

Sunnyvale Grade Separation Feasibility Study



Sunnyvale Avenue

Mary Avenue

Prepared for
City of Sunnyvale



Sunnyvale

Prepared by



Community Outreach



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EXECUTIVE SUMMARY

The City of Sunnyvale (City) is conducting a feasibility study (Study) of a project to vertically separate the road and the Caltrain trackway (grade separation) at Mary Avenue and Sunnyvale Avenue. The grade separation project aims to improve safety, enhance pedestrian and bicycle access, improve transportation efficiency, and reduce noise in the vicinity of the railroad at-grade crossings. The objective of the Study is to identify the preferred alternatives at each location which will be advanced to the environmental analysis and design development phases of work. Based on the selected alternatives, the City will initiate funding efforts related to the grade separations requirements in the City of Sunnyvale. In order to identify preferred alternatives, the study evaluates a range of criteria including safety, multimodal access, traffic circulation, environmental impacts, community support, and cost implications. Other related considerations consisted of visual, noise, constructability, stage construction, right of way, utility relocation impacts and requirements.

The Santa Clara Valley Transportation Authority (VTA) Measure B Program identifies Caltrain Grade Separations as a program category with an allocation of 11.11% of the program tax revenue, estimated at \$700M, to complete eight (8) grade separations in 30 years in the cities of Mountain View, Palo Alto and Sunnyvale. Two of the grade separations are in Sunnyvale. VTA will prepare an Implementation Plan to decide how to distribute funds. The Implementation Plan will recommend frontloading the program rather than metering the funds over the life of the program tax revenue.

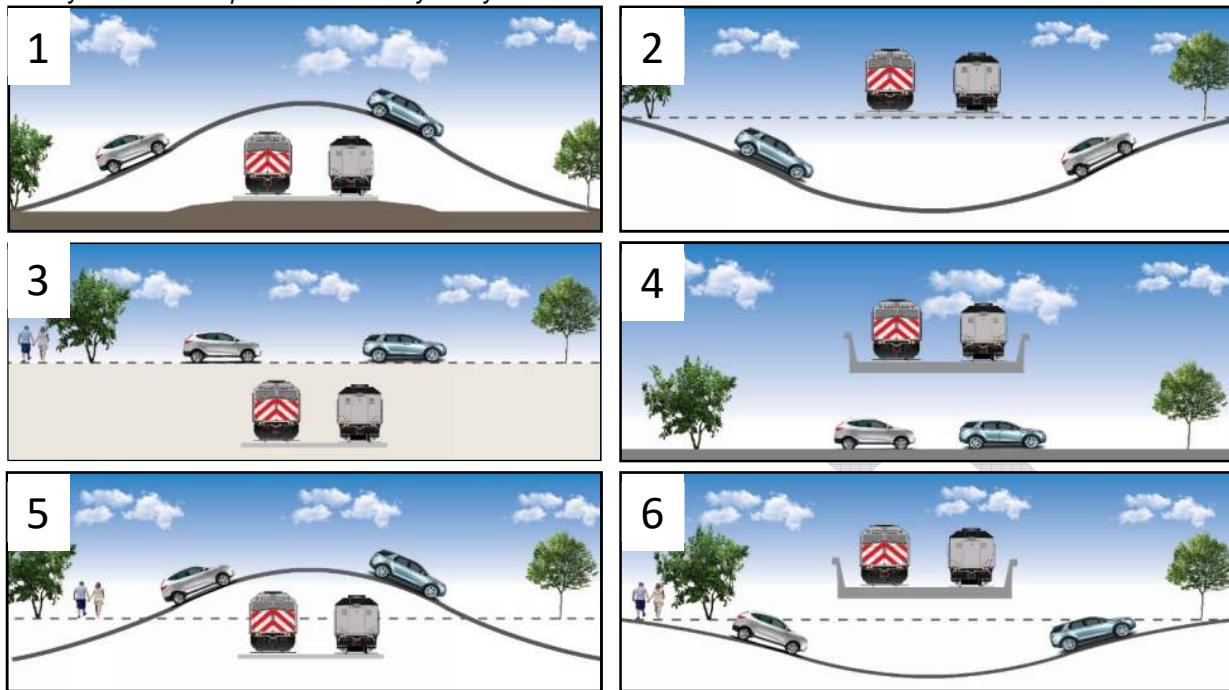
The City of Sunnyvale with BKF Engineers (BKF) has prepared a Feasibility Study to assess, screen, and evaluate the alternatives. The Study has recommended a preferred alternative for the Mary Avenue Grade Separation and Sunnyvale Avenue Grade Separation for the future phases of work that are required to advance the grade separations to construction.

Summary of Work Conducted

Preliminary Alternatives

In May 2017, six (6) preliminary grade separation alternatives were initially evaluated for each grade separation location at Mary Avenue and Sunnyvale Avenue. The 6 initial alternatives for each location were as follows:

1. Roadway Overpass (railroad to remain at present elevation; roadway is depressed beneath railroad tracks)
2. Roadway Underpass (railroad to remain at present elevation; roadway is elevated over railroad tracks)
3. Railroad Overpass (roadway to remain at present elevation; railroad is depressed beneath roadway)
4. Railroad Underpass (roadway to remain at present elevation; railroad is elevated over roadway)
5. Hybrid Overpass (partially elevated roadway, partially depressed railroad)
6. Hybrid Underpass (partially elevated railroad, partially depressed roadway)



During the initial selection process, the preliminary geometry, roadway profiles, impacts and design considerations of the preliminary alternatives were reviewed and evaluated based on preliminary investigations. After the initial review of the preliminary alternatives, the City of Sunnyvale directed BKF to develop additional alternatives as listed below:

Mary Avenue:

1. Roadway Underpass with Jughandle (Evelyn Avenue remain at present elevation with an undercrossing at depressed Mary Avenue)

Sunnyvale Avenue:

1. Roadway Underpass Tunnel (Evelyn Avenue remain at present elevation with an undercrossing at depressed Sunnyvale Avenue)
2. Bicycle/Pedestrian Overcrossing (Sunnyvale Avenue does not connect to Hendy and Evelyn Avenues)
3. Bicycle/Pedestrian Undercrossing (Sunnyvale Avenue does not connect to Hendy and Evelyn Avenues)

All the alternatives were summarized and presented to the community, potential stakeholders, and City Council. To create project awareness and a channel for communication and develop a level of consensus of the proposed project at Mary and Sunnyvale Avenues, the following community meetings were held for the community, businesses, potential stakeholders and City Council.

Meetings Conducted

During the course of the Study, several community meetings were conducted and presented to local community, businesses, Bicycle and Pedestrian Advisory Commission (BPAC), and regional officials. Below is a list of dates that meetings had been held:

- July 12, 2017 – Agency Stakeholder (VTA, County of Santa Clara, City of Mountain View and Caltrain) Meeting
- July 26, 2017 – Business Outreach Meeting

August 2022

Sunnyvale Grade Separation Feasibility Study

August 10, 2017 – Mary Avenue Community Meeting
August 17, 2017 – Bicycle and Pedestrian Advisory Committee (BPAC) Meeting
August 22, 2017 – Mary Avenue Expressions Neighborhood Meeting
August 24, 2017 – Sunnyvale Avenue Meeting
September 6, 2017 – Downtown Association Meeting
September 2017 – Sunnyvale Avenue Online Survey
October 17, 2017 – Joint City Council and BPAC Meeting
January 23, 2018 – City Council Meeting

Due to Covid-19 pandemic, the Study was placed on hold and resumed in 2022 when additional were conducted to update the community and stakeholders.

April 5, 2022 – City Council Study Session
June 8, 2022 – Mary Avenue Community Meeting
June 9, 2022 – Sunnyvale Avenue Community Meeting
June/July 2022 – Online Survey July 13, 2022 – Caltrain Stakeholder Meeting
July 21, 2022 – Bicycle and Pedestrian Advisory Commission Meeting for Sunnyvale Ave
August 1, 2022 – Bicycle and Pedestrian Advisory Commission Meeting for Mary Ave

Meeting minutes from the July 21, 2022 and August 1, 2022 BPAC meetings are forth coming and would be inserted as attachments once received.

A Draft Feasibility Study will be presented to the City Council on August 30, 2022.

Identification of the Studied Alternatives

In order to identify those alternatives from the preliminary alternatives that would be further studied and evaluated, a public outreach campaign was initiated to inform the public of the Study and the preliminary alternatives in consideration for evaluation. The outreach campaign consisted of bringing attention to the project via a City of Sunnyvale project website which provided project information and updates, attending community-based events such as farmer's markets and festivals and reaching out to the Sunnyvale Chamber of Commerce and home owner associations within the project site, Public input on the alternatives were obtained by presenting the project at community meetings and conducting an on-line survey, Additional input on the alternatives were obtained via a BPAC meeting where the alternatives were presented, questions answered and input and recommendations received.. Questions, concerns, and viewpoints were collected and considered.

Based on the findings from the assessment of the preliminary alternatives, community feedback received from the public meetings and other community outreach activities and the results of the on-line survey, it was recommended the Study focus the analysis on two alternatives for both the Mary Avenue Grade Separation and the Sunnyvale Avenue Grade Separation.

On October 17, 2017, the City Council accepted the recommendation to further develop two alternatives for each grade separation location but instructed the project to add for evaluation the railroad overpass (railroad depressed beneath the roadway) alternative to each location based on community support, lower noise impacts and opportunities for creating new open space or developable land.

On January 23, 2018, the City Council reconsidered adding the railroad overpass alternative at each location for further development and evaluation due to the alternatives' significant neighborhood impacts and high estimated project costs that makes the project much less competitive for grant

funding. The City Council directed the project to focus the Study on the originally recommended two alternatives at each grade separation location for further development and evaluation.

On April 5, 2022, during the City Council study session the status of the Study was discussed and the City Council supported to continue and complete the Study of the four alternatives identified in the October 17, 2017 and January 23, 2018 City Council meetings (Studied Alternatives).

Studied Alternatives

A total of four (4) alternatives have been evaluated in this Study. The studied alternatives are as follows:

At Mary Avenue Grade Crossing:

- Mary Avenue Underpass (Mary Avenue and Evelyn Avenue depressed)
- Mary Avenue Underpass with Jughandle (Mary Avenue depressed)

At Sunnyvale Avenue Grade Crossing:

- Sunnyvale Avenue Underpass Tunnel (Sunnyvale Avenue depressed)
- Sunnyvale Avenue Bicycle/ Pedestrian Undercrossing (Sunnyvale Avenue road closure)

Next Steps

Environmental Assessment and Clearance

The Study will be used to establish a preferred alternative for each grade separation location at Mary Avenue and Sunnyvale Avenue. Based on funding availability, the preferred alternatives will be further developed to conduct the environmental assessment and obtain environmental clearance prior to proceeding to the final design and construction phases of the project.

Funding

Funding opportunities include the VTA 2016 Measure B, California 190 Grade Separation Prioritization Program, One Bay Area Grant, as well as other local, State and Federal Funding opportunities will be actively pursued for the grade separation projects. Funding pursuits will target capturing the entire cost required for the projects.

References

- Caltrain Business Plan, City of Sunnyvale Booklet, May 2019, Caltrain (2017)
- Caltrain Engineering Standards (currently being updated)
<https://www.caltrain.com/about-caltrain/doing-business/engineering/engineering-standards>
- VTA (2017) FY18-19 Transit Service Plan <http://nextnetwork.vta.org/>
- San Mateo County Sheriff's Office (2017) Email from Dan Lieberman on Caltrain Stats 11/8/2017
- City of Sunnyvale (2003) Downtown Specific Plan
<https://sunnyvale.ca.gov/civica3x/filebank/blobdload.aspx?BlobID=22785>
- City of Sunnyvale Vision Zero Plan
<https://www.sunnyvale.ca.gov/home/showpublisheddocument/2858/637822670451930000>
- City of Sunnyvale Complete Streets Policy
<https://www.sunnyvale.ca.gov/home/showpublisheddocument/606/637819113533270000>
- City of Sunnyvale Downtown Specific Plan (September 2020)
<https://www.sunnyvale.ca.gov/home/showpublisheddocument/1910/637821539276000000>
- City of Sunnyvale Downtown Specific Plan Amendment

<https://www.sunnyvale.ca.gov/business-and-development/projects-in-sunnyvale/long-range-planning-initiatives/downtown-specific-plan-amendment>

DRAFT

1. Introduction

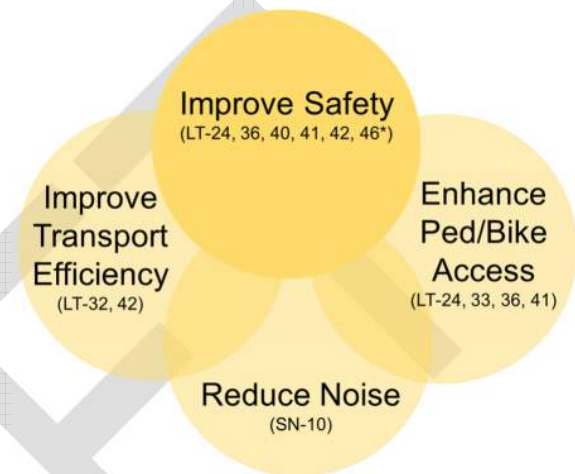
1.1 Goals and Objectives

The City of Sunnyvale is conducting a feasibility study (Study) of a project to vertically separate the roadway and railroad trackway (grade separation) at Mary Avenue and Sunnyvale Avenue, see Attachment A for Project Vicinity Map. The project goals for the grade separations are to:

- improve safety by removing conflicts between pedestrians, bicyclists, vehicles, and trains;
- enhance pedestrian and bicycle access;
- improve transportation efficiency; and
- reduce noise in the vicinity of railroad crossings in Sunnyvale.

These goals support the general policies outlined in Section 1.3 Policy Context.

The objectives of the Study are (1) to identify feasible alternative(s); (2) and to advance the environmental analysis, detailed design, and future funding efforts related to providing grade separation in Sunnyvale. In order to identify the preferred grade separation alternative for each location, the Study evaluates criteria related to multimodal access, traffic circulation, utility relocation, right of way, visual, noise and environmental impacts; as well as structural, construction and staging considerations, and preliminary cost estimates.



1.2 Background

Location

Sunnyvale is situated at the heart of Silicon Valley and connected to the greater San Francisco Bay Area via the Caltrain railroad corridor, US 101, and State Route 237. The studied at-grade crossings of the Caltrain railway line are located at Mary Avenue near Evelyn Avenue in the western portion of the city, and Sunnyvale Avenue near Hendy and Evelyn Avenues in the Historic Downtown District. The Study addresses the relationship between the roadway and railway line as well as adjacent intersections and land uses that could be affected. Depending on the alternative, the study area also includes areas that will be affected by construction, staging, and alterations in traffic circulations.

Existing Conditions

Multimodal Access Conditions

The Caltrain railroad corridor provides regional transit service for daily commuters traveling between San Francisco, the Peninsula and Silicon Valley. Since starting a Baby Bullet service in around 2003, Caltrain ridership has more than doubled, providing measurable congestion relief for roads and freeways in the region. In conjunction with this ridership increase, Caltrain service has increased their operations from 76 weekday services in 2003 to 92 in 2018. In

2019, the downtown Sunnyvale Station was the seventh busiest station in the Caltrain system, serving over 3,208 riders each day.¹

In Sunnyvale, the Caltrain railroad corridor has two (2) at-grade crossings at Mary Avenue in the western portion of the city and Sunnyvale Avenue which is situated in close proximity to the Downtown Sunnyvale Caltrain station. In 2018, Caltrain began preparation of the Caltrain Business Plan. The Caltrain Business Plan aims to help Caltrain support the changing and growing region and meet future demands on the system. Per Caltrain 2040 Long Range Service Vision, in October 2019, Caltrain Board approved a resolution approving the Caltrain Long Range Service Vision that “directs the railroad to continue its planning for a potential higher growth level of service as well as potential new regional and mega-regional connection.” The Service Vision would increase the number of trains traveling along the corridor between San Francisco and San Jose’s Diridon station from the current 104 to between 174 and 348 trains per weekday by 2040.

Caltrain has embarked on an electrification project that will electrify the railroad corridor from San Francisco Caltrain Station to the Tamien Caltrain Station. Electrification improvements include converting diesel-hauled trains to electric trains, increasing service to six trains per peak hour per direction, and maintaining operating speed up to 79 mph. The electrification project is currently in construction and the launch of electrified service is scheduled for 2024.

California High Speed Rail Authority is presently investigating to utilize the Caltrain tracks along this corridor for its trains. California High Speed Rail Authority is currently completing the Environmental Impact Report for the San Jose-San Francisco segment. It is projected that an additional 130 High Speed Rail trains would be added to the corridor every weekday.

Mary Avenue is a minor arterial roadway with Class II bicycle facilities that run north-south. South of Central Expressway, Mary Avenue is primarily residential, and north of Central Expressway land uses are primarily commercial, office and R&D. Approximately 16,000 motor vehicles travel along Mary Avenue each day,² with a peak of 2,000 motor vehicle crossing the Caltrain railroad during the morning peak hour and 2,400 during the evening peak hour. At the Mary/Evelyn Avenue intersection, there is about 140 pedestrian and bicycle movements during the morning peak hour and 100 in the evening peak hour³.

Sunnyvale Avenue rail crossing is located within Sunnyvale’s historic core, 700 feet east of the Downtown Sunnyvale Caltrain Station and within walking distance of key public spaces, and employment, retail and cultural destinations. The street is classified as a residential collector north of Evelyn Avenue, and a minor arterial south of Evelyn Avenue. In the segment south of Evelyn Avenue, Sunnyvale Avenue carries approximately 12,000 daily motor vehicles. At the tracks, there are approximately 900 motor vehicle movements during the evening peak hour and 630 in the morning peak hour.

Sunnyvale Avenue and the Downtown district serve an important transit access role for the Downtown Sunnyvale Caltrain Station, a major transit hub. Sunnyvale Avenue also serves as part of a priority bicycle route between residential areas in the south, the transit hub, Downtown area, and employment areas in Moffett Park (which can be reached via Sunnyvale Avenue using the Borregas pedestrian/bike bridges across US-101 and SR-237). In the Downtown area, there are high volumes of pedestrians and bicycles, with more than 280 pedestrian and bicycle

¹ Caltrain (2017) “2019 Annual Passenger Count Key Findings Report”. Accessed from <https://www.caltrain.com/about-caltrain/statistics-reports/ridership>

² City of Sunnyvale (2017) Average weekday motor vehicle trips (AWDT) reported for Mary Avenue between Evelyn and El Camino Real 5/10/2017

³ Ped/bike counts are not broken out by direction or turn movements.

peak hour movements through Sunnyvale/Evelyn Avenue intersection and 150 pedestrian and bicycle movements through Sunnyvale/ Hendy Avenue intersection in both the morning and evening peak hours.⁴

Sunnyvale Avenue at-grade crossing is also used by VTA bus route 55; however, this route was changed under VTA's FY18-19 Transit Service Plan, which would come into effect with the opening of BART service in San José (Berryessa station).⁵

Accident Data

Collisions that occur along the Caltrain railroad corridor are addressed by San Mateo County Sheriff's Office in their role as the Transit Police Bureau for the Caltrain system. Based on accident/incident reports for highway-rail grade crossing provided by the Department of Transportation Federal Railroad Administration (FRA), the number of reported accidents at Mary Avenue and Sunnyvale Avenue are tabulated in Table 1.1 and Table 1.2 below:

Table 1.1 Railroad Accidents at Mary Avenue Crossing		
Date of Accident	Highway User Involved	Fatal (yes/no)
5/4/2021	Pedestrian	yes
1/11/2016	Auto	no
8/3/2015	Auto	no
2/3/2011	Pedestrian	no

Table 1.2 Railroad Accidents at Sunnyvale Avenue Crossing		
Date of Accident	Highway User Involved	Fatal (yes/no)
1/11/2018	Auto	no
1/28/1981	Other	no
11/06/1975	Auto	no

Caltrain has indicated that there is ample evidence that grade separation is effective tool in preventing all types of pedestrian-train and vehicle-train collisions. Caltrain is also implementing positive train control, which would prevent train-to-train collisions and eliminate the need for double pre-emption of crossing gates and bells near the station.

1.3 Policy Context

General Plan

The General Plan is the document that establishes the principles, policies, standards and priorities for all development within a city. Sunnyvale's General Plan includes a Land Use and Transportation Element (LUTE) that was approved in 2017 and Safety and Noise Element that was included in the 2011 Consolidated General Plan. These two elements establish various policies that are related to grade separation as listed below:

⁴ Ped/bike counts are not broken out by direction or turn movements.

⁵ VTA (2017) FY18-19 Transit Service Plan <http://nextnetwork.vta.org/>

Grade Separation Goal General Plan Policy

Land Use and Transportation Element	
Improve Transportation Efficiency	LT-32 Require roadway and signal improvements for development projects to improve multimodal transportation system efficiency.
	LT-42 Ensure effective and safe traffic flows for all modes of transport through physical and operational transportation improvements.
	LT-36 Facilitate safe and orderly traffic flow and promote school pedestrian and bicycle safety.
	LT-40 Provide safe access to city streets for all modes of transportation. Safety considerations of all transport modes shall take priority over capacity considerations of any one transport mode.
	LT-46 Support statewide, regional, and sub-regional efforts that provide for a safe, effective transportation system that serves all travel modes consistent with established service standards.
Improve safety	LT-24 Promote modes of travel and actions that provide safe access to city streets and reduce single-occupant vehicle trips and trip lengths locally and regionally. The order of consideration of transportation users shall be: (1) Pedestrians, (2) Non-automotive (bikes, three-wheeled bikes, scooters, etc.), (3) Mass transit vehicles, (4) Delivery vehicles, (5) Single-occupant automobiles
	LT-36 Facilitate safe and orderly traffic flow and promote school pedestrian and bicycle safety.
Enhance Pedestrian and Bicycle Access	LT-41 Ensure that the movement of cars, trucks and transit vehicles, bicycles, and pedestrians of all ages and abilities does not divide the community. City streets are public spaces and an integral part of the community fabric.
	LT-33 Prioritize transportation subsidies and project financing over time to the most environmentally friendly modes and services. Support bicycling through planning, engineering, education, encouragement, and enforcement.
Safety and Noise Element	
Reduce Noise	SN-10 Maintained or Reduced Transportation Noise. Preserve and enhance the quality of neighborhoods by maintaining or reducing the levels of noise generated by transportation facilities.

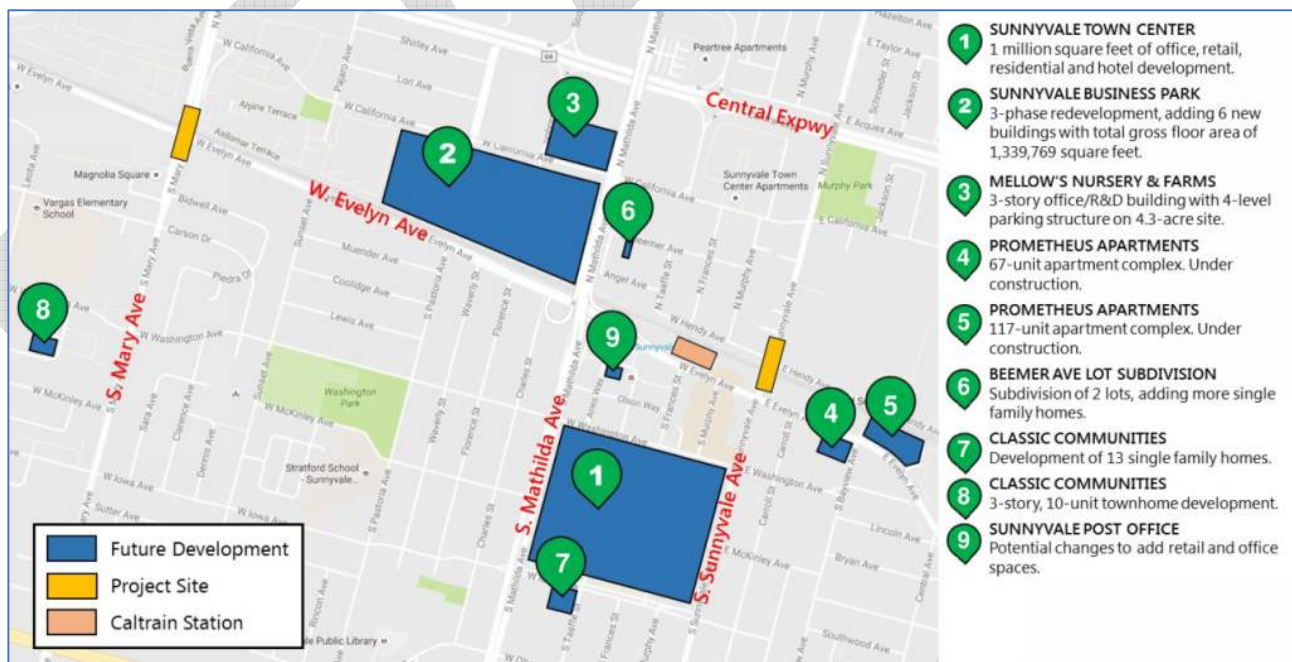
Downtown Specific Plan

Given the importance of the Downtown District, the General Plan is supplemented by the Downtown Specific Plan, which provides more guidance for this area.⁶ The Downtown Specific Plan establishes a vision of “an enhanced, traditional downtown serving the community with a variety of destinations in a pedestrian-friendly environment”. The Specific Plan also outlines policies and strategies to improve street character, encourage preservation of historic resources, create a sense of arrival, encourage strong pedestrian and bicycle linkages, facilitate use of mass transit, promote high quality development, restore the original street grid, and maintain motor vehicle traffic service levels.

Future Developments

With the construction of CityLine Sunnyvale and continued development planned in and around the at-grade crossings locations and Downtown Sunnyvale Caltrain Station, Caltrain ridership would more than likely grow proportionally, which inevitably result in further delays and congestion on the City’s local roadways.

As illustrated in Figure 1, development projects are occurring within the vicinity of the at-grade crossings locations. The proposed developments identified in Figure 1 demonstrates the evolution of the City transforming into a denser community. Each will not only generate additional vehicular traffic, but also pedestrian and bicycle traffics, making it even more important to eliminate the safety issues associated with the at-grade crossings. Traffic impacts associated with each development would require further consideration since many of these surrounding projects would be fully developed by the time of construction of the grade separations.



⁶ City of Sunnyvale (2003) Downtown Specific Plan
<https://sunnyvale.ca.gov/civica/x/filebank/blobload.aspx?BlobID=22785>

Caltrain Electrification

The Caltrain Electrification Project (aka the Caltrain Modernization Program) would allow faster and more frequent electric trains to replace Caltrain's current equipment through the installation of overhead catenary cables. The Electrification Project is expected to be launched in 2024 and is expected to be accompanied by an increase in daily service. The City would need to closely coordinate with Caltrain/PCJPB (Peninsula Corridor Joint Powers Board) to account for requirements associated with electrification. Caltrain is working with cities to encourage grade separation of 42 at-grade crossings along the corridor.

California High Speed Rail

Caltrain has agreements with the California High Speed Rail Authority (CHSRA) that would allow High Speed Rail (HSR) trains to operate in the Caltrain corridor using a blended corridor system. This service aims to achieve HSR service between San Francisco and Los Angeles with speeds of up to 110 mph. Although CHSRA has not planned to implement changes other than quad gates in Sunnyvale, they have indicated their openness to partnerships in relation to the City's grade separation projects.

2. Community Outreach

A crucial aspect of this project is recognizing that the potential safety benefits offered by a vehicle/train separation are counterbalanced by concerns of property values, noise, aesthetics, and construction cost and duration. As a result, solicitation of community participation assisted in identifying community attitudes and priorities toward the project and alternatives.

Community meetings were held for the general public, BPAC and City Council with the following objects:

- Create project awareness
- Create a channel for communication to voice questions and concerns
- Ascertain level of consensus for grade separations among neighborhood residents and businesses

Caltrain Grade Separation Study

Tell us your preferred crossing options

The City plans to lower the roadways at the Mary and Sunnyvale Avenue Caltrain crossings. The road would go beneath the railroad tracks. This project - called a grade separation - will:

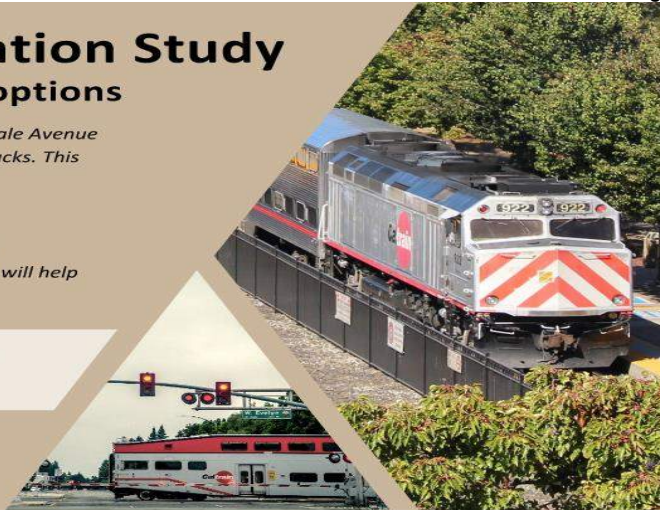
- Improve safety for all travelers,
- Improve bicycle and pedestrian pathways, and
- Decrease traffic delay and noise from the railroad gates.

We are studying two options for each intersection. Your input will help determine the best option for each location.

Project Webpage: Go to <https://sunnyvale.ca.gov> and search for "Caltrain Grade Separation". Stay informed by email using the "Subscribe" link at the top of the project webpage.

For more information, contact:

Angela Obeso, Principal Transportation Engineer, at aobeso@sunnyvale.ca.gov or (408) 737-7557



Upcoming Community Meetings:

Join us at the community meetings to hear about the study's findings and voice your feedback about the options.

**June
8
Wed**

Mary Avenue Caltrain Crossing Community Meeting

6:00pm | Zoom info to be posted on project webpage and emailed to subscribers

This meeting will focus on the options for the Mary Avenue crossing only.

**June
9
Thurs**

Sunnyvale Avenue Caltrain Crossing Community Meeting

6:00pm | Zoom info to be posted on project webpage and emailed to subscribers

This meeting will focus on the options for the Sunnyvale Avenue crossing only.

**June 13
- July 31**

Online Survey

Link to be posted on project webpage and emailed to subscribers

Options for both crossing locations will be presented online with a survey for providing your feedback.

**July
21
Thurs**

Bicycle and Pedestrian Advisory Commission Meeting

7:00pm | Zoom info to be posted on project webpage and emailed to subscribers

The Bicycle and Pedestrian Advisory Committee will recommend preferred options to City Council.

**Aug
30
Tues**

City Council Meeting

7:00pm | Zoom info to be posted on project webpage and emailed to subscribers

City Council will select a preferred option for each crossing location.



3. Evaluation Analysis

3.1 Design Criteria

In evaluating the feasibility of the potential grade separation in the City of Sunnyvale, basic design criteria that included safety, traffic operations, right of way issues, constructability (structural and work duration), construction costs, utility impacts, potential environmental issues, and community concerns were considered and applied.

Assessing traffic operations included the consideration of the number and severity of accident experience at each location, vehicular volume, posted roadway speed, and pedestrian and bicycle impacts. A Traffic and Circulation Memorandum (Memo), dated July 6, 2022, was prepared for the Study which provided a summary of results for No-Build and Built scenarios for the Mary Avenue Underpass Alternative, the Mary Avenue Underpass with Jughandle Alternative, the Sunnyvale Avenue Underpass Tunnel Alternative, and the Sunnyvale Avenue Bicycle/Pedestrian

Undercrossing Alternative. A summary including volume redistribution and assignment, traffic measures of effectiveness, and a multimodal impact analysis are summarized in the Memo, see Attachment D.

Assessing train operations included the consideration of train crossing frequency at each location, maximum railway speed, and type of facility (spur/mainline). Assessing design criteria included consideration of the proximity of intersecting streets, right of way acquisition, stage construction, utility relocations, grading limits, and construction costs. Assessing community input included the consideration of visual and noise impacts, access points and alternative access, land use, and public outreach responses.

In assessment of design criteria, right of way impacts, including utilities, played a pivotal role in the analyses. Right of way acquisitions, which included both full and partial parcel takes, were determined for each alternative. Additional design constraints considered in each alternative include: constructability, construction staging, utility relocations, drainage improvements, and meeting ADA requirements for pedestrian access.

For the roadway design, the American Association of State Highway and Transportation Officials (AASHTO), and for the railroad design, the Caltrain Engineering Standards were used as the basis of the design criteria for the grade separation alternatives. All alternatives adhere to the AASHTO design standard with the exception of the Mary Avenue Underpass with Jughandle Alternative, which provide a maximum roadway grade of 7%. For sidewalks, driveways, and ramps, the Americans with Disabilities Act (ADA) Standards for Accessible Design criteria and requirements were followed.

Design Criteria

	Roadway	Railroad
Grades	4.75%	1.2% 0.8% for temporary rail
Design speed	30 - 45 mph Based on posted speed plus 5 mph	79 mph for shoofly (temp rail) 110 mph for final condition
Bridge depth	5' Supporting roadway	6.75' Supporting railroad
Vertical clearance	Underpass 15.5' over roadway Roadway lowered 22'	Overpass 27' over railroad Roadway 32' above ground

4. Mary Avenue Shortlisted Alternatives

4.1 Mary Avenue Underpass Alternative

This alternative proposes to depress both Evelyn and Mary avenues creating an underpass at the Caltrain railroad crossing, thus grade separating train traffic from vehicular/pedestrian/bicycle traffic, see Attachment C. Along Mary Avenue, the proposed roadway improvements begin at Carson Drive and end at California Avenue and along Evelyn Avenue, the proposed roadway improvements begin approximately 550' east and end approximately 650' west of the Mary Avenue intersection.

The proposed roadway improvements include:

- Depression of Mary Avenue to provide:
 - For southbound direction - Three (3) 11-foot through lanes and two (2) 11-foot exclusive left turn lane;
 - For northbound direction - Three (3) 11-foot through lanes and two (2) 11-foot exclusive left turn lane;
 - Six-foot sidewalk along both Mary Avenue north and southbound directions;
 - Six-foot Class II bicycle facilities along both Mary Avenue north and southbound directions;
- Depression of Evelyn Avenue to provide:
 - For westbound direction - One (1) 11-foot exclusive left, one (1) 11-foot through lane, and one (1) shared through and right turn lane;
 - For eastbound direction - One (1) 11-foot exclusive left, one (1) 11-foot through lane, and one (1) 11-foot shared through and right turn lane;
 - Six-foot sidewalk along Evelyn Avenue westbound direction;
 - Six-foot Class II bicycle facilities along both Evelyn Avenue eastbound and westbound directions
- Construction of retaining walls along both sides of Mary Avenue and Evelyn Avenue within the depressed roadway section;
- Construction of a railroad bridge crossing Mary Avenue;
- Reconstruction/modification of five (5) driveways;
- Replacement and reconstruction of all curb ramps to improve pedestrian safety;
- Installation of new traffic signals at the Mary Avenue/Evelyn Avenue intersection;
- Relocation of existing utilities

In order to support the depressed Mary Avenue Underpass Alternative, other roadway improvements may include, but are not limited to: lighting, drainage/hydraulics including pump station, water quality (post construction BMPs), signage (including sign structures), pavement delineation, and landscaping.

4.1.1 Structure Work

This option requires a number of permanent structures to be constructed, including retaining walls, and bridges. Temporary structures such as excavation shoring and temporary bridge are required depending on the staging sequence.

Based on the available information, providing a shoofly for the railroad tracks is a possible construction option for developing construction concepts for this alternative. This construction option would include installation of a temporary shoofly bridge, including

temporary bridge supports to divert rail traffic away from the current Mary at-grade crossing and providing access for roadway excavation and bridge installation.

The depressed roadways along Mary and Evelyn Avenues would be constructed by excavating between parallel retaining walls on both sides of the roadways. One railroad bridge would be constructed at existing grade to carry two ballasted tracks over Mary Avenue. A 2-span bridge, approximately 140 feet long by 37 feet wide, would be supported on tall abutments at the ends and a center bent at the median of Mary Avenue. Due to unequal northbound and southbound lane configurations at the Mary/Evelyn Avenue intersection, the western span would be longer than the eastern span. Based on current Caltrain standards, the most preferred bridge superstructure type consists of multiple steel girders with cast-in-place concrete or steel deck. This superstructure type is feasible for the bridge spans considered. Steel decks are shallower than concrete decks and therefore minimize the overall structure depth. For an approximately 82-foot-long western span being considered, the structure depth from top of rail to bottom of steel girder is estimated to be 7.75 feet, which includes a 28-inch minimum vertical offset from top of rail to top of bridge deck. Front faces of the bridge abutments would align with front faces of the retaining walls supporting the roadway cut.

Due to Mary and Evelyn Avenues being depressed, retaining walls are needed on both sides of the streets in the depressed areas. Several structural systems are feasible for the permanent retaining walls and bridge abutments. These structural systems include cast-in-place concrete cantilever walls, U-channel concrete walls, soldier pile and lagging walls, and deep soil mix (DSM) walls reinforced with steel soldier piles. Steel soldier piles may be anchored or strutted as needed at deeper cut sections. A cast-in-place concrete or shotcrete facing may be installed in front of the soldier piles.

To maintain traffic on Mary Avenue during construction of the depressed roadway, a temporary shoring wall would be required along the median of Mary Avenue to facilitate excavation on half of the roadway. Once the shoofly is in place for rail traffic to ride on, the permanent rail bridge span on the excavation side can be installed. The bridge superstructure can then be installed after roadway excavation is complete or when the roadway excavation is just deep enough to clear the bridge soffit. For the latter condition, the roadway excavation would progress under the bridge span (i.e. a top-down construction method).

After one side of Mary Avenue depressed roadway is completed, vehicular and pedestrian/bicycle traffic would then be shifted to the new roadway to allow for construction on the opposite side while rail traffic riding on the shoofly. Refer to Section 4.1.2 Construction Staging for further discussion on staging and traffic handling.

4.1.2 Construction Staging

Stage construction and traffic handling for the construction of the Mary Avenue Underpass Alternative would be handled in two major stages.

Stage 1

The first stage would include construction of the temporary shoofly structure and tracks, construction of the main track structure, excavation and open trench construction of the east side of Mary Avenue and Evelyn Avenue east of Mary Avenue. During this stage, the east side of Mary Avenue would be closed and traffic would be shifted to the existing

westside of Mary Avenue while maintaining two-way traffic (minimum one lane in each direction). Evelyn Avenue east of Mary/Evelyn Avenue intersection would be closed for through movements, with access to local traffic only. Evelyn Avenue, west of the intersection, would maintain one lane in each direction. With the trains operating on the shoofly at existing grade, roadway excavation and construction of the underpass and retaining walls on the eastside of Mary Avenue can occur. Construction of Evelyn Avenue roadway improvements east of Mary Avenue shall be constructed concurrently in this stage. Access to the existing properties would remain open. Traffic on Evelyn Avenue would be detoured to surrounding streets.

Stage 2

The second stage would include completion of the remainder of the railroad track structure, and excavation and open trench construction of the west side of Mary Avenue and Evelyn Avenue west of Mary Avenue. During this stage, the west side of Mary Avenue would be closed and traffic is shifted to newly constructed eastside of Mary Avenue. Evelyn Avenue would be closed for through movements, with only access open to local traffic. While railroad operations continue on the shoofly, the remainder of the railroad structure would be completed. Upon completion of the structure, railroad train operations would be shifted to the main tracks. Construction of the Evelyn Avenue roadway improvements west of Mary Avenue/Evelyn Avenue intersection could be done concurrently with the improvements on the west side of Mary Avenue including the removal of the shoofly. Access to existing properties shall remain open. Traffic on Evelyn Avenue would be detoured to surrounding streets.

4.1.3 Other Construction Methods

There are several construction methods that would minimize the disruption to railroad traffic and do not require shoofly. Two methods that could potentially be used at this location include box jacking and micro tunneling. These construction methods do not require open trenching at the railroad track. Box jacking and micro tunneling methods could be employed with live traffic over a box or tunnel. These methods could provide benefits in terms of safety and minimized disruption to rail operations and local traffic.

4.1.4 Evaluation of Construction Methods

Currently, Caltrain is electrifying the corridor and expects to complete the electrification process by mid-2023. When Mary Avenue begins construction, the electrified Overhead Contact System (OCS) will be in place along the corridor, which would make construction of the undercrossing a more complex undertaking. Building across the electrified corridor would require careful consideration and coordination with Caltrain.

Therefore, it is recommended that the Jack and Bore construction method be evaluated during future phases of the project since it could provide increased safety for the public, faster project execution, and less disruption to vehicle, bicycle, pedestrian and rail traffic. Additionally, this method would not require the use of a shoofly track, which would require relocation of electrification poles and the building of a temporary bridge to maintain Caltrain traffic during the construction. Further study of various construction methods should be performed in the next phases in order to determine the optimal construction method for selection.

4.2 Mary Avenue Underpass with Jughandle Alternative

For this alternative, Mary Avenue is depressed while Evelyn Avenue and Caltrain stay at the existing elevation. Therefore, direct turning movements between Evelyn and Mary avenues are eliminated. To accommodate turning movements between Mary and Evelyn avenues, a jughandle roadway is proposed to connect the two roadways. The Jughandle is situated at the southwest corner of the current Mary Avenue/Evelyn Avenue intersection. New signalized intersections are proposed at either end of the Jughandle, one on Mary Avenue opposite the existing Magnolia Square Apartments and the other on Evelyn Avenue at Golden West Collision Center (see Attachment C). Along Mary Avenue, the proposed roadway improvements begin at Bidwell Avenue and end at California Avenue. Along Evelyn Avenue, the proposed roadway improvements begin approximately 500' east of Mary Avenue at J&L Auto Service and end approximately 700' west of Mary Avenue at Starlite Storage.

The proposed roadway improvements include:

- Depression of Mary Avenue to provide
 - For southbound direction - Two (2) 11-foot through lanes;
 - For northbound direction - Two (2) 11-foot through lanes and two (2) exclusive right turn lane from Mary Avenue northbound to Jughandle westbound directions;
 - Six-foot split-profile sidewalk along both Mary Avenue north and southbound directions;
 - Six-foot Class II bicycle facilities along both Mary Avenue north and southbound directions;
- Widening Evelyn Avenue:
 - For eastbound direction - One (1) 12-foot through lane and one (1) 12-foot exclusive left turn lane from Evelyn Avenue eastbound to Jughandle northbound directions. The lane configuration changes to two (2) 11-foot through lanes for Evelyn Avenue once it passes the Evelyn Avenue and Jughandle intersection.
 - For westbound direction - One (1) 11-foot through lane and two (2) 12-foot exclusive right turn lanes from Evelyn Avenue westbound to Jughandle northbound directions. The lane configuration change to one (1) 12-foot through lane.
 - Six-foot sidewalk facility along Evelyn Avenue westbound direction
 - Six-foot Class II bicycle facilities along both Evelyn Avenue west and eastbound directions
- Construction of Jughandle;
 - Five 11-foot lane cross-section, with the inclusion of an additional westbound right-turn lane approaching Mary Avenue
 - Six-foot sidewalk and Bicycle Class II facilities along Jughandle in both directions.
- Construction of retaining walls along Mary Avenue along the depressed segment;
- Construction of a railroad bridge crossing Mary Avenue;
- Construction of an Evelyn Avenue bridge crossing Mary Avenue;
- Reconstruction/modification of three (3) driveways;
- Replacement and reconstruction of all curb ramps to improve pedestrian safety;
- Installation of new traffic signals at both ends of the Jughandle;
- Relocation of existing utilities;

In order to support the Mary Avenue Underpass with Jughandle alternative, other roadway improvements may include, but are not limited to: lighting, drainage/hydraulics including pump station, water quality (post construction BMPs), signage (including sign structures), pavement delineation, and landscaping.

4.2.1 Structure Work

Similar to Mary Avenue Underpass alternative, this alternative requires a bridge crossing, roughly 37 feet in width, to carry two ballasted tracks over Mary Avenue. Additionally, since Evelyn Avenue remains at grade, a second bridge would be required to carry Evelyn vehicular traffic over Mary Avenue. The vehicular bridge width is on the order of 68 feet. Both the rail and vehicular bridges are approximately 110 feet in length with unequal spans. The longer western span would be roughly 66 feet long. The rail bridge structure depth from top of rail to bottom of steel girder is estimated to be 6.75 feet which includes a 28-inch minimum vertical offset from top of rail to top of bridge deck. The vehicular bridge deck would be relatively shallow and the vertical clearance underneath would not be critical. The two bridges would be supported by the bridge abutments at the ends and center bents at the Mary Avenue median. Front faces of bridge abutments would align with front faces of the retaining walls supporting the roadway cut. Feasible structural systems for the retaining walls and bridge abutments are described under Section 4.1.1 Mary Avenue Underpass Alternative.

Construction staging for this alternative would essentially be the same as that for the Mary Avenue Underpass alternative. In order to maintain traffic on Mary Avenue, a temporary shoring wall would be required along the median of Mary Avenue to facilitate excavation on one side at a time. A temporary shoofly bridge would also be needed to support the shoofly while allowing excavation to continue under the shoofly. The permanent vehicular bridge carrying Evelyn Avenue traffic would be constructed last, after the permanent rail bridge is in place and the shoofly is no longer needed. To minimize disruption to Mary Avenue traffic during bridge construction, the use of precast concrete slabs would be a feasible option for the span lengths considered. Falsework would not be required for this superstructure type.

Please see Section 4.1.4, for proposed evaluation of construction methods.

4.2.2 Construction Staging

Stage construction and traffic handling for the construction of the Mary Avenue Underpass Tunnel would be handled in two major stages.

Stage 1

The first stage includes construction of the temporary shoofly structure and shoofly tracks, shifting of trains to the shoofly tracks, construction of the main track structure, excavation and open trench construction of the east side of Mary Avenue and Evelyn Avenue east of the intersection.

During this stage, the east side of Mary Avenue would be closed and traffic would shift to the existing west side of Mary Avenue. Evelyn Avenue, east of Mary/Evelyn Avenue intersection, would then be closed, with access for local traffic only. Mary Avenue westbound direction would still maintain one lane in each direction.

A temporary shoofly track structure would be constructed first for rail operations along with temporary shoring walls. Once the train has been cut-over to the shoofly, the construction of the proposed main track bridge structure on the east side of Mary Avenue can begin including excavation and construction of the underpass. Construction of the Jughandle and Evelyn Avenue roadway improvements east of Mary Avenue can be done concurrently with the improvements on the east side of Mary Avenue. Access to the existing properties shall remain open. Traffic on Evelyn Avenue would be detoured to surrounding streets.

Stage 2

The second stage would include completion of the remainder of the railroad track structure, shifting of trains to the completed main tracks, excavation and open trench construction of the west side of Mary Avenue and Evelyn Avenue west of Mary Avenue.

During this stage, the west side of Mary Avenue is closed and traffic would be shifted to the new Mary Avenue eastside underpass constructed in the stage 1. Evelyn Avenue through movements would be closed, with access open to local traffic only.

While railroad operations remain on the shoofly at the beginning of this stage, the remainder of the main track bridge structure would be completed. Upon completion of the main track facilities, railroad train would then shift back to the main tracks. Removal of the shoofly tracks and temporary structure can begin along with the excavation and construction of the west side of Mary Avenue. Construction of the Evelyn Avenue roadway improvements west of Mary Avenue can be done concurrently with the improvements on the west side of Mary Avenue. Access to existing properties shall remain open. Traffic on Evelyn Avenue is detoured to surrounding streets.

Stage 3

The third stage would include construction of the permanent Evelyn Avenue bridge structure. During this stage, the Mary Avenue Underpass is opened to traffic. Evelyn Avenue would be closed east and west of Mary Avenue to construct the bridge structure. Traffic on Evelyn Avenue is detoured to surrounding streets.

4.3 Mary Avenue Underpass with Jughandle and Connector Ramps Alternative

In order to try to maintain existing turning movements at the Mary Avenue/Evelyn Avenue intersection, the Mary Avenue Underpass with Jughandle and Connector Ramps Alternative was developed. The roadway geometric layout for this alternative is similar to the Mary Avenue Underpass with Jughandle. The difference is that two (2) single-lane connector ramps that connect westbound Evelyn Avenue traffic with northbound Mary Avenue and southbound Mary Avenue traffic with westbound Evelyn Avenue are introduced. These direct connector ramps are added as a result of the high traffic volumes on Evelyn Avenue westbound and Mary Avenue northbound directions. A traffic signal would be needed for the westbound Evelyn Avenue to northbound Mary Avenue ramp.

Preliminary designs revealed that this alternative would impact the businesses along Evelyn Avenue. Fourteen parcels require partial takes and two (2) parcels require full right of way acquisition.

The alternative was eliminated from further evaluation and development due to the significant right of way impacts.

4.4 Safety

Railroad crossings pose a threat to the safety of all modes of traffic crossing the tracks. The Mary Avenue at-grade crossing creates numerous conflict points for cars, trains, pedestrians, and bicyclists along Mary Avenue due to the proximity of the Mary/Evelyn Avenue intersection with the rail crossing. The crossing forces both cars and trains to reduce their speed, increasing travel time and congestion of cars, decreasing overall efficiency of the rail network, and generating more air and noise pollutants to the surrounding communities.

Removing the at-grade rail crossing would substantially increase safety by removing the vehicle-train conflicts and pedestrian/bicyclist-train conflicts, and speed for both trains and cars will also increase. Roadway traffic including bike and pedestrian would move freely under the railroad tracks, reducing wait times due to gates for a passing train. Most importantly, the accident rate of collisions is eliminated as the crossing no longer puts traffic in front of trains.

4.5 Right of Way Impacts

Under Mary Avenue Underpass alternative, both Evelyn and Mary Avenues are depressed while only Mary Avenue is depressed under Mary Avenue Underpass with Jughandle Alternative. Thus, more private properties and businesses would be impacted by the Mary Avenue Underpass alternative than the alternative with the Jughandle.

For Mary Avenue Underpass Alternative, it is estimated that three (3) parcels require full acquisition, one parcel requires partial or “sliver” take, and five (5) driveways and drive aisles would need to be reconstructed to different grades.

As for Mary Avenue Underpass with Jughandle Alternative, one (1) parcel potentially requires full acquisition, and three (3) driveways need to be reconstructed.

Because Mary Avenue is depressed under both alternatives, utility easement corridors are necessary for utility relocation before construction can begin.

The right of way impacts for the alternatives are tabulated in Table 4.1 below.

Table 4.1 Right of Way Impact				
Alternatives	Full Parcel Acquisition	Partial Parcel Takes	Utility Corridor Easements	Number of Driveway Modifications
Mary Avenue Underpass	3	1	4	5
Mary Avenue Underpass Tunnel with Jughandle	1	0	3	3

There are two (2) parcels that are currently owed by the City of Sunnyvale that would be impacted by the Mary Avenue Underpass with Jughandle Alternative. Since the parcels belong to the City, it is not considered an impact and not considered as a right away take. However,

the businesses presently occupying these parcels would be affected and have to be vacate. The two (2) affected businesses are Golden West Collision Center, and Family Towing.

4.6 Environmental Impacts

Because the grade separation would allow the Caltrain gates and bells to be removed and the trains would no longer sound their horn while traveling through the crossing, noise would be reduced under both Mary Avenue Underpass Alternative and Mary Avenue Underpass with Jughandle Alternative. However, other impacts to environmentally sensitive resources could still occur as a result of the grade separation.

Below is a list of potential environmental impacts:

- Property impacts primarily borne by commercial properties – gas station, car repair
- Potential soil contamination issues (gas station, car repair)
- Ornamental landscape removal. Nest birds could be a concern during construction.
- No natural habitat or aquatic resources appear present. No permits (e.g. 404, 1602, 408, BCDC) appear needed.
- No historic structures appear present, nor are any local landmarks or heritage trees located in the project area.
- Archaeological resources may be present.
- Potential noise effects from Jug handle on residence along Bidwell Avenue. One of these residences may house a day care business. Signalized intersection on Mary Avenue/Jug Handle could create potential noise concerns at Magnolia Square apartments. Removal of crossing gates, signals would result in beneficial effect on noise
- Underpass should not create any visual or aesthetic concerns. Removal of crossing signals, gates would result in beneficial aesthetic effect.
- No Parks, recreational or other potential 4(f) resources appear present.

Preliminary findings indicate that both proposed alternatives are qualified as Statutorily Exemption per CEQA Section 15282 (g), "Removal of a At-Grade Crossing." For NEPA, grade crossings are qualified for Categorical Exclusion under NEPA (FRA 771.116).

Since there is no waters of the US nor waters of the State situated within or near the project limits, regulatory permits/approval from San Francisco Bay Regional Water Quality Control Board (RWQCB) 401 Water Quality Certification Permit is not required. However, the project is required to obtain tree pruning and removal permit from City of Sunnyvale, under Section 19.94, "Tree Preservation."

4.7 Utility Impacts

Due to similarities of both alternatives, utility impacts are identical. Below is a list of utility lines that would be impacted by both alternatives:

City of Sunnyvale – Sanitary Sewer, Water, Storm Drain
PG&E – Gas, Electricity
AT&T – Telephone
Cablecom – Fiber Optic
Century Link – Fiber Optic
Level 3 Communications– Fiber Optic
Verizon – Fiber Optic

It is important to note that utilities identified in this Study reflect information that is based on information provided by others. The exact location of underground and overhead utilities is conceptual and preliminary in nature and would require further evaluation during the environmental and design phases to confirm the accuracy. The proposed improvements would require utility relocation. Public utility easements are required to house the relocated utilities. Pump stations would be needed to continue the continuity of the existing storm drain and sanitary sewer system through the depressed sections of roadway.

4.8 Transportation Impacts

4.8.1 Mary Avenue Underpass Alternative

For the Mary Avenue Underpass Alternative, both Mary and Evelyn Avenues are depressed and remain connected, all the turning movements at the intersection remain the same as represented under the no-build scenario since the roadway geometric layout relatively remains the same as existing condition. The local streets would, however, no longer interact with the Caltrain railroad tracks.

There would be no traffic rerouted under this alternative. Since no redistribution of traffic is proposed under this alternative, operations for other intersections along Mary Avenue do not change. The Mary/Evelyn Avenue intersection would still operate at the same LOS as No Build alternative, under projected 2035 volumes. But since the intersection would not be subjected to gate closures at the railroad crossing, delay would be substantially reduced in both AM and PM peak periods. The only movement with a sizeable increase in time delay is the eastbound Evelyn Avenue to southbound Mary Avenue movement but this delay is minimal >15 seconds. Queue lengths would be reduced for the majority of the movements under this alternative but they are still long and may exceed storage pocket lengths in some approaches. The Mary Avenue Underpass Alternative reduces the travel times along Mary Avenue compared to the No Build alternative.

4.8.2 Mary Avenue Underpass with Jughandle Alternative

For this alternative, only Mary Avenue is depressed while Evelyn Avenue and the Caltrain railroad would remain at grade. A road connector or “Jughandle” would provide connection from Mary Avenue to existing Evelyn Avenue, or vice versa. For this scenario, all the turning movements at the Mary Avenue/Evelyn Avenue intersection are redistributed through the Jughandle. Some movements have improvements through reduction in vehicular delay, while others have greater delays. The through movements on both Mary and Evelyn Avenues would have fewer delays since they would travel through one signalized intersection with less traffic volumes. All turning movements from Evelyn Avenue to Mary Avenue would need to travel through both Jughandle intersections (at Mary Avenue and Evelyn Avenue).

Table 4.2 below shows the (LOSs) comparison between Mary Avenue Underpass with Jughandle Alternative and No-Build.

Table 4.2 LOS Comparison Between Mary Avenue w/ Jughandle versus No-Build						
Alternatives	Mary Ave/Evelyn Ave (Existing Condition)		Mary Ave/Jughandle Intersection		Evelyn Ave/Jughandle Intersection	
	AM Peak Hrs.	PM Peak Hrs.	AM Peak Hrs.	PM Peak Hrs.	AM Peak Hrs.	PM Peak Hrs.
No-Build	(LOS) F	(LOS) F	n/a	n/a	n/a	n/a
Mary Ave Underpass with Jughandle	n/a	n/a	(LOS) F	(LOS) C	(LOS) D	(LOS) E

With an exception to AM peak hours at Mary Avenue/Jughandle, traffic operations improve under the Underpass with Jughandle Alternative when comparing to No-Build. The delay for the majority of movements substantially decreases with the Jughandle alternative in both AM and PM peak hours.

4.9 Multimodal Considerations

4.9.1 Pedestrian/Bicycle

Mary Avenue Underpass Alternative

For the Mary Avenue Underpass Alternative, pedestrians and bicyclists would no longer be exposed to conflicts with trains. Sidewalk and Class II bicycle facilities are provided on Mary and Evelyn Avenues. The pedestrians and bicyclists, however, would experience 4.75% grade changes at Mary and Evelyn Avenue intersection. It is noted that no sidewalk is provided on the northside of Evelyn Avenue which is similar to the existing condition.

Mary Avenue Underpass with Jughandle Alternative

For the Mary Avenue Underpass with Jughandle Alternative, pedestrians and bicyclists would also no longer be exposed to conflicts with trains. However, under this alternative, bicyclists would travel along the roadway profile and experience a maximum grade of 7% on Mary Avenue. With the split profile, the pedestrians experience a maximum 5% grade. Along Jughandle, bicyclists and pedestrian would experience 3% maximum grade.

Pedestrian and Class II bicycle facilities on Evelyn Avenue would be the same as existing condition with bike and sidewalk running along southside of Evelyn Avenue. However, only Class II bicycle facility is provided on the north side of Evelyn Avenue. The City is currently studying a plan to build a multi-use trail on the north side of Evelyn Avenue between Bernardo Avenue and Mathilda Place. This alternative would not introduce any new conflict and so would not preclude the City's planned trail.

There would be no direct connection for pedestrians and bicyclists between Evelyn Avenue and Mary Avenue. Pedestrian and bicyclists have to use the Jughandle to get to and from Mary Avenue to Evelyn Avenue, or vice versa.

4.9.2 Transit

There are no transit routes on Mary Avenue or Evelyn Avenue therefore there are no impacts to transit routing.

4.10 Estimated Costs

Preliminary estimates have been prepared for both alternatives, and include construction capital costs, right of way acquisitions, and costs related to design and environmental services.

For Mary Avenue Underpass Alternative: Cost ranges between \$375 – 425 Million

For Mary Avenue Underpass with Jughandle Alternative: Cost ranges between \$280 – 320 Million

4.11 Summary of Findings

Two alternatives were studied/evaluated for the grade separation at Mary Avenue. Both options achieve its goals and objectives:

- Improve safety;
- Enhance pedestrian and bicycle access;
- Improve transportation efficiency; and
- Reduce noise in the vicinity of rail crossings at Sunnyvale Avenue.

Both alternatives, however, have differences in traffic circulation and right of way impacts, and construction cost.

Mary Avenue is heavily saturated with traffic in the No-Build scenario. While the two proposed alternatives eliminate the rail crossing conflicts, they do not address overall capacity constraints on the corridor. Therefore, while the alternatives reduce delay for most movements through the Mary Avenue and Evelyn Avenue areas, movements with deficient levels of delay still persist.

Both proposed alternatives provide substantial delay and queuing benefits to traffic movements on Evelyn and Mary Avenues relative to No-Build conditions. By distributing vehicle conflicts amongst two intersections, the Mary Avenue Underpass with Jughandle Alternative achieves higher LOS comparing to Mary Avenue Underpass Alternative. The traffic analysis shows that Mary Avenue Underpass Alternative would be the same as No Build scenario.

Both Mary Avenue grade separation alternatives substantially improve safety for pedestrians, bicyclists, and vehicles by eliminating conflicts with trains. With the Mary Avenue Underpass with Jughandle Alternatives, most pedestrians and bicyclists through the intersection would experience some out-of-direction travel through Jughandle from Mary Avenue to Evelyn Avenue, and vice versa. However, conflict points do increase for bicycle and pedestrian movements with the introduction of two (2) intersections (Mary Avenue/Jughandle; Jughandle/Evelyn Avenue) comparing to Mary Underpass alternatives which has only one (1) intersection (Mary Avenue/Evelyn Avenue).

The Mary Avenue Underpass Alternative costs is considerably higher than the Mary Avenue Underpass with Jughandle Alternatives. The differences in cost are a direct reflection of the

Mary Avenue Underpass Alternative having more right of way impacts, utility relocations, and construction impacts compared to the Mary Avenue Underpass with Jughandle Alternative.

5. Sunnyvale Avenue Grade Separation Alternatives

5.1 Sunnyvale Avenue Underpass Tunnel Alternative

This alternative is proposed a tunnel beneath Evelyn Avenue, the Caltrain railroad, and Hendy Avenue, see Attachment C. Vehicles traveling along Evelyn Avenue would no longer have direct connections to Sunnyvale Avenue, or vice versa. As for Hendy Avenue to Sunnyvale Avenue connections, only Hendy Avenue westbound connecting to Sunnyvale Avenue northbound and Sunnyvale Avenue southbound connecting to Hendy Avenue westbound are provided while other connections for vehicle movements are cut-off including direct connections from Sunnyvale Avenue to Hendy Avenue. Along Sunnyvale Avenue, the proposed roadway improvements begin at Washington Avenue and end north of Hendy Avenue. For Evelyn and Hendy Avenues, the improvements begin approximately 350' west and approximately 350' east of Sunnyvale Avenue.

The proposed roadway improvements include:

- Construction of an approximate 46-foot wide and 800-foot long tunnel underneath Sunnyvale Avenue from Hendy Avenue/Sunnyvale Avenue intersection to approximately 200 feet south of Evelyn Avenue/Sunnyvale intersection to provide:
 - Two (2) 11-foot through lanes;
 - Six-foot wide Class II bicycle facility for both directions
 - Twelve-foot wide multi-use path
- Installation of pedestrians/bicyclists ramps at southwest quadrant of Hendy Avenue/Sunnyvale Avenue intersection, and at northwest corner of Evelyn Avenue/Sunnyvale Avenue intersection;
- Connecting to the tunnel ends by constructing retaining walls on both sides of Sunnyvale Avenue where roadway is still depressed;
- Reconfiguration of the southern leg of Evelyn Avenue and Sunnyvale Avenue intersection into a cul-de-sac;
- Reconstruction/modification of several driveways;
- Replacement and reconstruction of all curb ramps to improve pedestrian safety;
- New Class II bicycle lanes on Hendy, Evelyn, Sunnyvale Avenues;
- Modification to traffic signals at Sunnyvale Avenue/Evelyn Avenue and Sunnyvale Avenue/Hendy Avenue intersections;
- Relocation of existing utilities;

In order to support the Sunnyvale Avenue Underpass Tunnel Alternative, other roadway improvements may include, but are not limited to: lighting, ventilation, drainage/hydraulics including pump station, water quality (post construction BMPs), signage (including sign structures), pavement delineation, and landscaping.

5.1.1 Structure Work

The proposed option is proposed to construct an approximate 500-foot tunnel box from Hendy Avenue/Sunnyvale Avenue intersection to Evelyn Avenue/Sunnyvale Avenue intersection to accommodate vehicular and pedestrian/bicycle traffic. The vertical height of the tunnel box may vary along the alignment due to varying profiles constraints applicable

to pedestrian traffic. The widest portion of the tunnel would require a clear width on the order of 46 feet. Thicknesses of the structural components are dependent on the width and height of the box and the soil cover above.

A number of construction methods have been evaluated for this location. Due to the proximity of the Caltrain station, box jacking construction method is selected for evaluation of this alternative to minimize impacts to the railroad including nearby Caltrain station. Although Caltrain currently does not have standard criteria for box jacking as discussed in Section 4.1.3 Other Construction Method, but with the similarities in project sizes and scopes and lessons learned from Bernardo Avenue Grade Separation Project situated in City of Mountain View and Sunnyvale that is currently being designed, box jacking would be feasible and considered.

With the lesson learn from Bernardo Avenue Grade Separation Project, the first step is to install temporary shoring to support an excavation area adjacent to the final box location. A concrete tunnel box would then be constructed in the excavated pit. As an alternative to cast-in-place concrete boxes, smaller boxes can also be precast off site and transported to the site. The box would jack through the ground to its final position with the hydraulic jacks. This construction method does not require open trenching at the tracks. Jacking operation may potentially be performed with live traffic over the box, if allowed by Caltrain.

Once a section of the box is jacked through, underneath, and beyond the railroad tracks, the rest of the tunnel would be constructed using open trench construction method. Temporary shoring walls would be required on either side of the tunnel box for the excavation and installation of the tunnel.

Pedestrian and bicycle access to the tunnel would be provided by cast-in-place concrete ramp structures at each end of the tunnel. Concrete retaining walls of various heights and types would be required to support the cuts along the Sunnyvale Avenue and pedestrian/bicycle ramps.

5.1.2 Staging/Construction

Stage construction and traffic handling for the construction of the Sunnyvale Avenue Underpass Tunnel Alternative would be handled in two major stages.

Stage 1

The first stage would be the roadway widening on the west side of Sunnyvale Avenue, north of Hendy Avenue, in order to maintain driveway access to the residents during stage 2 when the majority of the construction is performed.

Stage 2

The second stage would include all excavation and construction of underpass tunnel structure, retaining walls, and roadway improvements. Since tunnel construction underneath the railroad tracks would be by box jacking, shoofly tracks for the railroad would not be required. Construction beyond the railroad tracks would be by open trench construction and require closure of Sunnyvale, Evelyn, and Hendy Avenues. A southbound right turn lane for driveway access from Sunnyvale Avenue to westbound Hendy Avenue would remain open via the roadway widening completed during the first stage. All traffic would be detoured to surrounding streets. Access to businesses would still remain open with minimum disruption during construction.

5.2 Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative

The Sunnyvale Avenue Bicycle/ Pedestrian Undercrossing Alternative consists of improvements along Sunnyvale, Evelyn, Hendy Avenues. A segment of Sunnyvale Avenue between Hendy and Evelyn Avenues would be closed to traffic and converted to pedestrian and bicycle crossing only.

The improvements for this option include:

- Constructing an approximately 80-foot long and 25-foot wide box tunnel beneath the existing railroad tracks;
- Constructing pedestrian stair and pedestrian/bicycle access ramps at both ends of the undercrossing. This includes retaining walls along the access ramps;
- Realigning Hendy Avenue/Sunnyvale Avenue intersection to enhance mobility, reduce vehicular conflict zones, and improve bicycle and pedestrian safety;
- Modifying and reconstructing Emergency Vehicle Access at Villa Del Sol Apartments;
- Reconstructing sidewalks, curb ramps, and Class II bikeway along Hendy Avenue, Evelyn Avenue, and Sunnyvale Avenue;
- Modifying traffic signals at Hendy Avenue/Sunnyvale and Evelyn Avenue/Sunnyvale Avenue intersections;

5.2.1 Structure Work

Under this alternative, Sunnyvale Avenue would be permanently closed between Evelyn Avenue and Hendy Avenue. A tunnel box on the order of 80 feet long, with estimated clear width of 25 feet and clear height of 10 feet, would be jacked underneath the railroad track to minimize impact to the railroad operations. The construction method would be similar to Section 5.1.1 Sunnyvale Avenue Underpass Tunnel Alternative.

5.2.2 Staging/Construction

There is only one construction stage for this alternative. It is similar to Sunnyvale Avenue Underpass Tunnel Alternative Construction Stage 2, as described in Section 5.1.2 Staging/Construction.

5.3 Safety

Railroad crossings pose a threat to the safety of all modes of traffic crossing the tracks. The Sunnyvale Avenue at-grade crossing creates numerous conflict points for cars, trains, pedestrians, and bicyclists along Sunnyvale Avenue due to the proximity of the Hendy/Sunnyvale Avenue and Evelyn/Sunnyvale intersections with the rail crossing. The crossing forces both cars and trains to reduce their speed, increasing travel time and congestion of cars, decreasing overall efficiency of the rail network, and generating more air and noise pollutants to the surrounding communities.

Removing the at-grade rail crossing would substantially increase safety by removing the vehicle-train conflicts and pedestrian/bicyclist-train conflicts, and speed for both trains and cars will also increase. Roadway traffic including bike and pedestrian would move freely under the

railroad tracks, reducing wait times due to gates for a passing train. Most importantly, the accident rate of collisions is eliminated as the crossing no longer puts traffic in front of trains.

5.4 Right of Way Impacts

Lowering of Sunnyvale Avenue as proposed in the Sunnyvale Avenue Underpass Tunnel Alternative would impact more private properties when compared to Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative.

North of the railroad tracks, along Sunnyvale Avenue, the Sunnyvale Avenue Underpass Tunnel Alternative requires a longer segment of Sunnyvale Avenue to be lowered due to the depth/clearance required for a vehicular tunnel box underneath the railroad tracks. As a result, all turning movements between Sunnyvale Avenue and Hendy and Evelyn Avenues are cut-off. To maintain right turn connections from Hendy Avenue westbound to Sunnyvale Avenue northbound and from Sunnyvale Avenue southbound to Hendy Avenue westbound, widening to both sides of Sunnyvale Avenue would be required. This would have sliver right of way impacts to property frontages situated on both sides of Sunnyvale Avenue. For the Sunnyvale Avenue Bicycle/ Pedestrian Undercrossing Alternative, only one (1) property requires partial take due to Hendy/Sunnyvale Avenue intersection realignment.

South of the railroad tracks, due to lower roadway profile, the Sunnyvale Avenue Underpass Tunnel Alternative requires more reconstruction work onto private properties, including affecting driveway accesses to businesses, when compared to Sunnyvale Avenue Bicycle/ Pedestrian Undercrossing Alternative.

Table 5.1 below presents the right of way impact for each alternative.

Table 5.1 Right of Way Impact				
Alternatives	Full Parcel Acquisition	Partial Parcel Takes	Utility Corridor Easements	Number of Driveway Modifications
Underpass Tunnel	0	9	2	6
Pedestrian/Bike Undercrossing	0	1	1	1

5.5 Environmental Impacts

Noise impact would tremendously reduce with both alternatives at Sunnyvale Avenue because the grade separation would allow the Caltrain gates and bells to be removed and the trains would no longer sound their horn while traveling through the crossing. However, there would still noise due to nearby Caltrain Station. Other impacts to environmentally sensitive resources could still occur as a result of the project.

Below is a list of potential environmental impacts:

- Property effects appear minor, sliver frontage effects, affect parking lot, no displacement of businesses.
- Potential for soil contamination (car repair, industrial)

- No natural habitat or aquatic resources appear present. Some tree removal may be required throughout the project area. Nesting birds could be a concern during construction.
- Historic resources – several properties in the north east quadrant of Sunnyvale Avenue and Hendy appear to be over 50 years old including the Hendy Iron Works (Northrup Grumman) which is a local landmark.⁷ The Vargas Redwood Trees, which are also a local landmark located and one Heritage Tree (American Chestnut) are located at 501 Hendy Avenue and could be affected.
- There is also a Downtown Historic District west of the Caltrain tracks which does not appear to be adversely affected. May need to evaluate historic character of properties under local historic preservation requirements?
- Archaeological resources may be present.
- Noise effect appear minor, may be beneficial with removal of crossing gates and signals
- Underpass should not create any visual or aesthetic concerns. Removal of crossing signals, gates would result in beneficial aesthetic effect.
- No park or recreational facilities appear present.

Preliminary findings indicate that both proposed alternatives are qualified as Statutorily Exemption per CEQA Section 15282 (g), "Removal of a At-Grade Crossing." For NEPA, grade crossings are qualified for Categorical Exclusion under NEPA (FRA 771.116).

Since there is no waters of the US or waters of the State situated within or near the project limits, regulatory permits/approval from San Francisco Bay Regional Water Quality Control Board (RWQCB) 401 Water Quality Certification Permit is not required. However, the Project is required to obtain tree pruning and removal permit from City of Sunnyvale, under Section 19.94, "Tree Preservation."

5.6 Utility Impacts

Preliminary investigation indicates there are minimal utility impacts/relocations under Sunnyvale Avenue Bicycle/ Pedestrian Undercrossing Alternative because tunneling on Sunnyvale Avenue is limited between Hendy and Evelyn Avenues.

For Sunnyvale Avenue Underpass Tunnel Alternative, there are numerous utilities that would be impacted and require relocation. Below is the list of utility lines that would be affected:

- City of Sunnyvale – Sanitary Sewer, Storm Drain, Water
- PG&E – Gas, Electricity
- AT&T – Telephone
- Cablecom – Fiber Optic
- Century Link – Fiber Optic
- Level 3 Communications– Fiber Optic

⁷ Constructed in 1906, Hendy Iron Works was an industrial pioneer in Sunnyvale. Originally producing equipment for mining gold and silver, the company supplied marine engines in both World War I and World War II. In continuous operation from 1906 to 1946, the company was purchased by Westinghouse Electric in 1947. The water tower stored the city's emergency water supply in the early 1900s.

- Verizon – Fiber Optic
- XO Communications – Fiber Optic

It is important to note that utilities identified in this Study reflect information that is based on information provided by others. The exact location of underground and overhead utilities is conceptual and preliminary in nature and would require further evaluation during the environmental and design phases to confirm the accuracy. The proposed improvements would require utility relocation. Public utility easements are required to house the relocated utilities. Pump stations would be needed to continue the continuity of the existing storm drain and sanitary sewer system through the depressed sections of roadway.

5.7 Transportation Impacts

5.7.1 Sunnyvale Avenue Underpass Tunnel Alternative

Under this alternative, all turning movements between Sunnyvale and Evelyn Avenue and most of turning movements between Sunnyvale and Hendy Avenue would be disconnected. Vehicles that make turn movements would need to reroute using nearby streets. Vehicle circulation would be altered from existing condition since Sunnyvale Avenue would no longer connect to Evelyn and Hendy Avenue directly, with exceptions to the two right turn movements from Hendy Avenue westbound to Sunnyvale Avenue northbound and from Sunnyvale Avenue southbound to Hendy Avenue westbound. However, vehicular delays for those traveling straight on Sunnyvale Avenue between Washington and California Avenues would be eliminated due to the removal of three existing intersection at Evelyn Avenue, Hendy Avenue, and railroad tracks. Thus, travel times are substantially lower on Sunnyvale Avenue. Travel time for those who currently make turning movements between Sunnyvale Avenue and Evelyn and Hendy Avenues would increase due to vehicles being rerouted.

With the volume redistribution, streets including Fair Oaks, Mathilda and Washington Avenues would be affected. For those vehicles using Sunnyvale Avenue to connect to Evelyn and/or Hendy Avenues, they would need to use the Sunnyvale /Washington Avenue intersection to get to Fair Oaks Avenue on the south and Sunnyvale/California Avenue intersection to get to Fair Oaks Avenue on the north. When comparing to the No Build alternative, delays at the intersections of Sunnyvale/Washington Avenue and Sunnyvale/California Avenues increase. However, there would be a decrease in delay at Fair Oaks Avenue and Kifer Road intersection since drivers more likely choose Fair Oaks/California Avenue intersection. Delays at the intersection of Fair Oaks/California Avenue is similar to No Build alternative. For travel times along Fair Oaks, Sunnyvale, and California, and Mathilda Avenues, see Table 5.1 below.

Table 5.1 Underpass Tunnel – Corridor Travel Time Comparison						
Corridor	Segment	Direction	AM Peak Hour (sec.)		PM Peak Hour (sec.)	
			2035 No-Build	2035 Build Tunnel	2035 No-Build	2035 Build Tunnel
Mathilda	Indo to Washington	SB	181	178	565	582
	McKinley to Californian	NB	367	374	161	162
Fair Oaks	Arques to Evelyn	SB	160	126	466	428
	McKinley to Californian	NB	389	431	273	329
Sunnyvale	Arques to Evelyn	SB	325	186	775	409
	McKinley to Californian	NB	306	88	335	121

5.7.2 Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative

Under this alternative, all vehicles traveling along Sunnyvale Avenue would no longer be able to travel between Evelyn and Hendy Avenues. Bicyclists and pedestrians still travel via box tunnel underneath the railroad tracks. Vehicles that currently traveled north and south of Sunnyvale Avenue would need to reroute using parallel roads with railroad crossings, such as Mathilda and Fair Oak Avenues. T-intersections are created at both Evelyn and Hendy Avenues to maintain the connections between those streets and Sunnyvale Avenue. This alternative reduces the number of conflict points between vehicular traffic and active transportation modes such as bicycles and pedestrians, thus would increase safety.

The shifting of traffic from Sunnyvale Avenue to Mathilda and Fair Oaks Avenues results in an increased delay to the parallel roadways in the morning and evening travel times. For travel time comparison between this alternative and No Build, see Table 5.2 below.

Table 5.2 Pedestrian/Bike Crossing – Corridor Travel Time Comparison						
Corridor	Segment	Direction	AM Peak Hour (sec.)		PM Peak Hour (sec.)	
			2035 No-Build	2035 Build Tunnel	2035 No-Build	2035 Build Tunnel
Mathilda	Indo to Washington	SB	181	174	565	622
	McKinley to Californian	NB	367	389	161	175
Fair Oaks	Arques to Evelyn	SB	160	291	466	660
	McKinley to Californian	NB	389	624	273	362
Sunnyvale	Arques to Evelyn	SB	325	-	775	-
	McKinley to Californian	NB	306	-	335	-

5.8 Multimodal Considerations

5.8.1 Pedestrian/Bike

Sunnyvale Avenue Underpass Tunnel Alternative

For this alternative, pedestrians would no longer be exposed to conflicts with trains. The pedestrians would experience grade changes due to the depression of the pedestrian walkway along Sunnyvale Avenue. This alternative provides a 12-foot wide multi-use path on the west side of the proposed tunnel on Sunnyvale Avenue. The path is elevated above vehicle paths and would be accessed through the pedestrian ramps. The ramps are located on the northwest corner of the Sunnyvale/Evelyn Avenue intersection and the southwest corner of the Sunnyvale/Hendy Avenue intersection. Due to the locations of the access ramps there would be out-of-direction travel for pedestrians that do not originate west of Sunnyvale Avenue on both Evelyn and Hendy Avenues. To maintain ADA compliance, switch back ramps are introduced at both ends of tunnel, and thus lengthening the ramps. Access from Hendy Avenue would be from switchback ramp or stair at the Sunnyvale/Hendy Avenue intersection and mid-block crossing east of Murphy Avenue. Access from Evelyn Avenue would be via a switchback ramp at the Sunnyvale/Evelyn Avenue intersection. Pedestrian movements along Hendy, Evelyn, and Sunnyvale are still the same.

Class II bicycle lanes are provided on both sides of Sunnyvale Avenue. The bike lanes would follow the same roadway profile. Evelyn Avenue would still have Class II bicycle lane in each direction on both sides of Sunnyvale Avenue. To the east of Sunnyvale Avenue, Hendy Avenue would have Class II bicycle facilities in both directions. To the west of Sunnyvale, bicycle facility is provided along westbound Hendy Avenue only.

Sunnyvale Avenue Bicycle/ Pedestrian Undercrossing Alternative

Similar to the Sunnyvale Avenue Underpass Tunnel Alternative, a pedestrian undercrossing would remove the conflict between pedestrians, cyclists, and trains, which would provide substantial safety benefits.

Pedestrians would continue to have access along Sunnyvale Avenue between Evelyn and Hendy Avenues via pedestrian/bicycle crossing tunnel. Access from Hendy Avenue would be from switchback ramp or stair at the Sunnyvale/Hendy Avenue intersection. Access from Evelyn Avenue would be via a curve ramp or stair at the Sunnyvale/Evelyn Avenue intersection. Pedestrians would experience fewer conflict with vehicles at both Sunnyvale/Evelyn Avenue and Sunnyvale/Hendy Avenue intersections because one leg is closed at each intersection.

Identically, conflicts between cyclists and train would also be removed. Bicyclists traveling northbound and southbound directions on Sunnyvale Avenue would use similar pedestrian ramp accesses as described above from Hendy and Evelyn Avenues. Evelyn Avenue would continue to have a Class II bicycle facility. Class II bicycle facility is only provided to Hendy Avenue eastside of Sunnyvale Avenue.

5.8.2 Transit

Santa Clara Valley Transportation Authority (VTA) runs bus Routes 20, 21, and 55 through the intersection of Sunnyvale Avenue and Evelyn Avenue.

Under both alternatives, Route 21 is minimally affected as this bus line does not make any turns at the intersection and can still travel along Evelyn Avenue from the Sunnyvale Caltrain Station with no changes to the route map.

Route 20 does make a left turn from westbound Evelyn Avenue to southbound Sunnyvale Avenue. This route would not be affected by the Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative since the tunnel ends at Evelyn Avenue. However, it would be cut-off per Sunnyvale Avenue Underpass Tunnel Alternative because the Evelyn Avenue no longer has connection to Sunnyvale Avenue. Therefore, VTA would have to make modifications to the existing route.

As for Route 55, it is currently traveled along Sunnyvale Avenue crossing the railroad tracks to westbound Evelyn Avenue in the southbound direction and eastbound Evelyn Avenue to northbound Sunnyvale Avenue in the northbound direction. Under both alternatives, this route would be cut-off. Since Route 55 is the only route that connects Lakewood Village and the SNAIL neighborhood with Fremont High School, and access to the transit center on Frances Street, VTA would be required to make route alteration to maintain bus access to the communities.

Coordination with VTA and their transit routing plans would be required to maintain these routes.

5.9 Estimated Costs

Preliminary estimates have been prepared for both alternatives, and are included construction capital costs, Design (PS&E), Right of Way Acquisitions, and Final Design and Constructions.

For Sunnyvale Avenue Underpass Tunnel Alternative: Cost ranges between \$225 – 275 Million

For Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative: Cost ranges between \$90 – 120 Million

5.10 Summary of Findings

Two alternatives were evaluated for the grade separation at Sunnyvale Avenue. Both alternatives achieve its goals and objectives:

- Improve safety;
- Enhance pedestrian and bicycle access;
- Improve transportation efficiency; and
- Reduce noise in the vicinity of rail crossings at Sunnyvale Avenue.

Both alternatives, however, have differences in traffic and right of way impacts, and construction cost.

Due to the preservation of through movements on Sunnyvale Avenue, the Sunnyvale Avenue Underpass Tunnel Alternative requires less detour traffic to Mathilda and Fair Oaks Avenue and thus performs generally better than the Sunnyvale Avenue Bicycle/ Pedestrian Undercrossing Alternative in terms of vehicular corridor travel time on study area roadways and overall network delay. The Sunnyvale Avenue Underpass Tunnel Alternative results in a large decrease in corridor travel time on Sunnyvale Avenue comparing to No-Build.

The Sunnyvale Avenue Underpass Tunnel Alternative results in less vehicular detour and thus relatively better performance along Mathilda and Fair Oaks Avenues than the Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative, but does increase turning activity at a number of intersections in the immediate vicinity of the grade crossing, resulting in increased delay at number of intersections. However, of the two proposed alternatives, the Sunnyvale Avenue Bicycle/ Pedestrian Undercrossing Alternative detours a greater volume of vehicles to Mathilda and Fair Oaks Avenues, resulting in less delay at the intersections immediately around the existing grade crossing (Hendy/Sunnyvale Avenue; Evelyn/Sunnyvale Avenue), but three intersections along Fair Oaks Avenue become deficient or are already deficient and experience greater delay. In addition, the peak direction travel time along those detour roadways more substantially increases with the Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative. Considered together, the congestion effects associated with the Sunnyvale Avenue Bicycle/ Pedestrian Undercrossing Alternative are moderately greater than with the Sunnyvale Avenue Underpass Tunnel Alternative.

Both alternatives provide accommodations for pedestrians and bicyclists, although the Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative provides a much higher-quality facility across the railroad tracks since it would be dedicated only to bicycle/pedestrian undercrossing. It also results in less out-of- direction travel for both bicyclists and pedestrians by allowing for more direct ramping.

The Sunnyvale Avenue Underpass Tunnel Alternative would eliminate bus Routes 20 and 55 while Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative would only impact bus Route 55.

The Sunnyvale Avenue Underpass Tunnel Alternative costs almost three (3) times higher when compared to the Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative. The differences in cost are due to the difference in magnitude of right of way impacts, utility relocation, and construction impacts,

6. Coordination and Stakeholders

It is important that all parties affected by the project and have a stake in the outcome are identified, informed and provided with an opportunity to offer input. Stakeholder may include, but not be limited to, the following:

- Residents
- Business owners
- Community representatives
- Schools and churches within the area

- Neighborhood groups
- Homeowner associates
- Caltrain/PCJPB
- California High Speed Rail Authority
- VTA
- Utility Providers
- Emergency services
- Bicycle groups (BPAC)
- Others outside the study area with an interest in the project

Coordination should occur early with local officials and community leaders to help ensure that project stakeholders are involved and provided feedbacks. It is anticipated the list of stakeholders will grow throughout the future phases of work.

7. Implementation

7.1 Potential Funding Opportunities

Funding opportunities include the VTA 2016 Measure B Grade Separation Program, California 190 Grade Separation Prioritization Program, One Bay Area Grant, as well as other local, State and Federal Funding opportunities.

7.2 Suggested Phasing

Phasing of each grade separation will depend on the availability of funding. If there is enough funding, the City will move forward with the grade separation at both Mary and Sunnyvale Avenues. If not, Mary Avenue grade separation would be the first to be constructed.

7.3 Next Steps

The Draft Feasibility Report would be presented to the City Council on Tuesday August 30, 2022. Comments from the City Council would then be incorporated with recommendations for the preferred alternative for each location. The project would then proceed to the environmental phase.

8. ATTACHMENTS

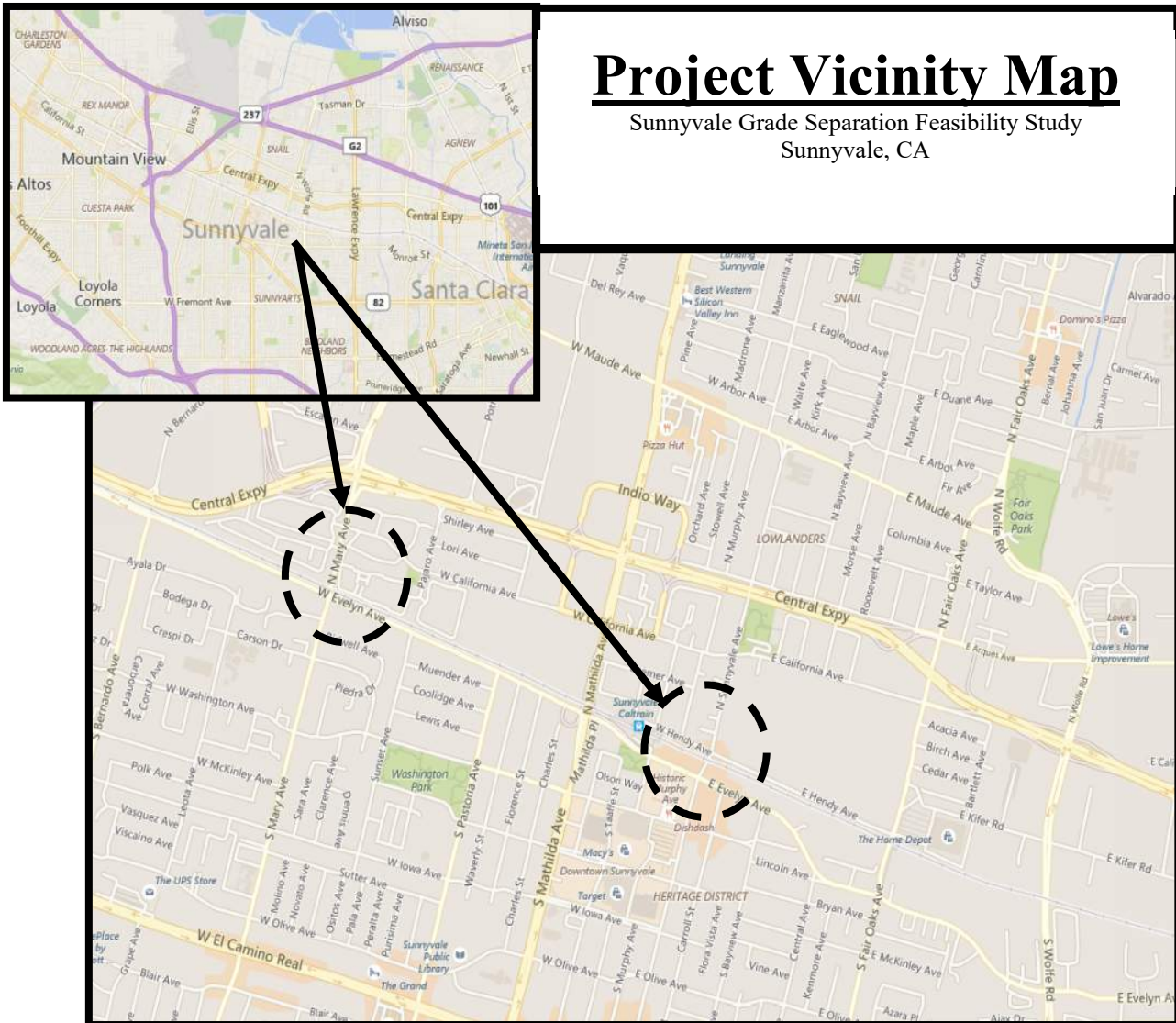
- A. Project Vicinity Map
- B. Location Map
- C. Roadway Plan and Profile Sheets
- D. Traffic Memo
- E. BPAC Meeting Minutes for Mary Avenue
- F. BPAC Meeting Minutes for Sunnyvale Avenue.

ATTACHMENT A

PROJECT VICINITY MAP

Project Vicinity Map

Sunnyvale Grade Separation Feasibility Study
Sunnyvale, CA

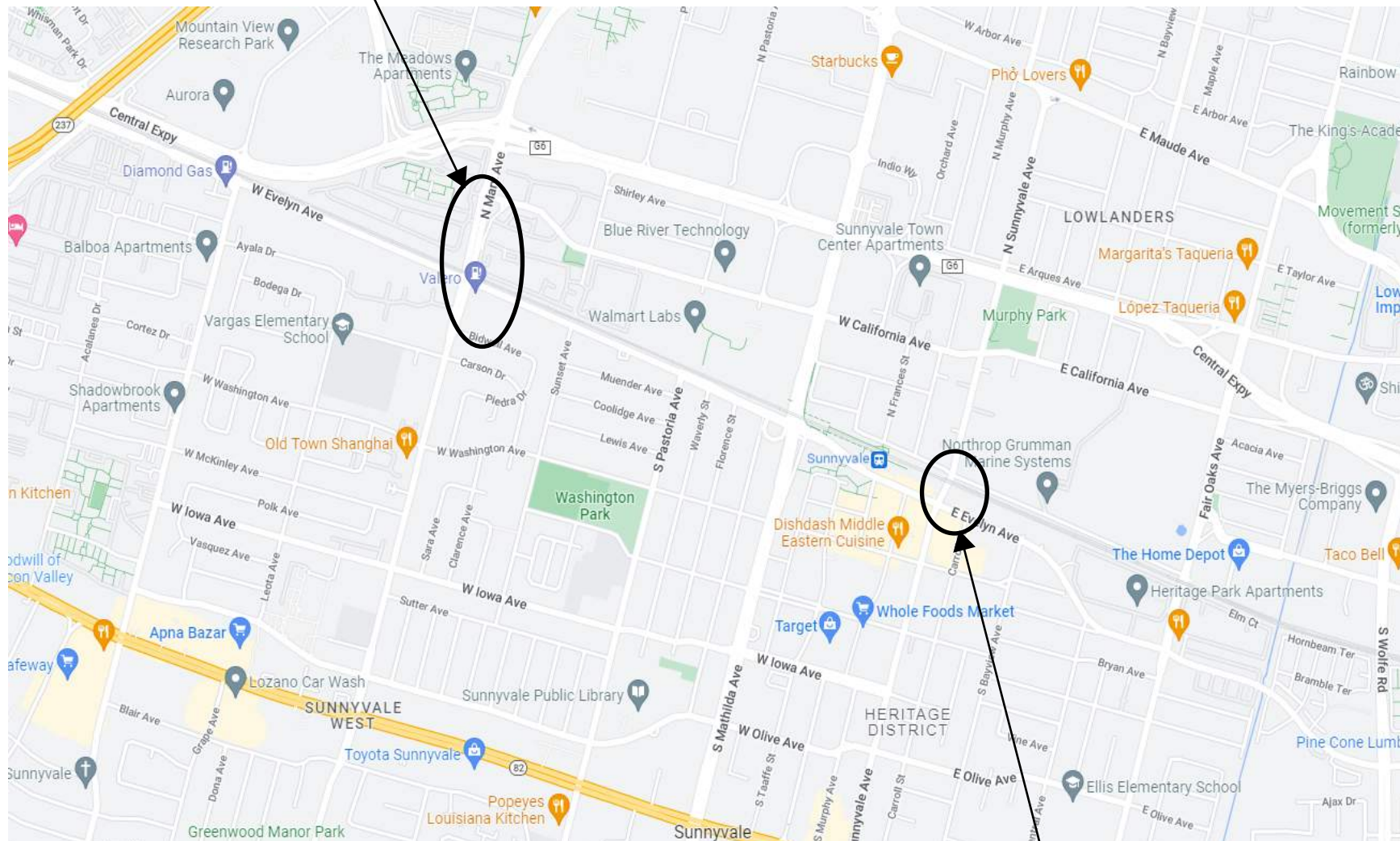


ATTACHMENT B

LOCATION MAP

Location Map

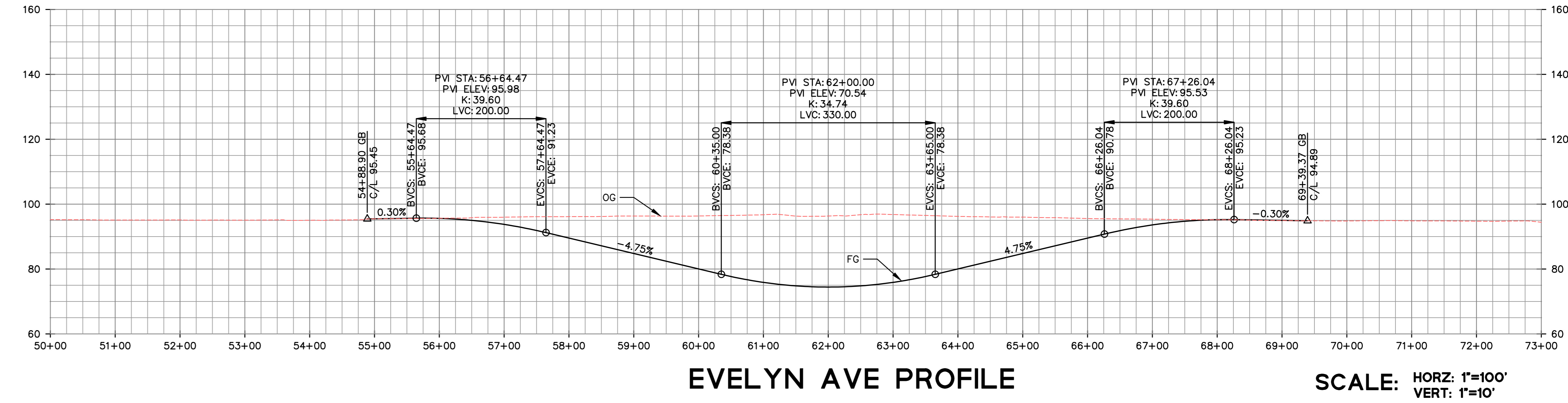
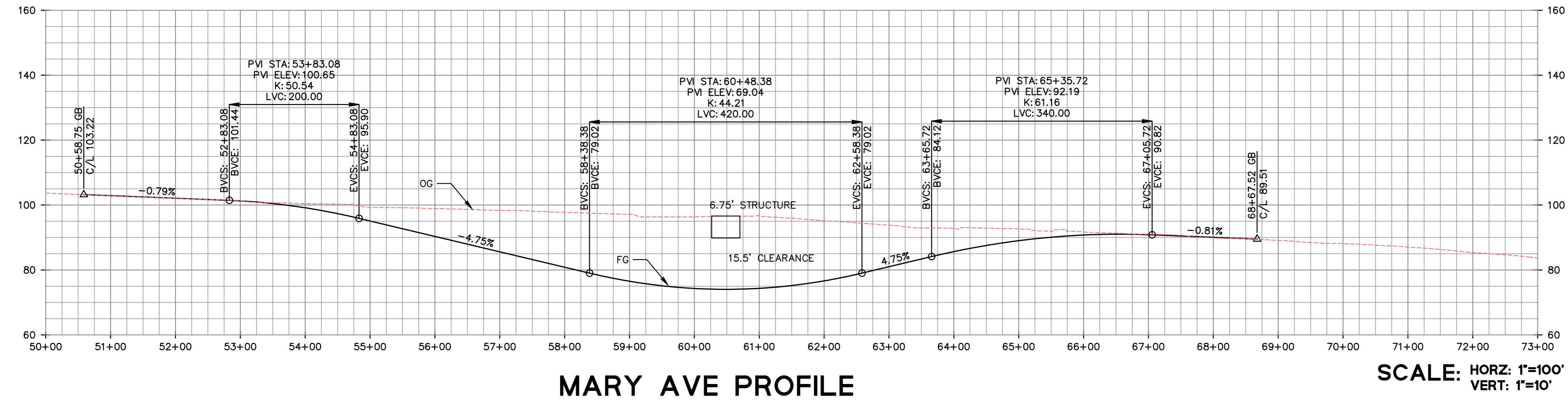
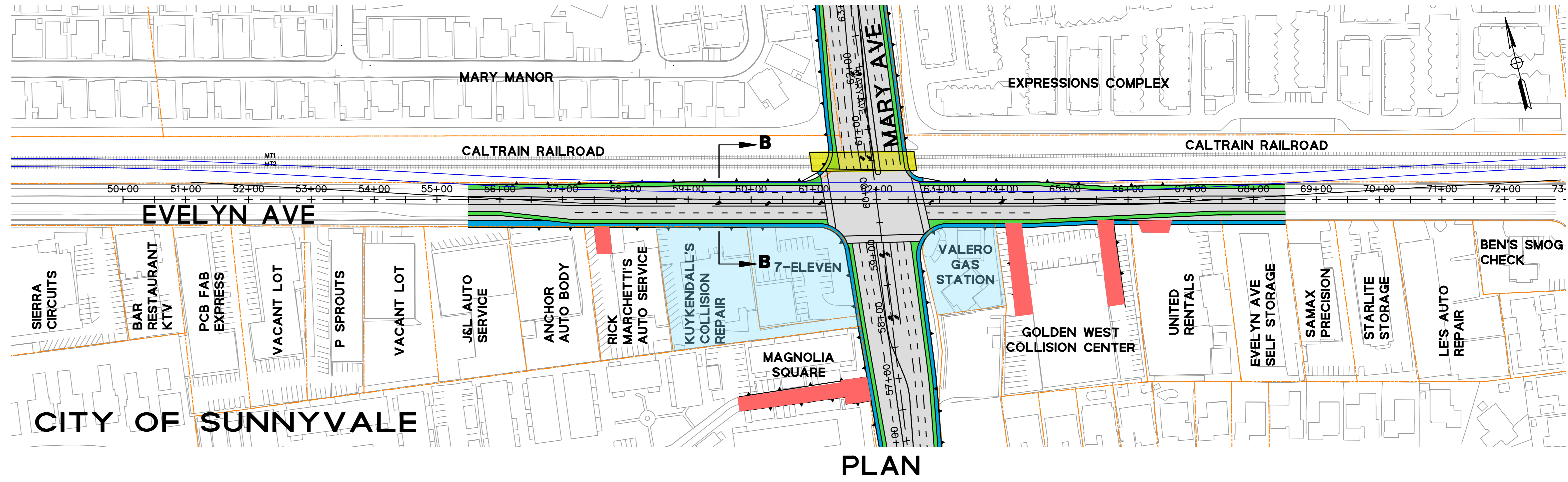
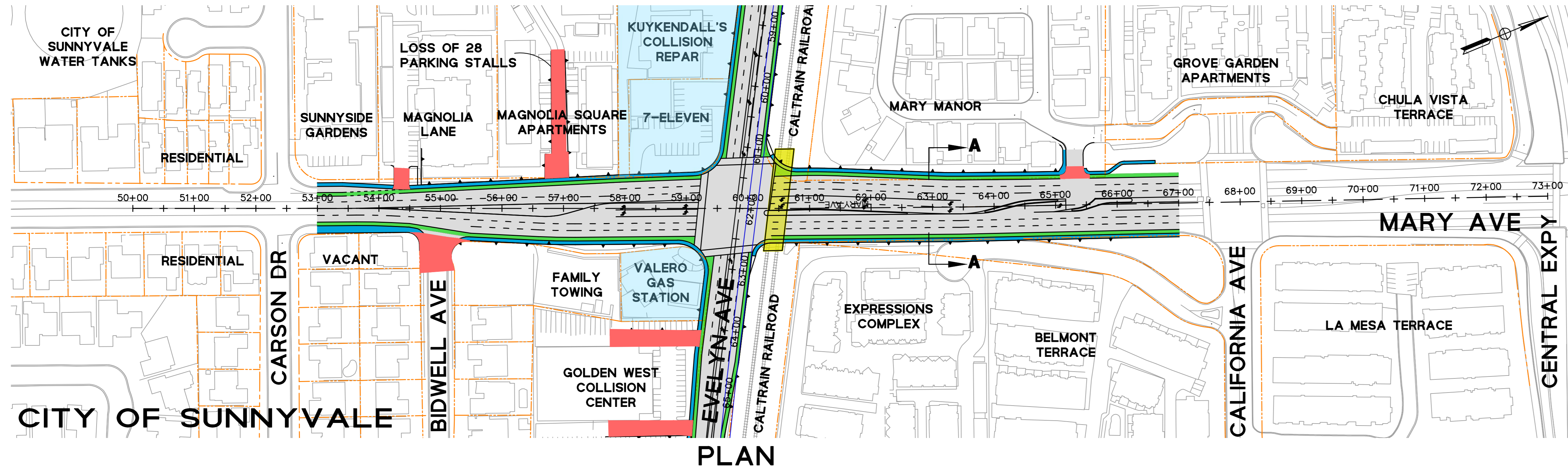
MARY AVENUE
(PROJECT LOCATION)



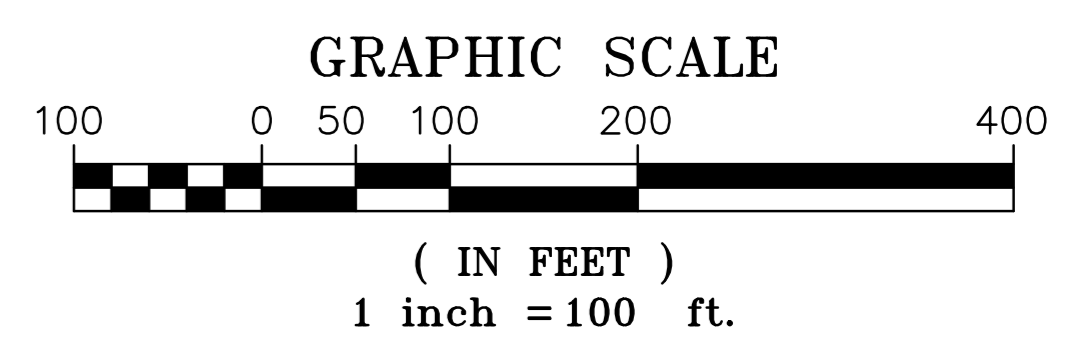
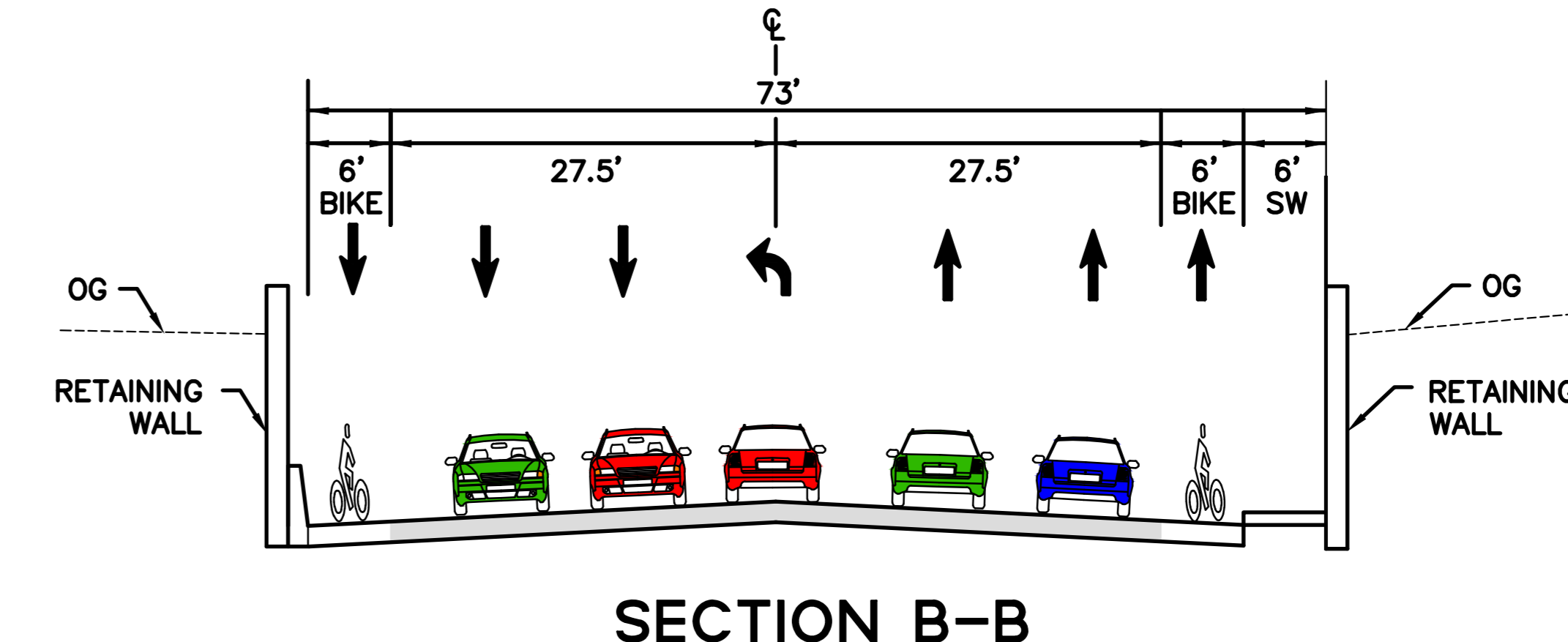
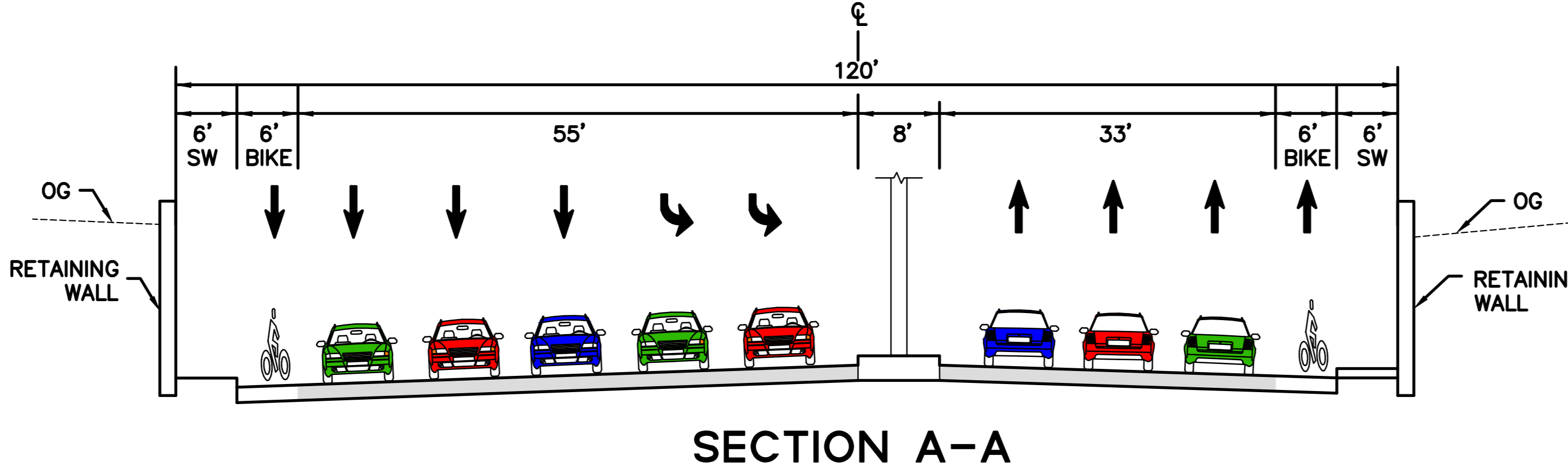
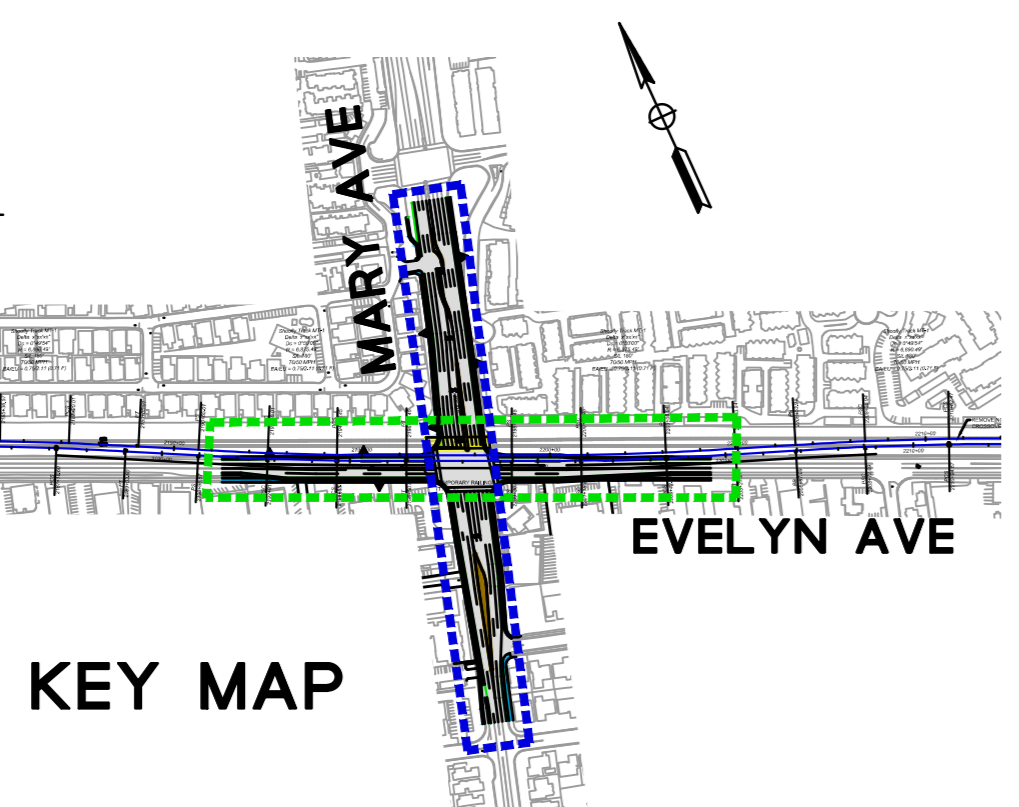
SUNNYVALE AVE
(PROJECT LOCATION)

ATTACHMENT C

ROADWAY PLAN AND PROFILES SHEETS



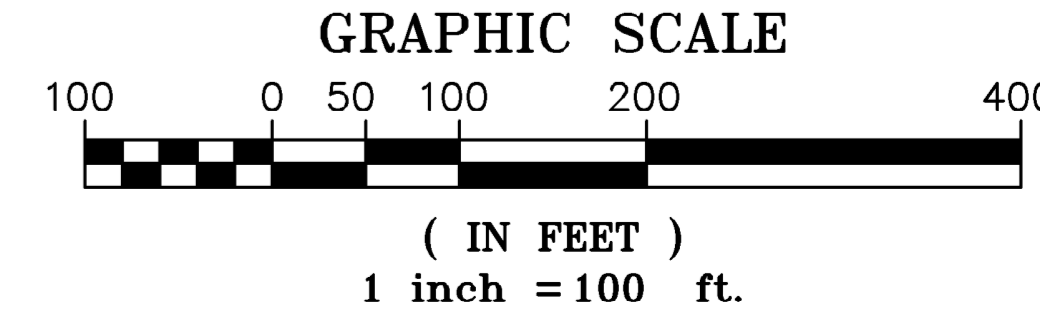
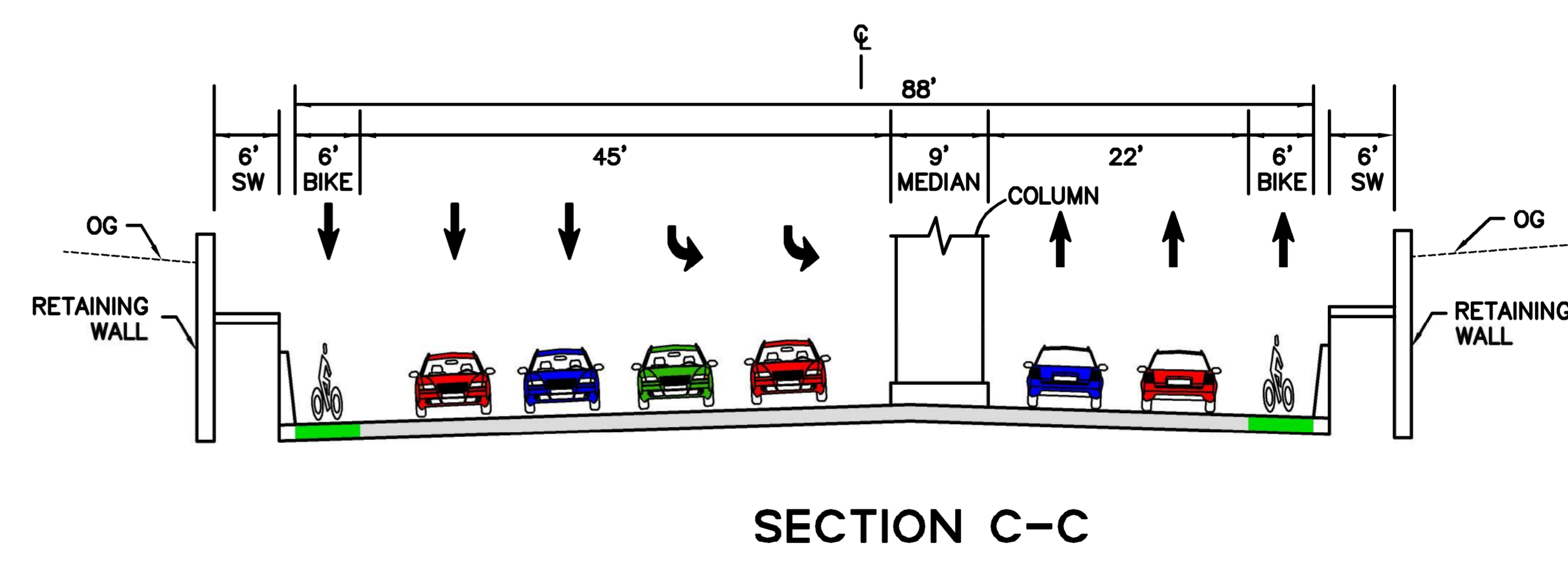
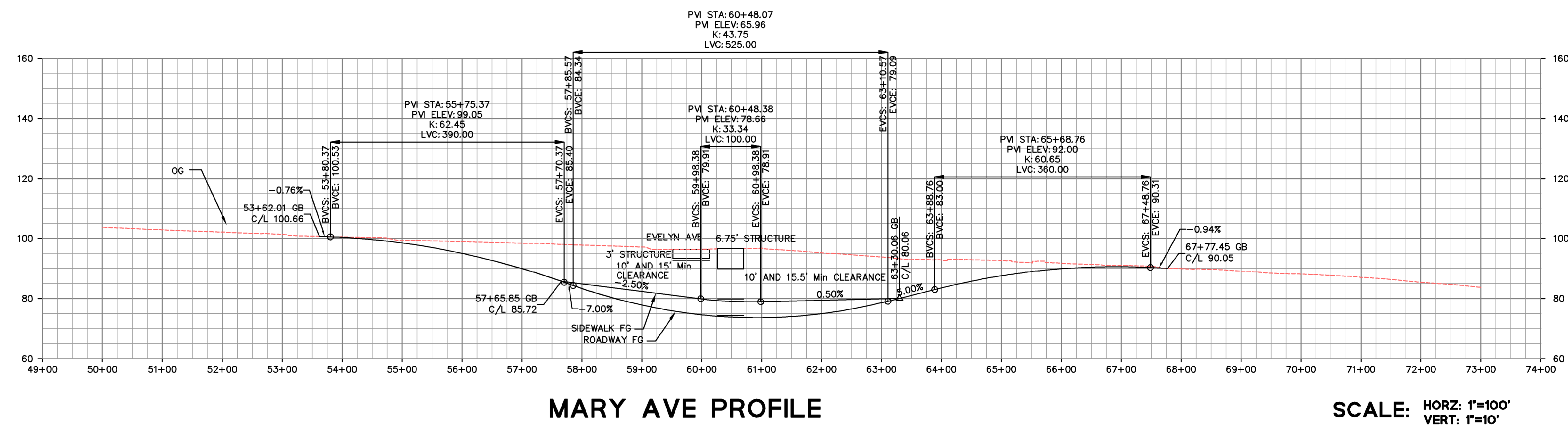
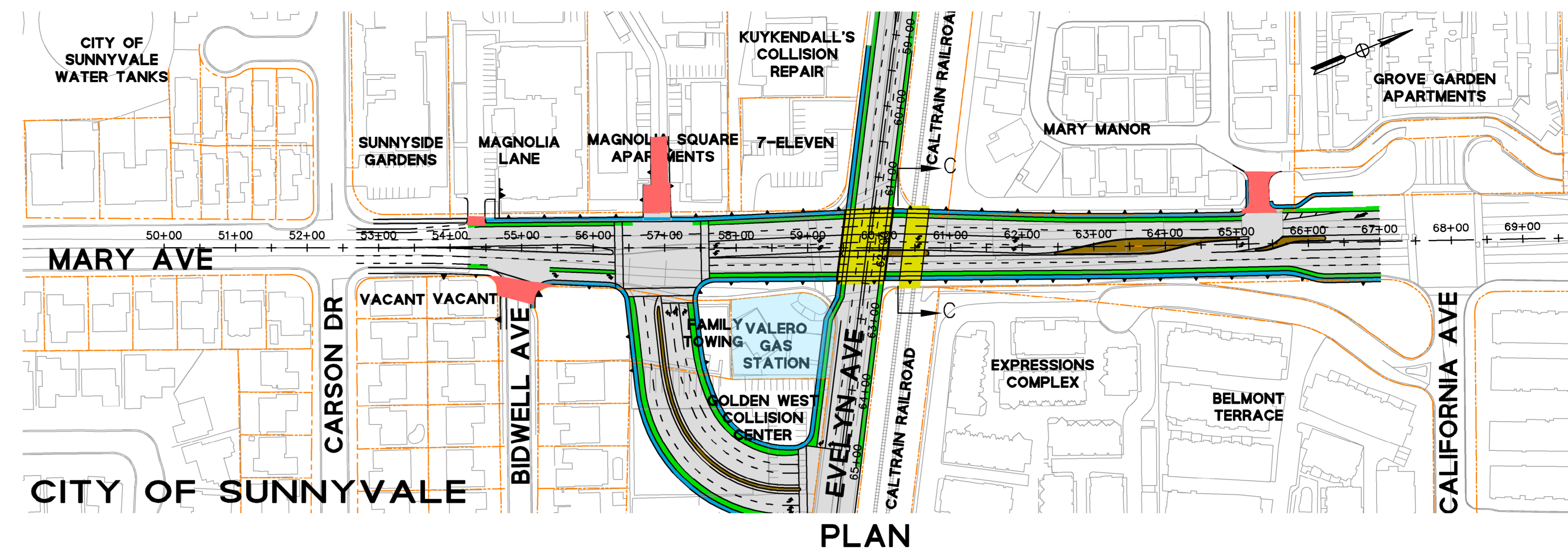
- LEGEND**
- PROPOSED ROADWAY
 - PROPOSED BIKE LANE
 - PROPOSED SIDEWALK
 - RECONSTRUCT DRIVEWAY
 - PROPOSED ACQUISITION PARCEL
 - CALTRAIN STRUCTURE



FOR PRELIMINARY REVIEW ONLY

MARY AVENUE GRADE SEPARATION PROJECT
ROADWAY UNDERPASS
IN SANTA CLARA COUNTY

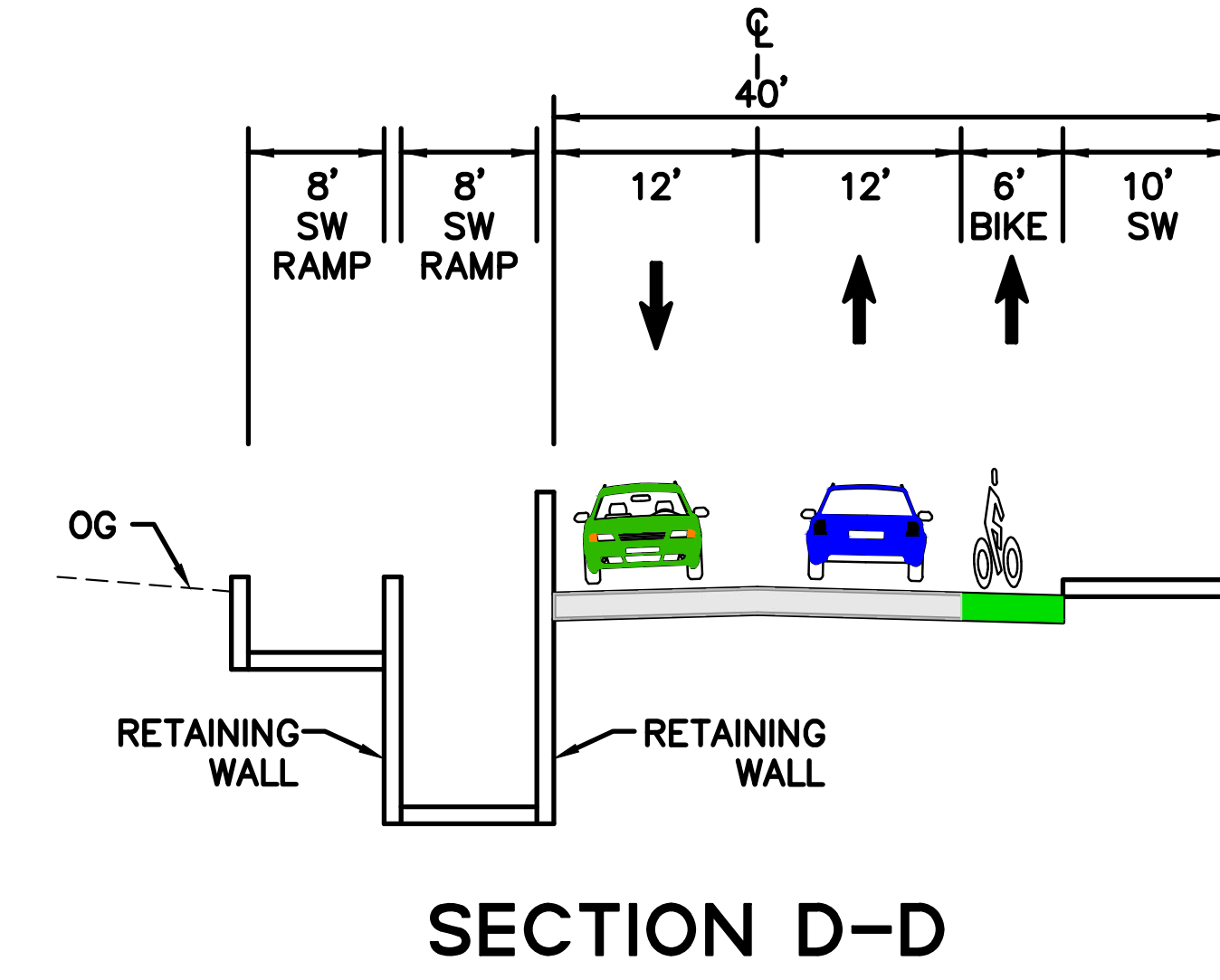
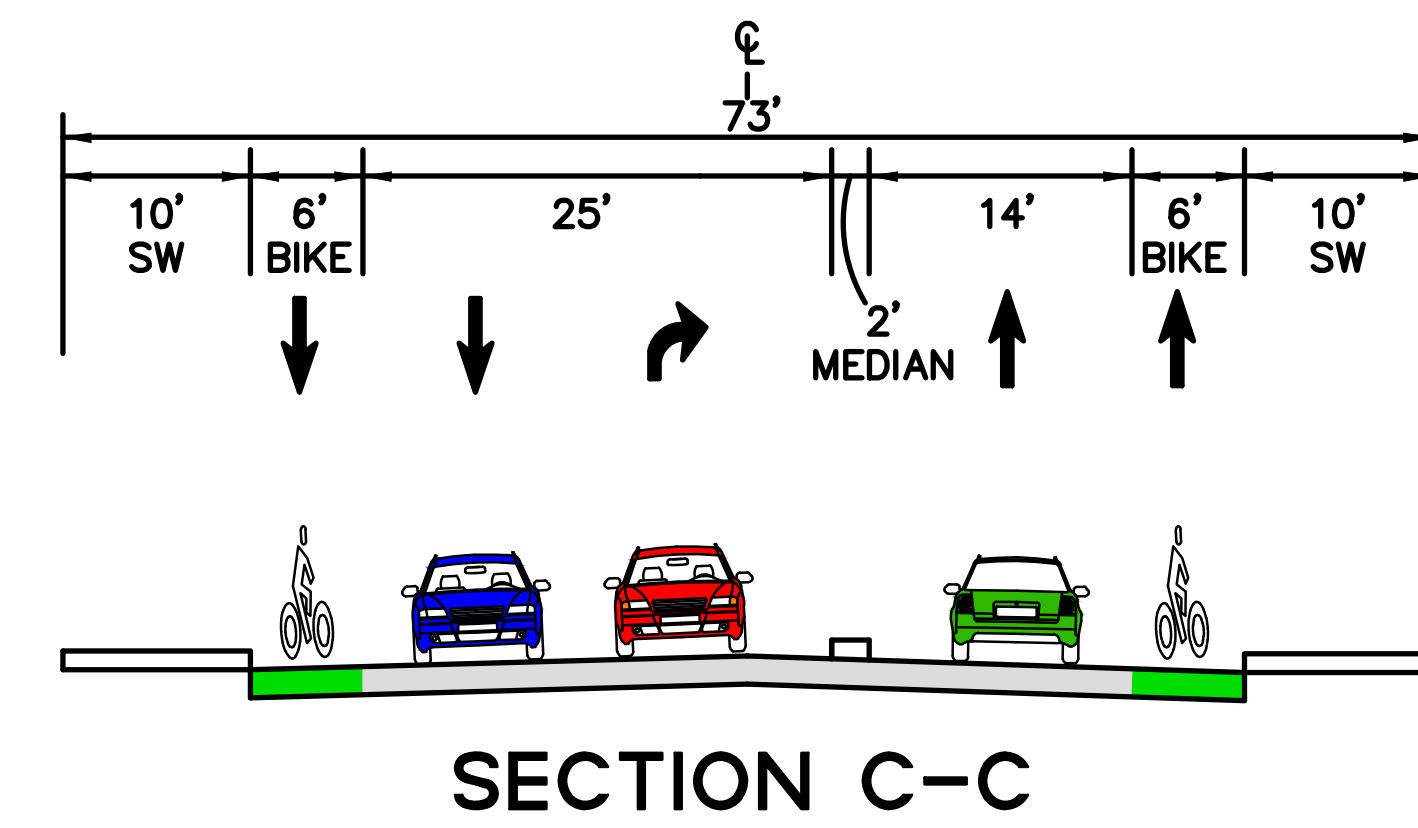
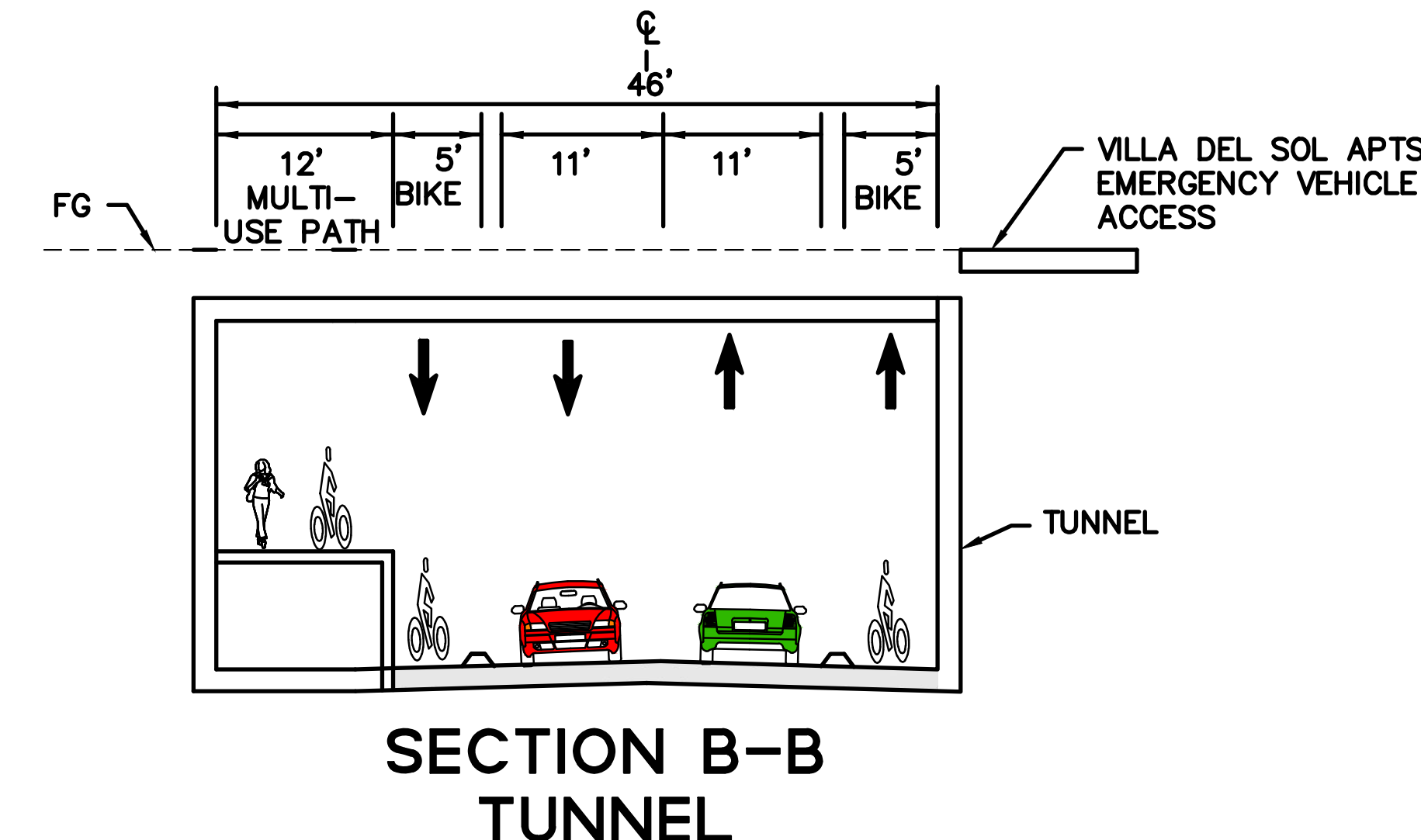
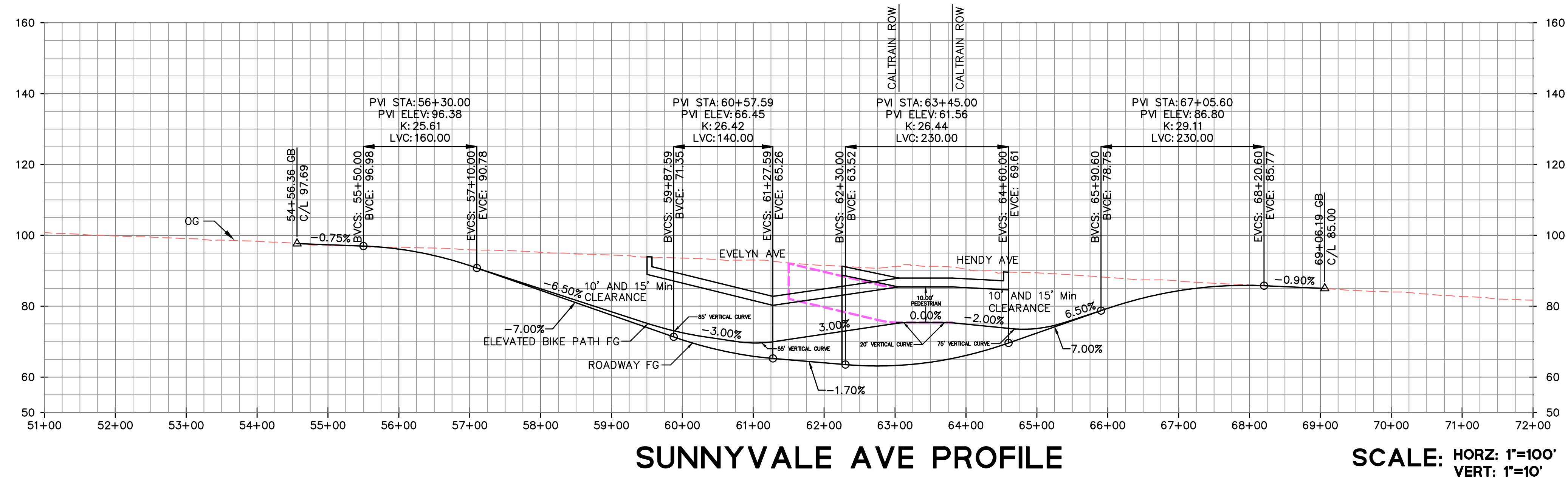
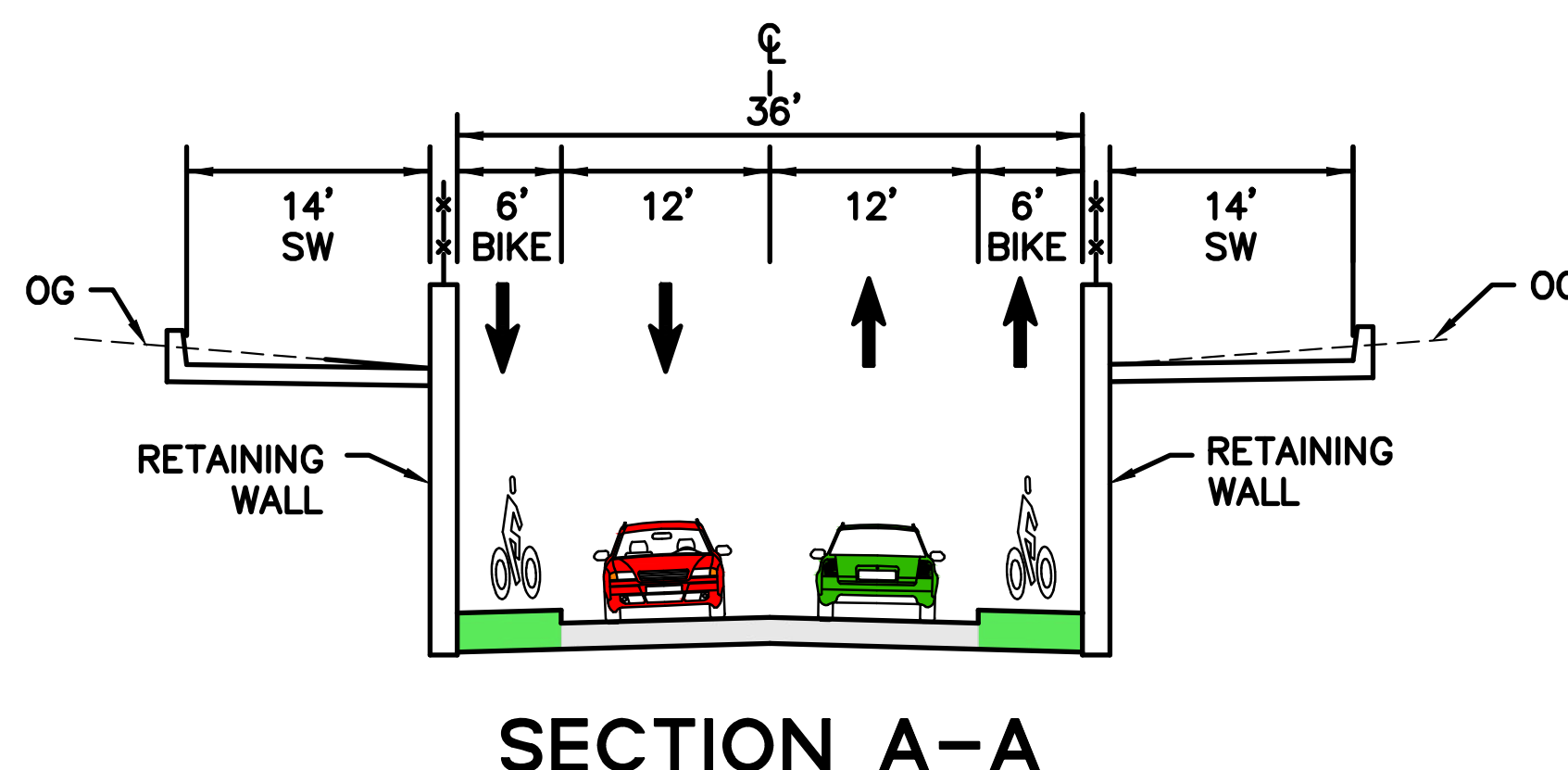
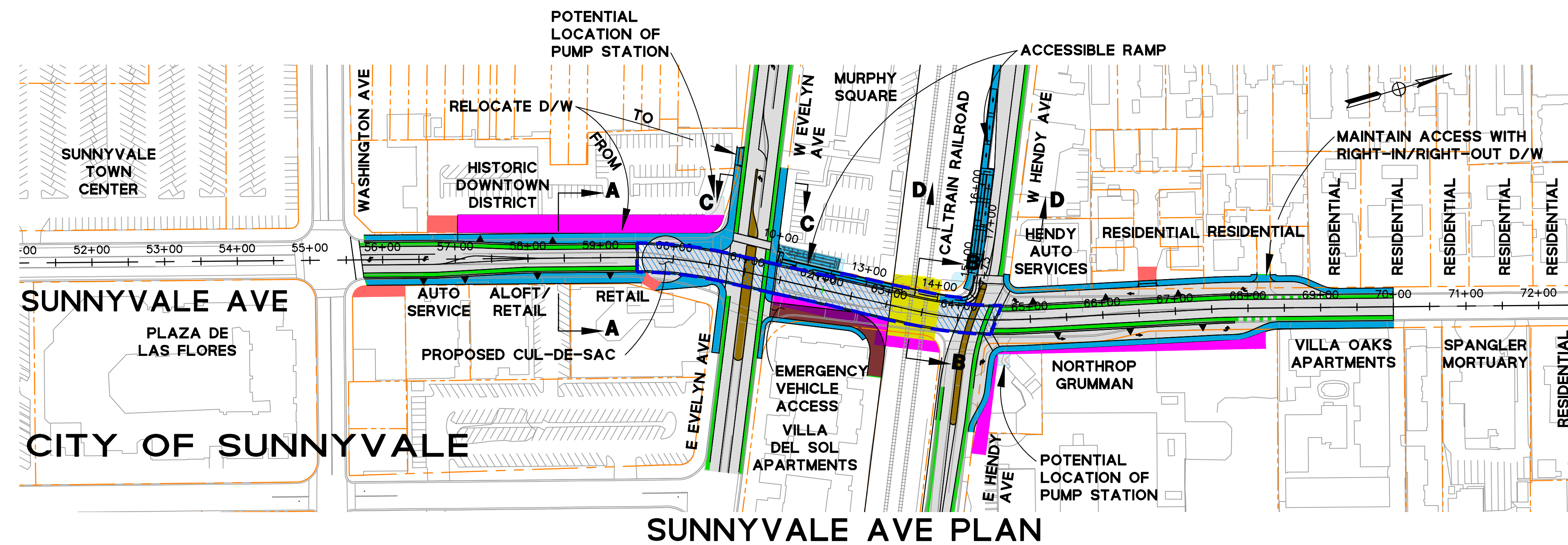




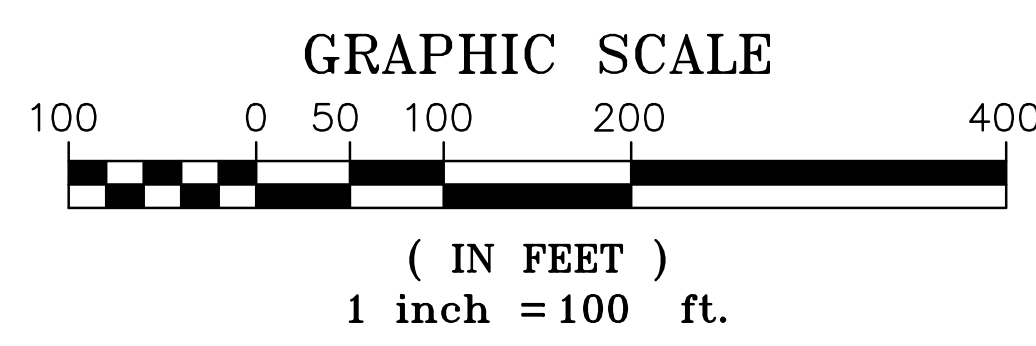
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LEGEND

- PROPOSED ROADWAY
- PROPOSED BIKE LANE
- PROPOSED SIDEWALK
- RECONSTRUCT DRIVEWAY
- PROPOSED ACQUISITION PARCEL
- PROPOSED PUBLIC UTILITY EASEMENT
- PROPOSED BRIDGE STRUCTURE
- EXISTING RIGHT-OF-WAY
- PROPOSED UNDERGROUND TUNNEL
- PROPOSED RETAINING WALL



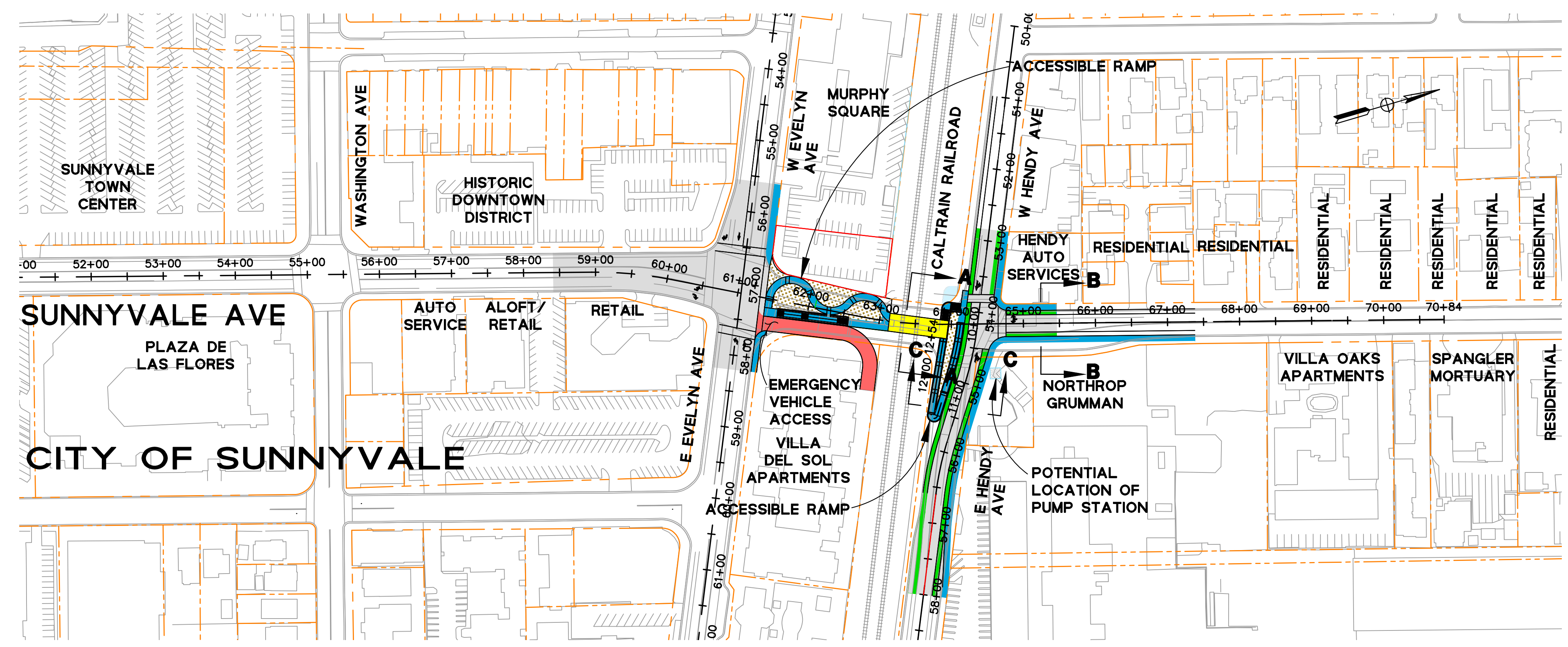
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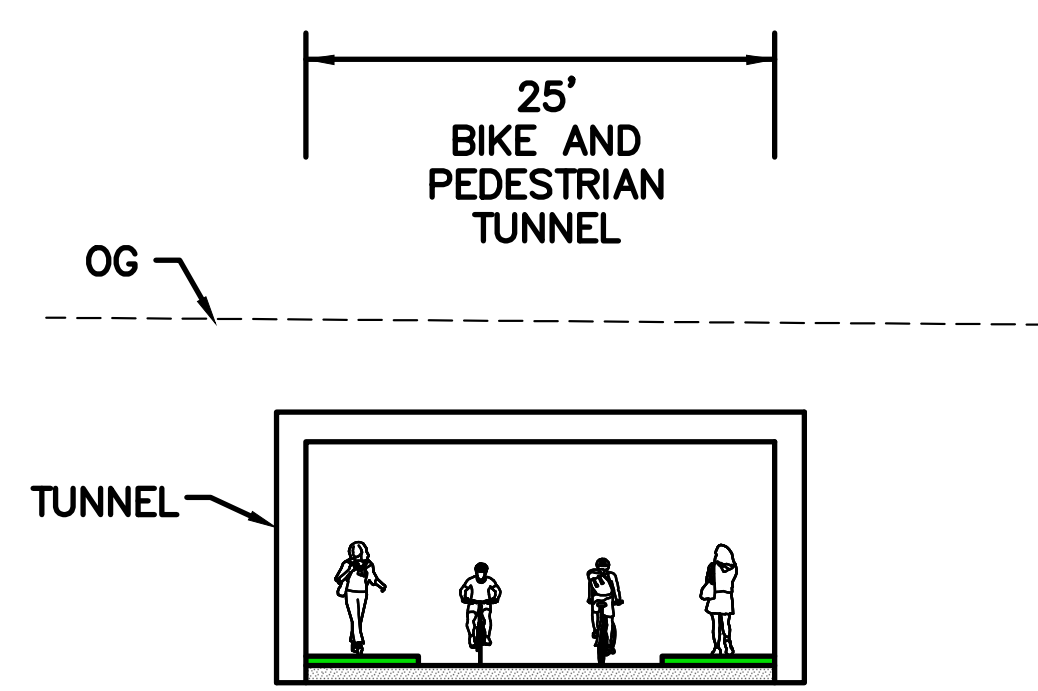
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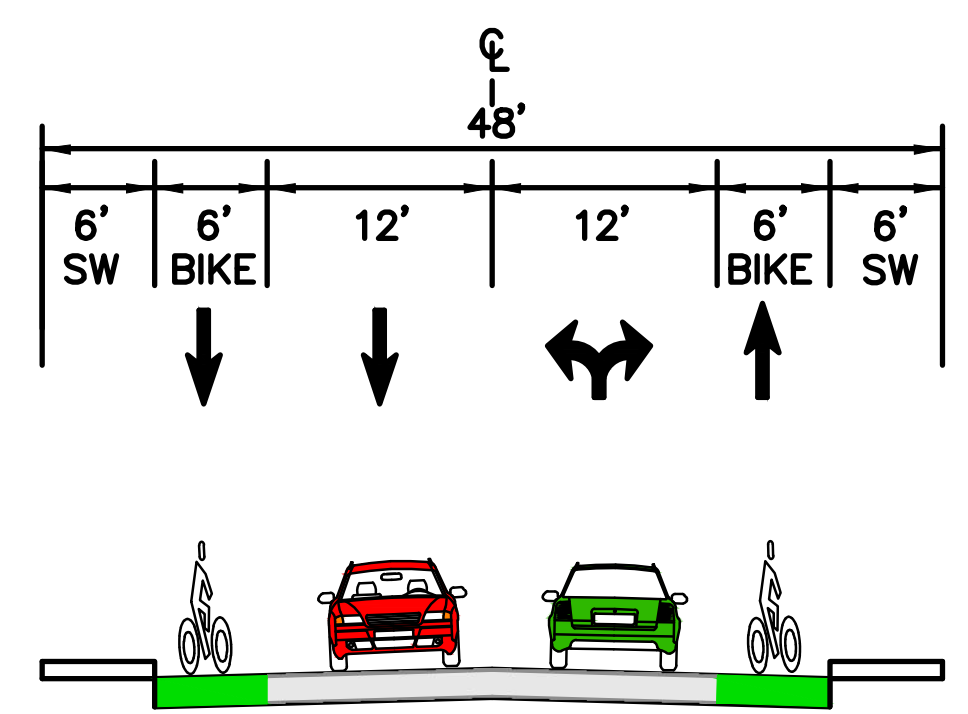
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- PROPOSED BIKE LANE
- PROPOSED SIDEWALK
- RECONSTRUCT DRIVEWAY
- PROPOSED ACQUISITION PARCEL
- PROPOSED PUBLIC UTILITY EASEMENT
- PROPOSED BRIDGE STRUCTURE
- EXISTING RIGHT-OF-WAY
- PROPOSED UNDERGROUND TUNNEL
- PROPOSED RETAINING WALL



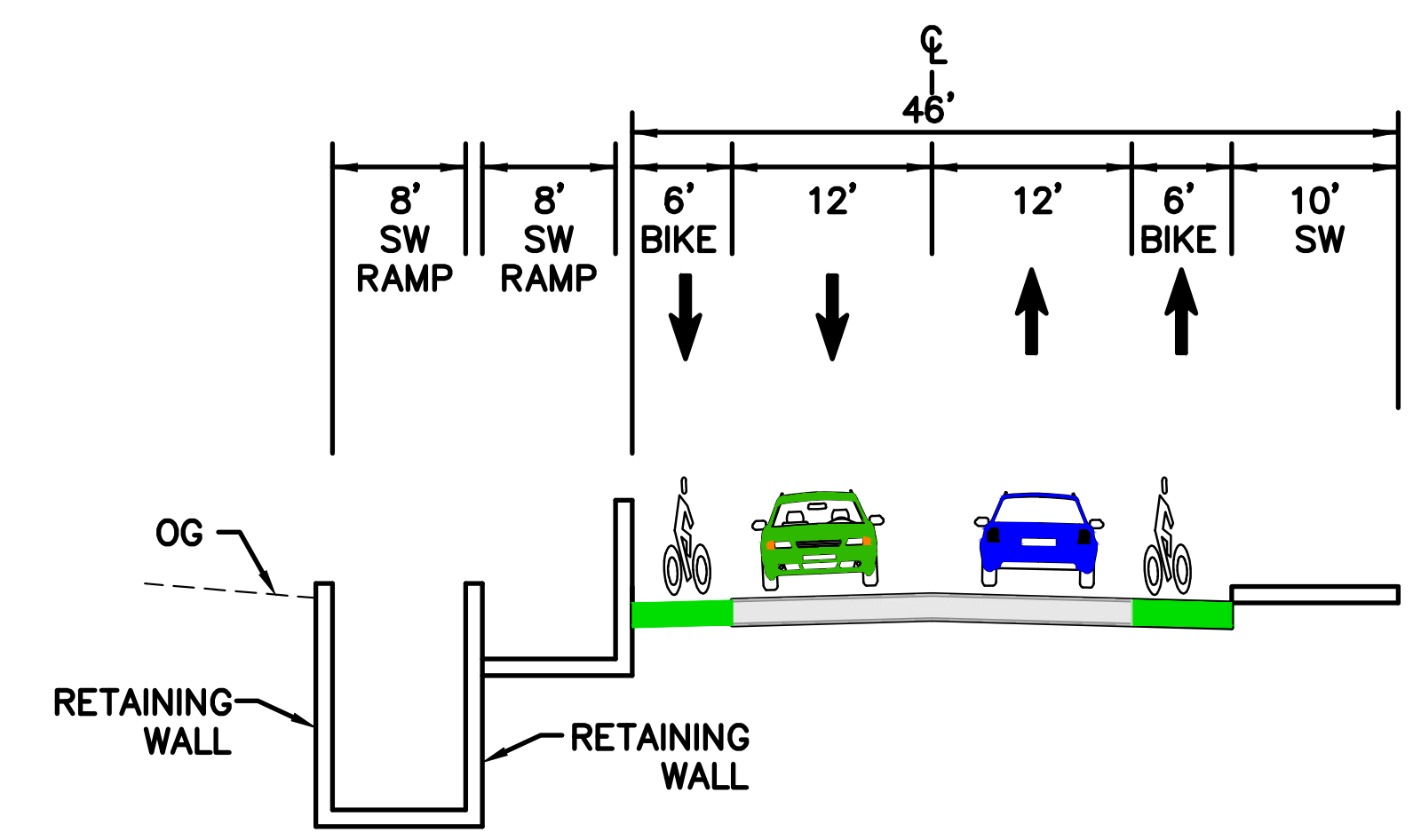
SUNNYVALE AVE PLAN



SECTION A-A
TUNNEL

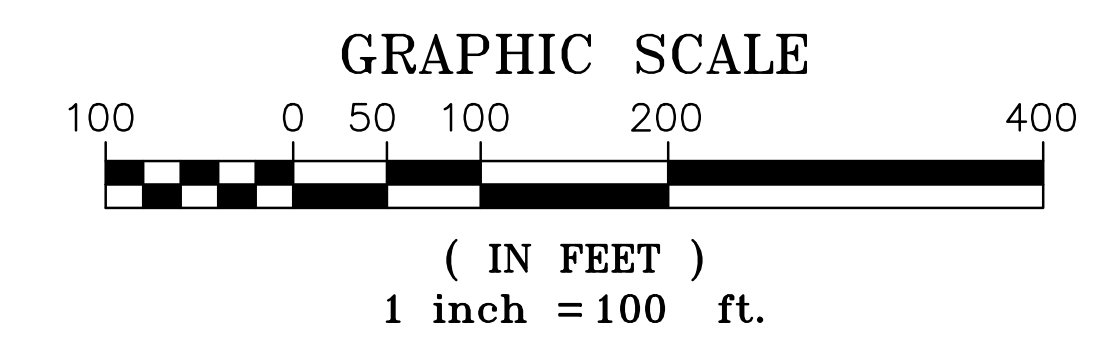


SECTION B-B



SECTION C-C

FOR PRELIMINARY REVIEW ONLY



ATTACHMENT D

TRAFFIC MEMO



MEMORANDUM

To: Dat Nguyen, P.E.
BKF Engineers

From: Adam Dankberg, P.E.
Kimley-Horn & Associates

Date: July 13, 2022

Subject: Sunnyvale Grade Separations Feasibility Study – Traffic and Circulation Memorandum

INTRODUCTION AND OVERVIEW

Project Background

The City of Sunnyvale currently has two at-grade railroad crossings of the rail corridor owned by the Peninsula Corridor Joint Powers Board (PCJPB) at Mary Avenue and Sunnyvale Avenue. PCJPB operates Caltrain commuter trains along this corridor. The Sunnyvale Caltrain Station lies between the two at-grade crossings. Caltrain currently operates five trains in each direction during the peak hour. With completion of the currently under-construction electrification of the rail corridor, the number of Caltrain trains operating on the corridor will increase to six trains per hour per direction. As part of the recently completed Caltrain Business Plan, Caltrain is working towards expanding service to eight trains per hour per direction. In addition, California High-Speed Rail (CHSRA) is planned to operate an additional four trains per hour per direction on the same corridor. This will result in more than double the number of train crossings during the peak hour compared to current conditions.

Due to the proximity of adjacent intersections to both at-grade crossings, the train crossings have a substantial effect on roadway capacity, congestion levels, and overall functionality of the multimodal circulation network in Sunnyvale. The City of Sunnyvale currently experiences high levels of congestion on its north-south roadways during peak travel periods. Gate down times and associated rail pre-emption events further exacerbate congestion and safety hazards in the vicinity of the two at-grade crossings. In addition, the Sunnyvale Avenue crossing is near the Sunnyvale Caltrain Station and downtown Sunnyvale, and thereby experiences high volumes of pedestrian and bicycle activity.

Kimley-Horn, as a subconsultant to BKF Engineers, evaluated project grade separation alternatives for both at-grade rail crossings, Mary Avenue and Sunnyvale Avenue, to assess their implications on traffic operations and multimodal circulation.

Traffic Analysis Scope

The study network includes 18 study intersections, as listed below. The study intersections and the study area can be seen in **Figure 1**. The study intersections were analyzed using the VISSIM micro-simulation tool to fully reflect the intersection operations associated with the at-grade crossings and

network-wide effects of the grade separation alternatives. Three scenarios were analyzed: Existing Conditions, 2035 No-Build, and 2035 Build.

The grade separation alternatives analyzed at Mary Avenue are not anticipated to result in any substantial traffic diversion to other corridors. The grade separation alternatives analyzed at Sunnyvale Avenue are anticipated to potentially divert traffic to the Mathilda Avenue and Fair Oaks Avenue corridors. Therefore, the impacts of each of the two grade separation are mutually independent (i.e., the solutions considered at Mary Avenue do not influence the performance of the solutions considered at Sunnyvale Avenue, and vice versa). Two separate VISSIM models were constructed, one for Mary Avenue, which includes the Mary Avenue corridor (Intersections #1-4), and one for Sunnyvale Avenue, which includes the remainder of the study area (Intersections #5-18).

Mary Avenue Modeling Area

1. Mary Avenue/Central Expressway
2. Mary Avenue/California Avenue
3. Mary Avenue/Evelyn Avenue
4. Mary Avenue/Washington Avenue

Sunnyvale Avenue Modeling Area

5. Mathilda Avenue/California Avenue
6. Mathilda Avenue SB Off-Ramp/Evelyn Avenue
7. Mathilda Avenue NB Off-Ramp/Evelyn Avenue
8. Mathilda Avenue/Washington Avenue
9. Evelyn Avenue/Frances Street
10. Washington Avenue/Frances Street
11. Evelyn Avenue/Murphy Avenue
12. Sunnyvale Avenue/California Avenue
13. Sunnyvale Avenue/Hendy Avenue
14. Sunnyvale Avenue/Evelyn Avenue
15. Sunnyvale Avenue/Washington Avenue
16. Fair Oaks Avenue/California Avenue
17. Fair Oaks Avenue/Kifer Road
18. Fair Oaks Avenue/Evelyn Avenue



Figure 1: Study Area





Alternatives Overview and Description

Five grade separation project alternatives were selected for this analysis. Three alternatives proposed for the Mary Avenue grade crossing include the Mary Avenue Underpass Tunnel, the Mary Avenue Underpass Tunnel with Jughandle option, and the Mary Avenue Underpass Tunnel with Jughandle and Connector Ramps option. Two alternatives proposed for the Sunnyvale Avenue grade crossing include the Sunnyvale Avenue Underpass Tunnel option and the Sunnyvale Avenue Bicycle/Pedestrian Undercrossing option. This section summarizes each of the individual alternatives.

Figure 2 illustrates the Mary Avenue Underpass with Jughandle Alternative. As shown, Mary Avenue would be depressed beneath the railroad tracks and Evelyn Avenue. To accommodate turning movements between Mary Avenue and Evelyn Avenue, a jughandle roadway is proposed to connect the two roadways, southeast of the current Mary Avenue/Evelyn Avenue intersection. New signalized intersections are proposed at either end of the jughandle, one on Mary Avenue opposite the existing Magnolia Square Apartments and the other on Evelyn Avenue. As shown in **Figure 2**, the jughandle was initially envisioned to consist of a four-lane cross section. However, initial performance of the traffic analysis found this cross-section deficient, and the alternative was revised to assume a five-lane cross-section, with the inclusion of an additional westbound right-turn lane approaching Mary Avenue. All results included in this memo assume the five-lane jughandle cross-section.

Figure 3 illustrates the Mary Avenue Underpass with Jughandle and Connector Ramps Alternative. As shown, the underpass and jughandle connections are the same as in the Mary Avenue Underpass with Jughandle Alternatives. This alternative also includes single-lane connector ramps to connect westbound Evelyn Avenue traffic with northbound Mary Avenue and southbound Mary Avenue traffic with westbound Evelyn Avenue. These movements were identified for the direct connector ramps as a result of their high volumes and the opportunity to reduce left-turn volumes at one or both jughandle ramp intersections. Both ramp connections are right-turn only at their connections with Mary Avenue. A half traffic signal will be installed for the westbound Evelyn Avenue to northbound Mary Avenue ramp. All other approaches at non-signalized intersections will be free flow and yield to bike lanes.

Figure 4 illustrates the Mary Avenue Underpass Tunnel Alternative. As shown, both Mary Avenue and Evelyn Avenue would be depressed, while the railroad remains at-grade. Pedestrian and bicycle access would be maintained via the depressed intersection. Under this alternative, Mary Avenue and Evelyn Avenue remain connected and the current intersection lane geometry is preserved.

Figure 5 illustrates the Sunnyvale Avenue Underpass Tunnel Alternative. As shown, Sunnyvale Avenue would be depressed beneath the railroad tracks, Hendy Avenue, and Evelyn Avenue in a tunnel. As a result, all turning movements at the Sunnyvale Avenue/Evelyn Avenue intersection would be redistributed to nearby intersections and only the westbound right-turn and southbound right-turn movements would be maintained at the Sunnyvale Avenue/Hendy Avenue intersection. Pedestrian and bicycle access would be maintained via dedicated space within the tunnel.

Figure 6 illustrates the Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative. As shown, while the road would be closed to autos, pedestrian and bicycle access would be preserved beneath



Figure 2: Mary Avenue Underpass Tunnel with Jughandle Alternative (Plan View)

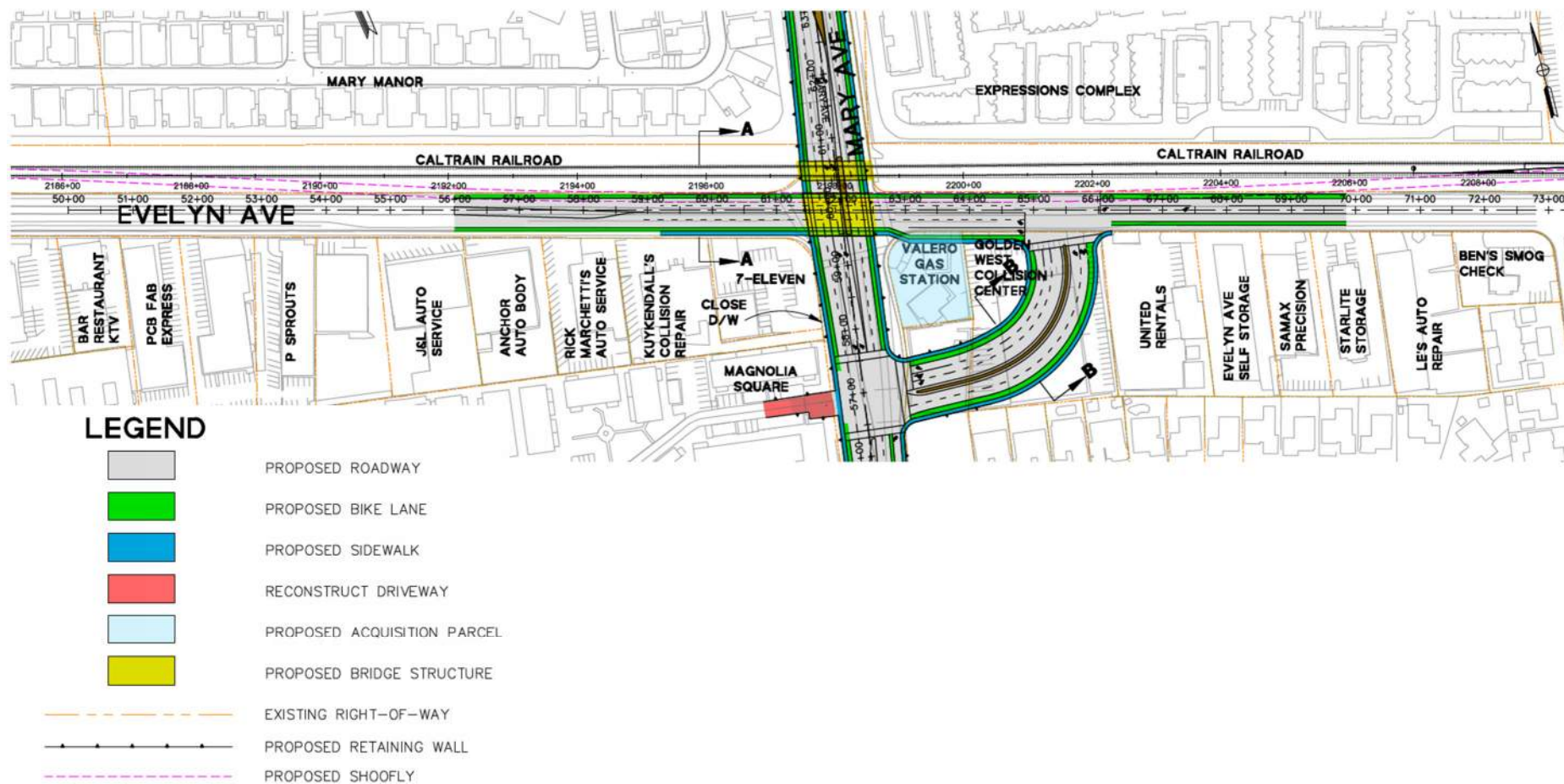
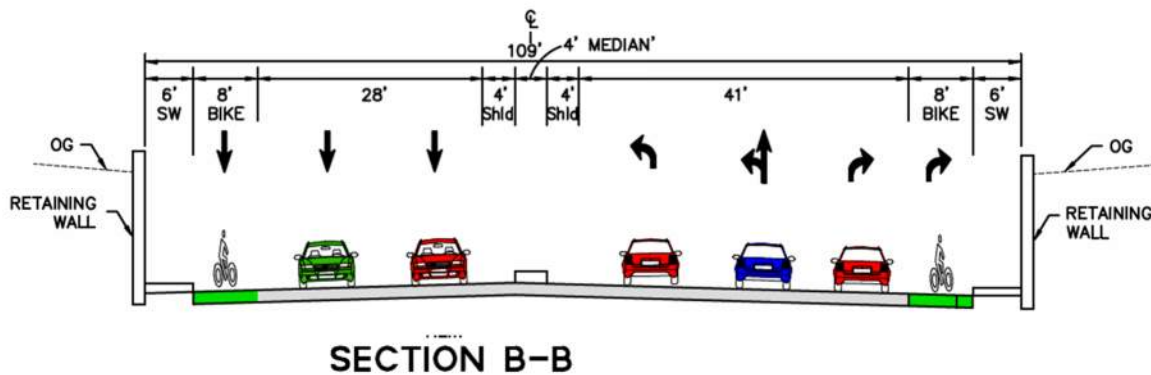
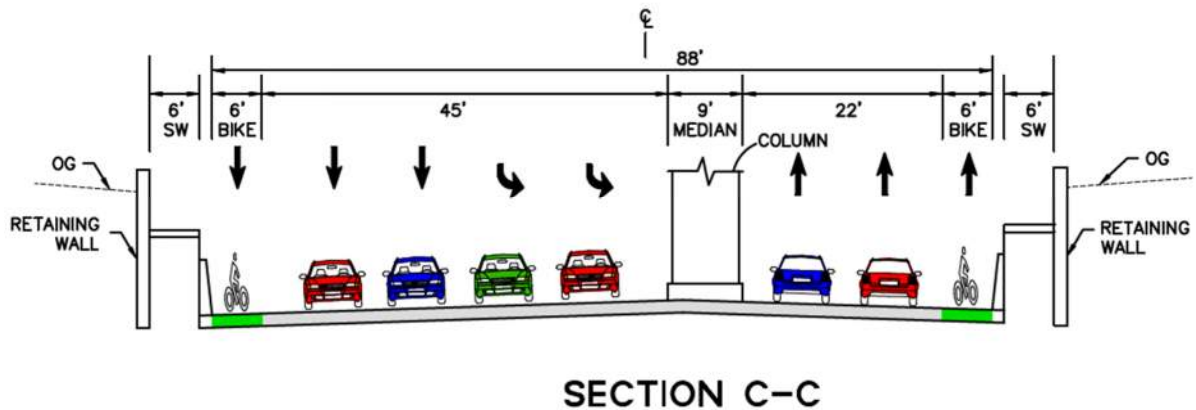




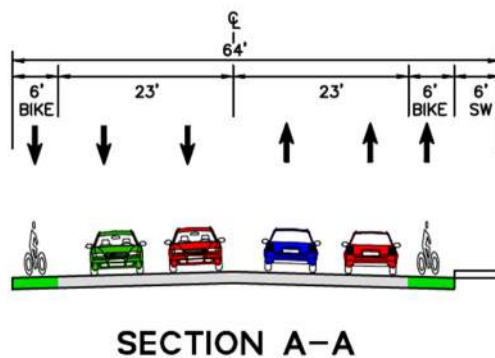
Figure 2 (cont'): Mary Avenue Underpass Tunnel with Jughandle Alternative (Cross-Sections)



Jughandle Cross Section



Mary Avenue Cross Section north of Jughandle



Evelyn Avenue Cross Section west of Mary Avenue

Source: BKF Engineers, received June 28, 2022



Figure 3: Mary Avenue Underpass with Jughandle and Connector Ramps Alternative (Plan View)

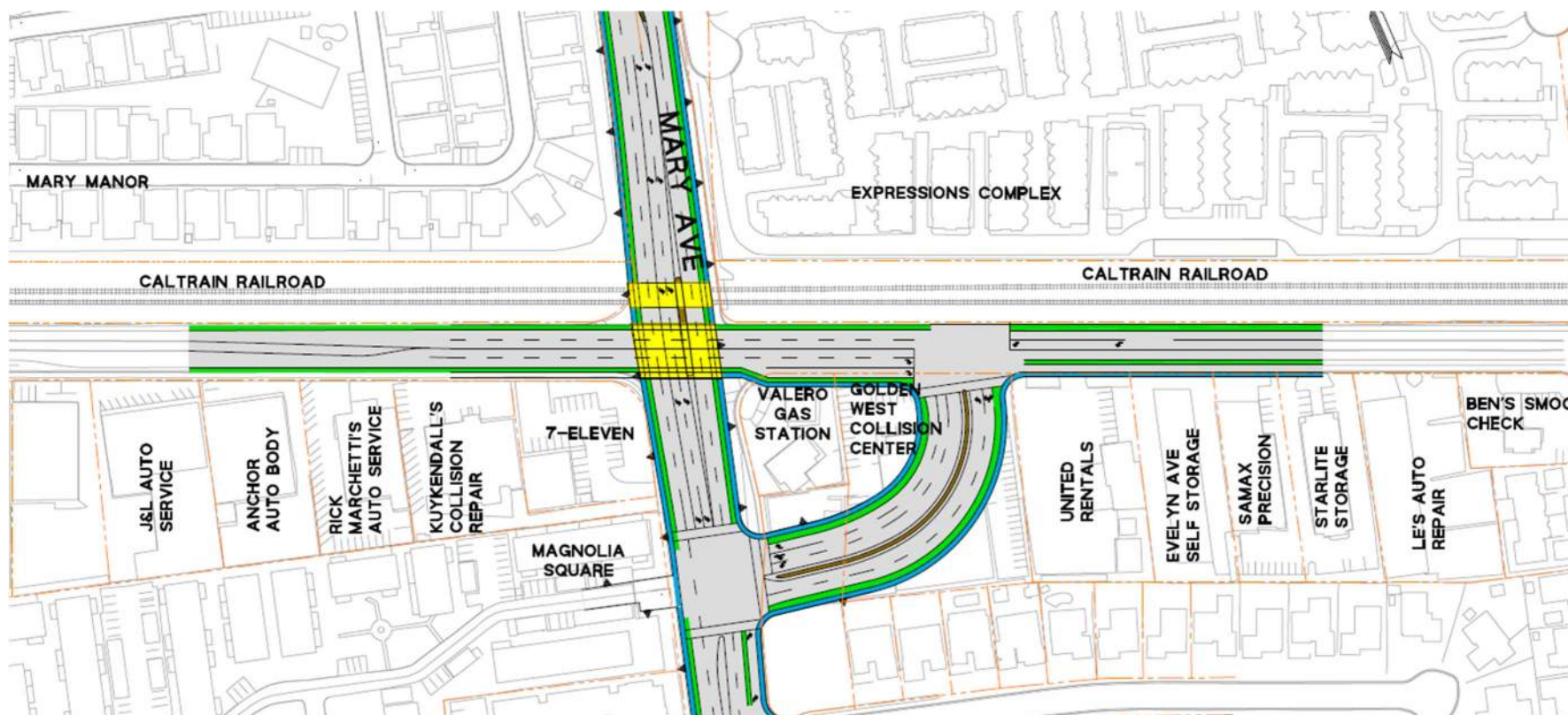
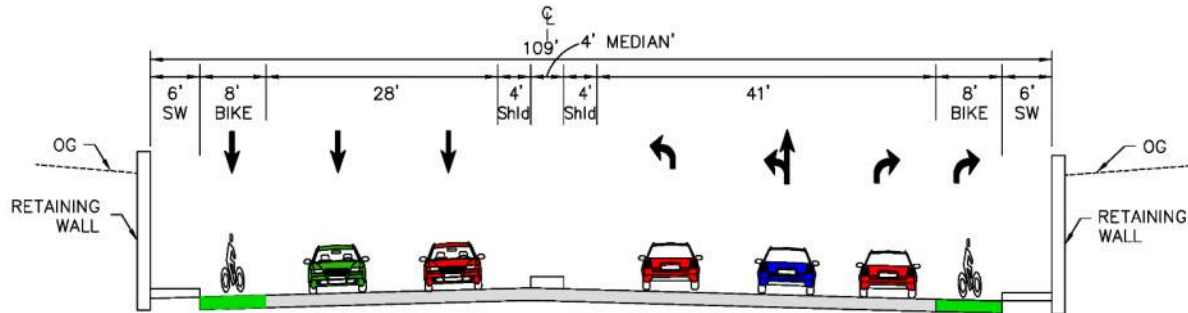
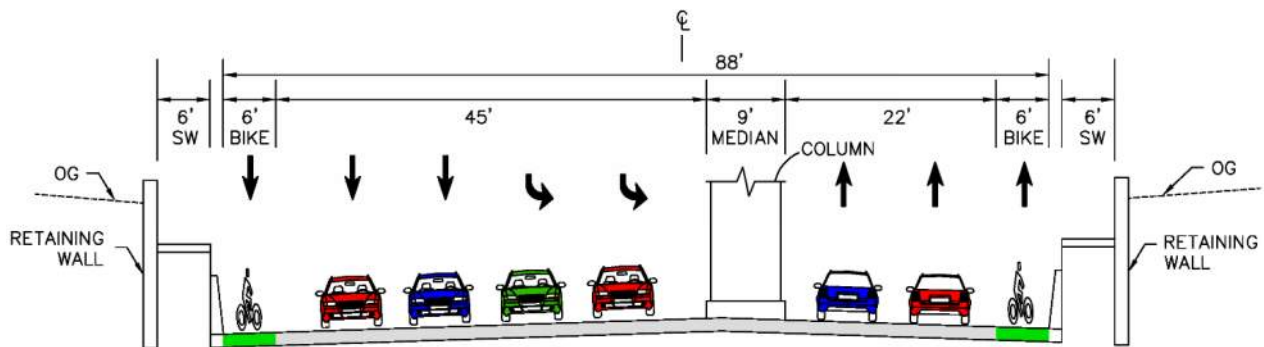




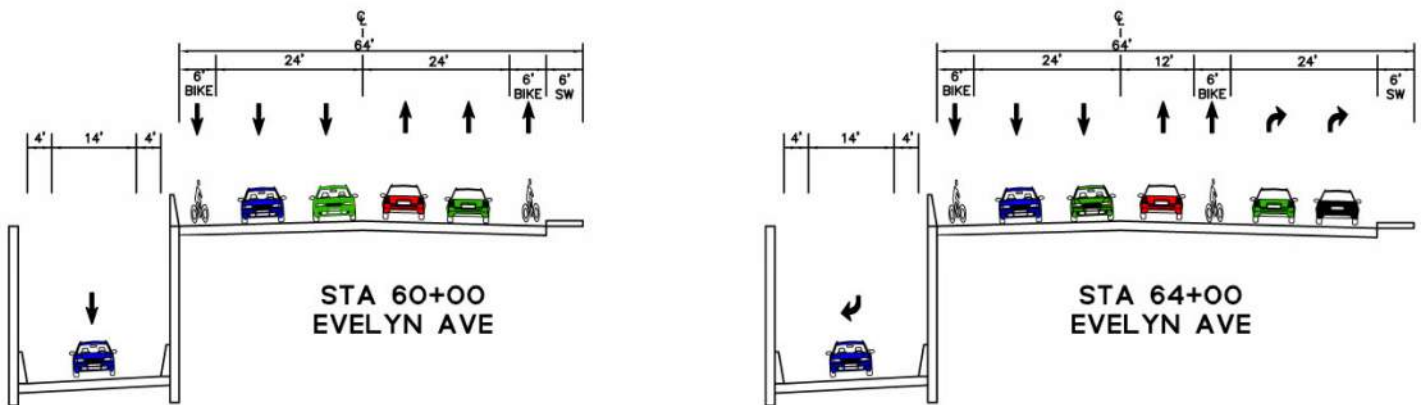
Figure 3 (cont'): Mary Avenue Underpass with Jughandle and Connector Ramps Alternative
(Cross-Sections)



Jughandle Cross Section



Mary Avenue Cross Section north of Jughandle



Evelyn Avenue Cross Section east and west of Mary Avenue

Source: BKF Engineers, received January 19, 2022



Figure 4: Mary Avenue Underpass Tunnel Alternative (Plan View)

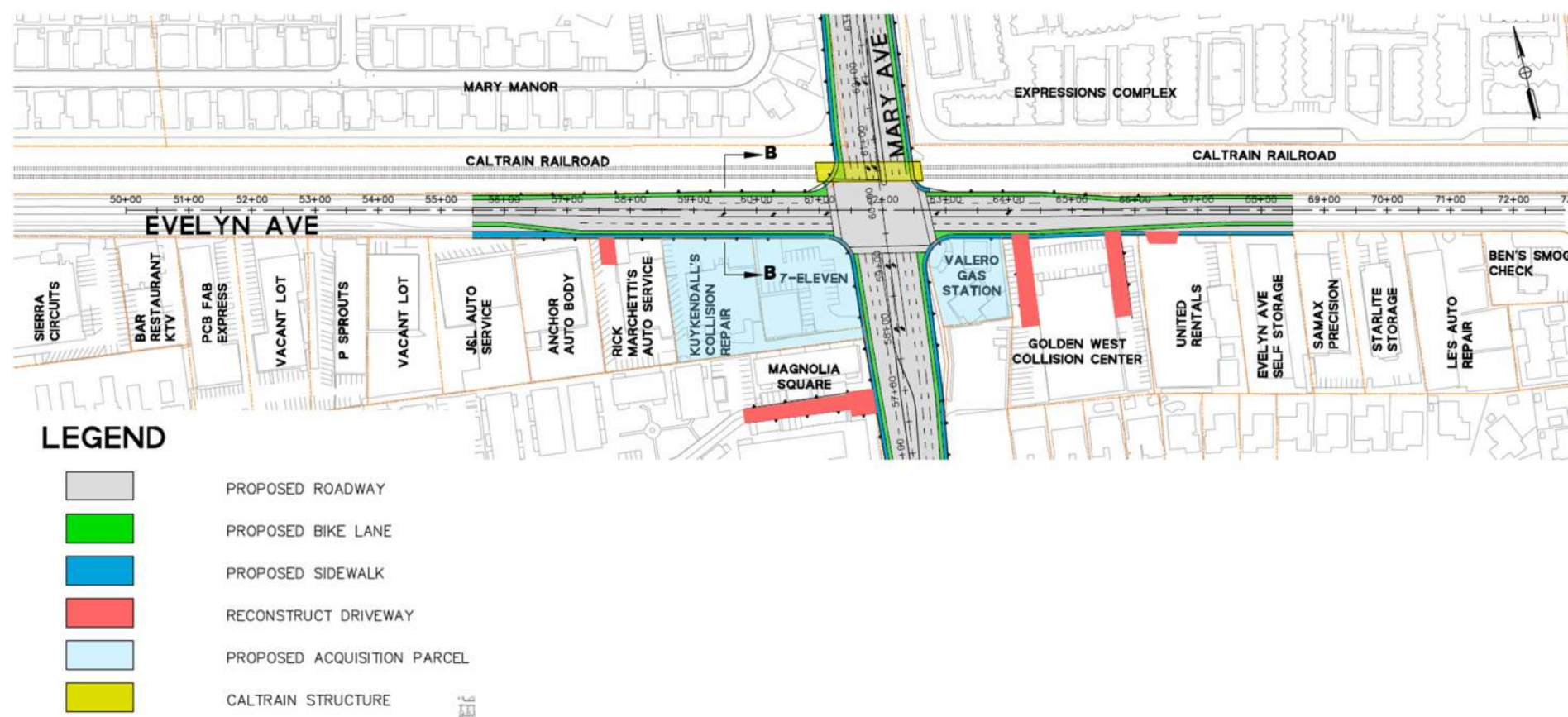
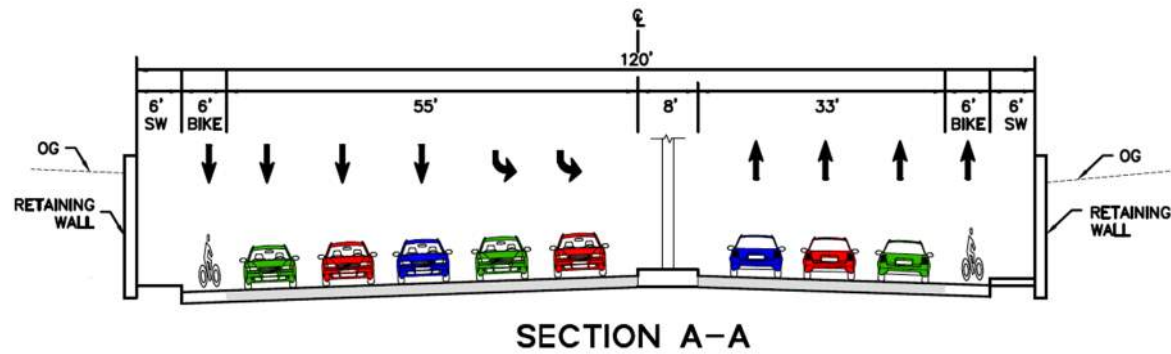
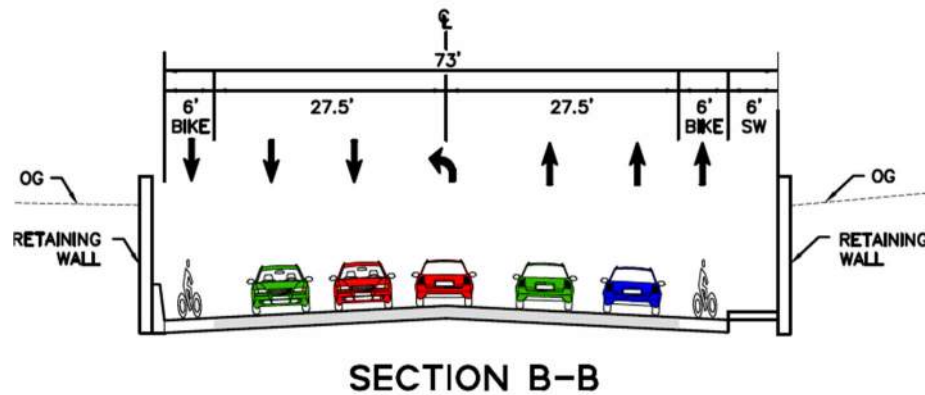




Figure 4 (cont.): Mary Avenue Underpass Tunnel Alternative (Cross-Sections)



Mary Avenue Cross Section North of Evelyn Avenue



Evelyn Avenue Cross Section east of Mary Avenue

Source: BKF Engineers, received June 28, 2022

Figure 5: Sunnyvale Avenue Underpass Tunnel Alternative (Plan View)

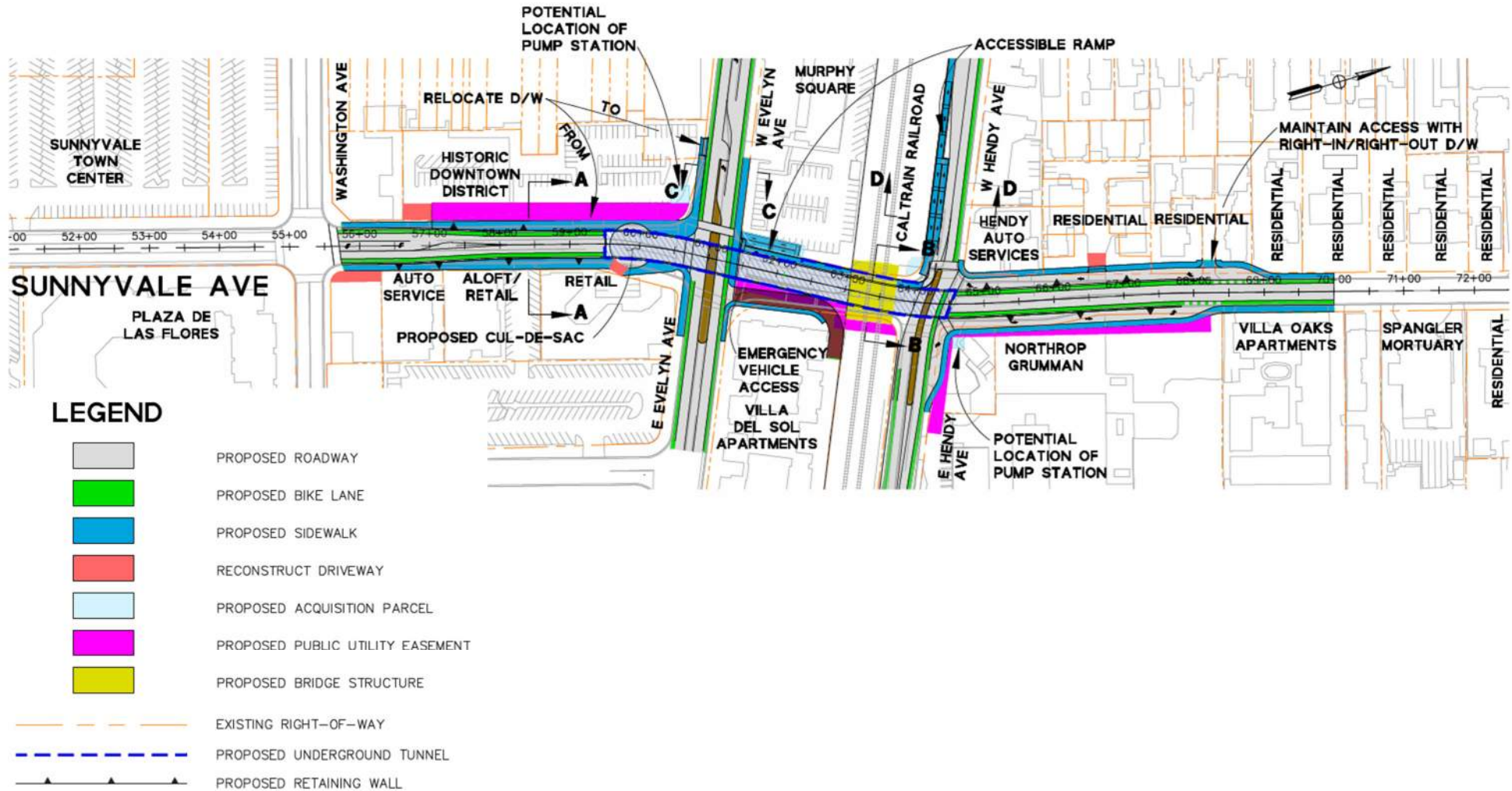
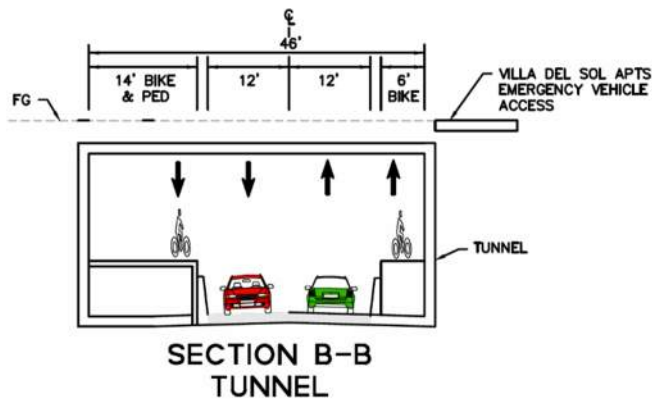
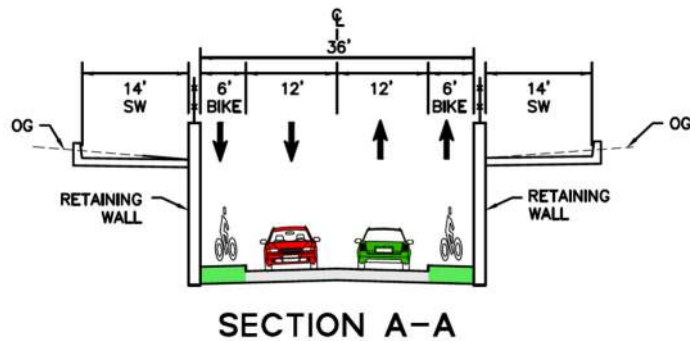




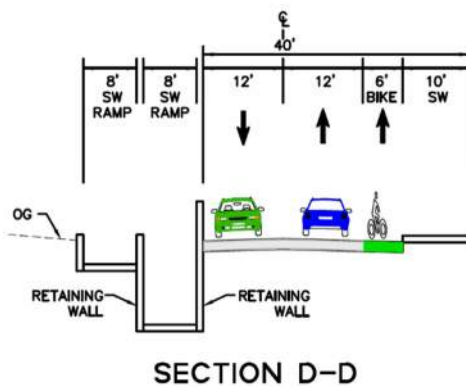
Figure 5 (cont.): Sunnyvale Avenue Underpass Tunnel Alternative (Cross-Sections)



Sunnyvale Avenue Underpass Tunnel Cross Section beneath Caltrain



Sunnyvale Avenue Cross Section south of Evelyn Avenue



Hendy Avenue Cross Section west of Sunnyvale Avenue

Source: BKF Engineers, received June 28, 2022



Figure 6: Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative (Plan View)

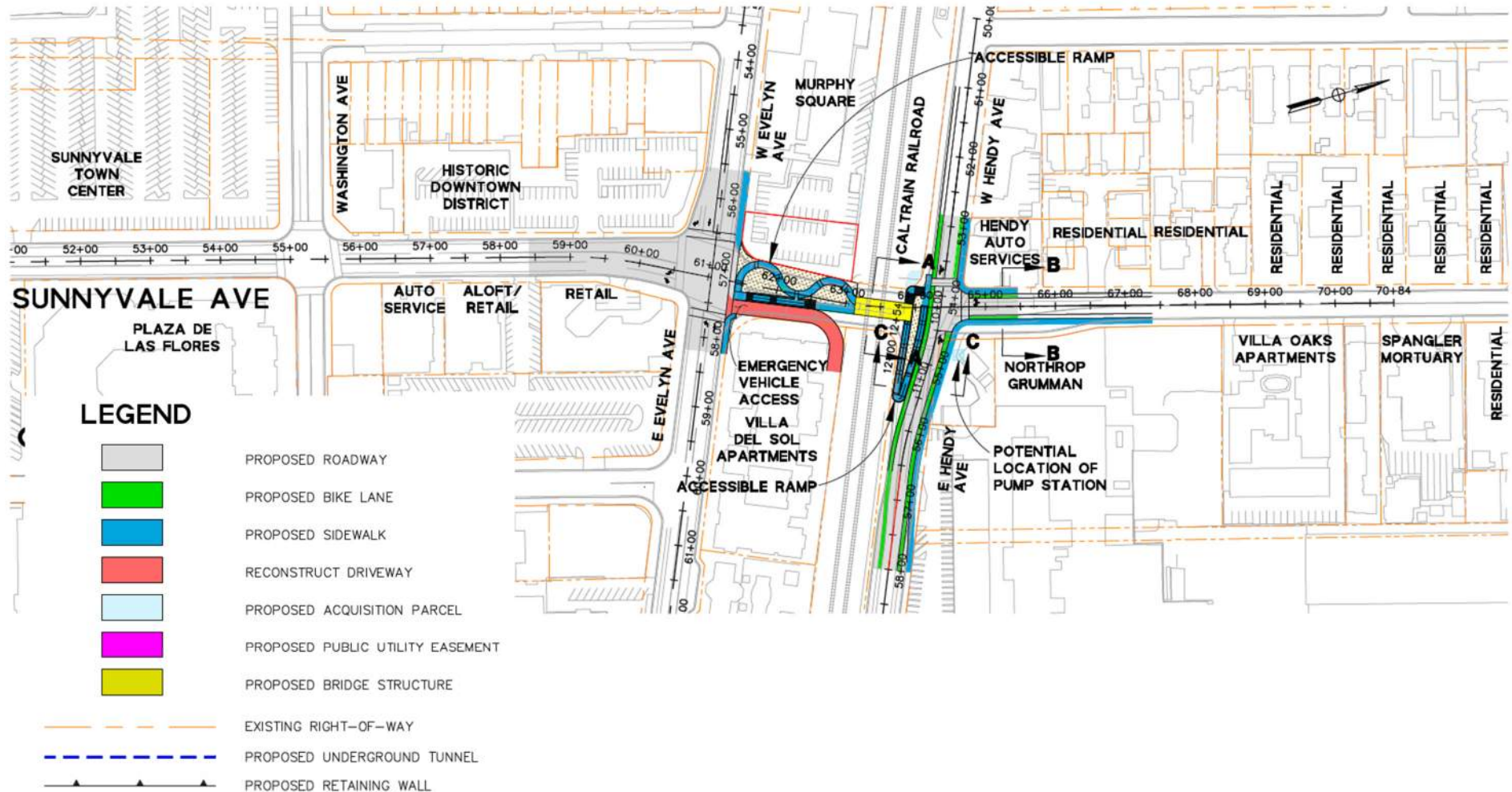
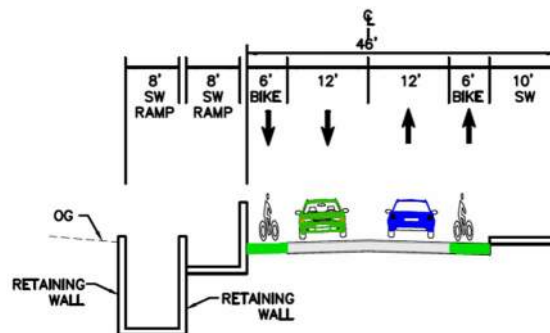


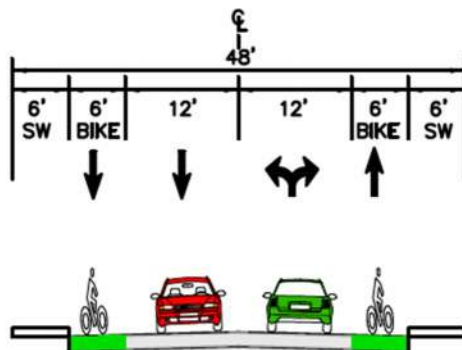


Figure 6 (cont.): Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative (Cross-Sections)



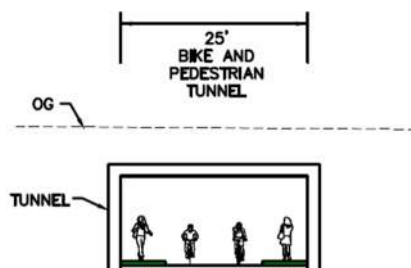
SECTION C-C

Hendy Avenue Cross Section west of Sunnyvale Avenue



SECTION B-B

Sunnyvale Avenue Cross Section north of Hendy Avenue



SECTION A-A TUNNEL

Bicycle and Pedestrian Tunnel Cross Section

Source: BKF Engineers, received June 28, 2022

the tracks via a pedestrian and bicycle undercrossing. Both the Sunnyvale Avenue/Evelyn Avenue and Sunnyvale Avenue/Hendy Avenue intersections would be converted to T-intersections with this alternative.

METHODOLOGY AND APPROACH

2016-2017 Existing Traffic Counts

Existing AM and PM peak period turning movement counts were collected in March 2017, except for the three study intersections along Fair Oaks Avenue which were collected in January 2018. In addition, to maintain consistency between overlapping studies, six previously collected turning movements counts were utilized for study intersections that overlap with the Mary Avenue Overcrossing EIR Traffic Analysis. The six study intersections where Mary Avenue Overcrossing EIR Traffic Analysis counts were utilized include the four study intersections along Mary Avenue, the Mathilda Avenue/California Avenue intersection and the Mathilda Avenue/Washington Avenue intersection.

2035 No-Build Model Development

Future turning movement volumes were developed by growing existing turning movement counts based on traffic growth projected by the City of Sunnyvale travel demand model. The most recent completed Sunnyvale model was utilized in this analysis. It includes recently approved plans, such as the Downtown Specific Plan, the Lawrence Station Area Plan, and the El Camino Real Specific Plan. **Attachments A and C** illustrate the 2035 No-Build volumes at each study intersection.

2035 No-Build and Build models include City projects that have been implemented subsequent to collection of existing conditions data in 2017/2018 as well as additional approved projects that have not yet been implemented.

Caltrain schedules were updated to assume three additional trains in each direction per hour as well as the assumption that all trains would stop at the Sunnyvale Station with the implementation of electrification (no express trips skipping the station). CHSRA is assumed to operate along the corridor in the future. It was assumed that four CHSRA trains per hour would pass through the Sunnyvale study area in each direction. These trains would not stop at the Sunnyvale station and would be traveling at up to 110 mph. This rail operating scheme is consistent with the adopted Caltrain Business Plan of 8 Caltrain + 4 CHSRA trains in the Peninsula corridor.

Gate operations and signal preemption parameters were adjusted to reflect the understanding that electrification of the corridor will eliminate the “double-pump” operation of the gates which are for southbound trains stopping at the Sunnyvale Station. Currently, southbound Caltrain trainsets stopping at the Sunnyvale Station are detected two times, once on the approach to the station, and once after leaving. This forces the traffic signal to preempt and gates to be lowered twice in a short period of time. Gate down times are consistent with the Caltrain Electrification Environmental Impact Report Transportation Analysis (February 2014).

2035 Build Model Development

A select link analysis was run with the City's travel demand model to identify origin-destination patterns for traffic currently using the Sunnyvale Avenue at-grade crossing. Based on that select link output, current traffic patterns, and an understanding of the traffic network, affected traffic flows were shifted to alternate routes with each of the Sunnyvale Avenue Underpass Tunnel and Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternatives. Traffic volumes for the Mary Avenue Underpass Tunnel with Jughandle Alternative were redistributed through the new jughandle intersections. Traffic volumes for the Mary Avenue Underpass Tunnel with Jughandle and Connector Ramps included additional redistribution through the new connector ramps. Traffic volumes for the Mary Avenue Underpass Tunnel Alternative were kept the same as No-Build. The respective geometries of each grade separation alternative were incorporated into the analysis models.

Operations Analysis

All study intersections were modeled using VISSIM software. Existing Conditions models were calibrated according to guidance from the Federal Highway Administration's (FHWA's) *Traffic Analysis Toolbox, Volume III*¹. This included a calibration of field-counted traffic volumes against modeled throughputs as well as field-collected travel times against modeled travel times. Modeled throughputs and travel times were found to meet FHWA-recommended calibration criteria. It is noted that while VISSIM provides approach and intersection delay values that have been translated into a Level of Service grade in accordance with Highway Capacity Manual (HCM) delay thresholds, it is not an HCM-derived methodology and thus findings would deviate from an HCM analysis approach. VISSIM was selected as the analysis tool because of its ability to accurately model the upstream and downstream effects of at-grade rail crossings, including the effect of rail pre-emption sequences on adjacent signalized intersection phasing. As rail crossings are inherently random in their occurrence and are associated with a distinctive signal sequence at any adjacent signals, they cannot be accurately reflected in an HCM-derived analysis.

RESULTS METHODOLOGY

The following section provides a summary of results for the No-Build and Build scenarios, including the Mary Avenue Underpass with Jughandle Alternative, the Mary Avenue Underpass with Jughandle and Connector Ramps Alternative, the Mary Avenue Underpass Tunnel Alternative, the Sunnyvale Avenue Underpass Tunnel Alternative, and the Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative. For each Build alternative, the following is summarized:

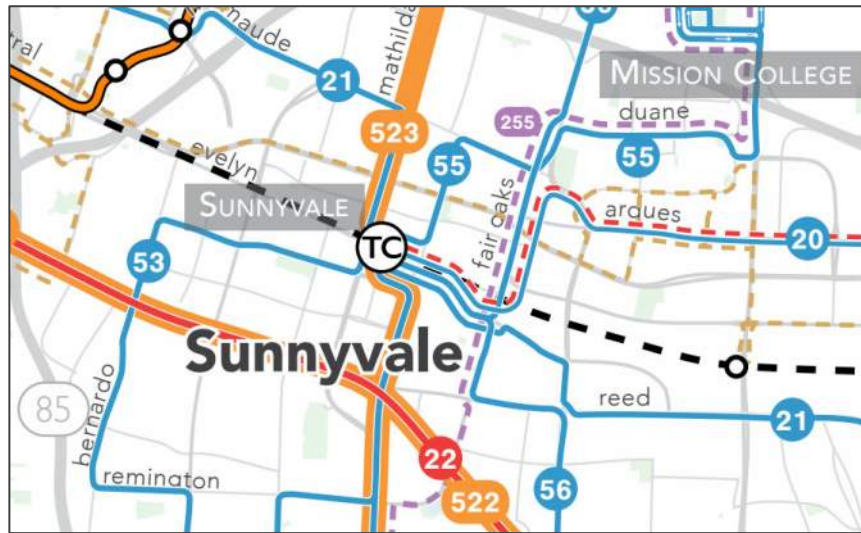
- **Volume redistribution and assignment:** Each Build alternative except for the Mary Avenue Underpass Tunnel Alternative assumes volume redistribution due to turning movement restrictions or modifications associated with the grade separation alternative.
- **Traffic measures of effectiveness:** The measures of effectiveness for the Mary Avenue grade separation alternatives include the change in delay and queue length by movement as well as the change in travel time along Mary Avenue. The measures of effectiveness for the

¹ https://ops.fhwa.dot.gov/trafficanalysisistools/tat_vol3/vol3_guidelines.pdf

Sunnyvale Avenue grade separation alternatives include change in intersection delay, corridor travel time, and network performance.

- **Multimodal impacts:** A qualitative multimodal impact analysis was conducted based on the proposed alternatives. Effects on pedestrian, bicycle, and transit circulation was evaluated, including out-of-direction travel, safety, and other circulation considerations.² The transit assessment assumes the Santa Clara Valley Transportation Authority's (VTA) FY18-19 transit service plan (i.e., Next Network), which was implemented prior to the COVID pandemic. **Figure 7** shows the Next Network service map within the City of Sunnyvale.

Figure 7: VTA Next Network Plan (Pre-Pandemic Service Pattern)



Source: <http://nextnetwork.vta.org/transit-service-maps>

Attachments B, D, E, and F illustrate the volume distribution and assignment for each alternative by study intersection, summarizing the current conditions, and conditions with the No-Build and Build scenarios. Volume distribution and assignment for the Mary Avenue Underpass Tunnel Alternative was not included as all No-Build turning movements are expected to remain the same.

² Out-of-direction travel refers to an increase in distance and associated travel time to travel from two termini. The out-of-direction travel metric is the difference between the length of the route alignment and the straight-line distance between the route's termini. This metric increases the more the route's alignment deviates from a straight-line path.

MARY AVENUE

Volume Distribution and Assignment

Underpass with Jughandle Alternative

All turning movements at the Mary Avenue/Evelyn Avenue intersection under the No-Build scenario are redistributed through the jughandle. For example, all vehicles who make a northbound left at the Mary Avenue/Evelyn Avenue intersection under the No-Build scenario will make a northbound right at the new signal at Mary Avenue/Jughandle (Int. #19) and a northbound left at the new signal at Evelyn Avenue/Jughandle (Int. #20) under this alternative. All through vehicles under the 2035 No-Build scenario are not rerouted under this alternative.

Underpass with Jughandle and Connector Ramps Alternative

Similar to the Underpass with Jughandle Alternative, most turning movements at the Mary Avenue/Evelyn Avenue intersection under the No-Build scenario are redistributed through the jughandle. However, in this alternative, traffic heading westbound on Evelyn Avenue to northbound Mary Avenue will be routed through a direct connector ramp and will make a right turn at the new half signal on Mary Avenue. Volumes travelling southbound on Mary Avenue and heading westbound on Evelyn Avenue will also be routed via a free right-turn to a connector ramp to Evelyn Avenue.

Underpass Tunnel Alternative

Since both Mary Avenue and Evelyn Avenue are depressed and remain connected, all turning movements at the intersection remain the same as represented under the No-Build scenario. No volumes under the 2035 No-Build scenario will be rerouted under this alternative.

Intersection Operations Results

Since there would be no redistribution of traffic associated with the Build Alternatives other than routing of vehicles through the jughandle and/or connector ramps, operations for other intersections along Mary Avenue do not change. See **Table 1** for a comparison of LOS and delay at the Mary Avenue/Evelyn Avenue or jughandle intersections with No-Build and Build conditions.

Table 1: Mary Avenue Jughandle Operations by Movement – 2035 No-Build and Build

Movement	2035 AM Peak Hour				2035 PM Peak Hour			
	No-Build (sec)	2035 Build (Jughandle)	2035 Build (Connector Ramps)	2035 Build (Tunnel)	No-Build (sec)	2035 Build (Jughandle)	2035 Build (Connector Ramps)	2035 Build (Tunnel)
Eastbound Evelyn Ave to Northbound Mary Ave	F (195.7)	D (48.0)	B (19.3)	E (75.6)	F (454.8)	E (56.4)	B (18.3)	F (254.2)
Eastbound Evelyn Ave	C (27.7)	E (59.1)	B (15.1)	C (28.5)	F (141.7)	D (49.0)	D (49.0)	F (128.4)
Eastbound Evelyn Ave to Southbound Mary Ave	C (23.0)	F (92.4)	E (68.9)	B (14.9)	F (139.1)	F (88.7)	F (83.0)	F (178.0)
Westbound Evelyn Ave to Southbound Mary Ave	F (297.2)	F (136.4)	F (119.7)	F (158.1)	F (291.3)	F (238.0)	F (151.2)	F (98.5)
Westbound Evelyn Ave	F (332.6)	D (37.0)	B (14.3)	F (163.8)	F (333.3)	F (122.7)	D (42.6)	F (252.3)
Westbound Evelyn Ave to Northbound Mary Ave	F (389.8)	F (92.0)	E (59.0)	F (166.7)	F (372.7)	F (205.8)	F (86.3)	F (88.0)
Northbound Mary Ave to Westbound Evelyn Ave	F (374.6)	F (189.2)	F (183.3)	F (245.2)	F (89.4)	D (40.5)	D (38.0)	E (78.3)
Northbound Mary Ave	F (333.6)	F (176.4)	F (178.8)	F (186.9)	E (78.2)	D (47.1)	D (46.2)	D (46.4)
Northbound Mary Ave to Eastbound Evelyn Ave	F (228.4)	F (183.1)	F (172.4)	F (134.3)	E (45.8)	D (37.4)	C (23.2)	C (23.4)
Southbound Mary Ave to Eastbound Evelyn Ave	E (73.5)	F (85.0)	E (71.1)	D (45.4)	F (141.1)	E (64.9)	D (49.6)	F (89.0)
Southbound Mary Ave	D (54.6)	A (8.8)	A (9.6)	C (33.9)	E (78.0)	B (18.0)	B (17.6)	E (62.0)
Southbound Mary Ave to Westbound Evelyn Ave	F (116.7)	F (91.1)	A (2.3)	F (130.0)	F (84.7)	E (67.9)	A (3.1)	E (63.8)
Overall Mary Ave/ Evelyn Ave Intersection Delay	F (230.3)	N/A	N/A	F (135.8)	F (167.8)	N/A	N/A	F (113.4)
Overall Mary Ave/ Jughandle Intersection Delay	N/A	F (99.5)	F (109.5)	N/A	N/A	C (34.4)	C (27.0)	N/A
Overall Evelyn Ave/ Jughandle Intersection Delay	N/A	D (39.5)	B (16.8)	N/A	N/A	E (65.5)	C (28.9)	N/A
Mary Avenue Half Signal	N/A	N/A	B (10.2)	N/A	N/A	N/A	B (14.5)	N/A

Note: Numbers in table reflect movement Level of Service (seconds of delay). The bolded text represents those movements that experience higher delays under the given Build scenario relative to the No-Build scenario.

Underpass with Jughandle Alternative

With the 2035 No-Build scenario, the Mary Avenue/Evelyn Avenue intersection operates at Level of Service (LOS) F in both peak periods. In the Build scenario, the Mary Avenue jughandle intersection operates at LOS F in the AM peak hour and LOS C in the PM peak hour and the Evelyn Avenue jughandle intersection operates at LOS D in the AM peak hour and LOS E in the PM peak hour.

Underpass with Jughandle and Connector Ramps Alternative

Under this alternative, the Mary Avenue jughandle intersection operates at LOS F in the AM peak hour and LOS C in the PM peak hour and the Evelyn Avenue jughandle intersection operates at LOS

B in the AM peak hour and LOS C in the PM peak hour. The westbound connector ramp half signal at Mary Avenue operates at LOS B in both peak hours.

Underpass Tunnel Alternative

Since no redistribution of traffic is proposed under this alternative, operations for other intersections along Mary Avenue do not change. With the 2035 No-Build Scenario, the Mary Avenue/Evelyn Avenue intersection operates at LOS F in both peak periods. With the Underpass Tunnel Alternative, the Mary Avenue/Evelyn Avenue intersection is no longer subject to gate closures as the railroad tracks would remain at-grade while all auto traffic is lowered. See **Table 1** for a comparison of overall intersection delay between No-Build and the Underpass Tunnel Alternative. While the Mary Avenue/Evelyn Avenue intersection would still operate at LOS F for the AM and PM peak hours with the depressed intersection, delay would be substantially reduced (50 seconds or greater) in both peak periods.

Vehicle Route Delay

Underpass with Jughandle Alternative

In the underpass with jughandle scenario, through vehicles traveling north and south on Mary Avenue will only experience delay at one intersection, similar to today. However, turning vehicles will need to pass through both jughandle intersections, thereby experiencing delay at two locations. Therefore, in order to compare delay in the No-Build condition with the Build, delay along the entire vehicle routing through the jughandle is recorded. See **Table 1** for a comparison of delay between movements through the jughandle and baseline movements at the Mary Avenue/Evelyn Avenue intersection. For example, the delay associated with the eastbound Evelyn Avenue to Northbound Mary Avenue movement in the No-Build scenario refers to the delay of the eastbound left movement at the No-Build at-grade Mary Avenue/Evelyn Avenue intersection, whereas in the Build scenario, the delay is the cumulative delay through both jughandle intersections (eastbound right at the Mary Avenue/Jughandle intersection and a westbound right at the Mary Avenue/Jughandle intersection).

As shown in the table, the delay for the majority of movements substantially decreases with the implementation of the jughandle. Based on movement delay and vehicular volume, the weighted average intersection delay is substantially lower in the underpass with jughandle scenario than in the No-Build, in both the AM and PM peak hour.

Underpass with Jughandle and Connector Ramps Alternative

In the underpass with jughandle and connector ramps scenario, through vehicles travelling south on Mary Avenue will only experience delay at the jughandle intersection. Vehicles travelling north will experience delay at two locations, one at the jughandle intersection and one north of Evelyn Avenue where a half signal is used to control traffic coming from the westbound connector ramp. Turning vehicles that need to pass through the jughandle will experience delays at both jughandle intersections. Vehicles travelling southbound on Mary Avenue and using the connector ramp to head westbound on Evelyn Avenue will experience only minimal delays associated with yielding to pedestrians and cyclists. Vehicles travelling westbound on Evelyn Avenue and using the connector ramp to head northbound on Mary Avenue will experience delay at the half signal only.

As shown in **Table 1**, nearly all movements in the AM and PM peak hours experience equal or less delays compared to the Underpass with Jughandle Alternative (without connector ramps). The only exceptions are on northbound and southbound Mary Avenue in the AM peak hour, where delay increases by up to three seconds. This additional delay is associated with the half signal (northbound direction) and nominal delay associated with queue delays for right-turning vehicles yielding to pedestrians.

Underpass Tunnel Alternative

As shown in **Table 1**, the delay for the nearly all movements decrease with the implementation of the Underpass Tunnel Alternative. The only movement with a sizeable increase in delay (> 15 seconds) is the eastbound Evelyn Avenue to southbound Mary Avenue movement. That movement receives a substantial amount of green time in the No-Build because it is not precluded by the train movement. Therefore, it would receive less green time relative to the No-Build alternative.

Vehicle Queuing

Underpass with Jughandle Alternative

Table 2 shows queue lengths by movement for the underpass with jughandle alternative for the 2035 Build scenario. The length of the proposed jughandle is approximately 400 feet.

Table 2: Average Queue Lengths at the Proposed Jughandle – 2035 No-Build and Build

Roadway ¹	Approach	Movement	Available Turn Pocket Storage Length		2035 AM Peak Hour		2035 PM Peak Hour	
			2035 No-Build Turn Pocket Storage (ft)	2035 Build Turn Pocket Storage (ft)	2035 No-Build ² Queue Length (ft)	2035 Build Queue Length (ft)	2035 No-Build ² Queue Length (ft)	2035 Build Queue Length (ft)
Mary Avenue Movements	Northbound	Left	125	-	-	-	25	25
		Through	-	-	1,350	1,050	75	75
		Right	-	200	-	750	-	25
	Southbound	Left	125	475	75	75	275	50
		Through	-	-	125	25	350	75
		Right	-	-	-	-	-	-
Evelyn Avenue Movements	Eastbound	Left	150	-	250	-	1,050	-
		Through	-	-	125	75	1,050	175
		Right	-	200	-	25	-	125
	Westbound	Left	125	150	1,650	300	1,700	775
		Through	-	-	1,725	300	1,700	775
		Right	-	-	-	-	-	-
Jughandle Movements	Westbound (at Mary Ave)	Left	N/A	370	N/A	125	N/A	225
		Through		370		-		-
		Right		370		125		225
	Northbound (at Evelyn Ave)	Left		370		75		50
		Through		-		-		-
		Right		370		100		75

¹ For the No-Build, queues reflect queues at the Mary Avenue/Evelyn Avenue intersection. For the Build, queues represent queues at the jughandle intersections with the noted streets

² Note that because the intersection location shifts from the No-Build to the Build, the queue length measurement does not start at the same point between the two scenarios.

Notes: Queue lengths in feet rounded to the nearest 25 feet. Movements shaded reflect queues that exceed the length of the storage pocket and would impede adjacent through movements and/or movements through upstream intersections. Storage lengths by definition cannot exceed distance to upstream intersection. Queue length only provided where dedicated lanes are provided. 2035 Build Queue Length Storage is based on current design assumptions.

As shown in the table, there would be minimal queue spillback within the jughandle roadway. However, the westbound left-turn movement from Evelyn Avenue to the jughandle would have an average queue length over 700 feet in the PM peak hour, exceeding any reasonable turn pocket length. Queue spillbacks and lane blockages would likely occur. In addition, the northbound right-turn movement from Mary Avenue to the jughandle would have an average queue length of 750 feet in the AM peak hour, exceeding any reasonable turn pocket length. For this movement, the long queue length is a produce of very long queues for the northbound through movement, limiting access to the right turn storage pocket. Therefore, no additional queue spillbacks and lane blockages would occur.

Underpass with Jughandle and Connector Ramps Alternative

Table 3 shows queue lengths by movement for the Underpass with Jughandle and Connector Ramps Alternative for the 2035 Build scenario. The length of the proposed jughandle is approximately 400 feet.

Table 3: Average Queue Lengths at the Proposed Jughandle – 2035 No-Build and Build

Roadway ¹	Approach	Movement	Available Turn Pocket Storage Length		2035 AM Peak Hour		2035 PM Peak Hour	
			2035 No-Build Turn Pocket Storage (ft)	2035 Build Turn Pocket Storage (ft)	2035 No-Build ² Queue Length (ft)	2035 Build Queue Length (ft)	2035 No-Build ² Queue Length (ft)	2035 Build Queue Length (ft)
Mary Avenue Movements	Northbound	Left	125	-	-	-	25	25
		Through	-	-	1,350	1,050	75	50
		Right	-	200	-	675	-	25
	Southbound	Left	125	475	75	25	275	25
		Through	-	-	125	25	350	50
		Right	-	-	-	-	-	-
Evelyn Avenue Movements	Eastbound	Left	150	-	250	-	1,050	-
		Through	-	-	125	25	1,050	150
		Right	-	200	-	25	-	25
	Westbound	Left	125	150	1,650	100	1,700	225
		Through	-	-	1,725	100	1,700	225
		Right	-	-	-	-	-	-
Jughandle Movements	Westbound (at Mary Ave)	Left	N/A	370	N/A	25	N/A	75
		Through		370		-		-
		Right		370		25		75
	Northbound (at Evelyn Ave)	Left		370		25		25
		Through		-		-		-
		Right		370		50		25

¹ For the No-Build, queues reflect queues at the Mary Avenue/Evelyn Avenue intersection. For the Build, queues represent queues at the jughandle intersections with the noted streets

² Note that because the intersection location shifts from the No-Build to the Build, the queue length measurement does not start at the same point between the two scenarios.

Notes: Queue lengths in feet rounded to the nearest 25 feet. Movements shaded reflect queues that exceed the length of the storage pocket and would impede adjacent through movements and/or movements through upstream intersections. Storage lengths by definition cannot exceed distance to upstream intersection. Queue length only provided where dedicated lanes are provided. 2035 Build Queue Length Storage is based on current design assumptions.

As shown in the table, there would be no queue spillback within the jughandle roadway during both the AM and PM peak hour. The northbound right-turn movement from Mary Avenue to the jughandle would have an average queue length of 675 feet in the AM peak hour, exceeding any reasonable turn pocket length. For this movement, the long queue length is a produce of very long queues for the

northbound through movement, limiting access to the right turn storage pocket. Therefore, no queue spillbacks and lane blockages would occur from this right-turn movement.

Underpass Tunnel Alternative

Table 4 shows queue lengths by movement for the depressed intersection for the 2035 Build scenario.

Table 4: Average Queue Lengths at the Proposed Underpass Tunnel Intersection – 2035 No-Build and Build

Approach	Movement	Available Turn Pocket Storage Length	2035 AM Peak Hour		2035 PM Peak Hour	
		2035 Turn Pocket Length Storage (ft)	2035 No-Build ² Queue Length (ft)	2035 Build Queue Length (ft)	2035 No-Build ² Queue Length (ft)	2035 Build Queue Length (ft)
Northbound	Left	125	1,350	1,250	25	25
	Through	-	1,350	1,250	75	200
	Right	-	-	-	-	-
Southbound	Left	125	75	75	275	100
	Through	-	125	75	350	250
	Right	-	-	-	-	-
Eastbound	Left	150	250	100	1,050	950
	Through	-	125	25	1,050	950
	Right	-	-	-	-	-
Westbound	Left	125	1,650	1,250	1,700	300
	Through	-	1,725	1,375	1,700	600
	Right	-	-	-	-	-

Notes: Queue lengths in feet rounded to the nearest 25 feet. Movements shaded reflect queues that exceed the length of the storage pocket and would impede adjacent through movements and/or movements through upstream intersections. Storage lengths by definition cannot exceed distance to upstream intersection. Queue length only provided where dedicated lanes are provided at the intersection of Sunnyvale Avenue and Evelyn Avenue.

As shown in the table, the queue lengths would be reduced for the majority of the movements under this alternative, although they would remain long.

Multimodal Considerations

Pedestrian

No-Build. In the No-Build scenario, there are no sidewalks on the north side of Evelyn Avenue fronting the rail tracks. Both sides of Mary Avenue have sidewalks. At the Mary Avenue/Evelyn Avenue intersection, pedestrians can cross the south, east, and west legs of the intersection. Pedestrians on Mary Avenue would continue to cross the rail tracks at-grade.

Underpass with Jughandle. The grade separation of Mary Avenue has substantial safety benefits for pedestrians as pedestrians would no longer be exposed to conflicts with trains. All conflicts between rail and pedestrians would be grade-separated.

Grade changes are introduced in the Build alternative with the depression of Mary Avenue. Pedestrians will experience up to a 3 percent grade as they travel along the jughandle and up to 2.5 percent along Mary Avenue. Currently, no pedestrian or bicycle facilities are provided on the north side of Evelyn Avenue adjacent to the Caltrain corridor. Provision of pedestrian facilities in that location are not a part of this project. However, the City is currently developing a plan to build a multi-use trail on the north side of Evelyn Avenue between Bernardo Avenue and Mathilda Place. Such an improvement would not be precluded by this alternative and no new conflicts would be introduced. Through pedestrian movements on the south side of Evelyn Avenue and on Mary Avenue would be maintained, with the only impact being the additional grade for pedestrians on Mary Avenue. However, due to the grade separation, most pedestrian movements originating on Mary Avenue and destined for Evelyn Avenue, and vice versa, would experience out-of-direction travel along the jughandle. Out-of-direction travel would be longest for pedestrians traveling between Mary Avenue north of the intersection and Evelyn Avenue west of the intersection amounting to an additional walk distance of approximately 650 feet. The intersection crossings would be similar to current conditions given the large number of turning lanes at each of the jughandle intersections.

Underpass with Jughandle and Connector Ramps. This alternative is expected to maintain the same pedestrian movements as the previous alternative, as no pedestrian facilities will be added to the connector ramps. As there are currently no pedestrian facilities on the north side of Evelyn Avenue, no new conflicts will be added on that roadway as a result of the connector ramps. If the City implements a multi-use trail on the north side of Evelyn Avenue in the future, it should be configured to remain at the same elevation as Evelyn Avenue alongside the Caltrain tracks to avoid a conflict with the connector ramp. The connector ramps will pose additional conflict points on Mary Avenue as pedestrians cross where the connector ramps meet Mary Avenue. The westbound to northbound connector ramp will be signalized at Mary Avenue, providing a protected crossing for pedestrians. The current concept does not have any traffic control at the southbound to westbound connector ramp, although it is a tight turn radius that will require vehicles to complete the turn at lower speed.

Underpass Tunnel. The grade separation of Mary Avenue has substantial safety benefits for pedestrians as pedestrians would no longer be exposed to conflicts with trains. All conflicts between rail and pedestrians would be grade-separated.

Grade changes are introduced in the Build alternative with the depression of Mary Avenue and Evelyn Ave. Pedestrians will experience up to 2.5 percent along Mary Avenue and Evelyn Avenue will be similarly depressed to connect with Mary Avenue. Similarly to the No-Build scenario, no sidewalks are provided on the north side of Evelyn Avenue under the Build scenario. The intersection crossings would be similar to current conditions.

Bicycle

No Build. In the No-Build scenario, Class II bike lanes are provided on both Mary Avenue and along eastbound Evelyn Avenue. Westbound Evelyn Avenue has sharrows through the Mary Avenue intersection in order to provide a second westbound through lane at the intersection. Bicyclists on Mary Avenue would continue to cross the tracks at-grade.

Underpass with Jughandle. The grade separation of Mary Avenue has substantial safety benefits for cyclists as they would no longer be exposed to conflicts with trains. In addition, the crossing of the rails themselves represents a hazardous condition, as bicycle tires can get stuck in the tracks, which would be removed with the project. With the jughandle, six-foot wide Class II bike lanes are currently planned along all roadways, including Mary Avenue, Evelyn Avenue, and the proposed jughandle, closing a current gap in the bicycle network along Evelyn Avenue. The City is in planning stages of a multi-use trail on the north side of Evelyn Avenue, which would be provided in lieu of dedicated bike lanes on both sides of Evelyn Avenue. This alternative would work well with such a plan, as no conflicts would occur along the multi-use trail in the vicinity of Mary Avenue.

Grade changes are introduced in the Build alternative with the depression of Mary Avenue. Cyclists will experience up to a 3 percent grade as they travel along the jughandle and up to 7 percent along Mary Avenue. Similar to pedestrians, cyclists would be routed through the jughandle to make any turning movements at the Mary Avenue/Evelyn Avenue intersection. With the provision of multiple vehicle turn lanes, two-stage turn boxes and demarcated bike stencils across intersections should be considered in future project phases at both intersections of the jughandle with Evelyn Avenue and Mary Avenue to provide a safe way for cyclists to make turning movements. This is particularly critical for the westbound left-turn bicycle movement from Evelyn Avenue to the jughandle, the westbound left-turn bicycle movement from the jughandle to Mary Avenue, the southbound left-turn bicycle movement from Mary Avenue to the jughandle, and the northbound left-turn bicycle movement from the jughandle to Evelyn Avenue. These treatments would avoid the need for a challenging auto-bicycle weave movement along the short length of the jughandle. Appropriate yield and caution signs should be installed at the intersections to make motorists aware of bicycles.

Underpass with Jughandle and Connector Ramps. The concepts included in this memo do not include any bicycle facilities on the connector ramps. The provision of exclusive bicycle lanes on the ramps should be evaluated in future project phases should this alternative advance. That would allow for convenient connections between bicycle facilities on Evelyn Avenue and Mary Avenue without having to navigate the jughandle intersections. The connector ramps add conflicts for bicyclists traveling through on both Mary Avenue and Evelyn Avenue. As currently shown in the concept, on Evelyn Avenue, vehicles accessing or merging from the connector ramps will be required to weave across the westbound bike lanes. With the City's plan for a multi-use trail on the north side of Evelyn Avenue, that conflict could be removed if the multi-use trail stays at the same elevation at Evelyn Avenue alongside the Caltrain tracks, avoiding the need to cross either connector ramp. On Mary Avenue, the connector ramps will add an additional conflict for through cyclists. The westbound to northbound connector ramp will be signalized at Mary Avenue, providing for a protected crossing for

Mary Avenue cyclists. The southbound to westbound connector ramp will not be signalized and thus would introduce a new uncontrolled conflict point for through cyclists.

Underpass Tunnel. The grade separation of Mary Avenue has substantial safety benefits for cyclists as they would no longer be exposed to conflicts with trains. In addition, the crossing of the rails themselves represents a hazardous condition, as bicycle tires can get stuck in the tracks, which would be removed with the project. With the provision of multiple vehicle turn lanes, two-stage turn boxes and demarcated bike stencils across intersections should be considered in future project phases to provide a safe way for cyclists to make turning movements. The Underpass Tunnel Alternative design allows for the City's planned multi-use trail on the north side of Evelyn Avenue.

Grade changes are introduced in the Build alternative with the depression of Mary Avenue and Evelyn Ave. Cyclists will experience up to 7 percent along Mary Avenue and Evelyn Avenue will be similarly sloped to connect with Mary Avenue. The grade changes can act as a deterrent for those unaccustomed to biking at steep slopes. In addition, a downhill slope of 7 percent can cause bicyclists to speed down towards the Mary Avenue/Evelyn Avenue intersection, which poses risks for potential bicycle-pedestrian or bicycle-vehicle conflicts, particularly if other negative variables, such as low visibility or bad weather, are present.

Transit

There are no transit routes on Mary Avenue or Evelyn Avenue; as such, there are no impacts to transit routing.

Corridor Travel Time

The VISSIM model was utilized to calculate the change in travel time on Mary Avenue between the 2035 No-Build and the two Build alternatives. Travel times were assessed for movements along Mary Avenue between Washington Avenue and California Avenue. This is summarized in **Table 5**.

Table 5: Mary Avenue - Corridor Travel Time

Segment	Dir	AM Peak Hour				PM Peak Hour			
		2035 No-Build	2035 Build (Jughandle)	2035 Build (Ramps)	2035 Build (Tunnel)	2035 No-Build	2035 Build (Jughandle)	2035 Build (Ramps)	2035 Build (Tunnel)
Washington to Evelyn	NB	562 sec.	331 sec.	332 sec.	336 sec.	149 sec.	118 sec.	116 sec.	115 sec.
California to Evelyn	SB	104	45	45	80	171	82	81	130

Note: Travel times in the peak direction of travel for each peak period are shaded

Mary Avenue is forecast to experience saturated conditions in the peak direction in each peak period in 2035 No-Build and Build scenarios. For southbound movements, Central Expressway and California Avenue both serve as meters on the amount of traffic that can approach Evelyn Avenue and the grade crossing. While Washington Avenue similarly meters northbound traffic, it has less conflicting east-west movement and therefore allows for higher throughput on Mary Avenue, and thus

a larger component of the northbound traffic demand than the southbound traffic demand reaches the Evelyn Avenue intersection and the grade crossing. As a result, northbound travel times and congestion is more readily apparent in the travel time results even though both directions have similar levels of underlying demand.

As shown in the table, travel times along Mary Avenue are substantially higher under the 2035 No-Build scenario than each of the build scenarios in the peak directions of travel in both peak periods. Travel time reductions in the northbound direction in the AM peak hour exceed three minutes with all alternatives and in the southbound direction in the PM peak hour exceed 40 seconds under the Underpass Tunnel Alternative and nearly 90 seconds with the two other build alternatives. The elimination of the at-grade crossing under all Build alternatives is observed to substantially reduce travel time.

Travel times are lowest under the Underpass with Jughandle and Underpass with Jughandle and Connector Ramp Alternatives, except for travel times in the northbound direction are slightly lower for the Underpass Tunnel Alternative during the PM peak hour. This is as expected, as the jughandle reduces the overall number of conflicts at the Mary Avenue/Jughandle intersection, relative to either the No-Build or Underpass Tunnel Alternative. The connector ramps and the additional northbound Mary Avenue half-signal have negligible effect on travel times on Mary Avenue.

SUNNYVALE AVENUE

Volume Distribution and Assignment

Attachment D depicts the redistribution of 2035 volumes with the Sunnyvale Avenue Underpass Tunnel Alternative. As shown, turning movements at the Sunnyvale Avenue/Evelyn Avenue intersection are redistributed to streets including Fair Oaks Avenue, Mathilda Avenue, and Washington Avenue. Through movements on Sunnyvale Avenue are maintained. Turning movements at the Sunnyvale Avenue/Hendy Avenue intersection are primarily redistributed to Fair Oaks Avenue via the Fair Oaks Avenue/Kifer Road intersection.

Attachment E shows the redistribution of 2035 volumes with the Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative. Volumes along Sunnyvale Avenue at the grade-crossing are redistributed to Mathilda Avenue and Fair Oaks Avenue.

Intersection Operations Results

Attachment F summarizes the No-Build and Build intersection operation results for all study intersections. The following highlights the intersections that degrade to a deficient LOS and those that are already deficient by four or more seconds in delay, per VTA traffic analysis standards.

- Sunnyvale Underpass Tunnel and Bicycle/Pedestrian Undercrossing Alternatives
 - No-Build scenario deficient, Build scenario increases delay
 - Sunnyvale Avenue/Washington Avenue (AM Peak Hour)
 - Fair Oaks Avenue/Kifer Road (PM Peak Hour)
 - Fair Oaks Avenue/Evelyn Avenue (AM and PM Peak Hours)

- Sunnyvale Avenue Underpass Tunnel Alternative
 - Build scenario renders intersection deficient
 - Sunnyvale Avenue/California Avenue (AM Peak Hour)
 - No-Build scenario deficient, Build scenario increases delay
 - Sunnyvale Ave/California Avenue (PM Peak Hour)
 - Sunnyvale Avenue/Washington Avenue (PM Peak Hour)
 - Washington Avenue/Frances Street (PM Peak Hour)
- Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternatives
 - Build scenario renders intersection deficient
 - Fair Oaks Avenue/California Avenue (AM Peak Hour)
 - Fair Oaks Avenue/Kifer Rd (AM Peak Hour)
 - No-Build scenario deficient, Build scenario increases delay
 - Sunnyvale Avenue/Evelyn Avenue (AM Peak hour)
 - Fair Oaks Avenue/California Avenue (PM Peak Hour)

Both grade separation alternatives typically result in delay reductions at two intersections adjacent to the grade-crossing: Sunnyvale Avenue/Hendy Avenue and Sunnyvale Avenue/Evelyn Avenue. The lone exception is at Sunnyvale Avenue/Evelyn Avenue in the AM Peak Hour with the Bicycle/Pedestrian Undercrossing Alternative due to an increase in turning movements from Sunnyvale Avenue to Evelyn Avenue. The intersection operations analysis found that both Sunnyvale Avenue alternatives increase traffic volumes and congestion primarily at study intersections along Fair Oaks Avenue and Sunnyvale Avenue. Intersection operations on Mathilda Avenue generally are shown to improve, particularly in the AM Peak Hour, as a result of the removal of forecast backups along Evelyn Avenue caused by very high left turn volumes from Evelyn Avenue to Sunnyvale Avenue.

Corridor Travel Time

The Synchro model was used to calculate corridor travel times along the three north-south corridors in the study area: Mathilda Avenue, Sunnyvale Avenue, and Fair Oaks Avenue.

Table 6 shows travel times in each direction along each of the major north-south roadways within the project limits in the model (Mathilda Avenue, Sunnyvale Avenue, and Fair Oaks Avenue) for each scenario.

Table 6: Sunnyvale Avenue - Corridor Travel Time

Corridor	Segment	Direction	AM Peak Hour			PM Peak Hour		
			2035 No-Build	2035 Build (Tunnel)	2035 Build (Bicycle/Ped UC)	2035 No-Build	2035 Build (Tunnel)	2035 Build (Bicycle/Ped UC)
Mathilda	Indio to Washington	SB	181 sec.	178 sec.	174 sec.	565 sec.	582 sec.	622 sec.
	McKinley to California	NB	367	374	389	161	162	175
Fair Oaks	Arques to Evelyn	SB	160	126	291	466	428	660
	McKinley to California	NB	389	431	624	213	329	362
Sunnyvale	Arques to McKinley	SB	325	186	-	775	409	-
	McKinley to Arques	NB	306	88	-	335	121	-

Note: Travel times in the peak direction of travel for each peak period are shaded

The following section provides a brief summary and explanation of these results.

- AM Travel Time Results
 - The shift of traffic from Sunnyvale Avenue to Mathilda Avenue and Fair Oaks Avenue results in increased delays for the two parallel roadways. Along Mathilda Avenue and Fair Oaks Avenue, travel times are generally highest under the Bicycle/Pedestrian Undercrossing Alternative because the volume shift to Mathilda and Fair Oaks Avenue is less with the Underpass Tunnel than the Bicycle/Pedestrian Undercrossing option. The finding from the VISSIM model of improved operations along Mathilda Avenue with the Build alternatives is not evident in the Synchro travel time results as Synchro does not consider downstream queue spillbacks when determining delay.
 - Along Sunnyvale Avenue, travel times are substantially lower under the Underpass Tunnel Alternative than the No-Build. The elimination of the at-grade crossing results in substantial reductions in travel time. No similar measurement of travel time along Sunnyvale Avenue is possible with the Bicycle/Pedestrian Undercrossing Alternative since the roadway would be closed for vehicles at the tracks.
- PM Travel Time results
 - The shift of traffic from Sunnyvale Avenue to Mathilda Avenue and Fair Oaks Avenue results in increased delays for the two parallel roadways. Along Mathilda Avenue and Fair Oaks Avenue, travel times are highest under the Bicycle/Pedestrian Undercrossing Alternative because the volume shift to Mathilda and Fair Oaks Avenue is much less with the Underpass Tunnel than the Bicycle/Pedestrian Undercrossing Alternative.

- Along Sunnyvale Avenue, a substantial drop in travel times is observed in the Underpass Tunnel Alternative in the northbound direction. The elimination of the at-grade crossing results in substantial reductions in travel time. No similar measurement of travel time along Sunnyvale Avenue is possible with the Bicycle/Pedestrian Undercrossing Alternative since the roadway would be closed at the tracks.

Network Performance

The VISSIM model allows for analysis of overall network performance under each of the alternatives. While alternatives may affect individual movements in different and often complex ways, a comparison of network performance accounts for how the overall change in geometrics and volumes affects network level congestion and throughput. Two network-wide metrics were analyzed: average vehicular delay for the entire vehicular path through the network and unserved demand, which reflects the traffic volume that was stuck in congestion and not able to traverse through the network.

Table 7: Sunnyvale Avenue – Network Performance Metrics

Performance Metrics	AM Peak Hour			PM Peak Hour		
	2035 No-Build	2035 Build (Tunnel)	2035 Build (Bicycle/Ped UC)	2035 No-Build	2035 Build (Tunnel)	2035 Build (Bicycle/Ped UC)
Average Vehicle Delay (sec.)	252	163	184	259	238	240
Unserved Demand	22%	19%	22%	31%	37%	39%

As shown in **Table 7**, both Build alternatives result in a measurable reduction in average vehicle delay in both peak periods of at least seven percent. The Sunnyvale Underpass Tunnel Alternative results in a slightly greater delay reduction than the Bicycle/Pedestrian Undercrossing Alternative, particularly in the AM Peak Hour. The unserved demand calculation finds that the amount of traffic stuck in congestion through the peak hour is pretty similar between the No-Build and the Build in the AM Peak Hour but is somewhat higher with both Build Alternatives in the PM Peak Hour. This is likely associated with increased traffic on already over-saturated corridors.

Multimodal Considerations

The proposed alternatives at Sunnyvale Avenue have the following considerations for multimodal operations:

Pedestrian

No-Build. Sidewalks are present on both sides of all approaches at both the Sunnyvale Avenue/Evelyn Avenue and Sunnyvale Avenue/Hendy Avenue intersections, except on the south

side of Hendy Avenue. Due to the adjacency of the railroad tracks, no crosswalk is present on the south leg of the Sunnyvale Avenue/Hendy Avenue intersection.

Underpass Tunnel Alternative. The grade separation of Sunnyvale Avenue has substantial safety benefits for pedestrians since they would no longer be exposed to conflicts with trains.

Grade changes are introduced in the Build alternative with the depression of the pedestrian walkway along Sunnyvale Avenue. In the Build scenario, an 8-foot pedestrian walkway with 10 feet of vertical clearance is provided on the west side of the proposed tunnel on Sunnyvale Avenue. The pedestrian walkway is separated and elevated above the bicycles and vehicles by a column wall and can be accessed through pedestrian ramps. The pedestrian ramps are located on northwest corner of the Sunnyvale Avenue/Evelyn Avenue intersection and the southwest corner of the Sunnyvale Avenue/Hendy Avenue intersection. The location of the access ramps causes out-of-direction travel for pedestrians that do not originate west of Sunnyvale Avenue on both Evelyn Avenue and Hendy Avenue. The switchback ramps will also lengthen the pedestrian path of travel for users of the undercrossing. Pedestrians on Evelyn Avenue will have reduced vehicle conflicts, as pedestrians on the north sidewalk of Evelyn Avenue will not have to cross Sunnyvale Avenue, and pedestrians on the south sidewalk would only have to cross a cul-de-sac with little traffic. It is recommended to provide a new sidewalk on the south side of Hendy Avenue, between Sunnyvale Avenue and the north entrance to Caltrain Station at North Frances Street, to connect the Caltrain Station to the at-grade Sunnyvale Avenue/Hendy Avenue intersection.

Bicycle/Pedestrian Undercrossing Alternative. Similar to the Underpass Tunnel alternative, a pedestrian undercrossing will be constructed to remove the conflict between pedestrians and trains, which would provide substantial safety benefits. A sidewalk would be constructed on the south side of Hendy Avenue, which is recommended to connect to the Sunnyvale Caltrain Station. Pedestrians will continue to have access along Sunnyvale Avenue between Evelyn Avenue and Hendy Avenue via the proposed pedestrian/bike undercrossing. Access to the undercrossing would be along a pathway with a maximum slope of 5 percent from both Evelyn Avenue and Hendy Avenue. Access from Hendy Avenue would be from a switchback ramp or stairs at the Sunnyvale Avenue/Hendy Avenue intersection. Access from Evelyn Avenue would be via a curved ramp or stairs at the Sunnyvale Avenue/Evelyn Avenue intersection. Pedestrians at both Sunnyvale Avenue/Evelyn Avenue and Sunnyvale Avenue/Hendy Avenue intersections would experience fewer conflicts with vehicles since one leg would be closed at each intersection and much of the traffic would be detoured to other routes.

Bicycle

No-Build. In the No-Build, Sunnyvale Avenue has a Class II bike facility south of Evelyn Avenue and a Class III bike facility north of Evelyn Avenue. A project was recently approved to add Class II buffered bike lanes on Sunnyvale Avenue between just north of Hendy Avenue and Maude Avenue. Evelyn Avenue has Class II bike lanes in each direction on both sides of Sunnyvale Avenue and Hendy Avenue has Class II bike lanes east of Sunnyvale Avenue only.

Underpass Tunnel Alternative. The tunnel crossing for bicyclists on Sunnyvale Avenue would remove conflicts with the train which is a major safety improvement. In addition, cyclists would no longer be exposed to the physical hazard of crossing the rails. The Sunnyvale Avenue tunnel would include 6-foot Class II bike lanes. A 6-foot Class II bike lane would also be provided on Hendy Avenue west of Sunnyvale Avenue in the westbound direction only. Sufficient space is not available for a Class II bike lane in the eastbound direction on Hendy Avenue due to the placement of the pedestrian ramps. Therefore, a Class III bike route would be designated for eastbound Hendy Avenue. Northbound cyclists on Sunnyvale Avenue accessing Hendy Avenue would need to use the 8-foot sidewalk on the west side of the tunnel similar to pedestrians and use the provided switchback ramp. The narrow nature of the pedestrian area and the ramps could create a conflict between cyclists and pedestrians.

Cyclists on Evelyn Avenue destined northbound on Sunnyvale Avenue would need to use the pedestrian ramps on the northwest side of the Sunnyvale Avenue/Evelyn Avenue intersection and travel along the pedestrian route through the tunnel. Similarly, cyclists traveling on Hendy Avenue destined southbound along Sunnyvale Avenue would need to use the pedestrian ramps on the southwest corner of the Sunnyvale Avenue/Hendy Avenue intersection. On the west side of the tunnel, a multi-use facility would serve cyclists traveling southbound on Sunnyvale Avenue and on the east side of the tunnel, a dedicated bicycle facility would serve cyclists traveling northbound on Sunnyvale Avenue. Through the tunnel, cyclists would experience up to 6.5 percent grades (within the tunnel grades would be limited to 3 percent, but grades on the roadway approach would be greater). The proposed multi-use path on the west side of the tunnel would be 14 feet wide and the bicycle-only facility on the east side would be 6 feet wide. Both facilities would be placed at an elevation above vehicles for vertical separation. Cyclists could alternatively elect to share the lane with auto and use the tunnel roadway. A detailed wayfinding plan for cyclists should be implemented to ensure cyclists know which facility to use depending on their final destination.

Bicycle/Pedestrian Undercrossing Alternative. The proposed undercrossing will remove conflicts between cyclists and trains thereby substantially improving safety. In addition, cyclists would no longer be exposed to the physical hazard of crossing the rails. In the Bicycle/Pedestrian Undercrossing Alternative, Evelyn Avenue would continue to have a Class II bike facility. Cyclists traveling northbound or southbound on Sunnyvale Avenue would have continued access through the proposed pedestrian/bike path and undercrossing. North of Hendy Avenue, a Class II bike facility will be provided that will connect to the buffered Class II bike lanes on Sunnyvale Avenue recently approved by the City. A 6-foot bike lane would also be developed in both directions on Hendy Avenue west of Sunnyvale Avenue, although the limits of that improvement are not yet defined.

Transit.

No-Build. VTA Route 55 operates across the Caltrain alignment along Sunnyvale Avenue. It departs the Sunnyvale Caltrain Station on Evelyn Avenue and then turns onto Sunnyvale Avenue. It currently operates on 16-minute frequencies during peak service periods. It is planned to continue operating along this route with the VTA Next Network Plan, but at 30-minute all-day frequency.

Underpass Tunnel Alternative. Route 55 would need to be re-routed since it would no longer be able to make turns at the Sunnyvale Avenue/Evelyn Avenue intersection. The bus route would need to be rerouted to the Caltrain Station via Washington Avenue instead of Evelyn Avenue. No other bus routes included in the Next Network plan would be affected by the Underpass Tunnel Alternative.

Bicycle/Pedestrian Undercrossing Alternative. Route 55 would need to be re-routed with the vehicular closure of Sunnyvale Avenue. The route would need to be shifted to Mathilda Avenue or Fair Oaks Avenue; thereby requiring a longer route to access the Sunnyvale Station and no longer serving Sunnyvale Avenue between California Avenue and Evelyn Avenue. As both Mathilda Avenue and Fair Oaks Avenue are more congested roadways, travel time on Route 55 may increase as well. No other bus routes included in the Next Network plan would be affected by the vehicular closure of Sunnyvale Avenue.

Summary

Both the Bicycle/Pedestrian Undercrossing and Underpass Tunnel Alternatives will provide substantial safety improvements to pedestrians as pedestrian-train conflicts will be removed. The path of travel for pedestrians traveling on Sunnyvale Avenue is slightly longer in the Underpass Tunnel Alternative due to the switchback ramping on both sides of the rail tracks that is lessened on the Evelyn Avenue side in the Bicycle/Pedestrian Undercrossing Alternative. Cyclists in both alternatives will also benefit from having grade separated crossings from the rail tracks. The Underpass Tunnel Alternative will require cyclists to use pedestrian ramps based on their destinations whereas they will have access to both Hendy and Evelyn Avenue via the pedestrian/bike path in the Bicycle/Pedestrian Undercrossing Alternative. Both alternatives will impact VTA transit Route 55 and require it to be rerouted to continue serving the Sunnyvale Station; however, the detour associated with the Bicycle/Pedestrian Undercrossing Alternative is longer.

SUMMARY AND FINDINGS

This section provides findings based on the analysis summarized herein for all of the grade separation alternatives considered.

Mary Avenue

Three alternatives were evaluated for the grade separation at Mary Avenue.

The Underpass Tunnel Alternative proposed depressing both Mary Avenue and Evelyn Avenue beneath the tracks, replicating the existing intersection at a lower grade, eliminating the rail conflict.

The Underpass Tunnel with Jughandle Alternative proposes the depression of Mary Avenue under Evelyn Avenue and the railroad tracks, eliminating the rail conflict and existing connection with Evelyn Avenue. To accommodate existing turning movements at the Mary Avenue/Evelyn Avenue intersection, a jughandle is proposed on the southeast side of the existing intersection. The initially-proposed four-lane jughandle was not sufficient to handle projected traffic volumes. Therefore, a modified 5-lane jughandle was analyzed and documented in this report.

The Underpass Tunnel with Jughandle and Connector Ramps Alternative proposes the depression of Mary Avenue under Evelyn Avenue and the railroad tracks, a jughandle on the southeast side of the existing intersection, and connector ramps for the westbound to northbound and southbound to westbound movements between Mary Avenue and Evelyn Avenue. The rail conflict is still eliminated, as is the connection with eastbound Evelyn Avenue.

Mary Avenue is heavily saturated with traffic in the No-Build scenario. While the three Build alternatives eliminate the rail crossing conflict, as they are focused on the Mary Avenue/Evelyn Avenue intersection, they do not address overall capacity constraints on the corridor. Therefore, while the Build alternatives substantially reduce delay for most movements through the Mary Avenue/Evelyn Avenue area, movements with deficient levels of delay still persist.

The analysis finds that all three Build alternatives provide substantial delay and queuing benefits to traffic movements on Evelyn Avenue and Mary Avenue relative to No-Build conditions. By distributing vehicle conflicts amongst two intersections and providing direct ramps for two movements, the Underpass Tunnel with Jughandle and Connector Ramps Alternative achieves the greatest reduction in the amount of delay along both the Mary Avenue and Evelyn Avenue corridors, improving overall traffic flow and reducing travel time on both streets relative to the No-Build and the Underpass Tunnel Alternative. The Underpass Tunnel with Jughandle and Connector Ramps Alternative provides the greatest delay reduction for most intersection movements. All of the Build alternatives provide substantial queuing benefits relative to the No-Build, with the Underpass Tunnel with Jughandle and Connector Ramps Alternative achieving the greatest queue length reductions for most movements.

All grade-separation alternatives of the Mary Avenue at-grade crossing substantially improve safety for pedestrians and bicyclists by eliminating conflicts with trains and the tripping/falling hazard of crossing the rail tracks themselves. With the two Underpass Tunnel with Jughandle Alternatives, most pedestrians and bicyclists through the intersection would experience some out-of-direction travel and would be required to ascend/descend moderate grades. Most pedestrian and bicycle movements would see shorter crossings. With the Underpass with Jughandle and Connector Ramps Alternative, the number of conflict points would increase for several bicycle and pedestrian movements. Most notably would be the additional conflicts across the westbound bicycle lane on Evelyn Avenue for vehicles accessing and merging from the connector ramps. However, that additional conflict would be eliminated if the City's current planning efforts for a multi-use path along the north side of Evelyn Avenue comes to fruition. In addition, with the Underpass Tunnel with Jughandle and Connector Ramps Alternative, one new uncontrolled vehicle conflict with bicycles and pedestrian arises where the southbound to westbound connector ramp is accessed from Mary Avenue. With the Underpass Tunnel Alternative, all pedestrians and bicyclists would have to ascend/descend moderate grades but would not be subject to out-of-direction travel. There would be no reduction in the number of conflicts or the length of crossings in the Underpass Tunnel Alternative relative to the No-Build.

A modified configuration of the Mary Avenue Underpass Tunnel with Jughandle and Connector Ramps Alternative was developed that leverages the additional connector ramps to reduce turn lane and roadway geometrics for movements that would see reduced traffic volumes as a result of the connector ramps. That configuration is shown in Attachment G. Modifications include: converting the

jughandle northbound shared left/right-turn lane to a right-turn only lane, allowing for a reduction of westbound Evelyn Avenue from two lanes to one lane over Mary Avenue; reducing the southbound left-turn from Mary Avenue to the jughandle from two lanes to one; and reducing the overall width of the jughandle from five lanes to four. This geometry was not modeled for the traffic analysis and no quantitative information is available on how it would perform. Qualitatively, it is expected that this alternative will still provide significant benefits to the No-Build condition, in a manner similar to the Underpass Tunnel with Jughandle and Connector Ramps Alternative described in more detail in this document. Should the reduced right-of-way impacts of this modified alternative warrant further consideration of the Underpass Tunnel with Jughandle and Connector Ramps Alternative, then it is recommended to model this reduced geometry option.

Sunnyvale Avenue

Two alternatives were evaluated for the grade separation at Sunnyvale Avenue. Due to the preservation of through movements on Sunnyvale Avenue with the Underpass Tunnel Alternative, it requires less detour traffic to Mathilda Avenue and Fair Oaks Avenue and thus performs generally better than the Bicycle/Pedestrian Undercrossing Alternative in terms of vehicular corridor travel time on study area roadways and overall network delay. The Underpass Tunnel Alternative results in a large decrease in corridor travel time on Sunnyvale Avenue relative to No-Build.

The Underpass Tunnel Alternative results in less vehicular detour and thus relatively better performance along Mathilda Avenue and Fair Oaks Avenue than the Bicycle/Pedestrian Undercrossing Alternatives but does increase turning activity at a number of intersections in the immediate vicinity of the grade crossing, resulting in a number of intersections experiencing increased delay. However, of the two Build alternatives, the Bicycle/Pedestrian Undercrossing Alternative detours a greater volume of vehicles to Mathilda Avenue and Fair Oaks Avenue, resulting in less delay at the intersections immediately around the existing grade crossing, but three intersections along Fair Oaks Avenue become deficient or are already deficient and experience greater delay. In addition, the peak direction travel time along those detour roadways more substantially increases with the Bicycle/Pedestrian Undercrossing Alternative. Considered together, the metrics indicate that the congestion effects associated with the Bicycle/Pedestrian Undercrossing Alternative are moderately greater than with the Underpass Tunnel Alternative.

Both alternatives provide accommodations for pedestrians and bicyclists, although the Bicycle/Pedestrian Undercrossing Alternative provides a much higher-quality facility across the rail tracks since it would be a dedicated bicycle/pedestrian undercrossing. It also results in less out-of-direction travel for both cyclists and pedestrians by allowing for more direct ramping. However, the Bicycle/Pedestrian Undercrossing Alternative would require a much longer detour for VTA Route 55 than the Underpass Tunnel Alternative due to the vehicular closure of Sunnyvale Avenue. Therefore, while the Underpass Tunnel Alternative is generally superior from a traffic circulation and transit routing standpoint, it does have trade-offs for cyclists and pedestrians.

Attachments:

Attachment A: Mary Avenue Grade Separation 2035 No-Build Intersection Volumes

Attachment B: Mary Avenue Underpass Tunnel with Jughandle Alternative and Mary Avenue Underpass Tunnel with Jughandle and Connector Ramps Alternative 2035 Build Intersection Volumes

Attachment C: Sunnyvale Avenue Grade Separation 2035 No-Build Intersection Volumes

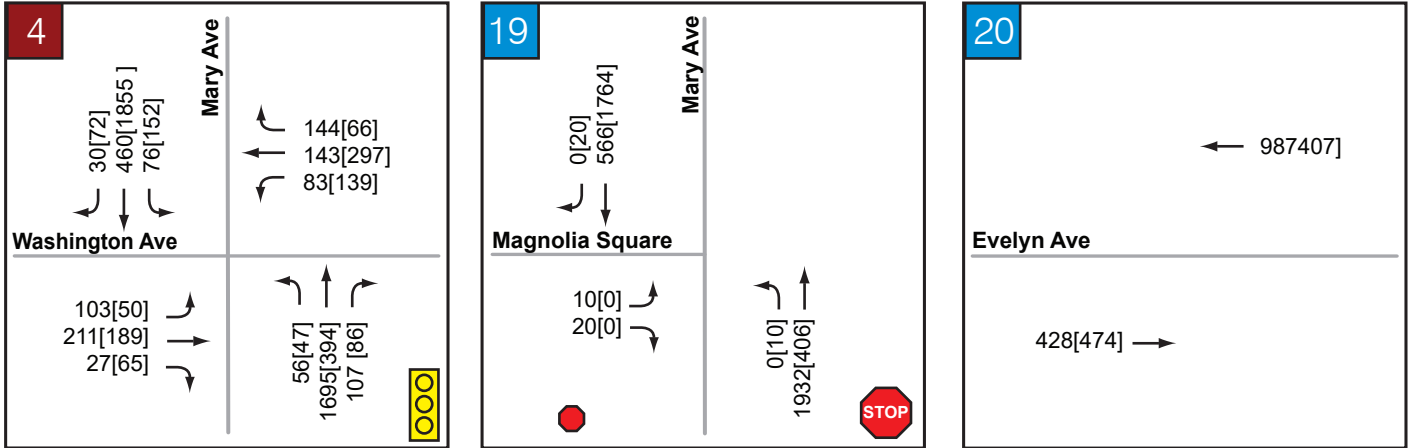
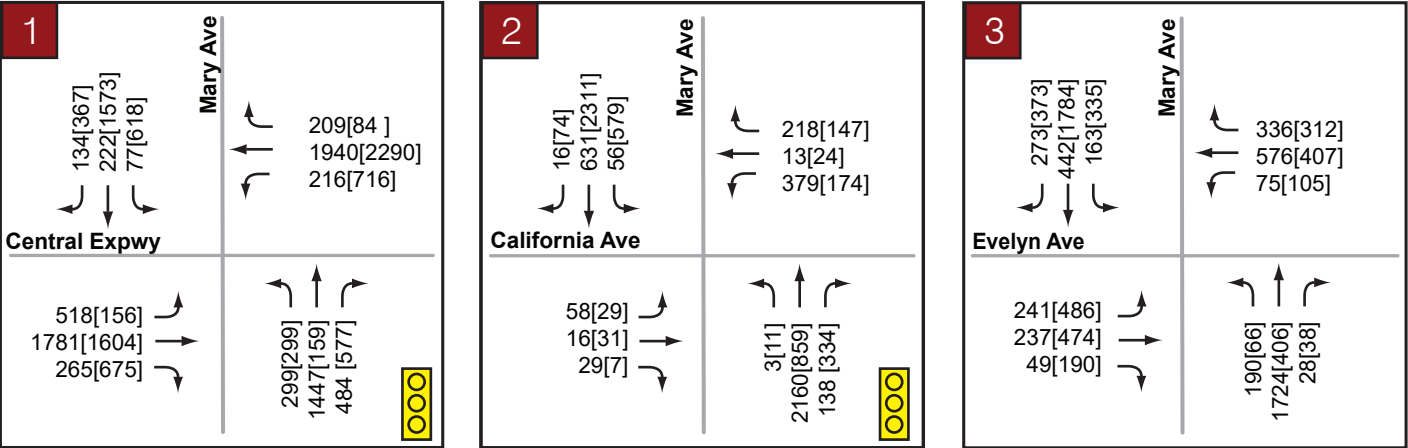
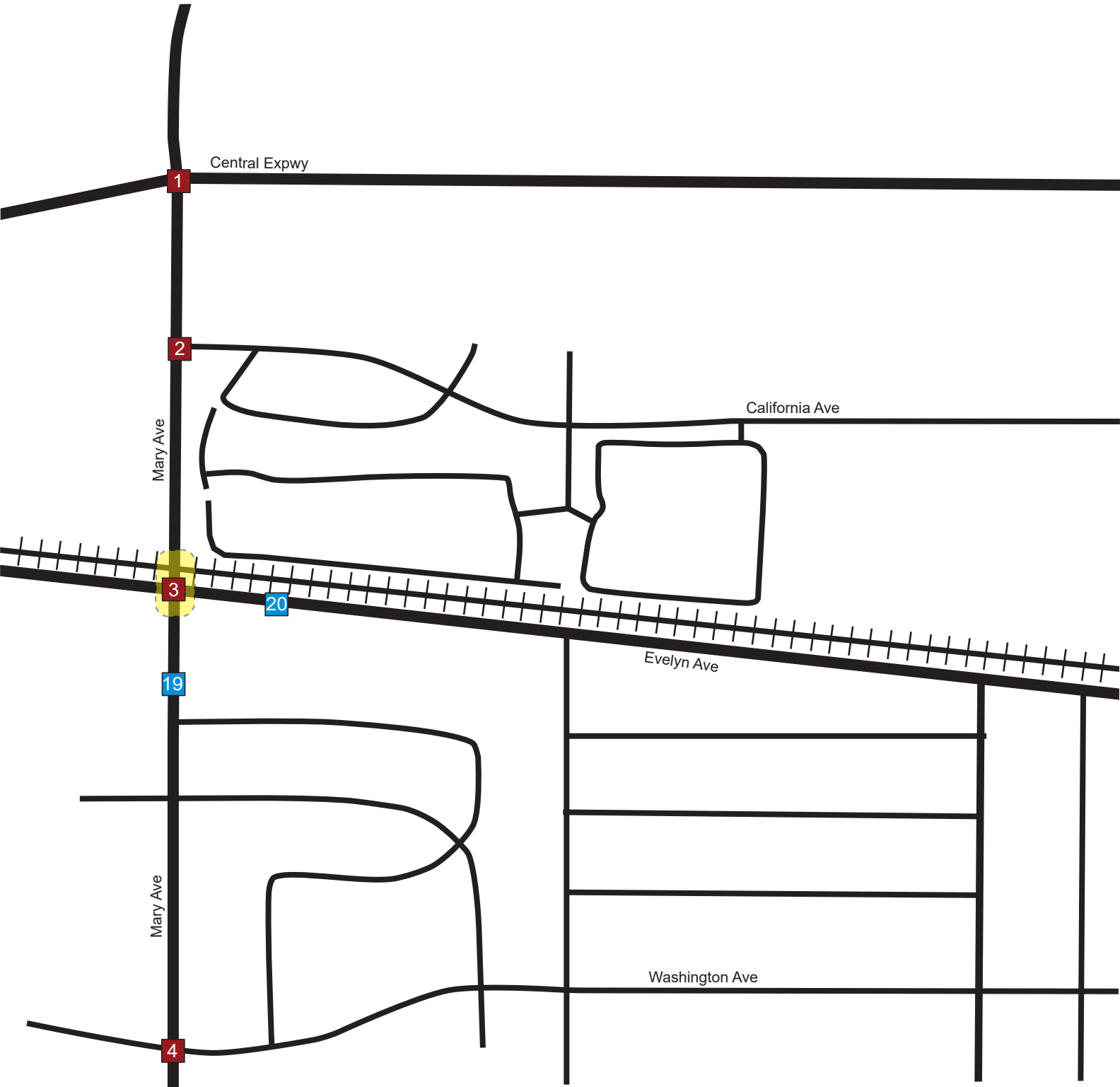
Attachment D: Sunnyvale Avenue Underpass Tunnel Alternative Change in Volumes and Build Intersection Volumes

Attachment E: Sunnyvale Avenue Bicycle/Pedestrian Undercrossing Alternative Change in Volumes and Build Intersection Volumes

Attachment F: Sunnyvale Avenue 2035 No-Build and Build Intersection Operations Results

Attachment G: Modified Mary Avenue Underpass Tunnel with Jughandle and Connector Ramps – Reduced Geometry Option

Sunnyvale Caltrain Grade Separations Feasibility Study



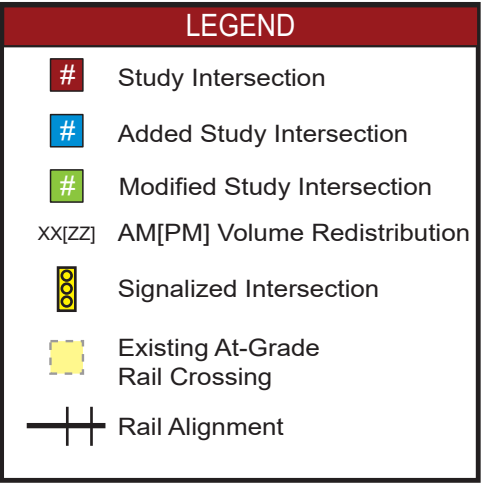
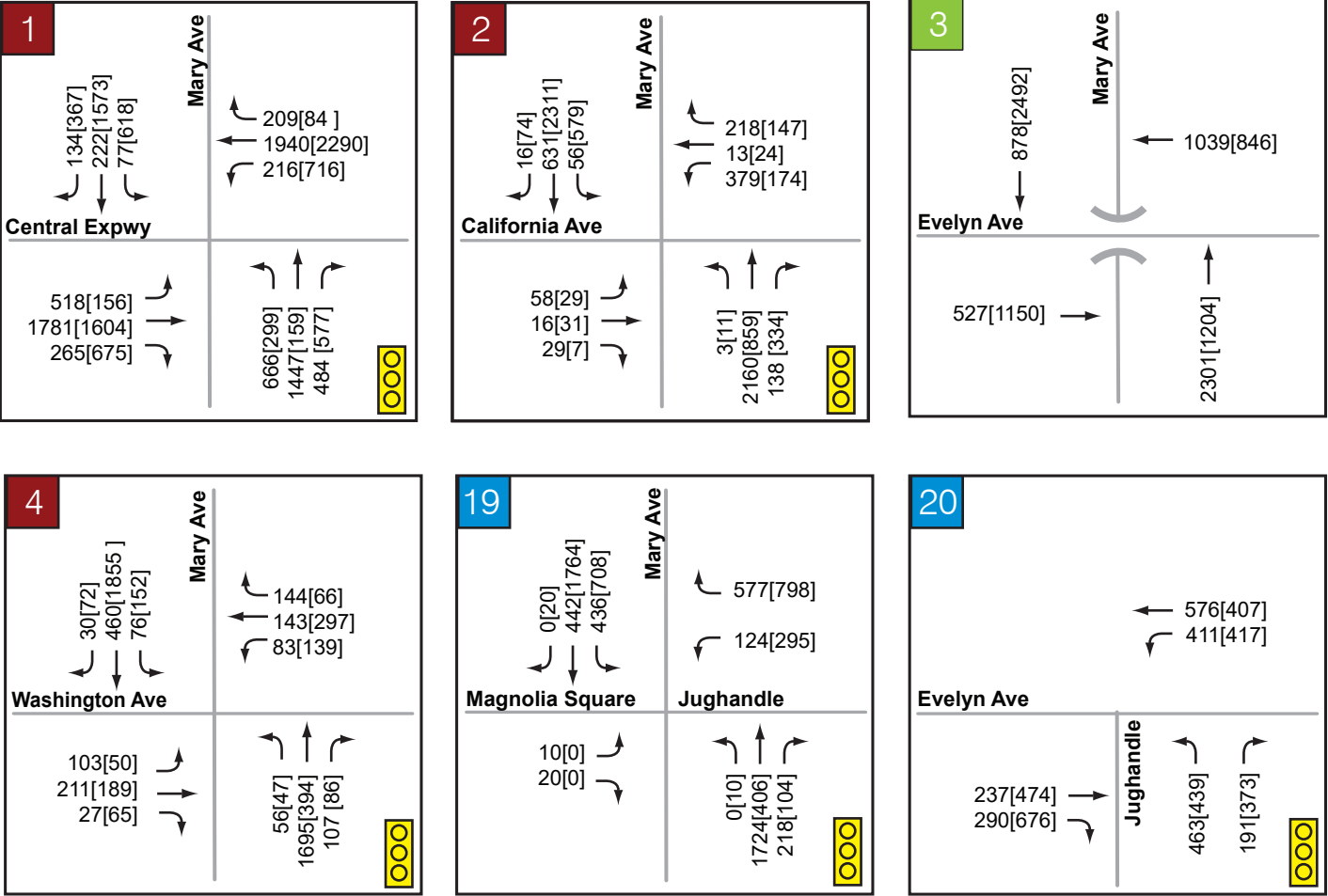
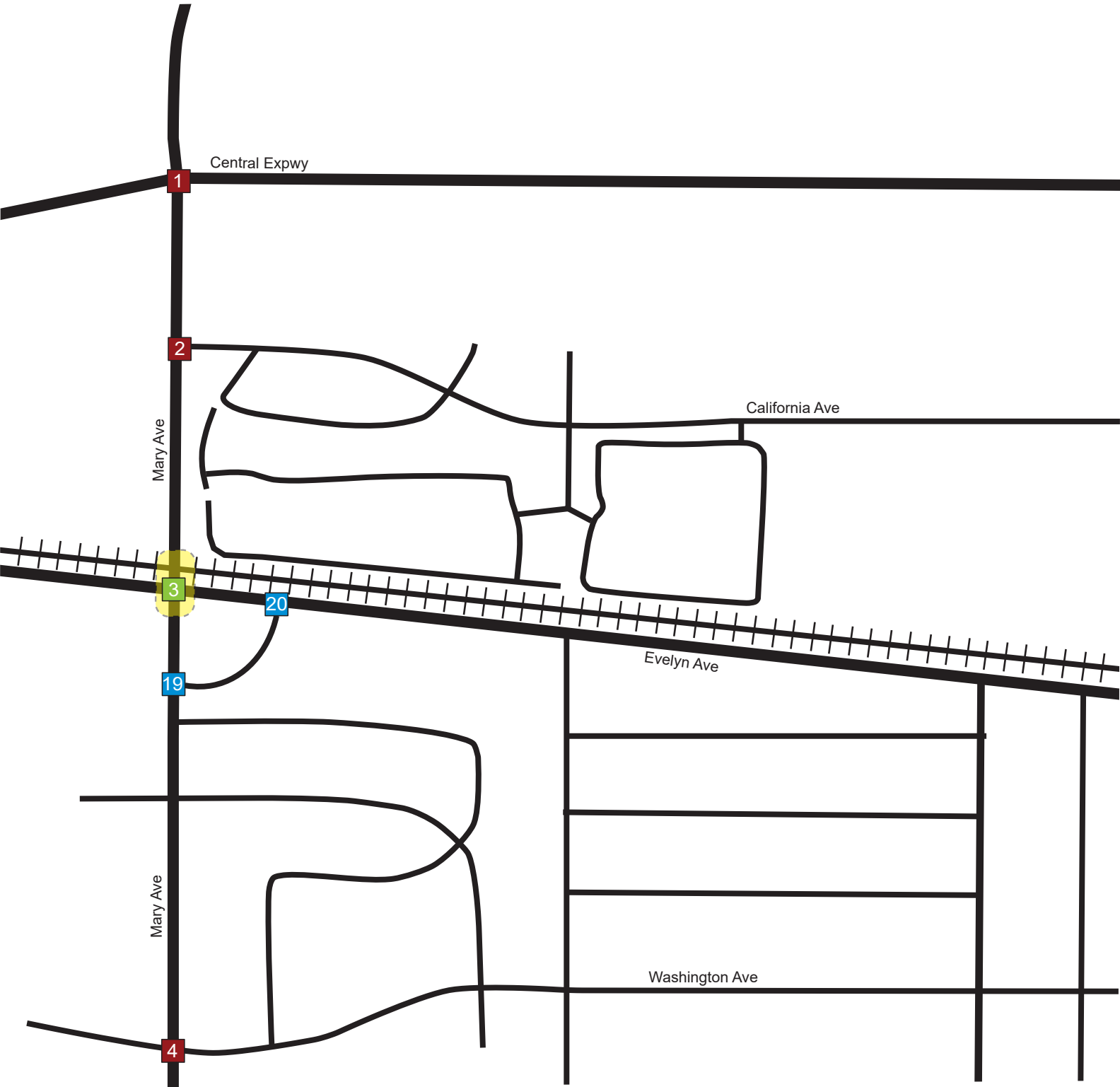
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LEGEND

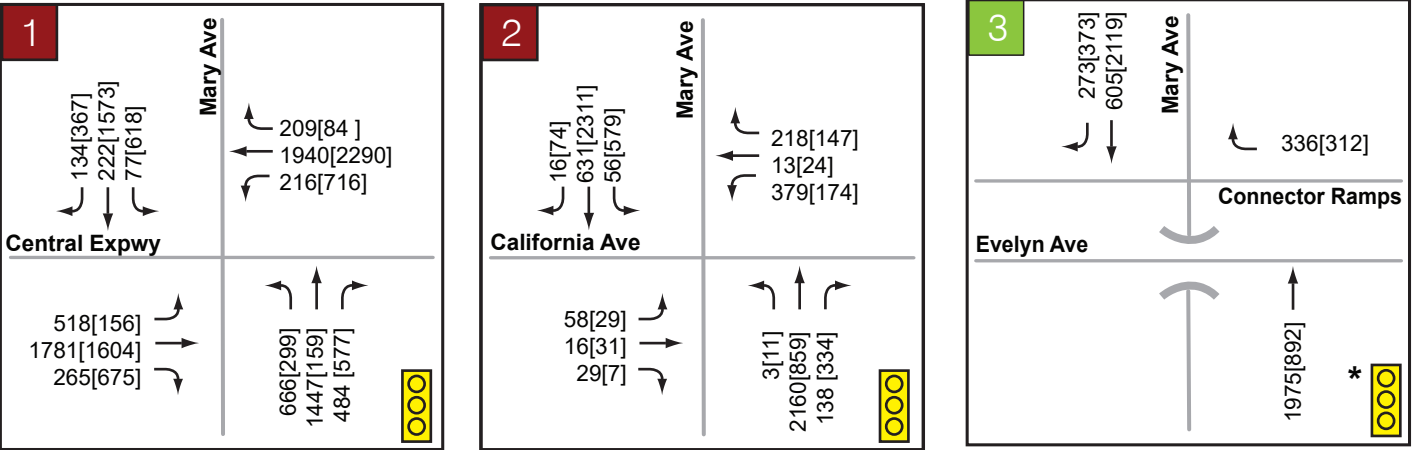
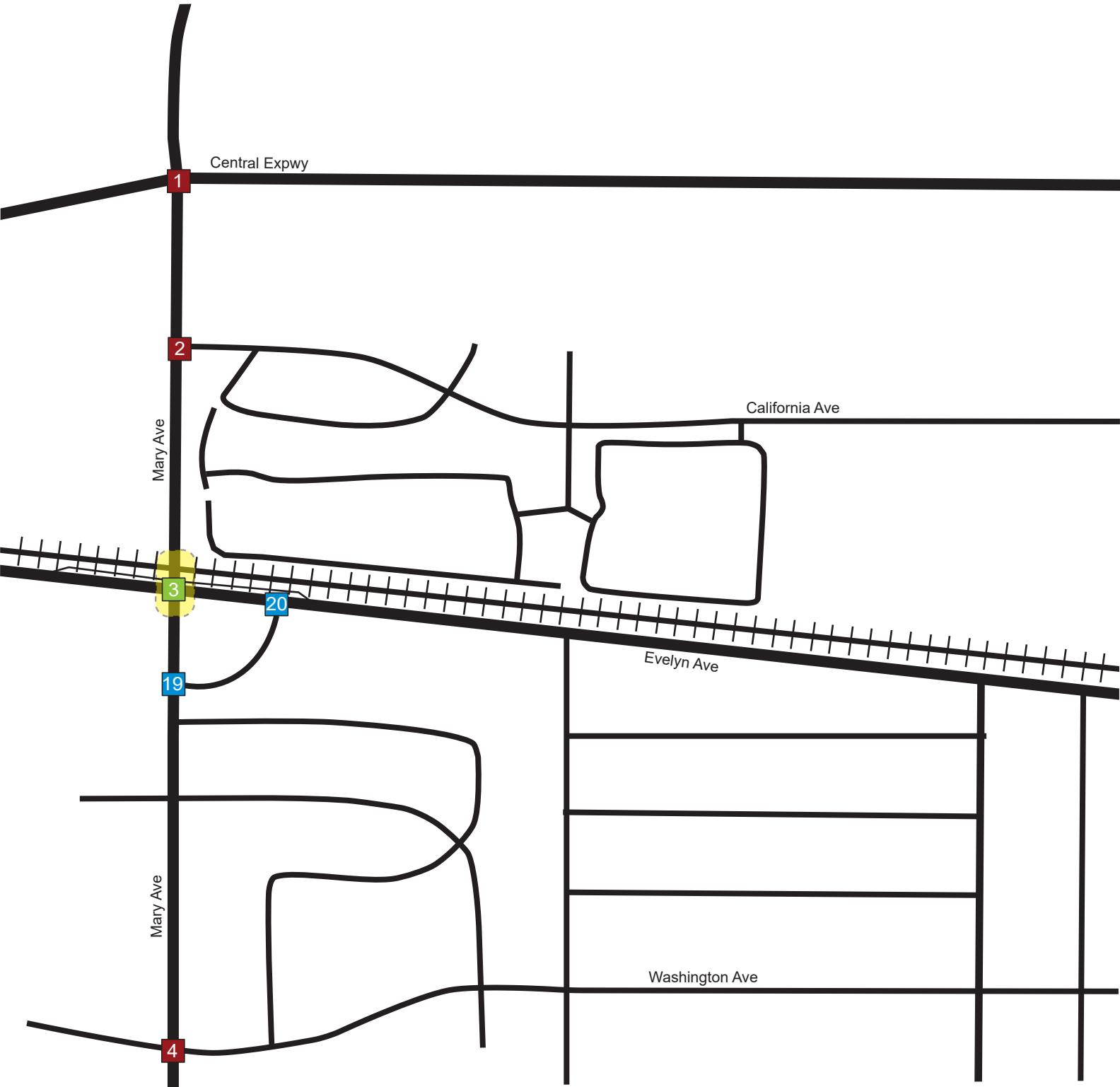
- # Study Intersection
- # Added Study Intersection
- xx[zz] AM[PM] Volume Redistribution
- STOP Stop Controlled Intersection
- Signalized Intersection
- Existing At-Grade Rail Crossing
- ++ Rail Alignment

Volumes into and out of Magnolia Square are estimated.

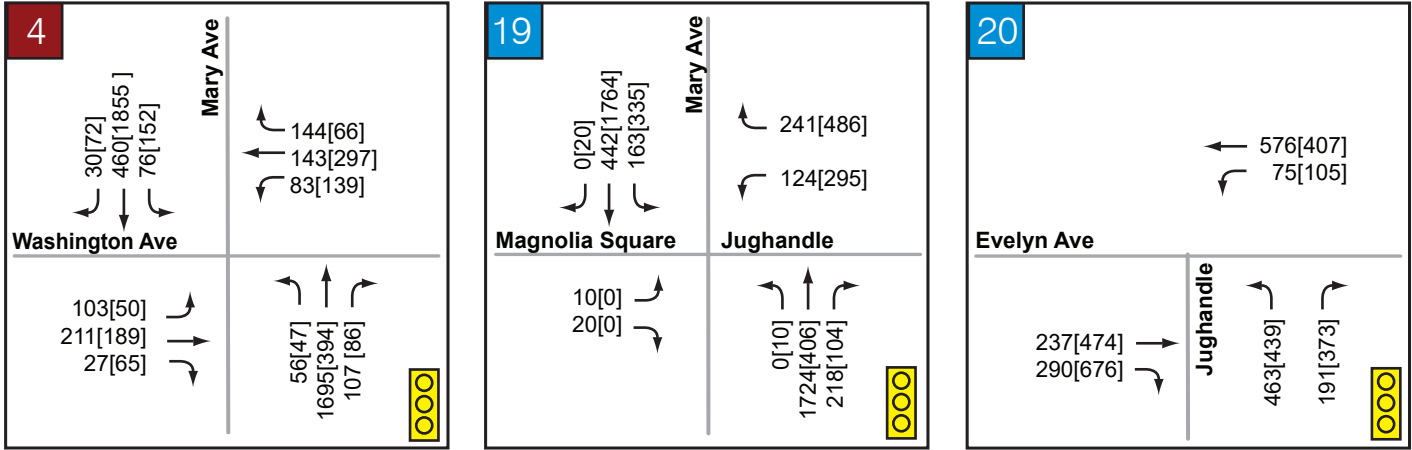
Sunnyvale Caltrain Grade Separations Feasibility Study



Sunnyvale Caltrain Grade Separations Feasibility Study



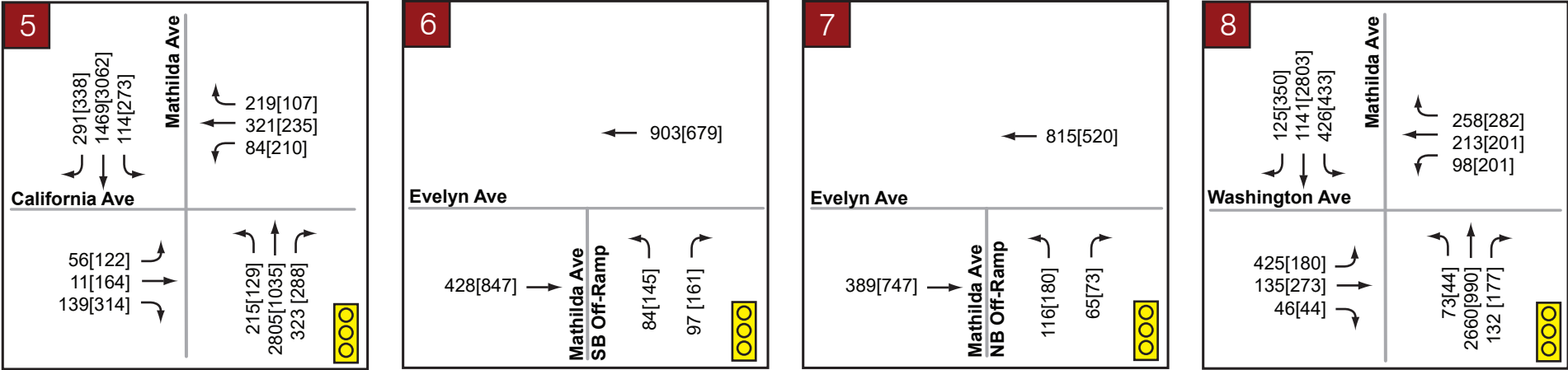
* Only NB Mary Ave and WB Connector Ramp movements are signalized



LEGEND

- # Study Intersection
- # Added Study Intersection
- # Modified Study Intersection
- xx[zz] AM[PM] Volume Redistribution
- Signalized Intersection
- Existing At-Grade Rail Crossing
- Rail Alignment

Sunnyvale Caltrain Grade Separations Feasibility Study



LEGEND

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Study Intersection

xx[zz]

AM[PM] Volume Redistribution

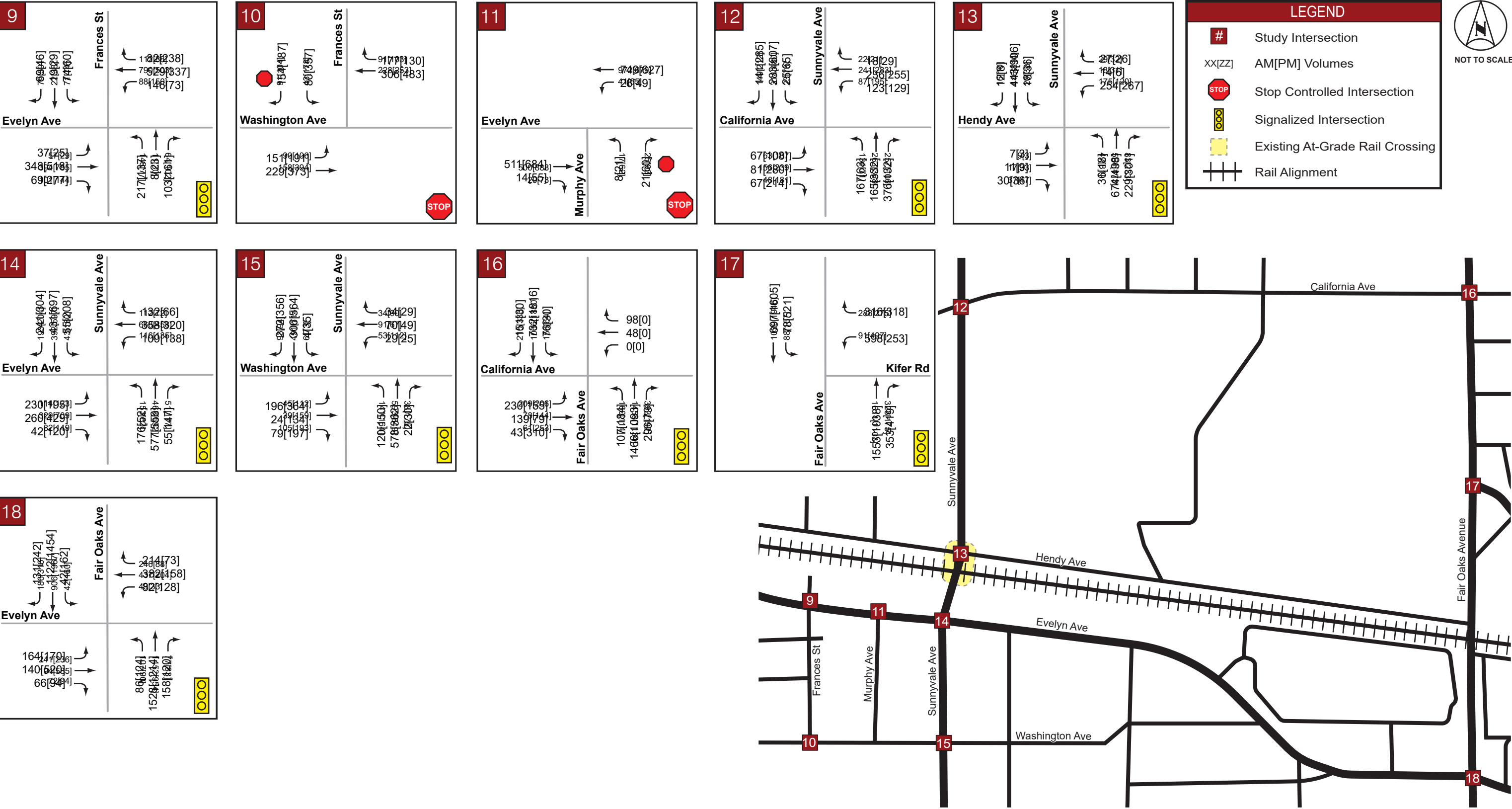
Signalized Intersection

Existing At-Grade
Rail Crossing

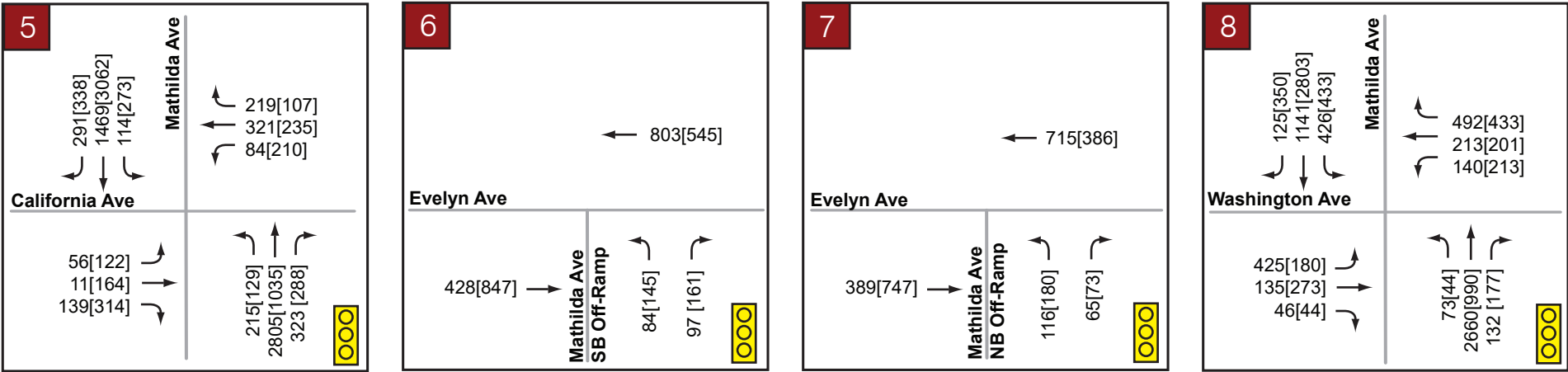
Rail Alignment



Sunnyvale Caltrain Grade Separations Feasibility Study



Sunnyvale Caltrain Grade Separations Feasibility Study



LEGEND

Study Intersection

xx[zz] AM[PM] Volume Redistribution

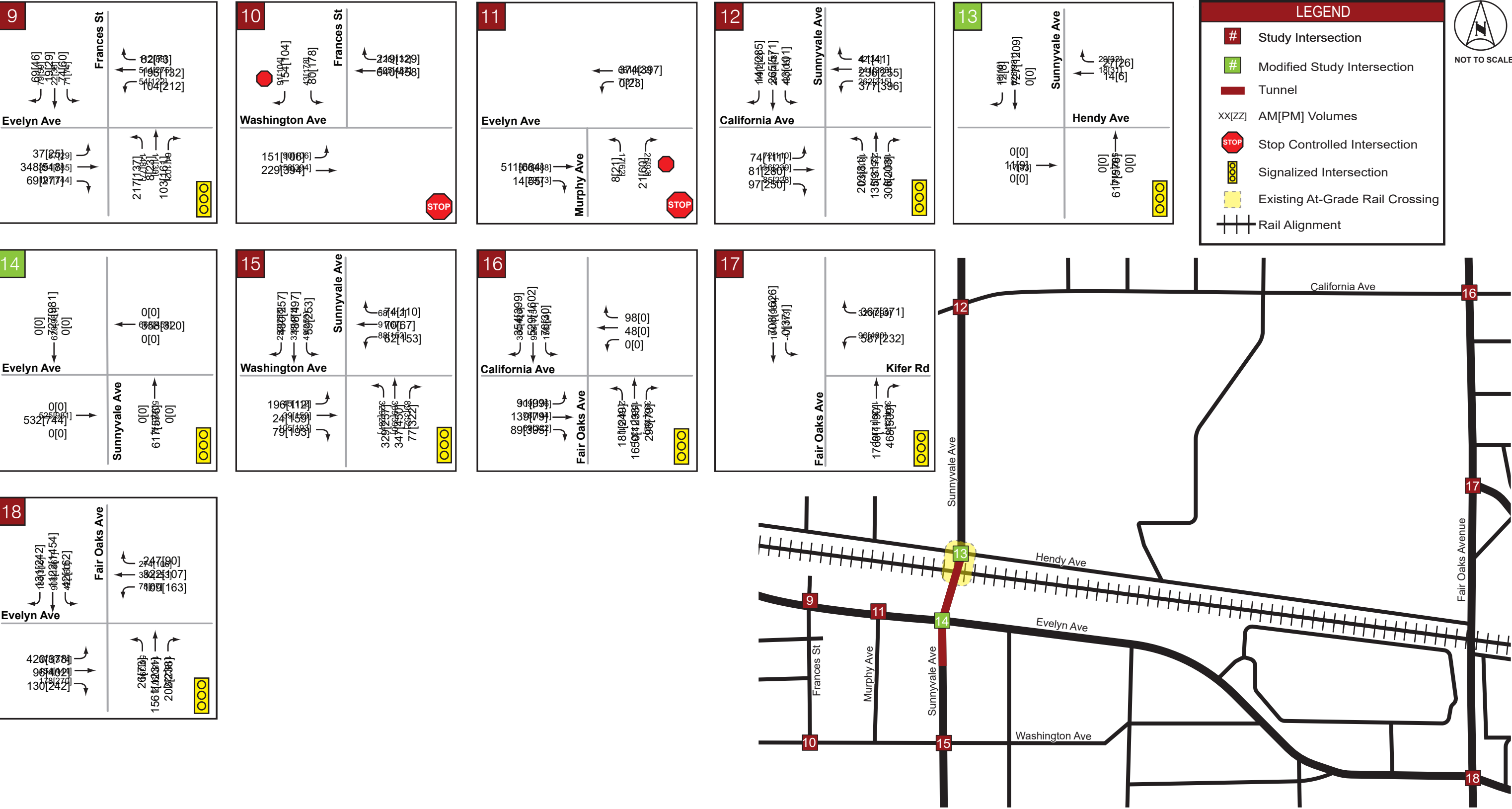
Signalized Intersection

Rail Alignment

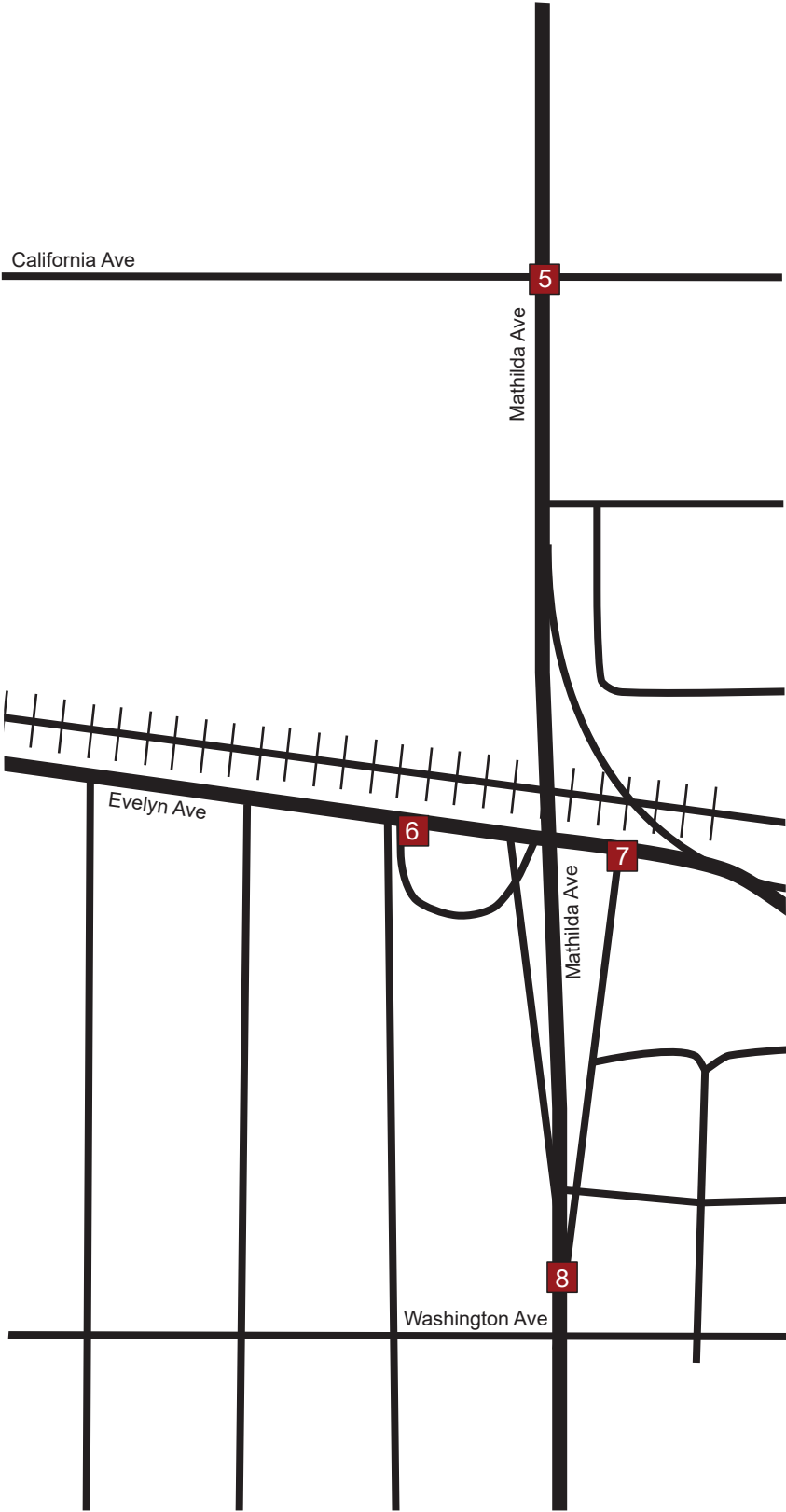
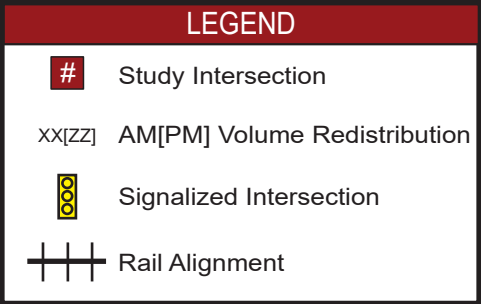
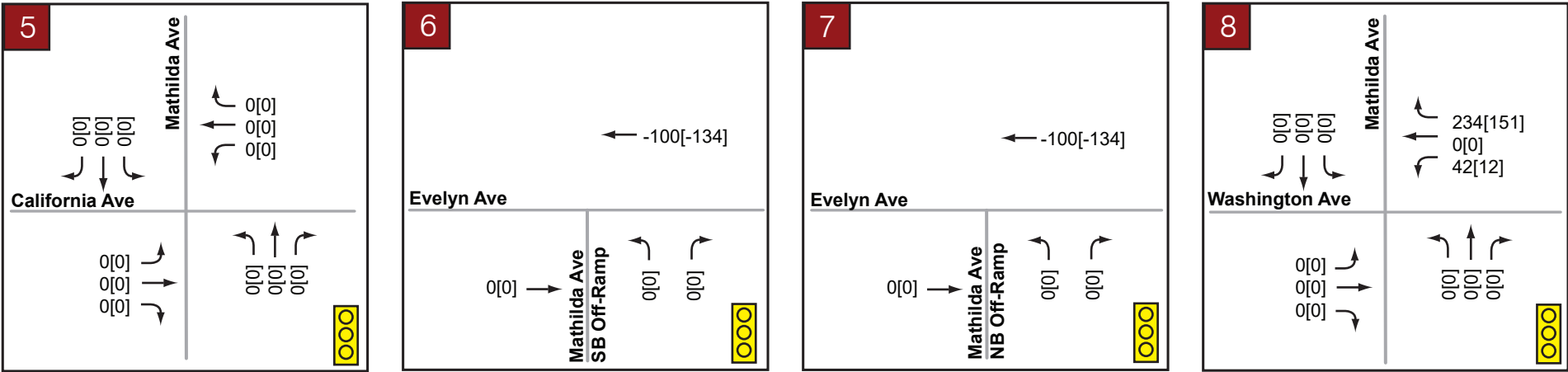
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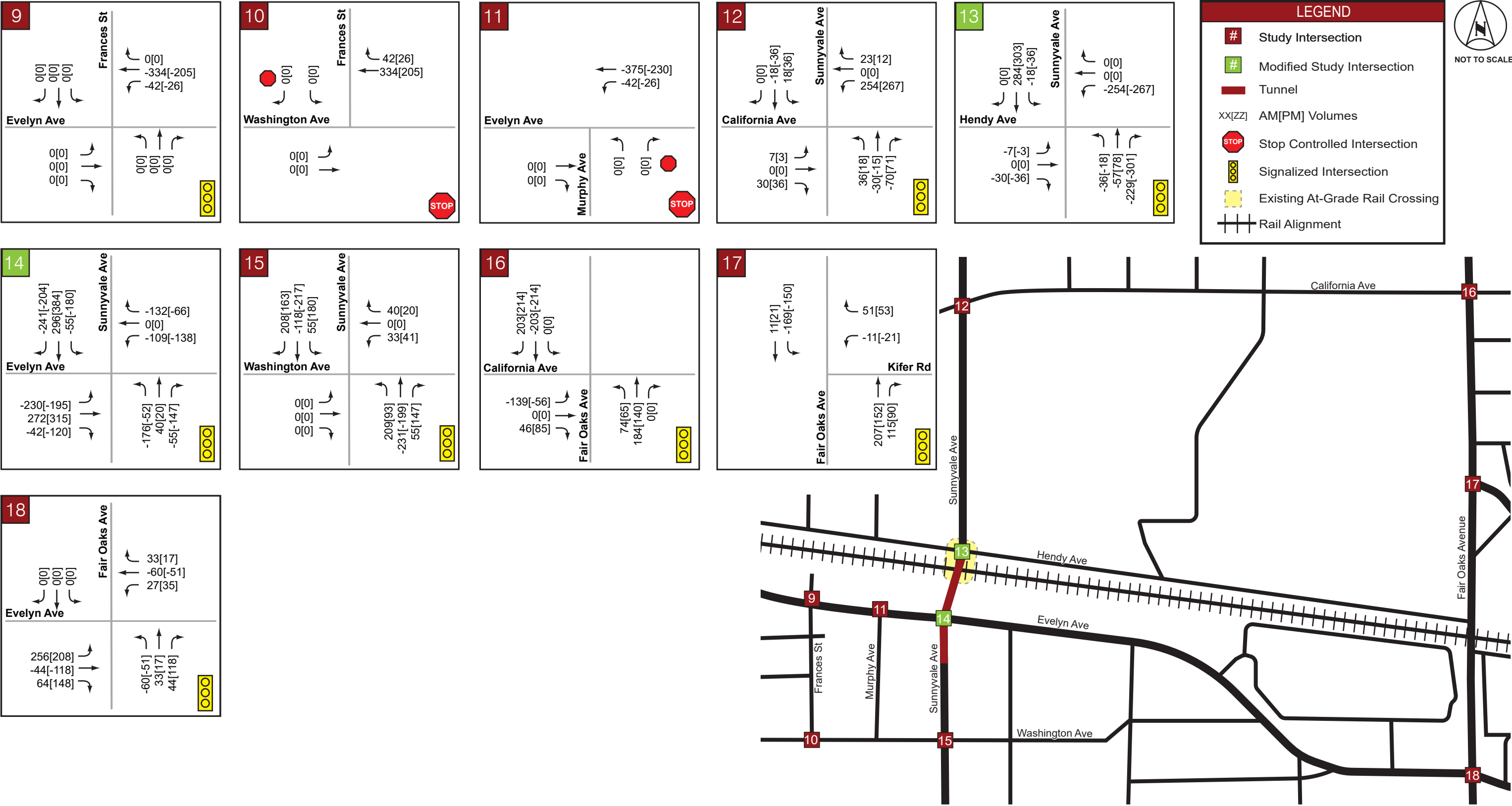
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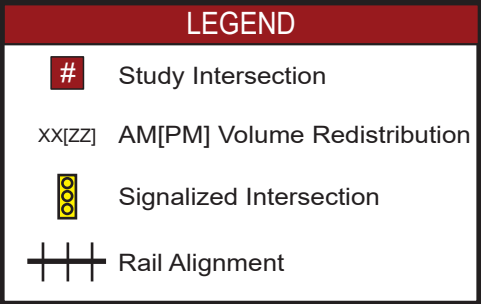
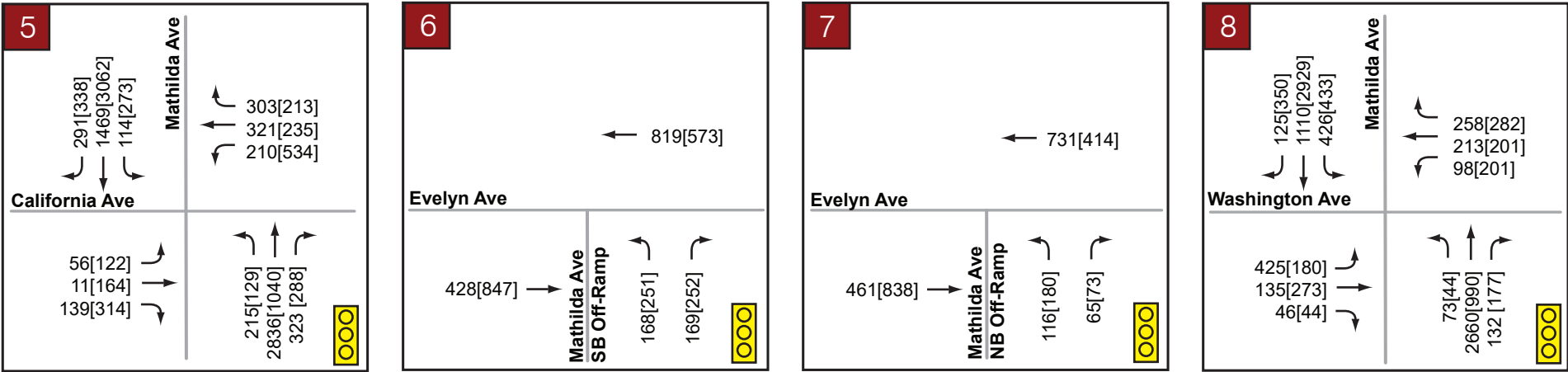
Sunnyvale Caltrain Grade Separations Feasibility Study



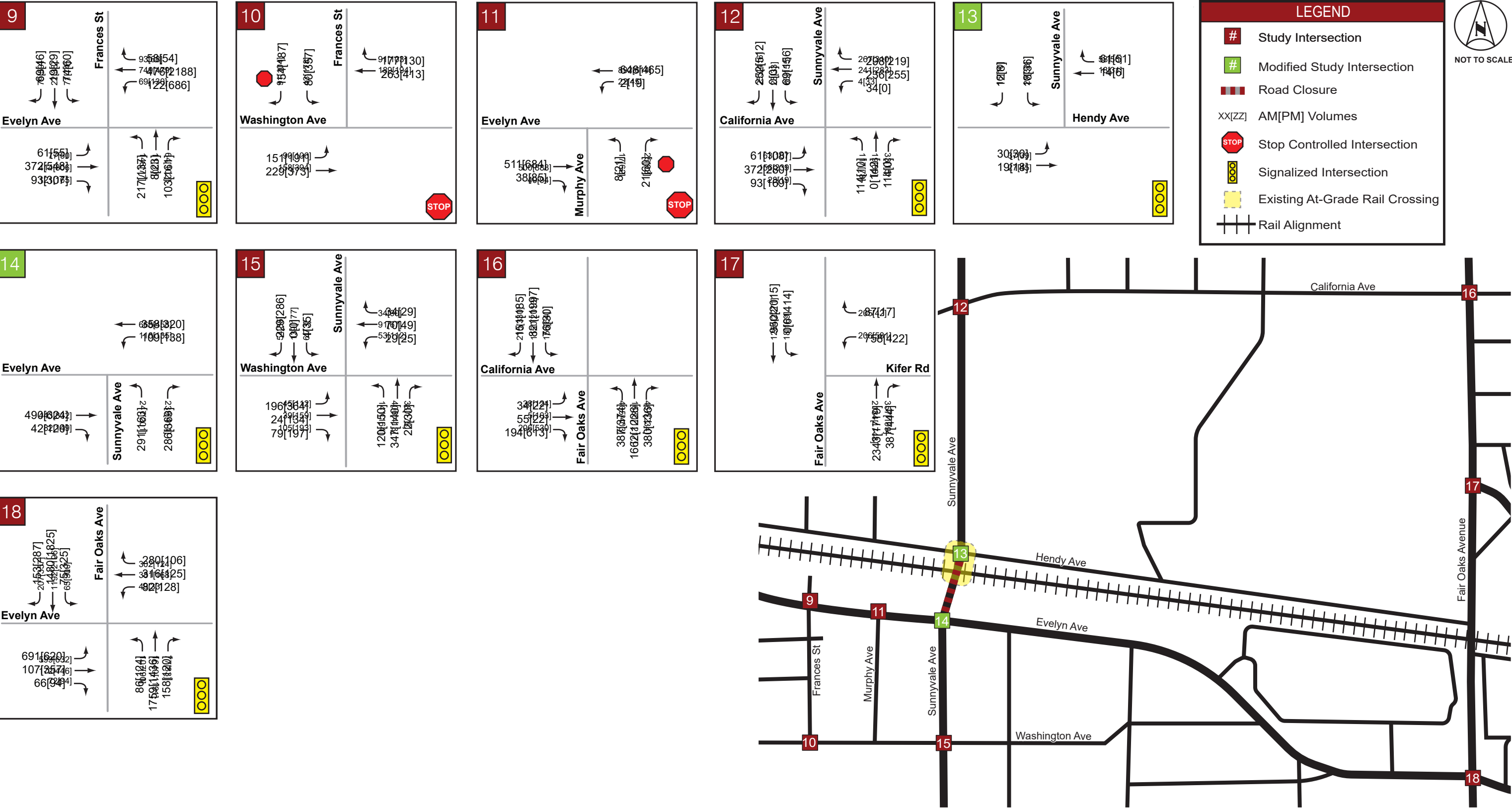
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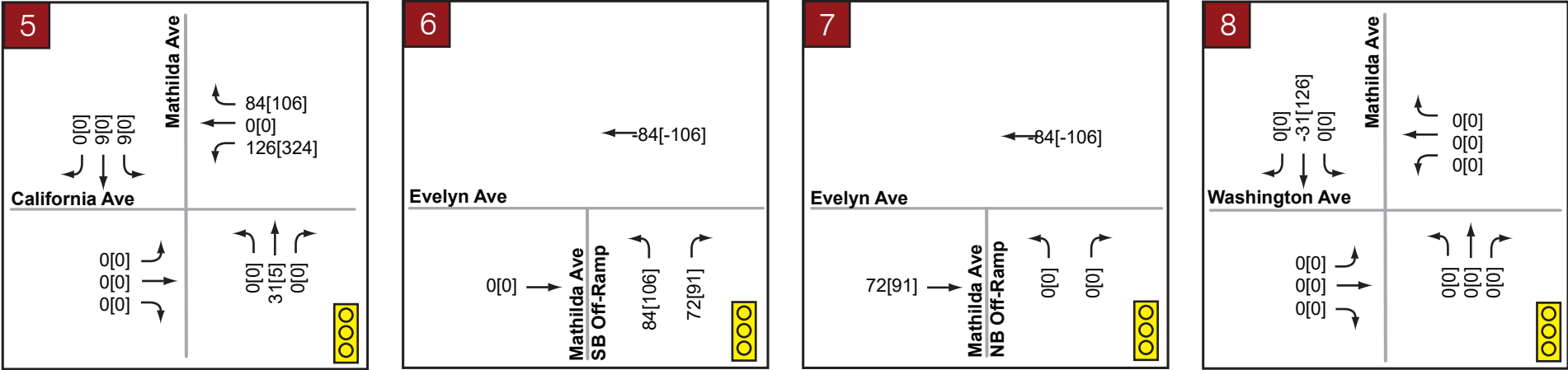
Sunnyvale Caltrain Grade Separations Feasibility Study



Sunnyvale Caltrain Grade Separations Feasibility Study



Sunnyvale Caltrain Grade Separations Feasibility Study



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Study Intersection

xx[zz]

AM[PM] Volume Redistribution

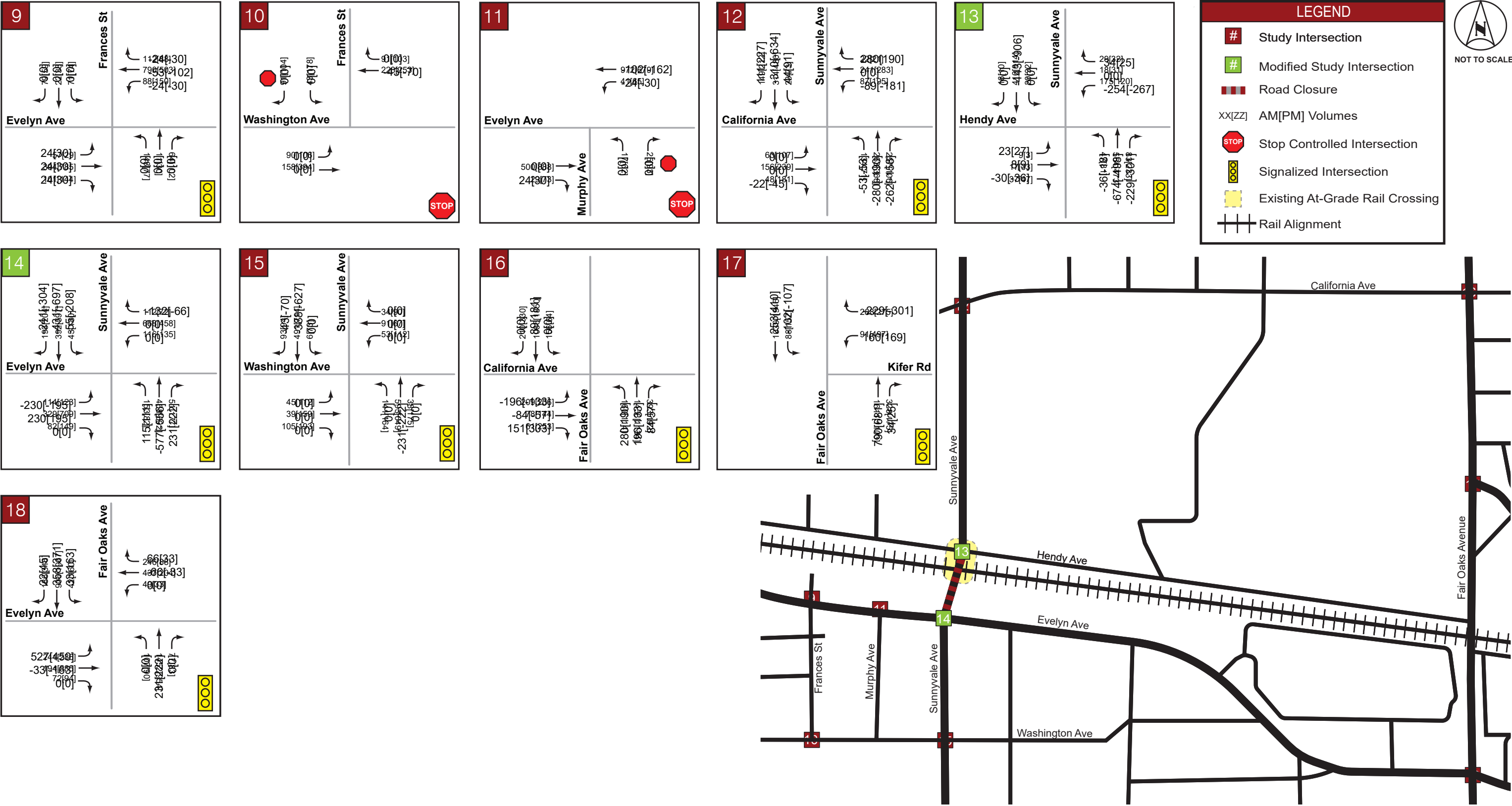
Signalized Intersection

Rail Alignment

NOT TO SCALE



Sunnyvale Caltrain Grade Separations Feasibility Study



Sunnyvale Caltrain Grade Separations Feasibility Study

Mathilda Ave / California Ave				
5	AM Peak		PM Peak	
	Scenarios	LOS	Delay (sec)	Delay (sec)
	No-Build	F	201.3	F 271.8
	Tunnel	F	99.8	F 263.1
Bike/Ped UC				
	F	123.8	F	273.0

Mathilda Ave SB Off Ramp / Evelyn Ave				
6	AM Peak		PM Peak	
	Scenarios	LOS	Delay (sec)	Delay (sec)
	No-Build	F	446.2	F 158.2
	Tunnel	B	14.1	B 14.5
Bike/Ped UC				
	C	33.5	C	25.8

Mathilda Ave NB Off Ramp / Evelyn Ave				
7	AM Peak		PM Peak	
	Scenarios	LOS	Delay (sec)	Delay (sec)
	No-Build	F	270.9	F 119.9
	Tunnel	B	11.6	C 26.4
Bike/Ped UC				
	B	12.8	D	39.8

Mathilda Ave / Washington Ave				
8	AM Peak		PM Peak	
	Scenarios	LOS	Delay (sec)	Delay (sec)
	No-Build	F	270.2	E 71.4
	Tunnel	F	159.0	E 72.0
Bike/Ped UC				
	F	135.9	E	63.3

LEGEND

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Study Intersection

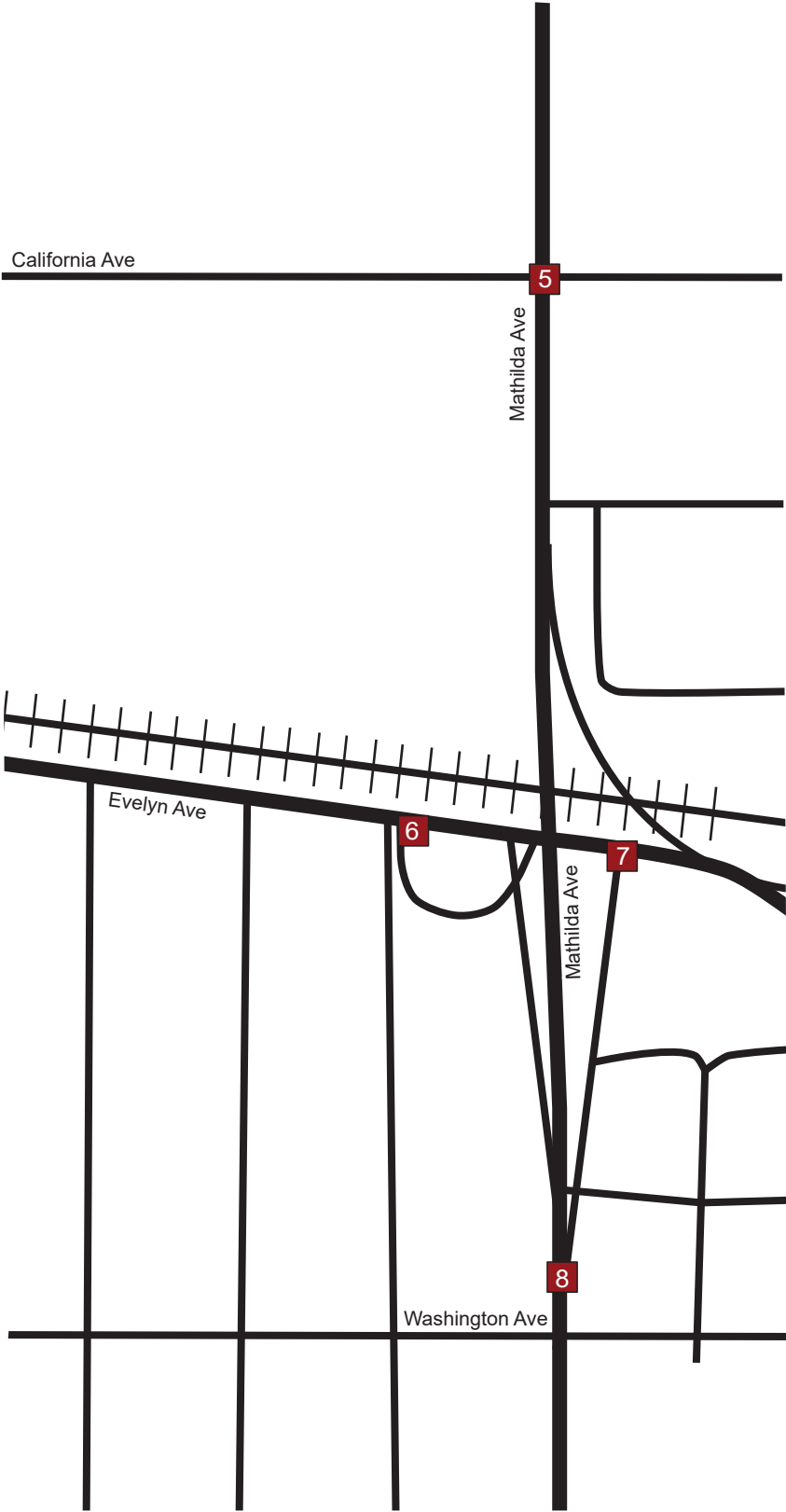
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Rail Alignment

NOT TO SCALE



Sunnyvale Caltrain Grade Separations Feasibility Study

Frances St - Sunnyvale
Station Access / Evelyn Ave

9

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	F	192.8	F	138.4
Tunnel	C	23.3	E	55.3
Bike/Ped UC	E	65.0	C	29.7

Washington Ave / Frances St

10

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	F	72.1	F	60.7
Tunnel	A	5.9	F	141.7
Bike/Ped UC	A	6.3	A	5.2

Murphy Ave / Evelyn Ave

11

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	F	51.6	E	46.4
Tunnel	C	18.0	B	10.1
Bike/Ped UC	E	37.2	B	12.3

Sunnyvale Ave / California Ave

12

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	D	46.7	F	155.9
Tunnel	F	124.6	F	182.4
Bike/Ped UC	C	34.0	F	97.4

Sunnyvale Ave / Hendy Ave

13

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	F	174.1	F	234.4
Tunnel	-	-	-	-
Bike/Ped UC	A	8.9	C	29.7

LEGEND

- # Study Intersection
- # Modified Study Intersection
- Roadway Modification (Sunnyvale Tunnel or Closure)
- Existing At-Grade Rail Crossing
- Rail Alignment



Sunnyvale Ave / Evelyn Ave

14

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	F	165.5	F	110.3
Tunnel	-	-	-	-
Bike/Ped UC	F	216.2	C	23.3

Sunnyvale Ave / Washington Ave

15

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	F	150.7	F	111.0
Tunnel	F	400.1	F	375.5
Bike/Ped UC	F	245.9	D	47.6

Fair Oaks Ave / California Ave

16

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	D	50.0	F	129.2
Tunnel	D	35.6	F	115.7
Bike/Ped UC	E	63.0	F	220.7

Fair Oaks Ave / Kifer Rd

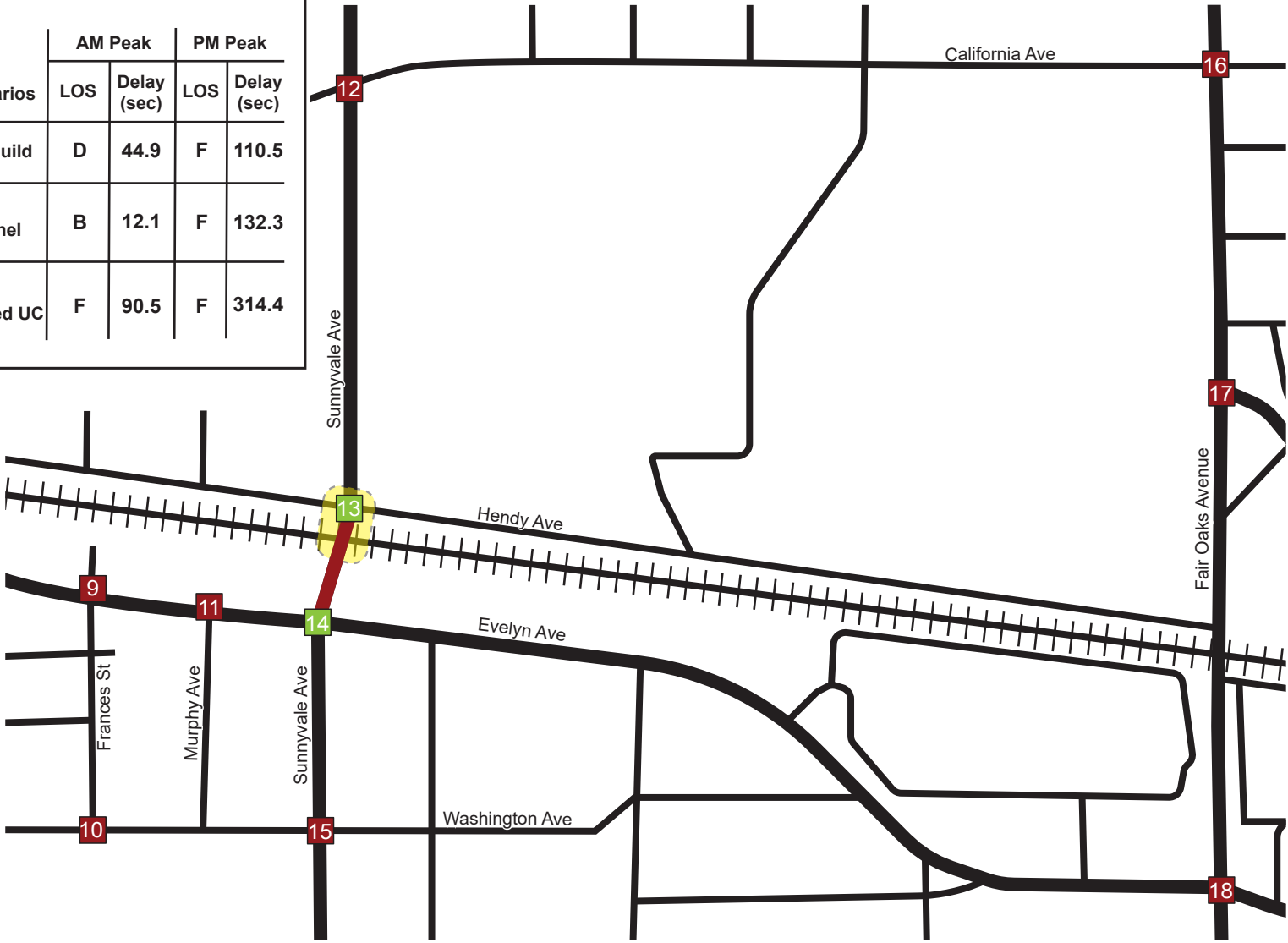
17

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	D	44.9	F	110.5
Tunnel	B	12.1	F	132.3
Bike/Ped UC	F	90.5	F	314.4

Fair Oaks Ave / Evelyn Ave

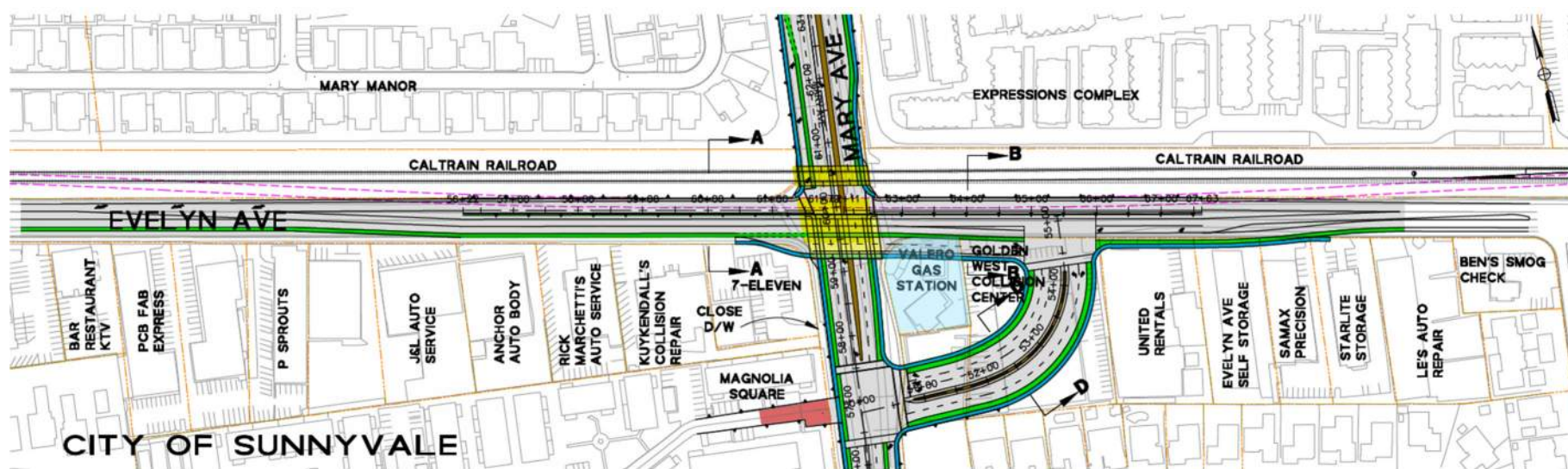
18

Scenarios	AM Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)
No-Build	E	74.8	F	82.5
Tunnel	F	95.6	F	110.7
Bike/Ped UC	F	139.9	F	231.4



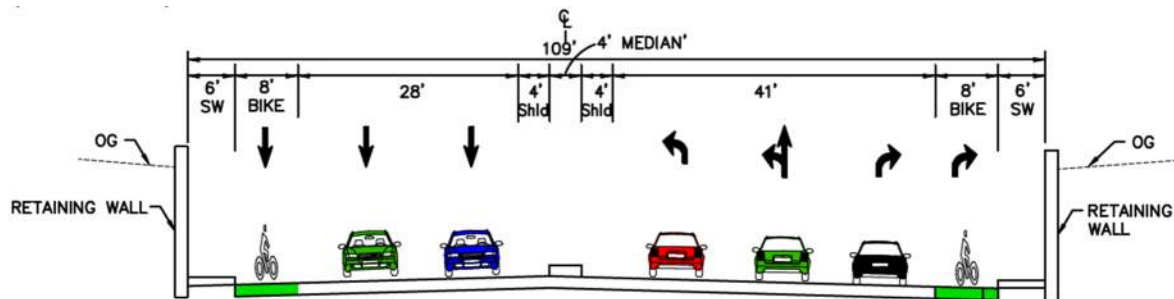
Attachment G

Mary Avenue Underpass with Jughandle and Connector Ramps Alternative – Reduced Geometry Option (Plan View)

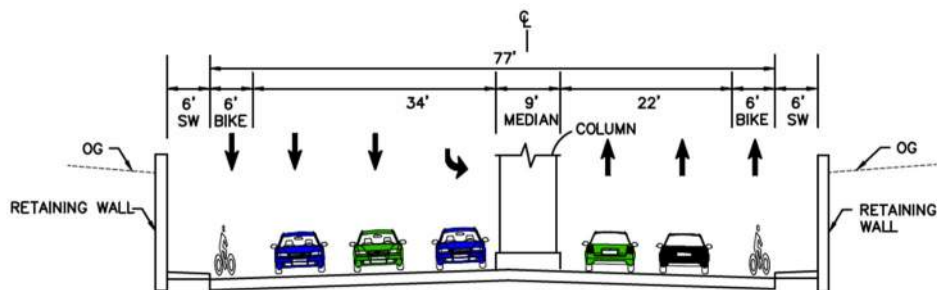


Mary Avenue Underpass with Jughandle and Connector Ramps Alternative Reduced Geometry Option

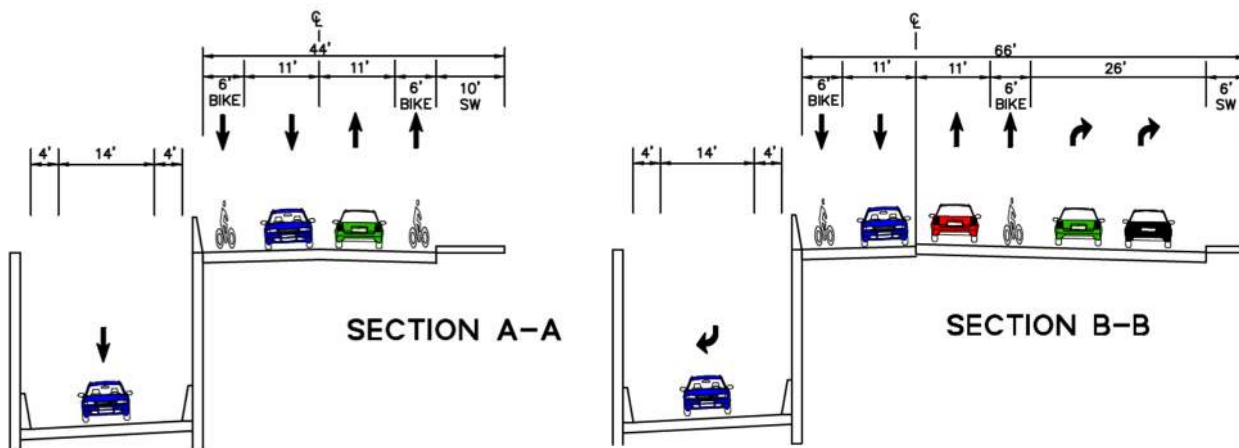
(Cross-Sections)



Jughandle Cross Section



Mary Avenue Cross Section north of Jughandle



Evelyn Avenue Cross Section east and west of Mary Avenue

Source: BKF Engineers, received June 28, 2022