowns. Contingency factors correlating to the risks of various alignments were applied as well to the final calculations.
- 22 Elements of the DTX as currently designed and environmentally cleared are shown in Exhibit 9 and listed here: a Trainbox extension, the intercity bus facility, vents, taxi staging area, BART/MUNI underground pedestrian connection, bicycle/controlled vehicle ramp, widened throat structure, AC Transit Bus Storage Facility, an underground station at 4th/Townsend, the tunnel stub box for future connection underground (as described in the Pennsylvania Avenue extension above), and the additional track-work including the turnback track and maintenance of way storage track.
- 23 It should be noted that some DTX elements may be relocated depending on alignment – e.g., the 4th/Townsend station in the Future with Surface Rail and Pennsylvania Avenue alignments is replaced with a new, underground station in 3rd Street in the Mission Bay alignment.
- 24 The nine-step backtrack movement includes: (1) a train is started up (2) the train (with no one except the conductor onboard) must leave 4th/King, (3) travel south to Mariposa and use the turnback track. (4) The train comes to a stop (5) The conductor would then turn off the train, (6) walks the length of the train, (7) turn the train back on – now sitting in the north facing cab, and (8) travels north entering into the DTX at 7th/Townsend, go past the underground 4th/Townsend station (without stopping) and (9) into the SFTC where operations would commence by loading passengers and then returning south into operations.
- 25 Minimum requirements for potential relocation sites included: 1) meeting the requirements for storage tracks as provided by Caltrain in 2016 (10, 8-car trains), 2) allowance for “run-through” or entering and existing the new off-line storage/maintenance site from the existing tracks, and 3) being consistent with Caltrain’s locational needs to be within the “10 minute from 4th/King bumpers”.

- 26 Caltrain trains currently move in, or out, of service in the following conditions: (1) to charge the system (start operations), (2) for AM peak, (3) after AM peak, (4) for PM peak, (5) after PM peak, (6) to discharge the system (end operations for the day).
- 27 Trains approaching the SFTC directly from storage in the new southern railyard could do so without using the turnback track and would require the closure of opposing tracks no more than once per trip, as trains may be traveling in the same direction as the southern railyard.
- 28 Both potential southern railyard locations under consideration are within the same 10-minute limit from the 4th/King surface railyard that is required for the turnback track. Therefore only those trains that would move from storage at 4th/King into operations starting at 4th/King (and not SFTC) would be affected. Current plans show this may be up to 2 trains per peak hour that would have terminated at 4th/King instead of SFTC that could require additional operational costs.
- 29 These Caltrain requirements include: 1) room to store 10 Electrical Multiple Unit (EMU) Caltrain 8-car trainsets, 2) construction of a building to hold a crew room, management office, employee parking, maintenance of way functions, storage for tools and equipment, etc., and 3) being located within 10 minutes from the current 4th/King terminus bumpers.
- 30 No cost estimates have been provided regarding such potential underground expansions as this concept has not yet been fully designed nor engineered.
- 31 All three of these additional storage tracks would terminate at the underground 4th/Townsend station and would not continue to SFTC.
- 32 This improvement describes the relationship of moving trains between storage (at 4th/King) into operations (at SFTC) and further assumes that use of either the Pennsylvania Avenue or Mission Bay alignments or the use of the Future with Surface Rail alignment with the extended trench for grade-separation of trains and traffic.
- 33 Originally four (4) extension/loop concepts were further analyzed. All exit the east end of the SFTC and continue for some distance to the east. Then either return to the south or continue across the Bay. The acceptable minimum radii for HSR trains (650-feet) was not met on two options (Main Street and Spear Street), and they were dismissed. Two other options were further analyzed (see Final Consultant Technical Report at sf-planning.org/rab).
- 34 As the Caltrain rail from San Jose to Gilroy is not to be electrified at this time, Caltrain “baby bullets” (traveling from Gilroy to San Francisco (4th/King railyard)) will remain diesel trains for the foreseeable future.
- 35 The length of tunnel a diesel train is allowed to travel in without additional ventilation is a factor of various characteristics including length of tunnel, average run time of trains in the tunnel, etc.
- 36 Caltrain is procuring electric trainsets with two sets of doors to accommodate both platform heights.
- 37 Current plans have a total of six (6) Caltrain trains and four (4) High Speed Rail trains per peak hour per direction. This, in total, would be 10 trains per peak hour per direction or 20 train movements in/out of the station that would be traveling on the Caltrain corridor in peak hours.
- 38 To estimate the right-of-way for a surface level boulevard, preliminary modeling suggested that a “small” six-lane configuration would be compatible with the existing traffic. Note, such a change would likely cause backups on I-280 northbound back to Islais Creek in the morning peak hours. Preliminary modeling also suggested that a “large” eight-lane configuration would likely accommodate anticipated traffic without adding delays to predicted vehicle trips. To further develop any boulevard option, additional public transportation options in the area would be needed.
- 39 If these conditions occur, Caltrain would also need to relinquish their operating easements with Caltrans north of 25th Street under the Future with Surface Rail alignment. Under both Pennsylvania Avenue and Mission Bay alignment, the rail is moved underground, so Caltrain would already have relinquished their operating easements north of 25th Street.