CITY OF PALO ALTO

CITY OF PALO ALTO
CITY COUNCIL
Special Meeting
Monday, April 29, 2024
Council Chambers & Hybrid
5:30 PM

Agenda Item

2. Review of Rail Grade Separation Alternatives for the advancement of the alternatives into the preliminary engineering and environmental documentation phase; CEQA status – statutorily exempt under CEQA section 15262 (feasibility and planning study).

CITY OF PALO ALTO

City Council Staff Report

From: City Manager
Report Type: STUDY SESSION
Lead Department: Transportation

Meeting Date: April 29, 2024
Report #:2402-2593

TITLE
Review of Rail Grade Separation Alternatives for the advancement of the alternatives into the preliminary engineering and environmental documentation phase; CEQA status – statutorily exempt under CEQA section 15262 (feasibility and planning study).

RECOMMENDATION
Staff recommends that the Council discuss and review the grade separation alternatives considering Rail Committee recommendations and other work completed to date for the possible selection of preferred alternative(s) and advancing grade separation alternatives into the Preliminary Engineering and Environmental Documentation Phase.

Staff intends to bring an item to the City Council on June 3, 2024 seeking the Council action on the following key decisions:

1. The Bicycle and Pedestrian crossing location at Kellogg Avenue versus Seale Avenue for the Partial Underpass Alternative at Churchill Avenue Crossing
2. The selection of Preferred Alternative(s) at Meadow Drive and Charleston Road for advancing grade separation alternatives into the Preliminary Engineering and Environmental Documentation Phase.

EXECUTIVE SUMMARY
Since the selection of the Partial Underpass as the preferred alternative for Churchill Avenue and the narrowing of the alternatives to Hybrid, Trench, and Underpass for Meadow Drive and Charleston Road crossings by the City Council in 2021, the City has conducted various studies and refinements to underpass alternatives. In addition, the Council-adopted Evaluation Criteria was updated following Rail Committee recommendation in June 2023[1].

The project involves the construction impacting railroad facilities with active commuter and

[1] Item 6, Action Item, https://portal.laserfiche.com/Portal/DocView.aspx?id=66112&repo=r-704298fc&searchid=3d172c2f-cf80-4489-901b-2b1344955bdd

freight lines. This study session provides the platform for review and Council discussion of the conceptual plans for various alternatives and staff is seeking Council feedback on:

1. Review the previously selected preferred alternative, Partial Underpass at Churchill Avenue Crossing, for the preferred location of bicycle and pedestrian crossing for Churchill Avenue Underpass Alternative between Kellogg Avenue and Seale Avenue locations. The Rail Committee unanimously selected the Seale Avenue as the preferred crossing location for Bicycle and Pedestrians as part of the Partial Underpass Alternative at Churchill Avenue crossing, and,

2. Narrowing the alternatives under consideration for Meadow Drive and Charleston Road for advancing grade separation alternatives into the Preliminary Engineering and Environmental Documentation Phase. The Rail Committee voted, with two in favor and one opposed, to recommend the Underpass Alternative and Hybrid Alternative at Meadow Drive and Charleston Road as the preferred options to the City Council for advancement into the Preliminary Engineering review.

In June, staff will be seeking Council action on the preferred bicycle and pedestrian crossing location for Churchill Underpass Alternative and the selection of the preferred alternative for grade separations at Meadow Drive and Charleston Road crossing to advance the crossings into Preliminary Engineering and Environmental documentation phase. Additionally, staff will seek Council approval for a funding agreement with the Federal Railroad Administration securing the grant funding contributions of $6.0 Million towards completing the Preliminary Engineering and Environmental Documentation for the three crossings at Churchill Avenue, Meadow Drive, and Charleston Road.

Caltrain engagement has also increased significantly through the alternatives analysis. In June 2022, the City requested evaluation of four tracking segment needs and concerns with the design criteria. As a result, Caltrain embarked upon the Caltrain Corridor Strategy Project to review the concerns of various local agencies with projects along the corridor including an analysis of 4 tracking needs. In June 2023, a service agreement was executed for Caltrain review of the project including impacts on the Caltrain Right of Way (ROW), and for technical input on conceptual plans. The City received comments from Caltrain in November 2023 and these comments, affecting various elements, discussed by the Rail Committee in January 2024.

Subsequently, City and Caltrain staff convened to understand the comments concerning Caltrain policies, updated standards, constructability, and the four tracking needs impacting the conceptual design for various alternatives. Impacts requiring high-level material changes to these concepts were discussed by the Rail Committee on March 19 and April 16, 2024.

BACKGROUND

After receiving the final report from the Expanded Community Advisory Panel (XCAP) on March 23, 2021 (Staff Report 11797)[2], Staff presented a detailed review of Meadow Drive and Charleston Road crossing alternatives on August 23, 2021 (Staff Report 13435[3]) and presented details on Churchill Avenue crossing alternatives for grade separation on November 1 & 29, 2021 (Staff Report 13543[4]) & (Staff Report 13787[5]).

City Council Selection of Alternatives

At these meetings in November 2021, the Council eliminated the Viaduct Alternative and selected the Partial Underpass Alternative as a preferred alternative for Churchill Avenue with the Closure Alternative as backup.

For Meadow Drive and Charleston Road crossing, the Council in August 2021 narrowed the alternatives in consideration to three alternatives, namely Hybrid, Trench, and Underpass. The City Council also directed staff to perform additional studies. These studies included work to refine Underpass alternatives with input from PAUSD, PABAC, and Stanford to address current shortcomings and to conduct additional outreach to these stakeholders. On May 23, 2022 (Staff Report 14341[6]) the City Council authorized an amendment with the consultant to perform these additional tasks.

Refinements to Underpass Alternatives

Following the City Council and Rail Committee direction, City Staff and the consultant reached out to the Pedestrian and Bike Advisory Committee (PABAC), Palo Alto Unified School District (PAUSD), Stanford, City School Transportation Safety Committee (CSTSC), and members from the community who were involved in developing the conceptual design of these partial underpass alternatives for their feedback and comments for refinement to the conceptual plans. Staff compiled all the comments received from these stakeholders and developed a master list of all comments. These comments were then categorized into four elements: Bicycle and Pedestrian, Roadway, Structures, and Rail. The following list of comments was reviewed and addressed in the refinements.

- Bicycle and Pedestrian Facilities:
    - Width and Pathway configurations
    - Grade/slope
    - Maneuvering and additional crossings

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[2] Item 1, Study Session, https://portal.laserfiche.com/Portal/DocView.aspx?id=55803&repo=r-704298fc

[3] Item 6, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=61831&repo=r-704298fc

[4] Item 15, Action Item, https://portal.laserfiche.com/Portal/DocView.aspx?id=61747&repo=r-704298fc

[5] Item 11, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=61795&repo=r-704298fc

[6] Item 11, Consent Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=59504&repo=r-704298fc

    - Design speed, design bicycle, turning radius and sight distance
    - Construction impacts
    - Bicycle and Pedestrian pathway on each side (Meadow and Charleston Underpass alternative)
    - Kellogg Avenue vs Seale Avenue and Bike Lane configurations on the pathway for Churchill Avenue Partial Underpass alternative
- Roadways:
    - Shoulder and lane widths
    - Vehicular lane reductions
    - Intersection, turning radius, school bus turning radius
    - Roadway Grade/Slope
    - Signage
    - Loss of landscaping strip on Alma Street
    - Roundabout for Charleston Underpass Alternative only
    - Bike boulevard continuity at intersections
- Structures
    - Bridge Depth thickness
    - Vertical clearance
    - Aesthetics
- Rail
    - Raise the rail

The various elements related to these facilities were discussed during Rail Committee study sessions on October 19, 2022 (Staff Report 14813[7]) and November 18, 2022 (Staff Report 14904[8]). Based on the study session review and feedback, the Conceptual Plans of the Partial Underpass at Churchill Avenue and Underpass Alternatives at Meadow Drive and Charleston Road were refined and approved by the Rail Committee on May 23, 2023 (Staff Report 2302-0973[9]). Attachment A (Churchill Avenue Partial Underpass Plan and Profile and Attachment E (Meadow Drive and Charleston Road Underpass Plan and Profile) to this staff report include updates resulting from this review.

Re-evaluation of Viaduct Alternative in-lieu of Trench alternative at Meadow Drive and Charleston Road crossing for review by Caltrain

During the Rail Committee study sessions reviewing the refinements of underpass alternatives in October and November of 2022, the members of the community, PABAC, and PAUSD expressed concerns about bicycle and pedestrian connectivity and requested to reconsider Viaduct Alternative for Rail Committee's review, evaluation, and recommendation to Council.

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[7] Item 2, Study Session, https://portal.laserfiche.com/Portal/DocView.aspx?id=56013&repo=r-704298fc
[8] Item 2, Study Session, https://portal.laserfiche.com/Portal/DocView.aspx?id=56014&repo=r-704298fc
[9] Item 2, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=66337&repo=r-704298fc

In addition, during the same time; Caltrain staff provided information regarding the four tracking needs in Palo Alto. Therefore, the Rail Committee paused further analysis of the trench alternative, mainly due to its high cost and feasibility challenges concerning accommodating and addressing the four tracking needs of Caltrain.

Furthermore, the Service Agreement between the City of Palo Alto and the Peninsula Corridor Joint Powers Board (Caltrain) for the Connecting Palo Alto Grade Separation Projects at these crossings was in the development process during this time. The draft service agreement was reviewed by the Rail Committee at its April 26, 2023, meeting (Staff Report 2303-1199[10]). The Service Agreement was intended to provide early coordination, technical review, input, and expertise to inform the capital project development process for the selection of Preferred Alternative(s). Therefore, the Rail Committee considered this an opportunity to further review the Viaduct Alternative instead of the Trench Alternative for Meadow Drive and Charleston Road crossing at the June 20, 2023, Rail Committee meeting (Staff Report 2305-1546[11]) to accommodate community concerns.

Based on Caltrain's review of the proposed viaduct alignment to keep the structure away from residential properties west of the railroad track while keeping existing tracks as shoefly track, addressing technical comments, and the four tracking needs; this alternative would cause significant encroachment on Alma Street potentially reducing the street into one lane in each direction. The Rail Committee meetings in March and April 2024 discussed a possible iteration to the viaduct alternative with the proposed viaduct alignment to shift westward towards the residential properties and to construct the shoefly tracks on the east side of the tracks. This alternative was not evaluated by Caltrain as the intent was to remain consistent with the previously envisioned concept that was developed through community input by the City. In addition, there were time and scope constraints in the Caltrain Service Agreement.

Following an in-depth review and discussion, the Committee voted, with two in favor and one opposed, to recommend the Underpass Alternative and Hybrid Alternative at Meadow Drive and Charleston Road as the preferred options to the City Council for advancement into the Preliminary Engineering review. Therefore, the Viaduct alternative was eliminated from further consideration by the Rail Committee.

City Council Adopted Evaluation Criteria & Additional Studies

The Rail Committee on March 29, 2023 (Staff Report 2302-1010[12]), and April 26, 2023 (Staff

[10] Item 2, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=66336&repo=r-704298fc
[11] Item 1, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=66338&repo=r-704298fc
[12] Item 1, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=66345&repo=r-704298fc

Report 2304-1269[13]), reviewed the Council Adopted Evaluation criteria, which led to a recommendation from the Rail Committee the additional measures to be included in the Council Adopted Evaluation Criteria. The revised evaluation criteria were unanimously approved by the Rail Committee and recommended to the City Council for approval. The City Council approved the updated evaluation criteria at its June 12, 2023, meeting (Staff Report # 2305-1426[14]).

The additional measures in the evaluation criteria include reviewing impacts such as connectivity, corridor travel times, pedestrian and bicycle circulation, sustainability, sea-level rise, and visual and privacy considerations. These additional elements for the alternatives in consideration were further evaluated. The Rail Committee reviewed the update to the Summary of Evaluation of Council Adopted Criteria at its February 20, 2024, meeting (Staff Report # 2401-2503[15]).

The City's engineering consultant (AECOM) also conducted the subsurface exploration and performed data collection for the project. A study report was prepared by the Consultant which included findings addressing subsurface conditions and the feasibility of alternative construction methods with respect to soil conditions and recommendations for additional studies in future phases. The study was presented to the Rail Committee on August 23, 2023, Rail Committee Meeting (Staff Report 2307-1747[16])

In addition, at the Rail Committee's request the Noise and Vibration Comparative Analysis Report prepared by AECOM Engineers in July 2020 for the evaluation of the Grade Separation Alternatives was reviewed to discuss the technical insights in a study session on September 19, 2023 (Staff Report 2308-1943[17])

Caltrain Review (Four Tracking and Technical Review of Alternatives)

The Caltrain 2040 Business plan's inclusion of a possible passing track segment in either Palo Alto or Mountain View presented challenges for grade separation planning in Palo Alto. At each of these crossings, Caltrain required that grade separation designs not preclude four-tracking. These requirements indicated a significant impediment to the timely and cost-effective project development. Caltrain staff had previously indicated that Caltrain was taking the most conservative approach in considering the potential for a four-track segment between the San Francisquito Creek Bridge in Palo Alto and just through the Mountain View Station. Therefore, in June 2022, City staff sent formal requests to consider narrowing the extent of

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[13] Item 2, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=66336&repo=r-704298fc

[14] Item 6, Consent Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=66112&repo=r-704298fc

[15] Item 1, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=70469&repo=r-704298fc

[16] Item 2, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=67605&repo=r-704298fc

[17] Item 2, Study Session, https://portal.laserfiche.com/Portal/DocView.aspx?id=67755&repo=r-704298fc

the four-track segment and review technical issues and concerns that surfaced related to their design criteria.

To address the City's concerns, Caltrain initiated a Caltrain Corridor Strategy Project to review the grade separation projects along the corridors and to provide a more thought-out and comprehensive review. Also, the City and Caltrain entered into a Service Agreement on June 8, 2023. The agreement would provide railroad expertise and technical input for the review of alternatives in consideration for advancement of the alternatives to select the preferred alternative for the three crossings at Churchill Avenue, Meadow Drive, and Charleston Road.

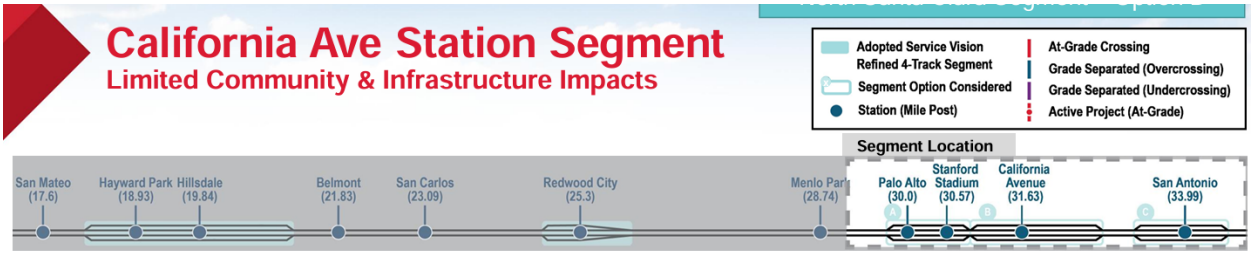
As part of the Caltrain Crossings Strategy, Caltrain also reviewed the need for four tracking segments along the corridor. A study session regarding the Caltrain review and proposal for a four-track segment in Palo Alto was conducted at the November 21, 2023, Rail Committee (Study Session, Presentation[18]). Caltrain staff reviewed various alternatives including four tracking segments at the following three locations:

- Palo Alto Avenue Station (Four tracking between Palo Alto Avenue and Churchill Avenue)
- California Avenue Station (Four tracking between Churchill Avenue and Meadow Drive)
- San Antonio Station (Four tracking between Rengstroff to Charleston Road)

The analysis indicated that the proposed segment at California Station requiring four tracks between Churchill Avenue and Meadow Drive crossing has the highest likelihood to address Caltrain needs while minimizing the community and infrastructure impacts and therefore the highest desirability to address passing needs in Palo Alto. Caltrain thus asked the City to ensure that designs for the grade separation at Meadow Drive and Churchill accommodate this four-tracking segment. The following exhibit from the Caltrain presentation depicts the proposed four tracking segment in Palo Alto.

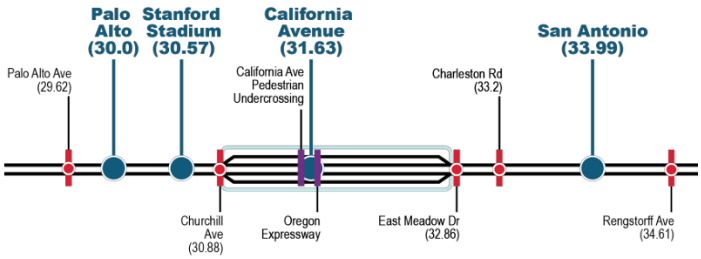
[18] Item 1, Study Session, https://cityofpaloalto.primegov.com/Portal/Meeting?meetingTemplateId=13219

Exhibit A: California Avenue Four Tracking Segment



Segment Characteristics	
MP Limits	MP 30.9 - 32.8
Length (miles)*	1.9
Stations Impacted	California Avenue
At-Grade Crossings Impacted	2
Grade Separations Impacted	2
Active Projects	Connecting Palo Alto

*Length includes 2- to 4-track transitions



On November 8, 2023, Caltrain staff conducted their first technical review and provided comments to City Staff. Staff presented the major elements affecting various alternatives and identified the initial impacts on alternatives for adherence to updated Caltrain Standards at the January 23, 2024 (Staff Report 2311-2303[19]) Rail Committee meeting. At this meeting, the Rail Committee directed staff to coordinate with Caltrain staff and to determine the material changes to the alternatives' concepts to address updated standards guiding the substantiate changes in the alternative's concepts. These comments are related to the following major elements.

a. Vertical Alignment
   - Roadway vertical clearance
   - Bridge structure depth
   - Railroad grade and profile
   - Pedestrian and Bicycle path clearance

b. Horizontal Alignment
   - Roadway Encroachment into Caltrain right-of-way
   - Pedestrian facilities encroachment into Caltrain right-of-way
   - Railroad encroachment into Caltrain right-of-way
   - Width of Bridges
   - Retaining wall offsets/clearance from structure and roadways
   - Maintenance and access requirements along railroad tracks
   - Clearance for MSE Wall construction between shoofly and new walls and maximize the right-of-way use

c. Four (4) tracking segments

[19] Item 1, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=70179&repo=r-704298fc

- Four (4) tracking segments and roadway encroachment into Caltrain right-of-way
- Four track alignment

d. Roadway Design
   - Road profile/sag curve/grades
   - Acceleration/deceleration lane, lane drops and weaving
   - Roundabout design
   - Curved bridges

e. Miscellaneous/Other
   - Construction technology
   - Culverts

Subsequently, City and Caltrain staff met to understand how addressing Caltrain comments and adhering to Caltrain Standards will impact the conceptual design alternatives and understand the high-level material changes that may be required to the concepts. A follow-up study session with the Rail Committee was conducted on March 19, 2024 (Staff Report 2402-2675[20]) presented key findings on the impacts to various alternatives and discussed the material changes required for various alternatives.

The Rail Committee discussion regarding Caltrain's comments continued to the April 16, 2024 meeting. City and Caltrain Staff provided the details of major elements affecting various alternatives identifying impacts on alternatives for adherence to updated Caltrain Standards. Following an in-depth review and discussion, the Committee voted, with two in favor and one opposed, to recommend the Underpass Alternative and Hybrid Alternative at Meadow Drive and Charleston Road as the preferred options to the City Council for advancement into the Preliminary Engineering review.

Additionally, the Rail Committee unanimously reconfirmed the preference for the Partial Underpass for the Churchill Avenue crossing. The Committee also recommended to consider the following elements for Underpass Alternatives at all crossings during the Preliminary Engineering phase.

- Seek ways to reduce property impacts
- Optimize bike/pedestrian crossings
- Where feasible, improve connections to bike infrastructure beyond the study area to improve the network
  - Improve connection to Park Blvd
  - Explore modifications/refinements to the Bike Blvd, along Park Blvd to improve overall bike network

[20] Item 1, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=70816&repo=r-704298fc

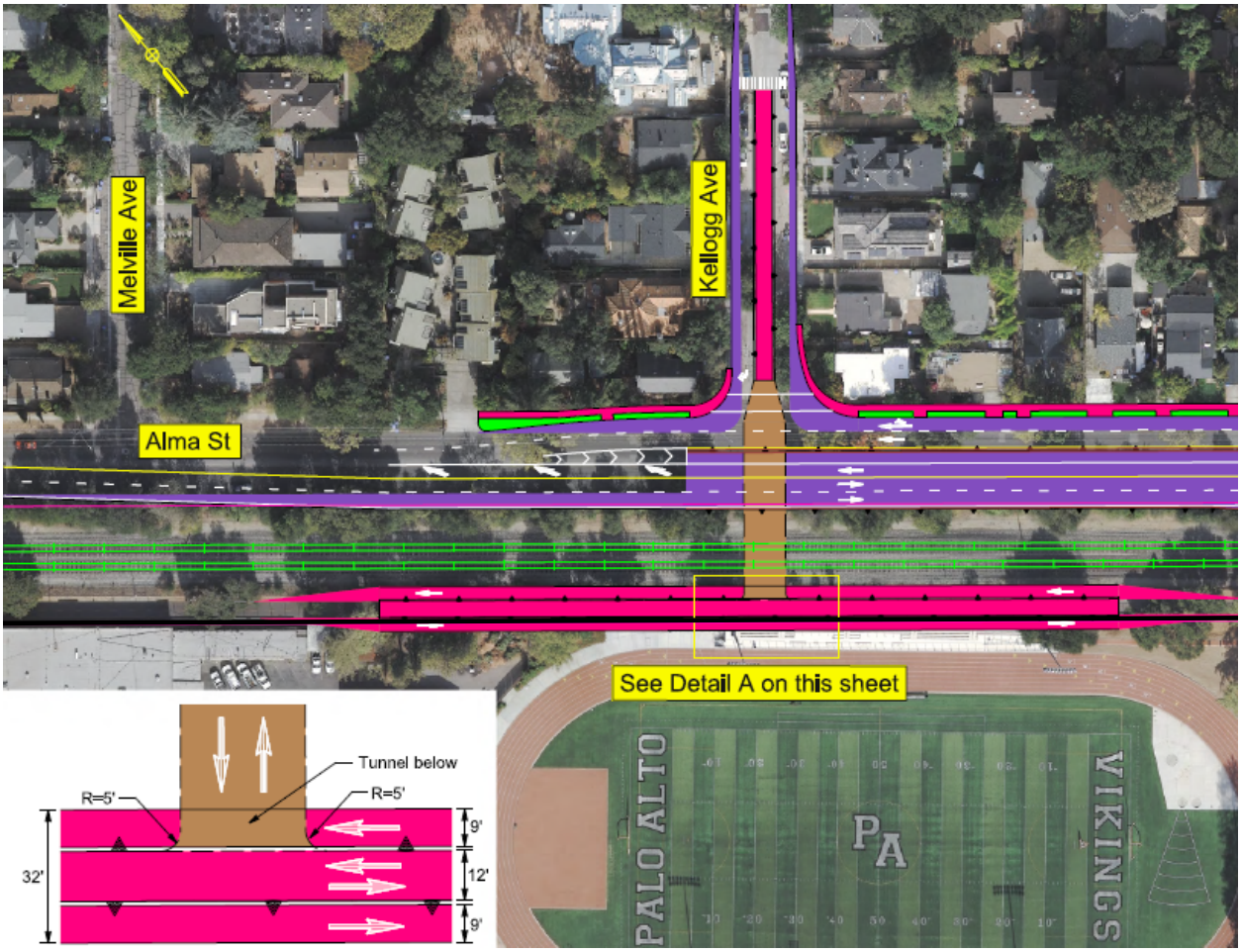
- Further refine the traffic circle on Charleston Road to reduce the property impacts
- Refine construction impacts to better understand possible mutations needed during the lengthy construction process.

Bicycle and Pedestrian Crossing - Kellogg Avenue vs. Seale Ave

At the November 29, 2021 City Council meeting, the Council directed staff to ensure that the Bicycle and Pedestrian Transportation Plan included an evaluation of the bicycle and pedestrian crossing for the Churchill Avenue Partial Underpass at the locations of Kellogg Avenue and Seale Avenue. The Bicycle and Pedestrian Plan completed the evaluation of this and prepared a technical memorandum summarizing their assessment (Attachment J: Technical Memorandum Seale vs Kellogg Grade Separated Rail Crossing Assessment)

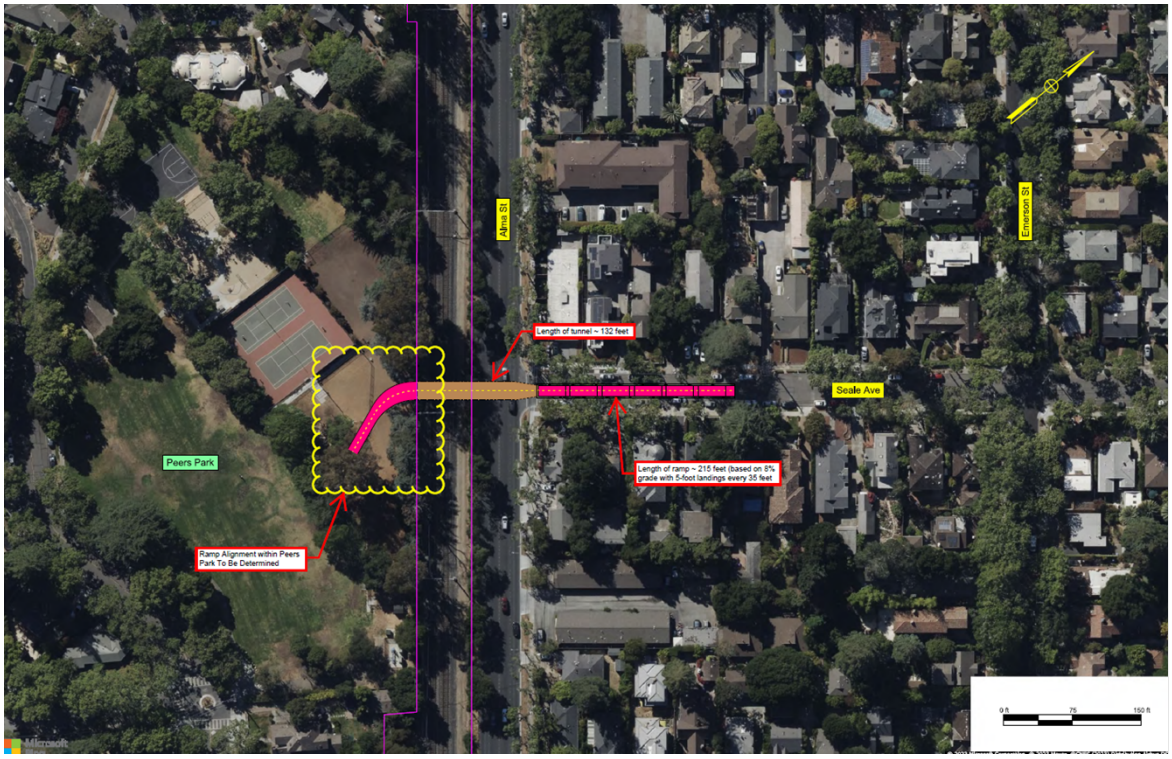
The assessment included a review of the prior analysis and plans, proximity to alternative routes, landing locations, network connectivity, and community input. Based on this analysis, it is recommended that bicycle and pedestrian crossing at Seale Avenue would fill a longer gap between alternative locations and would increase connectivity. In addition, due to right-of-way constraints on the west side of the railroad tracks at the Kellogg Avenue location, there is potential for additional impact on the Palo Alto Unified School District property. The Kellogg location also requires additional turns on the west side of the tracks to connect to the Embarcadero Bike path which is currently within the easement on the Caltrain property.

Exhibit B: Kellogg Avenue Pedestrian and Bicycle Crossing



In addition to the above factors, the Seale Avenue crossing ends in Peers Park (as is currently conceptualized). Significant construction involving Peers Park requires compliance with the City's park improvement ordinance process, which generally includes review by the City's Park and Recreation Commission and final approval by the City Council.

Exhibit C: Seale Avenue Pedestrian and Bicycle Crossing



Finalizing the location of a Bicycle and Pedestrian crossing presents complexities when considered with the planned partial underpass at Churchill including but not limited to land use and right of way. Staff is considering additional outreach to incorporate input from stakeholders including but not limited to Palo Alto Unified School District, residents around the crossings, and bike and pedestrian users including students at key locations such as Palo Alto High School and affected neighborhood streets. In addition, this will allow staff to review the crossing layout and the integration of a potential underpass with parkland uses at Peers Park before the Rail Committee makes its final recommendation to the City Council.

Staff presented a review of the merits of Kellogg vs Seal to the Rail Committee on April 16, 2024 (Staff Report 2403-2802[21]) The Rail Committee reviewed and unanimously selected Seale Avenue as the preferred bicycle and pedestrian crossing location. Staff plans to conduct additional outreach to stakeholders and inform the community about the bicycle and pedestrian crossing location.

[21] Item 2, Action Items, https://portal.laserfiche.com/Portal/DocView.aspx?id=71735&repo=r-704298fc

Next Steps

In May 2024, staff will expand the outreach efforts to keep the community informed about various technical studies and project updates. This outreach initiative will provide an opportunity to share project plans and gather feedback and comments from the community.

Following these outreach efforts, in June 2024, staff will present to the Council action to adopt the preferred location for the bicycle and pedestrian crossing in the Churchill Underpass Alternative. Staff will also seek Council consideration to select the preferred alternative for grade separations at Meadow Drive and Charleston Road crossings, aiming to advance these crossings into the Preliminary Engineering and Environmental Documentation phase.

Additionally, staff will seek council approval for a funding agreement with the Federal Railroad Administration, securing grant funding contributions of $6.0 Million towards completing the Preliminary Engineering and Environmental Documentation for the three crossings at Churchill Avenue, Meadow Drive, and Charleston Road.

FISCAL/RESOURCE IMPACT

This item is a study session only and does not have a fiscal impact. However, resources required for performing additional work is depend upon the alternatives under consideration. Both Caltrain and City staff are expected to require additional resources depending upon the final scope of work; amendments to the existing agreement would be required. Staff will prepare the amendment with AECOM and seek City Council approval accordingly.

STAKEHOLDER ENGAGEMENT

The Rail Committee and the City Council meetings are open to the public, offering community members opportunities to provide comments and feedback. The Rail Committee meetings are regularly conducted, and their information is posted on the City Calendar. Residents who have subscribed to City Meetings notifications receive notifications about the Rail Committee meetings. Additionally, notifications about the Rail Committee and the City Council meetings are disseminated through the City's YouTube Channel. The Transportation Department also provides updates on City projects, including Rail Grade Separation projects, in the Transportation Connect Newsletter and, on the project's, ConnectingPaloAlto.com website. As part of the next steps, staff are finalizing plans for additional community engagement and outreach, and public information sharing in advance of the June 3 Council meeting.

ENVIRONMENTAL REVIEW

The proposed action is part of a planning study for a possible future action, which has not been approved, adopted, or funded and is therefore exempt from the California Environmental Quality Act (CEQA) in accordance with CEQA Guidelines Section 15262. The future decision to approve the construction of any one of the identified potential alternatives would be subject to CEQA and require the preparation of an environmental analysis. The project plans to enter the Preliminary Engineering and Environmental Documentation Phase and will conduct an environmental review pursuant to CEQA and NEPA requirements.

ATTACHMENTS

Attachment A: Churchill Avenue Partial Underpass Plan and Profile

Attachment B: Churchill Avenue Closure Plan and Profile

Attachment C: Meadow Drive & Charleston Road Hybrid Plan and Profile

Attachment D: Meadow Drive & Charleston Road Trench Plan and Profile

Attachment E: Meadow Drive & Charleston Road Underpass Plan and Profile

Attachment F: Meadow Drive & Charleston Road Viaduct Plan and Profile

Attachment G: Caltrain 4 Tracking Analysis Presentation at Rail Committee

Attachment H: Caltrain Technical Comments Review Staff Presentation at Rail Committee

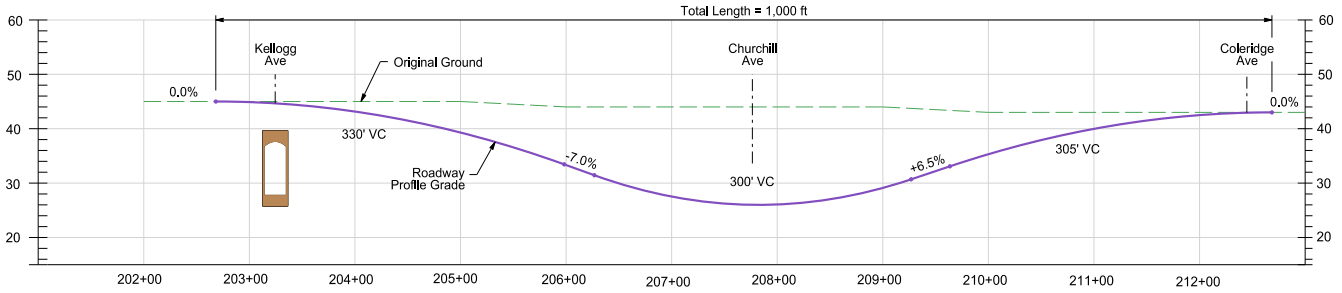
Attachment I: Caltrain Technical Review Results (Caltrain and City Staff Presentation) at Rail Committee

Attachment J: Technical Memorandum Seale vs Kellogg Grade Separated Rail Crossing Assessment

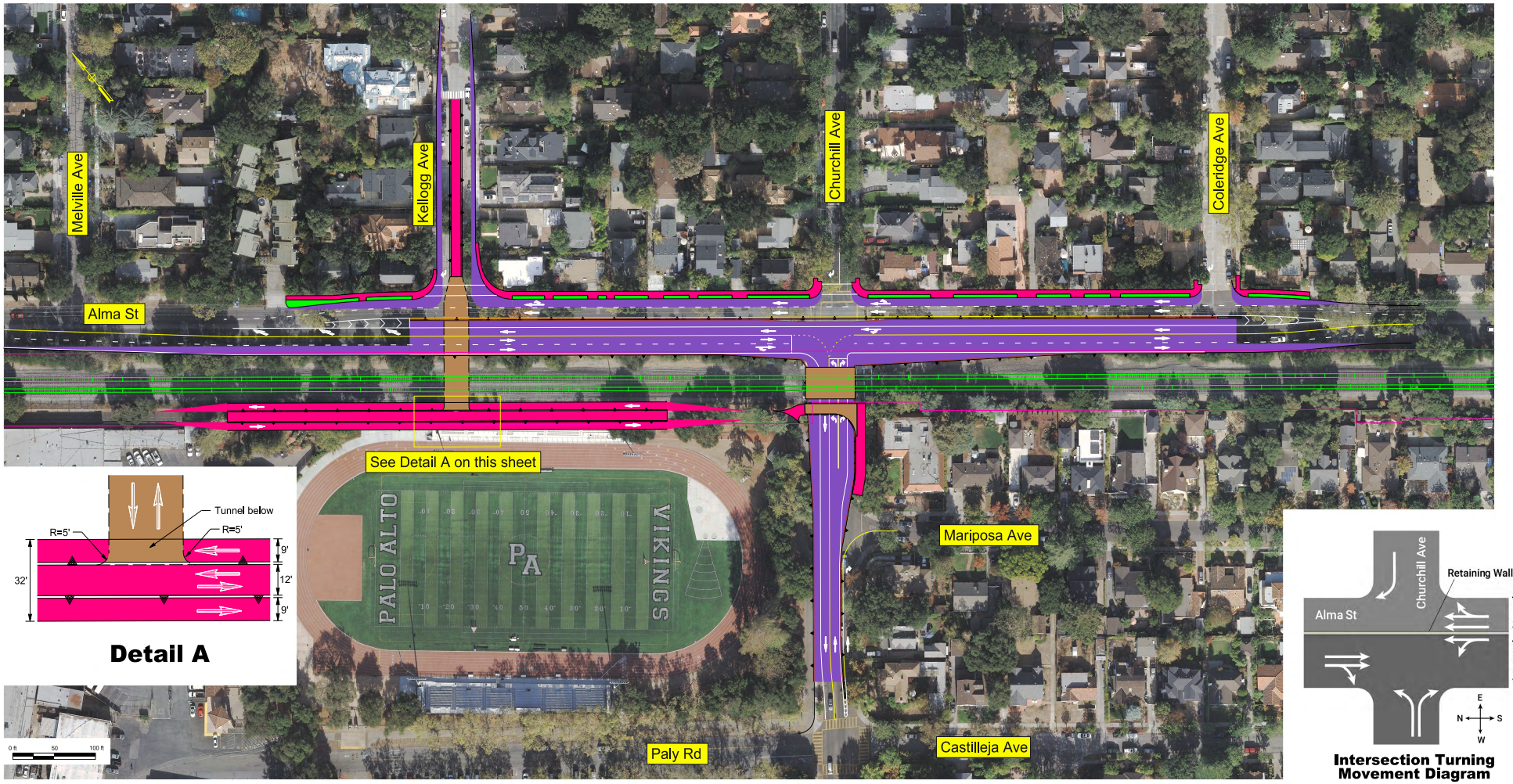
Attachment K: Summary of Evaluation Matrix based on Council Adopted Criteria

APPROVED BY:

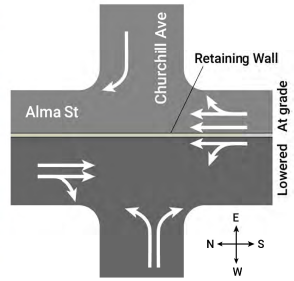
Philip Kamhi, Chief Transportation Official



Alma St (Profile)



Detail A



Intersection Turning Movement Diagram

Churchill Ave Aerial View (Plan)

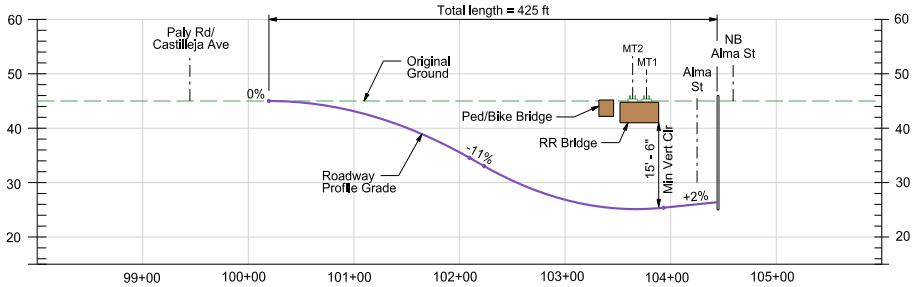
LEGEND:
- Track
- Retaining Wall
- Right-of-Way
- Roadway Modifications
- Ped/Bike Ramps & Sidewalks
- Structure
- Direction of Traffic

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

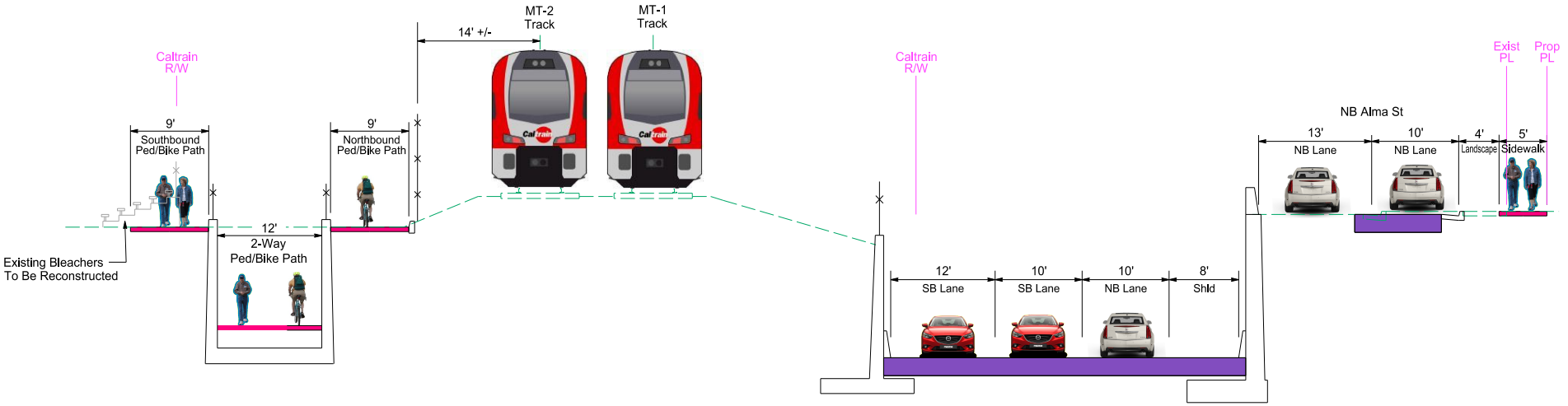
Churchill Underpass
Plan & Profile

CITY OF PALO ALTO

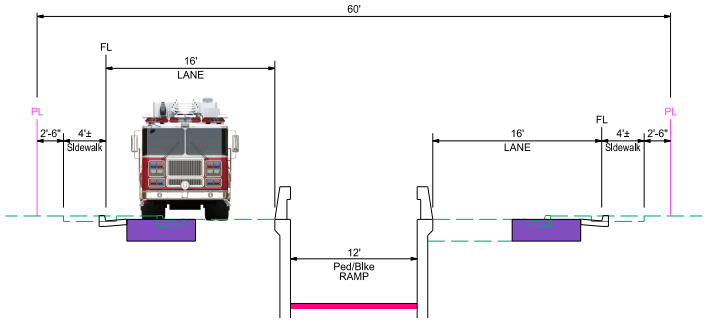
AECOM



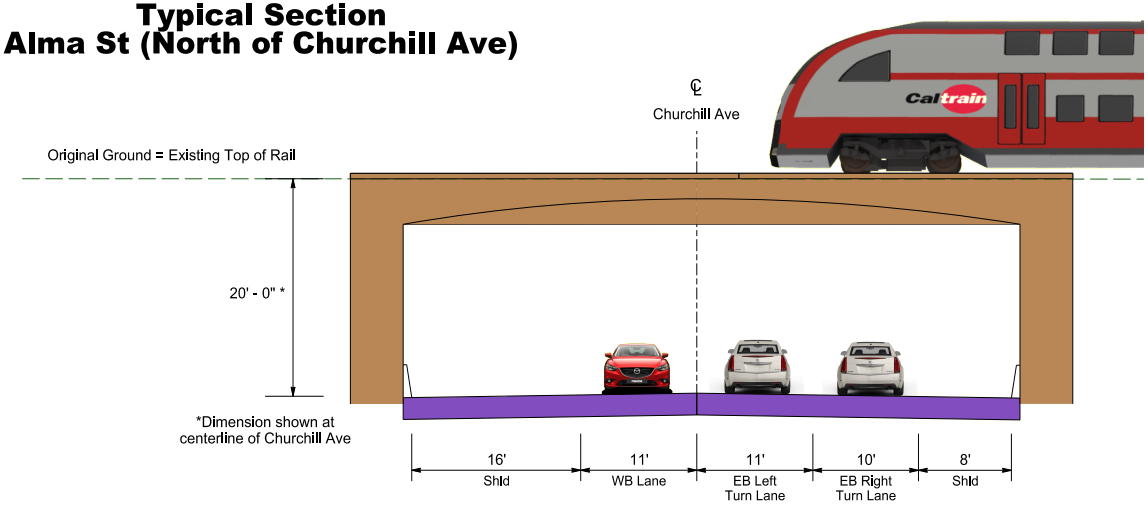
Churchill Ave (Profile)



Typical Section
Alma St (North of Churchill Ave)



Typical Section
Kellogg Ave



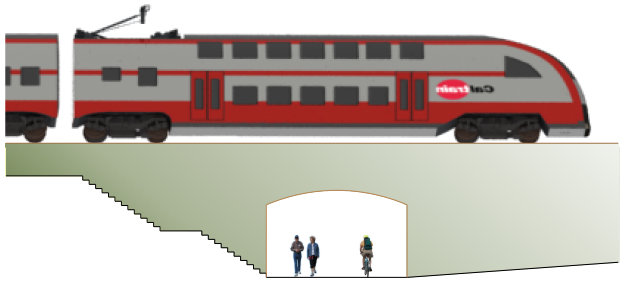
Typical Section
Churchill Ave Underpass

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

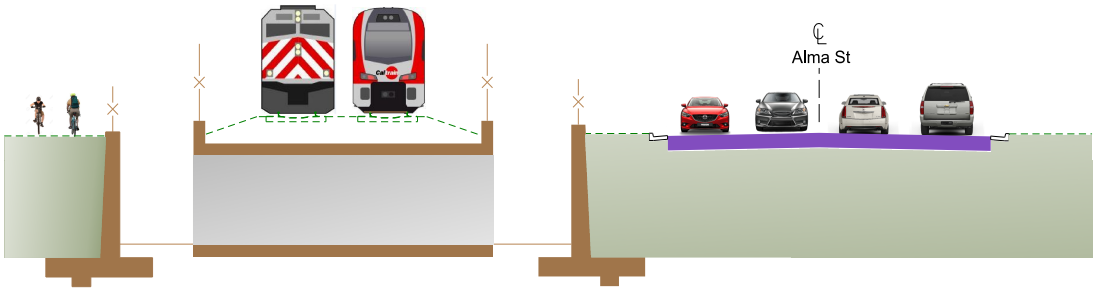
Churchill Underpass
Profile & Typical Sections

CITY OF PALO ALTO

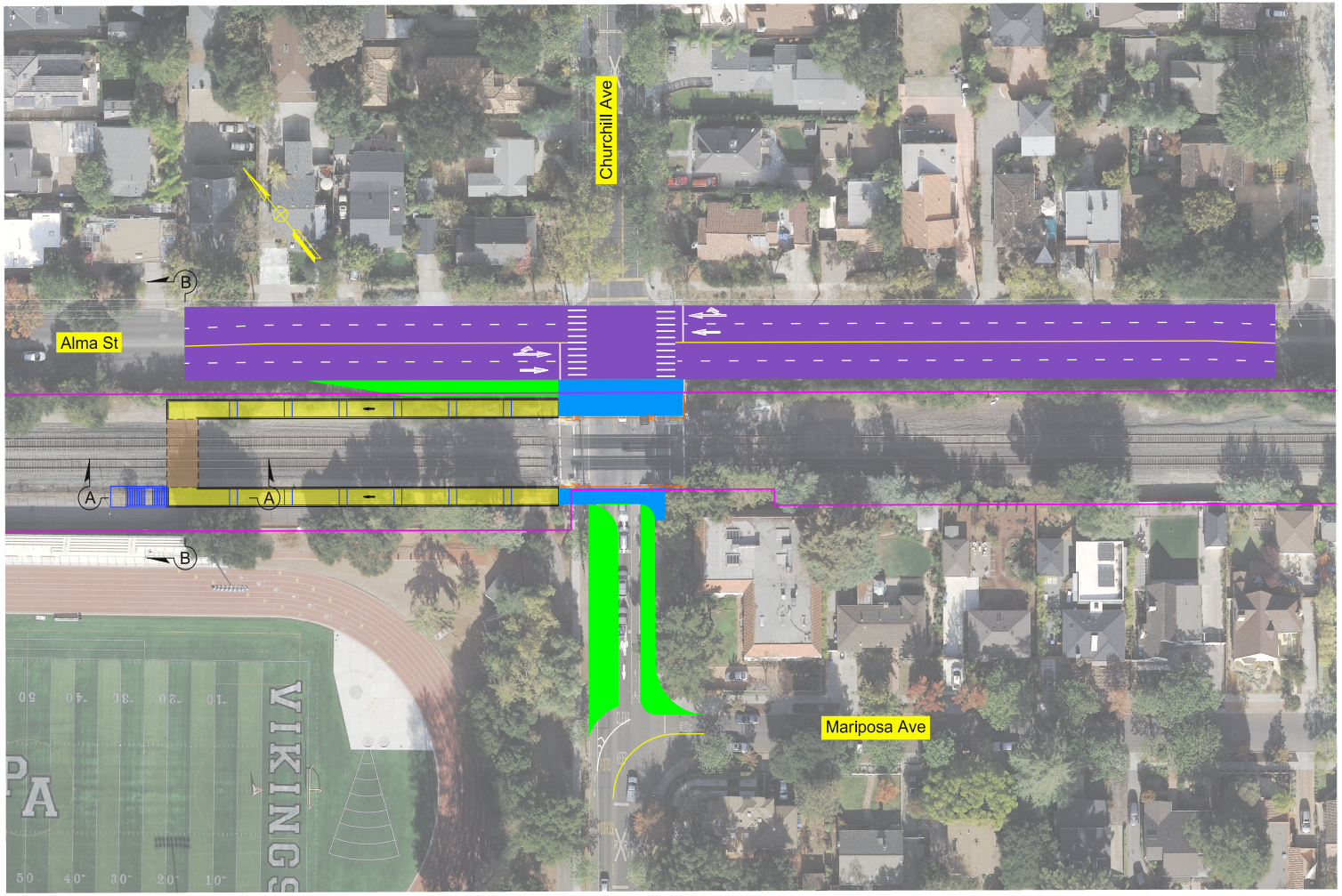
AECOM



Section A-A



Section B-B



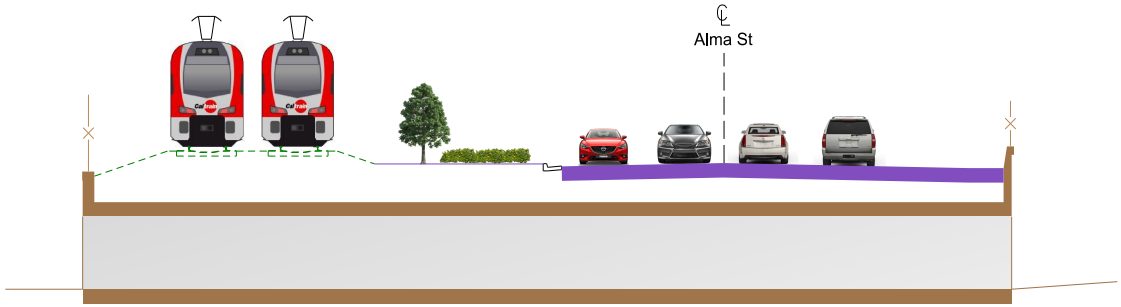
Churchill Avenue (Plan)

LEGEND
- Fence
- Right-of-Way
- Ramp
- Landscaping
- Roadway Modifications
- Sidewalk Modifications
- Undercrossing Structure
- Stairway

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Pedestrian/Bicyclist Undercrossing at Churchill Avenue
Plan & Cross Sections
Option 1

CITY OF PALO ALTO
alta PLANNING + DESIGN
AECOM



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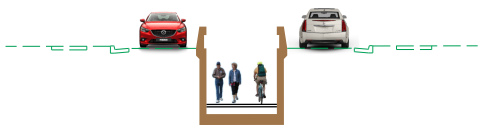

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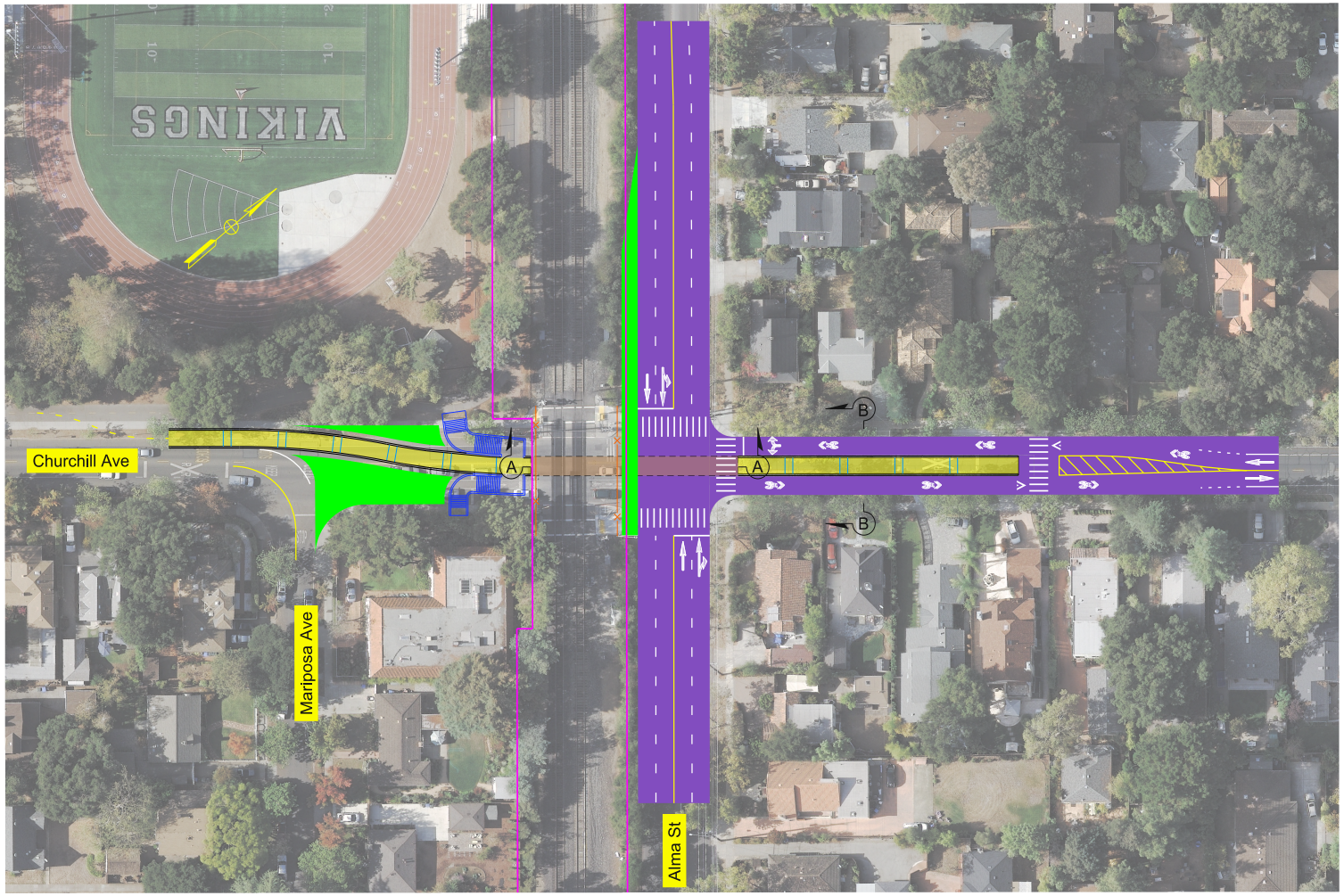

Churchill Avenue (Plan)

LEGEND
- Fence
- Right-of-Way
- Ramp
- Landscaping
- Roadway Modifications
- Sidewalk Modifications
- Undercrossing Structure
- Stairway

0 ft 50 100 ft

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Pedestrian/Bicyclist Undercrossing at Churchill Avenue
Plan & Cross Sections
Option 2

CITY OF PALO ALTO

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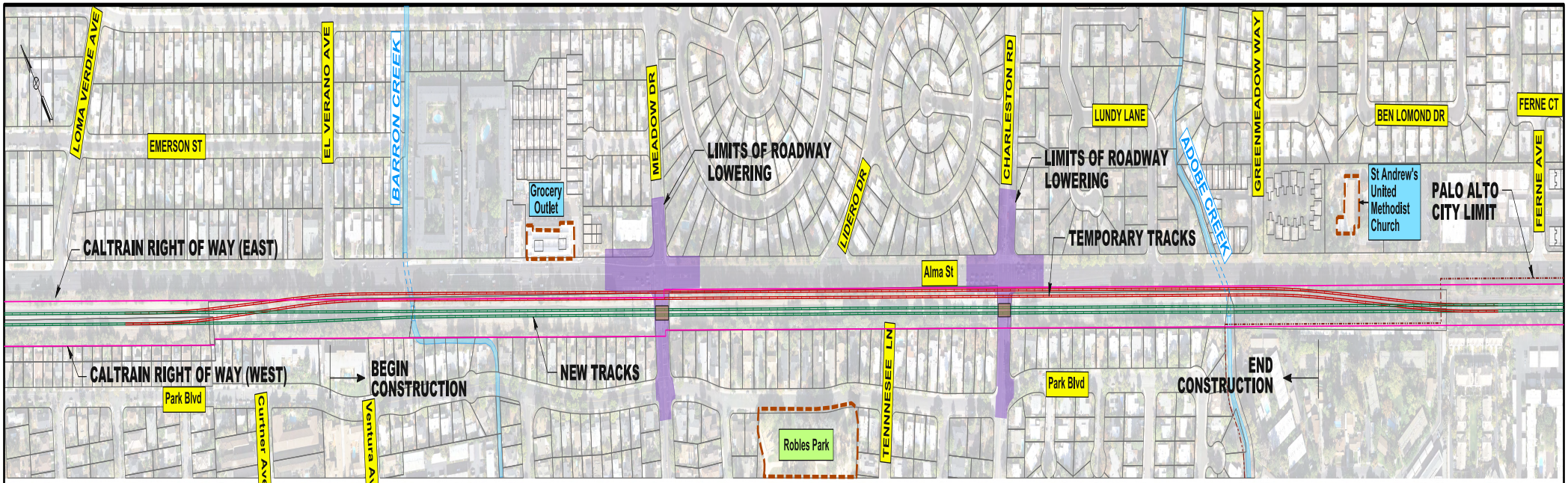
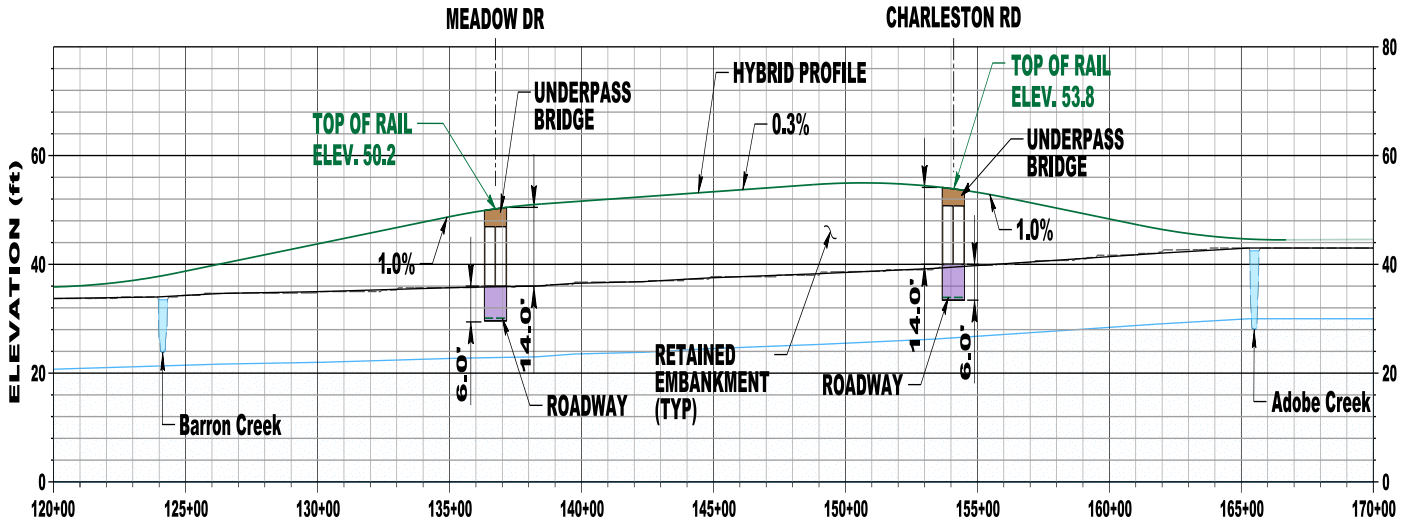
AECOM



AERIAL VIEW (PLAN)



ELEVATION VIEW (PROFILE)

LEGEND:

- New Permanent Track
- Temporary Track (Shoofly)
- Hybrid Track Profile
- Existing Ground Level
- Caltrain Right Of Way
- Bridge
- Landmark
- Creek
- Groundwater
- Limits Of Roadway Lowering

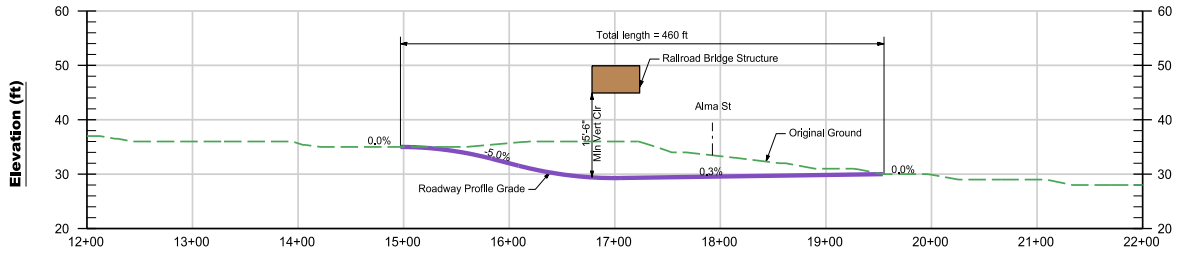
Meadow Drive & Charleston Road - Plan and Profile - Hybrid

CITY OF PALO ALTO

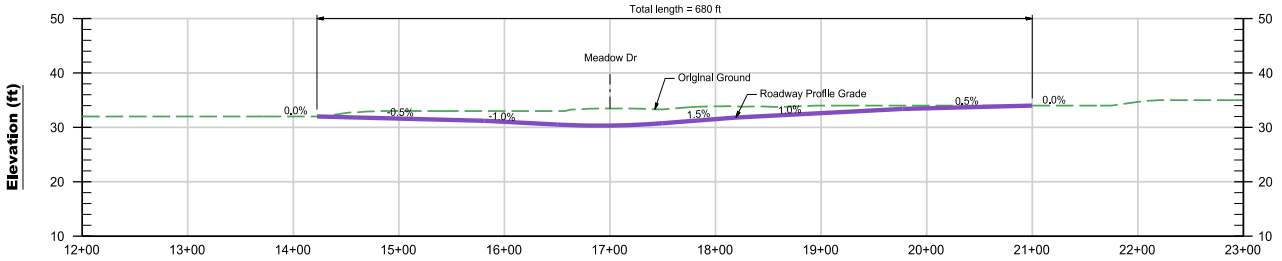
AECOM

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
NOVEMBER 08, 2018

GRAPHIC SCALE



Meadow Dr (Profile)



Alma St (Profile)

NOTE:

Design Speed = 25 MPH for W Meadow Dr
Design Speed = 35 MPH for Alma St

Meadow Dr Aerial View (Plan)

LEGEND:

- Permanent Track Alignment
- Retaining Wall
- Caltrain Right-of-Way
- Limits of Roadway Modifications
- Sidewalk Modification
- Bridge Structure
- Driveway Modification
- Direction of Traffic

0 ft 50 100 ft

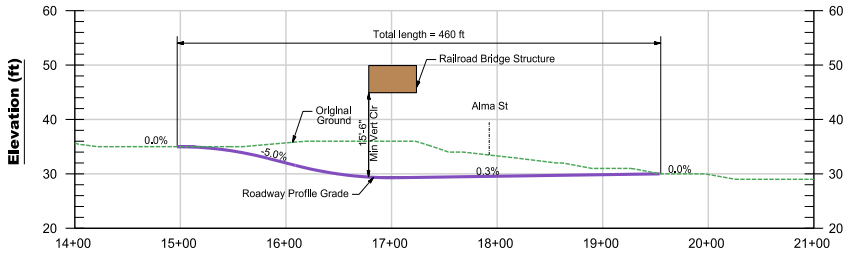
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Meadow / Charleston Hybrid
Plan & Profile

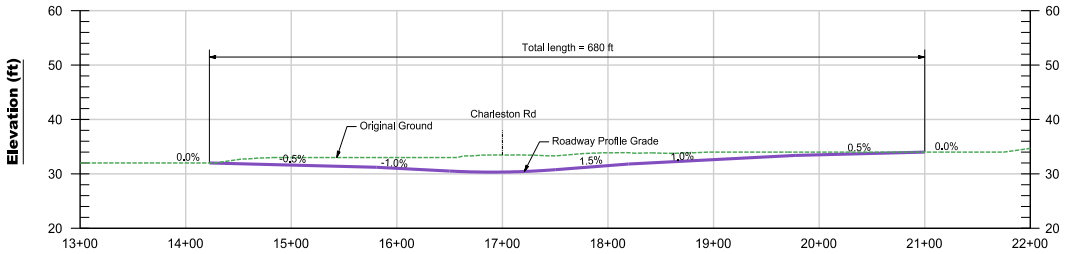
CITY OF PALO ALTO

alta PLANNING + DESIGN

AECOM



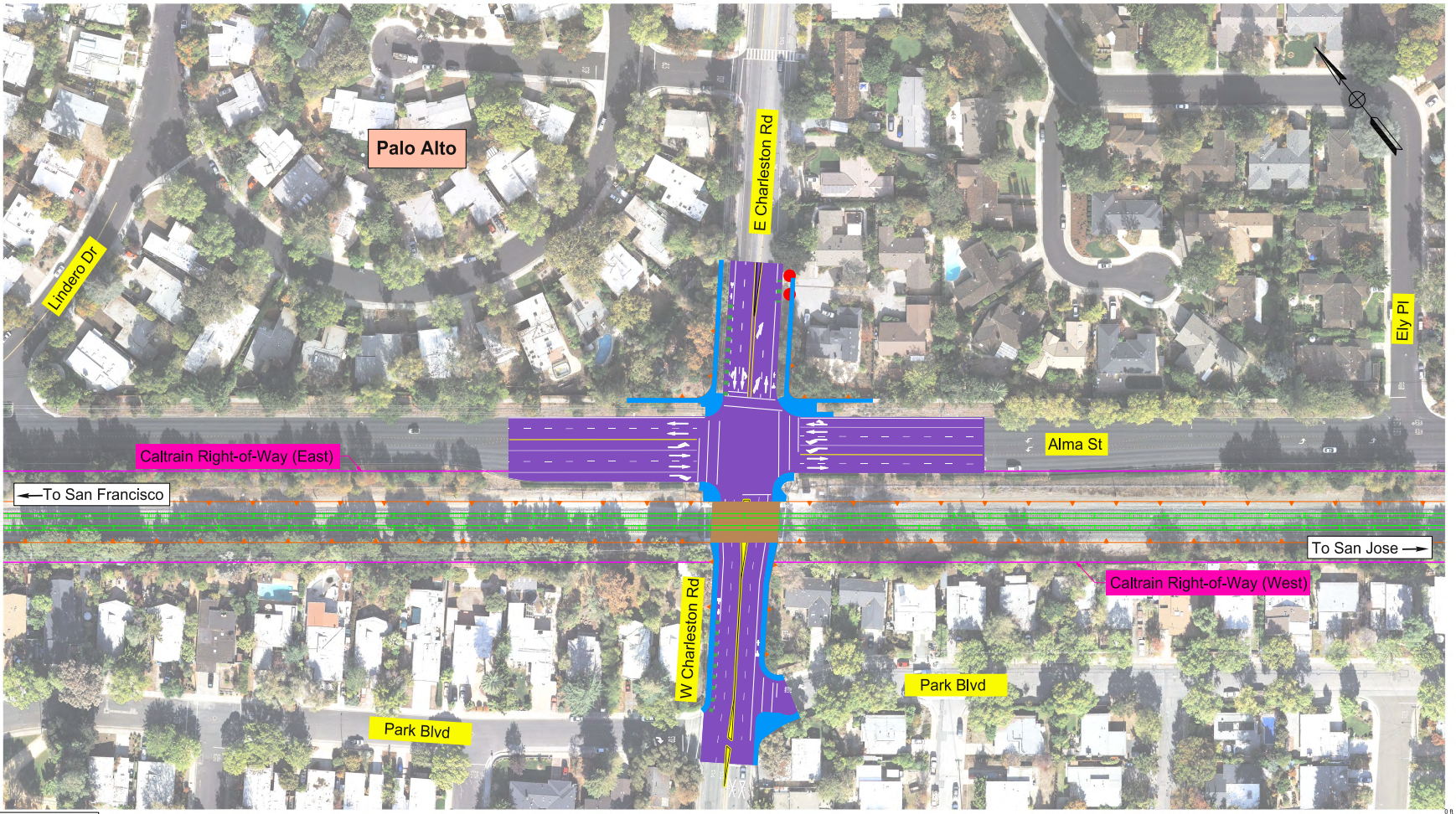
Charleston Rd (Profile)



Alma St (Profile)

NOTE:

Design Speed = 25 MPH for Charleston Rd
Design Speed = 35 MPH for Alma St



Charleston Rd Aerial View (Plan)

LEGEND:

- Permanent Track Alignment
- Retaining Wall
- Caltrain Right-of-Way
- Limits of Roadway Modifications
- Sidewalk Modification
- Bridge Structure
- Driveway Modification
- Direction of Traffic

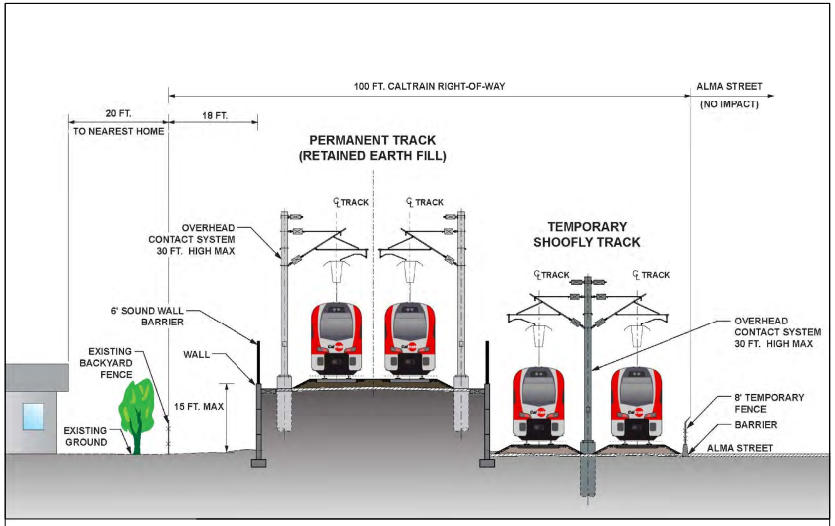
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Meadow / Charleston Hybrid
Plan & Profile

CITY OF PALO ALTO

alta PLANNING + DESIGN

AECOM



Example Sections - Hybrid - Looking North
(Between Meadow and Charleston)

Proposed Hybrid Solution Overview - Looking South West
Meadow Drive Intersection

Backyard View - Looking East
Typical Property West of Tracks

Ground Level View
Charleston Intersection

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Railroad Grade Separation Sections and Renderings
Hybrid

(Roadway Partially Lowered, Railroad Partially Elevated)

CITY OF PALO ALTO

AECOM

Brittan Avenue, San Carlos

Holly Street, San Carlos

San Bruno Avenue, San Bruno

42nd Avenue, San Mateo

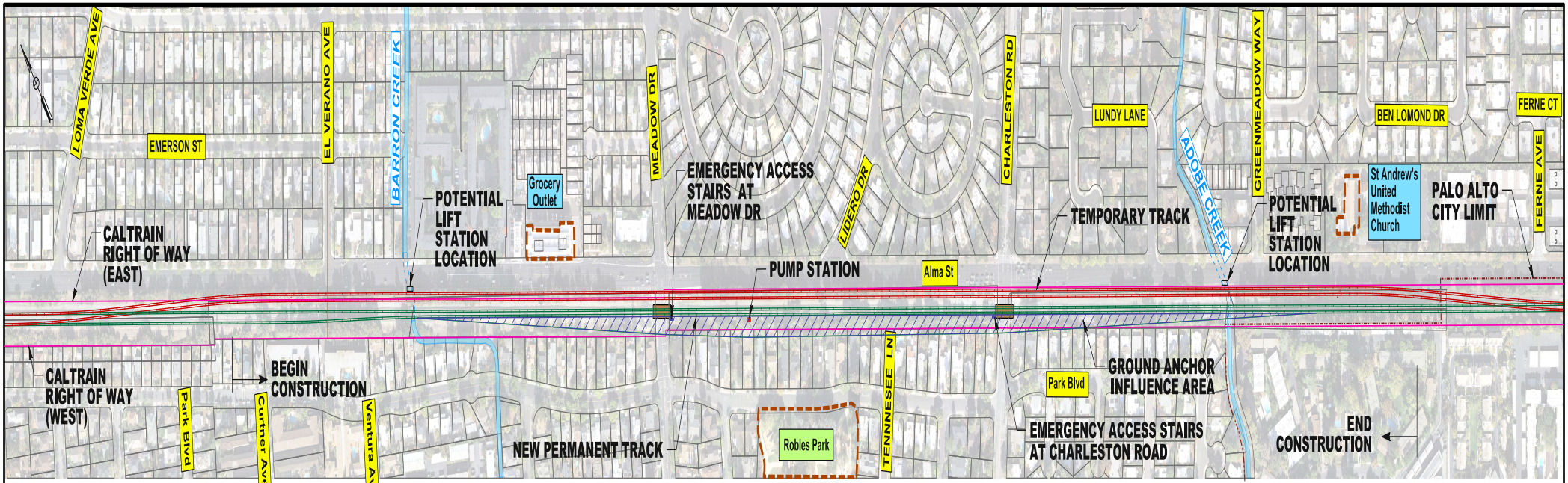
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Railroad Grade Separation Examples
Hybrid

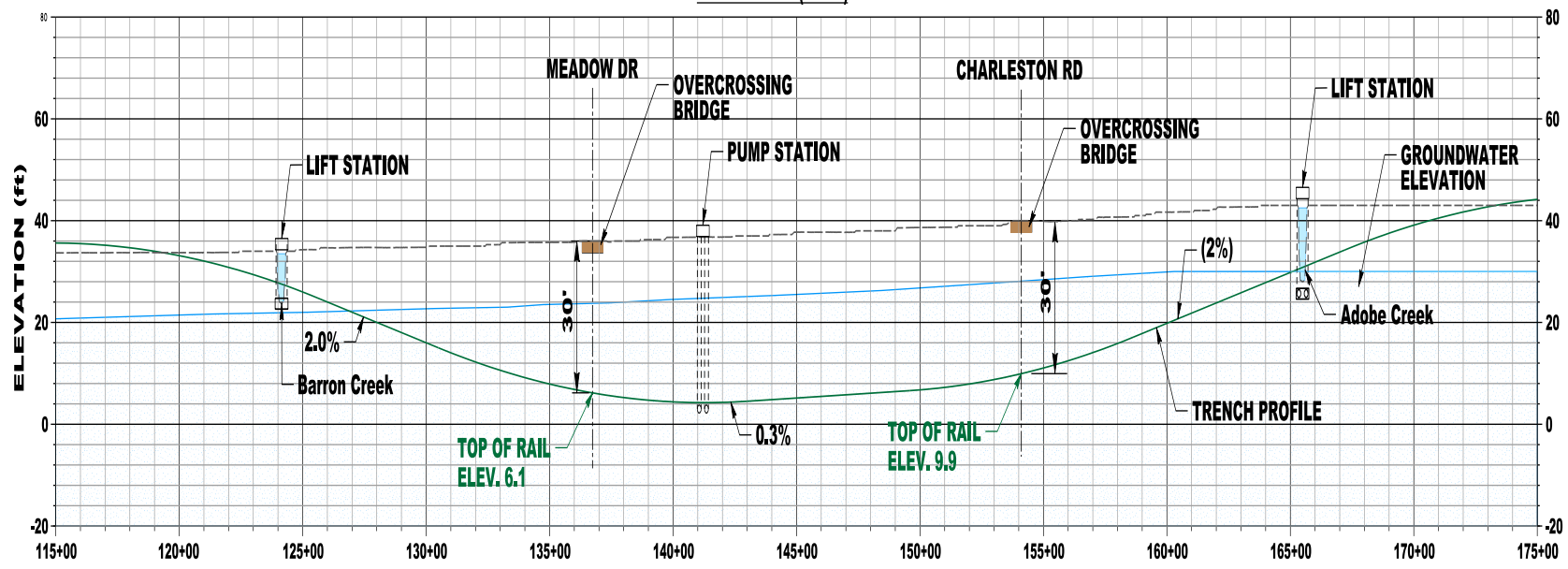
(Roadway Partially Lowered, Railroad Partially Elevated)

CITY OF PALO ALTO

AECOM



AERIAL VIEW (PLAN)



ELEVATION VIEW (PROFILE)

LEGEND:

- New Permanent Track
- Temporary Track (Shoofly)
- Trench Track Profile
- Existing Ground Level
- Caltrain Right Of Way
- Bridge
- Ground Anchor Influence Area
- Landmark
- Creek
- Groundwater

Meadow Drive & Charleston Road - Plan and Profile - Trench

CITY OF PALO ALTO

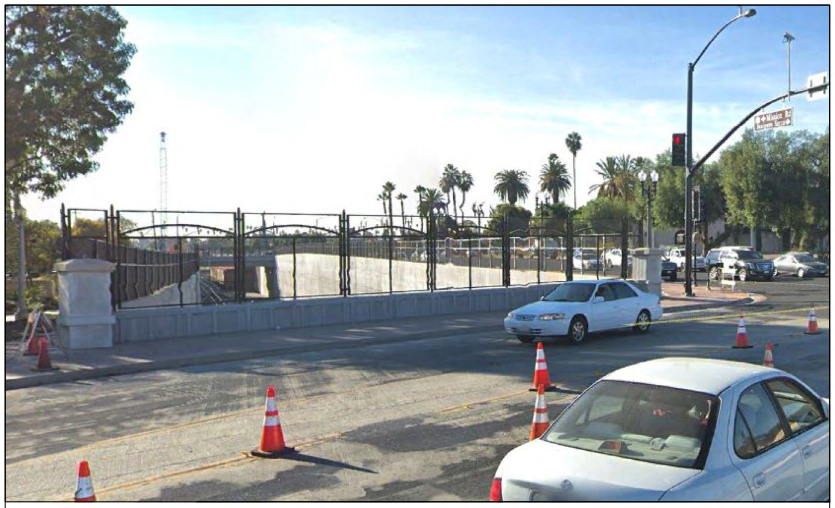
AECOM

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
NOVEMBER 28, 2018

100 0 100 200
GRAPHIC SCALE

Alameda Corridor East
Mission Road and Ramona St, San Gabriel, CA

Alameda Trench Corridor - Completed 2002
E Compton Blvd, Compton, CA



Alameda Corridor East
Mission Road - San Gabriel, CA

Alameda Trench Corridor - Completed 2002
E Compton Blvd & Alameda Street, Compton, CA

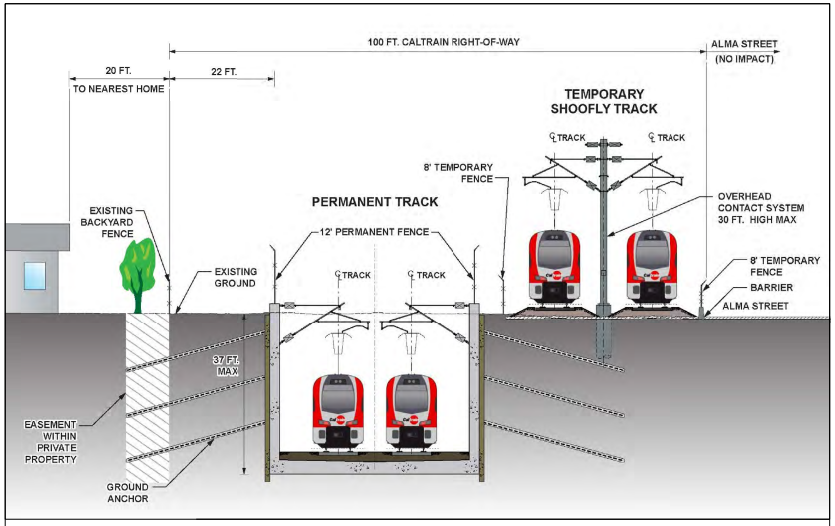
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Railroad Grade Separation Examples
Trench

(Roadway At Grade, Railroad Fully Lowered)

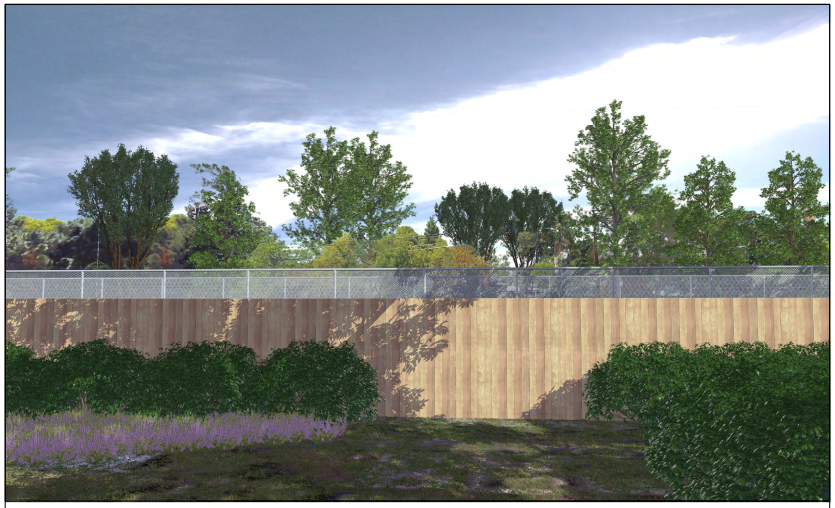
CITY OF PALO ALTO

AECOM



Example Section - Trench - Looking North
(Typlcal Between Meadow Dr & Charleston Rd)

Proposed Trench Solution Overview - Looking South West
Meadow Drive Intersection



Backyard View - Looking East
Typical Property West of the Trench

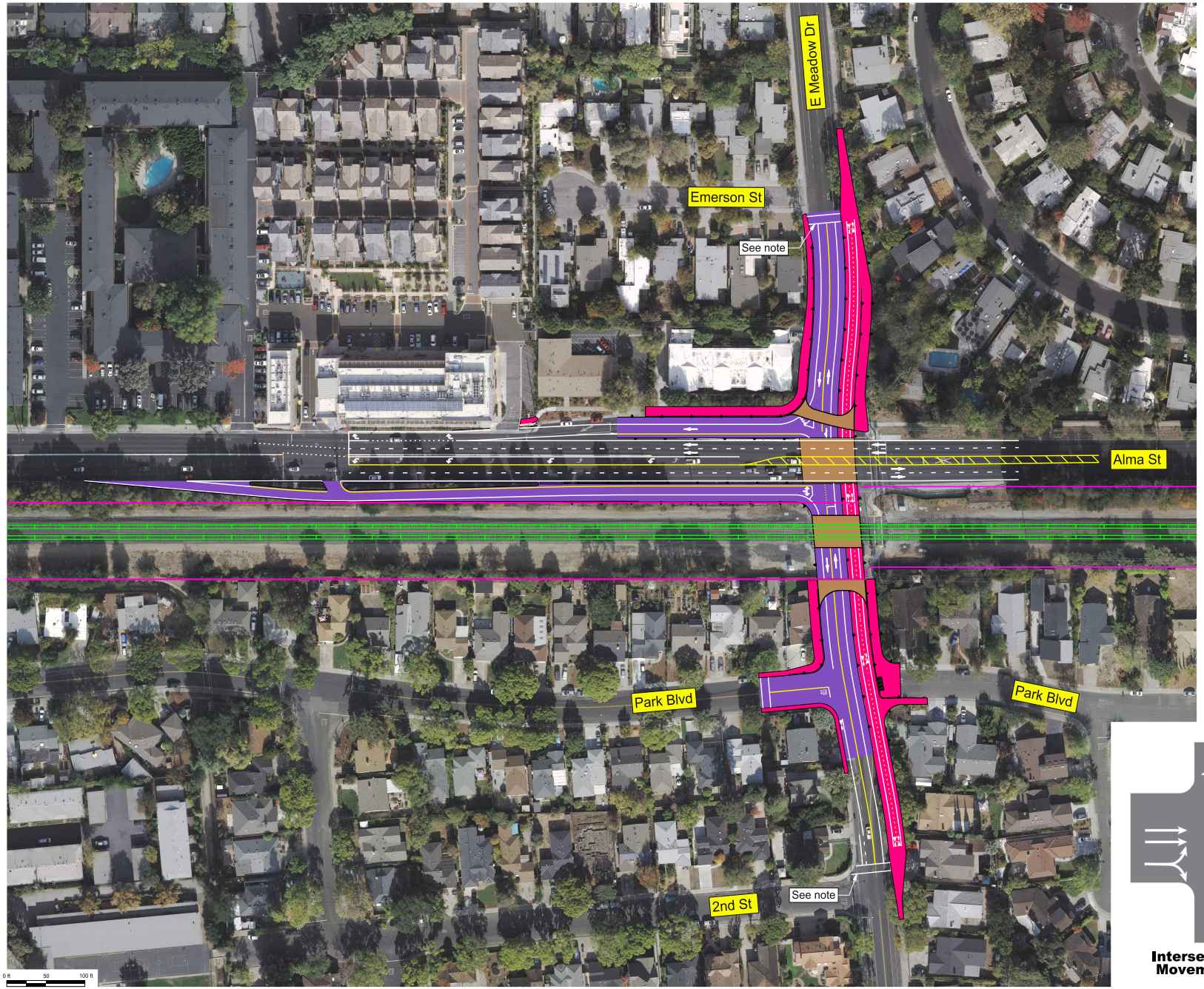
Ground Level Vlew - Looklng South West
Charleston intersection

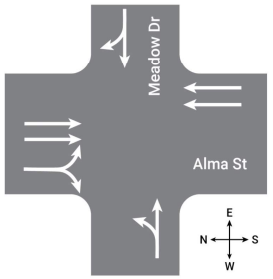
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Railroad Grade Separation Sections & Renderings
Trench
(Roadway At Grade, Railroad Fully Lowered)

CITY OF PALO ALTO

AECOM





Intersection Turning Movement Diagram

LEGEND:

- Track
- Retaining Wall
- Right-of-Way
- Roadway Modifications
- Ped/Bike Ramps & Sidewalks
- Structure
- Direction of Traffic

NOTE:
Additional features at crosswalks, such as HAWK traffic signals and rectangular rapid flashing beacons, to be considered in future phases.

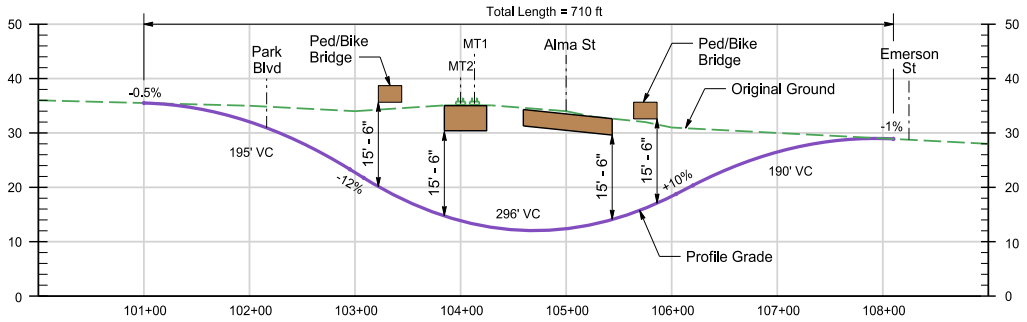
Meadow Drive Aerial View (Plan)

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

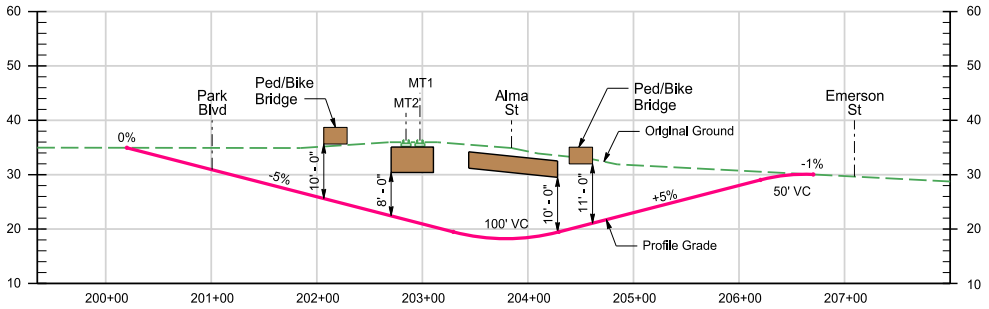
Palo Alto Grade Separation Planning Study
Meadow Underpass

CITY OF PALO ALTO

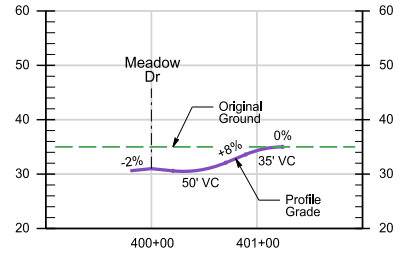
AECOM



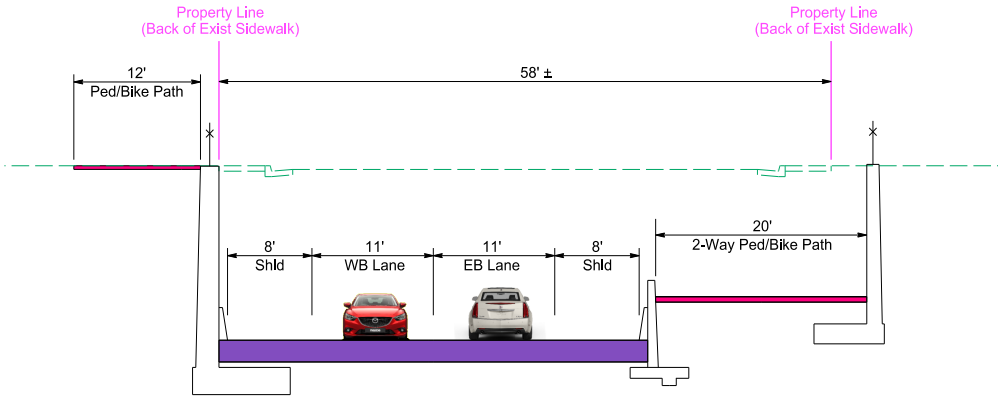
Meadow Dr Profile



Ped/Bike Profile from Park Blvd to Emerson St



Park Blvd Profile (North Side of Meadow Dr)



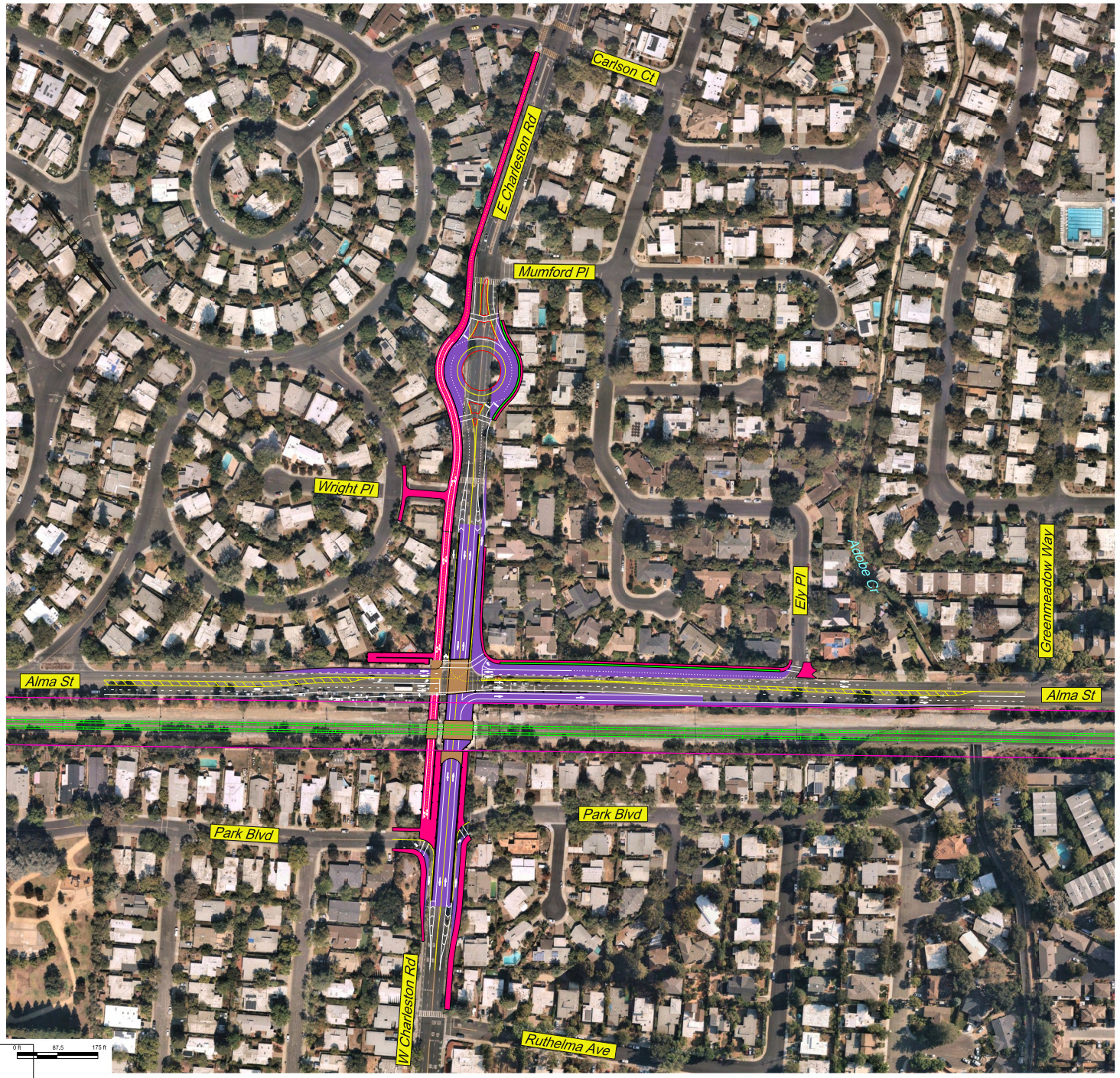
Typical Section Meadow Dr Underpass

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Meadow Dr Underpass Profiles & Typical Section

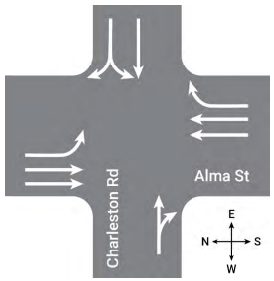
CITY OF PALO ALTO

AECOM



LEGEND:

- Track
- Retaining Wall
- Right-of-Way
- Roadway Modifications
- Ped/Bike Ramps & Sidewalks
- Structure
- Planting Area
- Direction of Traffic



Intersection Turning Movement Diagram

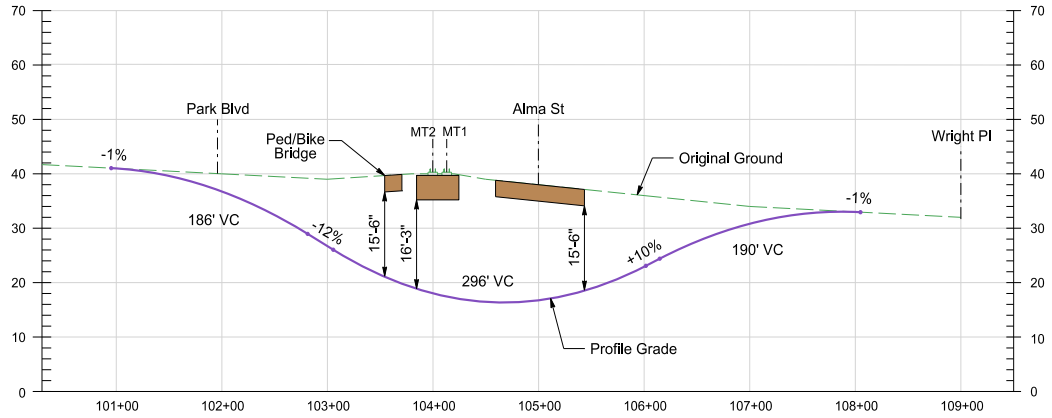
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Charleston Road Aerial View (Plan)

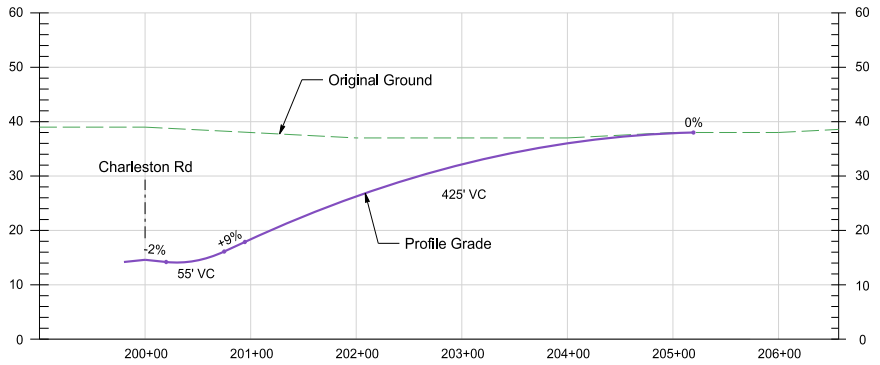
Palo Alto Grade Separation Planning Study
Charleston Underpass

CITY OF PALO ALTO

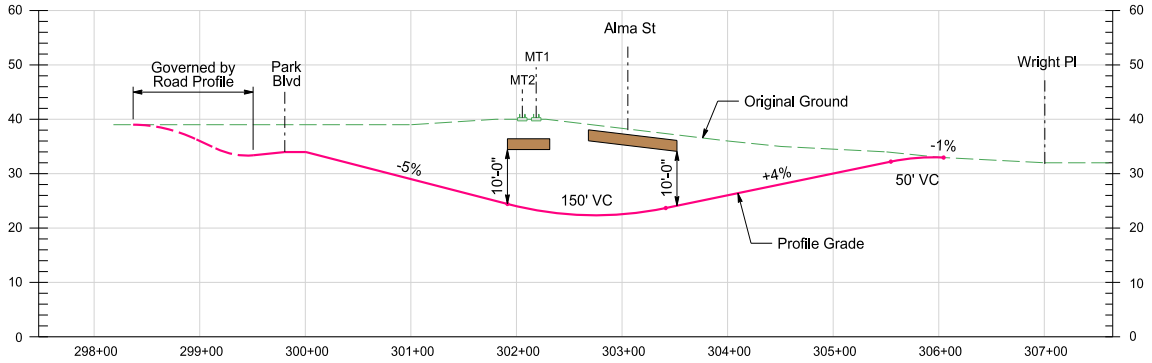
AECOM



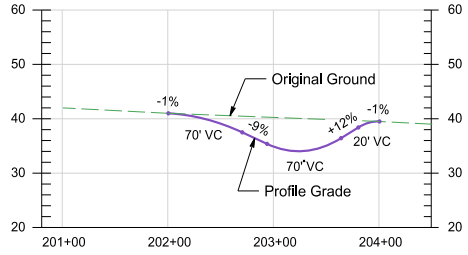
Charleston Rd Profile



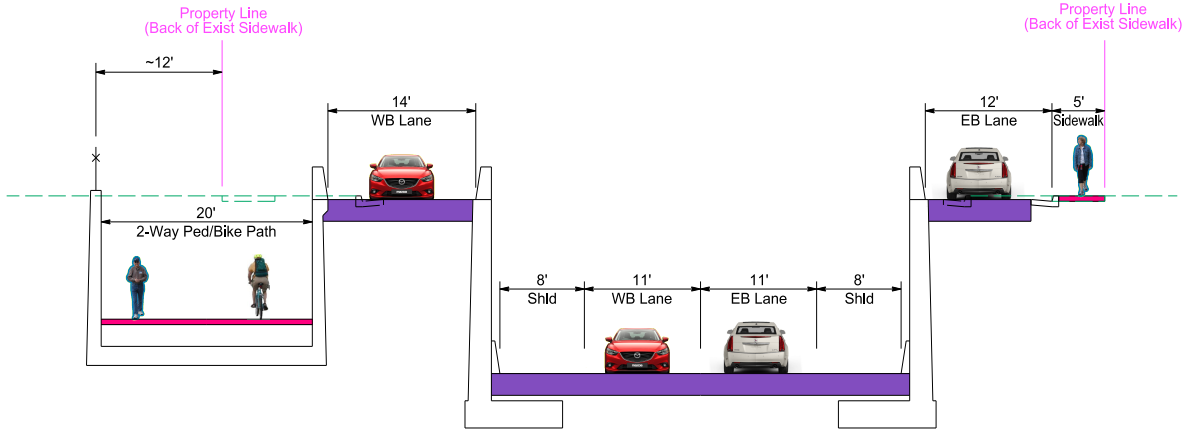
Ramp Profile
EB Charleston Rd to SB Alma St



Ped/Bike Profile from Park Blvd to Wright Pl



Park Blvd Profile (North Side)



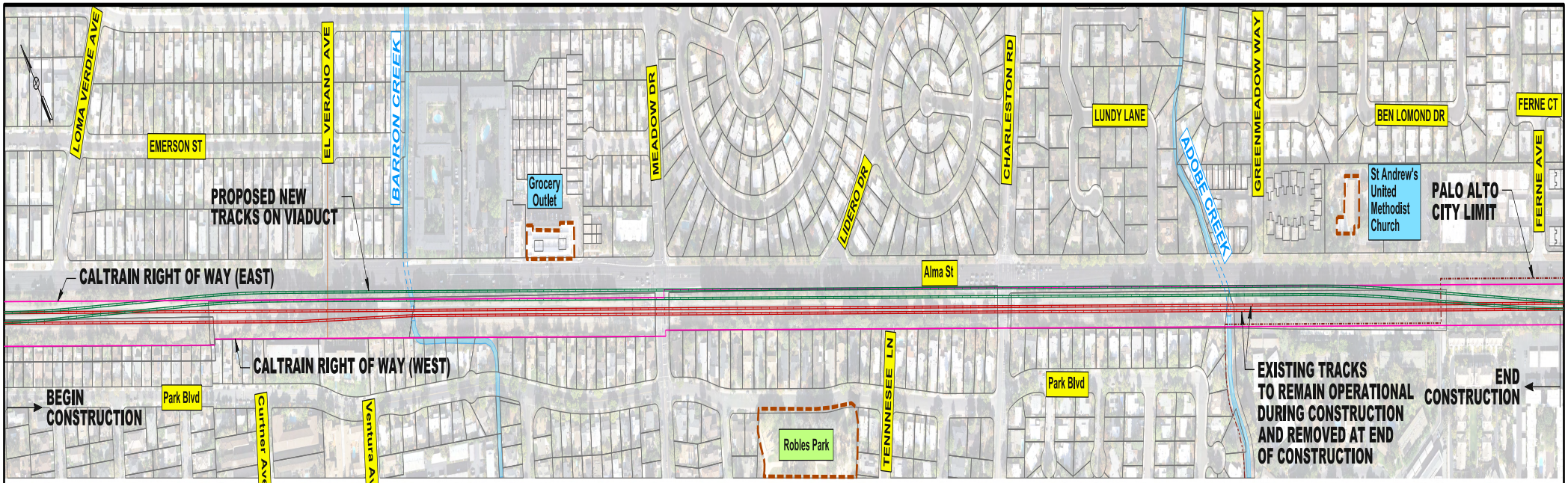
Typical Section - Charleston Rd Underpass

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

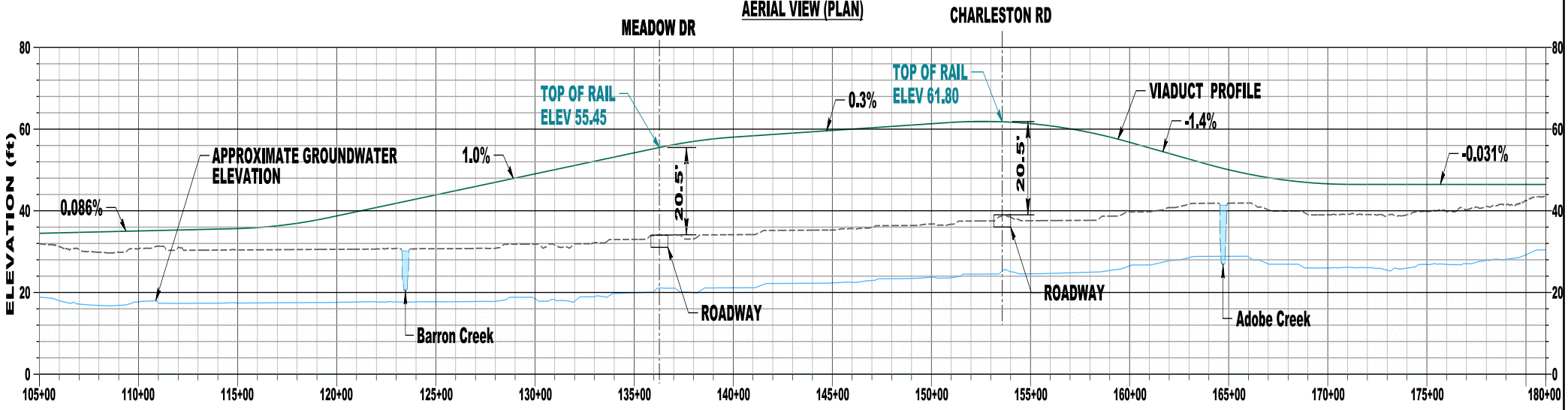
Charleston Underpass
Profiles & Typical Section

CITY OF PALO ALTO

AECOM



AERIAL VIEW (PLAN)



ELEVATION VIEW (PROFILE)

LEGEND:

- New Permanent Track
- Existing Tracks
- Viaduct Track Profile
- Existing Ground Level
- Caltrain Right Of Way
- Landmark
- Creek
- Bridge
- Groundwater

Meadow Drive and Charleston Road - Plan and Profile - Viaduct

CITY OF PALO ALTO

AECOM

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
NOVEMBER 28, 2018

100 0 100 200
GRAPHIC SCALE

Walnut Creek BART Station

Link Light Rail, East Marginal Way, Seattle, WA

BART Viaduct, El Cerrito, CA

BART Viaduct at distance, El Cerrito, CA

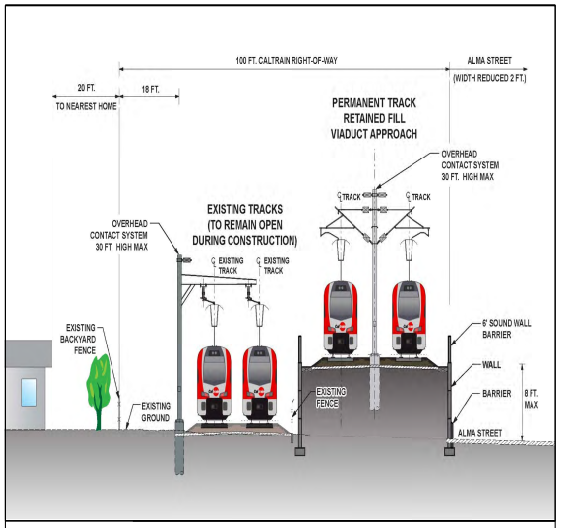
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Railroad Grade Separation Examples
Viaduct

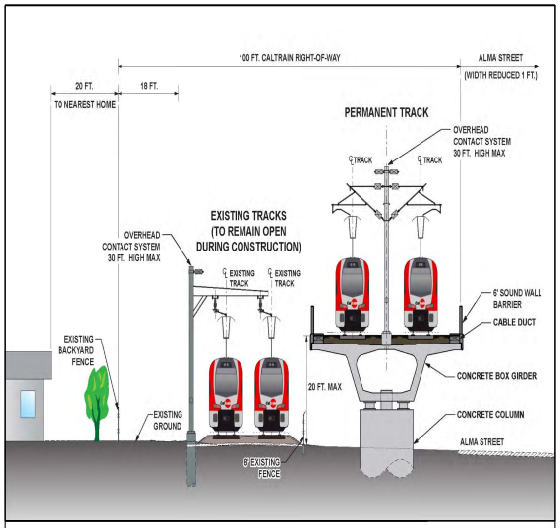
(Roadway At Grade, Railroad Fully Elevated)

CITY OF PALO ALTO

AECOM

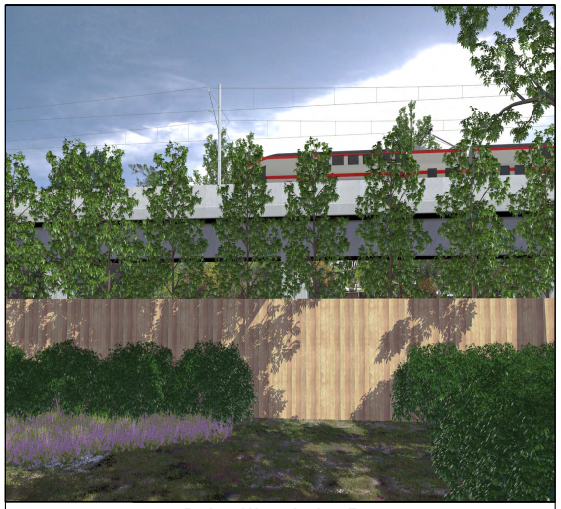


Example Section - Retained Fill - Looking North
(Typical End Sections)



Example Section - Viaduct - Looking North
(Typical Between Meadow Dr & Charleston Rd)

Track Level View - Looking North
(Typical Between Meadow Dr and Charleston Rd)



Backyard View - Looking East
Typical Property West of Tracks

Proposed Viaduct Solution Overview - Looking South West
Meadow Drive Intersection

Ground Level View - Looking South West
Charleston Road Intersection

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Railroad Grade Separation Sections & Renderings
Viaduct
(Roadway At Grade, Railroad Fully Elevated)

CITY OF PALO ALTO

AECOM

RAIL MEETING 1

11/21/23

☑ Received Before Meeting

Corridor Crossings

STRATEGY

4-Track Analysis

11.21.23

Caltrain

AGENDA

- **4-Track Analysis**
  Purpose & Initial Approach
- **Operations** Considerations
- **4-Track Analysis**
  Corridor and Palo Alto Segments
- **4-Track and Crossings**
  Preliminary Review
- **Next Steps** and Engagement

Caltrain | Corridor Crossings STRATEGY

Meeting Objectives

Review 4-Track Analysis approach considerations and trade-offs

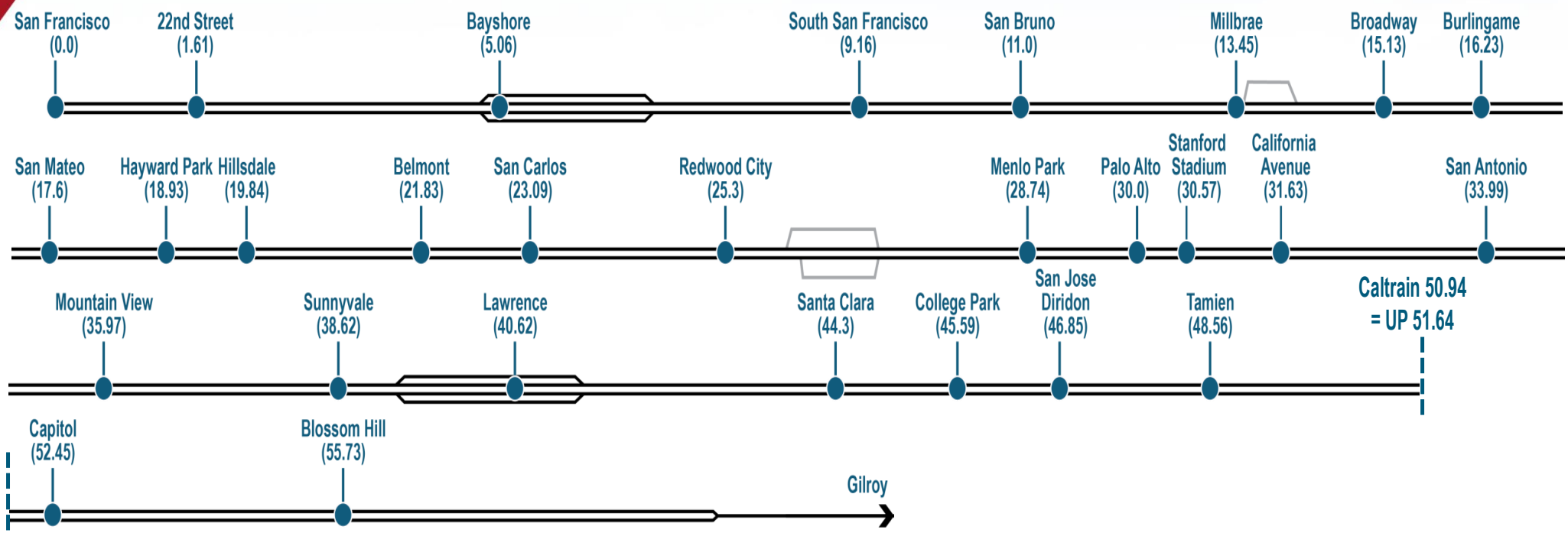
Review operations considerations and analysis

Outline N. Santa Clara Adopted Service Vision segments

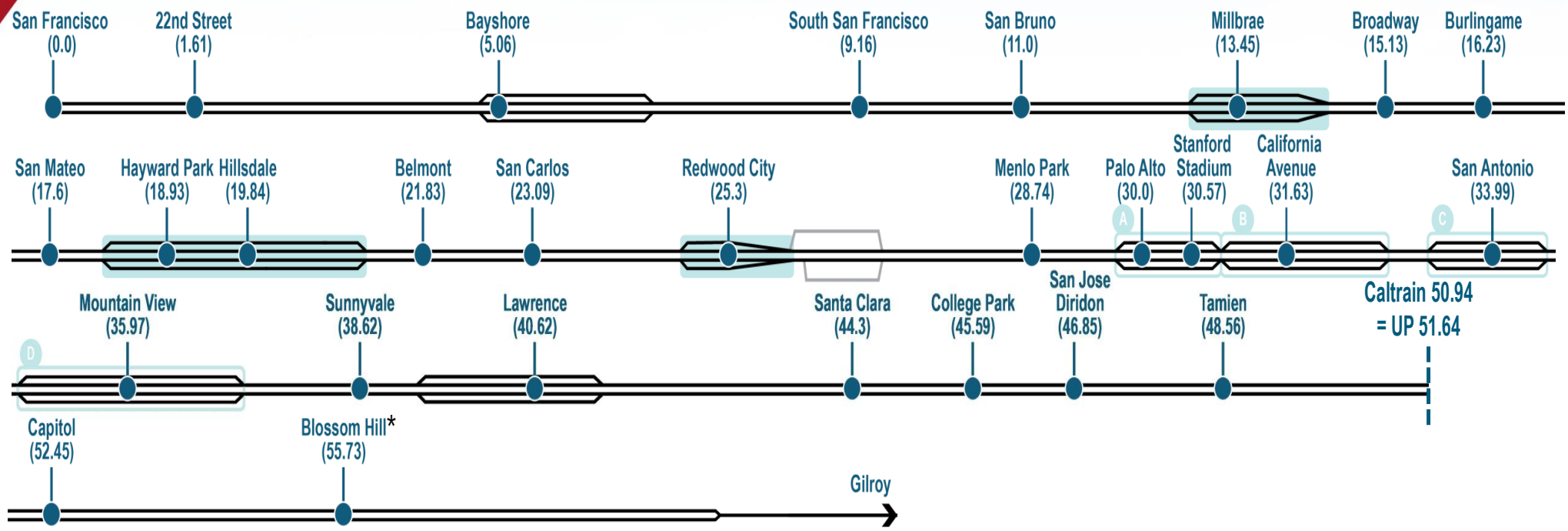
Discuss N. Santa Clara Adopted Service Vision segment observations and constraints

Caltrain | Corridor Crossings STRATEGY

Track Configuration Today



Adopted Service Vision 4-Track Segments



Notes:
* Identified in Business Plan

Caltrain | Corridor Crossings STRATEGY

4-Track Analysis

Purpose & Initial Approach

Caltrain | Corridor Crossings STRATEGY

4-Track Analysis Purpose

Purpose

- Provide location, length, and mile post limits based on 4-track segments identified in the Caltrain Business Plan
- Define required infrastructure to meet the 2040 Long Range Service Vision (Adopted Service Vision) for Caltrain and HSR service
- Utilize analysis of 4-track segments to guide grade separation projects

Business Plan (2017-2019): Growth Scenarios Recap

Moderate Growth (Adopted Service Vision)

- 8 Caltrain trains + 4 HSR trains phpd

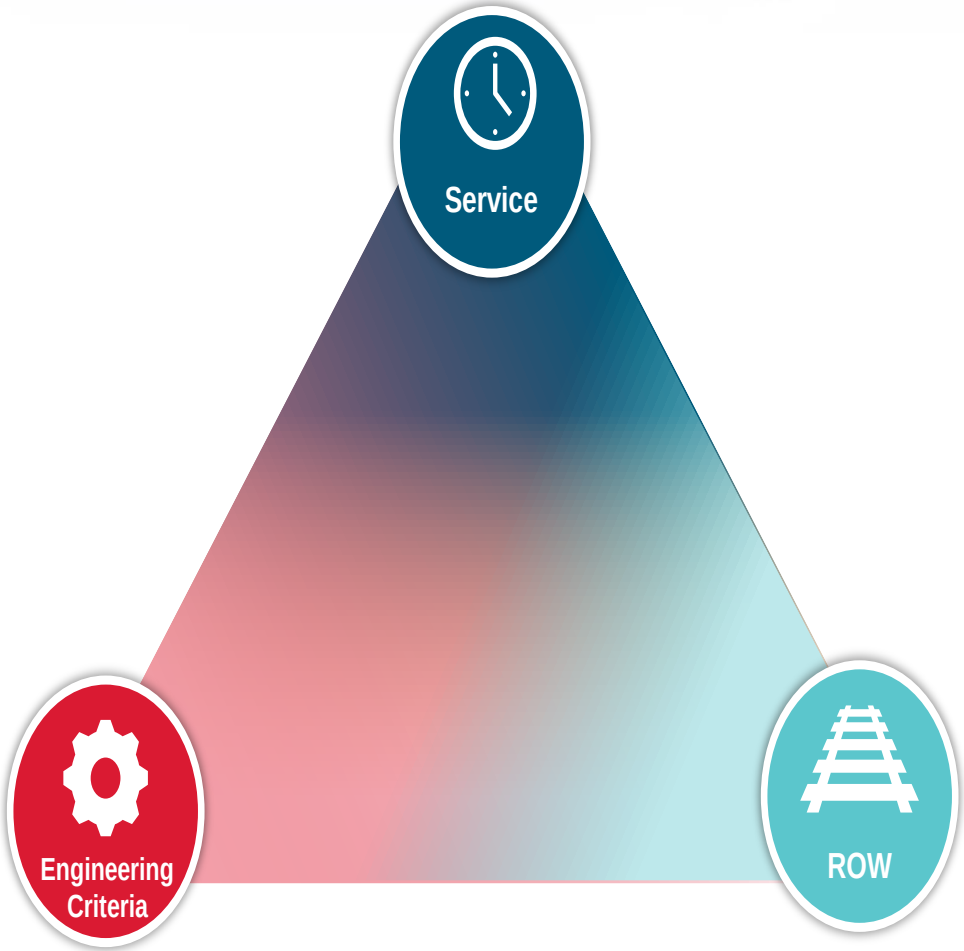
High Growth (Higher Growth Service)

- 12 Caltrain trains + 4 HSR trains phpd

*PCJPB agrees that it **shall not take action** ... that PCJPB knows or reasonably should have known at the time of the action **would effectively preclude or make materially more complicated or expensive CHSRA's future operation** in the Peninsula Rail Corridor…*
– PFMA Section 5.3.1

4-Track Initial Planning Approach

- **Tested** 4-track layouts using Caltrain, CPUC, and HSR engineering criteria
- **Evaluated** and simulated service parameters of 4-track layouts
- **Refined** and validated 4-track limits through service operations and engineering analysis



4-Track Initial Evaluation Process

North Santa Clara County Segments

- Focused on trade-offs between operations, ROW, and design
- Worked towards reducing potential impacts to the surrounding environment (i.e., at-grade crossings, adjacent land use, buildings, and infrastructure)
- Identified interdependencies between platform configuration, express/high-speed services (110mph), and turnout design and configuration
- Focused on horizontal layout, but considered vertical opportunities and constraints

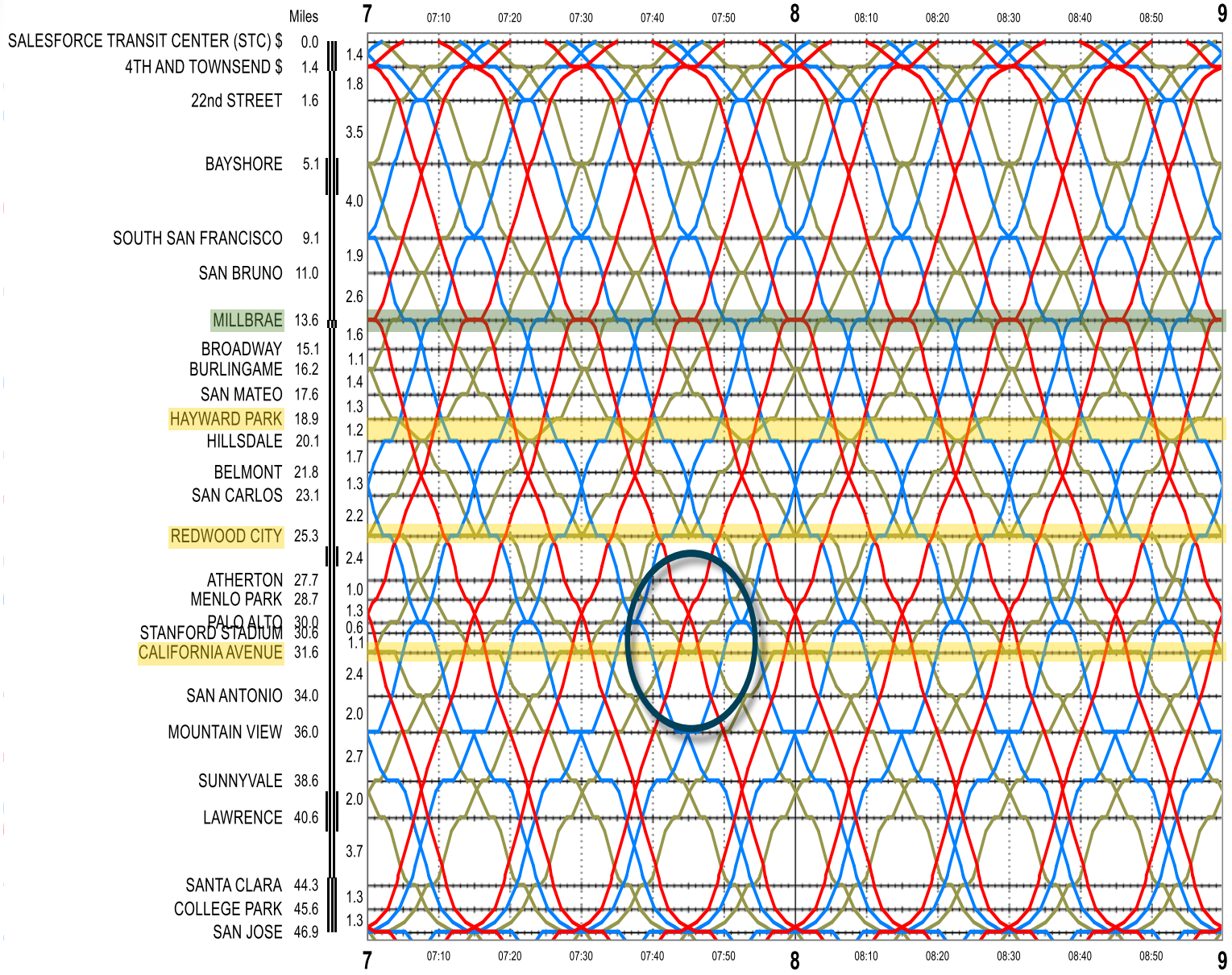
Operations Considerations

Caltrain | Corridor Crossings STRATEGY

Planning Parameter Assumptions

Planning Parameter	Assumption
Headway / Separation	2-minute minimum corridor separation time
Minimum Turnaround Time	HSR: 20 min Caltrain: 20 min
Minimum Dwell Time	HSR: 2 min Caltrain: 1 min at major stations, 0.7 min at minor stations
Rolling Stock	HSR: Generic High-Speed Trainset Caltrain: KISS EMU Freight: Dash9
Speed Limit	110 mph (Class 6 Passenger Track) 50 mph (Freight Speed)
Recovery Time	10% Distributed

Adopted Service Vision - 12 TPH (8 Caltrain + 4 HSR)

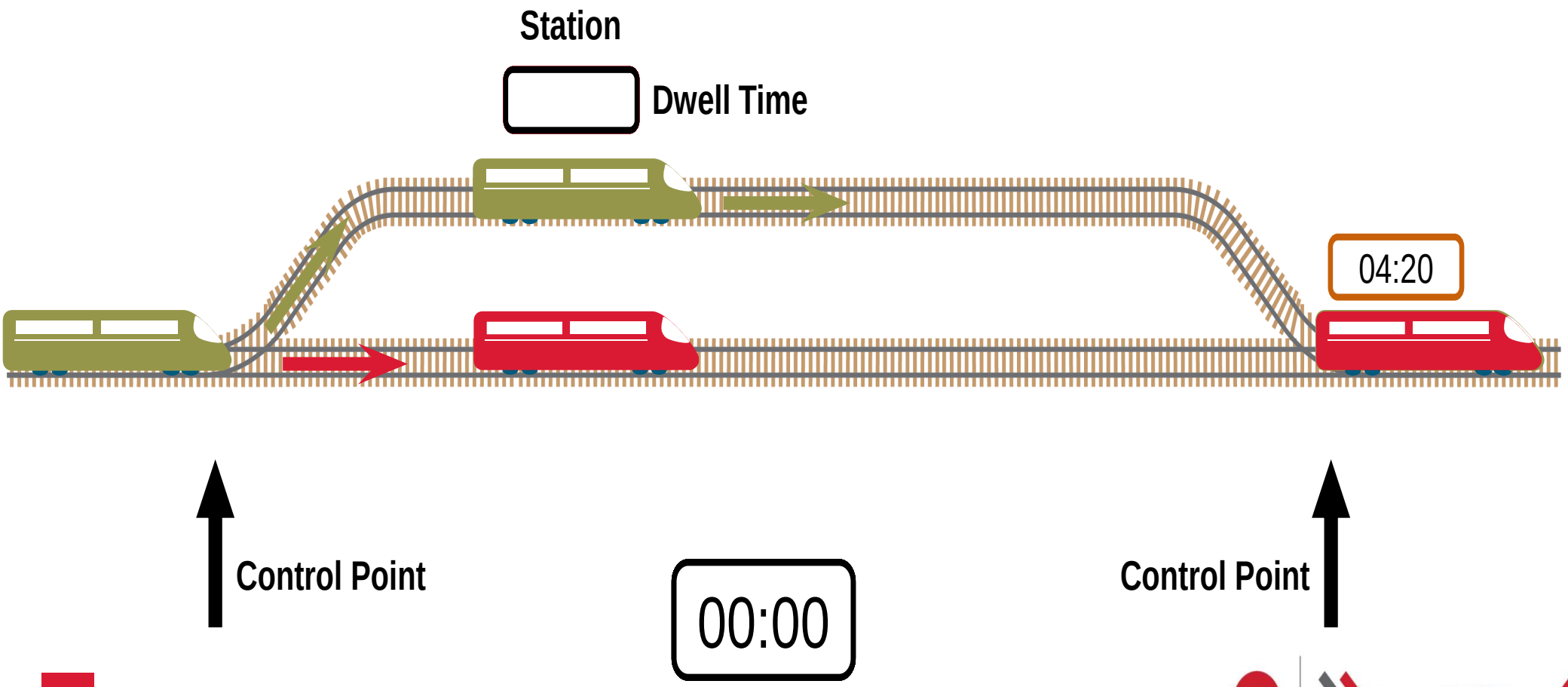


Proposed 4-track sections for HSR Platform

Proposed 4-track sections for overtakes

Two Minute Separation: In & Out of a 4-Track Segment

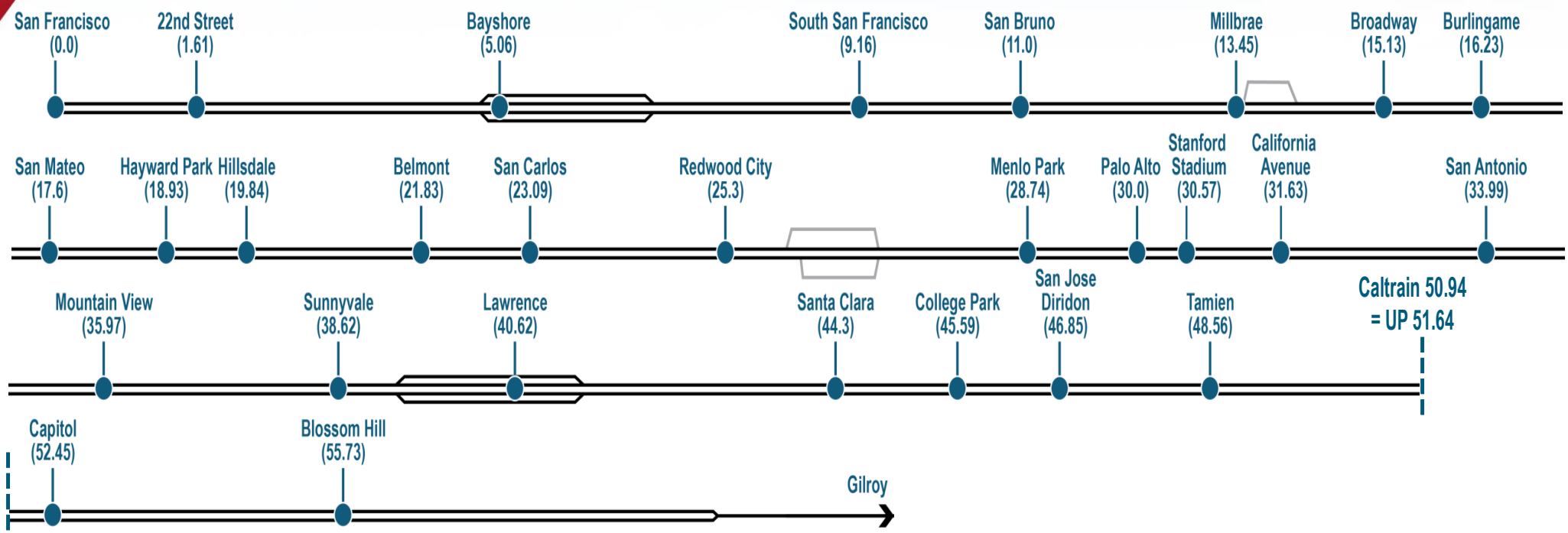
2-minute separation between trains



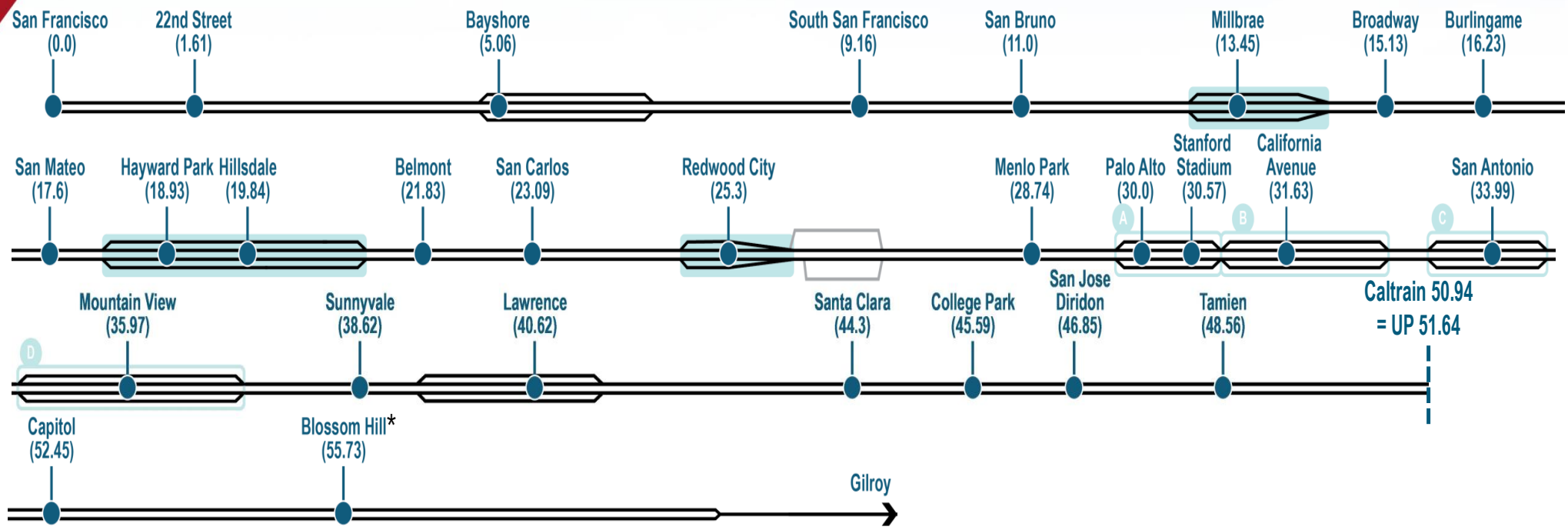
4-Track Segment Analysis

Caltrain | Corridor Crossings STRATEGY

Track Configuration Today



Adopted Service Vision 4-Track Segments



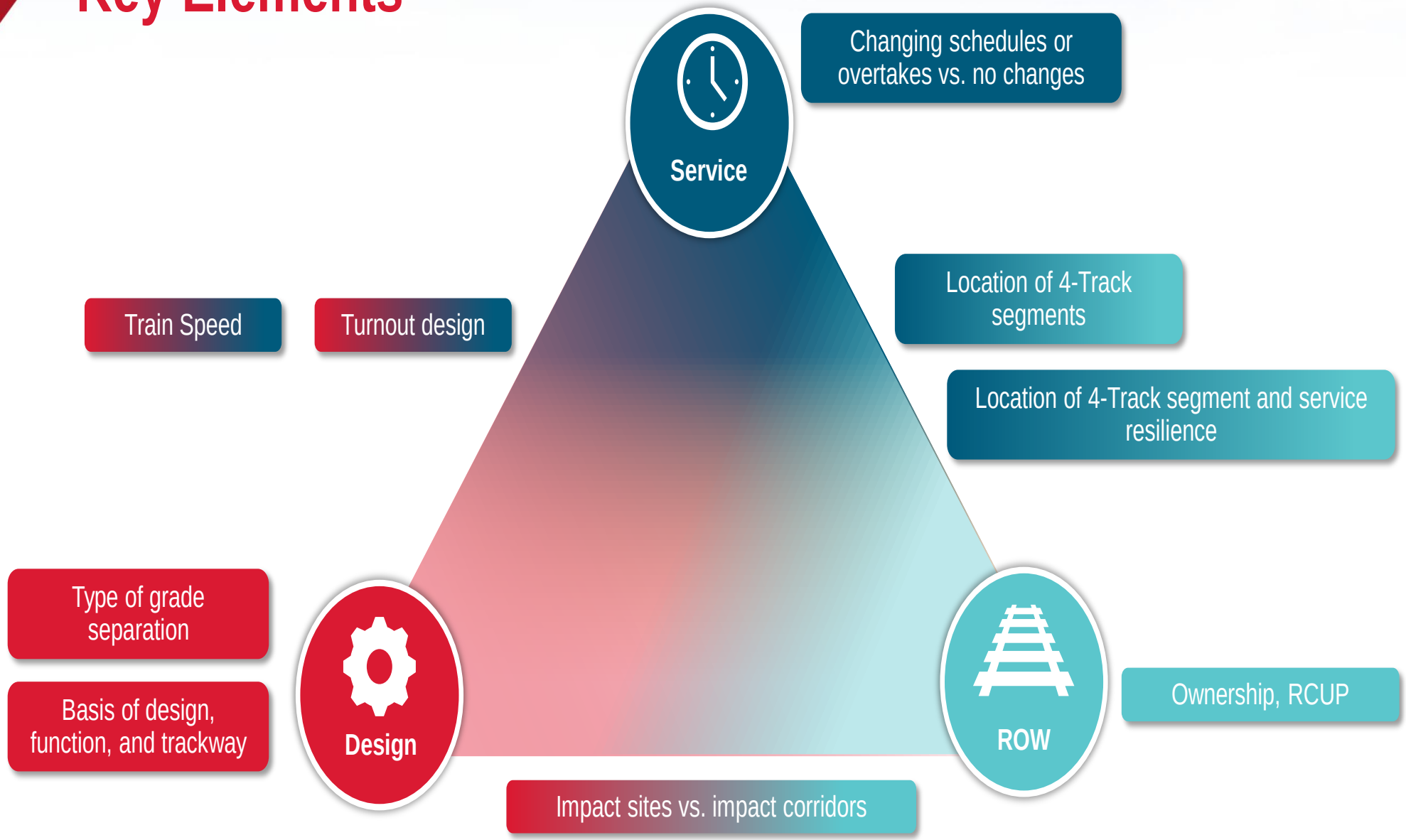
Notes:
* Identified in Business Plan

The Mountain View Transit Center was identified as a potential 4-track segment for the adopted Service Vision. The segment was removed prior to the 4-track analysis process due to:

- 4-track capacity further north better supports blended service patterns
- Not operationally preferred in the adopted Service Vision for a 4-track capacity because it would not support service patterns developed under the Service Plan

Caltrain | Corridor Crossings STRATEGY

Initial Trade-Offs & Key Elements

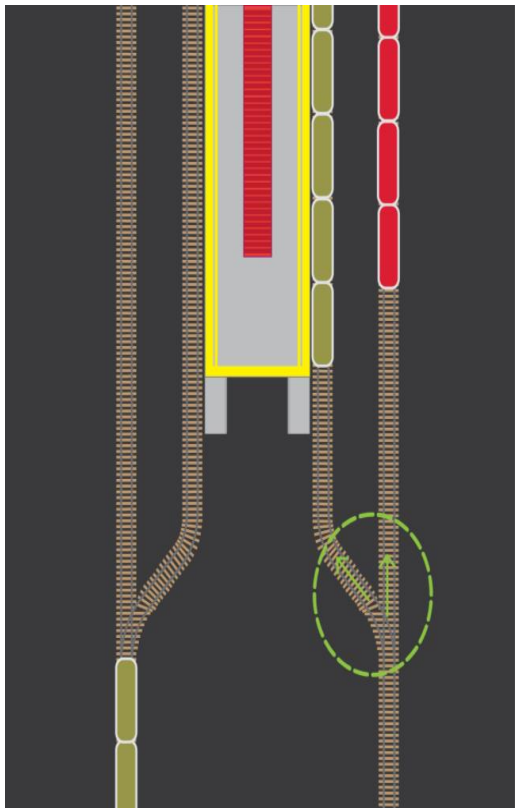


Influence of Turnout Design on Service

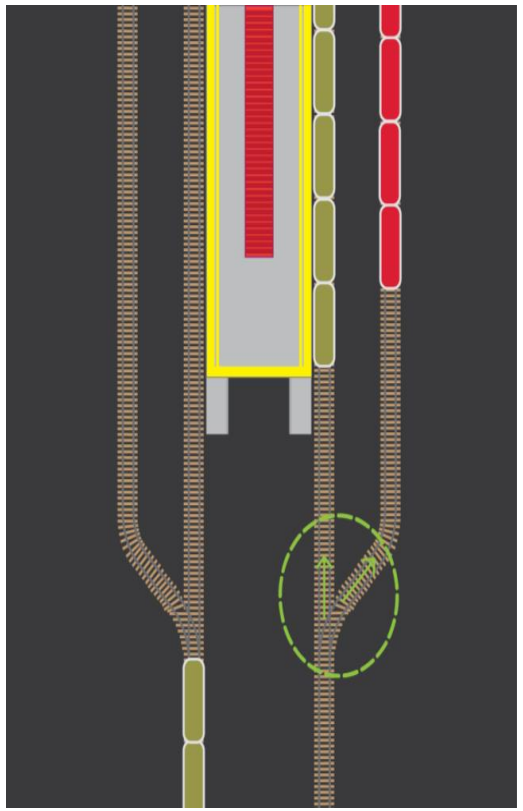
Maximum Allowable Speed	Transition Length to Center Platform with Left Hand Turnout (Approximate)	Transition Length to Center Platform with Right Hand Turnout (Approximate)
79 mph	1200 ft.	1800 ft.
110 mph	1500 ft.	2200 ft.

Turnout No.	Passenger Train Speed Through Turnout
20	50 mph
24	60 mph

Left Hand Turnout



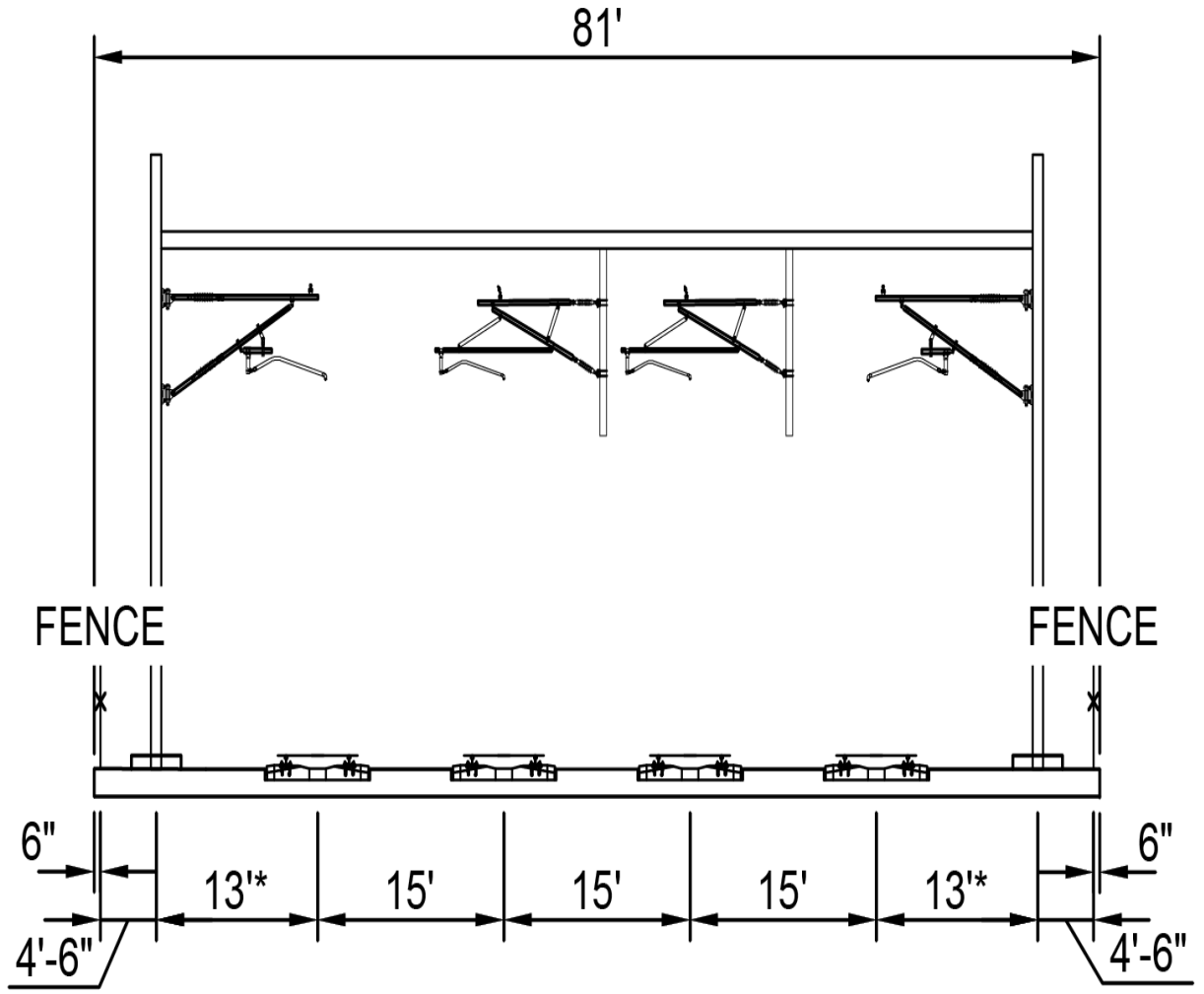
Right Hand Turnout



Caltrain | Corridor Crossings STRATEGY

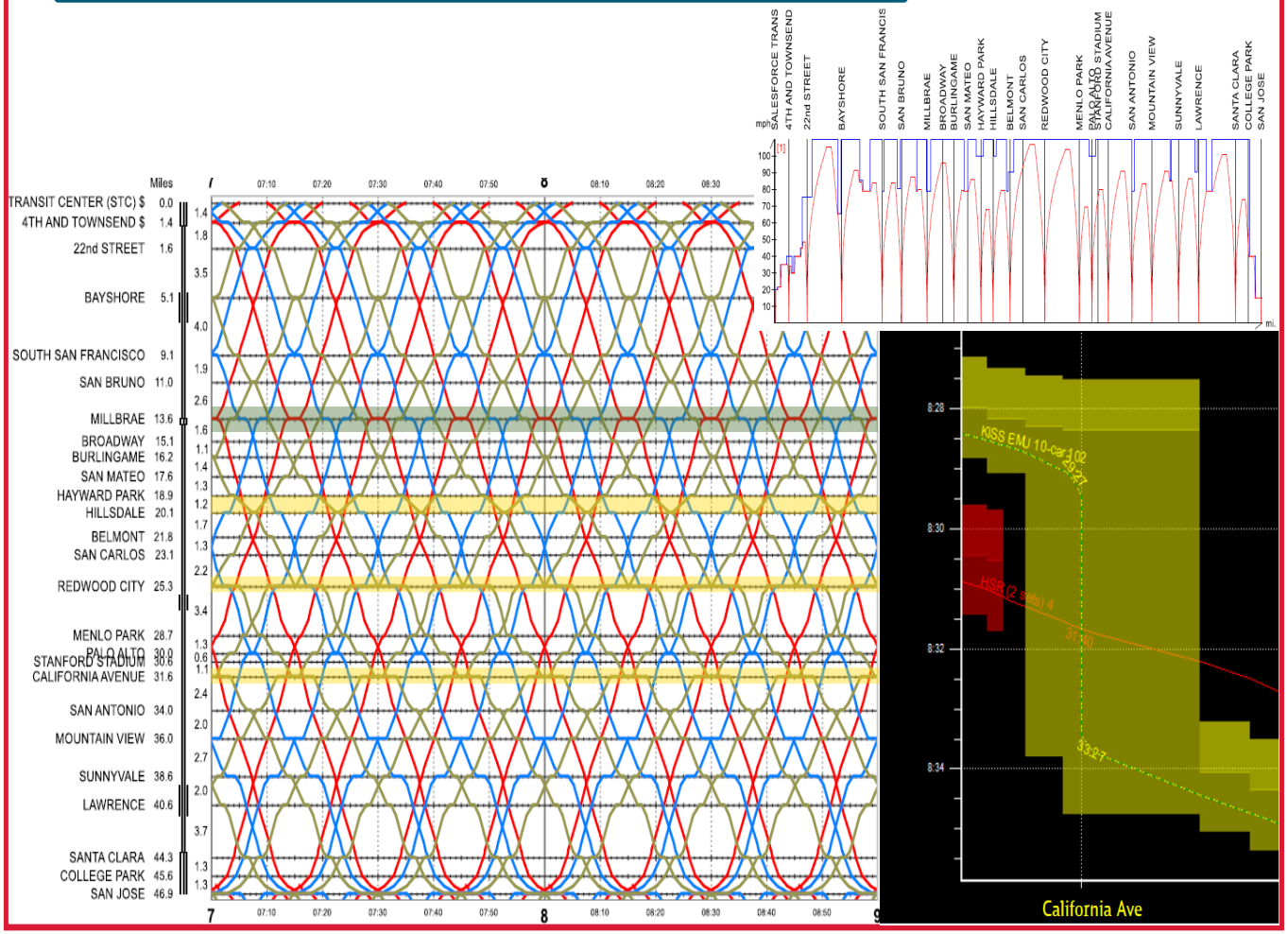
Typical Section for Running Track

- Parameter assumptions presented in Basis of Design
- Tangent 4-track running track section
- Reusing existing OCS equipment where possible

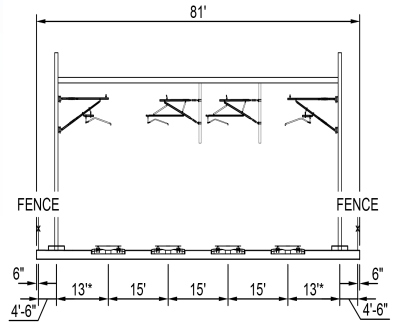


Technical Analysis

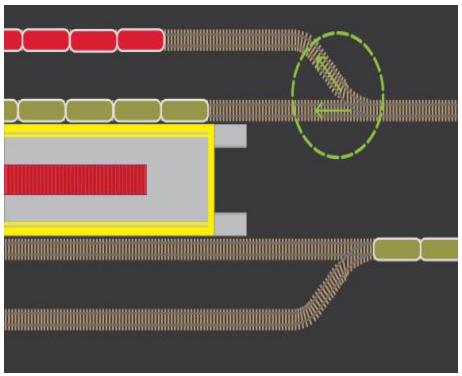
Operations



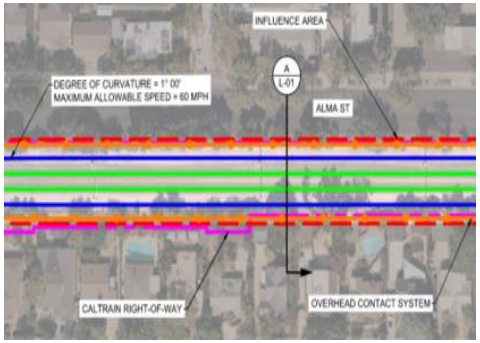
Cross-sections



Turnouts

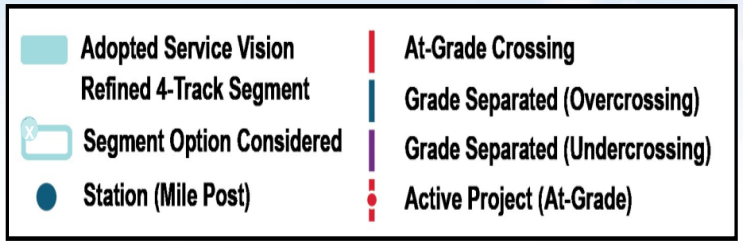


Alignment Concept

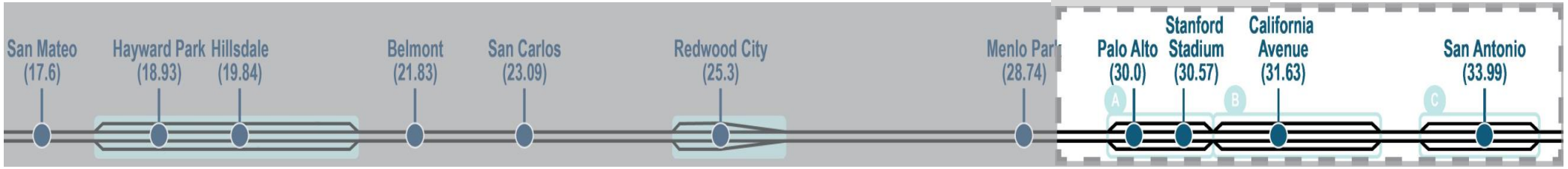


Palo Alto Station Segment

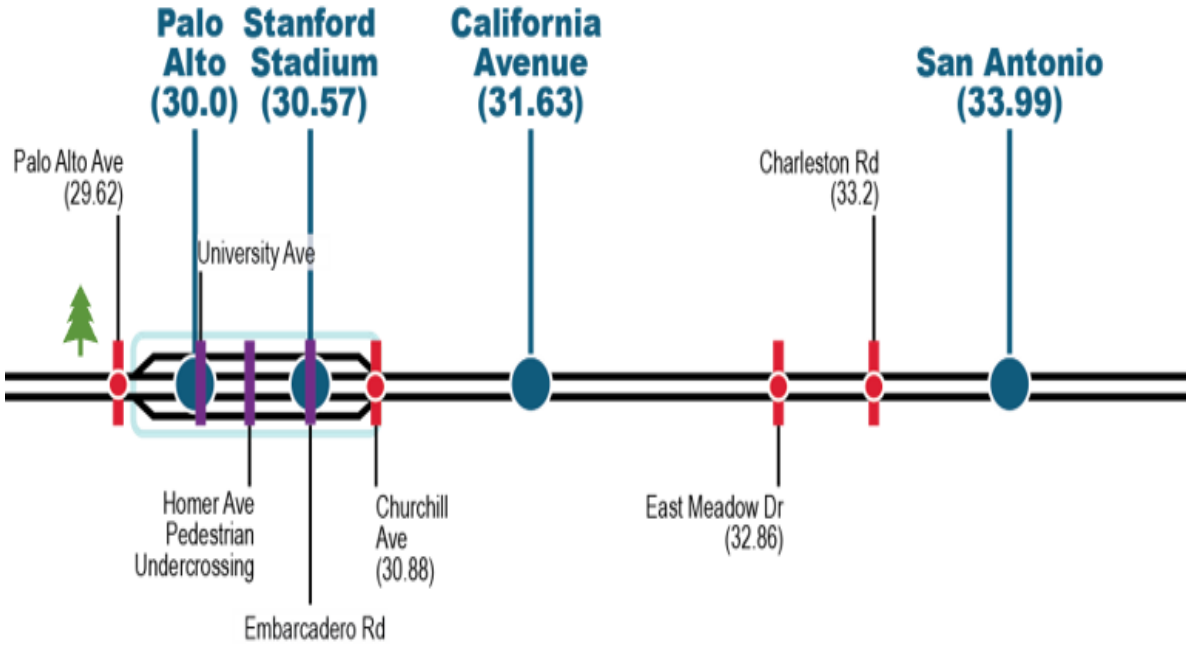
High Community & Infrastructure Impacts



Segment Location



Segment Characteristics	
MP Limits	MP 29.7 - 30.9
Length (miles)*	1.2
Stations Impacted	Palo Alto & Stanford Stadium
At-Grade Crossings Impacted	2
Grade Separations Impacted	3
Active Projects	Connecting Palo Alto



*Length includes 2- to 4-track transitions

Caltrain | Corridor Crossings STRATEGY

Palo Alto Station Segment

Area of Influence

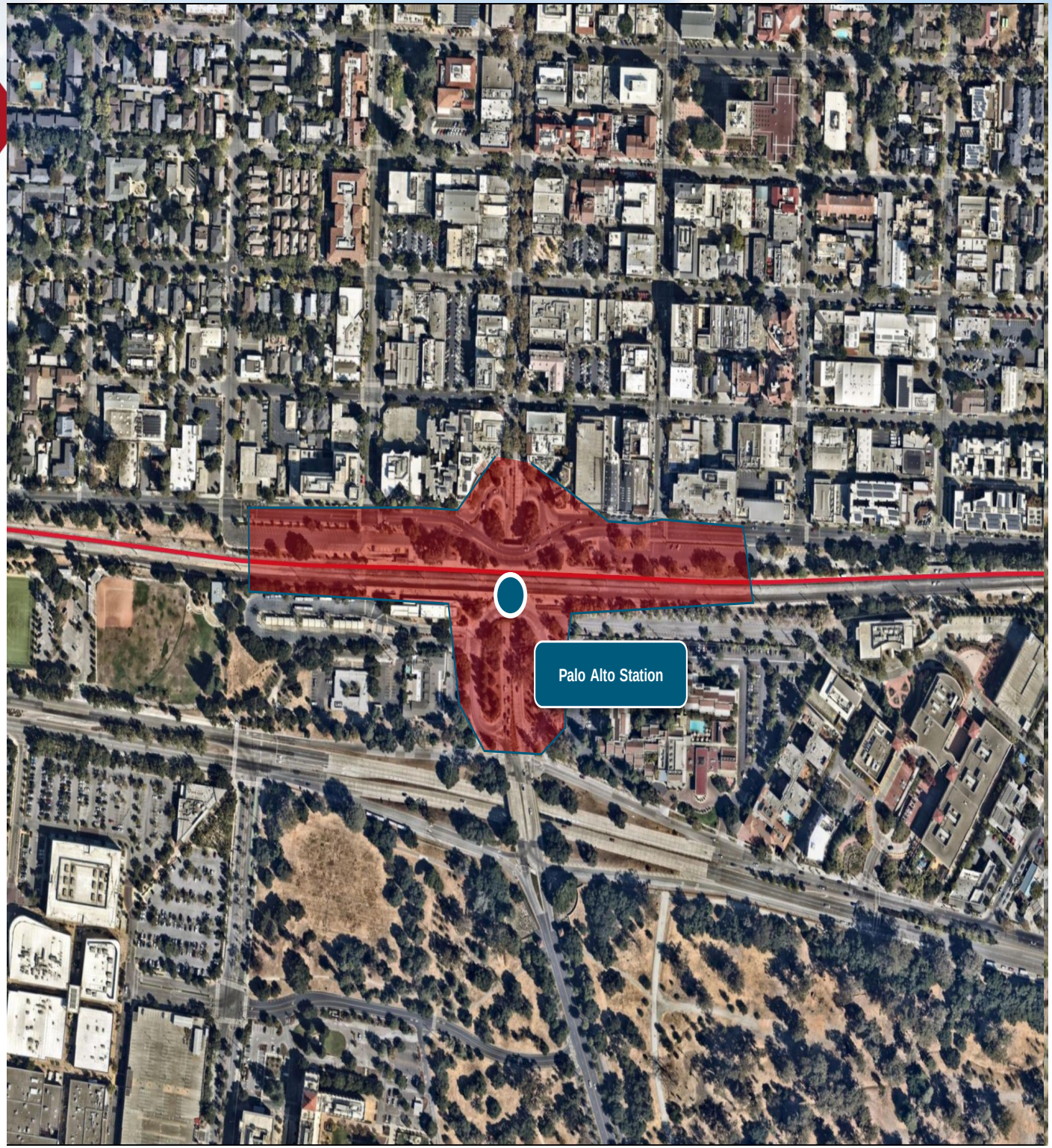
Caltrain Corridor

Palo Alto Station Segment

Legend Caltrain ROW Area of Influence

Illustrative – Tracks can shift, and/or elevated, as concept is further developed.

Palo Alto Station Infrastructure Impacts



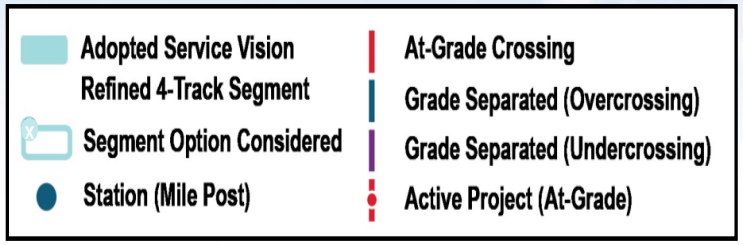
Infrastructure Modifications

Caltrain Corridor

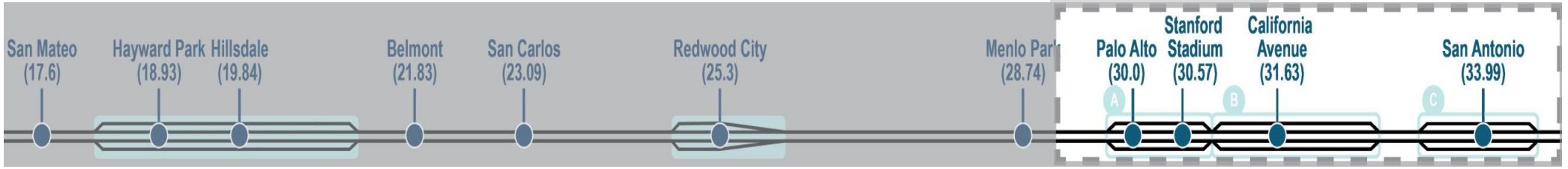
Caltrain | Corridor Crossings STRATEGY

California Ave Station Segment

Limited Community & Infrastructure Impacts

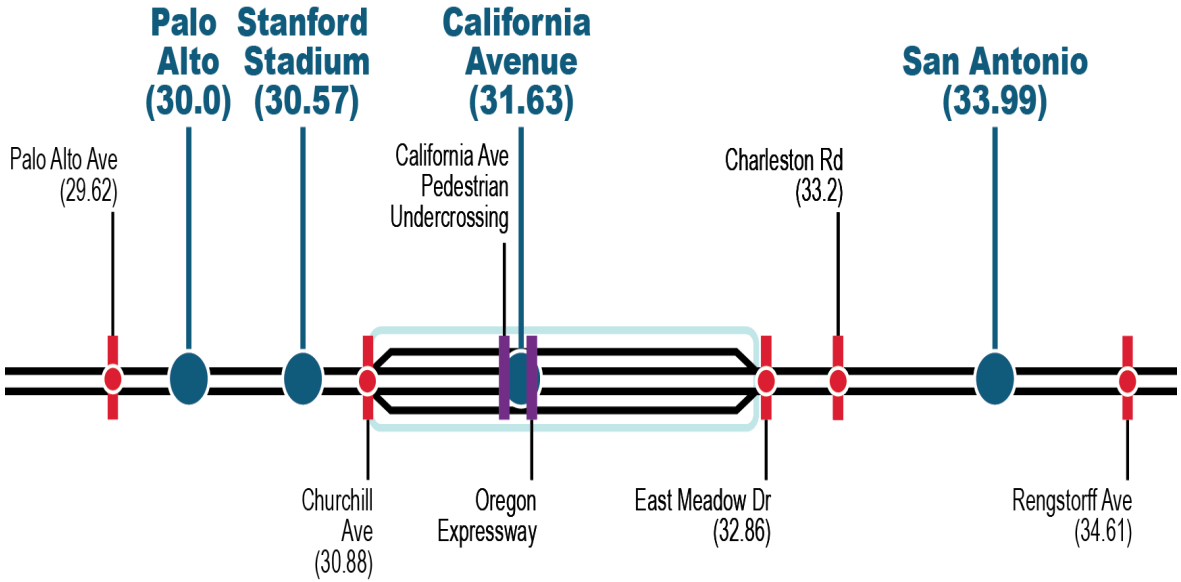


Segment Location



Segment Characteristics	
MP Limits	MP 30.9 - 32.8
Length (miles)*	1.9
Stations Impacted	California Avenue
At-Grade Crossings Impacted	2
Grade Separations Impacted	2
Active Projects	Connecting Palo Alto

*Length includes 2- to 4-track transitions

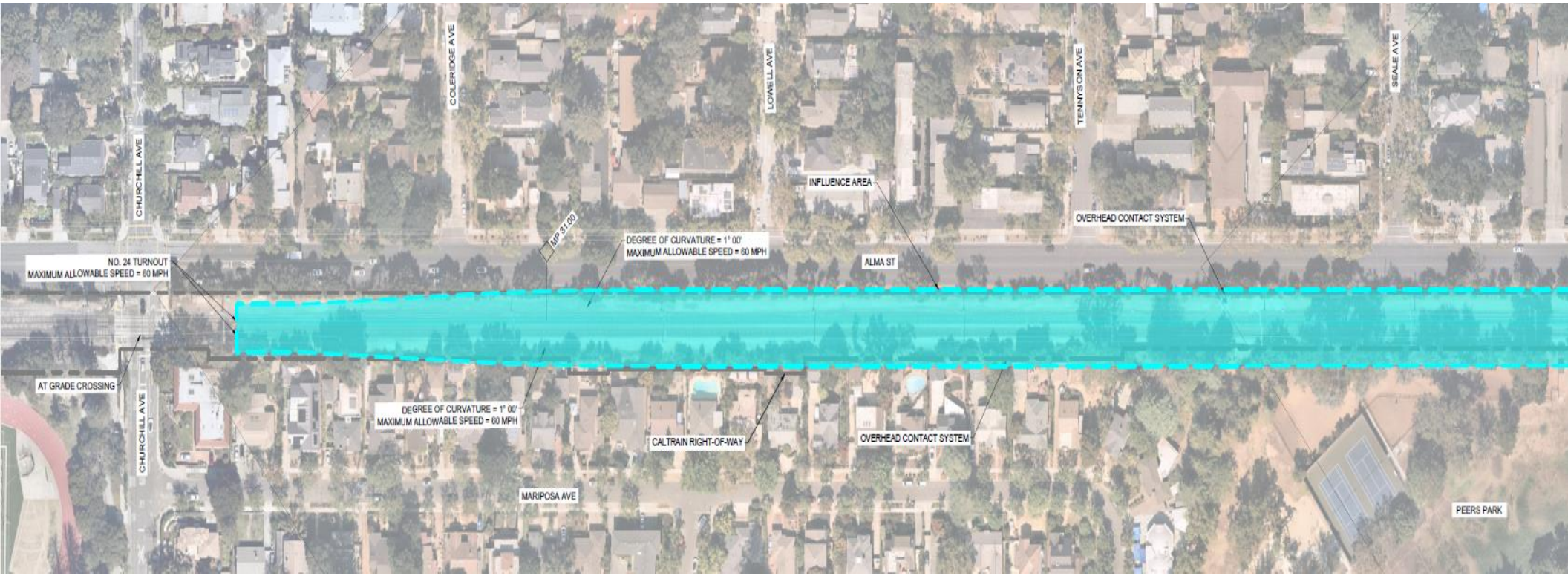


Caltrain | Corridor Crossings STRATEGY

California Avenue Station Segment

Area of Influence Caltrain Corridor

California Ave Station Segment



Legend Caltrain ROW Area of Influence

Illustrative – Tracks can shift towards Alma Street, and/or elevated, as concept is further developed.

Caltrain | Corridor Crossings STRATEGY

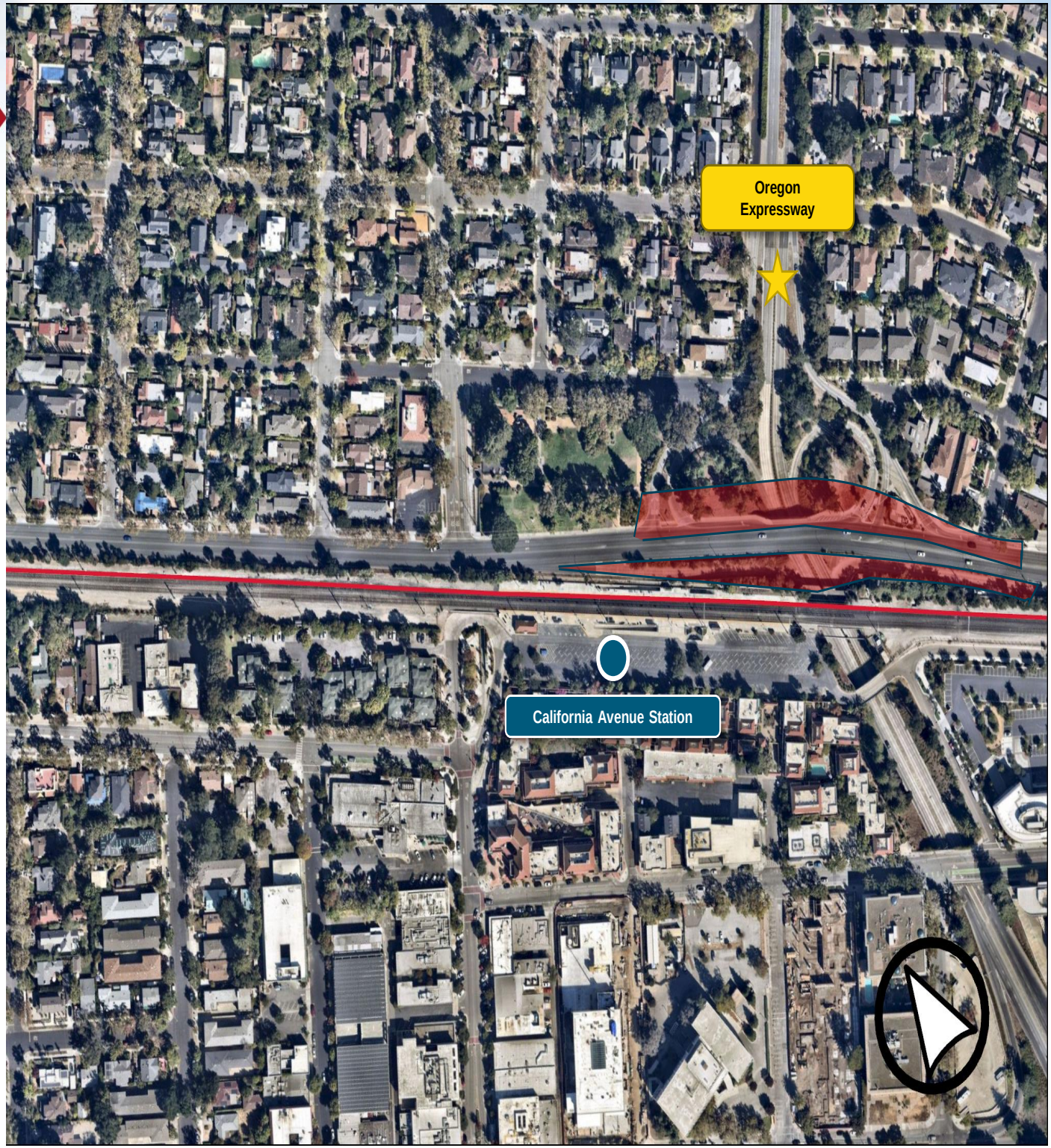
California Ave Station Segment

Legend Caltrain ROW Area of Influence

Illustrative – Tracks can shift, and/or elevated, as concept is further developed.

Caltrain | Corridor Crossings STRATEGY

California Avenue Station Infrastructure Impacts



Infrastructure Modifications

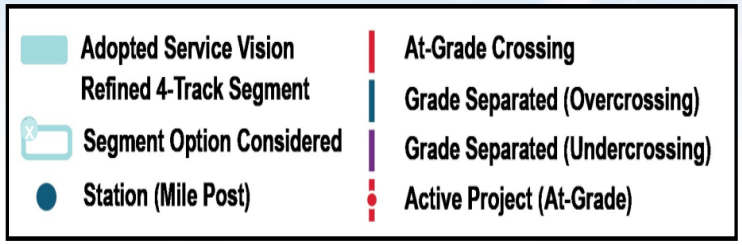
Caltrain Corridor

Caltrain

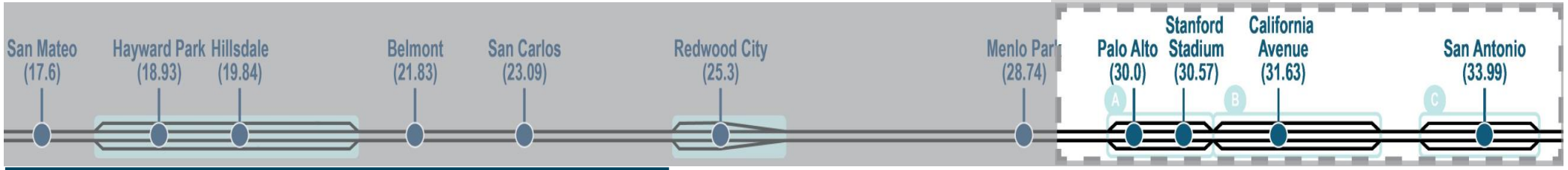
Corridor Crossings STRATEGY

San Antonio Station Segment

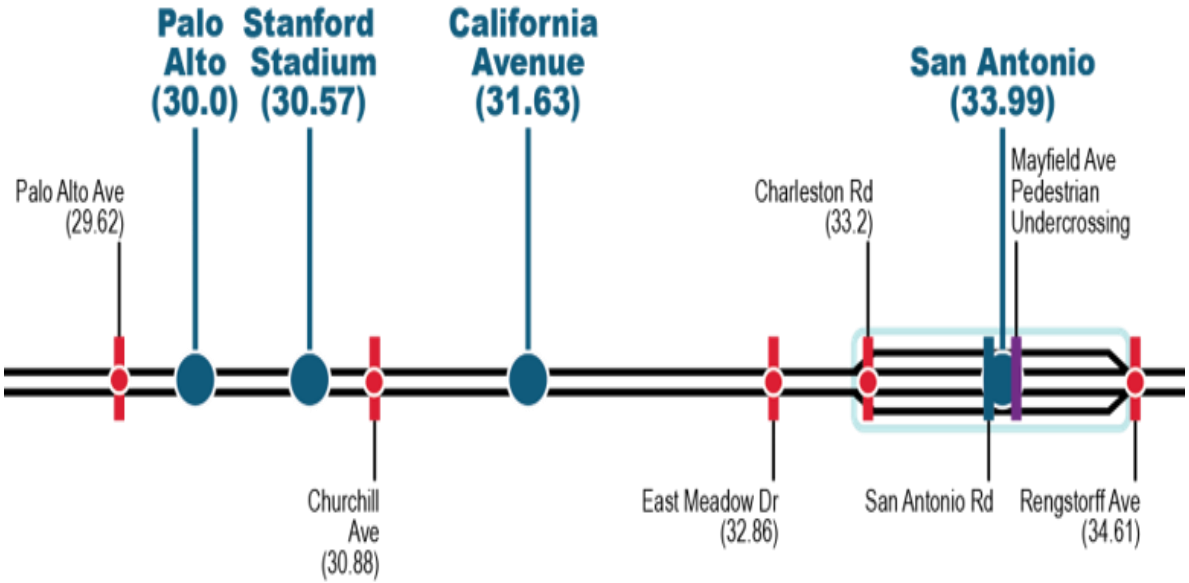
High Community & Infrastructure Impacts – Major Reconstruction



Segment Location



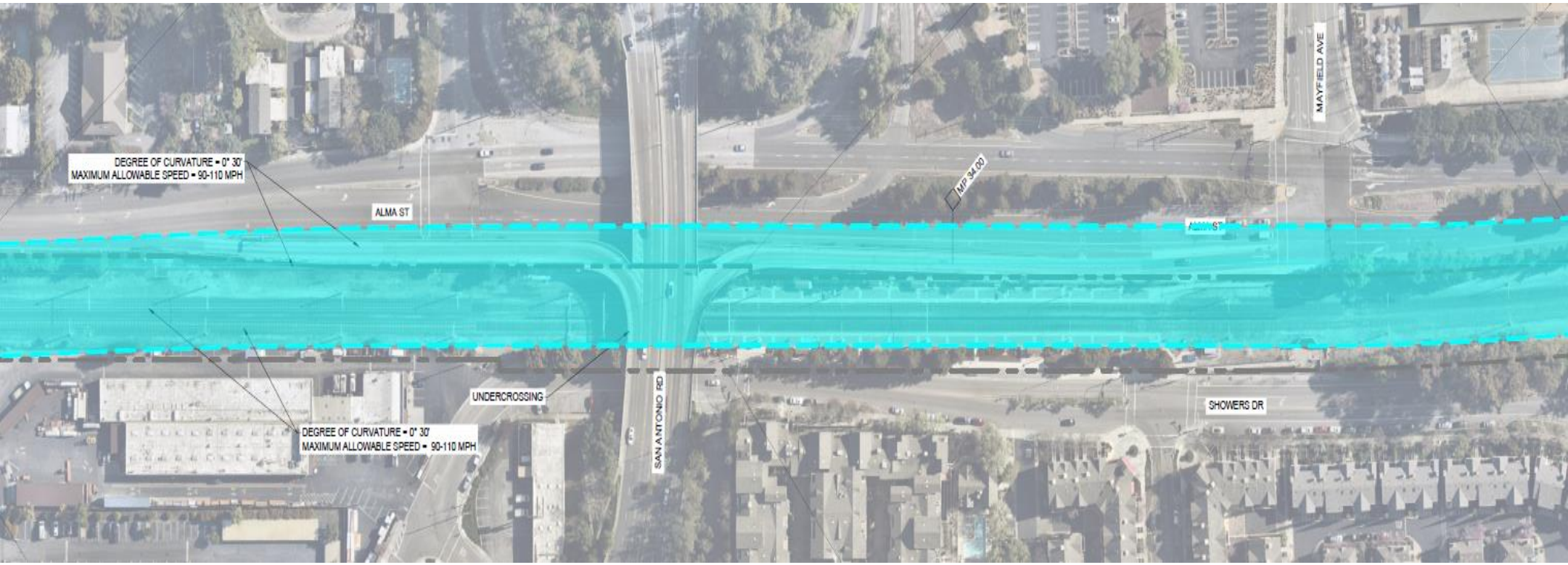
Segment Characteristics	
MP Limits	MP 33.25 - 34.60
Length (miles)*	1.35
Stations Impacted	San Antonio
At-Grade Crossings Impacted	3
Grade Separations Impacted	2
Active Projects	Connecting Palo Alto & Rengstorff Grade Separation



*Length includes 2- to 4-track transitions

Caltrain | Corridor Crossings STRATEGY

San Antonio Station Segment

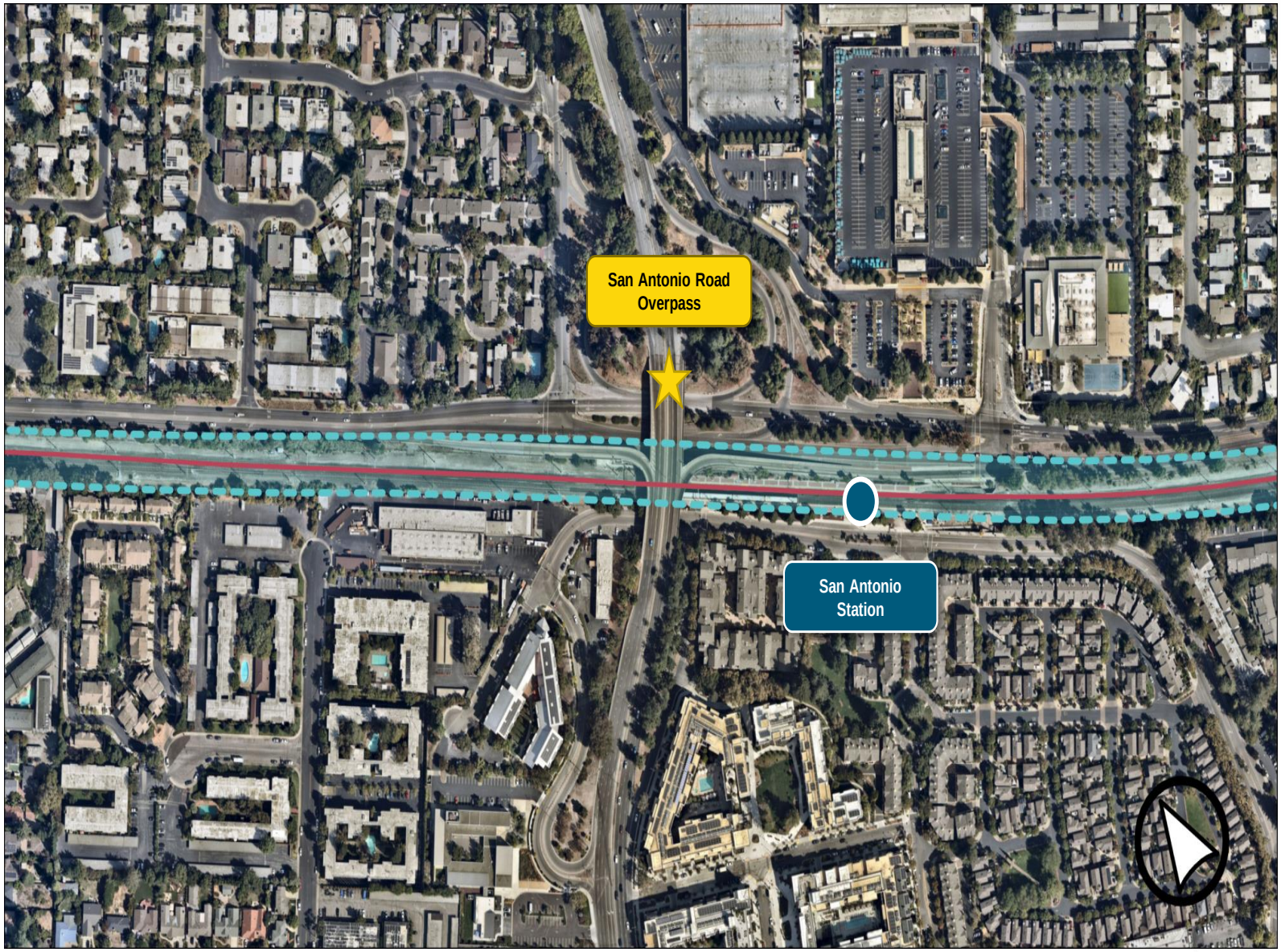


Legend Caltrain ROW Area of Influence

Illustrative – Tracks can shift, and/or elevated, as concept is further developed.

Caltrain | Corridor Crossings STRATEGY

San Antonio Station Segment



Area of Influence Caltrain Corridor

San Antonio Road Overpass

Caltrain | Corridor Crossings STRATEGY

San Antonio Road Overpass

Caltrain | Corridor Crossings STRATEGY

San Antonio Road Overpass

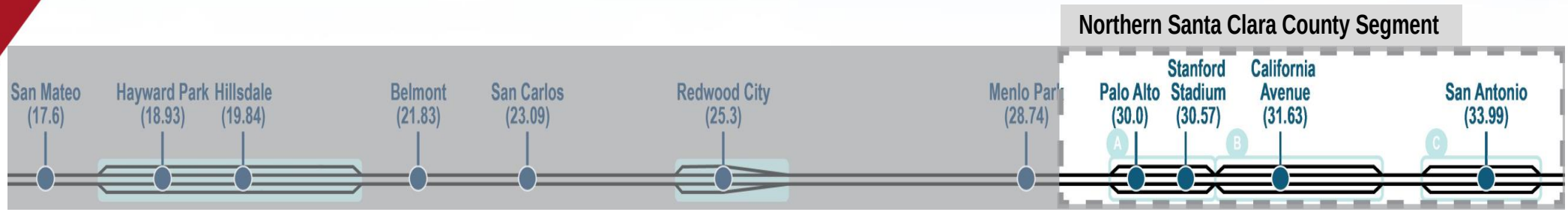
San Antonio Station Infrastructure Impacts

Infrastructure Modifications

Caltrain Corridor

Caltrain | Corridor Crossings STRATEGY

Northern Santa Clara County



	Palo Alto (A)	California (B)	San Antonio (C)
Constraints	• Palo Alto Southern Pacific Station (SHPO - Cultural Resource) • University Ave/Alma Street Interchange and Underpass • San Francisquito Creek Bridge and El Palo Alto Tree • El Camino Park • Homer Avenue pedestrian undercrossing • Sutter Health Center • Palo Alto High School	• Residential areas surrounding Caltrain ROW • Alexander Peers Park • Oregon Expressway – "T" intersections for ramp exits/entrances	• San Antonio Road Interchange and Overpass • Residential areas surrounding Caltrain ROW • Existing curve south of San Antonio Station (Speed Constrain below 110 mph)

Caltrain | Corridor Crossings STRATEGY

Northern Santa Clara County Preliminary Understanding

4-Track Segments in Northern Santa Clara County were analyzed to evaluate trade-offs and determine the most viable option to meet the needs of the Adopted Service Vision goals and Caltrain's obligations for blended service in the corridor.

Caltrain will continue to coordinate with the city to **not preclude future 4-track**, as the city develops their Connecting Palo Alto alternatives

Operations Simulation of Segments

- Validated 4-Track segment lengths
- Assumes upgraded signaling system for 2-minute buffer between trains (current signal system allows for 4-minute buffer)
- Supports and provides operational flexibility for the service in the Adopted Service Vision
- Local train dwells 4 minutes (3 minutes more than standard 1-minute station dwell)

Comments/Questions

Caltrain | Corridor Crossings STRATEGY

CITY OF PALO ALTO

Connecting Palo Alto Projects

Caltrain Technical Review

January 23, 2024

Purpose

Purpose

- Rail Committee's review of comments to provide guidance to staff on specific elements.
- Direct staff to proceed coordination with Caltrain Staff or their Consultants and/or City's project consultant for material changes to alternatives

Background

Goal

- Select Preferred Alternative to Proceed with Preliminary Engineering and Environmental Phase

Objective

- Federal Railroad Administration (FRA) Grant Funding Agreement in place by July 1, 2024.

Guidance

- Rail Committee to provide guidance to on implementing design changes sufficient to support the goal.

Background

CAP & XCAP

- *Alternatives developed, reviewed and updated (2018 - July 2020)*
- *Community Outreach & Community Feedback (August – October 2020)*
- *Deliberation and Recommendation to City Council (November 2020 - March 2021)*

City Council

- *Council Review and Discussion*
- *Meadow Drive – Charleston (Narrowed Alternatives) - August 2021*
- *Churchill Avenue (Preferred Alternative & Backup Selection) - November 2021*

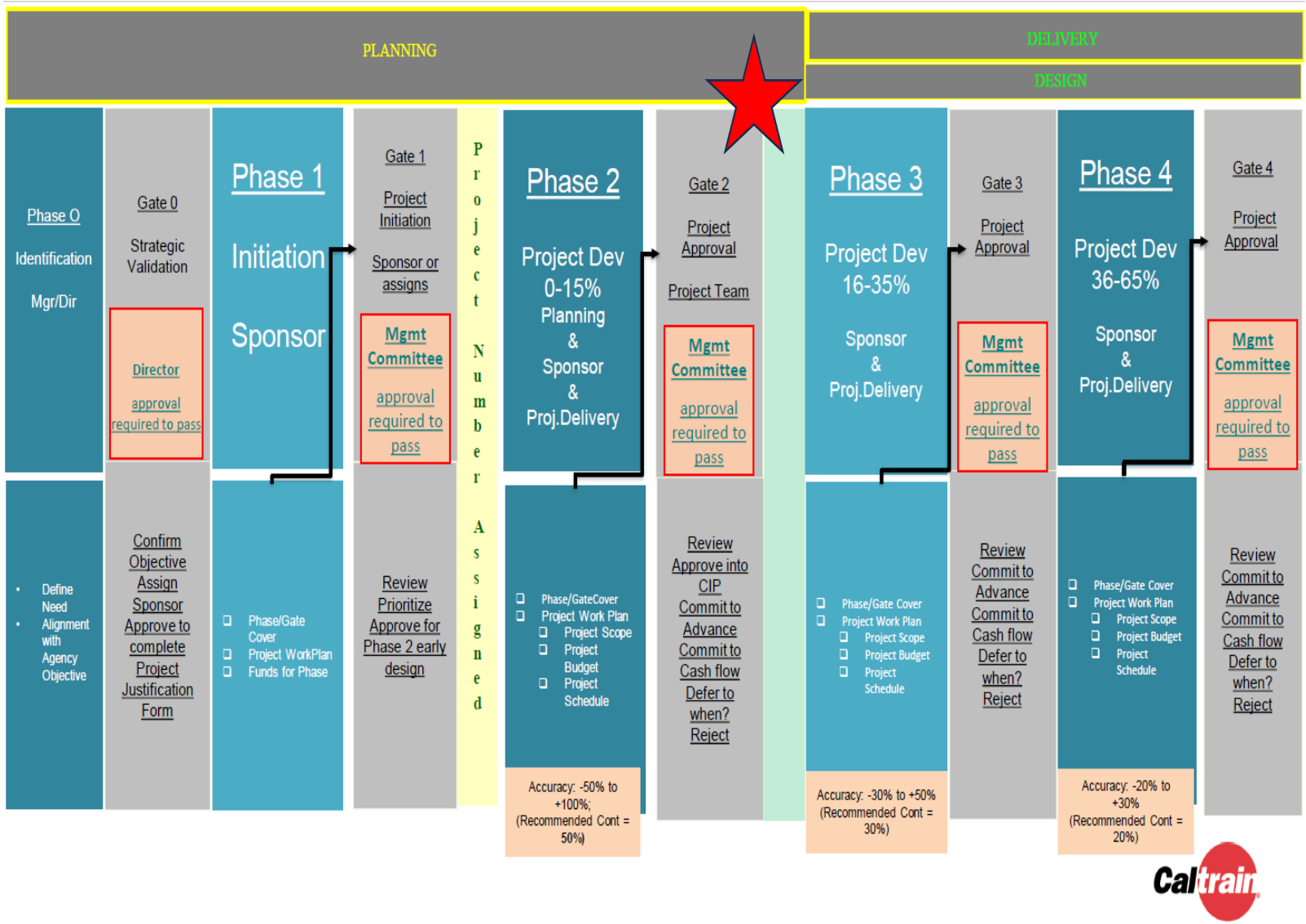
Rail Committee

- *Reviewed and Refined underpass alternatives (June 2023)*
- *Reviewed and updated Council Adopted criteria*
- *Conducted Review of Preliminary Geotechnical*

Caltrain /JPB Review

- *Service Agreement with Caltrain (June 2023)*
- *Technical Review and Comments to City November 2023*

Overview of Caltrain Capital Project Management Process



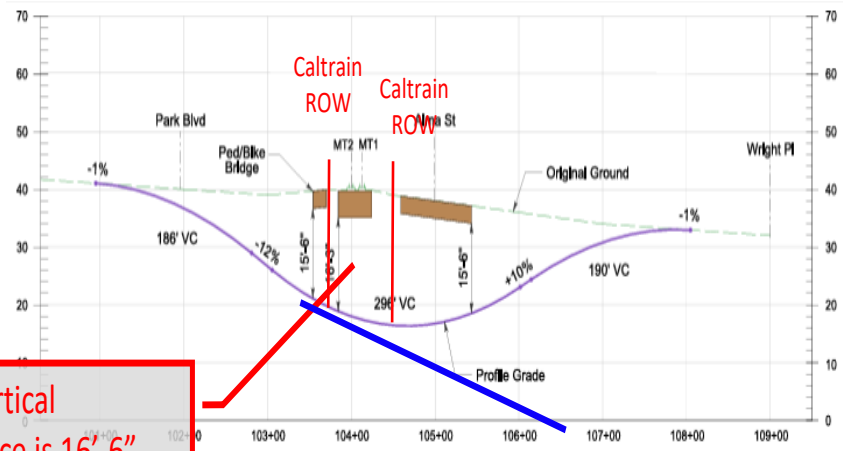
Major Elements

- **Vertical Alignment**
  - Vertical Clearance
  - Bridge Structure Elevation (Viaduct Only)
  - Railroad Grade Profile
  - Pedestrian and Bicycle Path Clearance
- **Horizontal Alignment**
  - Roadway Encroachment into Caltrain ROW
  - Pedestrian & Bicycle Facilities Encroachment into Caltrain ROW
  - Railroad Encroachment into City's ROW
  - Retaining Wall offset/clearance from structures and roadways
  - Maintenance Access requirement along the railroad tracks
  - Clearance for MSE Wall construction during construction and maximize use of ROW
- **Four Track Segment**
  - Four Track segments and Roadway encroachment into Caltrain ROW
  - Four Tracking Alignment
- **Roadway Design**
  - Road Profile, Sag Curves, Grades etc.
  - Offset from Barriers
  - Acceleration/Deceleration Lanes, Lane drops, weaving distance, etc.
  - Roundabout Design
  - Curved bridges
- **Construction Technology**
  - Shoofly vs Box Jacking
- **Culverts**
  - Reconstructing and extending culverts
- **Cost Estimates**
  - Preliminary Cost Estimates
- **Cumulative Concerns**
  - Compounded impacts from above comments

Vertical Alignment (Correction)

1. Vertical Dimensions (Roadway Vertical Clearance required across Caltrain ROW)

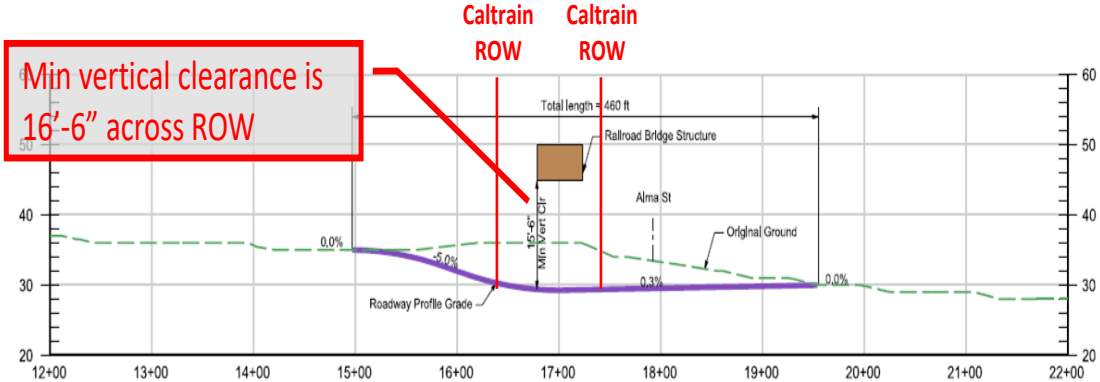
- Vertical Clearance for vehicular traffic under the Railroad (Increase from 15.5’ to 16.5’)



Min vertical clearance is 16’-6” across ROW

Charleston Rd Profile

Meadow Drive Underpass



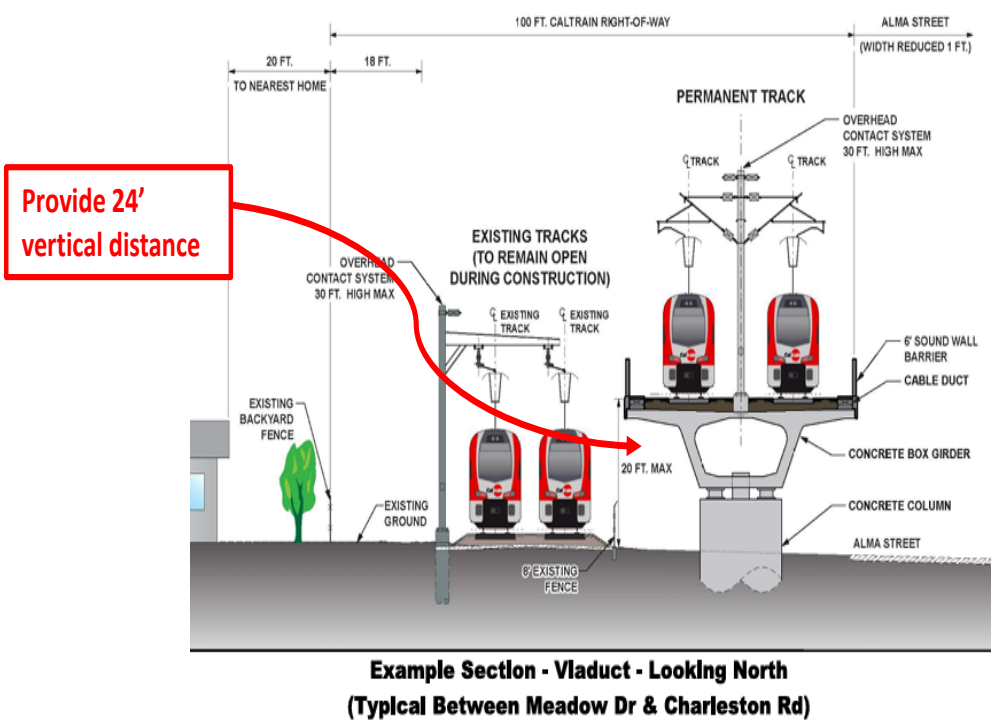
Profile View

Meadow Charleston - Hybrid

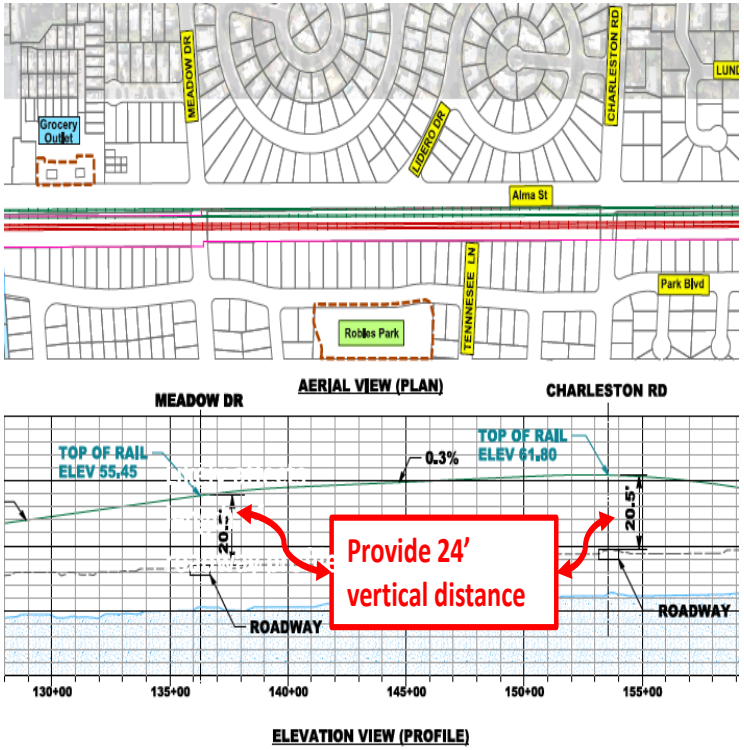
Vertical Alignment (Correction)

2. Vertical Dimensions (Top of Rail to Top of Roadway – Viaduct Alternative only)

- *Vertical Clearance for vehicular traffic under the Railroad (Increase from 20.5' to 24.0')*



Example Section - Viaduct - Looking North
(Typical Between Meadow Dr & Charleston Rd)



Meadow Charleston - Viaduct Alternative

Summary of Comments - Churchill Avenue

Churchill Closure with Mitigations - Option 1

- New active transportation facilities should be placed outside of Caltrain ROW. If not, they are subject to JPB Board approval

* No Changes for Churchill Avenue Closure with Mitigations Option 2

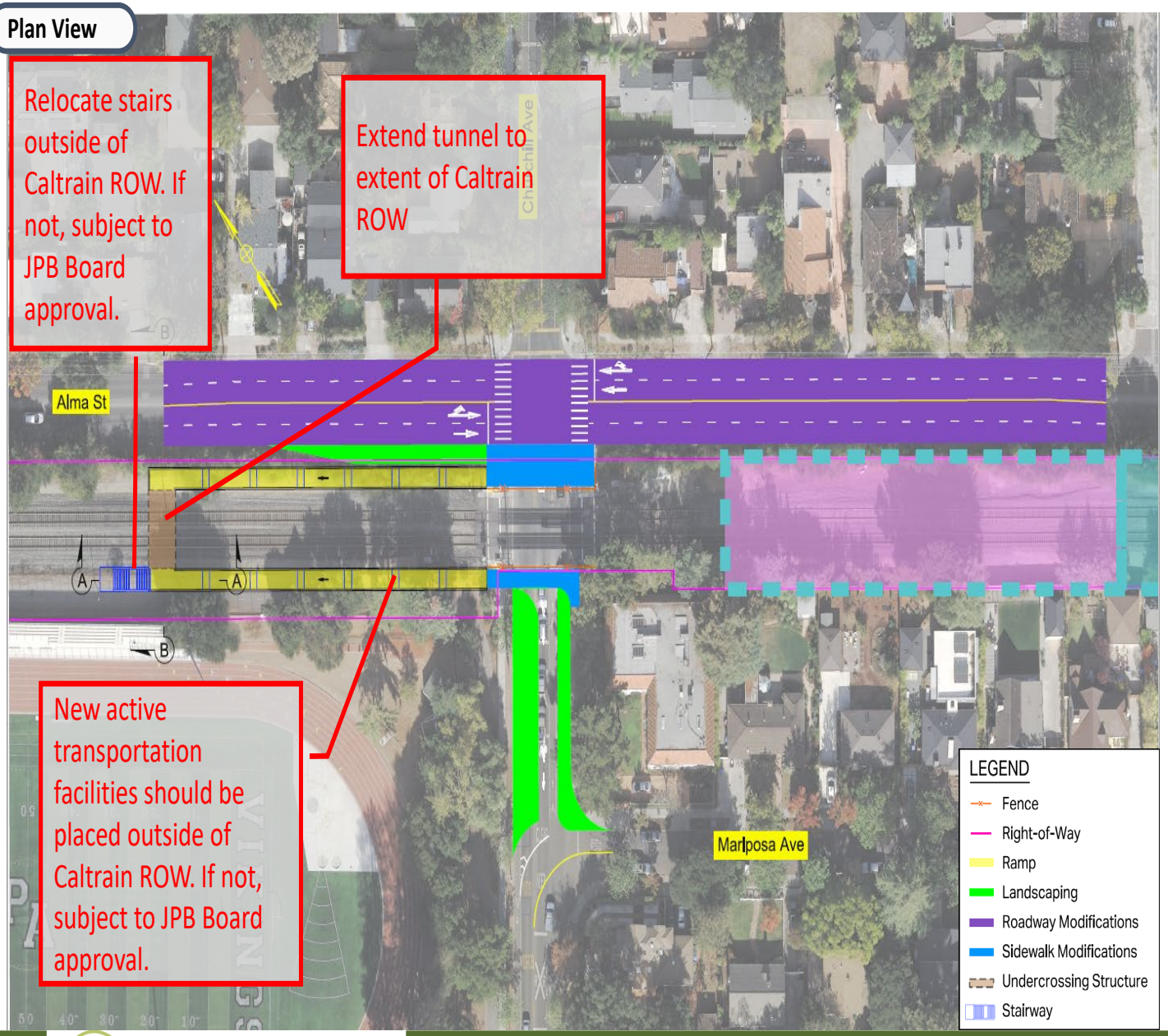
Summary of Comments - Churchill Avenue – Closure Option 1

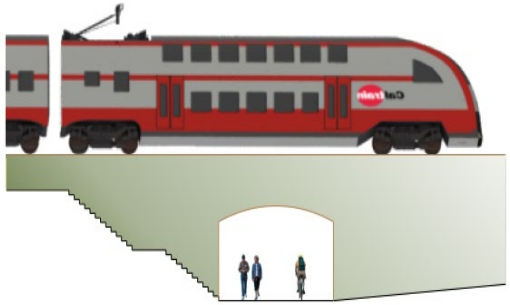
Plan View

Relocate stairs outside of Caltrain ROW. If not, subject to JPB Board approval.

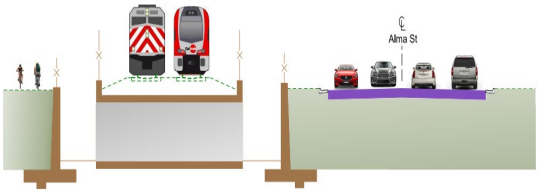
Extend tunnel to extent of Caltrain ROW

New active transportation facilities should be placed outside of Caltrain ROW. If not, subject to JPB Board approval.





Section A-A

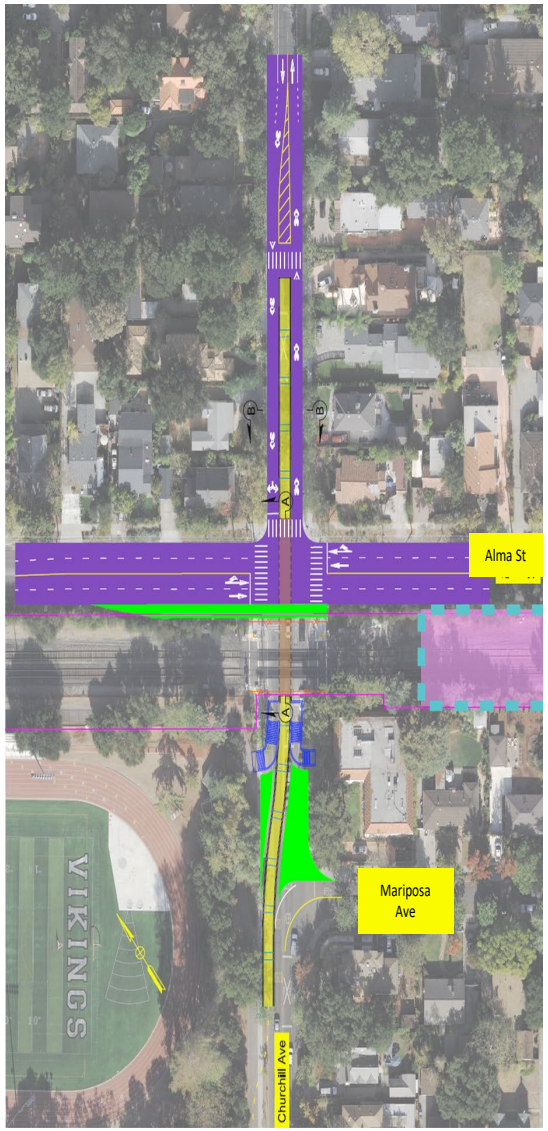


Section B-B

4-Track Influence Area

Transition between 2-Track and 4-Track

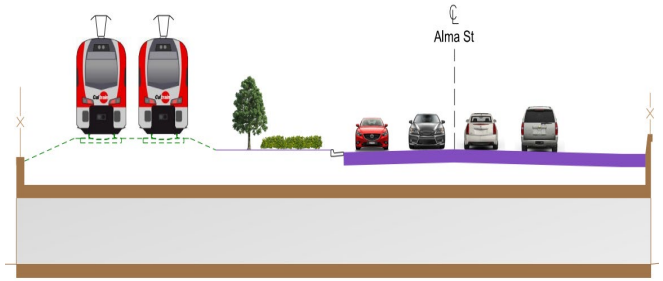
Summary of Comments - Churchill Avenue – Closure Option 2



LEGEND
- Fence
- Right-of-Way
- Ramp
- Landscaping
- Roadway Modifications
- Sidewalk Modifications
- Undercrossing Structure
- Stairway

Plan View

No Major/Significant Concerns



Section A-A

Show lane width and shoulder dimensions

Section B-B

Summary of Comments - Churchill Avenue

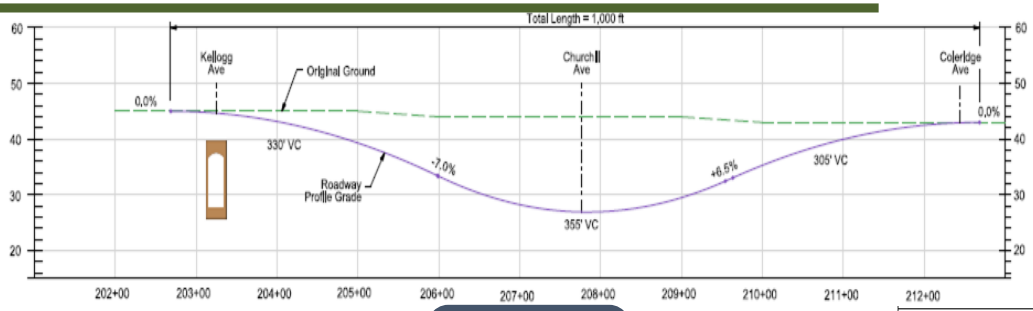
Churchill - Partial Underpass

- New active transportation facilities should be placed outside of Caltrain ROW. If not, they are subject to JPB Board approval.
- Adjust retaining walls outside of Caltrain ROW.
- Provide 16’6” vertical clearance requirement for the extent of the Caltrain ROW—will require reprofiling of roadway
- Bridge width to provide access for Caltrain maintenance and emergency vehicles.
- Roadway design to meet Caltrans HDM/AASHTO ‘Greenbook’/AASHTO ‘Highway Safety Manual’

Summary of Comments - Churchill Avenue – Partial Underpass

4-Track Influence Area

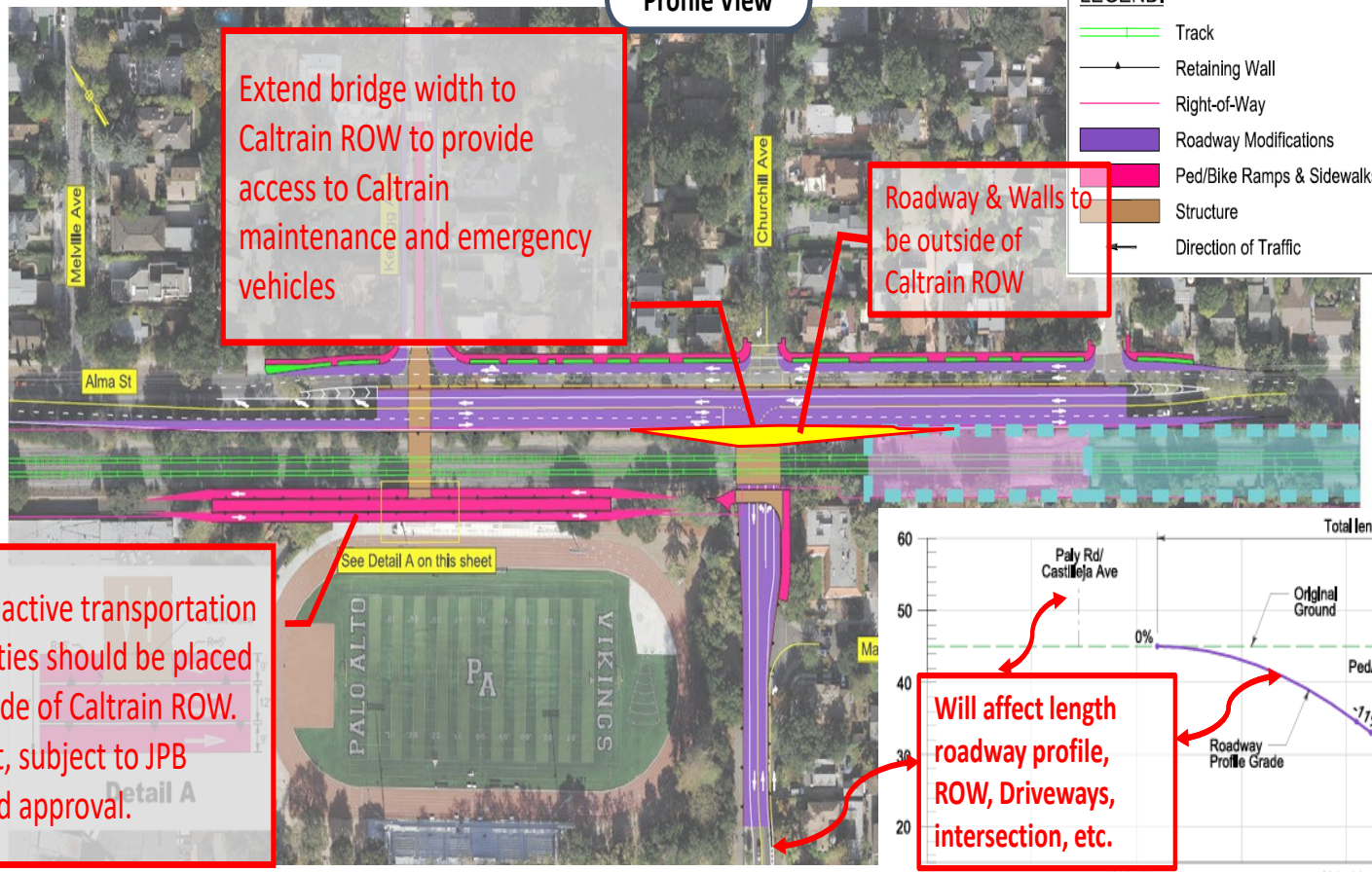
Transition between 2-Track and 4-Track



Profile View

Other elements:

- Merging taper/median design
- Offset from barriers
- Lane width etc.
- Curved bridges

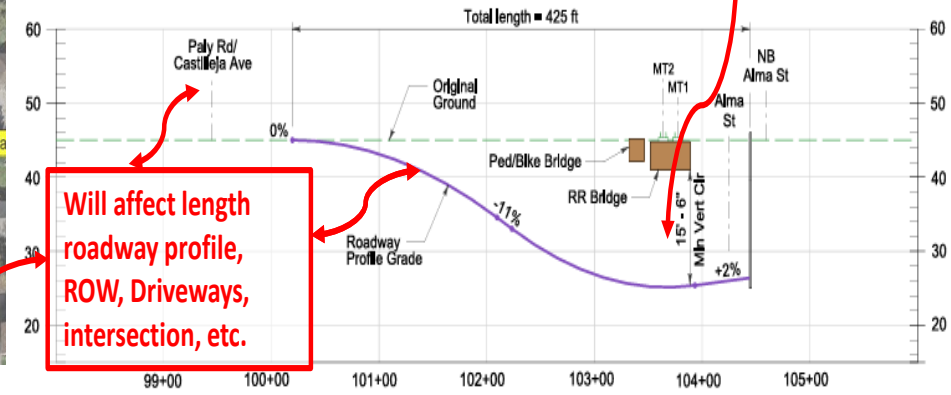


Extend bridge width to Caltrain ROW to provide access to Caltrain maintenance and emergency vehicles

Roadway & Walls to be outside of Caltrain ROW

New active transportation facilities should be placed outside of Caltrain ROW. If not, subject to JPB Board approval.

Provide 16'-6" vertical clearance



Will affect length roadway profile, ROW, Driveways, intersection, etc.

Churchill Ave (Profile)

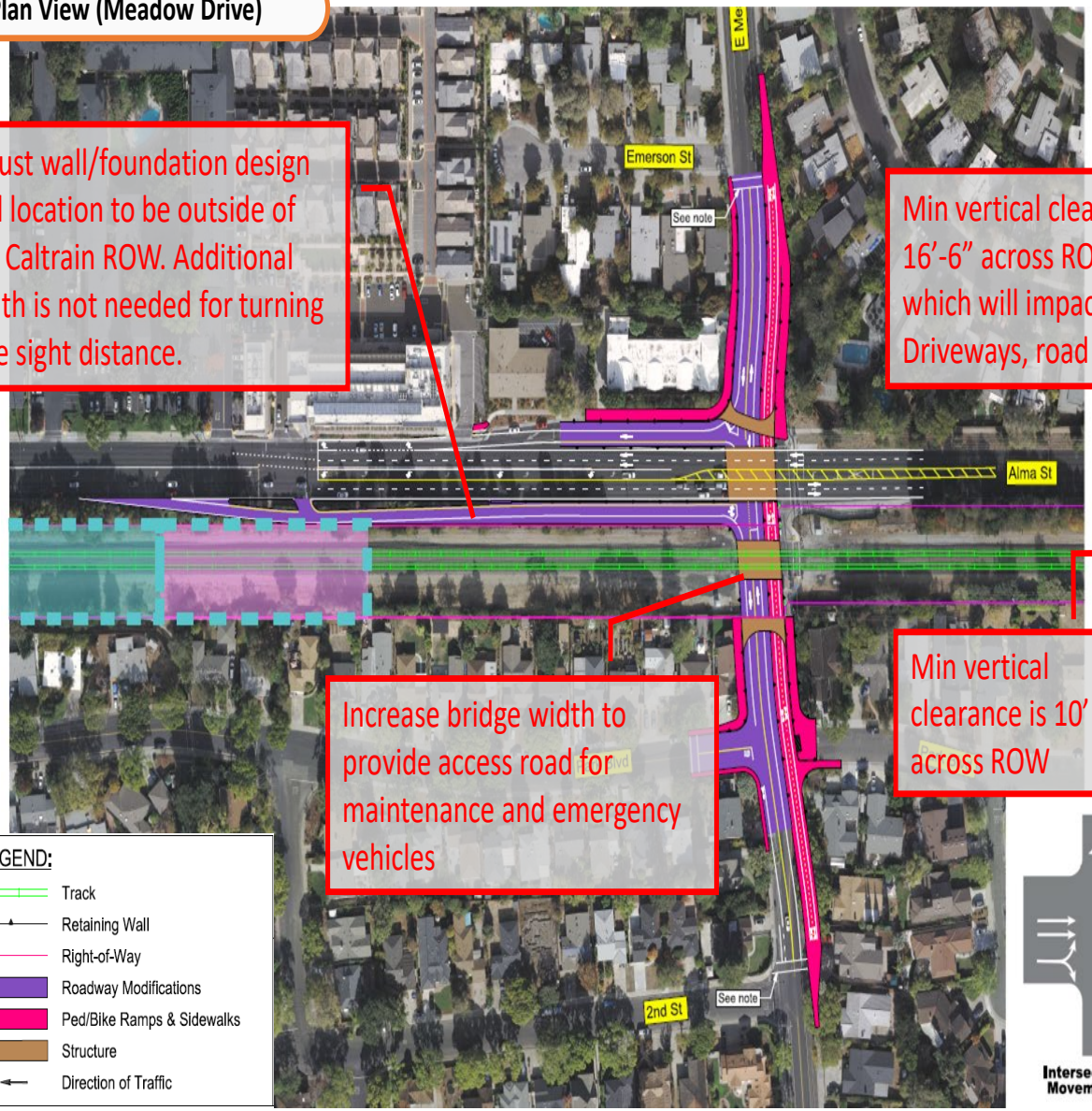
Summary of Comments – Meadow Drive & Charleston Road

Meadow Charleston - Underpass

- Provide 16’6” vertical clearance requirement for the extent of the Caltrain ROW—will require reprofiling of roadway.
- Provide bridge width to provide access for Caltrain maintenance and emergency vehicles.
- Adjust retaining walls outside of Caltrain ROW to accommodate 4-track and 4-track transitions, provide sufficient space (10’ min) for maintenance vehicle access, and maximize utility of Caltrain ROW.
- Roadway design to meet Caltrans HDM/AASHTO ‘Greenbook’/AASHTO ‘Highway Safety Manual’

Summary of Comments – Meadow Dr - Underpass

Plan View (Meadow Drive)

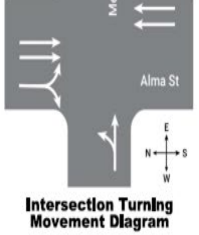


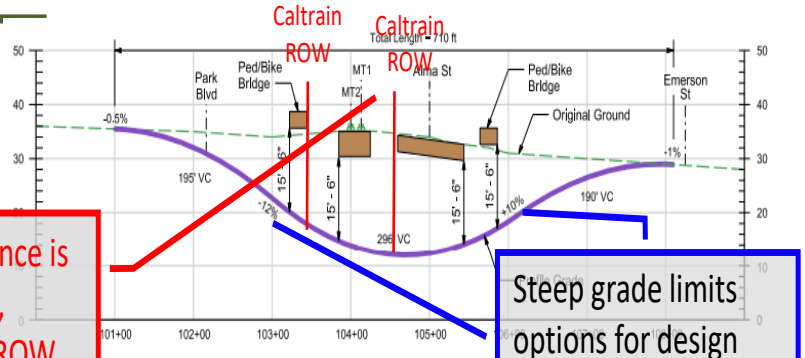
Adjust wall/foundation design and location to be outside of the Caltrain ROW. Additional width is not needed for turning lane sight distance.

Min vertical clearance is 16'-6" across ROW, which will impact ROW, Driveways, road profile.

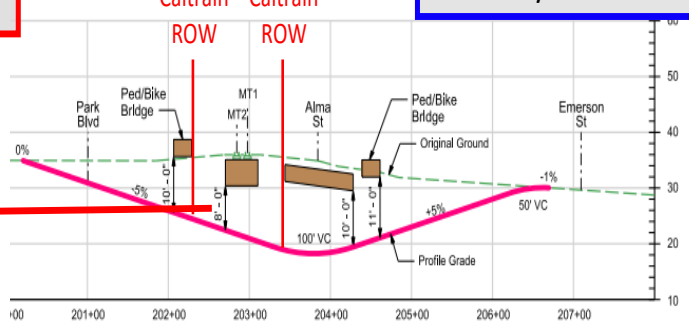
Increase bridge width to provide access road for maintenance and emergency vehicles

Min vertical clearance is 10' across ROW

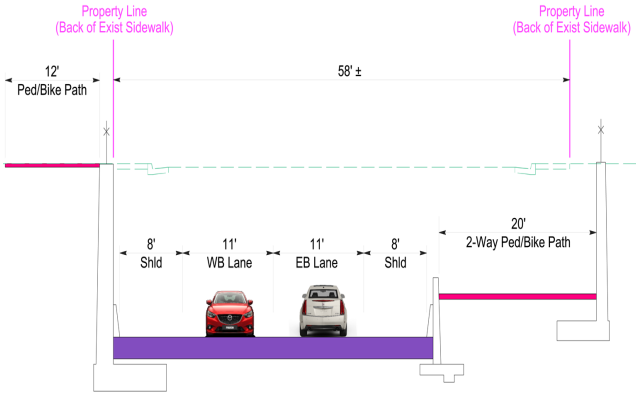




Steep grade limits options for design flexibility



Ped/Bike Profile from Park Blvd to Emerson St



Typical Section Meadow Dr Underpass

4-Track Influence Area

Transition between 2-Track and 4-Track

CITY OF PALO ALTO

Summary of Comments –Charleston Rd - Underpass

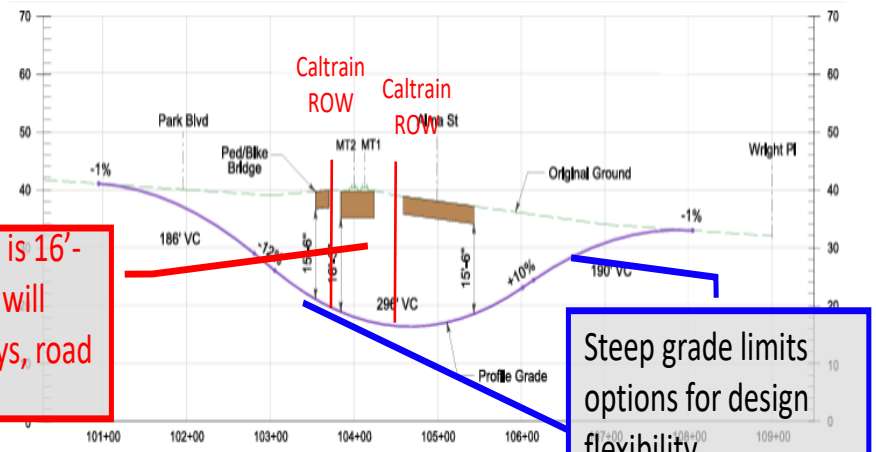
Plan View (Meadow Drive)

Min vertical clearance is 16'-6" across ROW, which will impact ROW, Driveways, road profile.

Increase bridge width to provide access road for maintenance and emergency vehicles

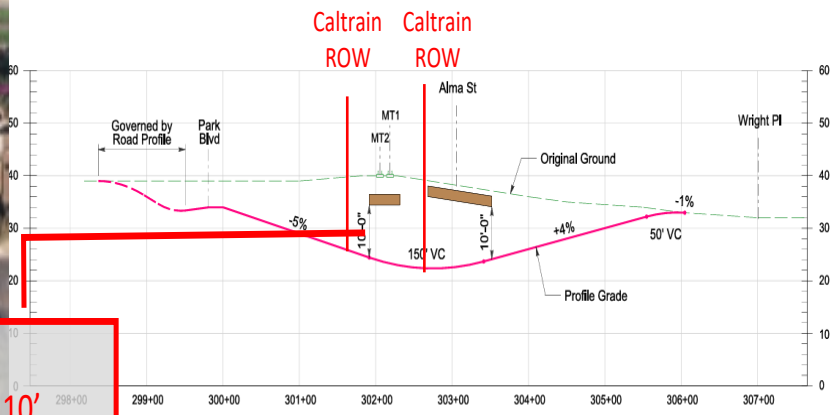
Min vertical clearance is 10' across ROW

LEGEND:
- Track
- Retaining Wall
- Right-of-Way
- Roadway Modifications
- Ped/Bike Ramps & Sidewalks
- Structure
- Direction of Traffic



Steep grade limits options for design flexibility

Charleston Rd Profile



Ped/Bike Profile from Park Blvd to Wright Pl

4-Track Influence Area

Transition between 2-Track and 4-Track

Summary of Comments – Meadow Drive & Charleston Road

Meadow Charleston - Hybrid

- Provide 16’6” vertical clearance requirement for the extent of the Caltrain ROW.
- Adjust retaining walls to accommodate 4-track and 4-track transitions.
- Provide sufficient space (10’ min) for maintenance vehicle access and maximize utility of Caltrain ROW.
- Provide sufficient space (10’ min) clearance from the walls to the roadway or structures
- Construction of permanent MSE walls to be at 20’ from center of shoofly track—constructability clearance from OCS and active railroad.

Summary of Comments – Meadow Dr & Charleston Rd - Hybrid

4-Track Influence Area

Transition between 2-Track and 4-Track

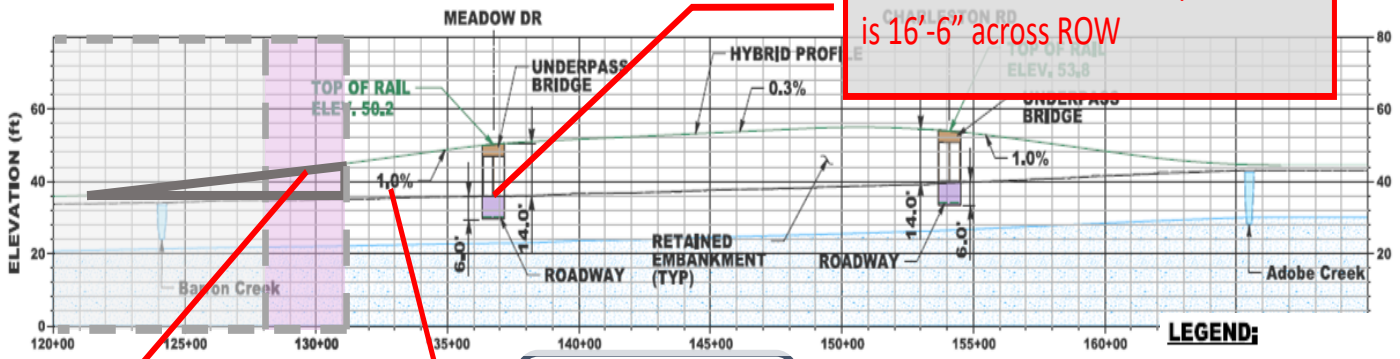
Provide additional width on the bridge to accommodate access road for maintenance and emergency vehicles

Fill retaining walls to accommodate 4-track and transition between 2-track and 4-track

Plan View

Design speed is 110 mph for passenger rail

Min vertical clearance requirement is 16'-6" across ROW



Profile

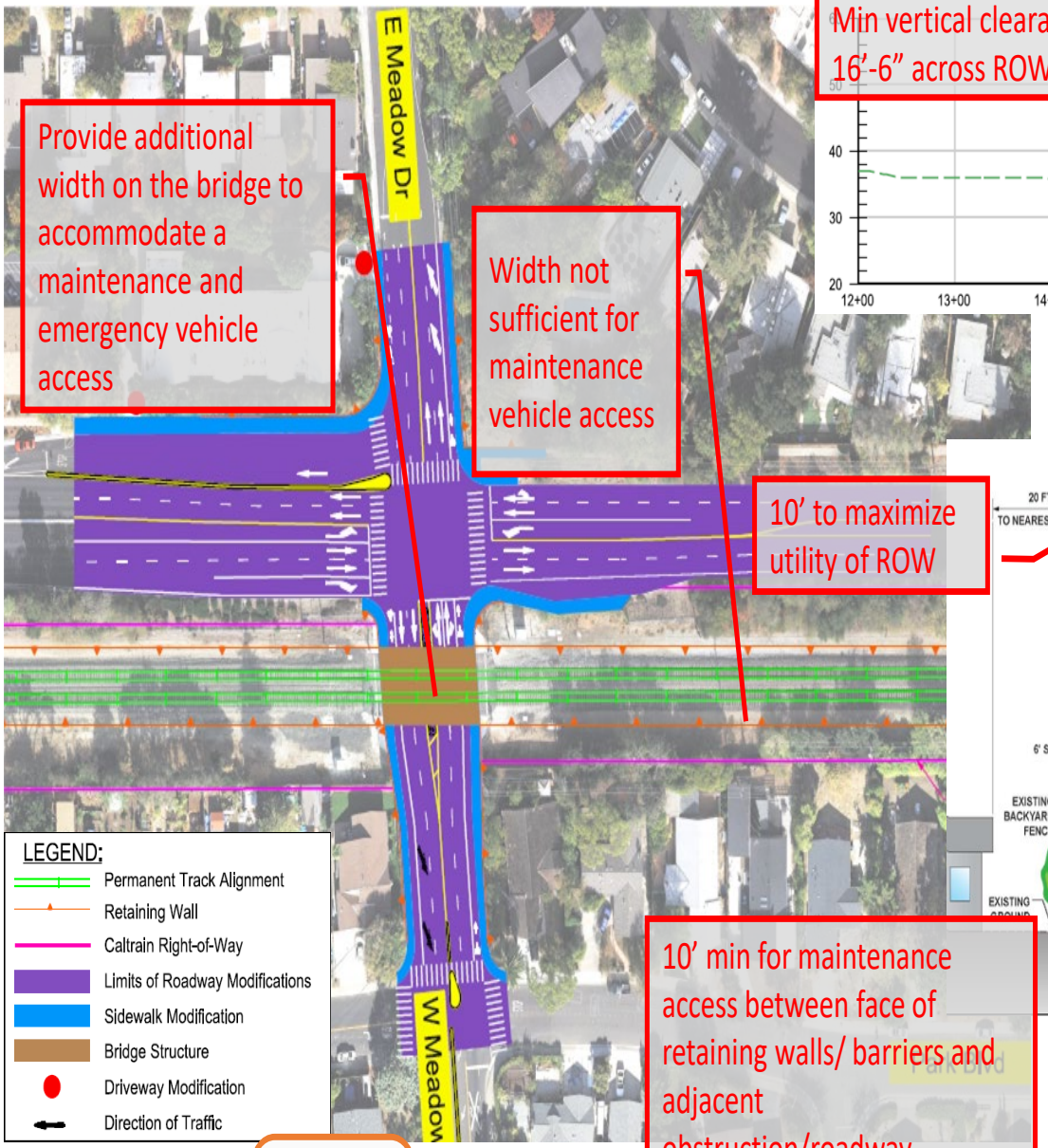
Transition segment should be tangent as special trackwork should stay outside of vertical curves

1% grade is the current maximum without variance. 1% to 2% grade requires review and approval by the Director of Engineering

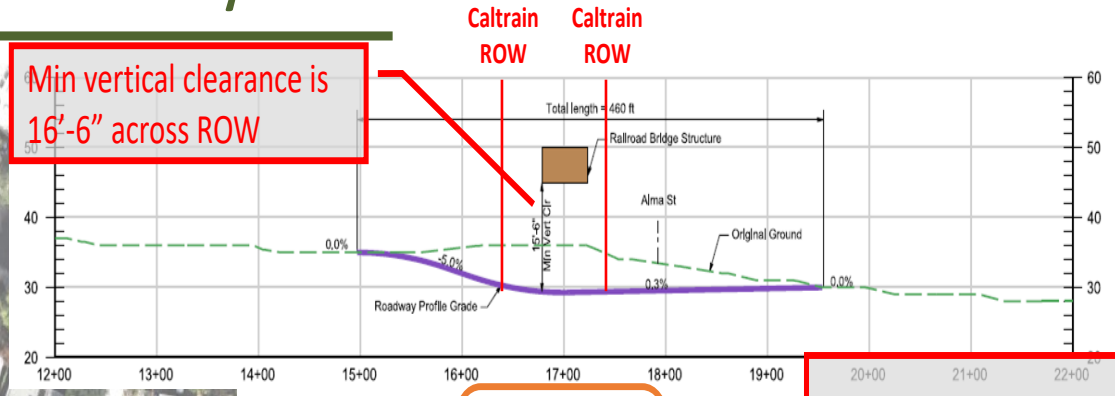
LEGEND:

- New Permanent Track
- Temporary Track (Shoofly)
- Hybrid Track Profile
- Existing Ground Level
- Caltrain Right Of Way
- Bridge
- Landmark
- Creek
- Groundwater
- Limits Of Roadway Lowering

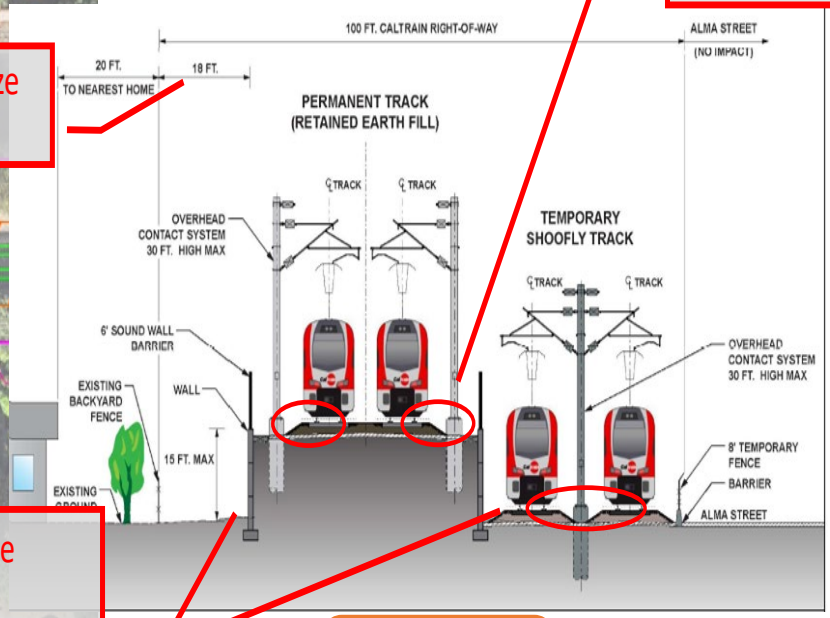
Summary of Comments – Meadow Dr - Hybrid



Plan View



Profile View

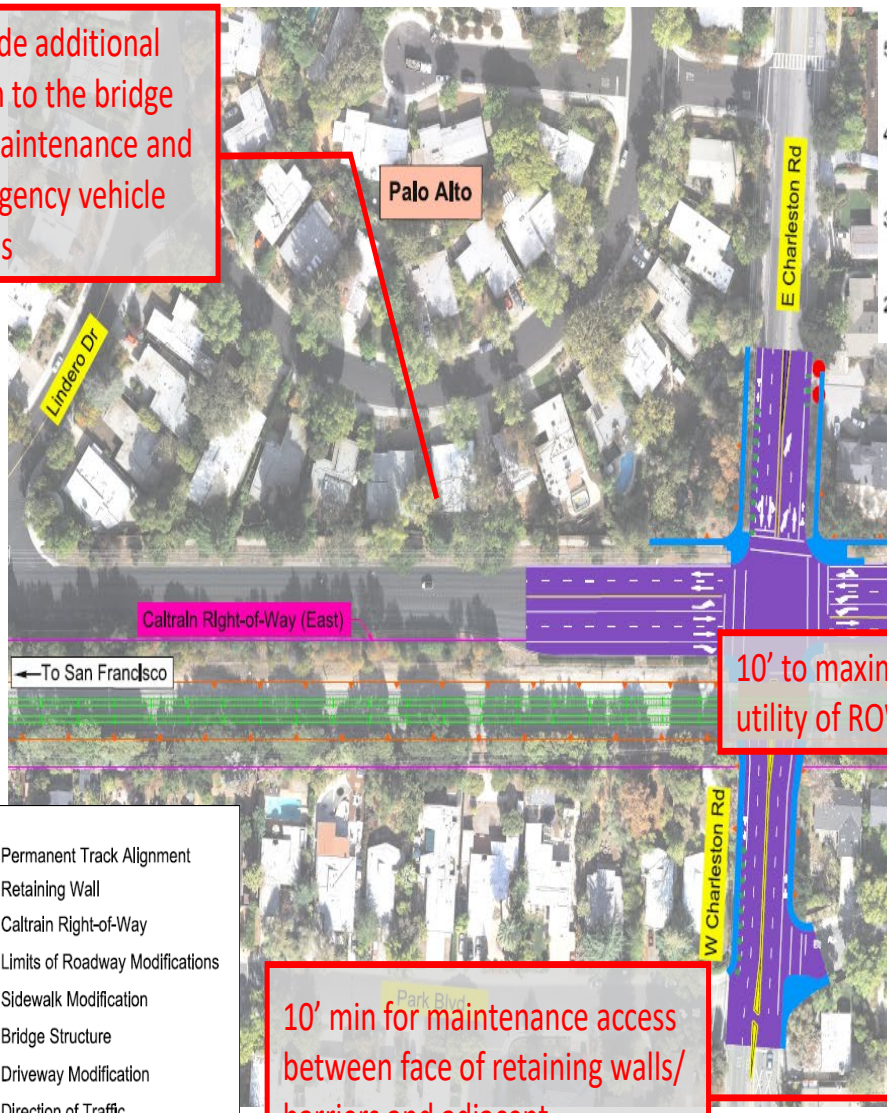


Confirm proximity of OCS and centerline of tracks

Typical Section

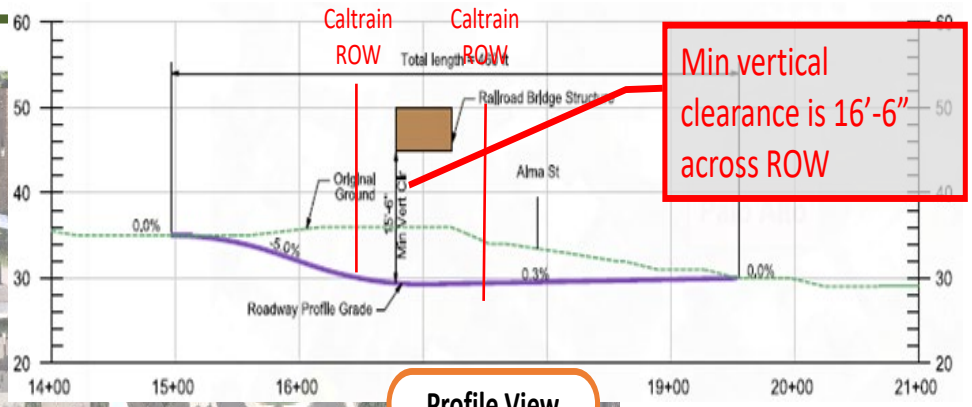
Summary of Comments – Charleston Rd - Hybrid

Provide additional width to the bridge for maintenance and emergency vehicle access



10' min for maintenance access between face of retaining walls/ barriers and adjacent obstruction/roadway

Plan View

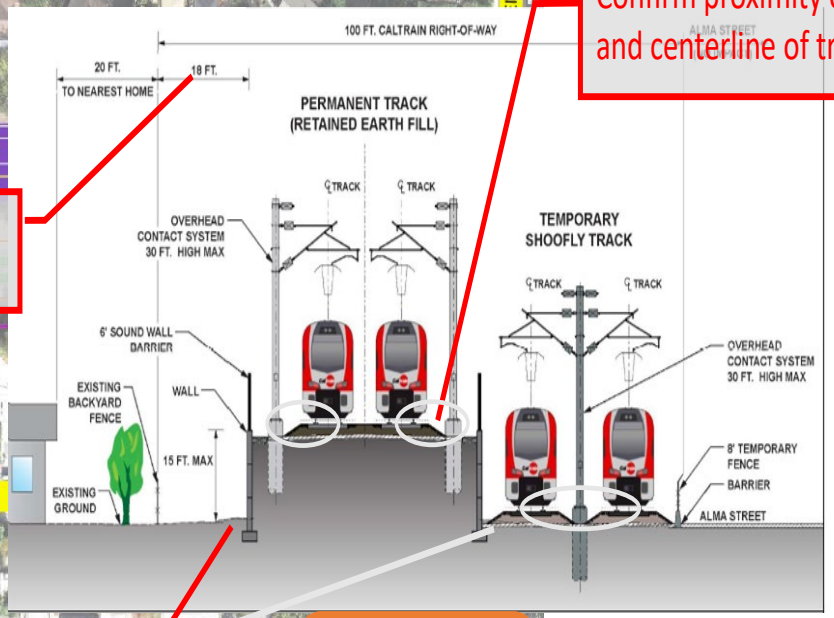


Min vertical clearance is 16'-6" across ROW

Profile View

Confirm proximity of OCS and centerline of tracks

10' to maximize utility of ROW



Typical Section

Summary of Comments – Meadow Drive & Charleston Road

Meadow Charleston - Viaduct

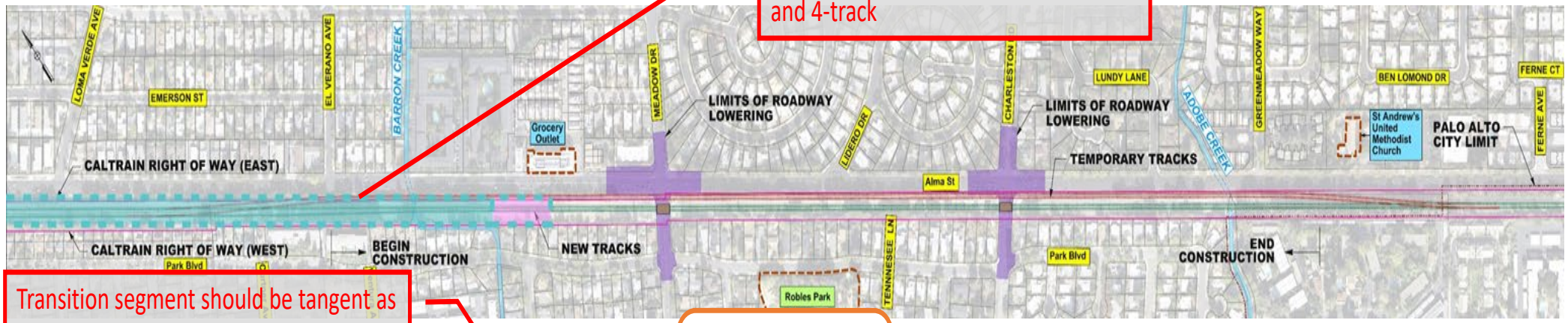
- Provide 16’6” vertical clearance requirement for the extent of the Caltrain ROW—will require reprofiling of roadway and/or Caltrain tracks.
- The vertical dimension from the top of the roadway to the top of the rail should be 24’ instead of 20’ to accommodate 5-foot bridge depth and 2’-6” Rail.
- Provide bridge width to provide access for Caltrain maintenance and emergency vehicles.
- Adjust retaining walls to accommodate 4-track and 4-track transitions.
- Provide sufficient space (10’ min) for maintenance vehicle access and maximize utility of Caltrain ROW.
- Construction of permanent MSE walls to be at 20’ from center of shoofly track—constructability clearance from OCS and active railroad.
- Roadway design to meet Caltrans HDM/AASHTO ‘Greenbook’/AASHTO ‘Highway Safety Manual’

Summary of Comments – Meadow Dr & Charleston Rd - Viaduct

4-Track Influence Area

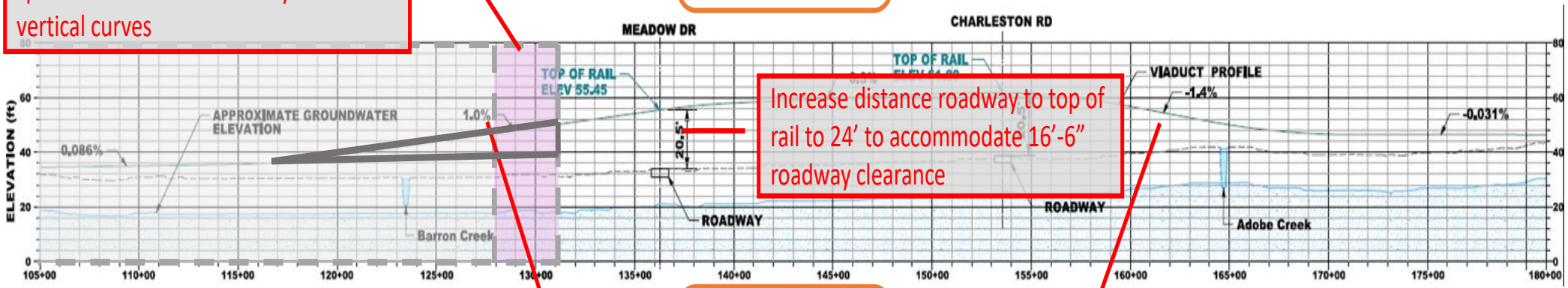
Transition between 2-Track and 4-Track

Fill retaining walls to accommodate 4-track and transition between 2-track and 4-track



Plan View

Transition segment should be tangent as special trackwork should stay outside of vertical curves



Profile

Increase distance roadway to top of rail to 24' to accommodate 16'-6" roadway clearance

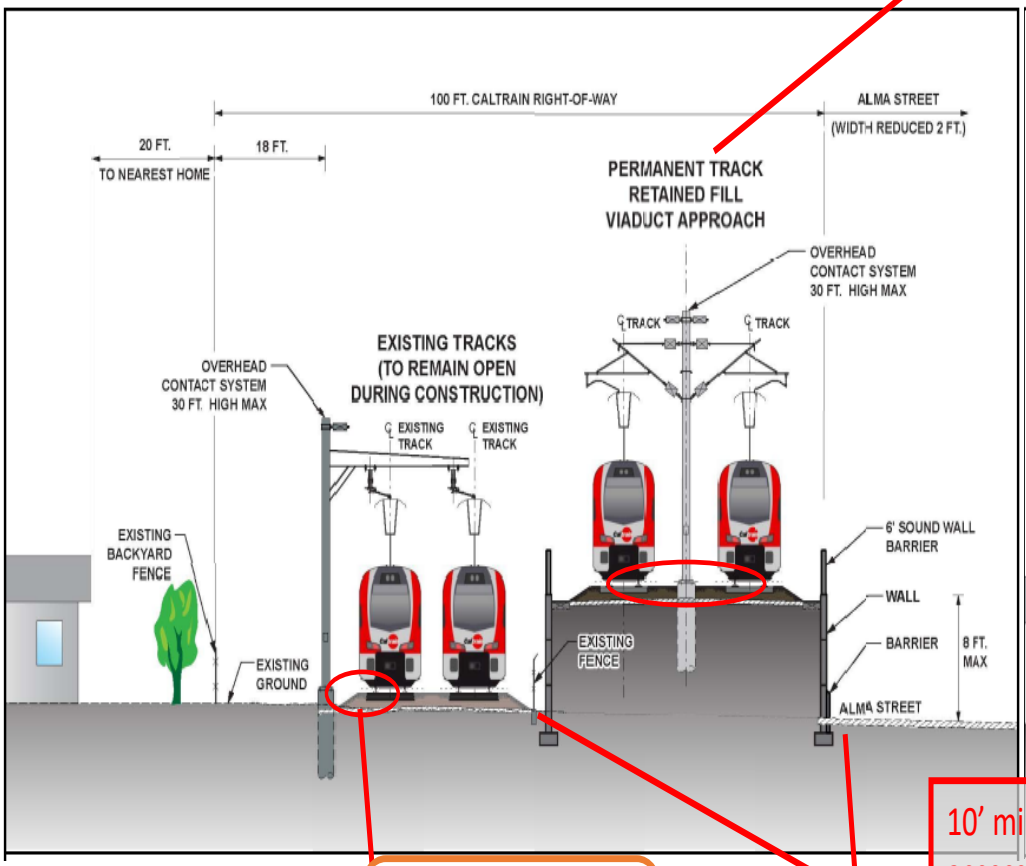
Design speed is 110 mph for passenger rail

1% grade is the current maximum without variance. 1% to 2% grade requires review and approval by the Director of Engineering

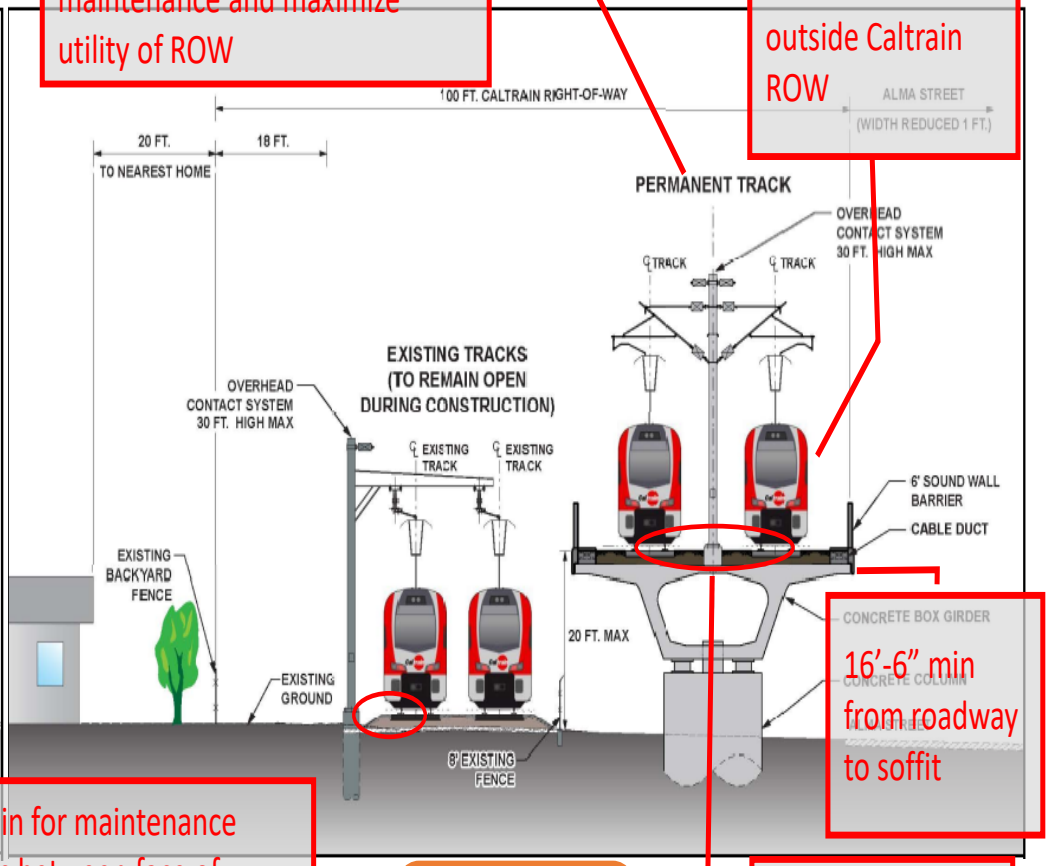
LEGEND:

- New Permanent Track
- Existing Tracks
- Viaduct Track Profile
- Existing Ground Level
- Caltrain Right Of Way
- Landmark
- Creek
- Bridge
- Groundwater

Summary of Comments – Meadow Dr & Charleston Rd - Viaduct



Typical End Section



Typical Section

Place the permanent track alignment to enable maintenance and maximize utility of ROW

The plans show part of the viaduct constructed outside Caltrain ROW

16'-6" min from roadway to soffit

Confirm proximity of OCS and centerline of tracks

10' min for maintenance access between face of retaining walls/ barriers and adjacent obstruction/roadway

Extend OCS foundation to connect with bridge pier

Next Steps

Next Steps

The goal is to provide sufficient information for Rail Committee to evaluate alternatives and make recommendation to the City Council. Therefore, Staff is seeking

- Rail Committee's review of comments to provide guidance to staff on specific elements.
- Direct staff to proceed coordination with Caltrain Staff or their Consultants and/or City's project consultant for material changes to alternatives

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Caltrain

Connecting Palo Alto Projects

Caltrain Technical Review Results

March 19, 2024

City and Caltrain Staff

City Staff

- Philip Kamhi, Chief Transportation Official
- Ripon Bhatia, Senior Engineer

Caltrain Staff

- Robert Barnard, Chief, Rail Design and Construction
- Mike Rabinowitz, Principal Planner
- Navi Dhaliwal, Government & Community Affairs Officer
- Edgar Torres, Consultant, Kimley Horn and Associates

Purpose

Purpose

- Review of the Grade Separation Alternatives for Churchill Avenue, Meadow Drive, and Charleston Road Crossings, including Consideration of Caltrain's Review and Results
- Rail Committee's reviews and provide guidance and directions to staff.
- Recommend that Council Advances (or Eliminates) Specific Alternative(s) for Preliminary Engineering and Environmental Documentation.

Background

CAP & XCAP

- *Alternatives developed, reviewed and updated (2018 - July 2020)*
- *Community Outreach & Community Feedback (August – October 2020)*
- *Deliberation and Recommendation to City Council (November 2020 - March 2021)*

City Council

- *Council Review and Discussion*
- *Meadow Drive – Charleston (Narrowed Alternatives) - August 2021*
- *Churchill Avenue (Preferred Alternative & Backup Selection) - November 2021*

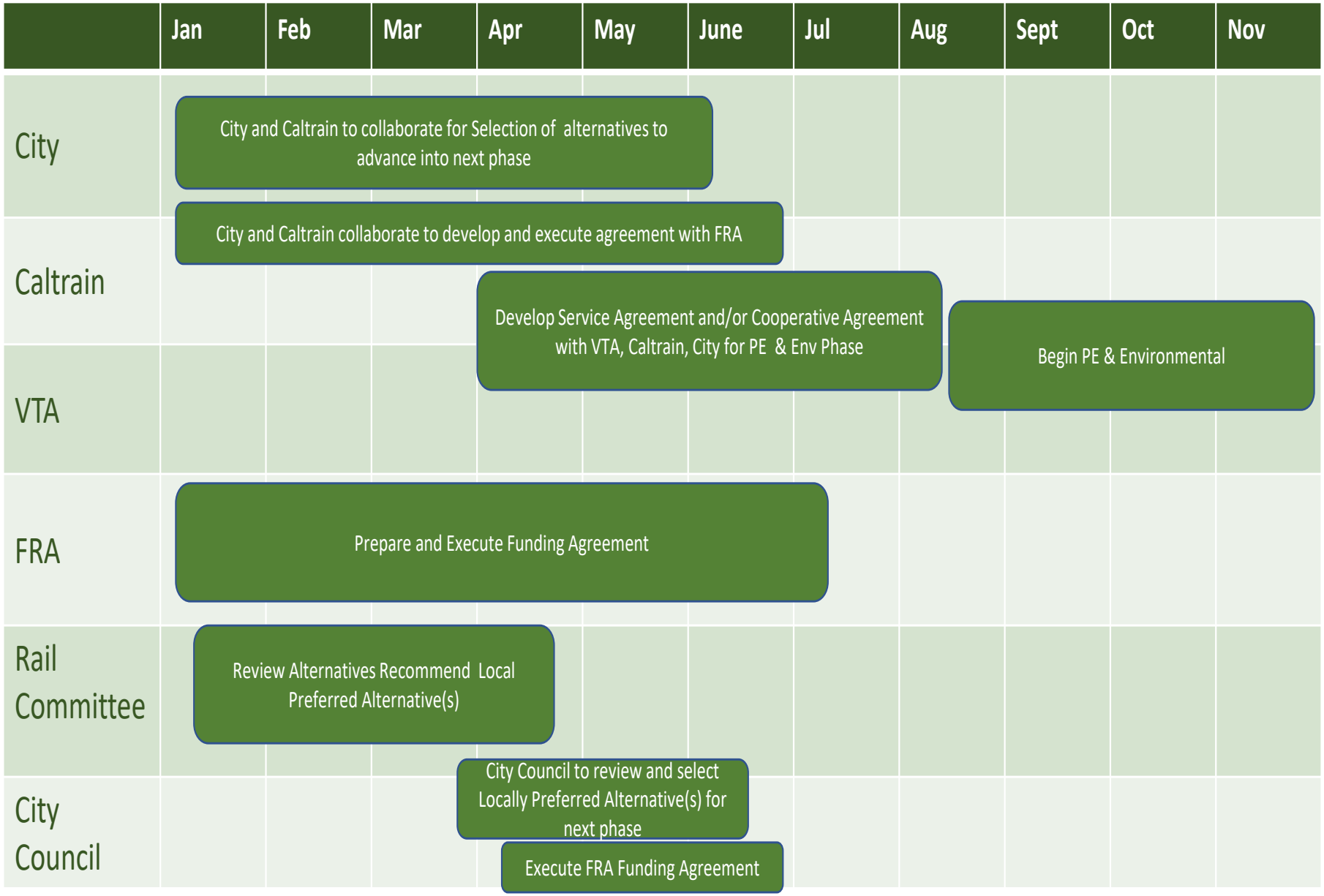
Rail Committee

- *Reviewed and Refined underpass alternatives (June 2023)*
- *Reviewed and updated Council Adopted criteria (May 2023)*
- *Conducted Review of Preliminary Geotechnical (August 2023)*
- *Study Session of Caltrain four-track segment analysis (November 2023)*
- *Discussion of Caltrain comments with Rail Committee (January 2024)*
- *Reviewed Updated Summary of Evaluation Criteria (February 2024)*

AGENDA

- Schedule
- Caltrain's Guiding Principles
- Executive Summary
- Caltrain's Results of Process by Alternative
- Next Steps

Project Planning



Next Steps

Next Steps

The goal is to provide sufficient information for Rail Committee to evaluate alternatives and make recommendation to the City Council. Therefore, Staff is seeking

- Rail Committee's review and selection of preferred alternative for recommendation to the City Council
- Study session with City Council (April 2024)
- City Council to select preferred alternative for advancement into Preliminary Engineering & Environmental Documentation phase for Meadow and Charleston Crossing (May/June 2024)
- Execute Agreement with FRA and Service Agreement/Cooperative Agreement for Preliminary Engineering & Environmental with Caltrain & VTA

CONNECTING PALO ALTO CONCEPTUAL ALTERNATIVES TECHNICAL REVIEW

MARCH 19, 2024

Caltrain

Caltrain's Engagement

Caltrain's engagement on Connecting Palo Alto Alternatives

- **Execute** Service agreement
- **Initial review** against Caltrain's 2024 standards and policies
- **Meetings** with Palo Alto staff to share initial observations
- **Presentation** to Palo Alto's January Rail Committee of initial observations
- **Today** - presentation with an intent to focus on developing solutions

Caltrain's Partnership

Developed **draft solutions** based on available **planning level information**

- Deeper dive analysis to **support decision-making**
- Seeking to **balance** needs of railroad and community
  - Maintain utility of region's investment in Caltrain
  - Enable community's vision for Palo Alto
- Intent to **minimize** additional private property impacts

Caltrain Partnership

Steps Guiding Solution-Oriented Thinking

1/29	• **Engineering Team workshop** of potential design and constructability solutions for all alternatives (internal)
1/30	• **Shared** potential design and constructability solutions with **City** • Received Questions from City
1/31	• Caltrain Team met with **Chief Safety Officer, Chief Operating Officer, Director of Engineering** regarding solutions and questions (internal) • Shared feedback on design and constructability solutions with **City**
2/1	• Caltrain Team met with **Executive Director** regarding solutions and Caltrain expectations (internal)
2/2 - 2/9	• Caltrain Team begins **applying direction** to exhibits and materials (internal) • **Ongoing coordination** between City staff and Caltrain
2/13 and 2/16	• Caltrain Team **shares materials with City staff**
3/19	• Rail Committee presentation

Caltrain's Focus of Review

Reviewed Connecting Palo Alto Alternatives with a focus on

- **Safety** – Constructability
- **Engineering** – Practical Constraints
- **Maintenance and Operations**
- **Policy and Agreements** – Ensure projects are designed to meet Caltrain's future railroad needs and preserve property rights.
  - Design Criteria "*Preserve the existing ROW*" (2007, 2011, 2020, 2024)
  - Rail Corridor Use Policy (RCUP) (2020)
  - Property Conveyance and fee schedule policy (2010, 2021)
  - California High Speed Rail Authority agreements
  - Union Pacific Railroad agreements

Caltrain's Guiding Principles

Railroad property is Caltrain's most *valuable and durable asset*

- Caltrain will explore encroachments through **revocable license** agreements subject to appraisals, annual fees escalated at CPI, and **Board approval** via the RCUP and Property Conveyance processes.

- For all alternatives and configurations requiring temporary use of Palo Alto right-of-way, a future "construction, operation, and maintenance agreement" between the City and Caltrain is needed.

Caltrain's Guiding Principles

Caltrain must be able to **retain the utility and durability of Caltrain's ROW** now and in the future. Caltrain is seeking to be held fiscally harmless from the City of Palo Alto's selected alternative.

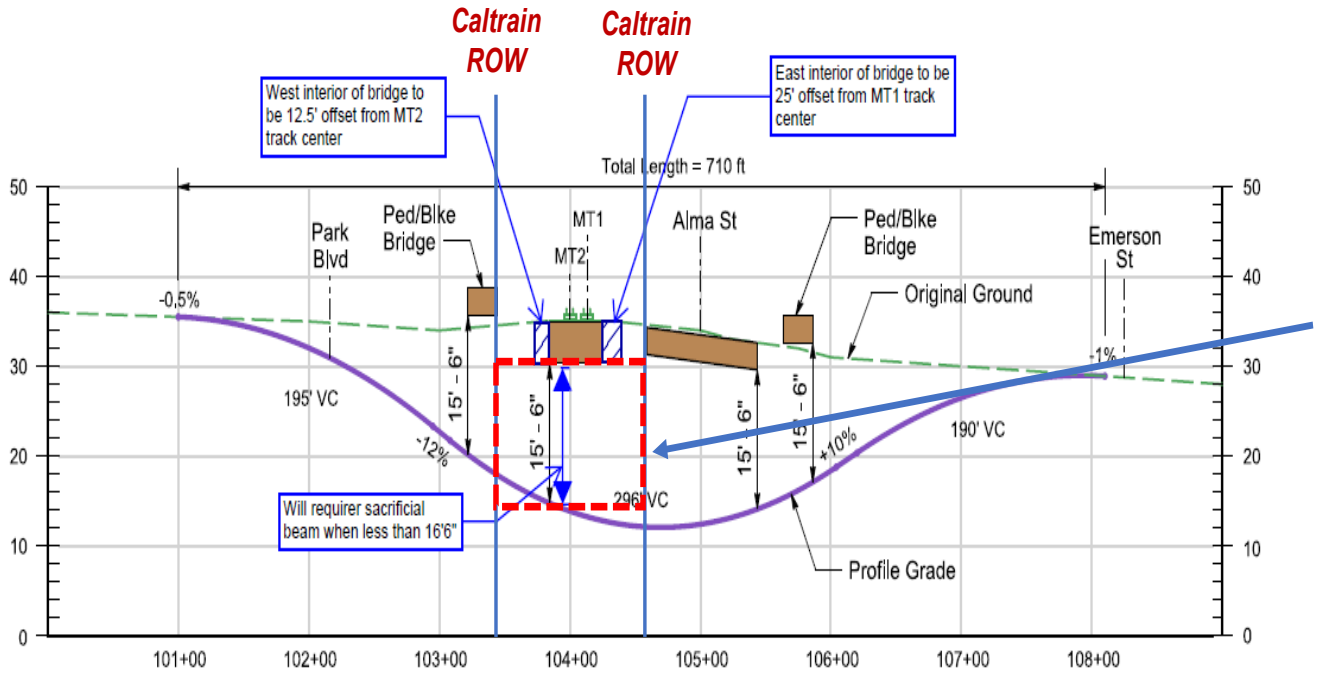
Current at-grade crossings support Caltrain's use of its **full ROW width** for railroad purposes

2021 Conveyance Policy

*"Staff will analyze the request to ensure . . . applicant's improvements are designed to be compatible with the **broadest range** of possible transportation alternatives for the **entire width of the ROW**"*

Caltrain's Guiding Principles

Caltrain must be able to **retain the utility and durability of Caltrain's ROW** now and in the future. Caltrain is seeking to be held fiscally harmless from the City of Palo Alto's selected alternative.

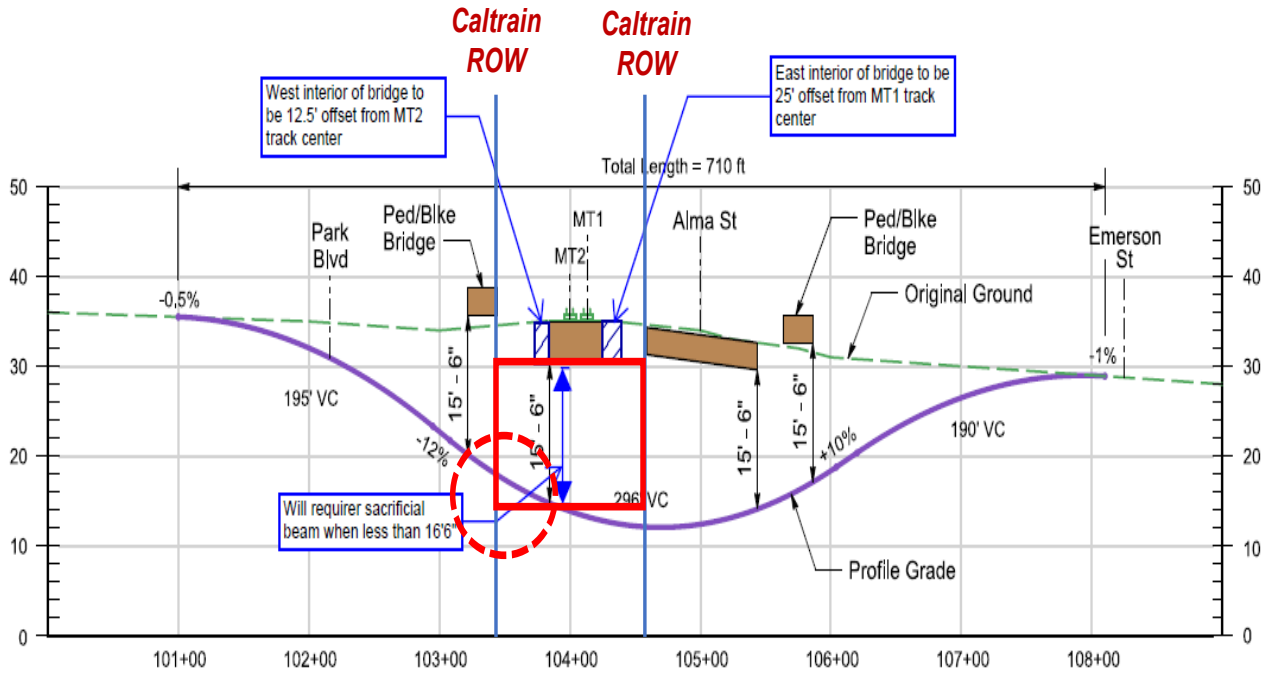


Provide a minimum **15'-6" vertical clearance** with **variance** and sacrificial beams across **entire width** of Railroad ROW

Caltrain's Guiding Principles

Caltrain must be able to **retain the utility and durability of Caltrain's ROW** now and in the future. Caltrain is seeking to be held fiscally harmless from the City of Palo Alto's selected alternative.

- *City designs that **do not allow** for above **may proceed**, but City will be responsible for re-building roads, or the incremental cost to the railroad to utilize the Caltrain ROW.*



Executive Summary

Churchill Summary of Findings

Alternative	Partial Underpass w/ Kellogg Undercrossing (LPA)	Closure Option 1 (With Mitigations)	Closure Option 2 (With Mitigations)
High-level Findings	• **Roadway and railroad improvements viable with refinements** to Alma Street cross section • Bikeway western **encroachment into Caltrain ROW** not viable • Reduce width of pathway facility to fit within available 25' expired easement or widen to the west • **Or** relocate pathway undercrossing to Seale Ave/Peers Park (under preliminary review by others)	• **Moderately viable with refinements**, less than optimal eastern ramp width (~7') • Wider eastern ramp would **impact Alma Street** travel lanes	• **Viable as shown**

Meadow/Charleston Summary of Findings

Alternative	Hybrid	Viaduct	Underpass
High-level Findings	• **Viable with refinements** • Includes elevating width of Caltrain's ROW to retain utility • Shoofly tracks will impact Alma travel lanes (12') during construction	• **Viable with refinements** • Permanent impact to Alma travel lanes for approach structures (19') • Reducing the impact to Alma travel lanes for approach structures requires a new shoofly track (6') • To retain use of Alma travel lanes below viaduct requires a more complex structure • Caltrain to retain existing at grade tracks for railroad purposes	• **Viable with refinements**

**Trench Alternative*: *At the City of Palo Alto's request, Caltrain was not charged with reviewing the trench alternative after it was replaced by the viaduct alternative within the Service Agreement.*

Caltrain's Results of Preliminary Review by Alternative

Churchill Alternatives

Partial Underpass w/ Kellogg Undercrossing (LPA)	Closure Option 1 (With Mitigations)	Closure Option 2 (With Mitigations)

Meadow/Charleston Alternatives

Hybrid	Viaduct	Underpass

Caltrain's Results of Preliminary Review by Alternative

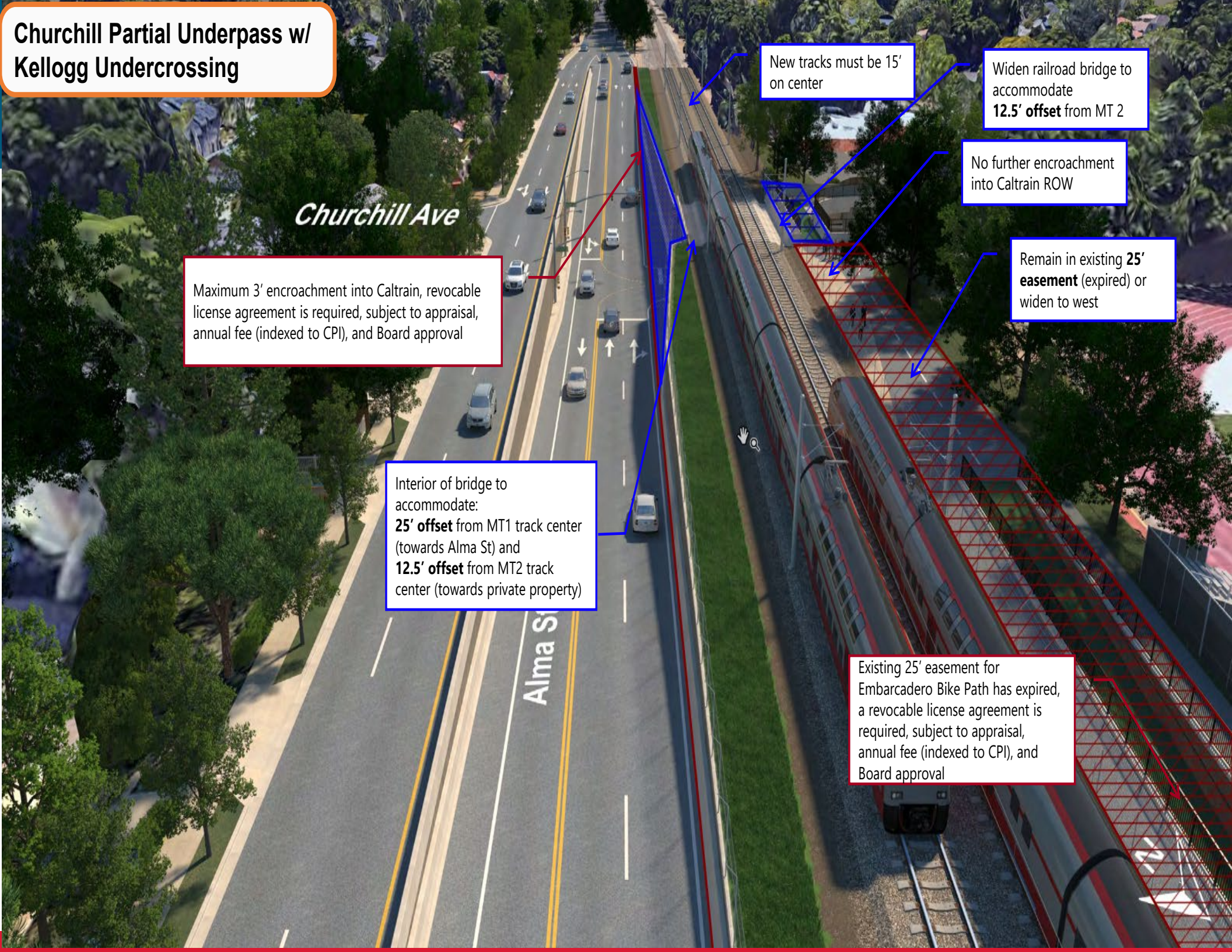
Churchill Alternatives

Partial Underpass w/ Kellogg Undercrossing (LPA)	Closure Option 1 (With Mitigations)	Closure Option 2 (With Mitigations)

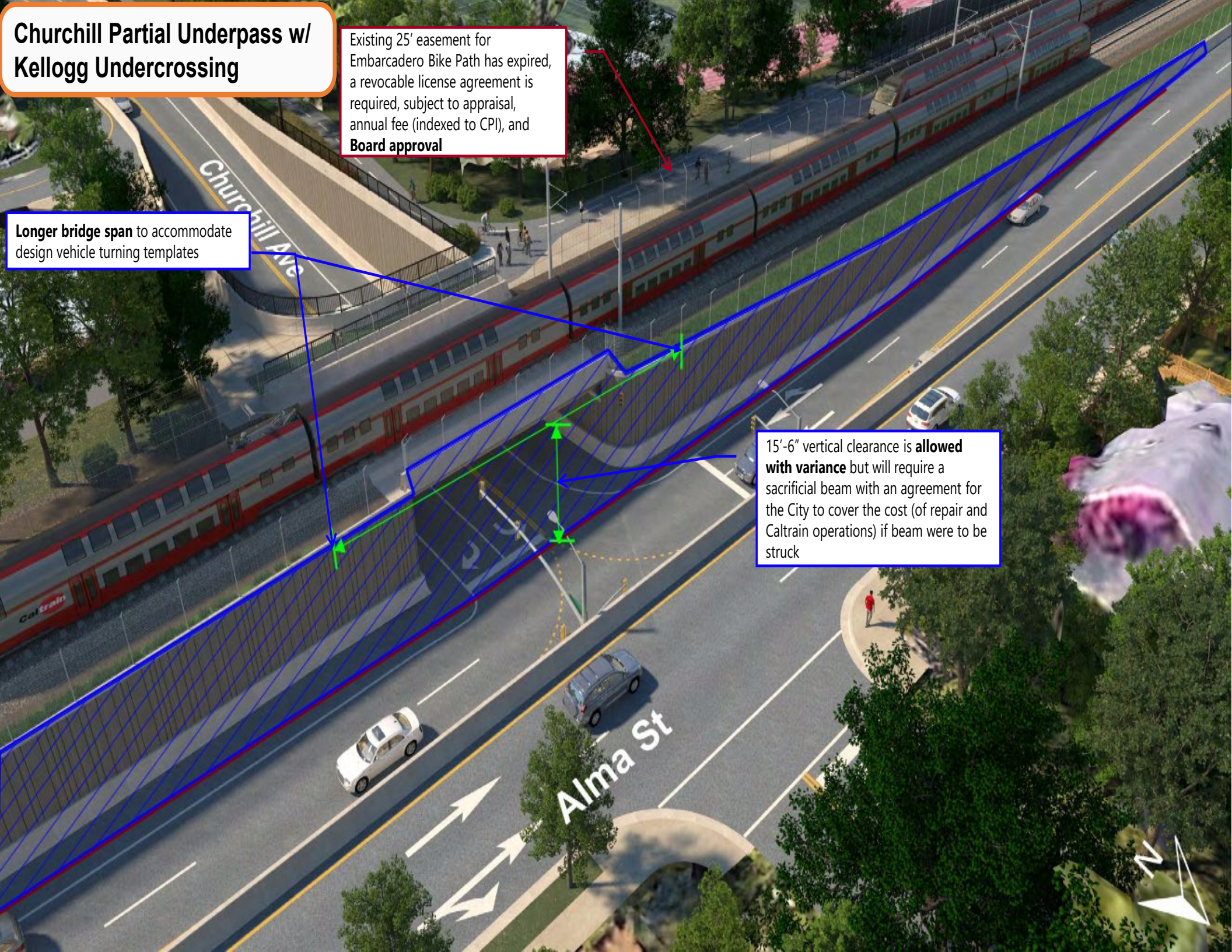
Meadow/Charleston Alternatives

Hybrid	Viaduct	Underpass

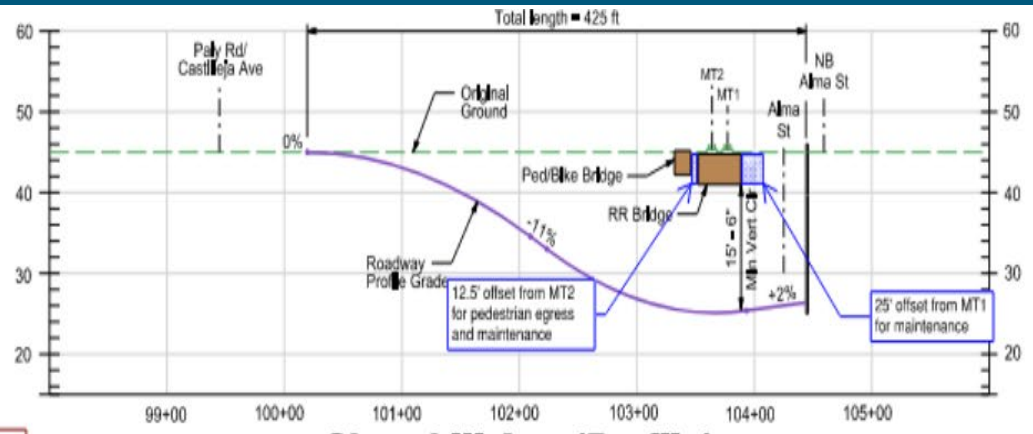
Churchill Partial Underpass w/ Kellogg Undercrossing



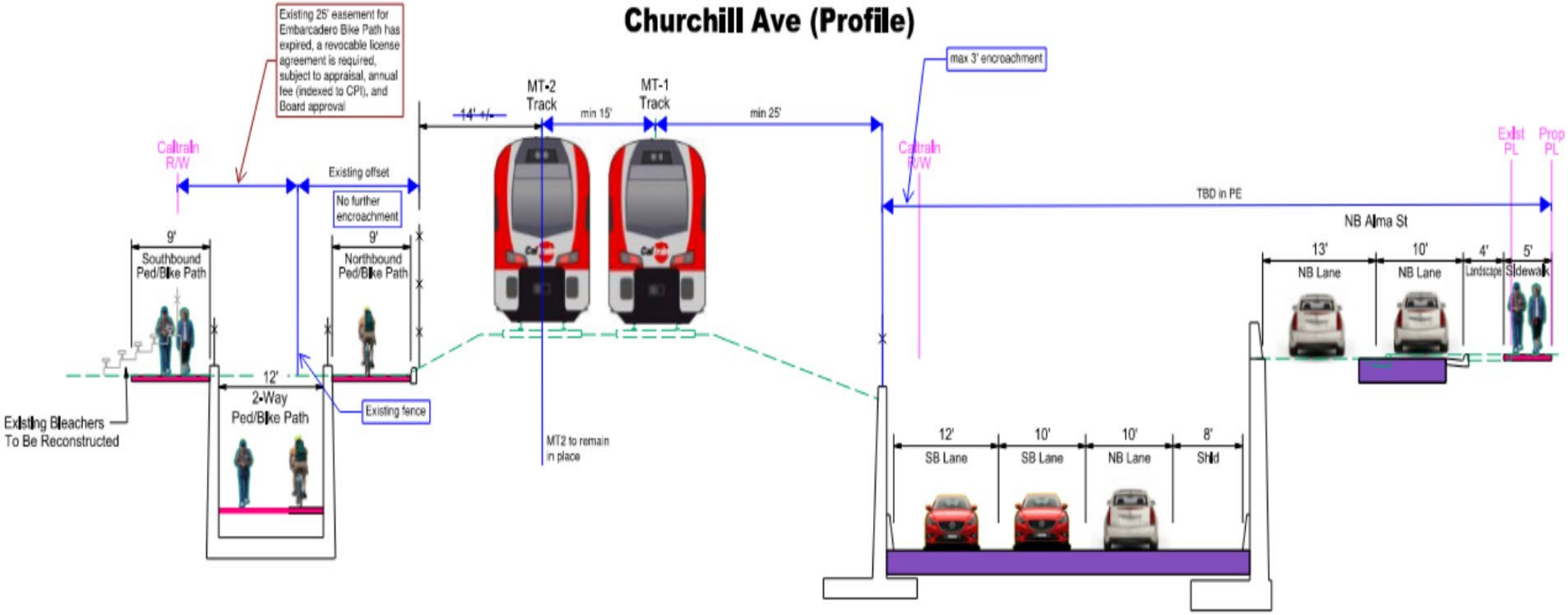
Churchill Partial Underpass w/ Kellogg Undercrossing



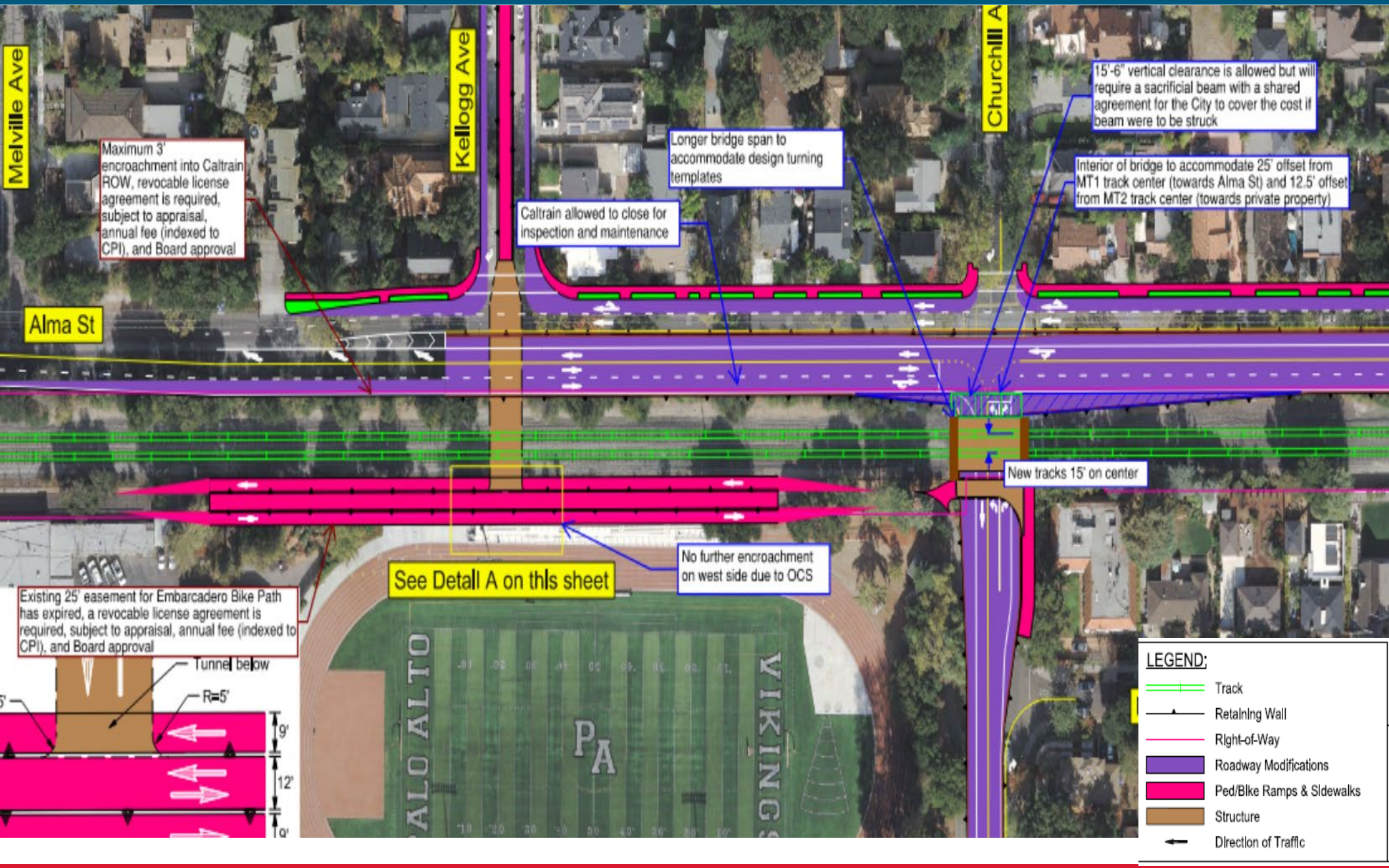
Churchill Partial Underpass w/ Kellogg Undercrossing



Churchill Ave (Profile)



Churchill Partial Underpass with Kellogg Undercrossing Summary



Caltrain's Results of Preliminary Review by Alternative

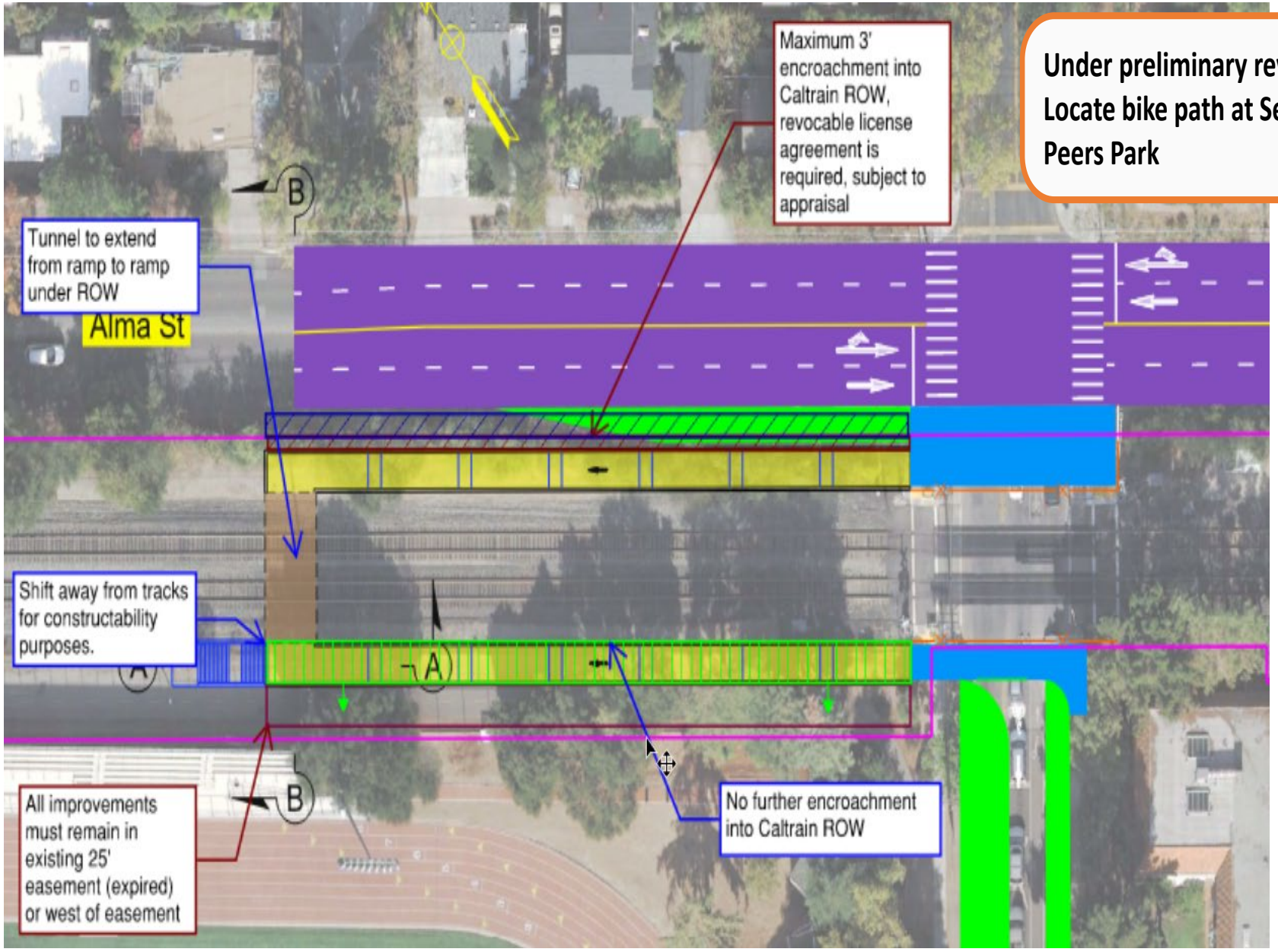
Churchill Alternatives

Partial Underpass w/ Kellogg Undercrossing (LPA)	Closure Option 1 (With Mitigations)	Closure Option 2 (With Mitigations)

Meadow/Charleston Alternatives

Hybrid	Viaduct	Underpass

Churchill Closure
w/ Kellogg Underpass Summary



Under preliminary review by others:
Locate bike path at Seale Ave connecting Peers Park

Caltrain's Results of Preliminary Review by Alternative

Churchill Alternatives

Viable as shown

Partial Underpass (With Kellogg Undercrossing LPA)	Closure Option 1 (With Mitigations)	Closure Option 2 (With Mitigations)

Meadow/Charleston Alternatives

Hybrid	Viaduct	Underpass

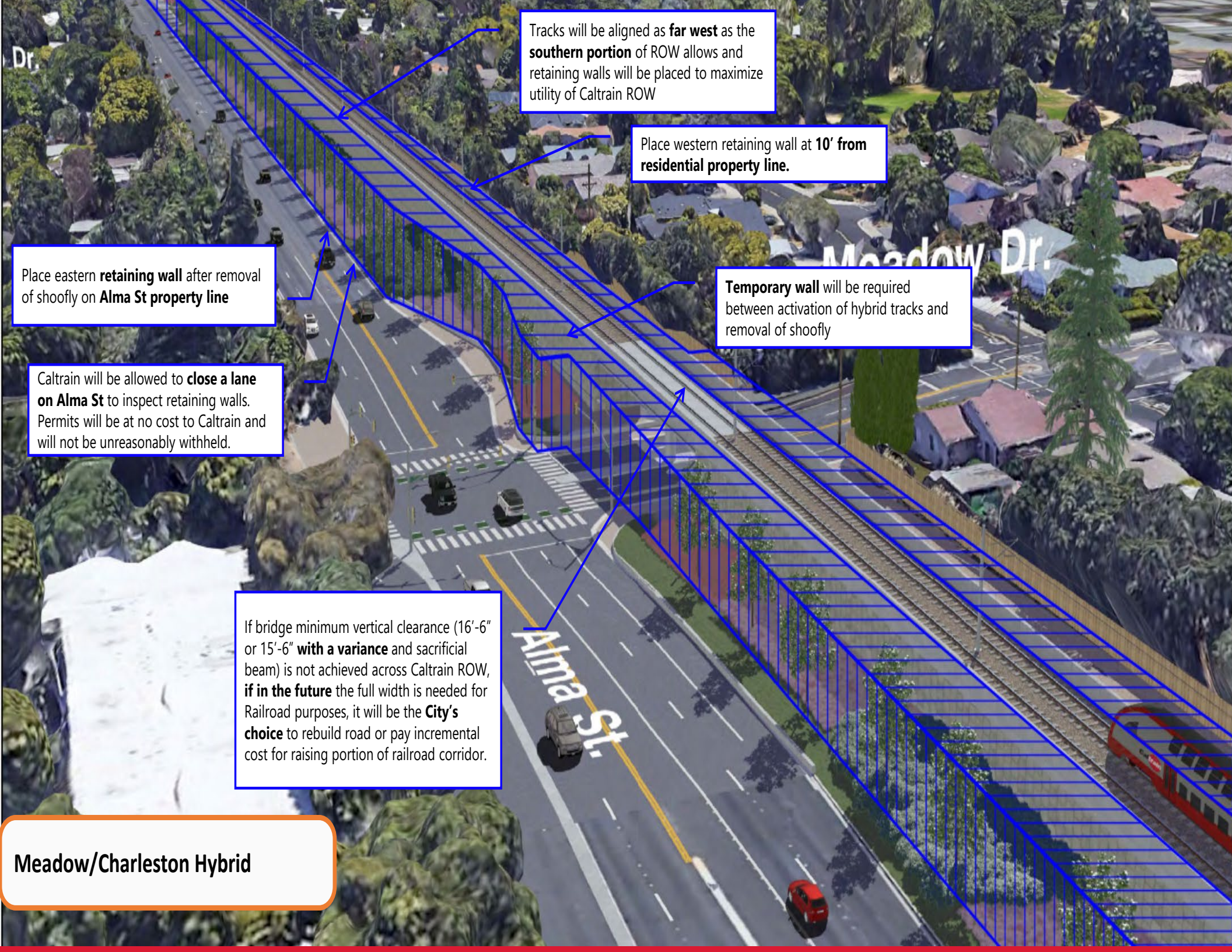
Caltrain's Results of Preliminary Review by Alternative

Churchill Alternatives

Partial Underpass w/ Kellogg Undercrossing (LPA)	Closure Option 1 (With Mitigations)	Closure Option 2 (With Mitigations)

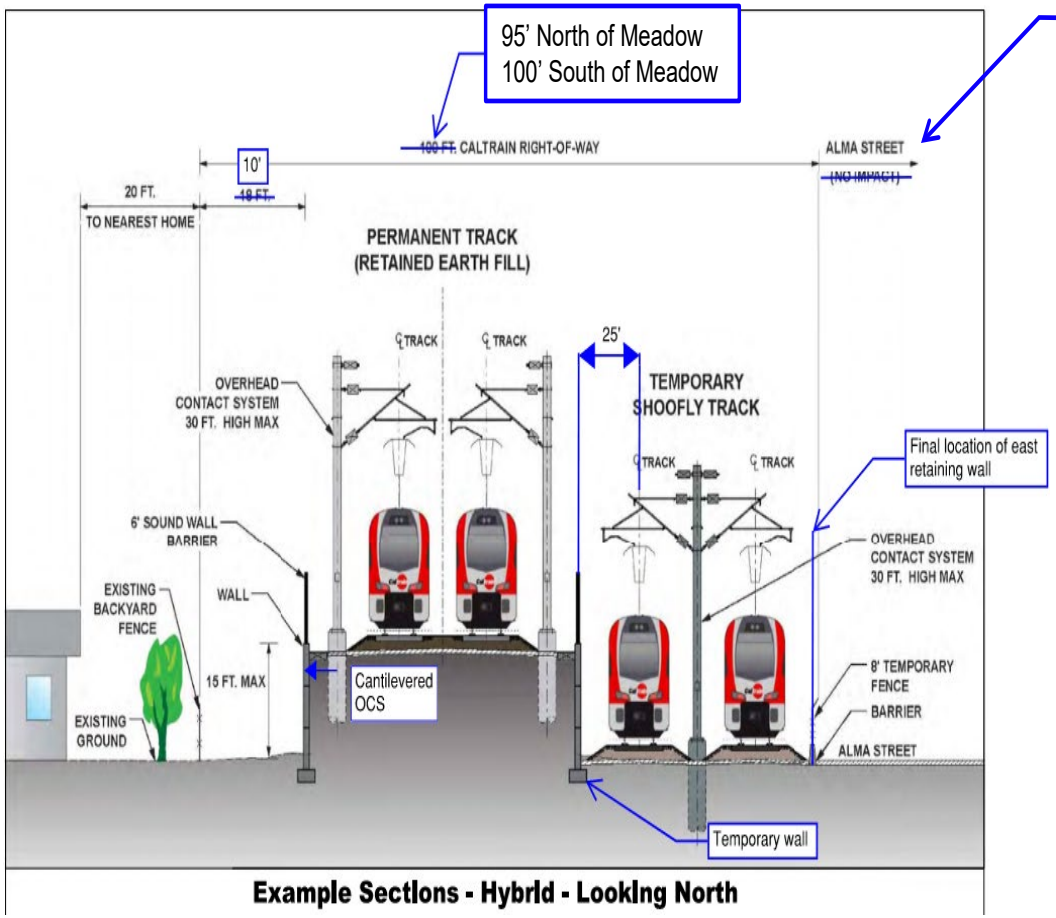
Meadow/Charleston Alternatives

Hybrid	Viaduct	Underpass



Meadow/Charleston Hybrid

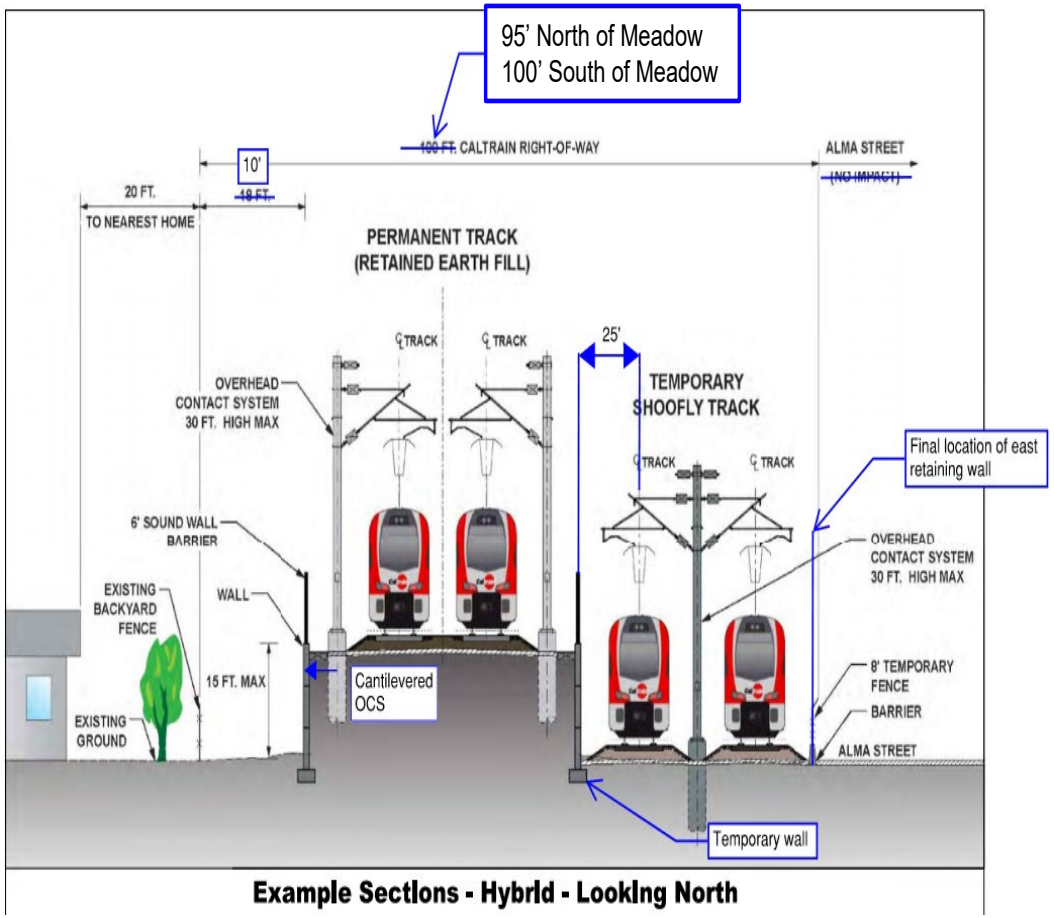
Meadow/Charleston Hybrid



Example Sections - Hybrid - Looking North

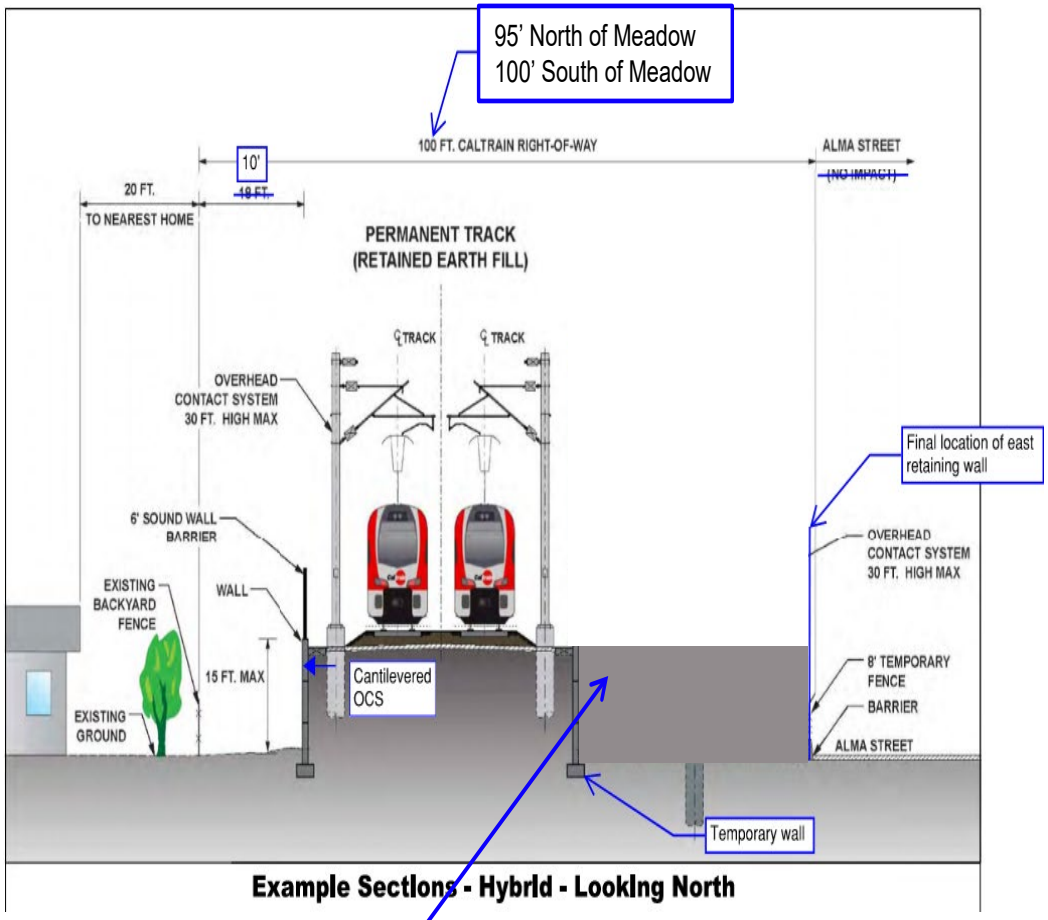
Interim Condition

Meadow/Charleston Hybrid



Example Sections - Hybrid - Looking North

Interim Condition



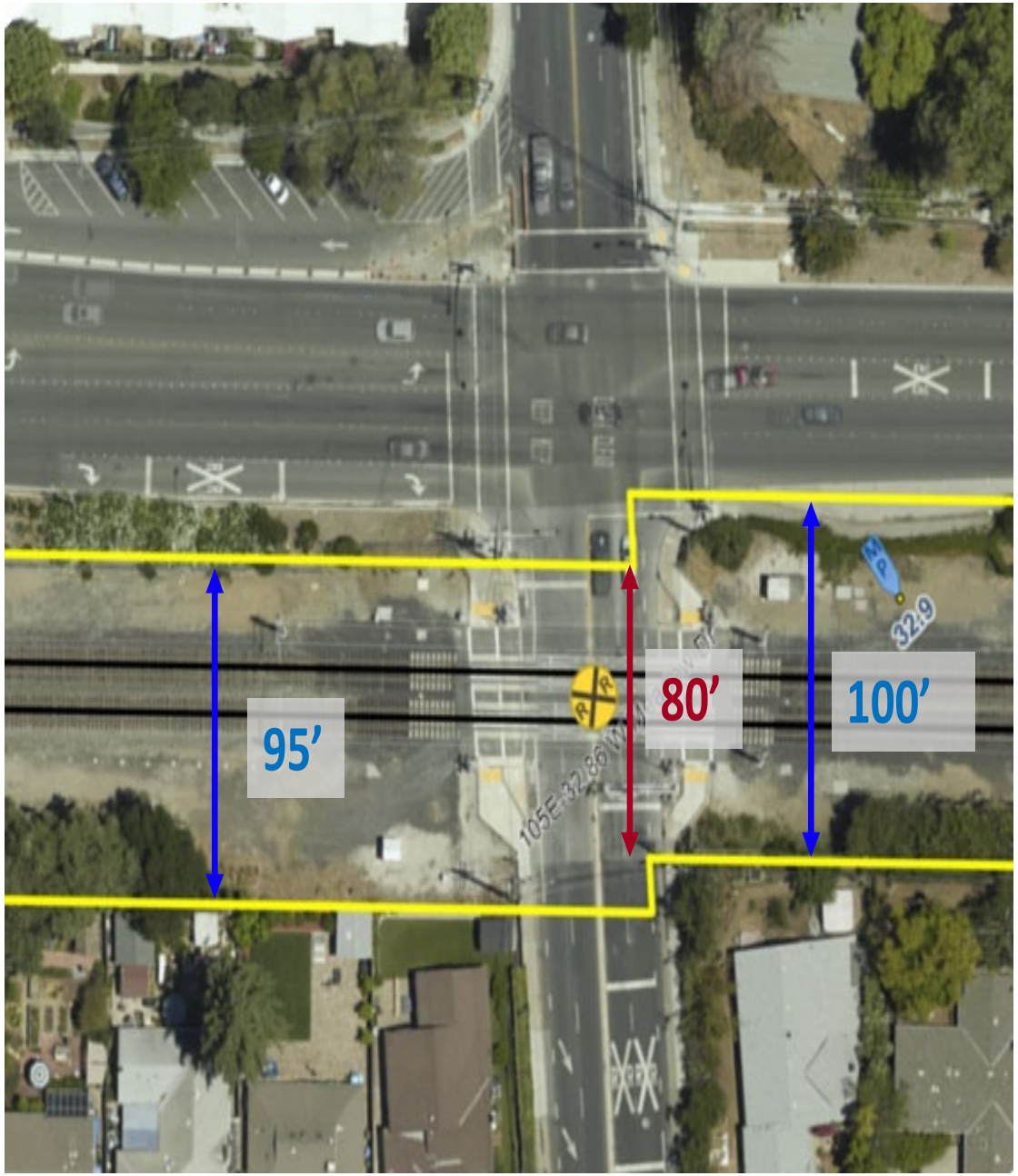
Example Sections - Hybrid - Looking North

Retained fill between temporary wall and Alma Street wall to **maintain utility of Caltrain operating ROW.**

Final Condition

Meadow/Charleston Hybrid

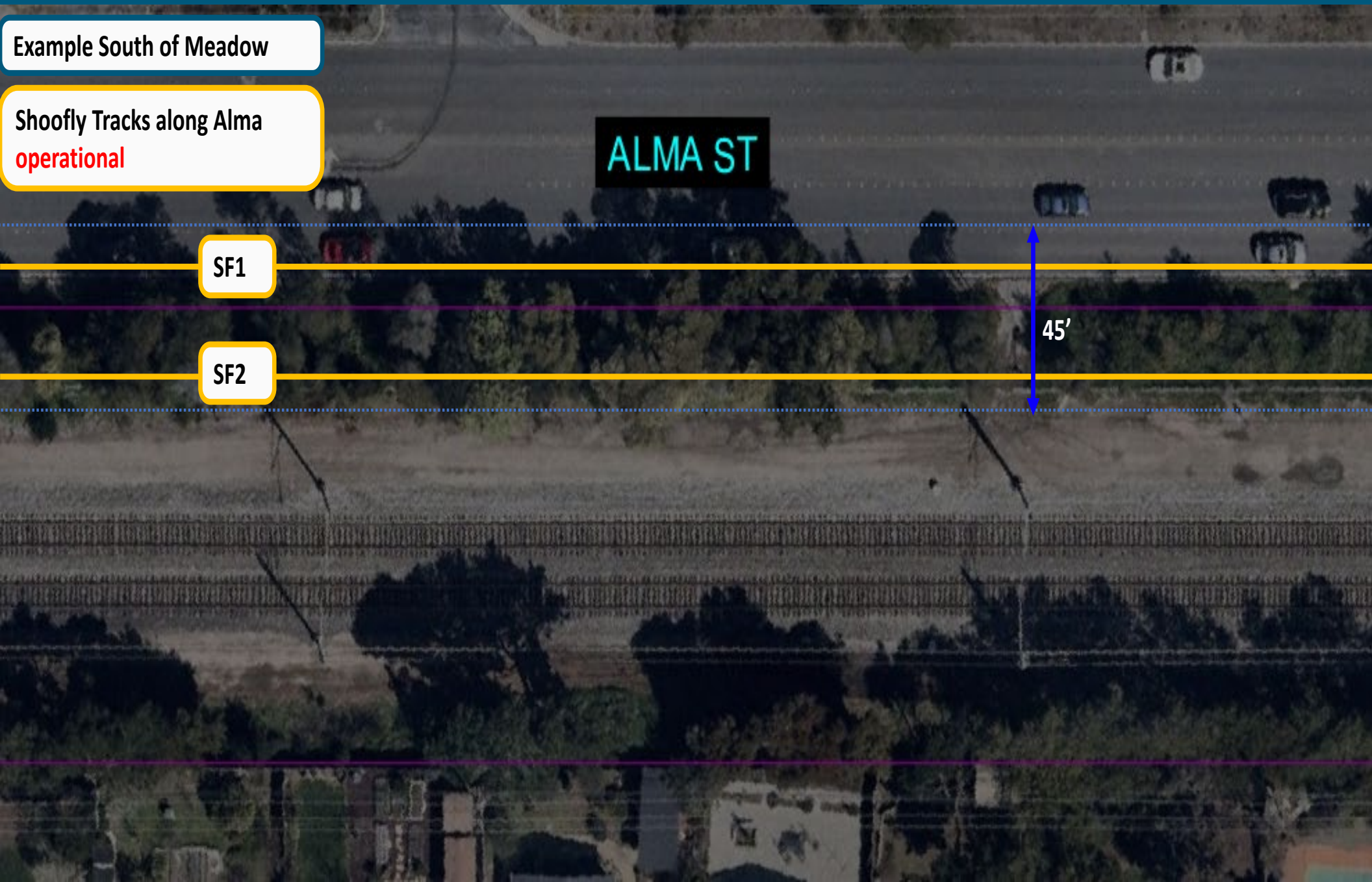
Implications of ROW Offset at Meadow Drive



Meadow/Charleston Hybrid

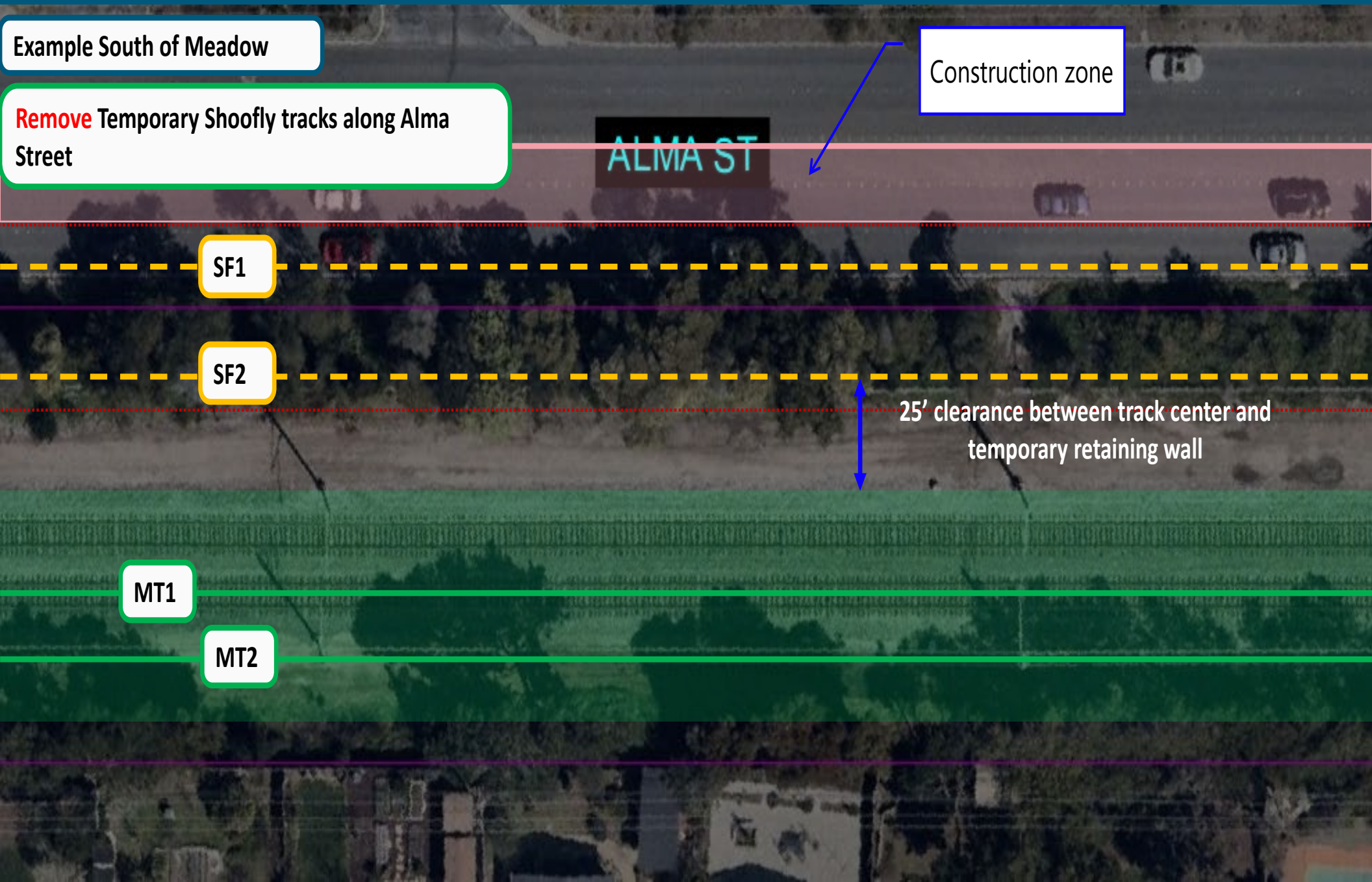
Meadow/Charleston Hybrid

Meadow/Charleston Hybrid



Meadow/Charleston Hybrid

Meadow/Charleston Hybrid

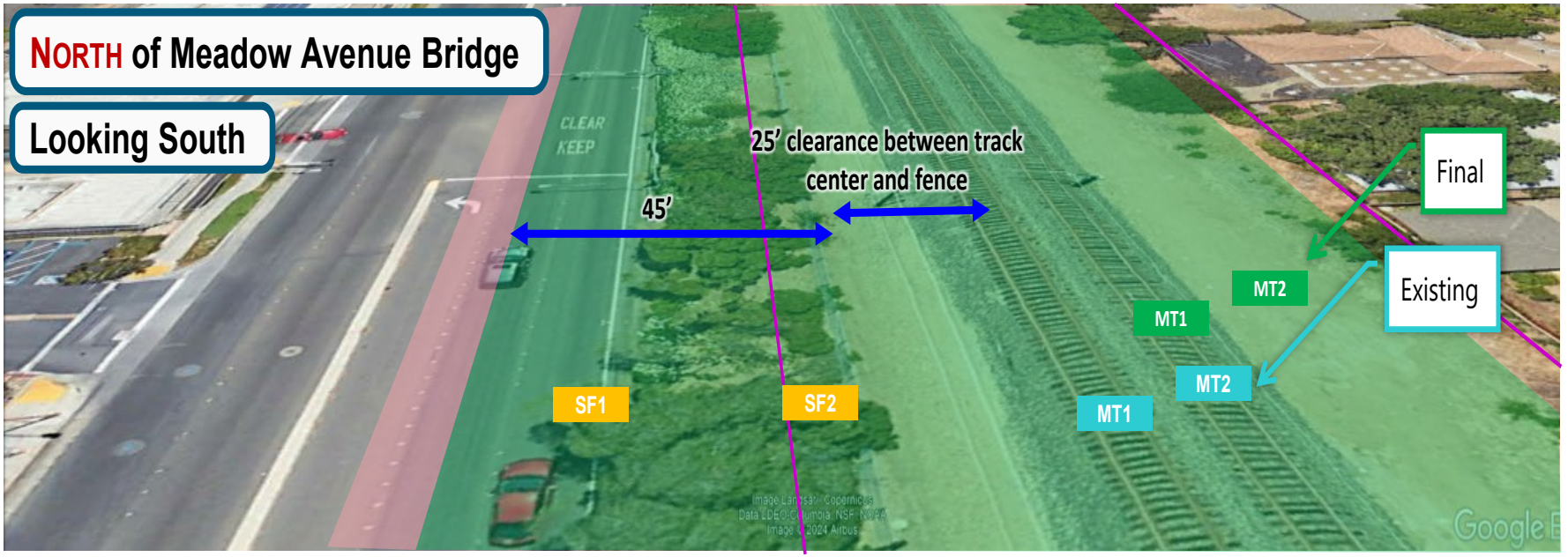


Meadow/Charleston Hybrid

Meadow/Charleston Hybrid

Meadow/Charleston Hybrid

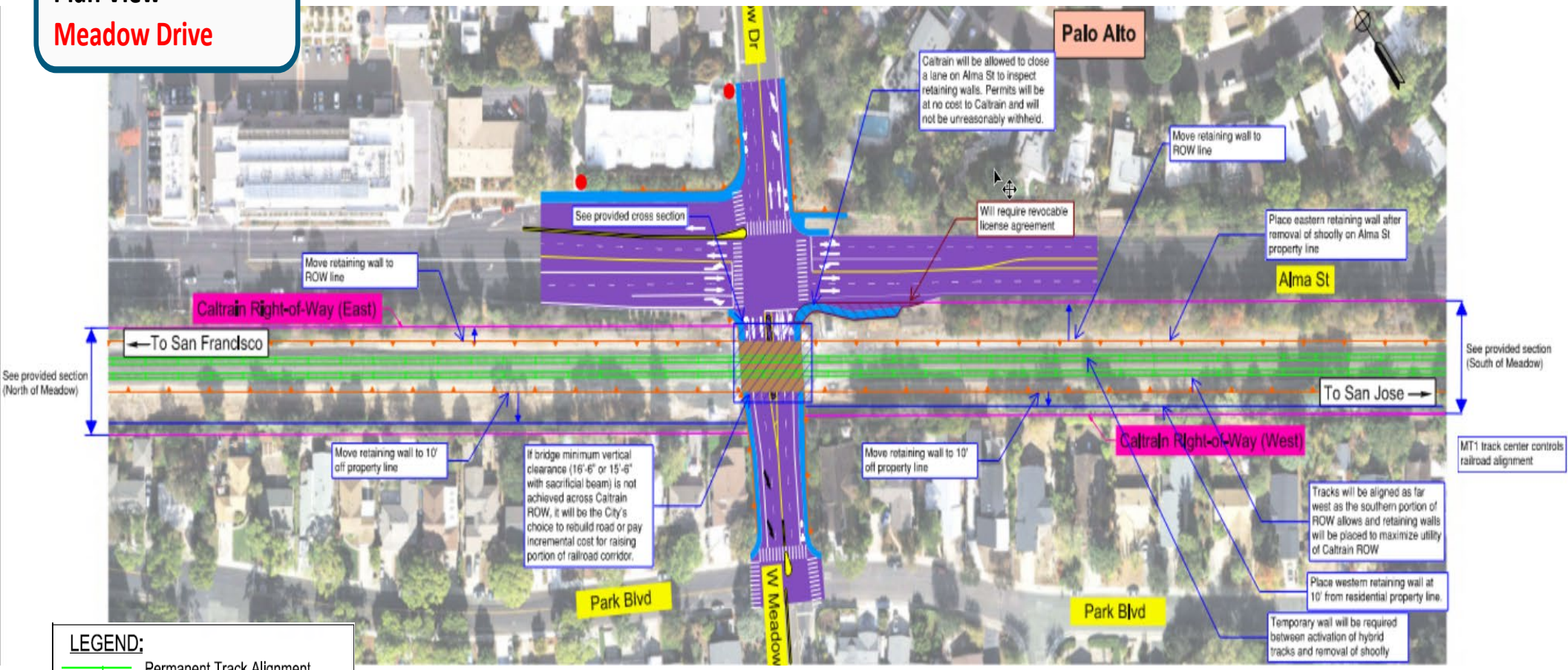
Meadow/Charleston Hybrid



Source: Google Earth, Google Street View, April 2023, Accessed February 2024

Meadow/Charleston Hybrid Summary

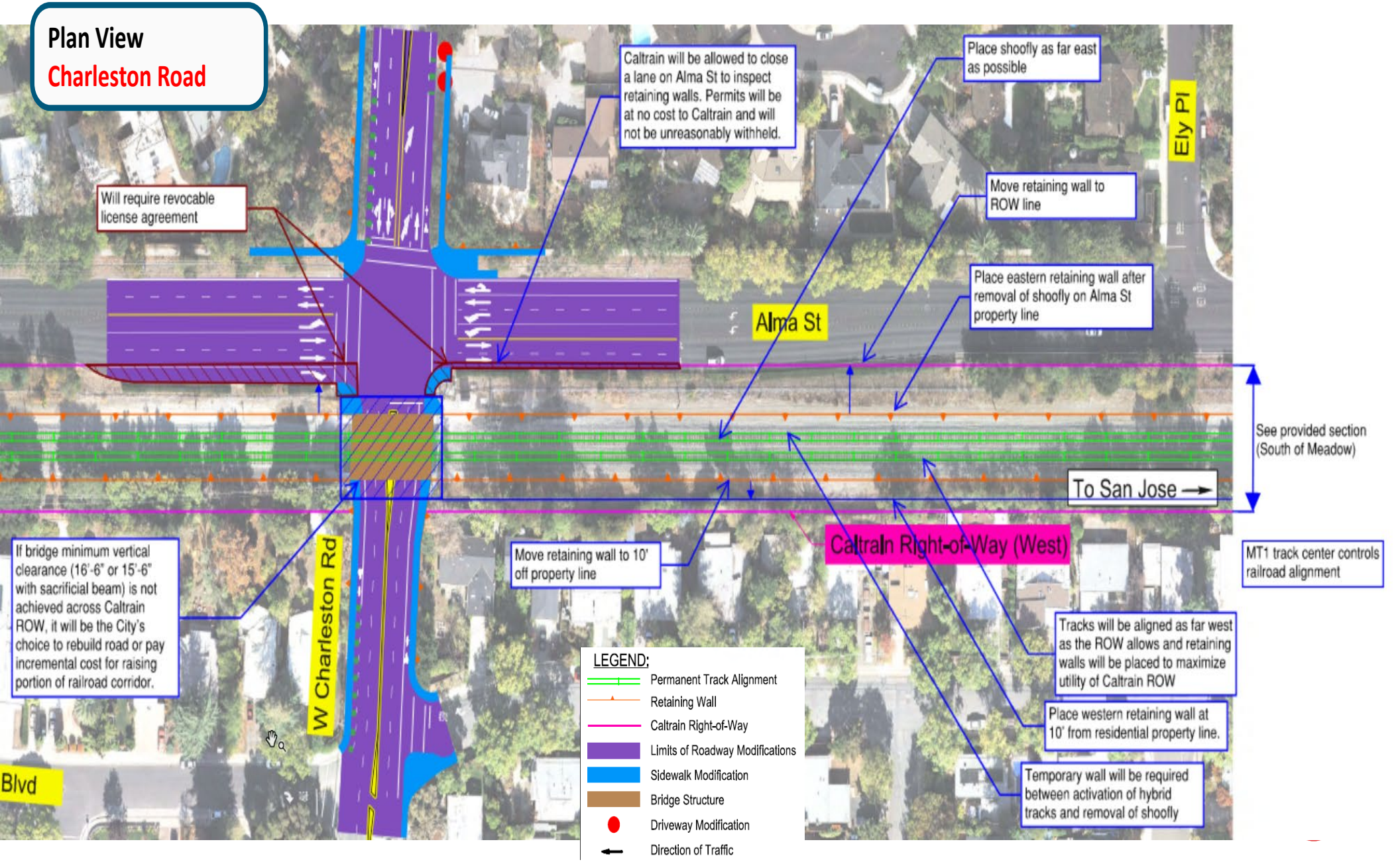
Plan View
Meadow Drive



LEGEND:

- Permanent Track Alignment
- Retaining Wall
- Caltrain Right-of-Way
- Limits of Roadway Modifications
- Sidewalk Modification
- Bridge Structure
- Driveway Modification
- Direction of Traffic

Meadow/Charleston Hybrid Summary



Caltrain's Results of Preliminary Review by Alternative

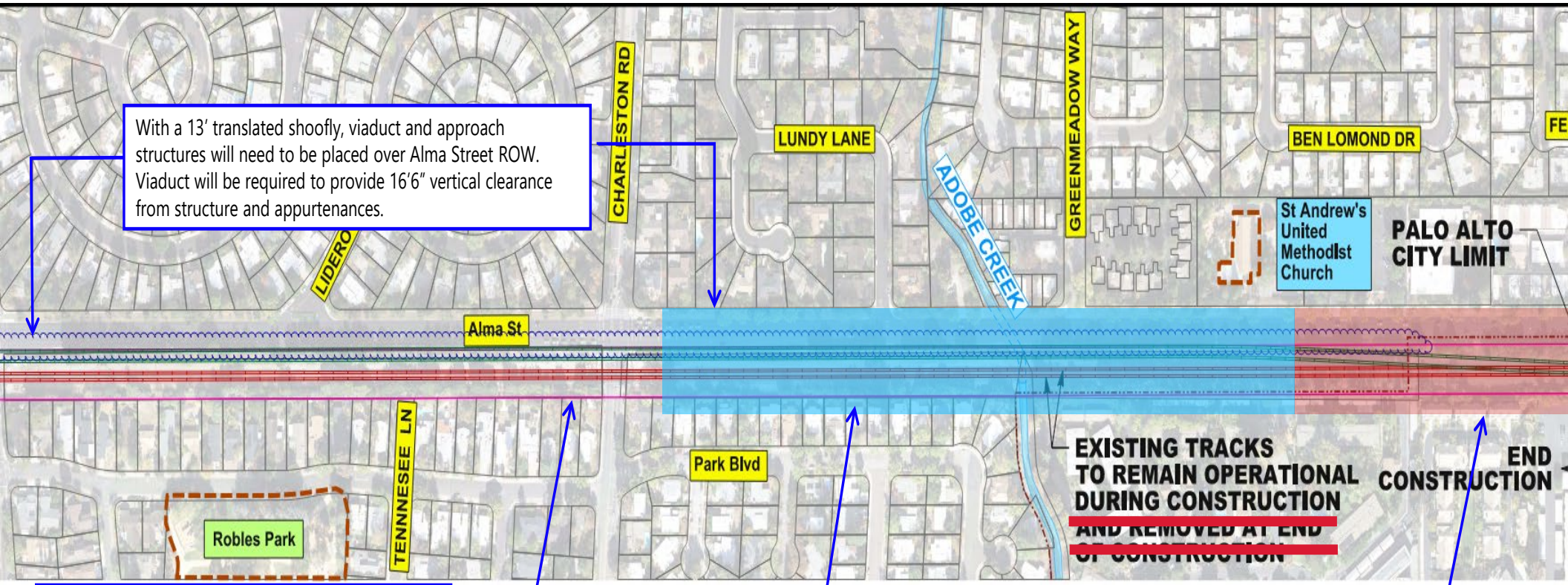
Churchill Alternatives

Partial Underpass w/ Kellogg Undercrossing (LPA)	Closure Option 1 (With Mitigations)	Closure Option 2 (With Mitigations)

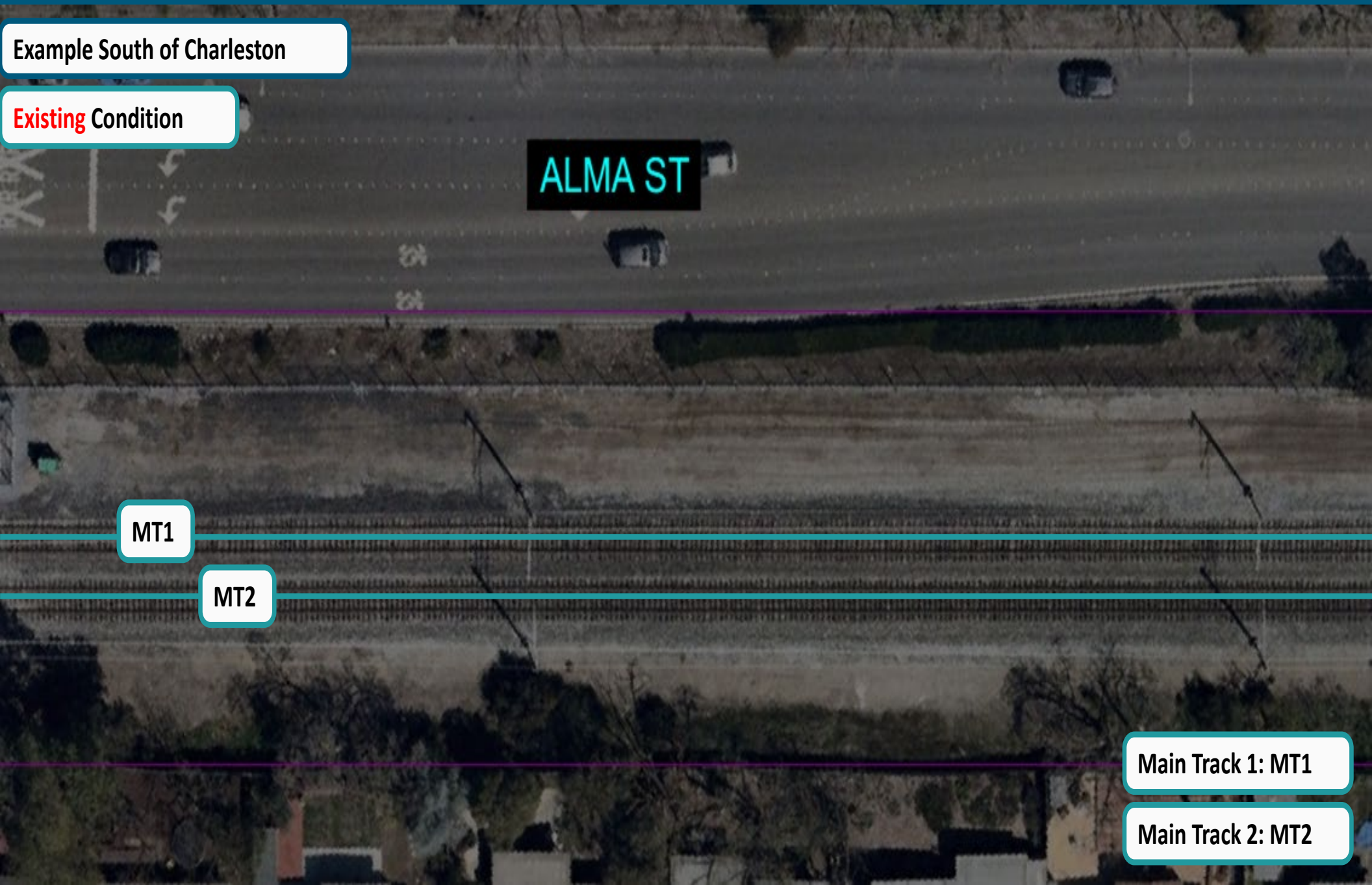
Meadow/Charleston Alternatives

Hybrid	Viaduct	Underpass

Meadow/Charleston Viaduct

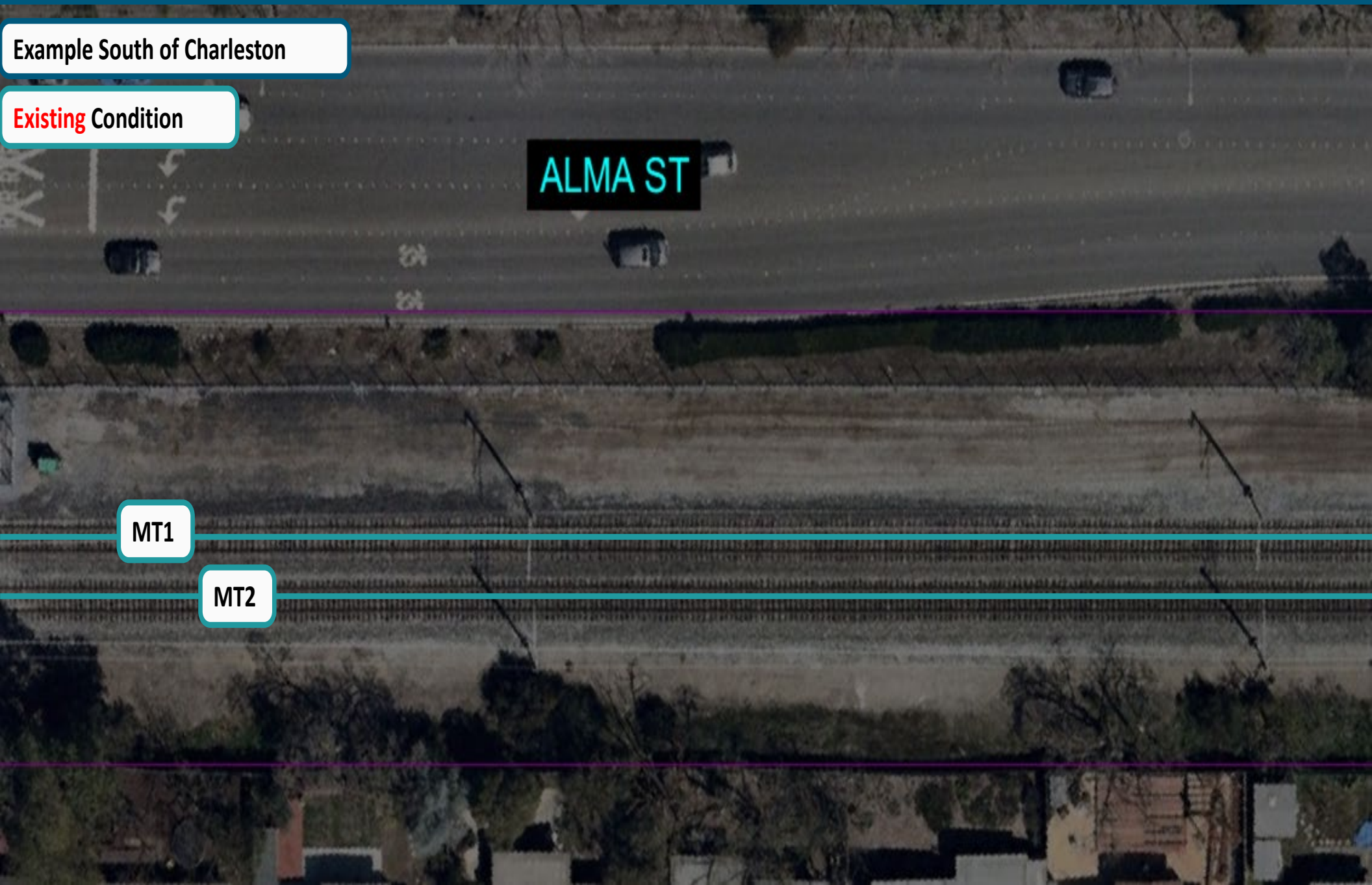


Meadow/Charleston Viaduct

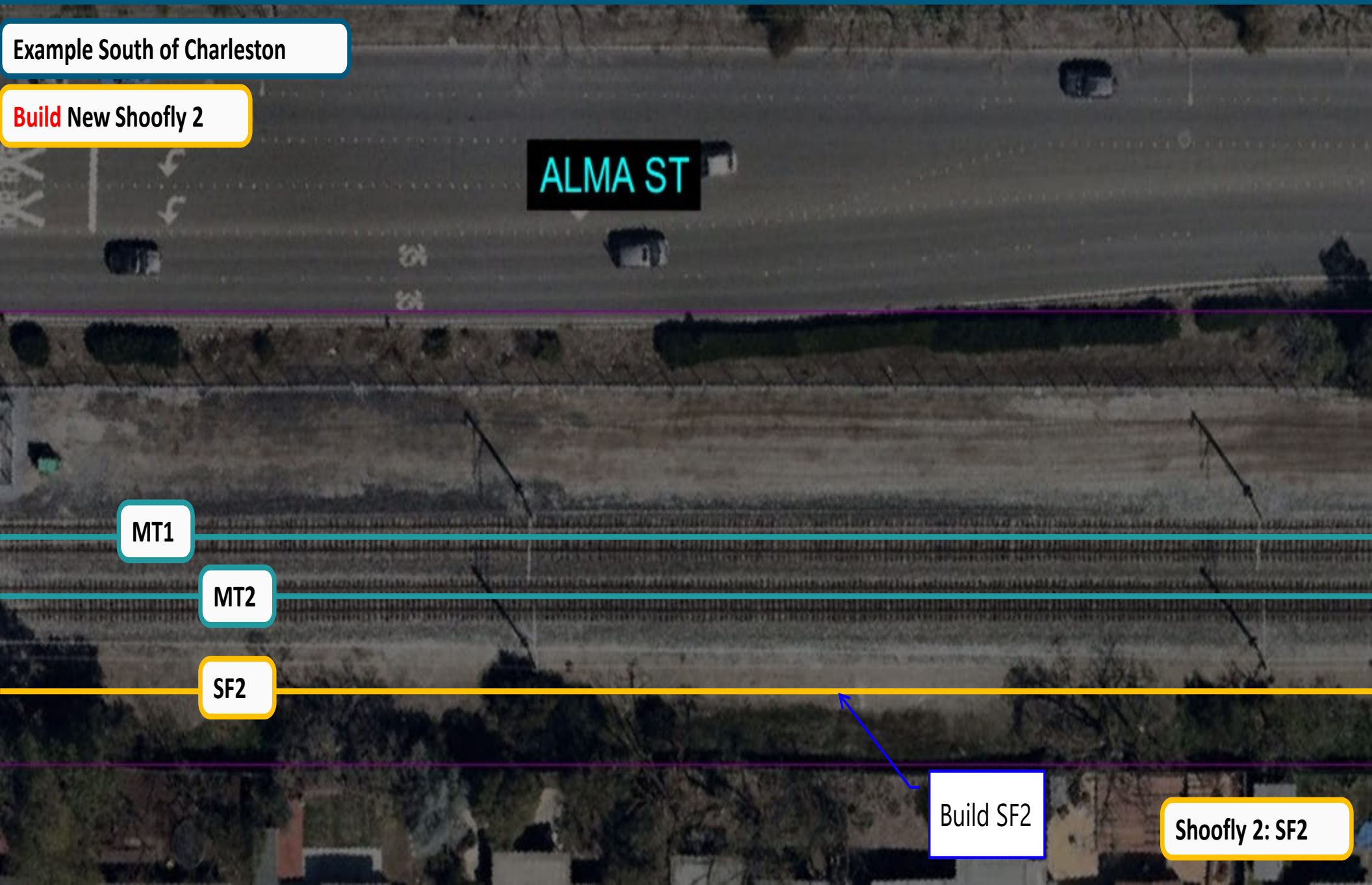


Meadow/Charleston Viaduct

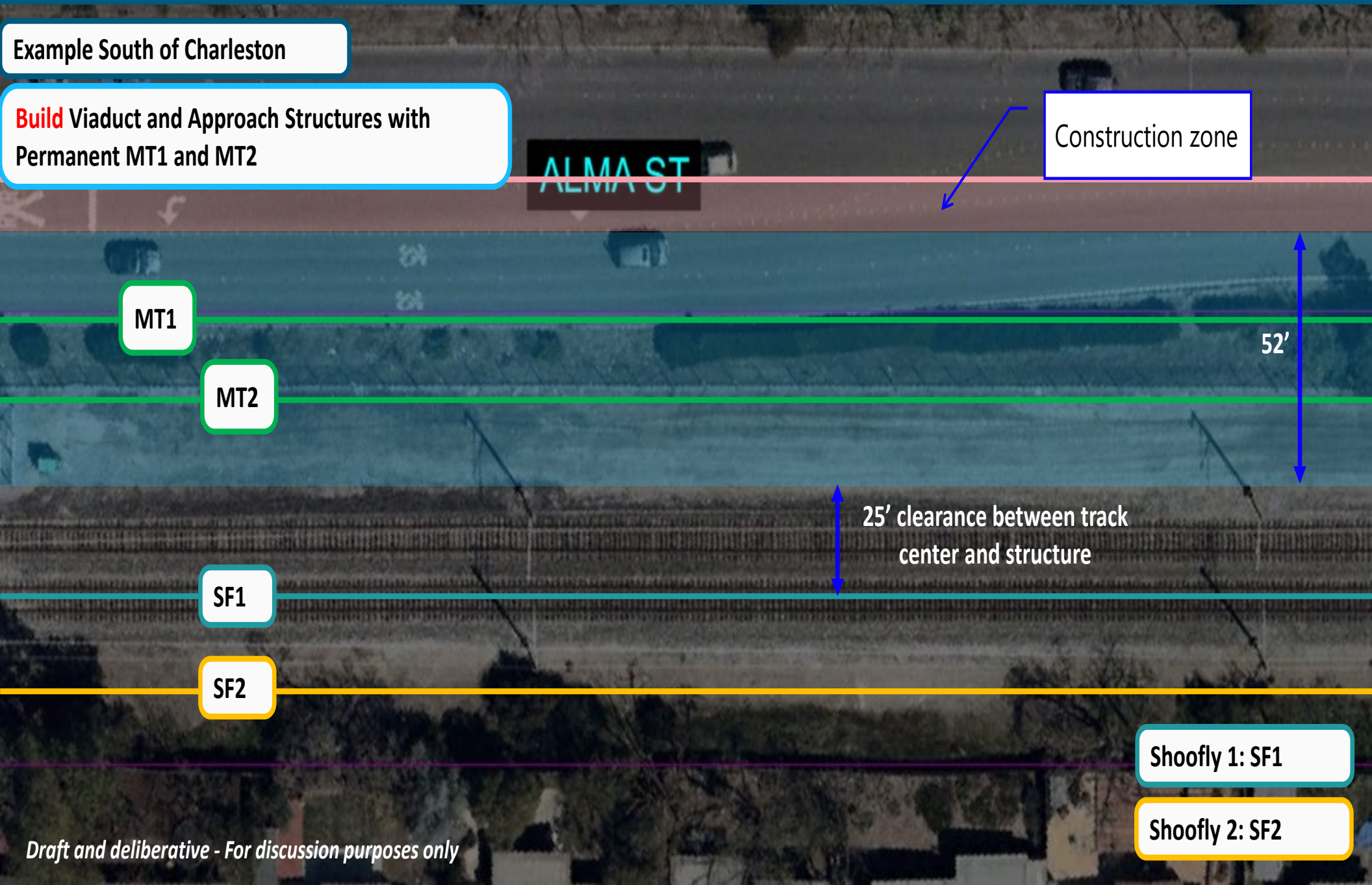
Meadow/Charleston Viaduct



Meadow/Charleston Viaduct

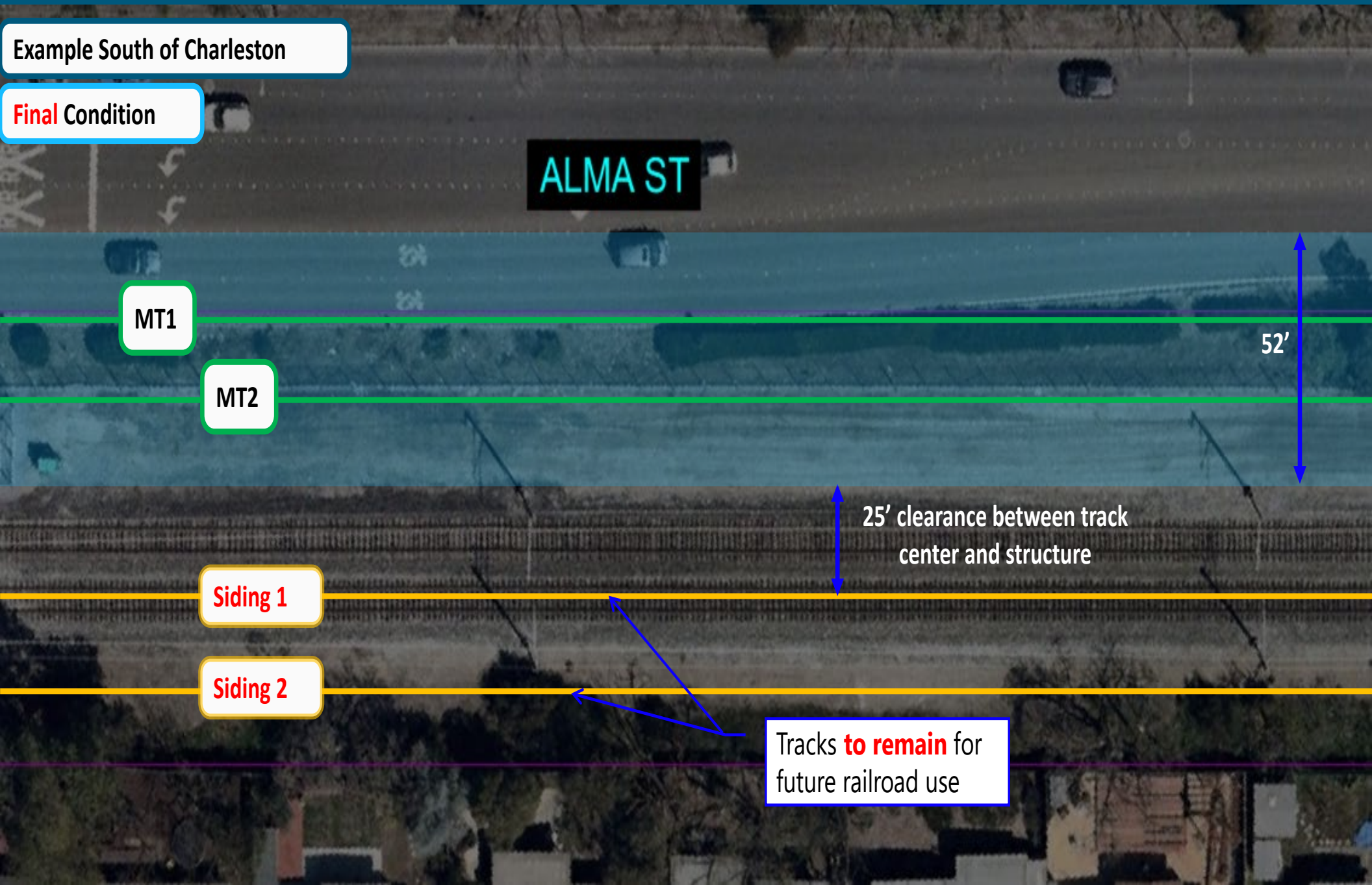


Meadow/Charleston Viaduct

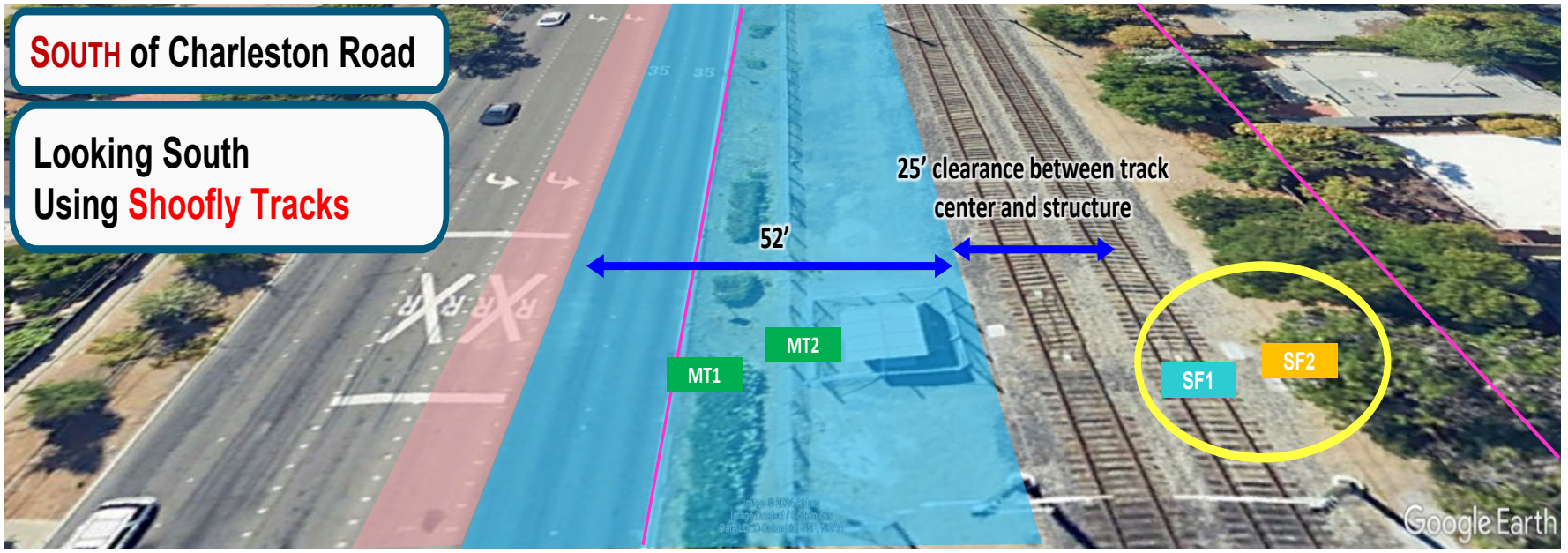


Draft and deliberative - For discussion purposes only

Meadow/Charleston Viaduct

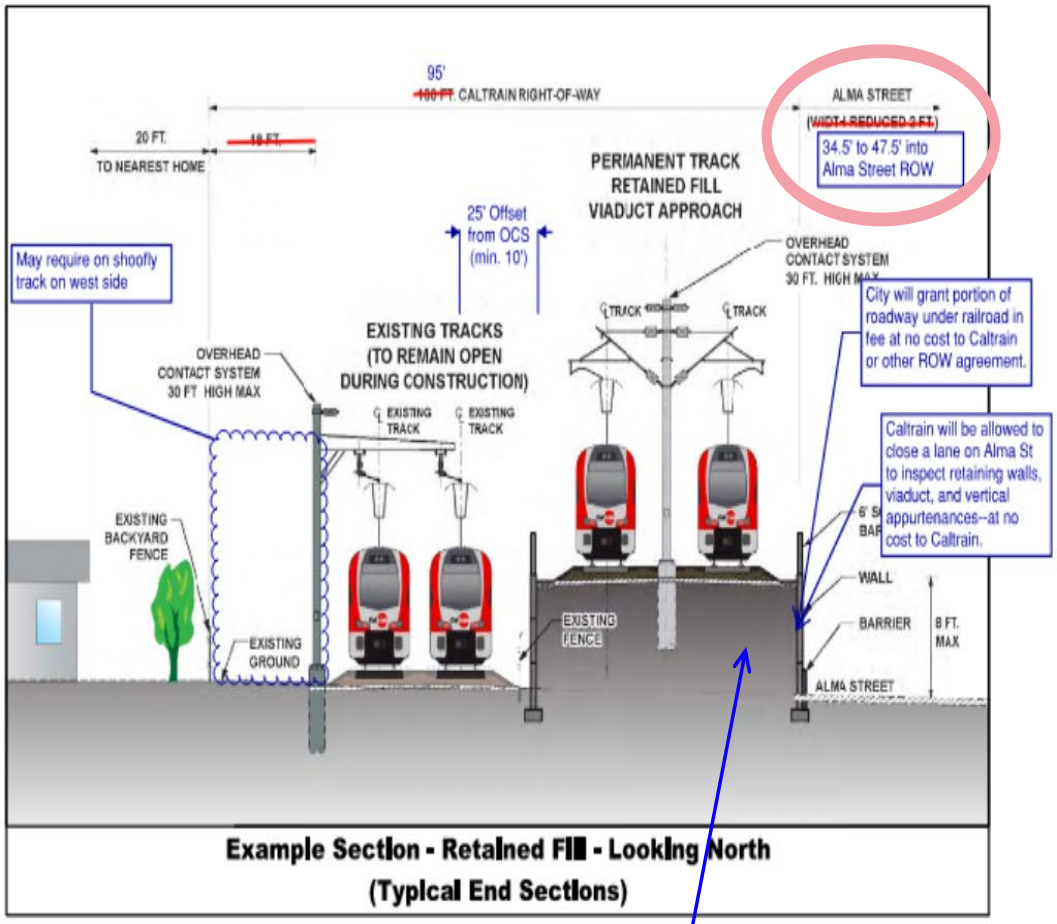


Meadow/Charleston Viaduct

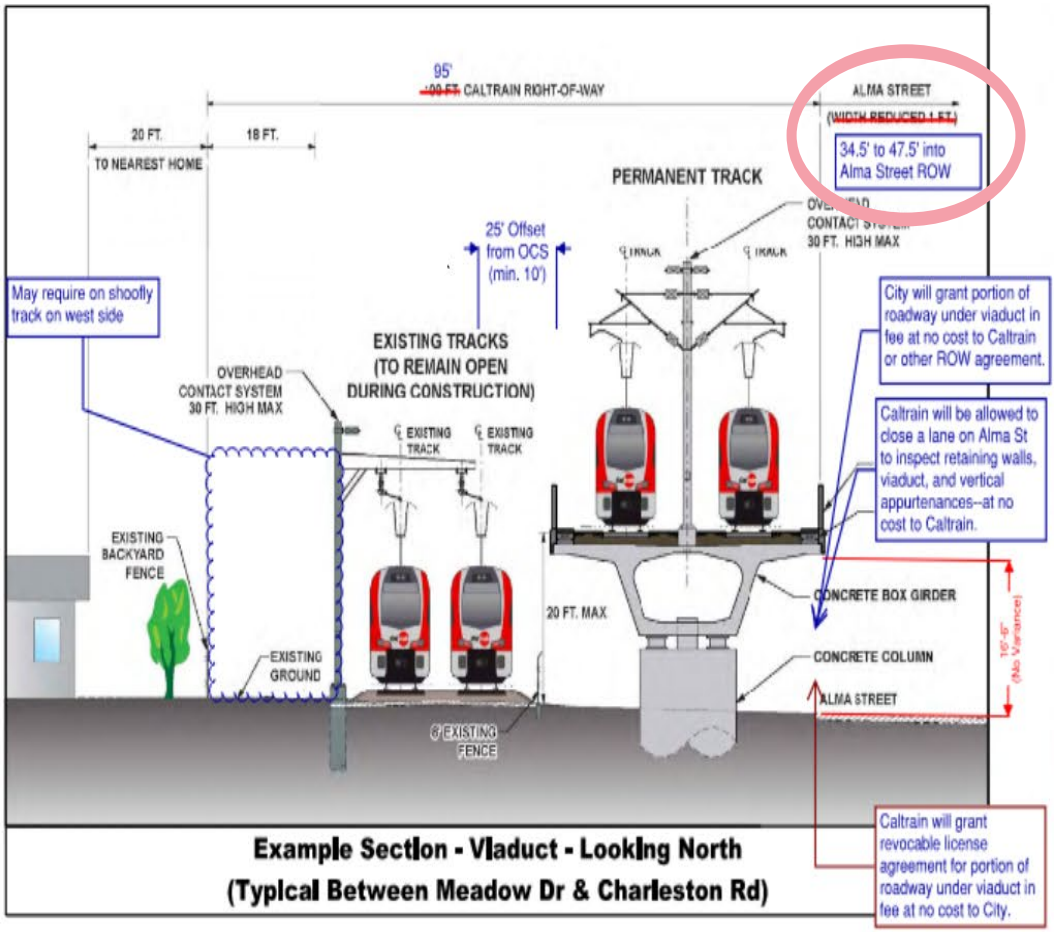


Source: Google Earth, Google Street View, April 2023, Accessed February 2024

North of Meadow Viaduct



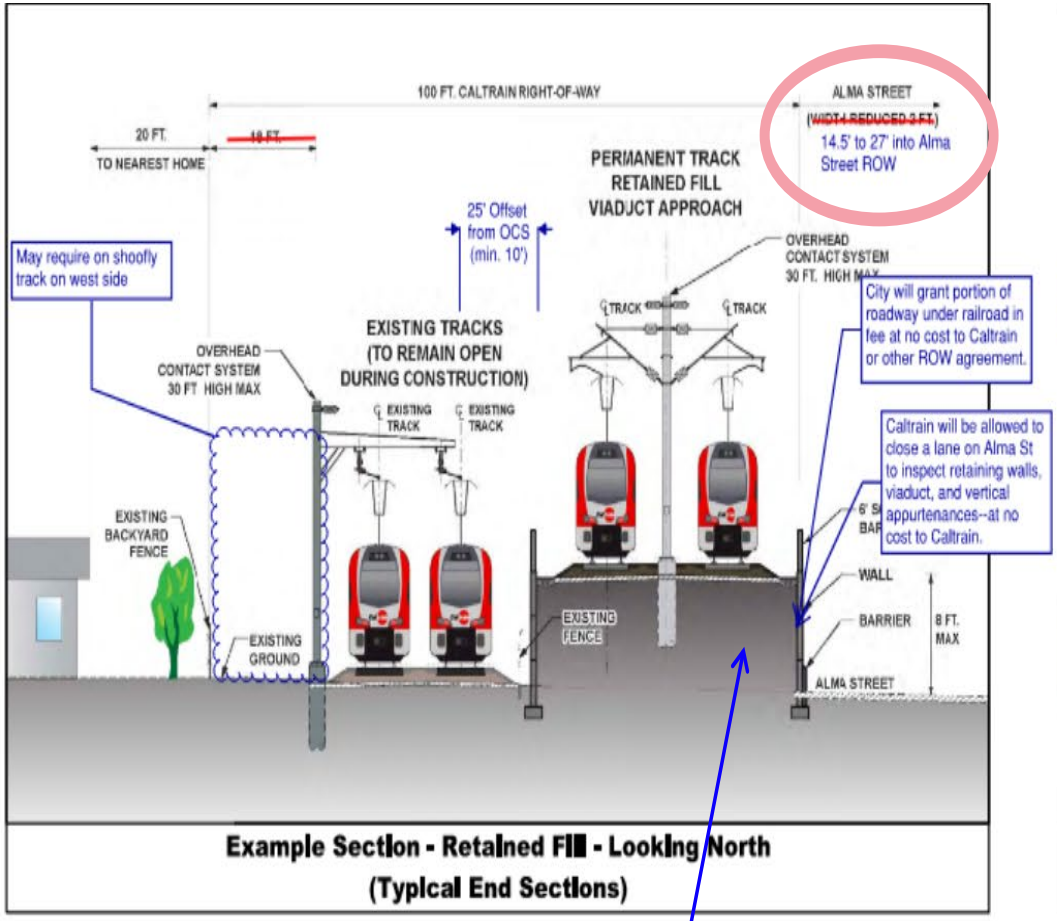
Example Section - Retained Fill - Looking North
(Typical End Sections)



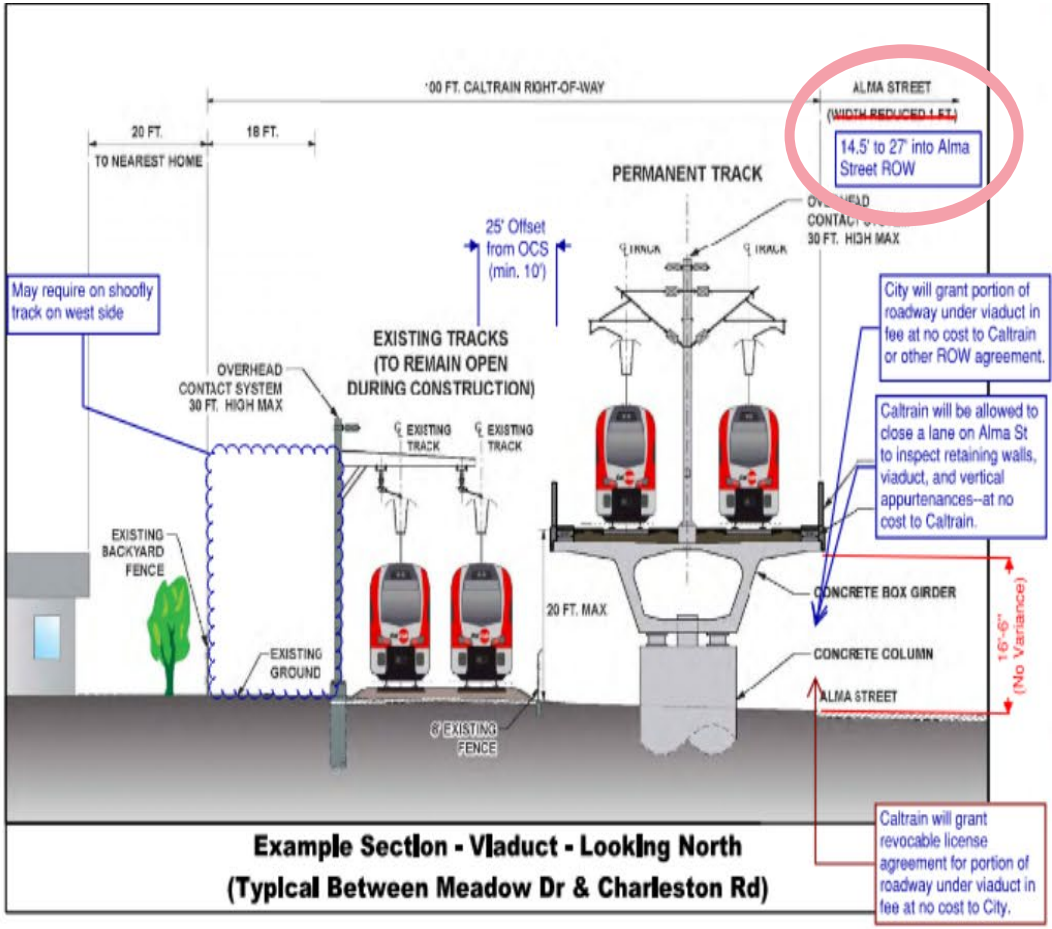
Example Section - Viaduct - Looking North
(Typical Between Meadow Dr & Charleston Rd)

Approach structure approximately **1,600 feet** long **south** of Charleston Road and **2,000 feet** long **north** of Meadow Dr

South of Meadow Viaduct



Example Section - Retained Fill - Looking North
(Typical End Sections)



Example Section - Viaduct - Looking North
(Typical Between Meadow Dr & Charleston Rd)

Approach structure approximately **1,600 feet** long **south** of Charleston Road and **2,000 feet** long **north** of Meadow Dr

Meadow/Charleston Viaduct

Proposed Vladuct Solutlon Overvlew - Looklng South West
Meadow Drlve Intersectlon

Viaduct and approach structures will need to be placed **over/on** Alma Street ROW

Existing Tracks at Grade to Remain in Place

Caltrain

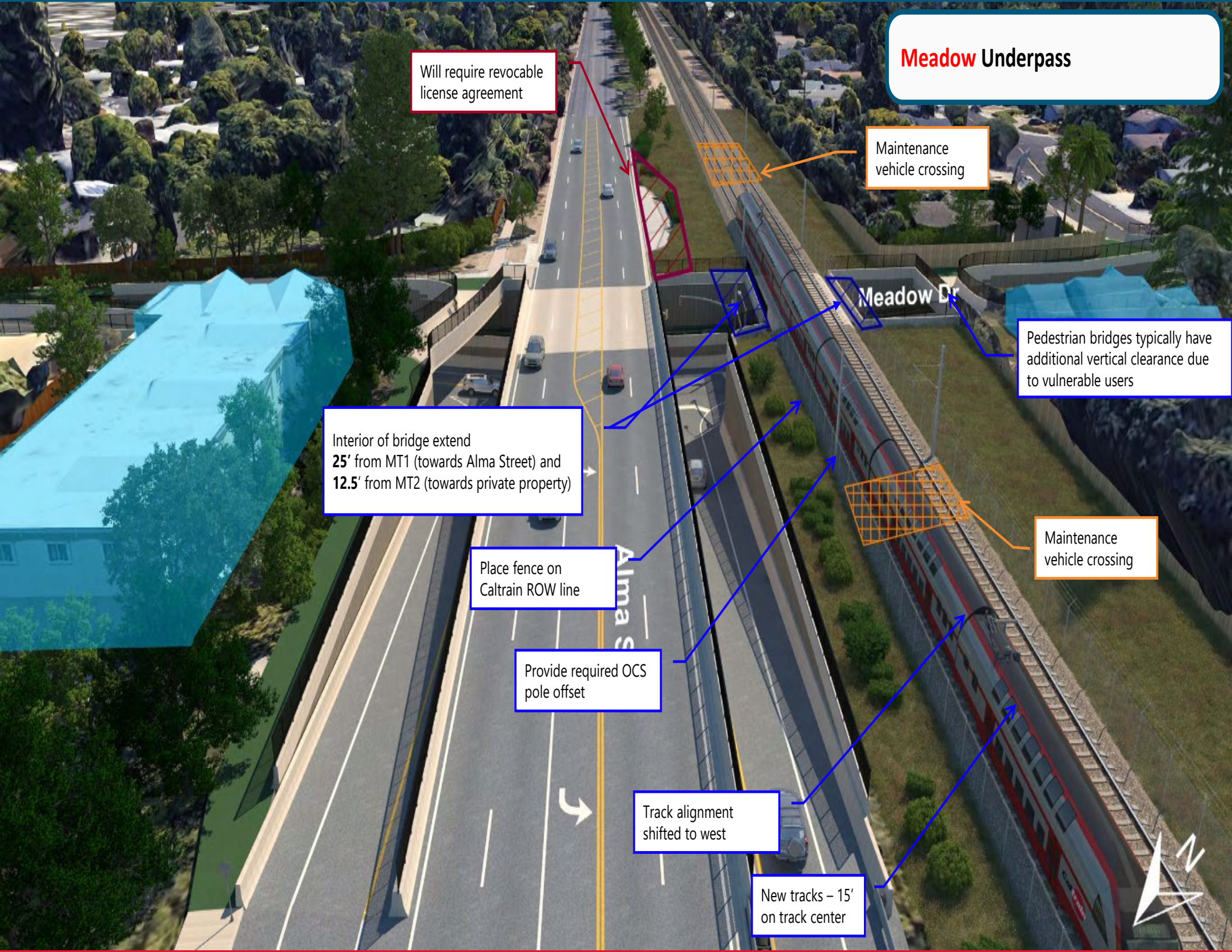
Caltrain's Results of Preliminary Review by Alternative

Churchill Alternatives

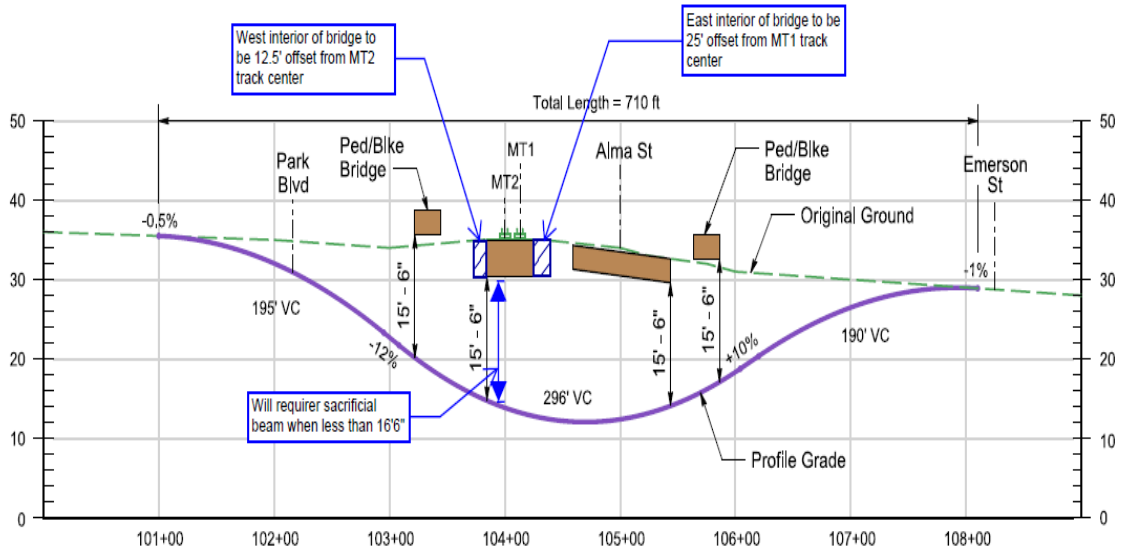
Partial Underpass w/ Kellogg Undercrossing (LPA)	Closure Option 1 (With Mitigations)	Closure Option 2 (With Mitigations)

Meadow/Charleston Alternatives

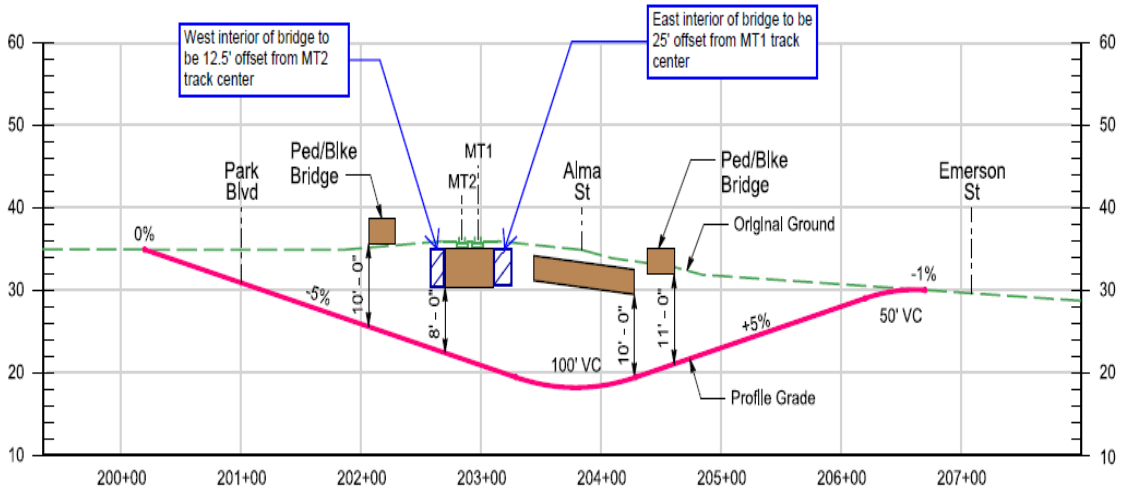
Hybrid	Viaduct	Underpass


Meadow Underpass
Will require revocable license agreement
Maintenance vehicle crossing
Meadow Dr
Pedestrian bridges typically have additional vertical clearance due to vulnerable users
Interior of bridge extend **25'** from MT1 (towards Alma Street) and **12.5'** from MT2 (towards private property)
Place fence on Caltrain ROW line
Maintenance vehicle crossing
Provide required OCS pole offset
Track alignment shifted to west
New tracks – 15' on track center
N

Meadow Underpass



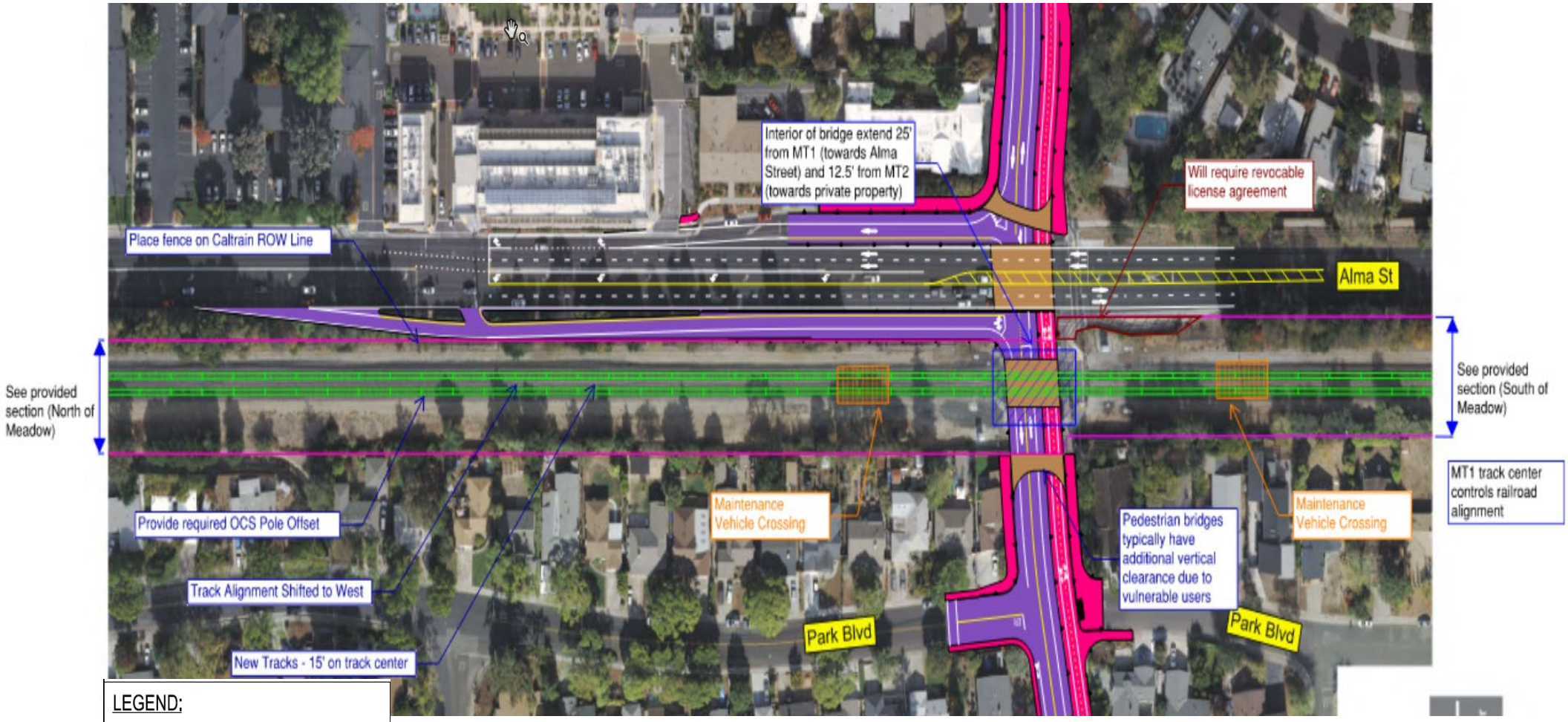
Meadow Dr Profile

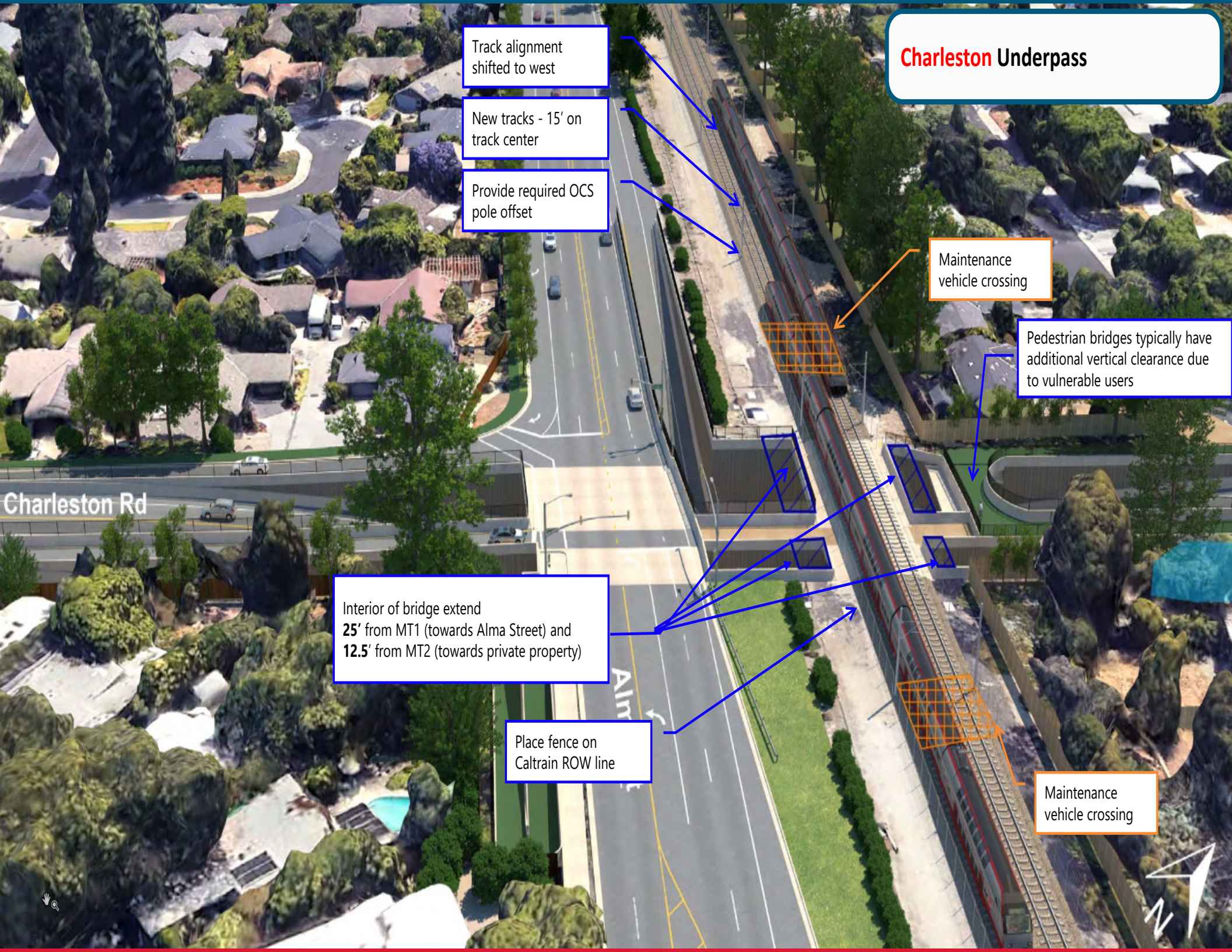


Ped/Bike Profile from Park Blvd to Emerson St

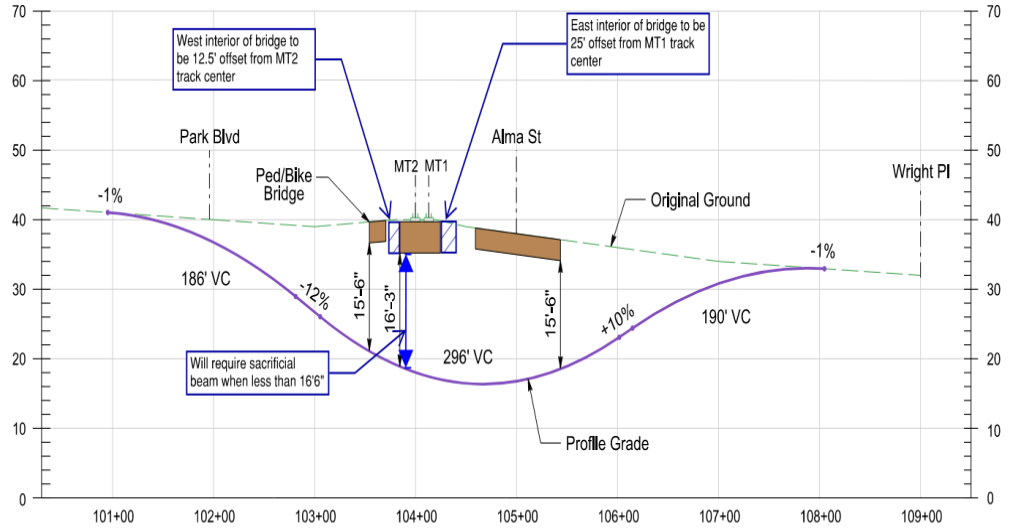
- Interior of bridge over Meadow Dr to accommodate **25'** offset from proposed MT1 track center (towards Alma St) and **12.5**' from MT2 (towards private property
- Add maintenance **crossovers** on either side of bridge over Meadow Dr
- **15'-6"** vertical clearance is allowed but will require a **variance** and sacrificial beam with an **agreement** for the City to cover the cost (of repair and Caltrain operations) if beam were to be struck

Meadow Underpass Summary

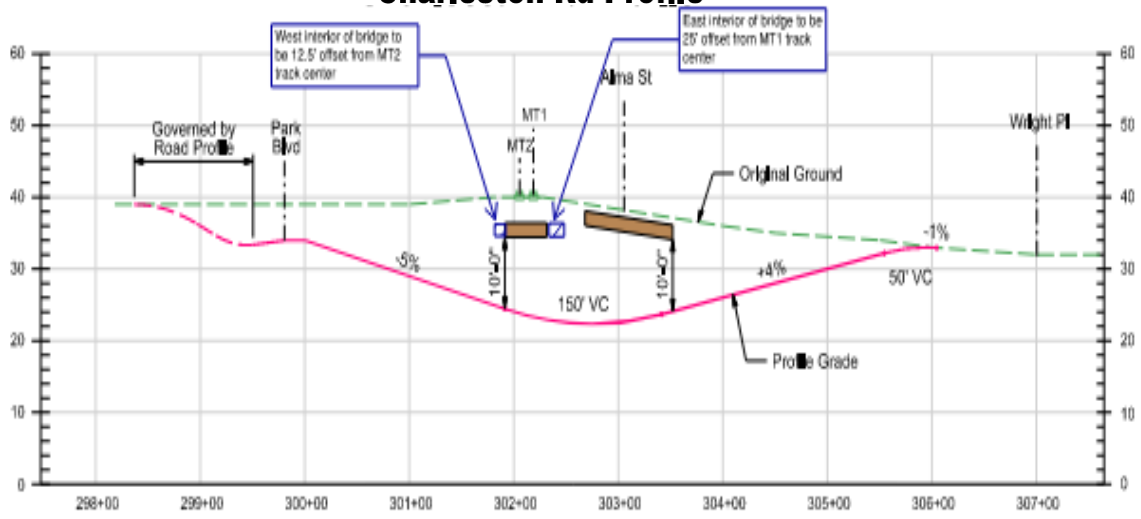



Charleston Underpass
Track alignment shifted to west
New tracks - 15′ on track center
Provide required OCS pole offset
Maintenance vehicle crossing
Pedestrian bridges typically have additional vertical clearance due to vulnerable users
Charleston Rd
Interior of bridge extend **25′** from MT1 (towards Alma Street) and **12.5**′ from MT2 (towards private property)
Place fence on Caltrain ROW line
Maintenance vehicle crossing
N

Charleston Underpass



Charleston Rd Profile

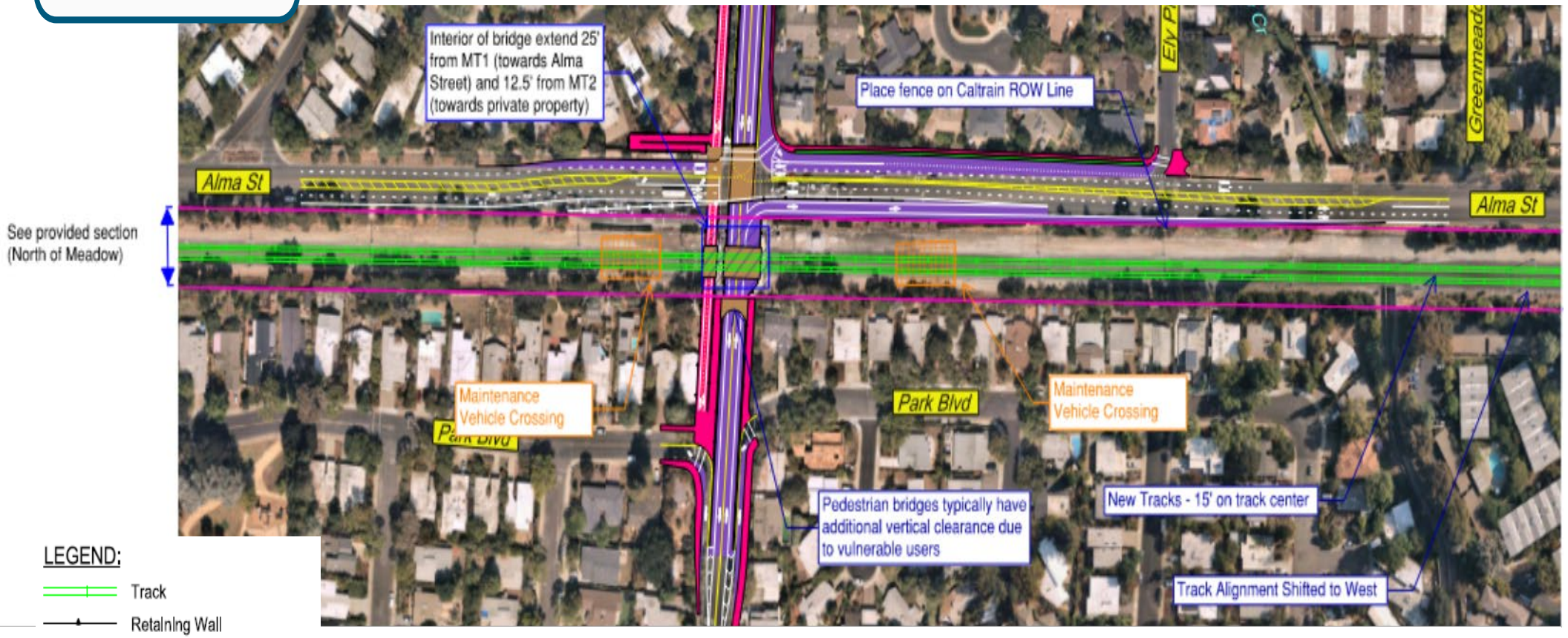


Ped/Bike Profile from Park Blvd to Wright PI

- Interior of bridge over Charleston Rd to accommodate **25'** offset from proposed MT1 track center (towards Alma St) and **12.5'** offset from proposed MT 2 track center (towards private property)
- Add maintenance **crossovers** on either side of bridge over Charleston Rd
- **15'-6"** vertical clearance is allowed but will require a **variance** and sacrificial beam with an **agreement** for the City to cover the cost (of repair and Caltrain operations) if beam were to be struck

Charleston Underpass Summary

Plan View
Charleston Road



Next Steps

Next Steps

The goal is to provide sufficient information for Rail Committee to evaluate alternatives and make recommendation to the City Council. Therefore, Staff is seeking

- Rail Committee's review and selection of preferred alternative for recommendation to the City Council
- Study session with City Council (April 2024)
- City Council to select preferred alternative for advancement into Preliminary Engineering & Environmental Documentation phase for Meadow and Charleston Crossing (May/June 2024)
- Execute Agreement with FRA and Service Agreement/Cooperative Agreement for Preliminary Engineering & Environmental with Caltrain & VTA

CITY OF
PALO
ALTO

KITTELSON & ASSOCIATES
155 Grand Avenue, Suite 505
Oakland, CA 94612
P 510.839.1742

TECHNICAL MEMORANDUM

March 14, 2024 Project# 28476

To: Ozzy, Arce
Palo Alto Office of Transportation
,

From: Kittelson & Associates, Inc.

RE: Seale vs Kellogg Grade Separated Rail Crossing Assessment

Seale vs Kellogg Grade Separated Rail Crossing Assessment

The BPTP Update consultant team evaluated the merits of each location (Seale and Kellogg) for a grade separated rail crossing based on the following assessment topics:

- Prior analyses and plans
- Proximity to alternative routes
- Landing location
- Network connectivity
- Community input

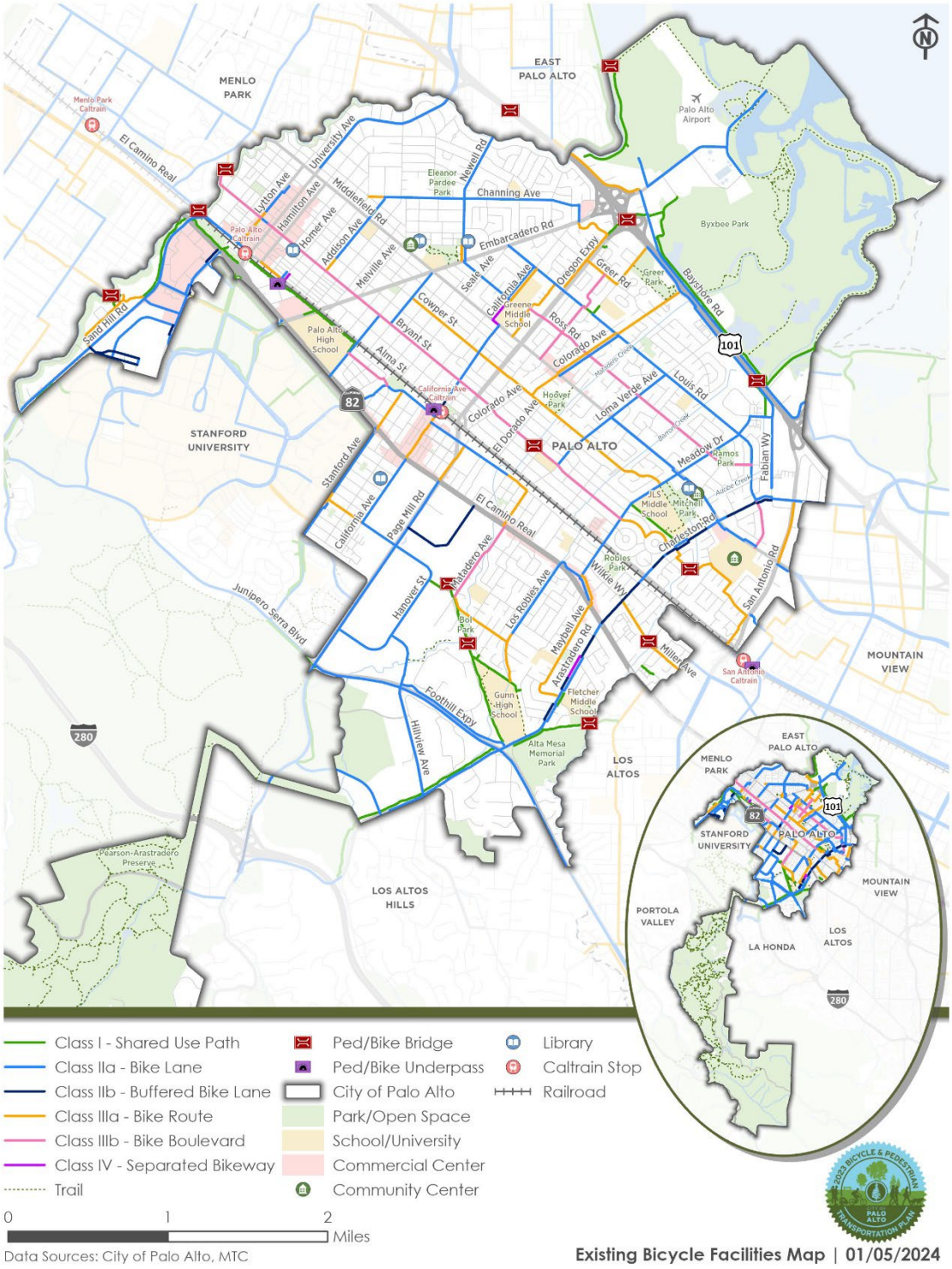
The findings of the assessment are presented in Table 1.

Table 1 Seale vs Kellogg Grade Separated Rail Crossing Assessment

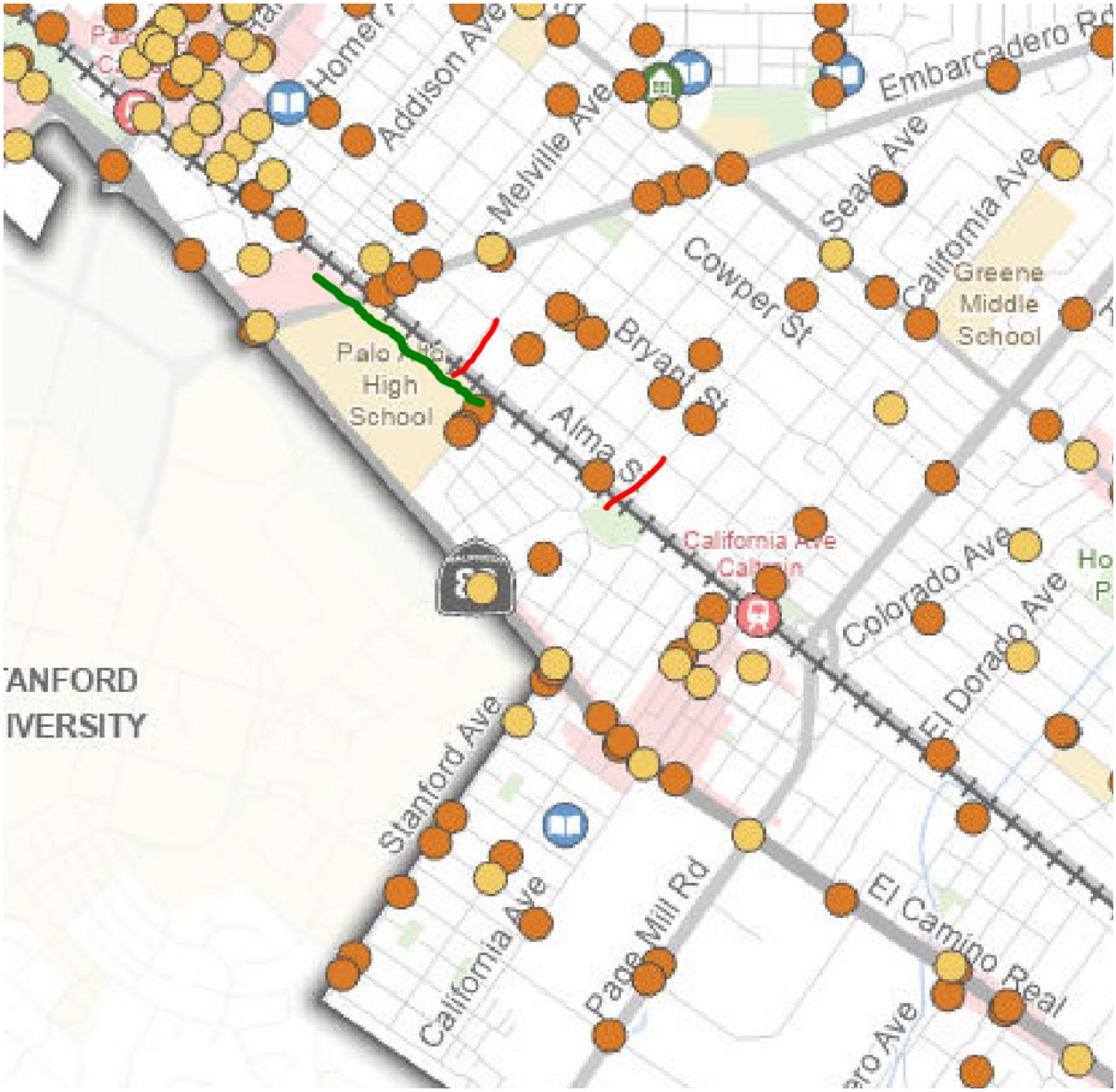
Assessment Topic	Seale	Kellogg
Prior analysis and plans	The 2012 BPTP identifies Seale Avenue as a recommended location for an across barrier connection. The 2013 Palo Alto Rail Corridor Study identified Seale Avenue a potential crossing location. The 2021 XCAP Report identified the addition of a bike/ped crossing at Seale as a general potential mitigation for the Churchill grade separation. This option was selected with mitigation.	The 2012 BPTP does not identify Kellogg Avenue as a recommended across barrier connection or location for a grade separated rail crossing. The 2013 Palo Alto Rail Corridor Study identified Kellogg Avenue a potential crossing location. The 2021 XCAP Report included a ped/bike tunnel as part of concept designs for the Churchill Avenue Partial Underpass. This option was not selected.
Proximity to alternative routes	Seale Avenue is located about 1,700 feet north of the Cal Ave Tunnel and about 1,850 feet south of the at-grade rail crossing at Churchill Ave.	Kellogg Avenue is located about 450 feet north of the at-grade crossing at Churchill and about 1,200 feet south of the grade-separated rail crossing at Embarcadero.
Landing locations	There is space available at Peers Park for a landing.	There is limited space available for a landing at Paly High School.
Network connectivity	Seale Avenue connects to the Serra Street/Park Boulevard and Stanford Avenue east-west bikeways (along with the north-south Castilleja-Park-Wilkie Bicycle Boulevard) across Caltrain.	Kellog Avenue connects to the Embarcadero Bike Path and Bryant Street Bike Boulevard. Kellog Avenue terminates at Waverley Street three blocks east of the rail line, limiting utility of this route as a through connection.
Community input	Comments received on the interactive map during the BPTP Update indicate a strong demand for a grade-separate bike/ped crossing of Alma and the rail line. Ideas proposed for a new crossing include an	While comments received on the interactive map during the BPTP Update indicated demand for grade separated crossings, they did not identify Kellogg as a preferred alignment.

	alignment at Seale under the tracks to Peers Park. Churchill Avenue, the crossing nearest to Seale, was flagged as stressful for cyclists and pedestrians, indicating a lower stress route is desired. A grade separated crossing at Seale would provide an alternate low-stress facility.	
Overall	The Seale Avenue crossing is supported by prior plans and analyses, would fill a longer gap between alternative crossing locations, appears to have adequate space for a landing location, would increase connectivity to the transportation network, and has been identified as a potential alignment for a grade-separated rail crossing in public involvement efforts for the BPTP Update.	The Kellog Avenue crossing would not fill as long a gap between crossing locations and have limited utility in terms of increasing network connectivity.

REFERENCES


MENLO PARK
EAST PALO ALTO
STANFORD UNIVERSITY
PALO ALTO
LOS ALTOS
LOS ALTOS HILLS
MOUNTAIN VIEW
PORTOLA VALLEY
LA HONDA
Menlo Park Caltrain
Palo Alto Caltrain
California Ave Caltrain
San Antonio Caltrain
Palo Alto Airport
El Camino Real
University Ave
Lytton Ave
Hamilton Ave
Middlefield Rd
Homer Ave
Addison Ave
Melville Ave
Newell Rd
Eleanor Pardee Park
Channing Ave
Embarcadero Rd
Seale Ave
Oregon Expy
Greer Rd
Byxbee Park
Bayshore Rd
Sand Hill Rd
Cowper St
Bryant St
Alma St
California Ave
Greene Middle School
Palo Alto High School
Ross Rd
Colorado Ave
Hoover Park
El Dorado Ave
Loma Verde Ave
Louis Rd
Meadow Dr
Ramos Park
Fabian Wy
JLS Middle School
Mitchell Park
Charleston Rd
San Antonio Rd
Stanford Ave
California Ave
Page Mill Rd
Matadero Ave
Los Robles Ave
Robles Park
Wilkie Wy
Maybell Ave
Arastradero Rd
Miller Ave
Fletcher Middle School
Gunn High School
Foothill Expy
Hillview Ave
Alta Mesa Memorial Park
Junipero Serra Blvd
Hanover St
Pearson-Arastradero Preserve
82
101
280
Class I - Shared Use Path
Class IIa - Bike Lane
Class IIb - Buffered Bike Lane
Class IIIa - Bike Route
Class IIIb - Bike Boulevard
Class IV - Separated Bikeway
Trail
Ped/Bike Bridge
Ped/Bike Underpass
City of Palo Alto
Park/Open Space
School/University
Commercial Center
Community Center
Library
Caltrain Stop
Railroad
0
1
2
Miles
Data Sources: City of Palo Alto, MTC
2012 BICYCLE & PEDESTRIAN TRANSPORTATION PLAN
Existing Bicycle Facilities Map | 01/05/2024

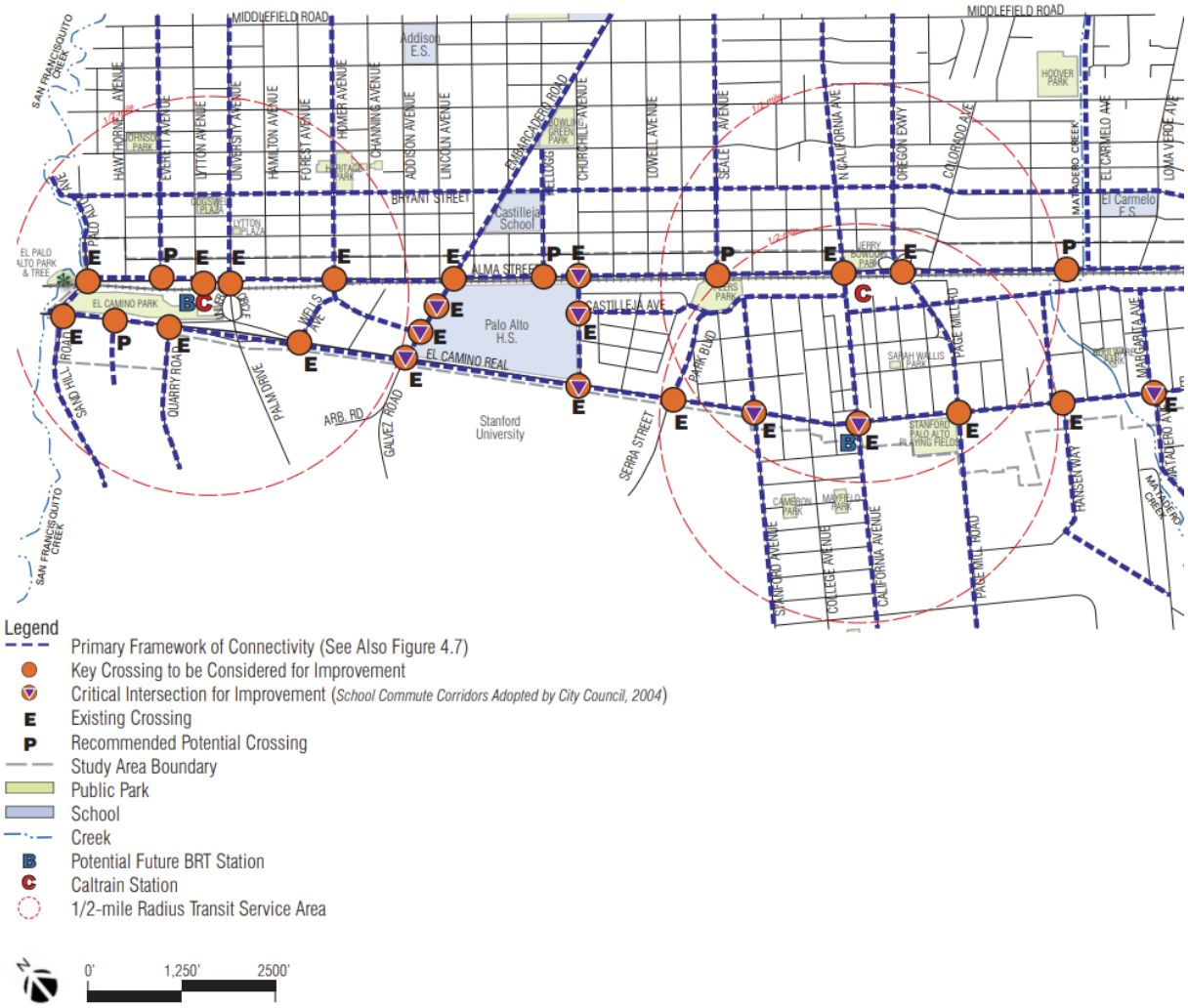
- BPTP Update – Existing Bicycle Facilities Map



Yellow = pedestrian-involved collisions
Orange = bicycle involved collisions
Red line = Kellog (northwest) and Seale (southeast) crossing locations
Green line = bike/ped path access to Paly

- BPTP Update – Draft Technical Analyses
    - Five-Year (2018-2022) Collisions TIMS

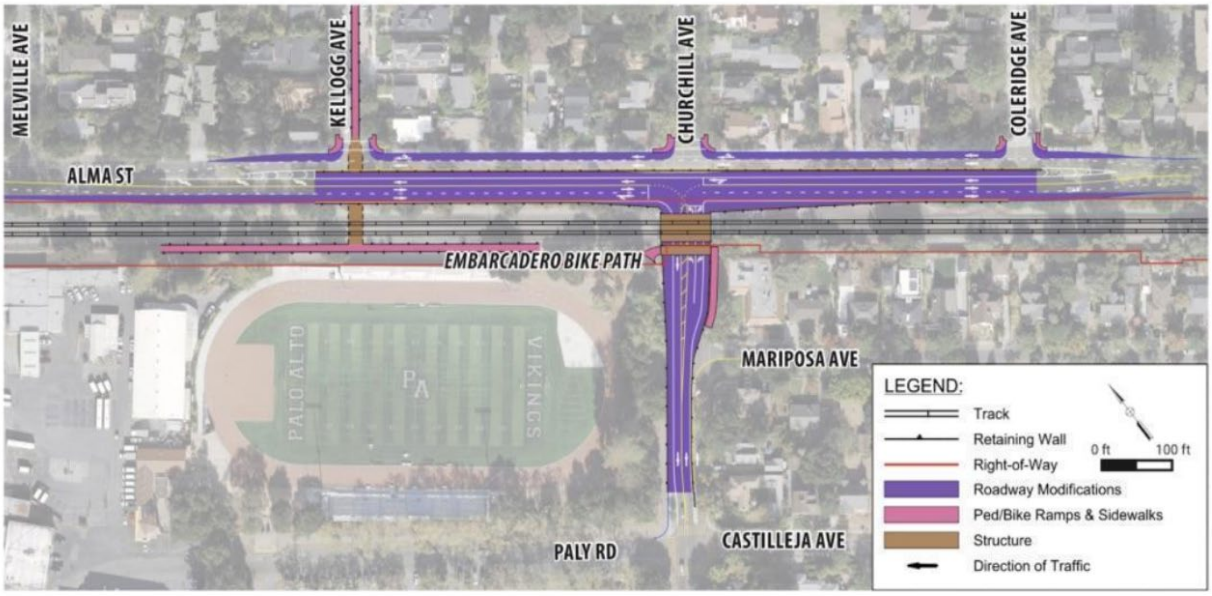
Figure 4.1: Framework of Crossings & Connectivity



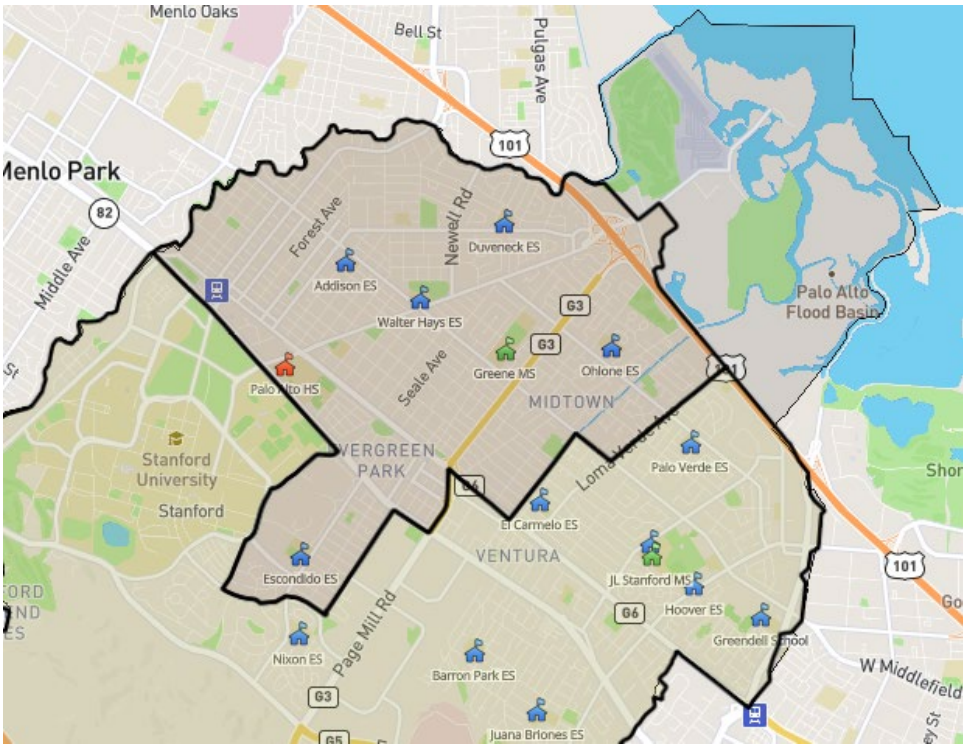
- Rail Crossing Study
  - Figure 4.1

Street Level View of Entrance to Proposed Kellogg Avenue Bike/Pedestrian Tunnel from Old Palo Alto

- 2021 Report of the Expanded Community Advisory Panel (XCAP) on Grade Separations for Palo Alto, page 57



Churchill Avenue Partial Underpass Aerial (Plan)



- School Catchment Area Maps - https://locator.pea.powerschool.com/?StudyID=171992

Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Trench	Hybrid	Viaduct	Underpass
A	Facilitate movement across the corridor for all modes of transportation	- ▨▨▨▨■■■ + Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.	- ▨▨▨▨■■■ + Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.	- ▨▨▨▨■■■ + Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open. Viaduct provides opportunities for additional crossings for all modes.	- ▨▨▨▨■■▨ + East/West (through) traffic on Meadow Drive and Charleston Road will be grade separated from the railroad and Alma Street for all modes. Turning movements from Meadow Drive to southbound Alma Street will be prohibited. Turning movements from northbound Alma Street will require a U-turn at Alma Village Circle. All turning movements on Charleston Road to/from Alma Street will be permitted; however, some movements will be facilitated via a roundabout approximately 600 feet east of Alma Street, resulting in longer routes for all modes compared to the Trench, Hybrid, and Viaduct alternatives.
B	Reduce delay and congestion for vehicular traffic at rail crossings	- ▨▨▨▨■■▨ + With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates.	- ▨▨▨▨■■▨ + With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates.	- ▨▨▨▨■■▨ + With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates.	- ▨▨▨▨■■■ + With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates. Pedestrian and cyclist mode separation will also help reduce intersection congestion. Some turning movements will be prohibited at the Alma/Meadow intersection and thus would use the Charleston Road intersection or the new signal at Alma Village Circle. At the Alma/Charleston intersection, some turning movements will increase overall delays due to the circuitous nature of the movements, as vehicles would need to use the Charleston roundabout and return to the Alma intersection to complete the movements (e.g. eastbound left-turns to Alma, northbound left-turns and southbound right-turns to Charleston).
C	Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles	- ▨▨▨▨■■▨ + Pedestrians/cyclists will be separated from train traffic. Conflicts between pedestrians/cyclists and motor vehicles will remain at the Alma intersections. Bike lanes will be added to Meadow Drive and Charleston Road intersections. Additional pedestrian/cyclist separations routes can be explored in the next phase of design.	- ▨▨▨▨■■▨ + Pedestrians/cyclists will be separated from train traffic. Conflicts between pedestrians/cyclists and motor vehicles will remain at the Alma intersections. Bike lanes will be added to Meadow Drive and Charleston Road intersections. Additional pedestrian/cyclist separations routes can be explored in the next phase of design.	- ▨▨▨▨■■▨ + Pedestrians/cyclists will be separated from train traffic. Conflicts between pedestrians/cyclists and motor vehicles will remain at the Alma intersections. Bike lanes will be added to Meadow Drive and Charleston Road intersections. Additional pedestrian/cyclist separations routes can be explored in the next phase of design.	- ▨▨▨▨■■■ + Pedestrians and cyclists traveling east/west will be completely separated from train and vehicular traffic on Alma Street. Full pedestrian and cyclist movement is maintained. Pedestrians and cyclists will have more circuitous routes traveling east/west across the corridor because the pedestrian/bike path is located on one side of the street only: on the south side of Meadow Drive and on the north side of Charleston Road. For example, cyclists traveling eastbound on Charleston Road near Ruthelma Street will have to cross Charleston Road to get onto the north side of the road, then cross Charleston Road again at the roundabout near Mumford Place to get back onto the right/south side of the road.

Impact ⟷ Improvement

Most Impact	- ■■■▨▨▨▨ +
Moderate Impact	- ▨■■▨▨▨▨ +
Some Impact	- ▨▨■▨▨▨▨ +
Neutral (No Impact or Improvement)	- ▨▨▨■▨▨▨ +
Some Improvement	- ▨▨▨▨■▨▨ +
Moderate Improvement	- ▨▨▨▨■■▨ +
Most Improvement	- ▨▨▨▨■■■ +

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Trench	Hybrid	Viaduct	Underpass
D	Support continued rail operations and Caltrain service improvements	- + A temporary railroad track will be required, and a crossover track located north of the San Antonio Caltrain Station will be relocated. With the pump stations, there will be potential risks to train operations from flooding.	- + A temporary railroad track will be required, and a crossover track located north of the San Antonio Caltrain Station will be relocated.	- + New railroad tracks can be built without a temporary track, and a crossover track located north of the San Antonio Caltrain Station will be relocated.	- + A temporary railroad track is likely to be required unless an alternate construction methodology and sequencing is acceptable to Caltrain.
E	Finance with feasible funding sources (order of magnitude cost)	- + The trench will require greater levels of local funding in the form of fees, taxes or special assessments, the feasibility of which are still being studied in the context of overall citywide infrastructure funding needs.	- + The hybrid would require lower levels of local funding, with a substantial portion of capital costs covered by Regional, State and Federal sources.	- + The viaduct would require substantial local funding resources more than the hybrid alternative, but less than the trench and tunnel alternatives.	- + The underpass will require substantial local funding resources more than the hybrid alternative, but less than the trench and tunnel alternatives.
F	Minimize right-of-way acquisition (Private property only)	- + Subsurface acquisition will be required for the ground anchors for the trench retaining walls and private properties will be required for creek diversion pump station.	- + No acquisition of private properties is required; however, driveway modifications will be required.	- + No acquisition of private properties is required.	- + Five (5) full private property acquisitions are required in multiple locations (two at Meadow Drive and three at Charleston Road). Multiple driveway modifications will be also required. Partial (sliver) acquisition of residential properties and removal of trees will be required at various locations and summarized below: At Meadow Drive: • Six (6) front yard acquisitions on both sides of Meadow between 2nd Street and Park Boulevard. • One (1) side yard acquisition on the north side of Meadow, just west of Emerson Street. • Five (5) backyard acquisitions on the south side of Meadow between Alma Street and Emerson Street. At Charleston Road: • On both sides of Charleston between Ruthelma Avenue and Park Boulevard. Seven (7) front yard acquisitions; two (2) on the north side, five (5) on the south side of Charleston. • One side yard acquisition on the south side of Charleston between Park Boulevard and the railroad tracks. • Eight (8) property acquisitions on both sides of Charleston between Alma St and Wright Place; six (6) backyard acquisitions on the north side of Charleston, and two (2) front yard acquisitions on the south side of Charleston (closest to Alma). • Six (6) backyard acquisitions on the north side of Charleston between Wright Place and Mumford Place. • Six (6) property acquisitions along Alma Street between Charleston Road and Ely Place; five (5) backyard acquisitions, and one side yard acquisition (closest to Ely Place).

Impact ◄► Improvement

- Most Impact -
- Moderate Impact -
- Some Impact -
- Neutral (No Impact or Improvement) -
- Some Improvement -
- Moderate Improvement -
- Most Improvement -

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of City Council-Adopted Criteria

Evaluation Criteria		Trench	Hybrid	Viaduct	Underpass
G1	Reduce rail noise and vibration	Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing EMU trains instead of diesel locomotives will also reduce noise. Trains operating in trench will reduce noise in neighborhoods. Acoustically treated trench walls will eliminate acoustical reflections. There would be a slight reduction to vibration levels at nearby receptors.	Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing EMU trains instead of diesel engines will also reduce noise. Six-foot high parapet sound barriers will help reduce propulsion and wheel/rail noise. There would be a slight reduction to vibration levels at nearby receptors.	Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing EMU trains instead of diesel engines will also reduce noise. Six-foot high parapet sound barriers will help reduce propulsion and wheel/rail noise. There would be significant reduction to vibration levels at nearby receptors.	Train horn noise and warning bells will be eliminated by the replacement of the at-grade crossings with grade separations. Utilizing EMU trains rather than diesel engines will also reduce noise. Modern rail bridge design will reduce excess structural noise. Sound barriers will also help to reduce propulsion and wheel/rail noise. There would be little to no change to vibration levels at nearby receptors. An optional 6-foot high noise barrier near the tracks and on the overpass structure could significantly reduce wheel/rail and propulsion noise.
G2	Sea Level Rise Susceptibility	The low point of the track profile (Elevation 4 feet) for the trench alternative would be close to the projected sea level rise inundation zone for the year 2100 (a sea level rise of 3.42 feet). The trench's track profile is below the estimated groundwater (approximately between Elevation 20 and 25) for about 4,000 feet along the track. Increased groundwater elevations from sea level rise would further expose the trench to emergent groundwater by 2100. A pump station is proposed, but groundwater depletion and additional studies would be needed to further assess the feasibility of this alternative.	The hybrid alternative would be outside of the projected sea level rise inundation zone for the year 2100. The low point of the proposed roadway for the Hybrid at Meadow (Elevation 30 feet) is about 9 feet higher than current groundwater (Elevation 21). The low point of the proposed roadway for the Hybrid at Charleston (Elevation 34 feet) is about 12 feet higher than current groundwater (Elevation 22). Increased groundwater elevations from sea level rise can damage a roadway from below, increasing the likelihood of cracks, potholes, and sinkholes.	The viaduct structure is not anticipated to be affected by sea level rise or emergent groundwater.	The underpass alternative would be outside of the projected sea level rise inundation zone for the year 2100. The low point of the proposed roadway for the underpass at Meadow (Elevation 12 feet) is about 9 feet below current groundwater (Elevation 21). The low point of the proposed roadway for the underpass at Charleston (Elevation 16 feet) is about 6 feet below current groundwater (Elevation 22). Increased groundwater elevations from sea level rise would further expose the underpass alternative to emergent groundwater by 2100.
G3	Heat Island Effect	Construction extents are limited to the existing railroad tracks. Negligible changes to heat island effects due to minimal changes to land use.	The replacement of asphalt pavement for roadway grading results in some impact to heat island effects, because newer asphalt pavement surfaces have lower albedo ratings that will increase with age. Lower albedo ratings are less favorable because more light is absorbed, which heats up the surrounding air.	Construction extents are limited to the existing railroad tracks. Negligible changes to heat island effects due to minimal changes to land use.	As the alternative with the largest construction extents, the replacement of existing darker concrete with new concrete with higher albedo ratings results in some expected improvement to heat island effects. Higher albedo ratings are more favorable because more light is reflected, which can help cool the surrounding air.
G4	Stormwater Treatment	Construction extents are limited to the existing railroad tracks. Significant changes to the amount of stormwater runoff generated from project area expected, due to changes in land use from existing railroad ballast to significantly more impervious concrete surfaces.	Changes to land use and additional impervious areas (i.e., new underpass bridge) are minimal.	Construction extents are limited to the existing railroad tracks. With the assumption that runoff from the raised viaduct can all be directed to the underlying vegetated areas, no net increase in runoff generation is expected.	As the alternative with the largest construction extents and changes to land use, especially with the conversion of existing vegetated areas to concrete and asphalt surfaces, a moderate impact to the amount of stormwater to be treated is expected.
H	Maintain access to neighborhoods, parks, and schools along the corridor, while reducing regional traffic on neighborhood streets	No diversion of regional traffic with construction of grade separations.	No diversion of regional traffic with construction of grade separations.	No diversion of regional traffic with construction of grade separations.	Regional traffic will be diverted due to the restricted turning movements; however, travel in all directions will be possible, but may require a longer route and take more time. Turning movements at Ely Place will be limited to right turns on northbound Alma Street only. Pedestrian and cyclist access will improve due to mode separation.

Impact ◄► Improvement

- Most Impact
- Moderate Impact
- Some Impact
- Neutral (No Impact or Improvement)
- Some Improvement
- Moderate Improvement
- Most Improvement

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Trench	Hybrid	Viaduct	Underpass
I	Minimize visual changes along the corridor	- + Railroad tracks will be below grade with high fencing at grade. Landscaping options will be limited to plants with shallow roots in areas where ground anchors are required for the trench retaining walls.	- + Railroad tracks will be approximately 15 feet above grade. Landscaping with trees will be incorporated for screening where feasible. During the winter, late afternoon (after 3 pm) shadows are significant on the east side of the structure as they extend to the west-facing, residential properties on the east side of Alma Street.	- + Railroad tracks will be approximately 20 feet above grade. Landscaping with trees will be incorporated for screening where feasible. Shadows from the viaduct structure extend about 15 feet from each side of the structure in the mid-morning (9 am) and mid-afternoon (3 pm) hours during the summer solstice. During the winter, late afternoon (after 3 pm) shadows are significant on the east side of the structure as they extend to the west-facing, residential properties on the east side of Alma Street.	- + Railroad tracks will remain at-grade. On Charleston Road, removal of the planting strip on both sides of the road will be required along with the planting strip on the east side of Alma Street between Charleston Road and Ely Place.
J	Minimize disruption and duration of construction	- + Extended road closures at Meadow Drive and Charleston Road are required. Construction would last for approximately 6 years.	- + Extended lane reductions at Alma Street, Meadow Drive, and Charleston Road will be required. Construction would last for approximately 4 years.	- + The viaduct will have minimal road closures (nights/weekends only). Construction would last for approximately 2 years.	- + Lane reductions and temporary closures (nights/weekends only) on Alma Street, a closure of Meadow Drive between Emerson Street and Park Boulevard, and a closure of Charleston Road between Alma Street and Park Boulevard will be required for the majority of construction. The total duration of construction will be approximately 3.5 to 4 years; however the durations are subject to change depending on the construction methodologies used.
	Order of magnitude cost	$800M to 950M*	$190M to $230M*	$400M to 500M*	$340M to $420M*

Meadow-Charleston Evaluation of Engineering Challenges

	Engineering Challenges	Trench	Hybrid	Viaduct	Underpass
L	Creek/Drainage Impacts	- + • Requires diversion of Adobe and Barron creeks resulting in the need for pump stations. • Numerous regulatory agency approvals required for creek diversion. • Pump stations also required to dewater the trench. • Increased risk of flooding due to pump stations.	- + • Pump stations required for lowered roadways. • Increased risk of flooding due to pump stations.	- + • No significant creek or drainage impacts.	- + • Pump station required for lowered roadways. • Increased risk of flooding due to pump station.

Impact ◄► Improvement

- Most Impact - +
- Moderate Impact - +
- Some Impact - +
- Neutral (No Impact or Improvement) - +
- Some Improvement - +
- Moderate Improvement - +
- Most Improvement - +

* Total Preliminary Construction Cost for infrastructure of both railroad crossings in 2018 dollars, and includes escalation to 2025 (Subject to Change).

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of Engineering Challenges

	Engineering Challenges	Trench	Hybrid	Viaduct	Underpass
M	Long-Term Maintenance	- ■ ■ ■ ▨ ▨ ▨ ▨ + Increased maintenance costs due to: • Pump stations for creek diversions. • Pump stations for trench dewatering. • Below ground railroad alignment.	- ▨ ■ ■ ▨ ▨ ▨ ▨ + Increased maintenance costs due to: • Pump stations for trench dewatering. • Above ground railroad alignment with embankments and undercrossing structures.	- ▨ ▨ ■ ▨ ▨ ▨ ▨ + Increased maintenance costs due to: • Above ground railroad alignment with embankments and viaduct structures.	- ▨ ■ ■ ▨ ▨ ▨ ▨ + Increased maintenance cost due to: • Pump stations for underpass dewatering. • Above ground structures for both road and rail.
N	Utility Relocations	- ■ ■ ■ ▨ ▨ ▨ ▨ + • Major utility relocations for lowered railroad.	- ▨ ■ ■ ▨ ▨ ▨ ▨ + • Moderate amount of utility relocations for utility relocations for lowered roadways.	- ▨ ▨ ■ ▨ ▨ ▨ ▨ + • Some utility relocations required.	- ■ ■ ■ ▨ ▨ ▨ ▨ + • Major utility relocation due to the fully lowered roadway.
O	Railroad Operations Impacts during Construction	- ■ ■ ■ ▨ ▨ ▨ ▨ + • Temporary track (i.e., shoofly) is required.	- ▨ ■ ■ ▨ ▨ ▨ ▨ + • Temporary track (i.e., shoofly) is required, but a bit shorter than the trench shoofly.	- ▨ ▨ ■ ▨ ▨ ▨ ▨ + • No temporary track (i.e., shoofly) required.	- ▨ ■ ■ ▨ ▨ ▨ ▨ + • Temporary track (i.e., shoofly) likely required unless an alternate construction methodology and sequencing is acceptable to Caltrain.
P	Local Street Circulation Impacts during Construction	- ▨ ■ ■ ▨ ▨ ▨ ▨ + • Removal of right turn lanes on Alma Street at Meadow Drive and Charleston Road; however, traffic will still be able to flow as needed despite lane reduction. • Closes Meadow Drive while Charleston Road roadway bridges are constructed and visa versa.	- ■ ■ ■ ▨ ▨ ▨ ▨ + • Removal of right turn lanes on Alma Street at Meadow Drive and Charleston Road; however, traffic will still be able to flow as needed despite lane reduction. • Alma Street, Charleston Road, and Meadow Drive reduced to 2 lanes.	- ▨ ▨ ■ ▨ ▨ ▨ ▨ + • Reduced lane widths on Alma Street, north of Meadow Drive and south of Charleston Road. • Possible night time closures of Meadow Drive and Charleston Road.	- ■ ■ ■ ▨ ▨ ▨ ▨ + • Lane reduction on Alma Street during construction of the shoofly and bridge. • Closure of Meadow Drive and Charleston Road throughout excavation and construction of the undercrossing and related features.
Q	Caltrain right-of-way Impact (Probability of approval by Caltrain of permanent encroachment inside Caltrain's right-of-way is unknown at this time).	- ▨ ■ ■ ▨ ▨ ▨ ▨ + Permanent encroachment inside Caltrain's right-of-way is required to accommodate pump station(s).	- ▨ ▨ ▨ ■ ▨ ▨ ▨ + No permanent encroachment inside Caltrain's right-of-way is required.	- ▨ ▨ ■ ▨ ▨ ▨ ▨ + No permanent encroachment inside Caltrain's right-of-way is required. However, options of a linear park or dual use under the viaduct would require Caltrain approval.	- ▨ ▨ ▨ ■ ▨ ▨ ▨ + No permanent encroachment inside Caltrain's right-of-way is required.
R	Caltrain Design Exceptions Needed	2% grade on track required. Maximum grade allowed by Caltrain is 1%.	Temporary vertical clearance of 12 feet at undercrossing structures during construction. Minimum vertical clearance allowed by Caltrain is 15.5 feet.	1.4% grade on track required. Maximum grade allowed by Caltrain is 1%.	No Caltrain design exceptions required.

Impact ◄► Improvement

- Most Impact - ■ ■ ■ ▨ ▨ ▨ ▨ +
- Moderate Impact - ▨ ■ ■ ▨ ▨ ▨ ▨ +
- Some Impact - ▨ ▨ ■ ▨ ▨ ▨ ▨ +
- Neutral (No Impact or Improvement) - ▨ ▨ ▨ ■ ▨ ▨ ▨ +
- Some Improvement - ▨ ▨ ▨ ▨ ■ ▨ ▨ +
- Moderate Improvement - ▨ ▨ ▨ ▨ ■ ■ ▨ +
- Most Improvement - ▨ ▨ ▨ ▨ ■ ■ ■ +

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Churchill Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Closure with Mitigations	Partial Underpass
A	Facilitate movement across the corridor for all modes of transportation	- + Churchill Avenue will be closed to vehicles at the railroad tracks. Pedestrians and cyclists will be grade separated from the railroad in Option 1. For Option 2, pedestrians and cyclists will be grade separated from the railroad and vehicle traffic on Alma Street.	- + Churchill Avenue will be grade separated from the railroad for all modes and will remain open. Through traffic on Churchill Avenue is no longer possible, and some traffic will have to take alternate routes. Pedestrian/bike (only) traffic will be grade separated from the railroad and vehicle traffic on Alma Street via an undercrossing at Kellogg Avenue or Seale Avenue.
B	Reduce delay and congestion for vehicular traffic at rail crossings	- + With closure of Churchill Avenue, traffic will be diverted to Embarcadero and Page Mill Road and thus, nearby intersections will be impacted; however, operational improvements are proposed at the Embarcadero/Kingsley/Alma intersection, El Camino Real intersections at Embarcadero Road and Page Mill Road and Alma/Oregon Expressway interchange that would mitigate the traffic impacts.	+ With construction of the grade separation, the railroad crossing gates and warning lights at Churchill Avenue will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates. Pedestrian undercrossing at Kellogg Avenue or Seale Avenue will also help reduce intersection congestion.
C	Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles	+ Pedestrians/cyclists will be separated from train traffic and vehicles.	+ Pedestrians and cyclists will be completely separated from train and vehicular traffic. Full pedestrian and cyclist movement is maintained with a new undercrossing at Kellogg Avenue or Seale Avenue.
D	Support continued rail operations and Caltrain service improvements	- + A temporary railroad track will not be required.	- + A temporary railroad track is likely to be required unless an alternate construction methodology and sequencing is acceptable to Caltrain.
E	Finance with feasible funding sources (Order of magnitude cost)	- + The closure would require the lowest levels of local funding, with a substantial portion of capital costs covered by Regional, State and Federal sources.	- + The underpasses would require lower levels of local funding, with a substantial portion of capital costs covered by Regional, State, and Federal sources.
F	Minimize right-of-way acquisition (Private property only)	- + No acquisition of private properties is required; however, there will be impacts to the Palo Alto High School property. Loss of street parking loss and removal of the planter strip on both sides of Churchill Avenue, east of Alma Street, will be required for the pedestrian/bike undercrossing (Option 2 only).	- + Driveway modifications, removal and relocation of planter strips, and and partial (sliver) acquisitions of residential properties will be required due to widening of Alma Street between Kellogg Avenue and Coleridge Avenue. Some (sliver) acquisition of the high school and/or residential property fronting Churchill Avenue on the west side of the tracks will be required. For the pedestrian undercrossing at Kellogg Avenue (or Seale Avenue), loss of street parking and removal of the planter strip on both sides of Kellogg Avenue (or Seale) will be required for approximately 250-300 feet from Alma Street.
G1	Reduce rail noise and vibration	- + Train horn noise and warning bells will be eliminated with the removal of the at-grade crossings with roadway closure. Utilizing EMU trains instead of diesel engines will also reduce noise. There would be no change to vibration levels at nearby receptors. An optional 6-foot high noise barrier near the tracks could significantly reduce wheel/rail and propulsion noise.	- + Train horn noise and warning bells will be eliminated by the replacement of the at-grade crossings with grade separations. Utilizing EMU trains rather than diesel engines will also reduce noise and some road noise would be reduced. Modern rail bridge design will reduce excess structural noise. There would be little to no change to vibration levels at nearby receptors. An optional 6-foot high noise barrier near the tracks and on the overpass structure could significantly reduce wheel/rail and propulsion noise.
G2	Sea Level Rise Susceptibility	- + The closure alternative would be outside of the projected sea level rise inundation zone for the year 2100. The lowest pedestrian underpass elevations (27 feet at Kellogg, and 20 feet at Seale Avenue) would still be well above current groundwater levels (Elevation 8-11 feet).	- + The underpass alternative would be outside of the projected sea level rise inundation zone for the year 2100. The lowest elevations (27 feet for the pedestrian underpass at Kellogg, 25 feet for the roadway underpass at Churchill and 20 feet for the pedestrian underpass at Seale Avenue) would still be well above current groundwater levels (Elevation 8-11 feet). This alternative is not anticipated to be affected by sea level rise or emergent groundwater.
G3	Heat Island Effect	- + The introduction of new vegetated areas, with higher albedo ratings than asphalt surfaces and increased provision of shading, southwest of the Alma St & Churchill Ave intersection results in an expected improvement to heat island effects. Higher albedo ratings are more favorable because more light is reflected, which can help cool the surrounding air.	- + The combination of replacing existing concrete with lighter albedo concrete and replacing existing asphalt with darker albedo asphalt pavements results in an expected neutral impact to heat island effects.
G4	Stormwater Treatment	- + The introduction of new vegetated areas, with lower runoff coefficients and higher expected perviousness, southwest of the Alma St & Churchill Ave intersection results in some expected reduction in stormwater generation.	- + Due to the large area of regraded (lowered) and replaced impervious surfaces the volume of runoff requiring treatment will increase substantially as compared to existing conditions.

Impact ◄► Improvement

- Most Impact -
- Moderate Impact -
- Some Impact -
- Neutral (No Impact or Improvement) -
- Some Improvement -
- Moderate Improvement -
- Most Improvement -

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Churchill Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Closure with Mitigations	Partial Underpass
H	Maintain access to neighborhoods, parks, and schools along the corridor, while reducing regional traffic on neighborhood streets	- + Vehicle access will be diverted and resultant regional traffic will be mitigated. Pedestrian and cyclist access will improve to mode separation.	- + Regional traffic will be diverted due to the restricted turning movements. Pedestrian and cyclist access will improve due to mode separation.
I	Minimize visual changes along the corridor	- + Railroad tracks remain at existing grade. Residual roadway areas from the closure provide opportunities for landscaping at Churchill between Mariposa Avenue and the tracks. Some tree removals will be required on both sides of Churchill for a length of approximately 250-300 feet east of Alma Street to accommodate a ped/bike ramp down the center of Churchill (Option 2 only).	- + The railroad tracks and the northbound lanes of Alma Street will remain at-grade, and the east side of Churchill Avenue will remain unchanged. Mature trees and overhead power poles within the Alma Street planting strip, from just north of Kellogg Avenue to just south of Coleridge Avenue, will be removed. Landscaping restoration is limited due to space constraints.
J	Minimize disruption and duration of construction	- + The closure will have minimal road closures (nights/weekends only). Construction would last for approximately 2 years.	- + Closure of Churchill Avenue between Alma Street and Mariposa Avenue will be required for the majority of construction. Alma Street will be one-way northbound for approximately 6+ months. Total duration of construction will be approximately 2.5 to 3 years; however the durations are subject to change depending on the construction methodologies used.
	Order of magnitude cost	$50M to $65M*	$160M to $200M*

Churchill Evaluation of Engineering Challenges

	Engineering Challenges	Closure with Mitigations	Partial Underpass
L	Creek/Drainage Impacts	- + • Pump station required for lowered pedestrian/bike undercrossing. • Increased risk of flooding with pump stations. • Relocation of the pump house at Embarcadero Road required to accommodate widening of Alma Street.	- + • Pump station required for lowered roadways. • Increased risk of flooding due to pump station.
M	Long-Term Maintenance	- + Increased maintenance costs due to: • Pump stations for undercrossing dewatering.	- + Increased maintenance cost due to: • Pump stations for underpass dewatering. • Above ground structures for both road and rail.
N	Utility Relocations	- + • Potential utility relocations in Alma Street and Churchill Avenue for pedestrian/bike undercrossing. • Minor utility relocations for Embarcadero Road/Alma Street improvements.	- + • Major utility relocations for lowered roadways.
O	Railroad Operations Impacts during Construction	- + • No temporary track (i.e., shoofly) required, only single tracking during nights and weekends.	- + • Temporary track (i.e., shoofly) likely required unless alternate construction methodology and sequencing is acceptable to Caltrain.

Impact ◄► Improvement

- Most Impact - +
- Moderate Impact - +
- Some Impact - +
- Neutral (No Impact or Improvement) - +
- Some Improvement - +
- Moderate Improvement - +
- Most Improvement - +

* Total Preliminary Construction Cost for infrastructure of the railroad crossing in 2018 dollars, and includes escalation to 2025 (Subject to Change).

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Churchill Evaluation of Engineering Challenges

	Engineering Challenges	Closure with Mitigations	Partial Underpass
P	Local Street Circulation Impacts during Construction	- ▫ ▫ ■ ▫ ▫ ▫ ▫ + • Path along Palo Alto High School will temporarily be impacted during construction. • Temporary night and weekend closure of lanes on Churchill Avenue, Alma Street, Embarcadero Road, El Camino Real, and Oregon Expressway.	- ■ ■ ■ ▫ ▫ ▫ ▫ + • Lane reduction on Alma Street during construction of the shoofly and bridge. • Likely closure of Churchill Avenue throughout the excavation and construction of the undercrossing and related features. • Likely closure of Kellogg Avenue for the duration of the pedestrian underpass construction; driveway access from one direction only.
Q	Caltrain right-of-way Impact (Probability of approval by Caltrain of permanent encroachment inside Caltrain's right-of-way is unknown at this time).	- ▫ ■ ■ ▫ ▫ ▫ ▫ + Requires permanent longitudinal encroachment inside Caltrain's right-of-way for the pedestrian/bike ramps for undercrossing Option 1.	- ■ ■ ■ ▫ ▫ ▫ ▫ + Requires permanent longitudinal encroachment inside Caltrain's right-of-way for the pedestrian/bike ramps (to the undercrossing at Kellogg Avenue) and for the lanes/shoulders for southbound Alma Street.
R	Caltrain Design Exceptions Needed	None required.	No Caltrain design exceptions needed.

Impact ◄► Improvement

- Most Impact - ■ ■ ■ ▫ ▫ ▫ ▫ +
- Moderate Impact - ▫ ■ ■ ▫ ▫ ▫ ▫ +
- Some Impact - ▫ ▫ ■ ▫ ▫ ▫ ▫ +
- Neutral (No Impact or Improvement) - ▫ ▫ ▫ ■ ▫ ▫ ▫ +
- Some Improvement - ▫ ▫ ▫ ▫ ■ ▫ ▫ +
- Moderate Improvement - ▫ ▫ ▫ ▫ ■ ■ ▫ +
- Most Improvement - ▫ ▫ ▫ ▫ ■ ■ ■ +

The color of the matrix is comparative between each alternative at this location.