

# Appendix B

## General Information

Due to file size, this appendix is separated into six PDFs:

PDF 1 of 6: Appendix A-1 thru A-2-1

PDF 2 of 6: Appendix A-2-2 (01-04)

PDF 3 of 6: Appendix A-2-2 (05-08)

PDF 4 of 6: Appendix A-3 thru A-6

PDF 5 of 6: Appendix B – General Information

PDF 6 of 6: Appendix C – XCAP

### Report of the Expanded Community Advisory Panel (XCAP) on Grade Separations for Palo Alto

**Completed on**

March 4, 2021

**Presented at**

City Council Meeting

March 23, 2021

By

Nadia Naik (Chair)

Larry Klein (Vice Chair)

Greg Brail

Phil Burton

Tony Carrasco

Inyoung Cho

Dave Shen

Keith Reckdahl

Cari Templeton

## Appendix B – General Information

### B-1. Community Generated Ideas as presented to XCAP

- A. Churchill Ave Partial Underpass Proposal - Michael Price
- B. South Palo Alto Tunnel Proposal - Roland LeBrun
- C. Viaduct with Roundabout at Embarcadero Proposal - Tony Carrasco
- D. Meadow-Charleston Underpass Proposal (Part 1) - Elizabeth Alexis
- E. Meadow-Charleston Underpass Proposal (Part 2) - Elizabeth Alexis

### B-2. AECOM's Technical Review of Community Generated Ideas and Notes from XCAP Technical Advisory Committee

- A. AECOM Technical Review of Community Ideas (part 1)
- B. AECOM Technical Review of Community Ideas (part 2)
- C. 12-18-2019 Update from Technical Working Group Regarding Review of New Ideas with Volunteer Civil Engineers and AECOM

### B-3. Traffic Studies and Presentations

1. Final Traffic Study - Hexagon Traffic Consultants - Analysis of Churchill, Meadow and Charleston Grade Separation (Final Aug 2020)
2. DRAFT Traffic Study- TJKM - Draft Traffic Impact Study Report - Churchill Ave Closure (Aug 2019)
3. 1-8-2020- Presentation to XCAP: Review of Traffic Study and Discussion of Submitted Questions
4. 2-12-20 XCAP Traffic Questions and Hexagon Responses

### B-4. Noise and Vibration Comparative Analysis Report

### B-5. Frequently Asked Questions from Connecting Palo Alto website

### B-6. Eminent Domain Information

1. Eminent Domain Transcript Feb 5 2020 - Presentation by Norm Matteoni - Land Use Attorney
2. Eminent Domain handout - Feb 5 2020 - Information from Norm Matteoni
3. 2020-2-05 XCAP Meeting Minutes Verbatim

### B-7. Palo Alto Police and Fire Departments Letters

1. Palo Alto Fire Department Memo regarding Churchill Closure
2. Palo Alto Police Department Memo regarding Churchill Closure

## B-8. Caltrain Communications/Presentations

- A. Caltrain Response to City of Palo Alto Council Letter 12-18-2018
- B. Caltrain Business Plan Update to Local Policy Maker Group 4-19-2019
- C. Caltrain Letter to High-Speed Rail - Re: Preferred Alternatives 8-22-19
- D. City of Palo Alto letter to Caltrain re: Business Plan 9-30-2019
- E. Caltrain Presentation to XCAP Verbatim Meeting Minutes 1-29-20
- F. Caltrain presentation to XCAP 1-29-20
- G. Caltrain Rail Corridor Use Policy 2-6-20
- H. Caltrain Booklet for City of Palo Alto
- I. Caltrain Pandemic Rider Survey Topline Report Fall 2020
- J. Caltrain Email Regarding Encroachment 2020-04-22
- K. Caltrain Follow Up Email Regarding Shoofly Discussed at XCAP Meeting 05-20-20

## B-9. Palo Alto Unified School District (PAUSD)

- 1. PAUSD Letter#1 to XCAP 2-20-20
- 2. PAUSD Letter #2 to XCAP 12-7-20

## B-10. Safe Routes to Schools

## B-11. PTA Council (PTAC)

- 1. PTAC Letter to City Council re Bike-Ped improvements 1-22-2020
- 2. PTAC Letter to City Council 1-18-2021

## B-12. Palo Alto Comprehensive Plan Excerpts

## B-13. Rail Corridor Study – 2012 Excerpts

## B-14. Embarcadero Road and El Camino Real Corridor Improvement Study Aug 2016

## **Caltrain Grade Separation in Palo Alto**

Churchill Crossing: An Alternative

Michael Price

October 24, 2019

There has been much discussion about how to achieve grade separation at the Caltrain crossing at Churchill Avenue in Palo Alto. The city has presented a number of options in past years, but all have met with significant resistance. This proposal is an attempt to address the concerns of residents while meeting the requirements of Caltrain.

The goal of this proposal is to preserve as much of the access provided by the Churchill/Alma intersection as possible.

### **Churchill Grade Crossing Options To Date**

Close Churchill Avenue

Not a true grade separation alternative, closing Churchill and adding a bike/pedestrian tunnel for crossing Alma is probably the least expensive option. It also insulates bikes and pedestrians from cars. However, there is widespread concern about traffic impacts on El Camino, Embarcadero and Oregon Expressway if current Churchill traffic – approximately 9500 cars per average weekday – is diverted. Based on a survey conducted in July 2019, it also appears that a majority of Southgate residents are opposed to closing Churchill Avenue.

Churchill-only Viaduct

Many residents whose properties are adjacent to the tracks oppose a viaduct because they fear that having an elevated structure so close to their homes will materially affect their privacy, their views, and other aspects of their quality of life. In addition, there are widespread fears that an elevated train would too-radically transform the Palo Alto visual landscape and cause train noise to be distributed more widely. Raising, then lowering, the tracks for at-grade train stations may also concern Caltrain, which may wish to avoid frequent height changes.

Hybrid Design

In the most common version of this option, the train is raised halfway and the roads are lowered halfway. By reducing the height of the train relative to grade, a hybrid mitigates some of the concerns about the Viaduct, but in most versions involves significant property takings.

## Underground Options – Tunnel or Trench

Lowering the grade for train traffic below ground has a number of aesthetic and functional advantages very appealing to residents. However, both underground options are by far the most expensive designs and require the longest construction time, with accompanying disruption of traffic along Alma. They also involve significant property takings, as the temporary tracks would need to be placed along Alma, preventing residents from accessing their properties during construction.

## Design Objectives

Analysis of previous options and their drawbacks leads to the following objectives for the Churchill Avenue crossing:

1. Separate Caltrain tracks from Churchill Avenue
2. Take no private properties
3. Allow vehicular access to Alma from Churchill Avenue
4. Improve bike and pedestrian safety while crossing Alma
5. Avoid rapid grade changes along the tracks (don't convert Caltrain into a roller coaster)

## Design Features of This Proposal

1. Separates Caltrain from Churchill Avenue
2. Requires no property takings
3. Partially closes Churchill Avenue, but preserves access to Alma – and therefore downtown and south Palo Alto – for Southgate and other residents west of Alma.
4. Prevents use of Churchill as a cut-through to Embarcadero, thereby reducing traffic congestion on Churchill east of Alma (Churchill East).
5. Keeps Caltrain at grade level – i.e., no raising or lowering of tracks
6. Separates bicycle and pedestrian traffic crossing Alma from car traffic
7. Provides a bridge over Churchill Avenue to the bike trail next to Palo Alto High School
8. All infrastructure is at or below grade level, so it doesn't create an eyesore like that of a viaduct

**The Proposal - A Modified Underpass**

This proposal achieves these goals by creating a modified underpass at the Alma/Churchill intersection. It requires lowering both Churchill and Alma about 21 feet to allow West Churchill to pass underneath the Caltrain tracks, while keeping East Churchill at grade and closing it to through traffic from West Churchill. While a full underpass would preserve all traffic, bike, and pedestrian access between Churchill and Alma, it would also require the taking of many private properties. This proposal sacrifices some movement of traffic but avoids takings by stopping the underpass at East Churchill while preserving one lane at existing grade on both Alma and Churchill to allow access to properties on those streets. The underpass depth and road slope/grade is copied from the Jefferson Street underpass in Redwood City.

The most significant traffic-flow change is that no through traffic is allowed on Churchill across Alma. The table below summarizes traffic movement at the Alma/Churchill intersection.

For cars on Alma approaching the Churchill intersection:

	Left onto Churchill	Right onto Churchill	Straight through
southbound on Alma	✗	✓	✓
northbound on Alma	✓	✓	✓

For cars on Churchill approaching the Alma intersection:

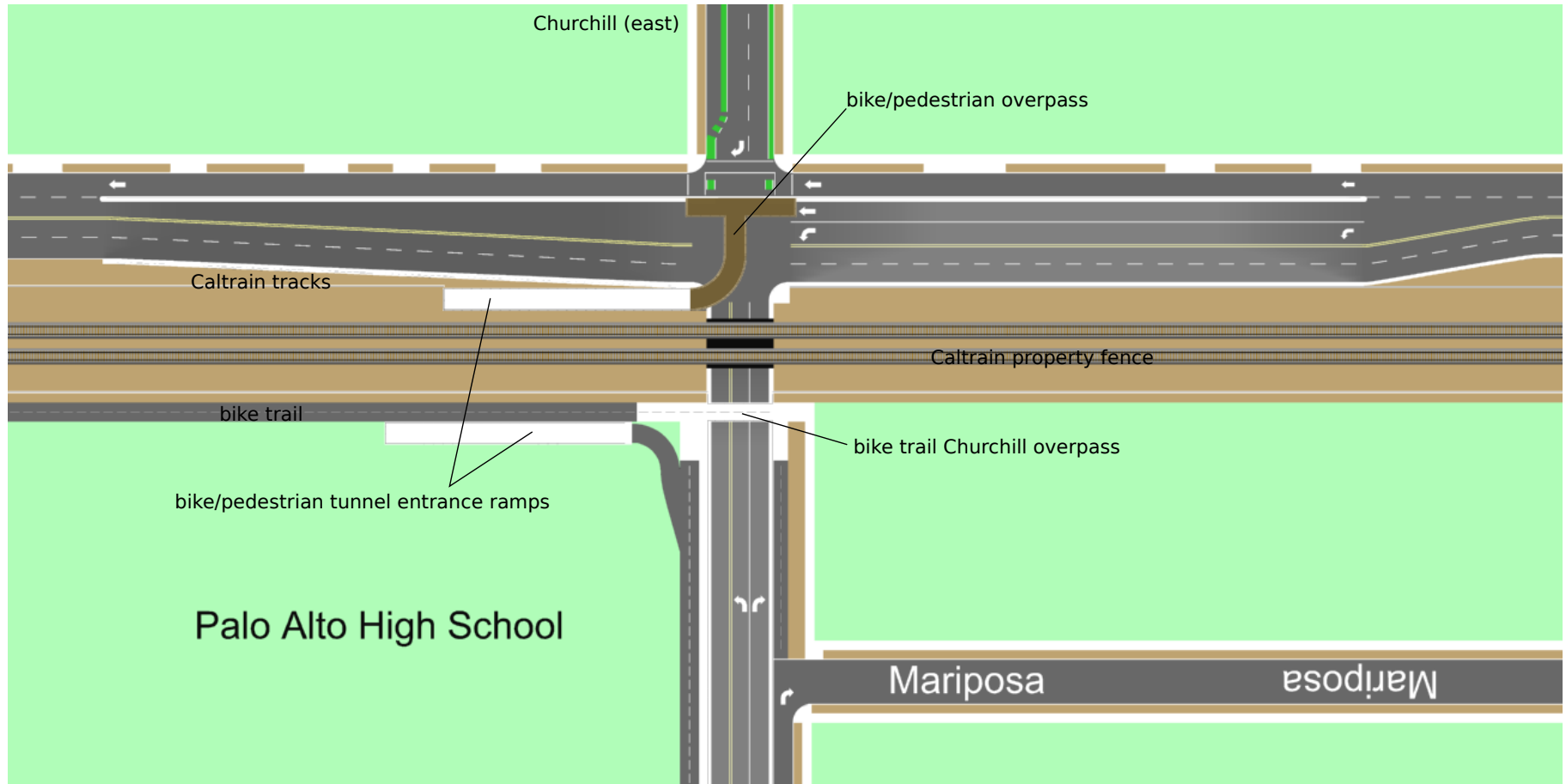
	Left onto Alma	Right onto Alma	Straight through
eastbound on Churchill	✓	✓	✗
westbound on Churchill	✗	✓	✗

All pedestrian and bike access is preserved and separated from car traffic on Alma and Churchill.

**Eastbound Churchill Traffic**

From studies published by the City of Palo Alto, it appears that eastbound Churchill Ave. traffic is split in three relatively equal ways: south on Alma, north on Alma, and continuing east of Churchill, most of which is likely heading for Embarcadero.

## Overhead View (looking straight down) of the Intersection



The above illustration is a bird's-eye view of the Alma/Churchill intersection. Traffic on West Churchill from El Camino and much of Southgate enters from the bottom. There are two lanes on Churchill as it approaches Alma: one for turning left and one for turning right. No traffic can cross Alma to the other side. Traffic heading west on Churchill from the east side of Alma (entering from the top) can only turn right on Alma, heading north. There is no access to southbound Alma or the other side of Churchill from East Churchill.

## **Alma Traffic**

Cars heading north on Alma have three choices:

- Stay at grade in the right lane and turn right onto Churchill heading east
- Descend and continue north on Alma in the left lane
- Merge into the left turn lane to head west on Churchill

Cars heading south on Alma have no access to Churchill East (no left turn), but can

- Turn right onto Churchill heading west using the right-turn lane
- Continue south in the other two lanes

(Note: The existing right-turn lane is shown in these illustrations, but It would be possible to eliminate it with this design, since right-turning traffic would no longer need to queue due to preemption by the train.)

## **Churchill Traffic**

Cars heading east on Churchill from Southgate or El Camino can

- Descend and turn left or right onto Alma
- Stay at grade in the right-hand lane and turn right onto Mariposa.

Cars heading west on Churchill from Alma have the same access to Mariposa as they have today (no left turn onto Mariposa is currently permitted).

Cars heading west on Churchill from east of Alma can only turn right onto Alma to head north. There is no access to Alma southbound or to the other side of Churchill.

## **Preserving Private Property**

The right turn lane onto Mariposa allows access to Mariposa from Churchill, but also allows those houses along Churchill to have access to their driveways even though Churchill is descending below grade.

Similarly, the right-hand lane on northbound Alma remains at grade, allowing access to driveways along Alma while also providing access to Churchill heading east.



This is how an underpass at Churchill is possible without taking private property. There may be some disruption during construction, however.

### **Bike and Pedestrian**

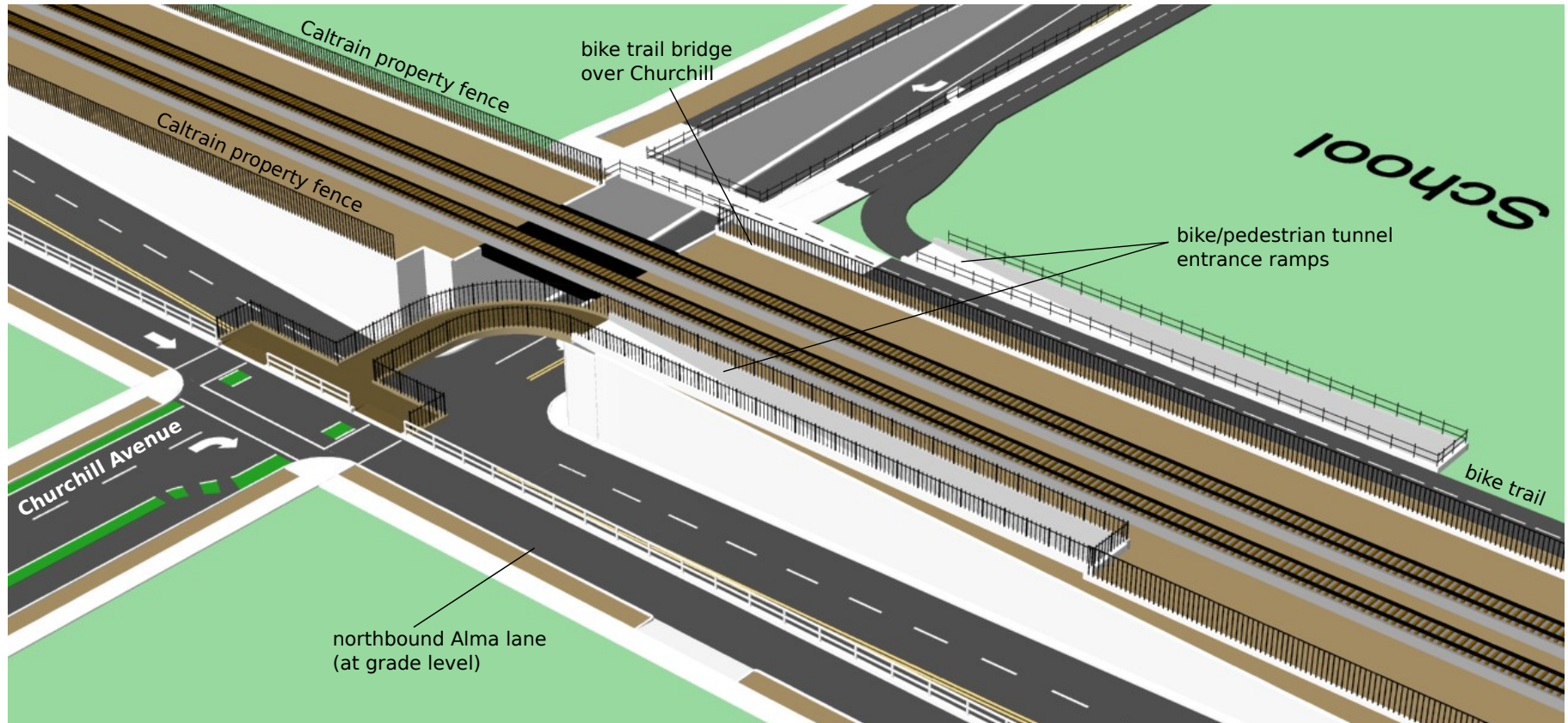
Bicyclists and pedestrians cross Alma on an overpass (at grade level since Alma is lowered) then pass underneath Caltrain in a tunnel, emerging along Churchill.

### **References**

In this document, the portion of Churchill east of Alma is referred to as East Churchill. The portion west of Alma (between Alma and El Camino) is referred to as West Churchill.

## Overview of the Intersection

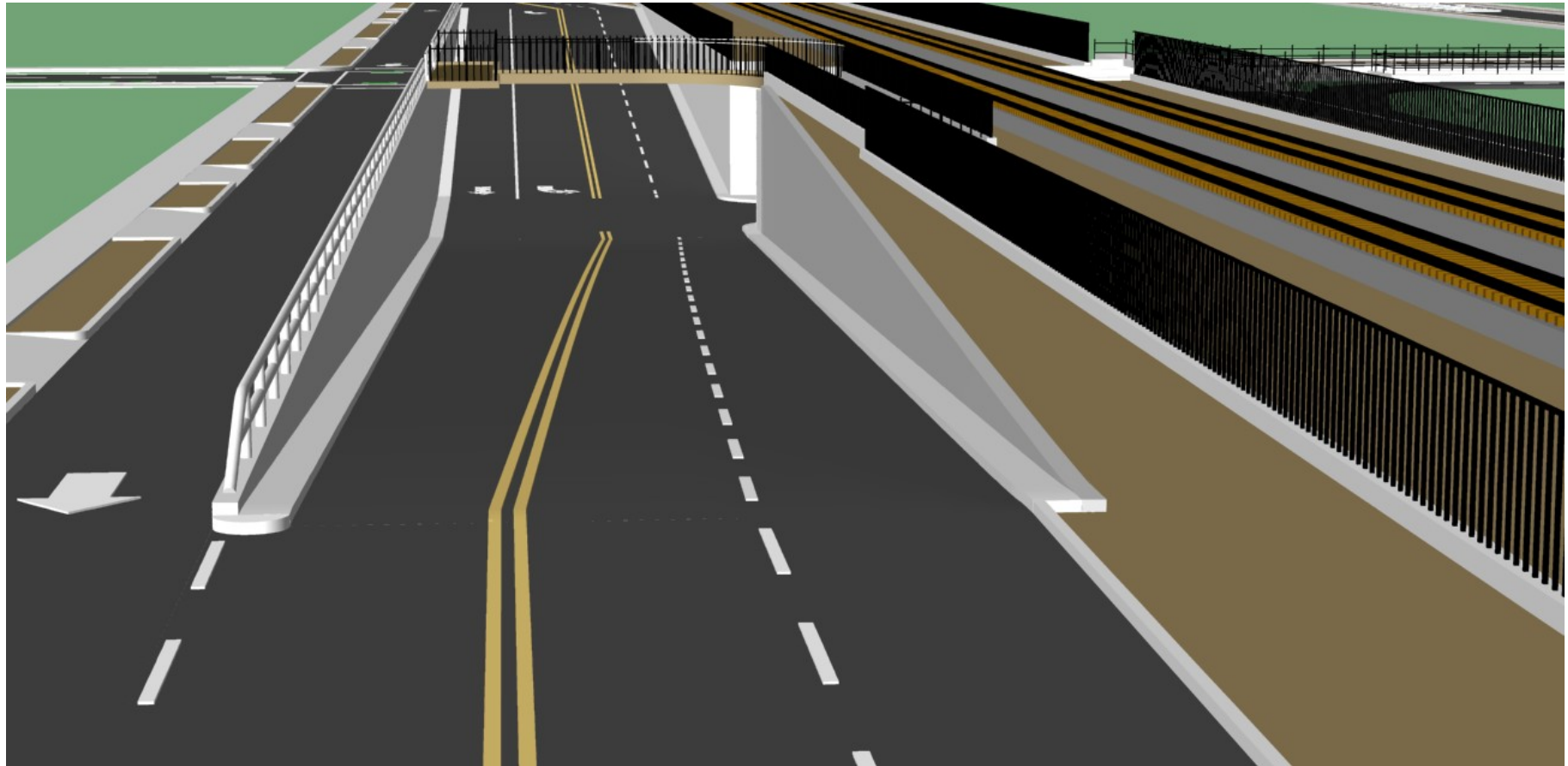
The illustration below is a perspective view looking down at the intersection from the northeast.



Most of Alma drops down to the Churchill underpass. West Churchill goes under the Caltrain tracks which remain at grade level. East Churchill also remains at grade and connects to one northbound lane of Alma. Bikes and pedestrians cross Alma on a bridge, then follow the ramps to a tunnel under Caltrain. The bike trail crosses Churchill on a bridge.

The intersection will need a traffic light, to allow left turns off Alma and to allow Churchill traffic to turn onto Alma.

Below is a perspective view of the intersection looking south along Alma.



This illustration shows the intersection and underpass at Churchill, about 21 feet below grade level. The right hand northbound Alma lane (on the left side of the illustration above) continues at grade level providing access to East Churchill and the properties along Alma. Southbound lanes move right to provide space for a northbound left turn lane. The lanes today also move slightly right to make room for the left turn lane at Churchill, but that turn has been eliminated. The right turn lane has also been eliminated, since no cars need to queue for a right turn.

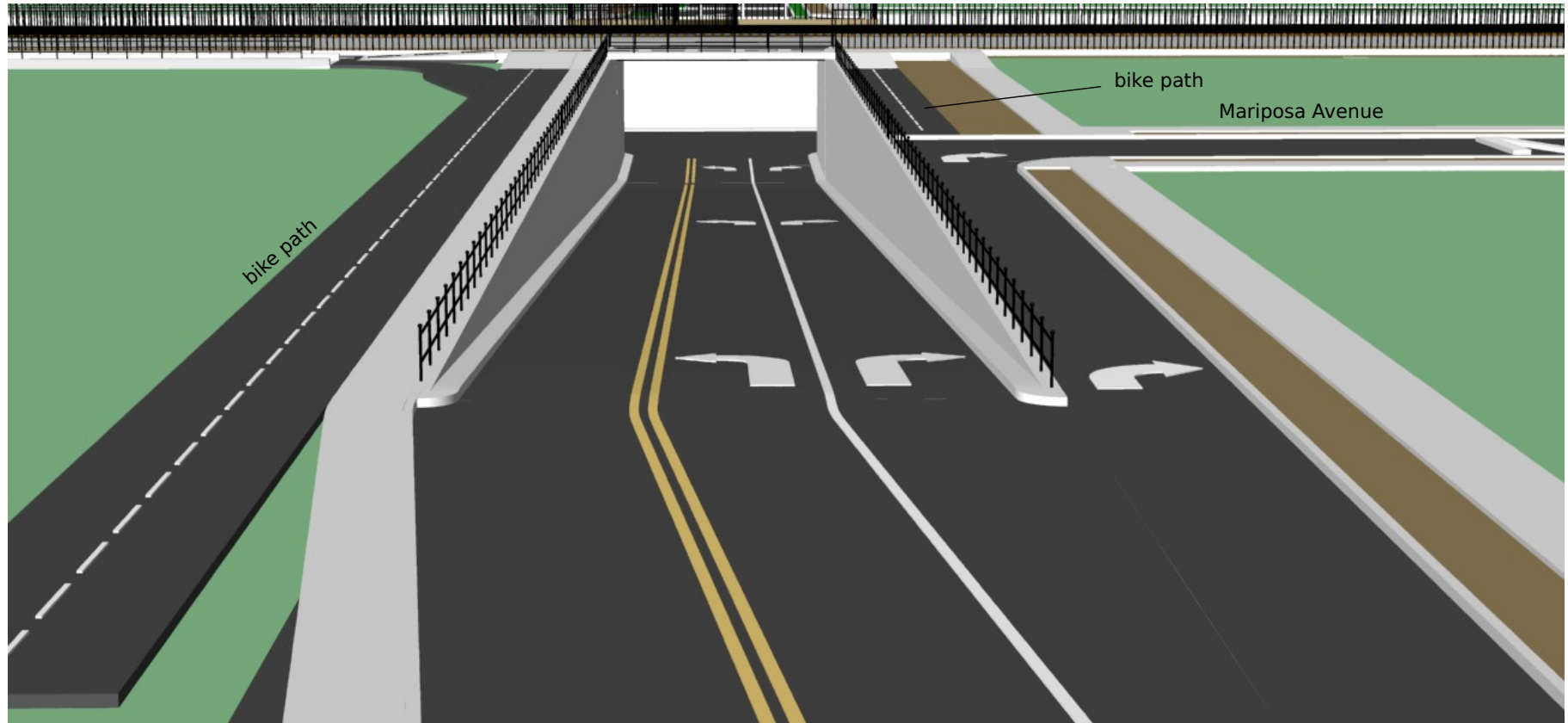
Bikes and pedestrians cross Alma using the overpass bridge.

This illustration is a perspective view looking north along Alma toward the Alma/Churchill intersection.



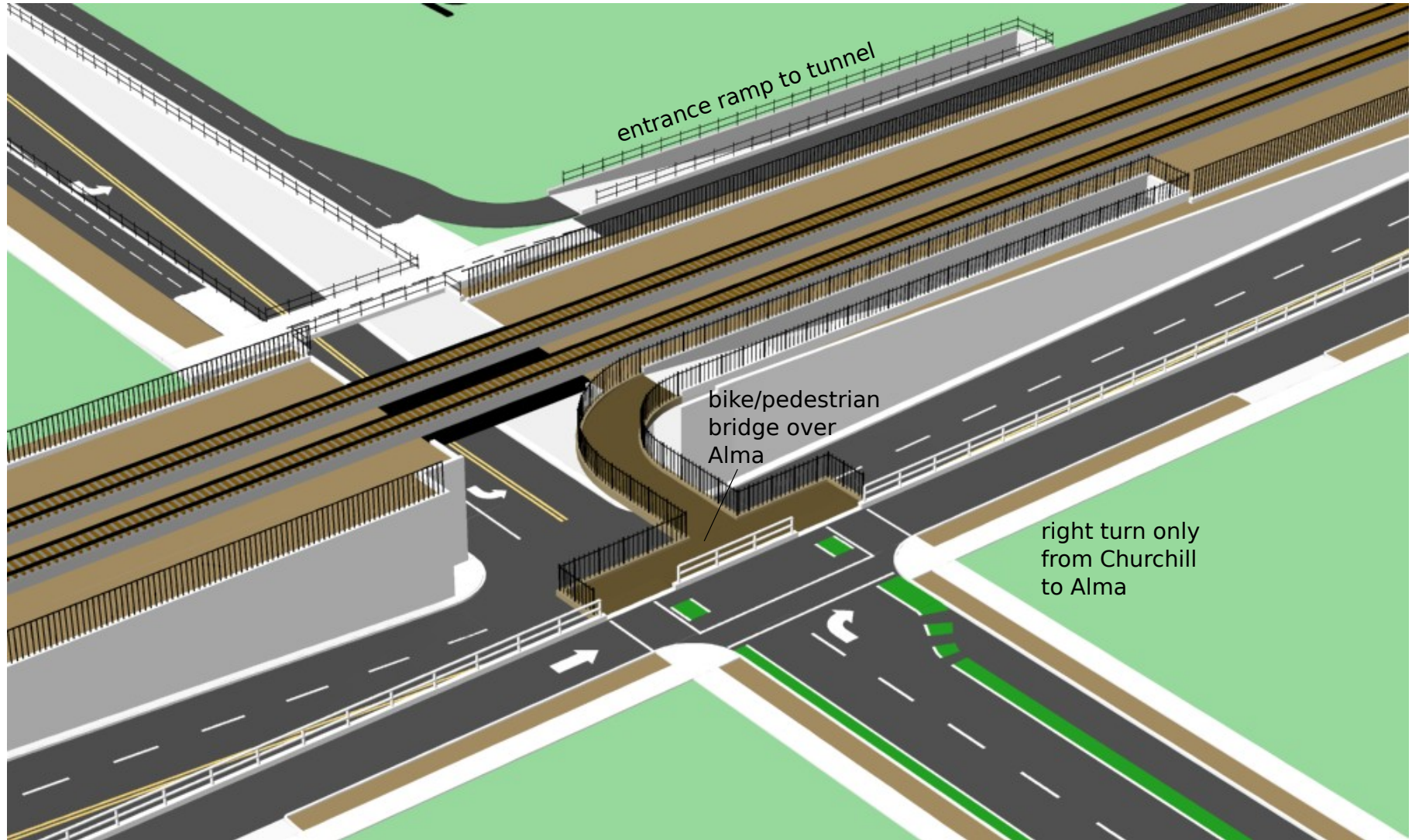
Both southbound lanes and one northbound lane are lowered to allow connection to the Churchill Ave underpass. The right-hand northbound lane stays at grade level to provide access for the driveways along Alma and to East Churchill Avenue.

This illustration is a perspective view looking east along West Churchill toward the Alma/Churchill intersection.



Traffic heading east on West Churchill enters one of two lanes, turning either left or right onto Alma. There is no through route to East Churchill. The right most lane provides driveway access for the properties along Churchill and to Mariposa Ave. All bike and pedestrian traffic is diverted to the bike trail and sidewalk on the left side of Churchill, which connect to the tunnel under the Caltrain tracks and the bridge over Alma.

This illustration is a perspective view looking down at the Alma/Churchill intersection from above East Churchill.



This shows East Churchill and the right-hand northbound lane of Alma. Only right turns are permitted. A traffic light will be needed to allow pedestrians and bikes to cross over to the bridge and enter Caltrain tunnel.

## West Churchill

To the right is an overhead view (looking straight down) of West Churchill showing the Castilleja and Mariposa intersections. East is up.

The road layout is unchanged between El Camino and Castilleja. The traffic lane veers left and splits into left and right turns lanes for Alma. Churchill traffic can only turn left (north) or right (south) at Alma.

Cars wanting access to Mariposa move to the right and proceed to the intersection with Mariposa. This lane also provides access to the properties along Churchill that would otherwise be inaccessible because of the lowering of Churchill.

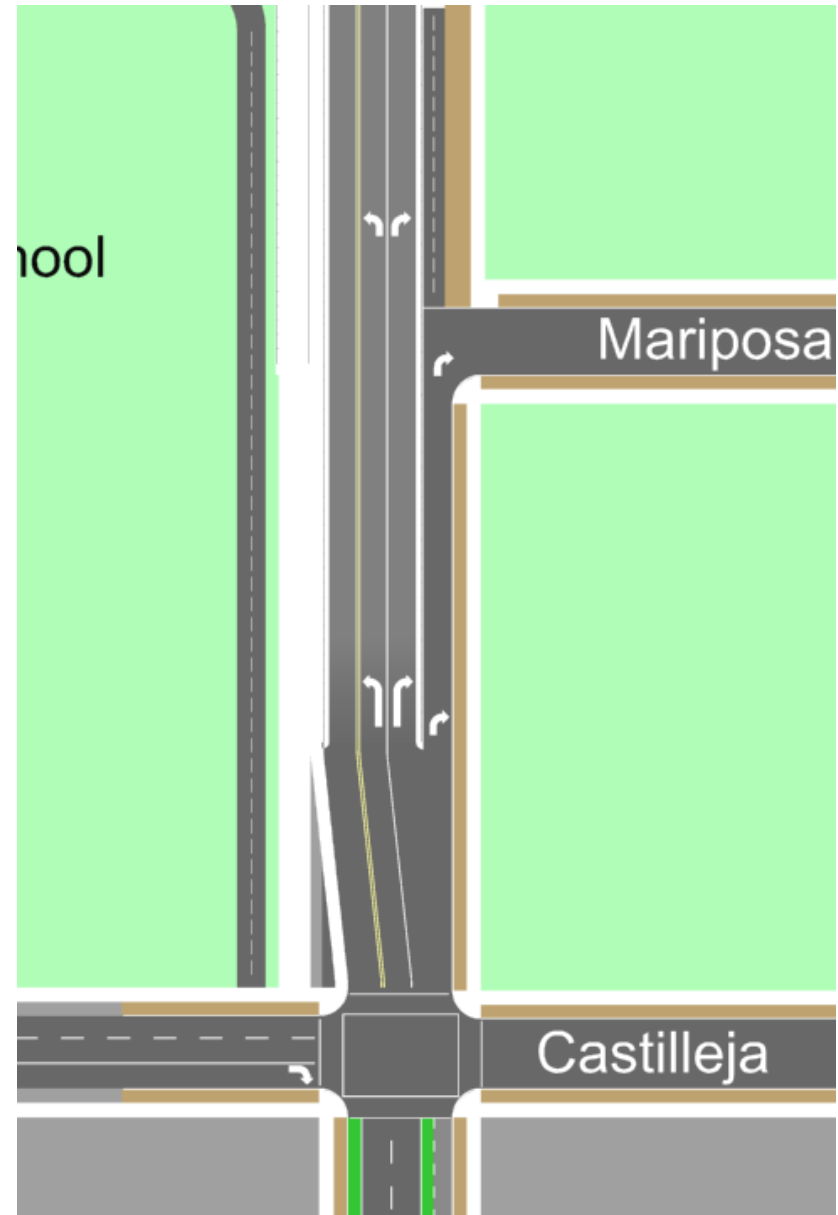
Cars on Mariposa heading to Churchill or Alma must use Miramonte and Castilleja.

No right turn off Churchill onto Mariposa for cars heading west is possible, but that turn is now prohibited.

Eastbound bikes have two options:

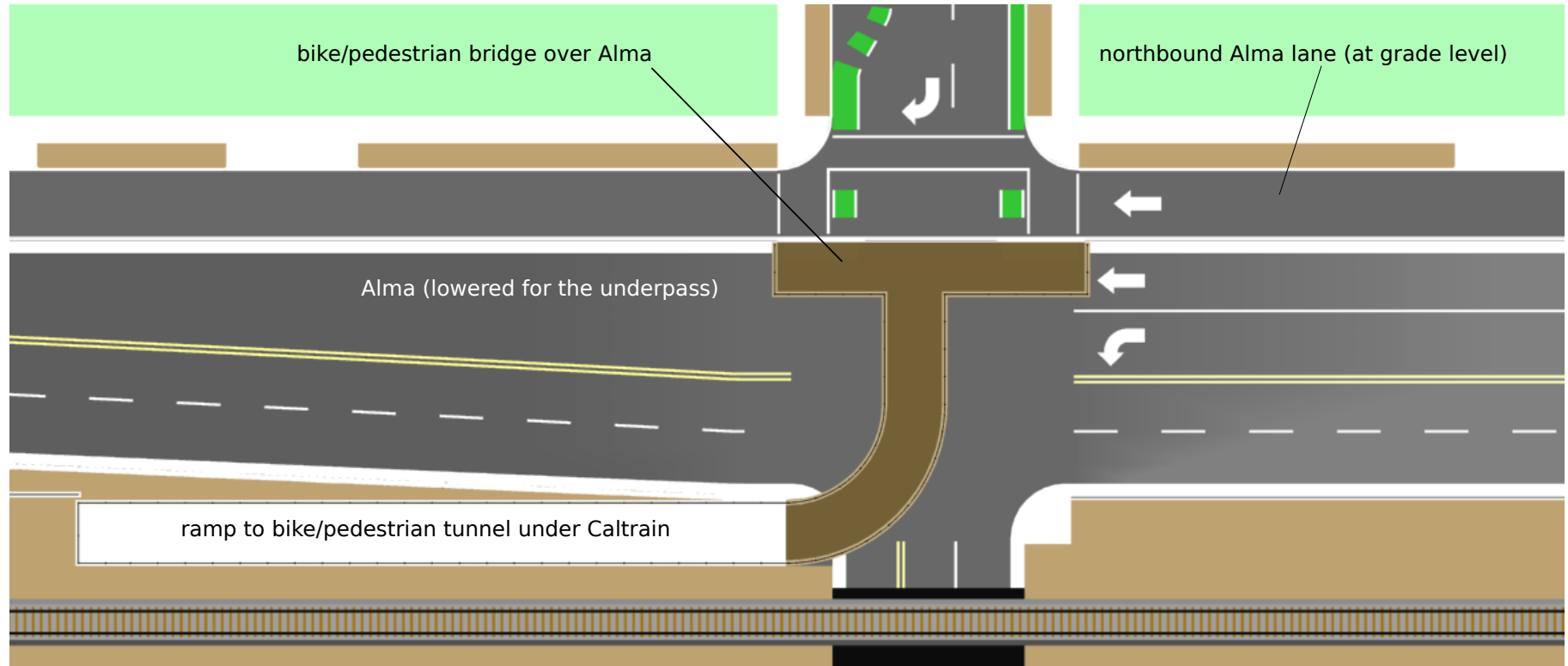
- a) they can stay right, proceed up past Mariposa and cross Churchill on the bridge to access the bike trail.
- b) they can cross Churchill at Castilleja and travel up to the entrance to the bike/pedestrian tunnel under Caltrain, and proceed to East Churchill.

There is no bike access to Alma from Churchill.



## East Churchill

Below is an overhead view (looking straight down) of East Churchill and the Alma intersection. East (ish) is up.



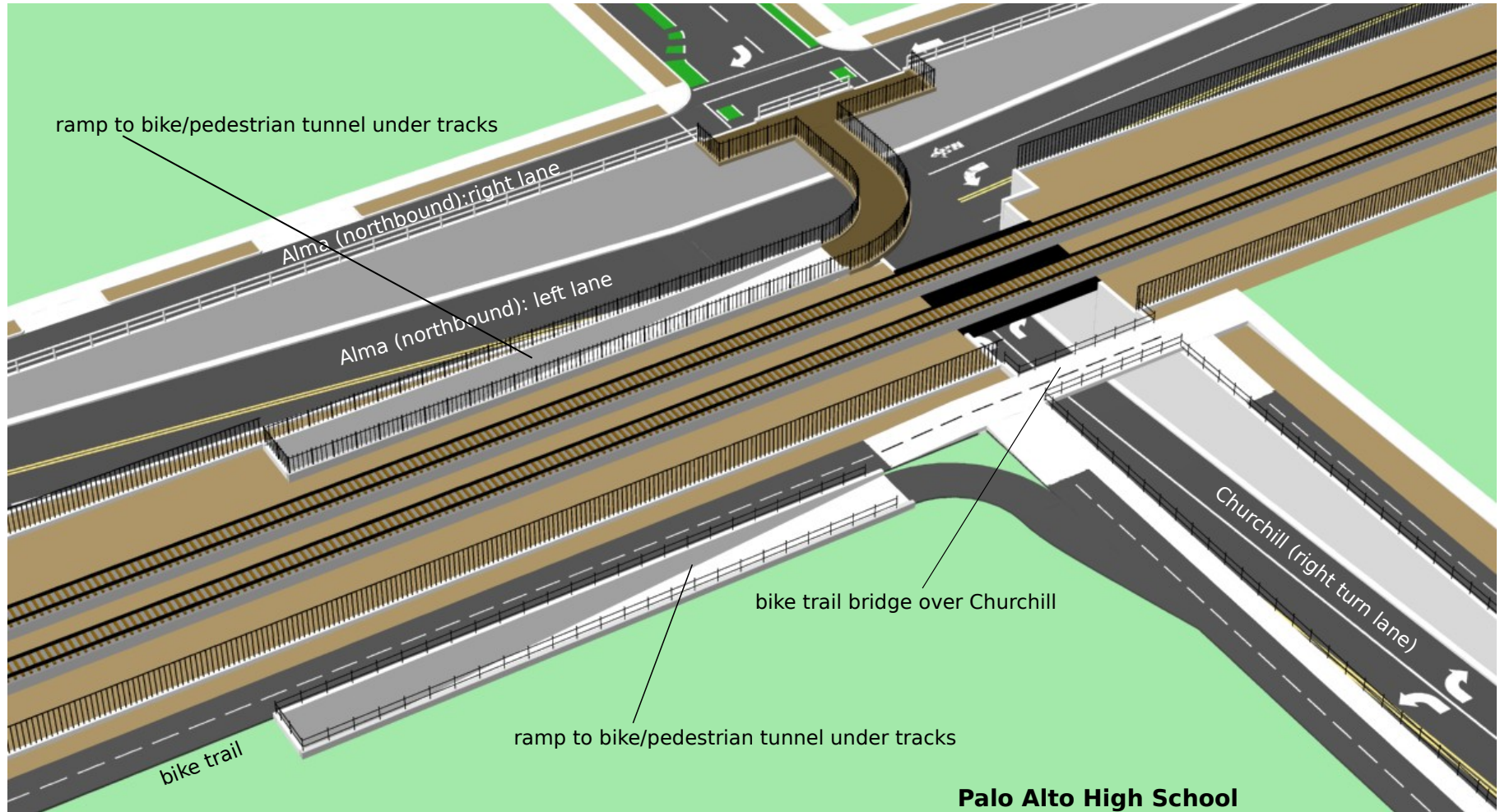
There is no southbound Alma access to East Churchill (no left turn from southbound Alma). There is no access to southbound Alma for traffic traveling west on East Churchill

The right hand lane of northbound Alma continues at grade allowing access from the properties along Alma near the Churchill intersection, between Coleridge and Kellogg Avenues. Access to these properties is only from northbound Alma. Cars exiting these driveways must turn north on Alma.

Pedestrians and bikes cross the single northbound Alma lane and then over the rest of Alma on a bridge. A crossing light will be needed at Churchill.



This illustration is a perspective view of the Alma/Churchill intersection looking down from above the Palo Alto High school.



The bike trail along the High School continues to a bridge over Churchill and connects to Mariposa. The trail also continues along Churchill to the Palo Alto High School entrance at Castilleja. The bike and pedestrian bridge over Alma enters the tunnel under the Caltrain via a ramp and reemerges on the other side of the tracks with a ramp connecting to the bike trail.

### **Bike and Pedestrian Access.**

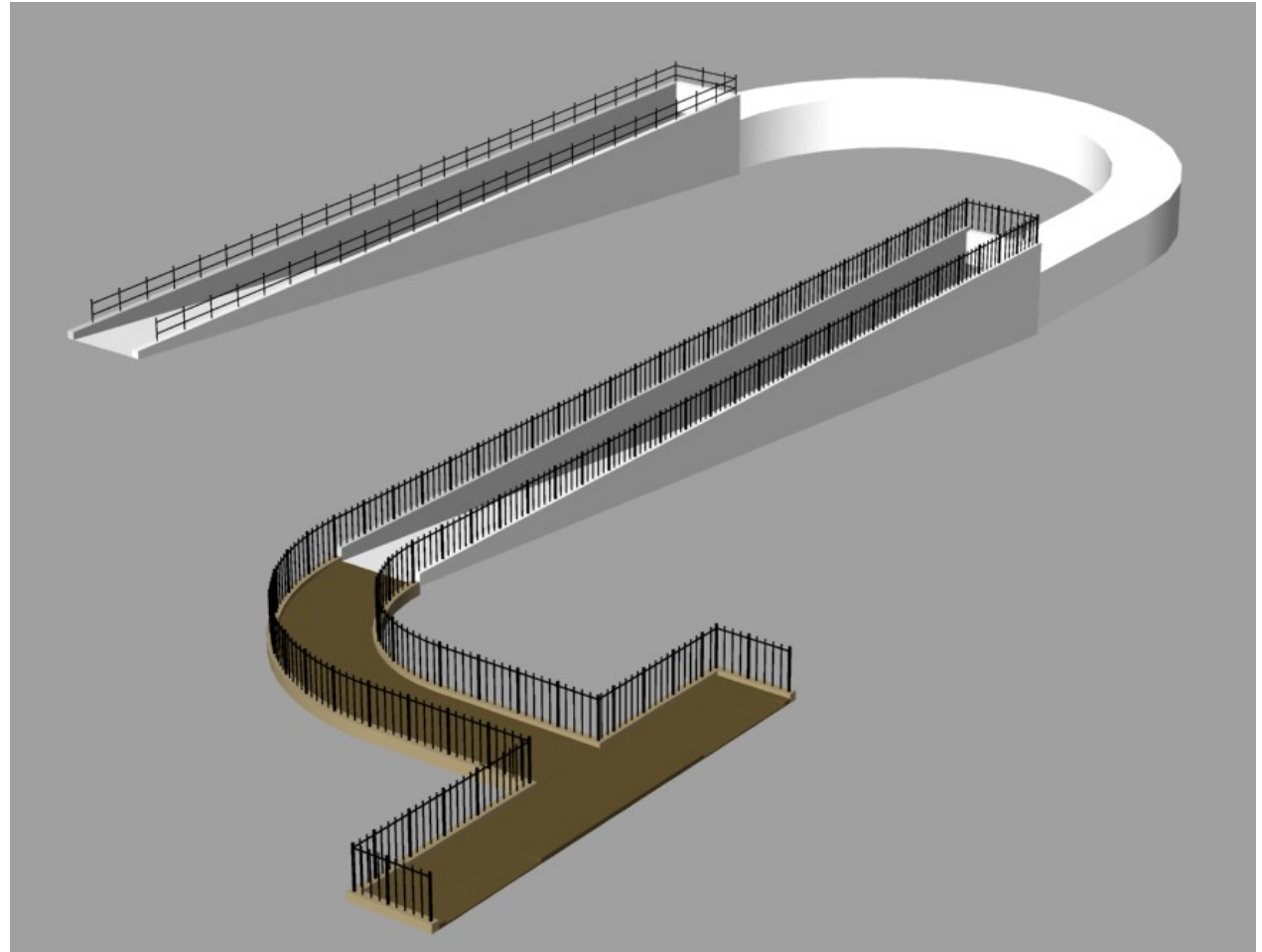
One goal was to eliminate the need for bikes and pedestrians to cross Alma. This is mostly achieved with the tunnel under the tracks and a bridge over Alma, although there is still a need to cross the right-hand northbound lane of Alma.

The bridge over the Alma/Churchill intersection connects with a ramp leading to a tunnel under the Caltrain tracks and then emerges along Churchill.

The tunnel appears in the illustration to the right, which shows the East Churchill bridge over Alma and the ramps down to the tunnel.

The curve in the tunnel serve two purposes:

- a) it make bike transit easier (no sharp turns)
- b) it eliminates corners for someone to lurk behind (to enhance safety)



## **Implementation Issues**

There are three issues that have to be addressed for this to proceed:

1. Will Caltrain permit the encroachment onto their right-of-way for the ramp leading to the tunnel under the tracks>
2. Splitting the lanes on Alma to prevent taking properties introduces some safety issues, such as an abutment between the two lanes that could be a hazard. This needs to be investigated, but there are mitigations for the safety issues. There are many examples of this configuration elsewhere in California.
3. The bike/pedestrian ramp will extend onto the Palo Alto High School property on the Alma side. The high school will need to be consulted.

Thanks to Susan Newman and Mike Dixon for contributions to this proposal.

# South Palo Alto tunnel with freight at grade

A responsible approach to urban rail surgery

Slides by Roland Lebrun

Proposal for Agenda Item #4 - New Ideas

XCAP Meeting, November 13, 2019

# Why are we revisiting this?

- Impacts on Alma (loss of one lane in each direction).
- Impacts on creeks
- Impacts on vegetation
- Utility relocations
- Costs

# How are we addressing these impacts?

- **No impacts on Alma, Meadow or Charleston**
  - Shooflies/permanent freight tracks relocated to **existing** Caltrain Right of Way (ROW)
- **No impacts on creeks**
  - **Reduced tunnel diameters** enable going OVER Matadero and UNDER Barron & Adobe
  - No siphon/pumping stations (tunnel drain only)
  - No TBM “Pit” to launch/extract TBMs

Smaller tunnel diameters result in shorter and shallower ramps (no utility relocations north of Matadero)

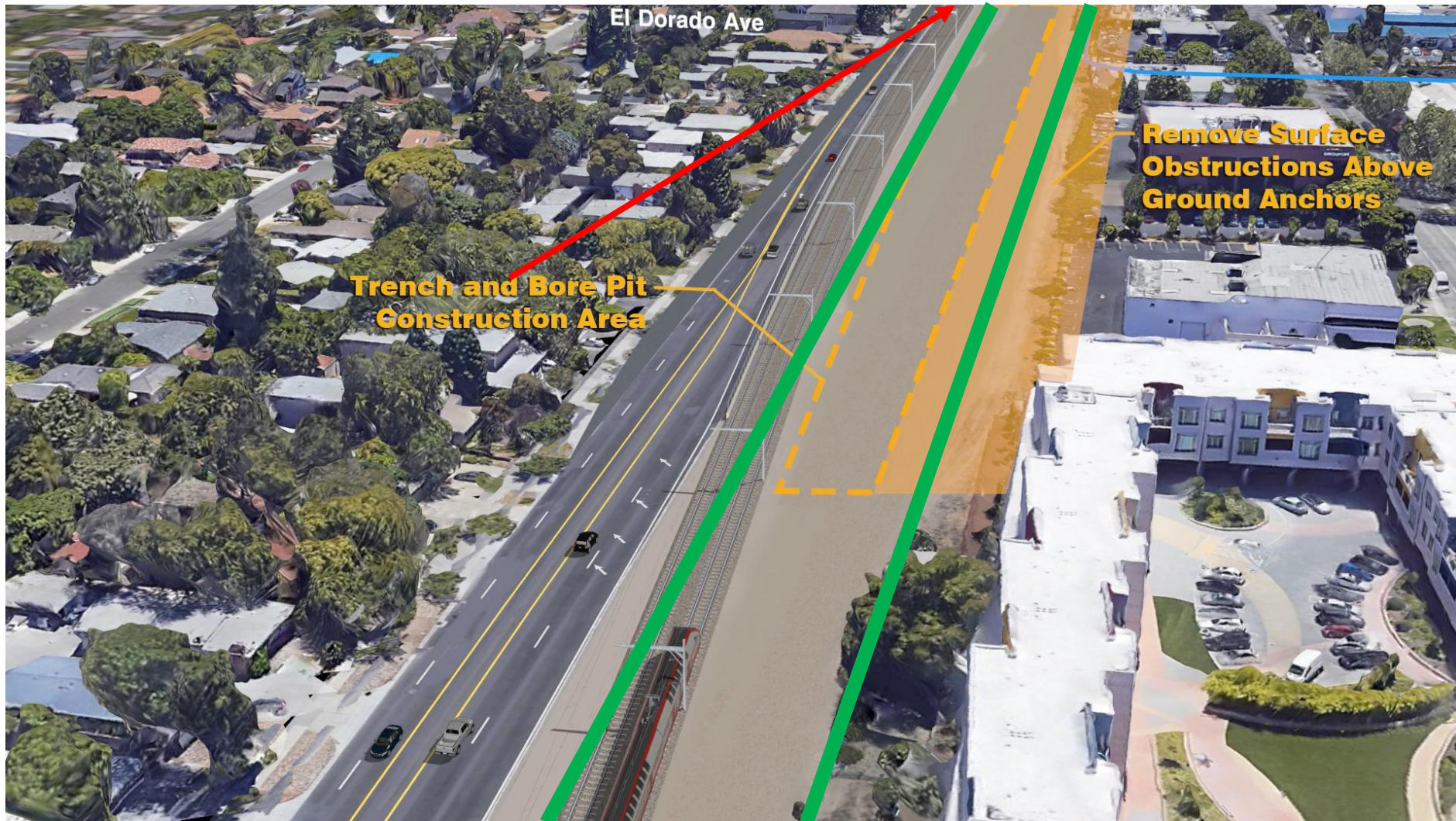


# Freight tracks constructed **within existing Caltrain ROW** (no impacts on ALMA)

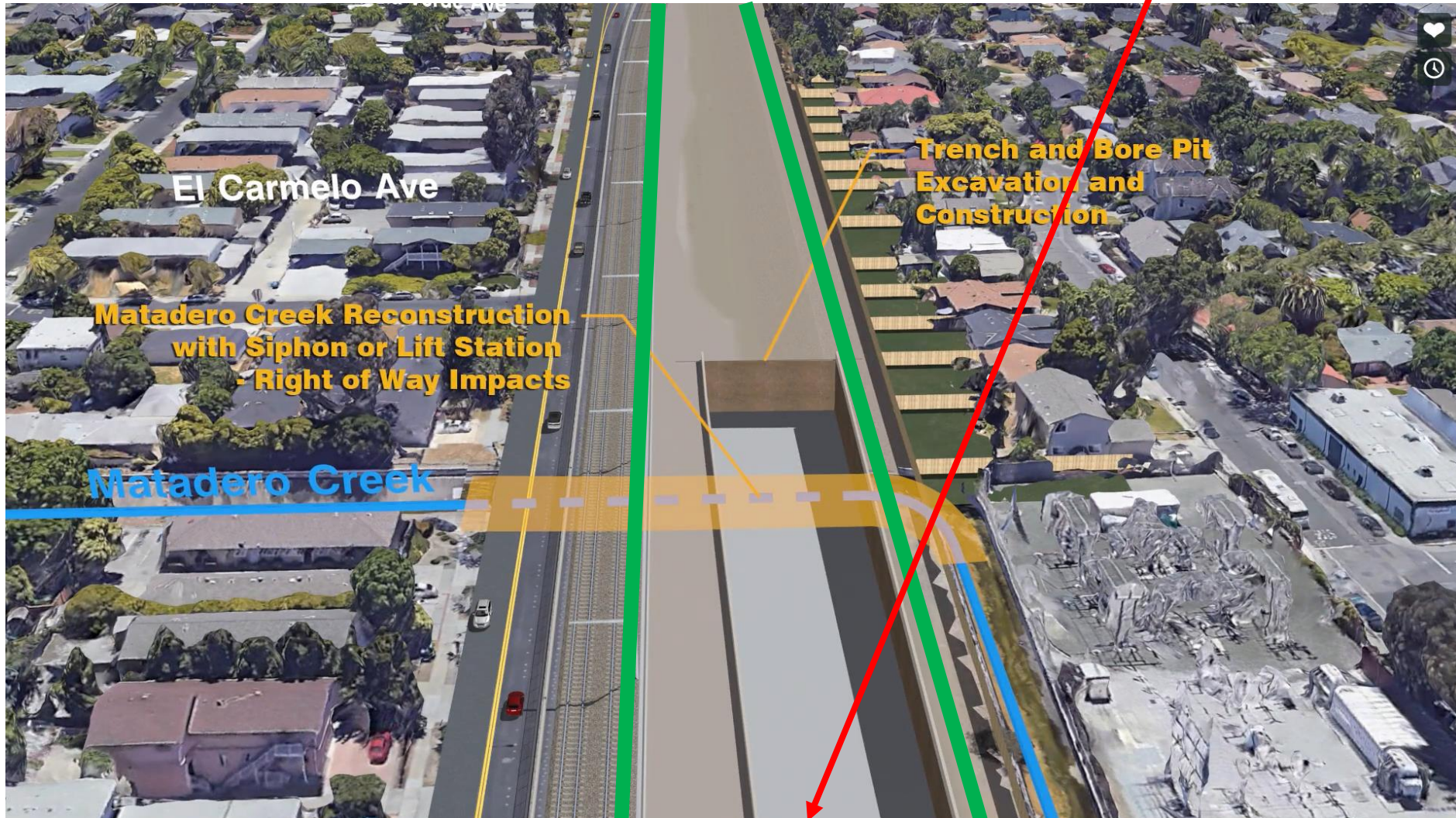




# Start of ramp shifted south to eliminate impacts on Matadero Creek



Start of ramp moved south (200 feet north of Matadero Creek no lifts/siphons)



# 65-foot headwall with 30-foot spacing between bore centers (no lane takings)



# 65-foot headwall with 30-foot spacing between bore centers



# Tunnels go under Barron Creek (no change)



# No impacts on Meadow Drive (no change)



# No construction impacts on Charleston

## No construction impacts on Alma



# Trench and tunnel eyes move south of Adobe (no impacts on Alma)



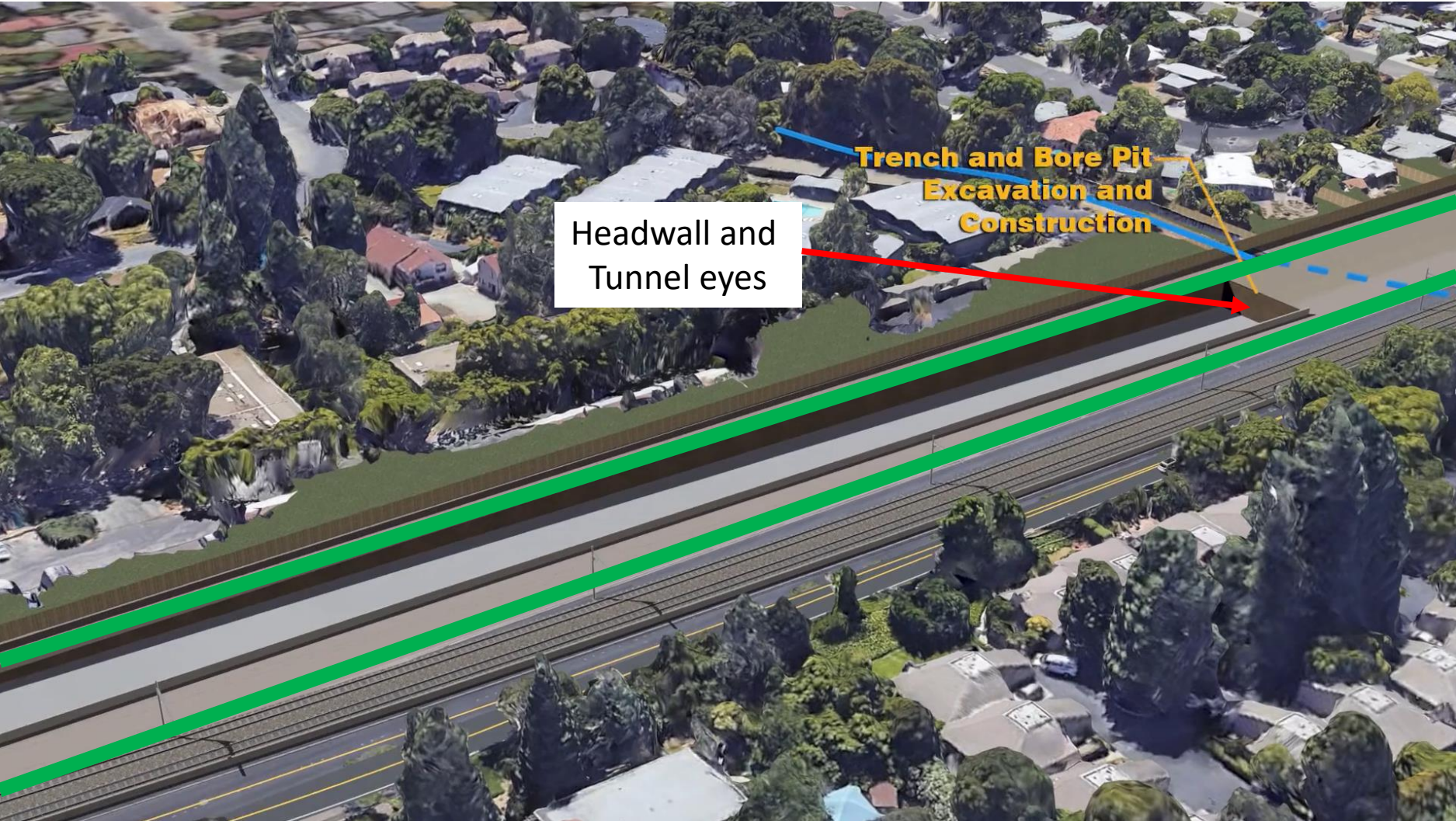


# No impacts on Adobe Creek or Alma

## No siphons or lift stations



# No bore pit and no impacts on Alma



# Costs

Tunnel	Length	Diameter		TBM		Total cost	
	mi	ft.	ft.	EUR	USD	EUR	USD
Kaiser-Wilhelm Tunnel	2.61	29.53	33.14	18,000,000	21,597,480	105,000,000	125,985,300
Katzenberg Tunnel	5.83	30.84	36.48	20,000,000	23,997,200	340,000,000	407,952,400
Albvorland Tunnel	5.08	31.50	35.66	21,572,000	25,883,380	380,000,000	455,946,800
Finne Tunnel	4.33	31.50	35.66	18,735,000	22,479,377	258,000,000	309,563,880

# Questions?



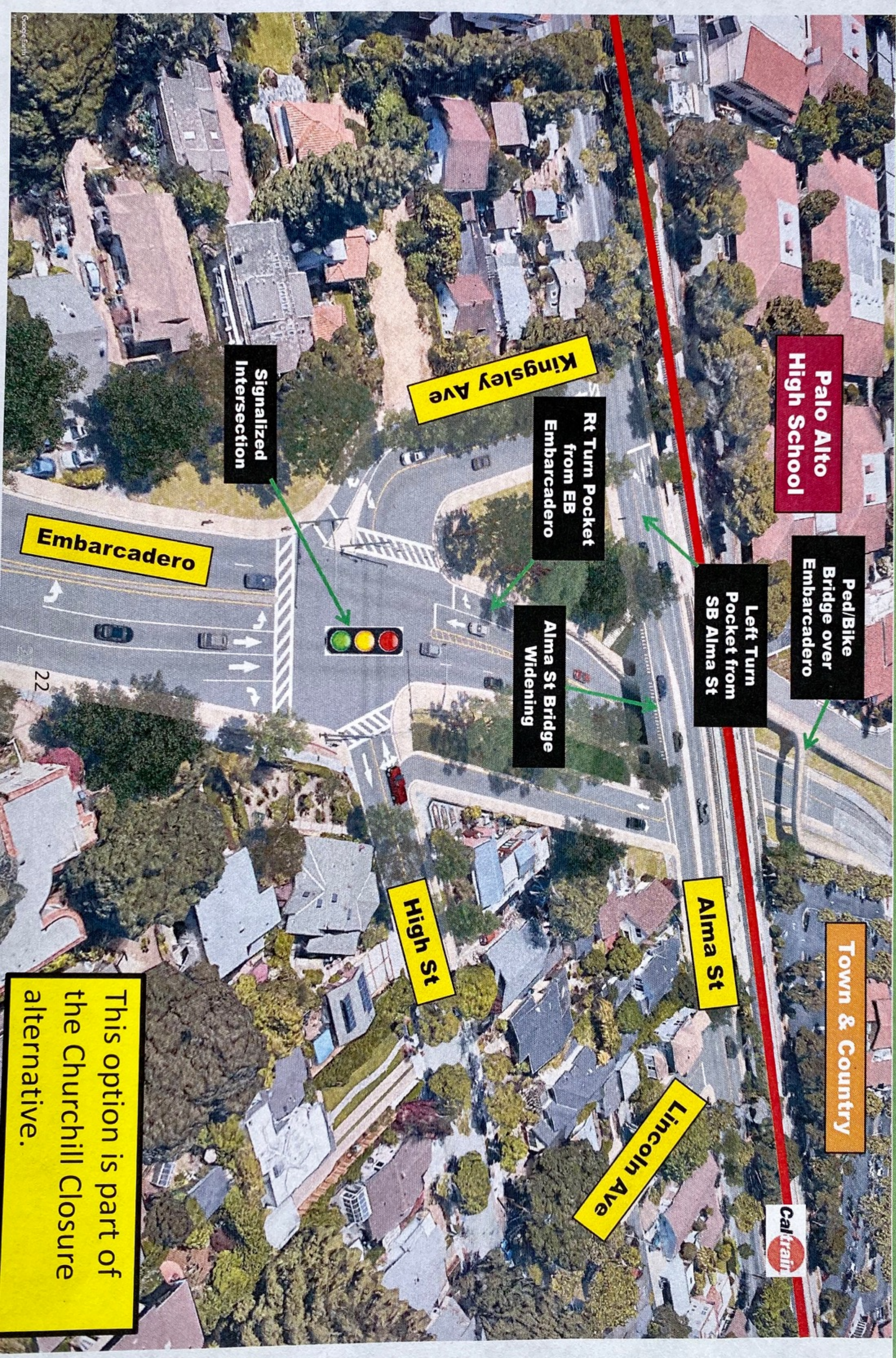
# **Slides from Tony Carrasco**

## **Proposal for Agenda Item #4 - New Ideas**

**XCAP Meeting, November 13, 2019**



# Recap: Embarcadero/Alma (3D Rendering. Looking West)



Palo Alto High School

Ped/Bike Bridge over Embarcadero

Left Turn Pocket from SB Alma St

Rt Turn Pocket from EB Embarcadero

Alma St Bridge Widening

Kingsley Ave

Signalized Intersection

Embarcadero

Town & Country

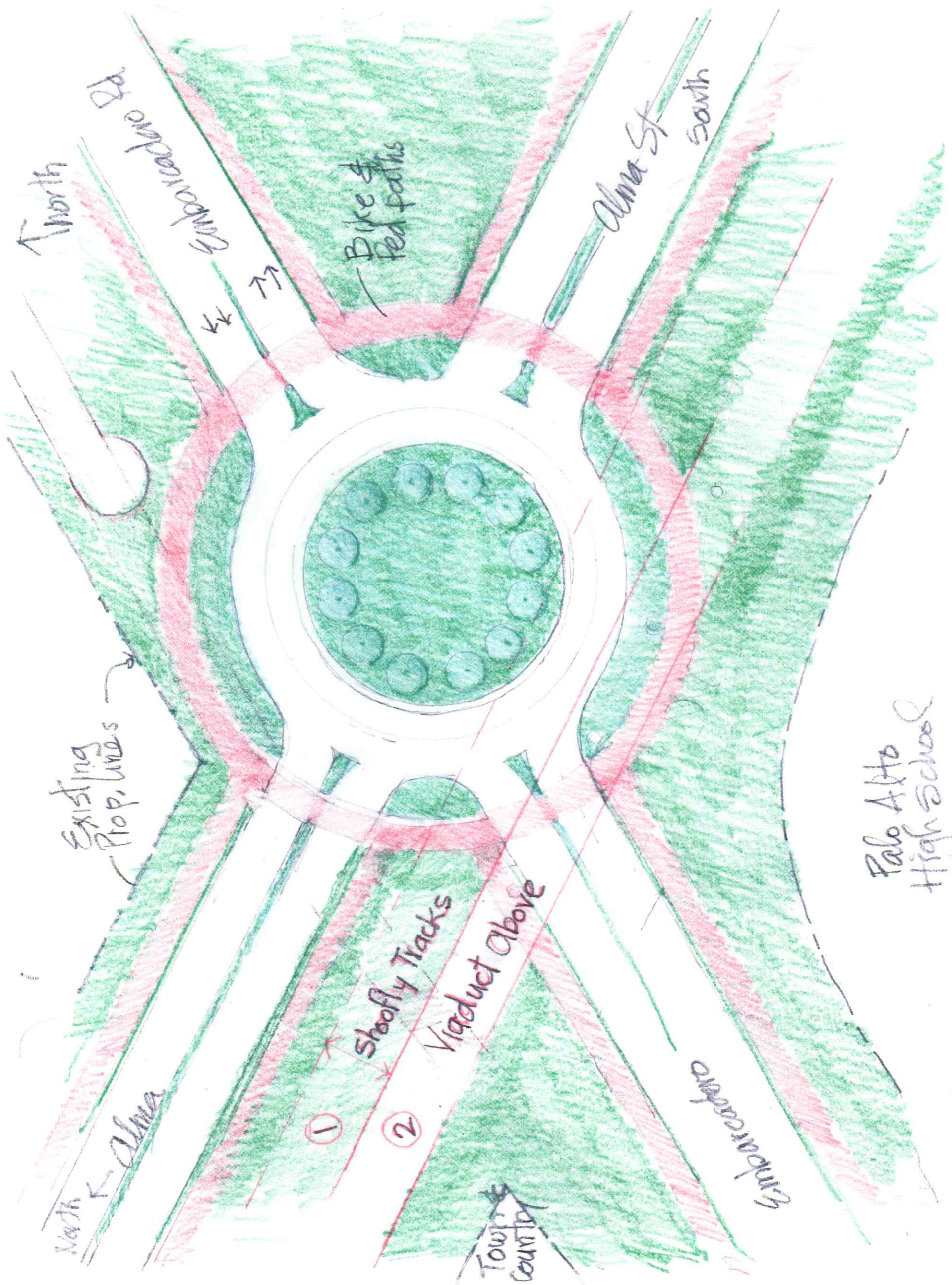
Alma St

Lincoln Ave

High St

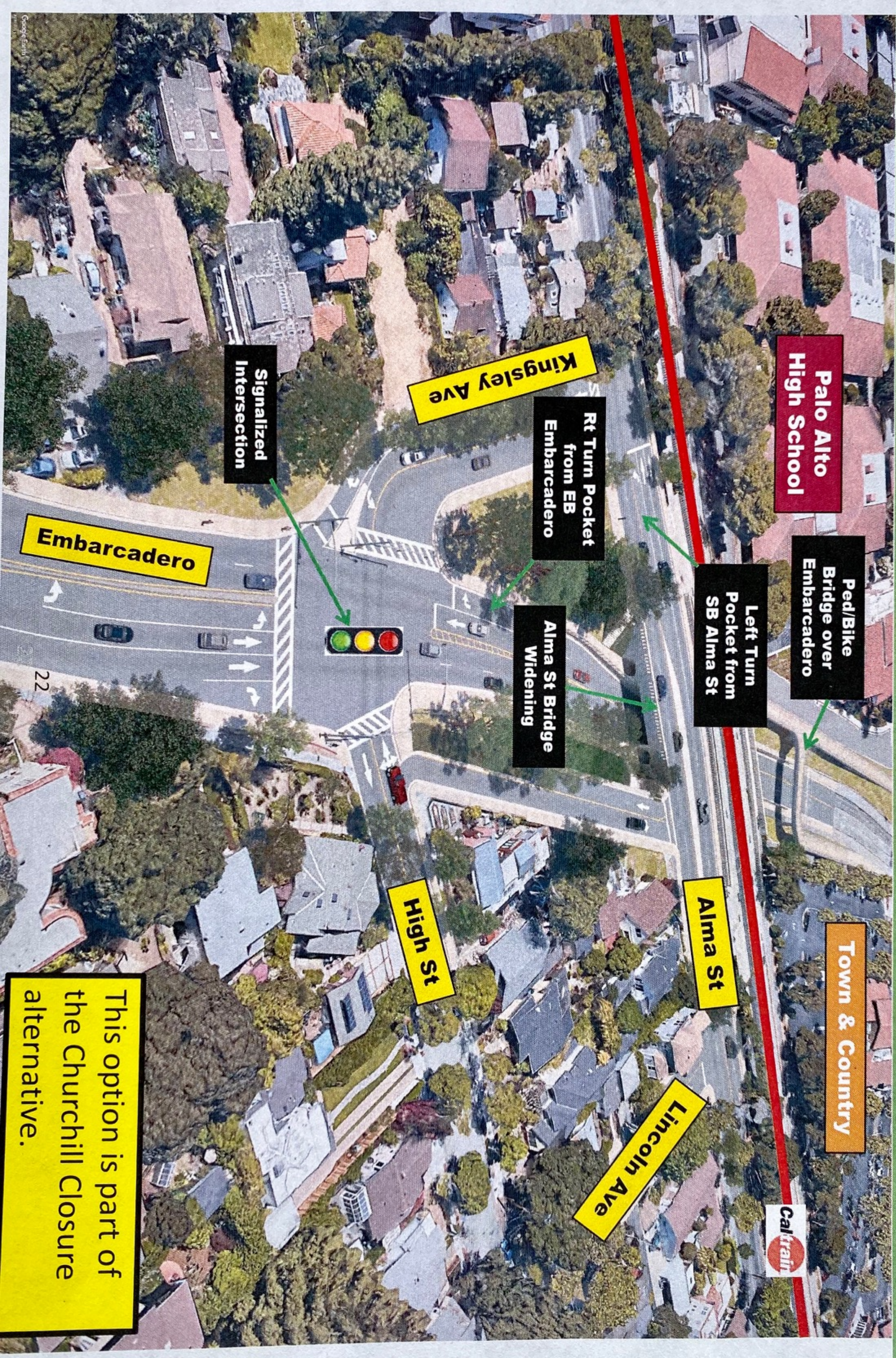
This option is part of the Churchill Closure alternative.

Roundabout - classic





# Recap: Embarcadero/Alma (3D Rendering. Looking West)



Palo Alto High School

Ped/Bike Bridge over Embarcadero

Left Turn Pocket from SB Alma St

Alma St Bridge Widening

Rt Turn Pocket from EB Embarcadero

Kingsley Ave

Signalized Intersection

Embarcadero

Town & Country

Alma St

Lincoln Ave

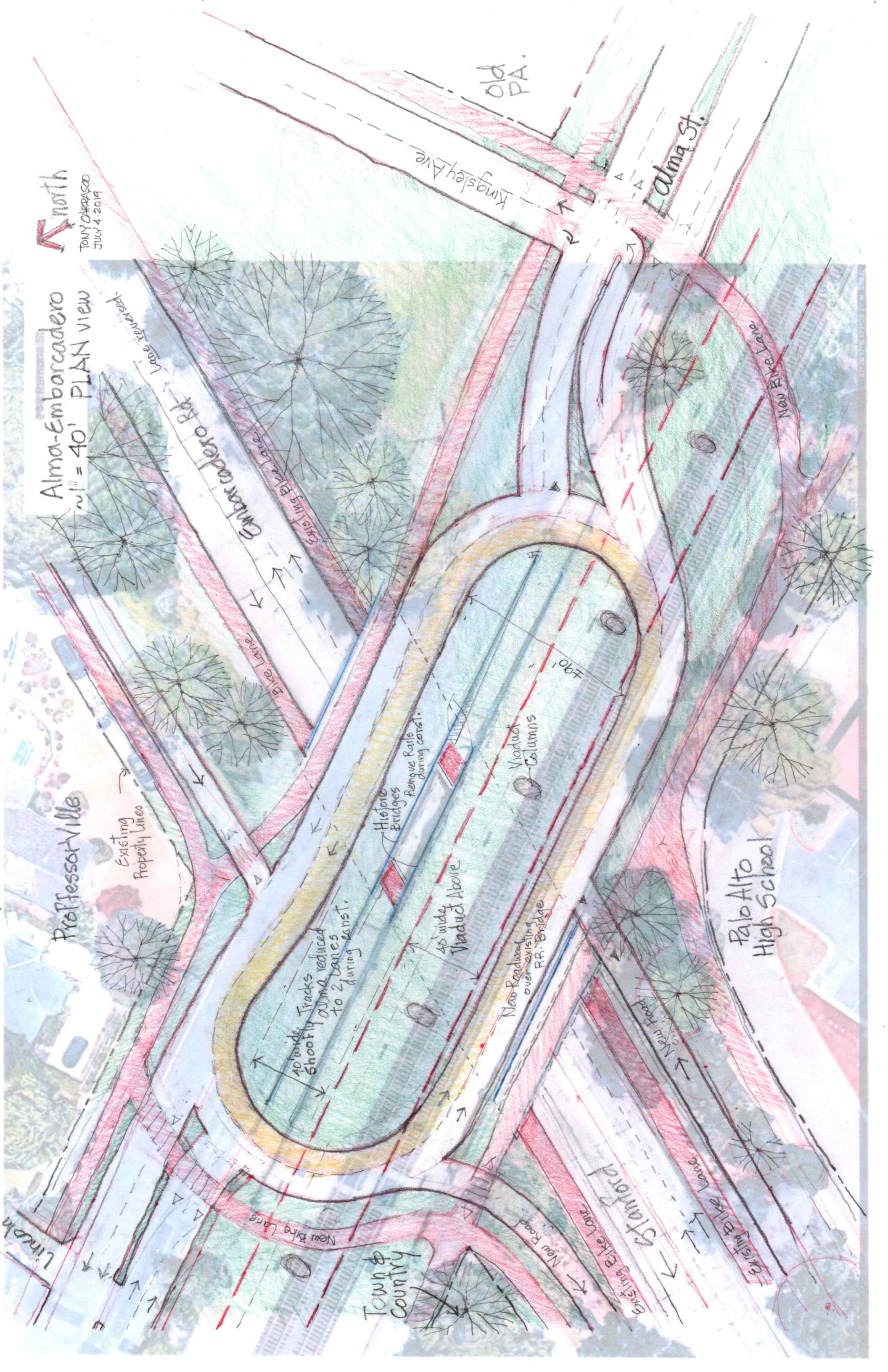
High St

This option is part of the Churchill Closure alternative.



North  
TONY CHARRASCO  
JULY 4, 2019

# Alma-Embarradero 1" = 40' PLAN VIEW



Professorville

Existing Property Lines

40' wide Shootly adma vedines to 2 during const.

Historic Bridges

Retrograde Railo during const.

40' wide Viaduct Above

New Roadway over existing R.R. Bridge

Viaduct Columns

Palo Alto High School

Town & Country

Stanford

New Road

New Bike Lane

New Road

Existing Elke Lane

Existing Bike Lane

New Bike Lane

Lane reversed

Embarradero Rd.

Existing Elke Lane

Bike Lane

Kingsley Ave

Old PA.

Alma St.

# Charleston/Meadow Underpass Concept

November 13, 2019

Elizabeth Alexis

# Why another alternative?

- Tunnel very pricey/ water impacts
- Hybrid likely VERY undercosted because of Caltrain work windows
  - 2% design typically excludes explicit phasing/ work window cost
  - Alma detours complicated
- Both alternatives likely to induce SIGNIFICANT new traffic

# Revisiting road undercrossing concept

- Two variations studied in 2014 by HMM
  - Lower Alma and Charleston - same intersection as today but sunken
  - Just lower Alma, no turns allowed
  - Assumed two lanes in each direction
  - Assumed VERY thick Caltrain bridge
  - Significant impacts to houses along Charleston/Meadow because of access issues
- Ignored Charleston/Arastradero concept
  - One lane in each direction
  - Extra lanes on Charleston/ Alma so cars can wait / get through lights/tracs
  - Very slow speeds/ several short merges
  - Possible to meter traffic because of signals in all directions

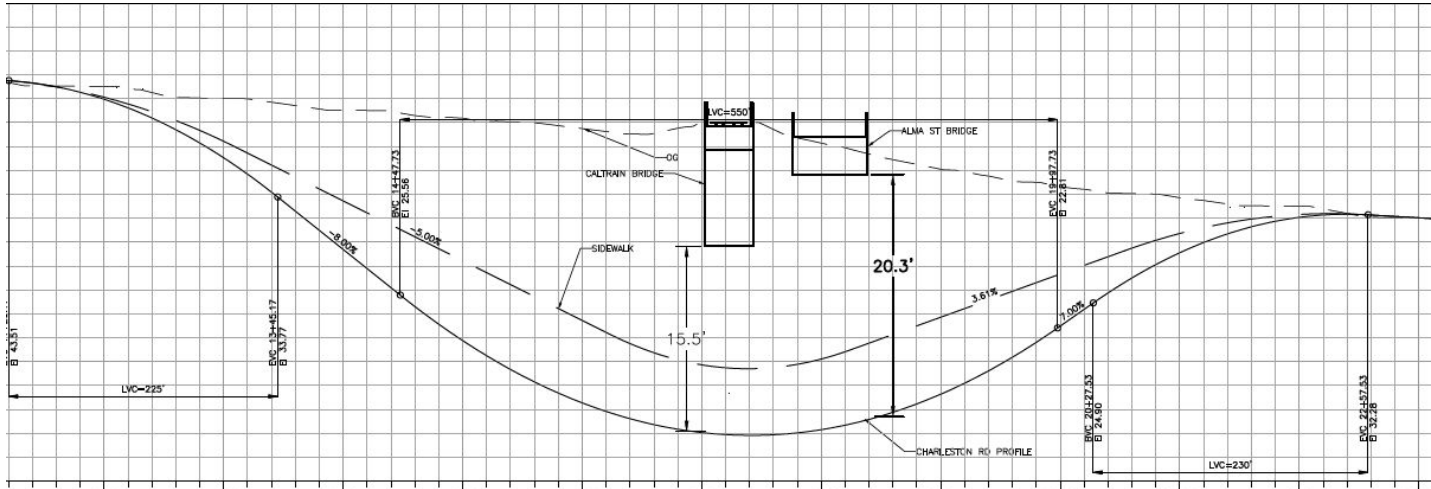
# Turn philosophy

- All turn movements on and off Alma should be possible
- All turns should be safe
- Design should accommodate but not encourage turns from Alma to West Charleston/ West Meadow
- Conflicts with bicyclists and pedestrians should be minimized

# Concept

- East-bound and west-bound single lane (plus bike/ped at split grade) underpasses
- Driveway access on ALMA for homes on Charleston
- Allow east-bound cars to U-turn at Wright Place
- Wright Place cul-de-saced to limit cut through traffic

# Original undercrossing plan

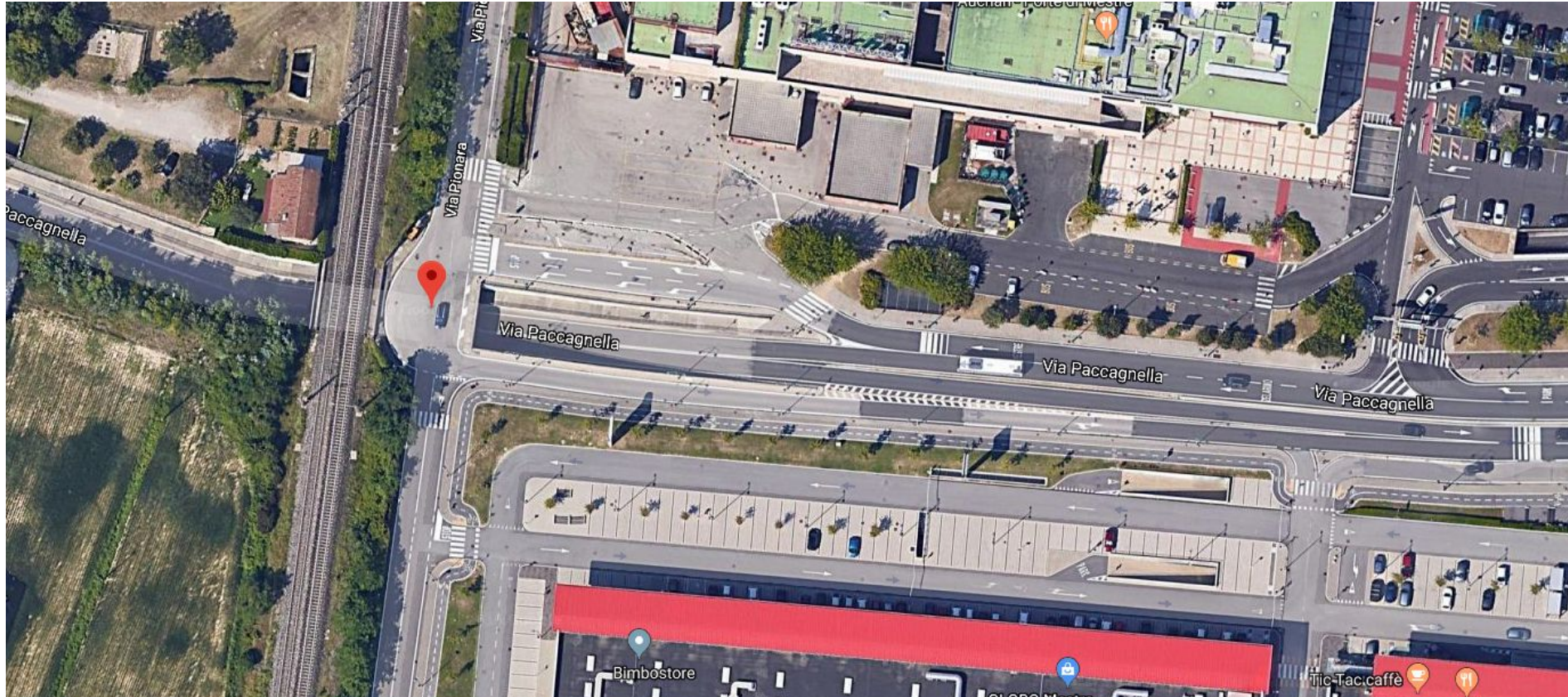




# Old school thin deck bridge



# Similar concept in Italy



# Road underpass in Italy



# Charleston/E. Meadow Two Lane Underpass Concept

Elizabeth Alexis  
December 4, 2019

# Why an underpass?

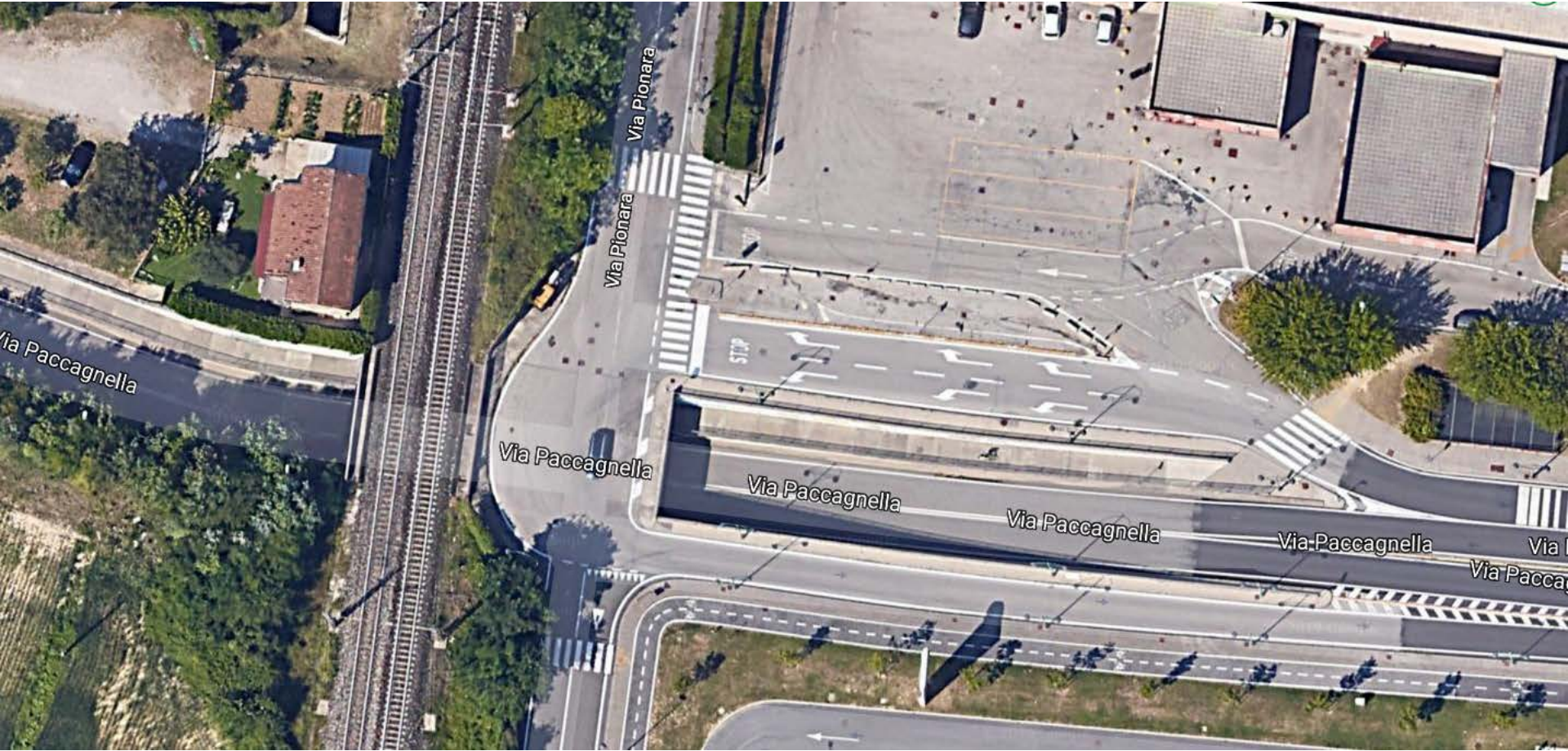
- VTA has strong preference for solution that leaves rail unchanged.
- Residents strongly opposed to solution that elevates rail
- Financial and technical concerns about tunnel or trench
- Cost (per HMM, 2014) for much more expensive version- less than \$50 million per crossing (ex ROW) - RWC underpasses < \$30 million
- MUCH CHEAPER, faster construction, consistent with C/A plan

# Idea

- Narrow two lane car underpass (10 foot lanes)
- Through traffic on Charleson/ E Meadow would go under Alma and the train tracks
- Separate two-way bike/ped underpass
- All turn movements allowed; some at Alma, other using “U-turn bay”, similar to how Hoover Elementary is accessed

# Previous underpass ideas (HMM, 2014)

- Four lane underpass with turns at Alma > required lowering of Charleston/Meadow AND Alma
- Four lane underpass without turns > assumed 80 foot wide underpass, acquisition of 29 homes, and 10 foot Caltrain “superstructure”



Via Paccagnella

Via Pionara

Via Pionara

Via Paccagnella

Via Paccagnella

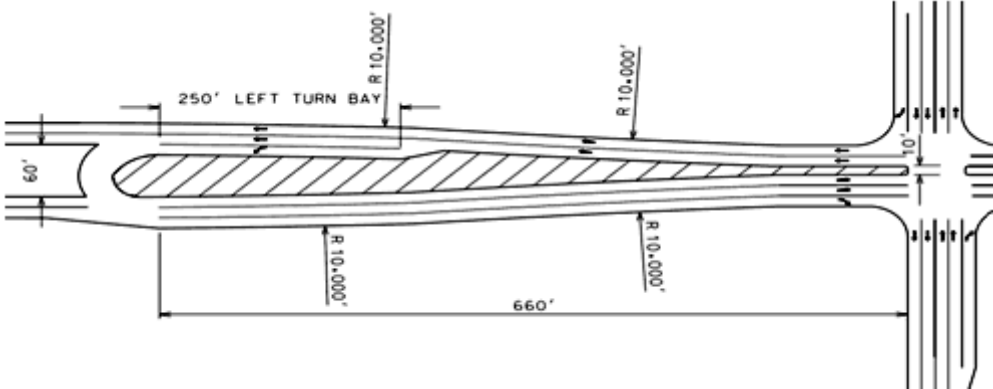
Via Paccagnella

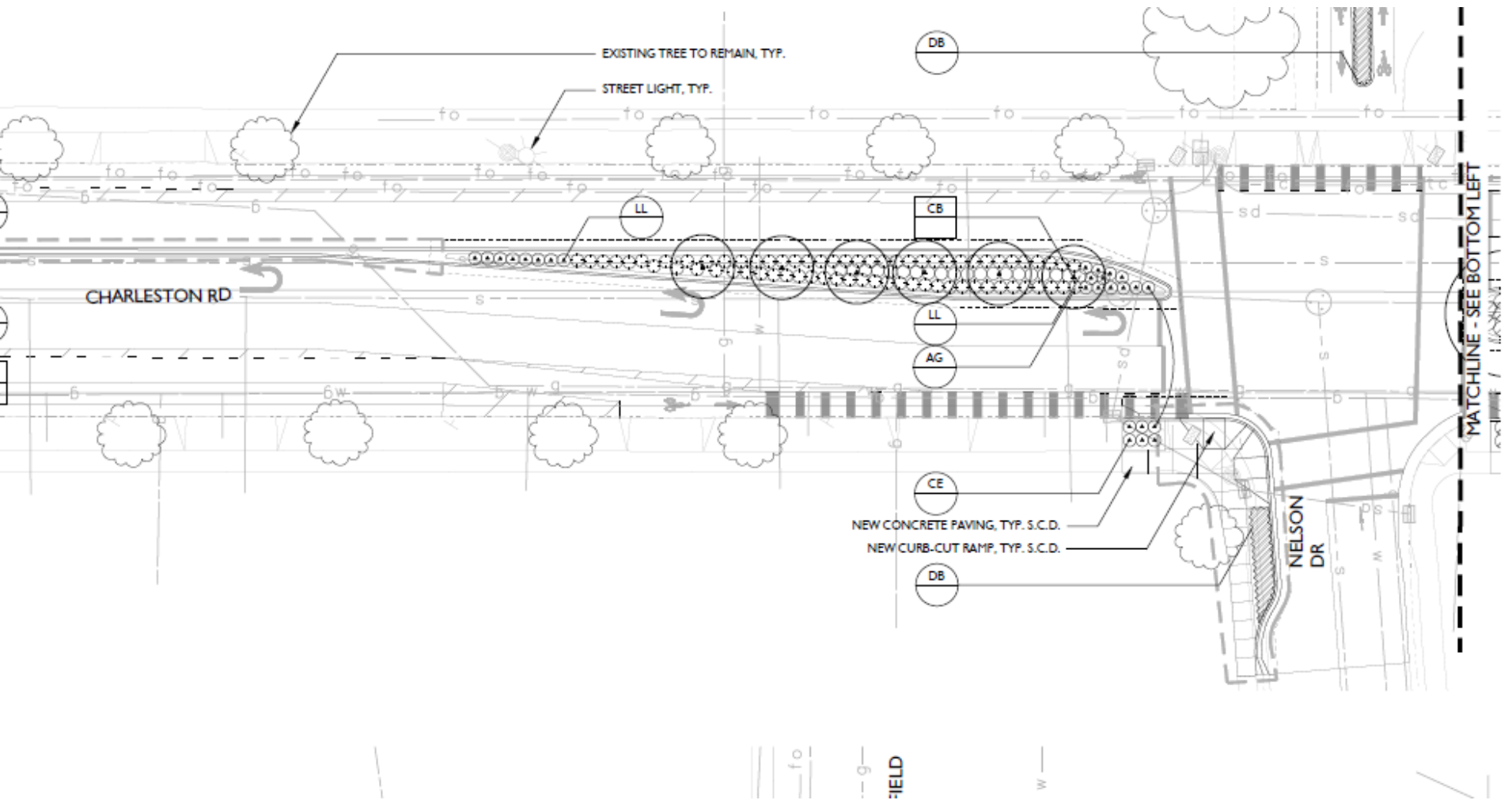
Via Paccagnella

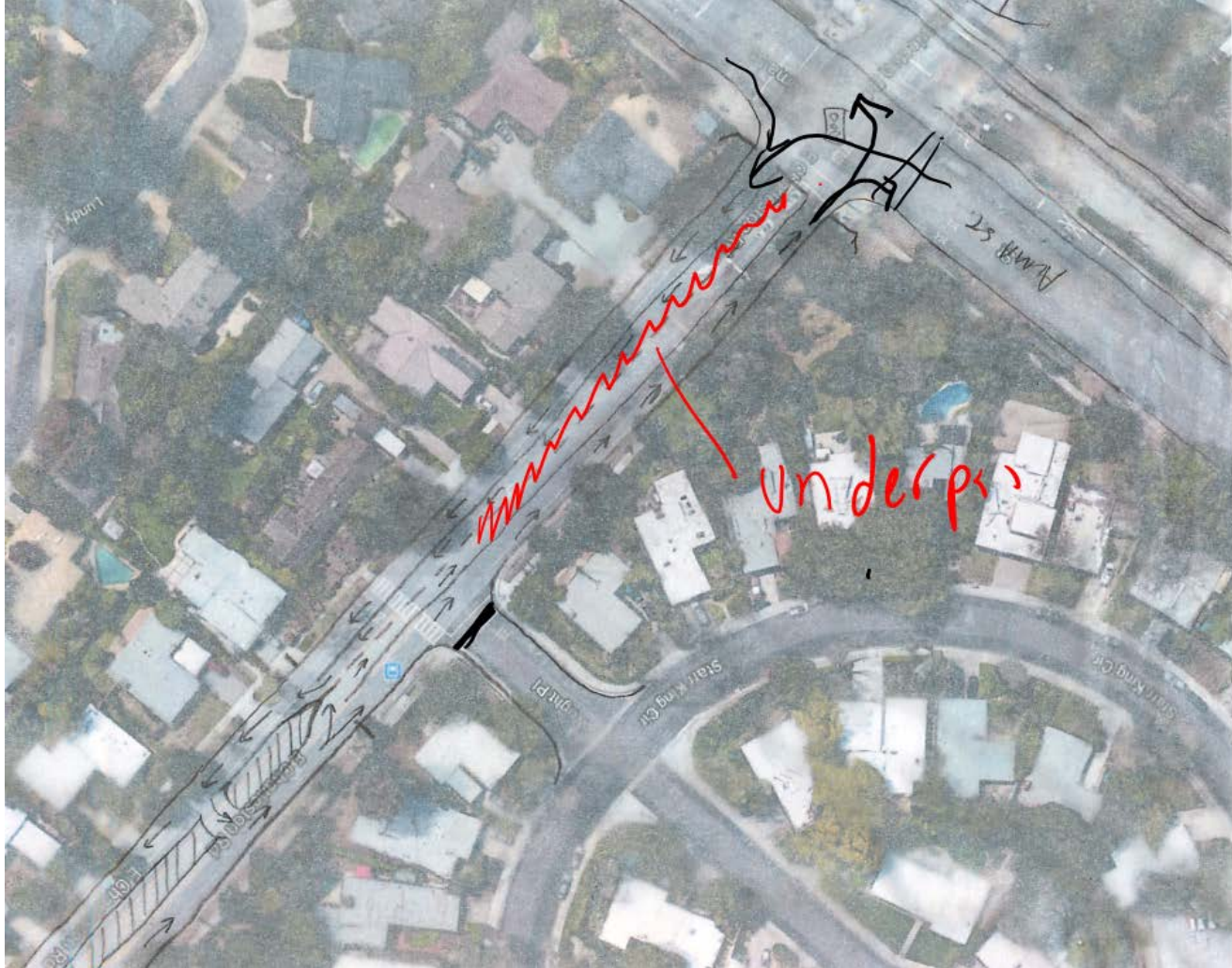
Via Paccagnella



# Use U-turn Bay for some turns







# Access for homes near Park Blvd

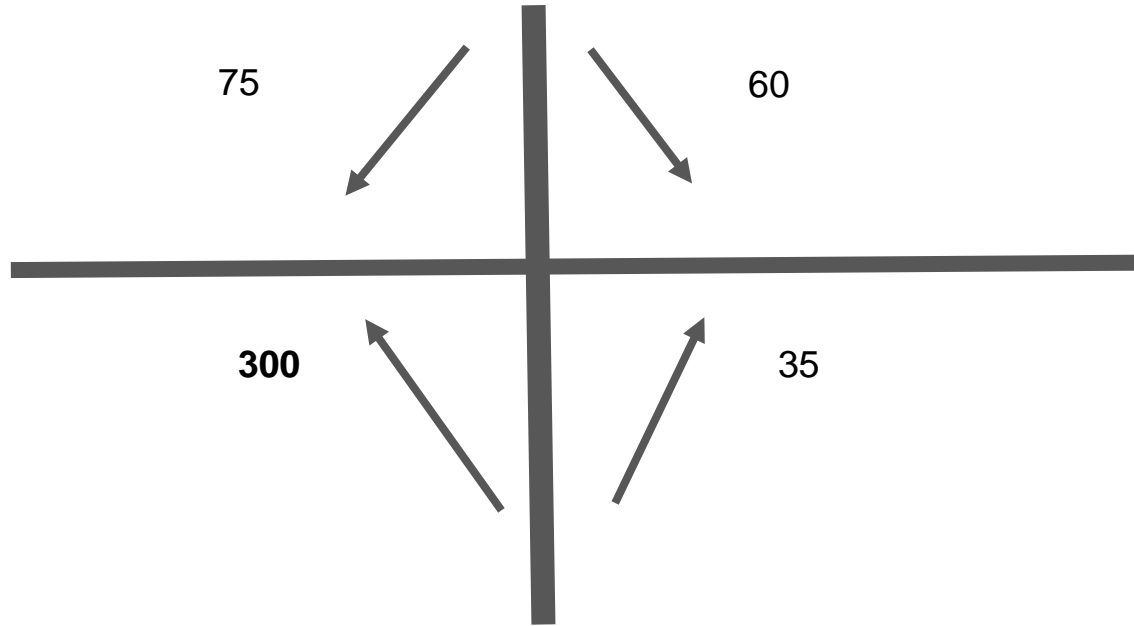


# Bike/ ped access

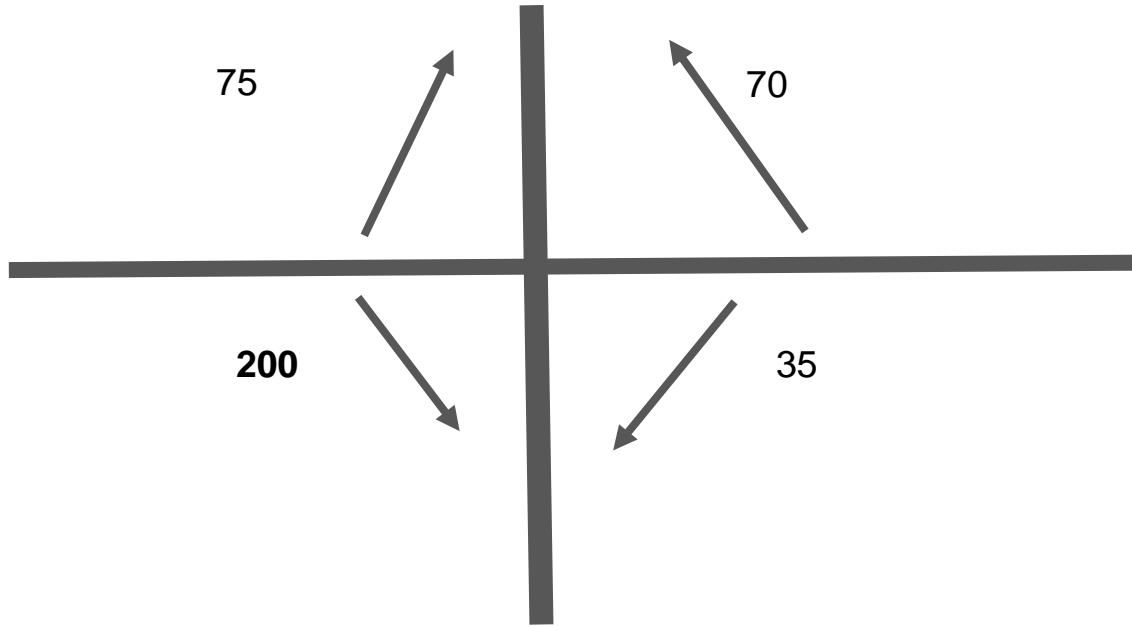
Separate two-way bike/ped underpass

- North side of Charleston
- South side of East Meadow

# Turns from Alma Peak hourly volumes



# Turns from Charleston hourly volumes



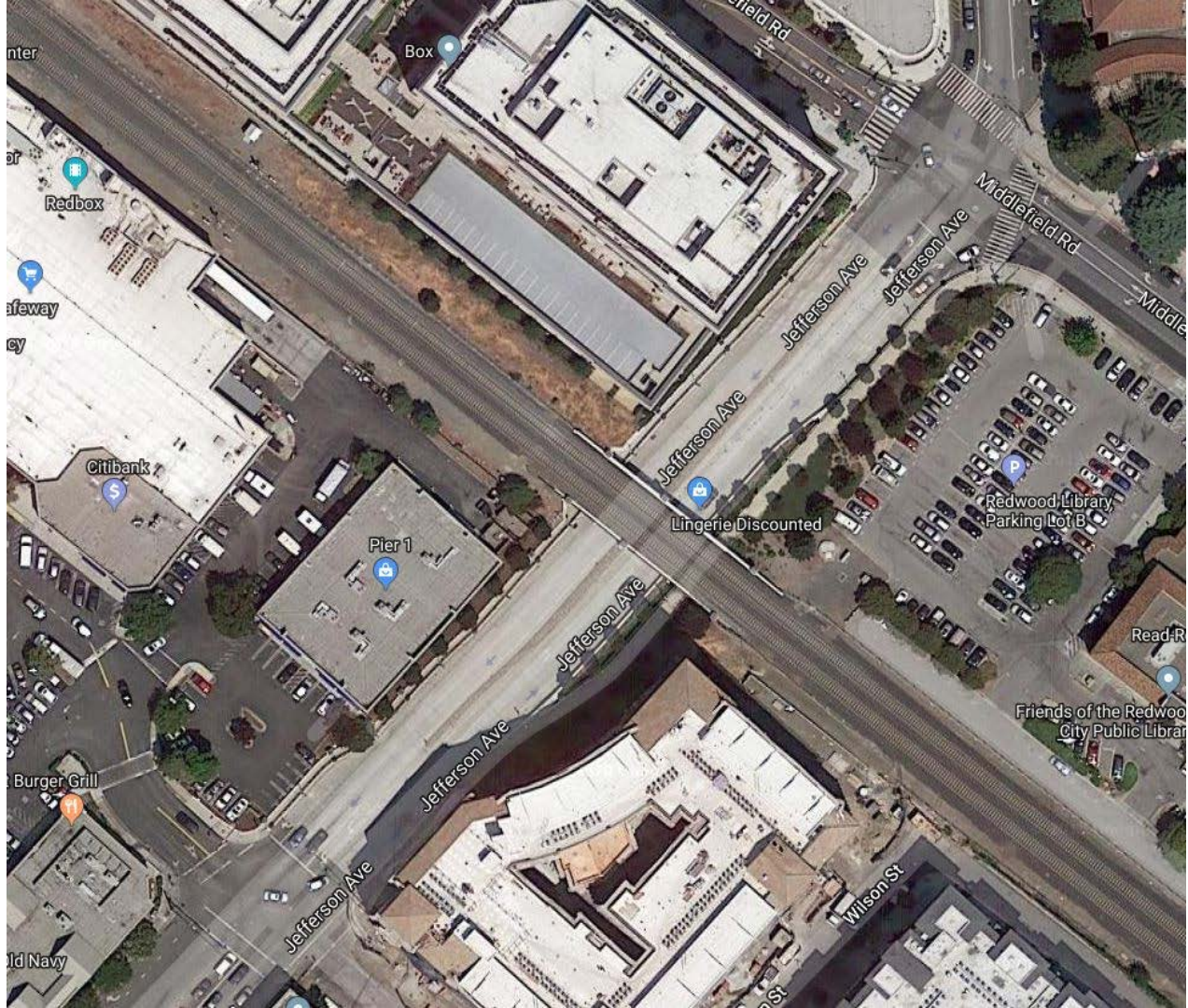






Golden State Family Dentistry/ Fara...

Google



December 18, 2019

XCAP Meeting

**Item #3: Discussion: Update from Technical Working Group Regarding Review of New Ideas/Iterations with Volunteer Civil Engineers and AECOM**

**Overview of Attachments for this Item:**

Item #3 has three (3) attachments, each with sub-attachments. The list of attachments and sub-attachments is included below:

**Attachment 1:** Memo from Nadia Naik with Technical Working Group Summary Notes

Attachment 1a: Memo from AECOM to the Technical Working Group from Dec. 5, 2019

**Attachment 2:** Email Memo from Retired Civil Engineer, Joe Teresi

Attachment 2a: Copy of the South Palo Alto Tunnel Fact Sheet

Attachment 2b: Regulatory Status of Local Creeks (from Joe Teresi)

**Attachment 3:** Email Memo from XCAP Member, Phil Burton

Attachment 3a: Palo Alto Design Criteria Report

Attachment 3b: Phil's Calculations for Vertical Curve

Attachment 3c: Design Standards for Vertical Clearances for Caltrain Electrification Project

If you have any questions, please contact staff at [transportation@cityofpaloalto.org](mailto:transportation@cityofpaloalto.org).

# **Attachment 1**

**To:** Expanded Community Advisory Panel (XCAP)  
**From:** Nadia Naik, Chair  
**Date:** December 12, 2019  
**Subject:** Notes and Update from Technical Working Group Regarding Review of New Ideas/Iterations with Volunteer Civil Engineers and AECOM  
**Agenda Item:** This relates to Agenda Item #3 on the December 18 XCAP Agenda

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### **XCAP Summary Meeting Notes**

**Date:** December 5, 2019  
**Location:** City Hall-1st Floor-City Council Conference Room

**Attendees:**

**City Staff:** Ed Shikada, Philip Kamhi, Chantal Gaines

**AECOM:** Ety Mercurio, Millette Litzinger, Peter DeStefano, John Maher

**Hexagon (Traffic):** Gary Black

**Volunteer Civil Engineers:** Sreedhar Rao, Joe Teresi, Edgar Ugarte, Ron Owes

**XCAP Tech Working Group:** Tony Carrasco, Phil Burton, Keith Reckdahl, Larry Klein, Nadia Naik

---

The XCAP Technical Working Group, the volunteer Civil Engineers and the AECOM team discussed with City Staff the new ideas previously presented at the XCAP meeting. In addition to the information presented in AECOM's memo (see attached), the group had the following observations:

#### **South Tunnel At-Grade Concept (Roland Lebrun)**

The idea was ultimately considered an iteration on an existing alternative/idea which has already been studied by AECOM. The group noted that if the XCAP/City Council recommended pursuing the South Palo Alto Tunnel option further, more detailed evaluation of the benefits presented by this iteration could be considered at that time.

#### **Embarcadero / Alma Roundabout and Viaduct (Tony Carrasco)**

This proposed idea was considered a new alternative with two options:

**Option 1:** placing a viaduct above the existing Embarcadero grade separation and using today's existing structure to create a roundabout.

**Option 2:** removing the existing Embarcadero grade separation, filling in the underpass, creating a new on-grade roundabout and building a viaduct over the roundabout.

Both options require a viaduct and would either a) require rebuilding the existing Embarcadero grade separation (Option 1) or b) demolishing the existing Embarcadero grade separation and filling in the underpass (Option 2).

The on-grade roundabout (Option 2) would require further study (for design, capacity) but could provide significantly more flexibility in mitigating traffic in the area.

It was noted that this concept could be considered for further study, but the cost of either option would likely be higher than the cost of each of the existing Churchill alternatives (viaduct and closure).

### **Churchill Crossing Concept (Mike Price)**

This concept was considered a new alternative that, if technically feasible, could be a cheaper alternative than a viaduct, but more expensive than the closure of Churchill.

There were some technical concerns related to road geometry (can it be engineered to allow enough space for buses to turn; is there enough space on the road; etc.) that need further evaluation. AECOM will try to come back with these quick checks prior to the December 18, 2019 XCAP Meeting.

### **Charleston/Meadow Underpass Concept (Elizabeth Alexis)**

This concept was considered a new iteration on an idea that was previously discarded (underpass). The group recognized that this concept requires further work to flesh out key components, but that it should be studied due to the potential benefits.

Significant cost savings compared to other alternatives are possible given that the train tracks do not move, thereby potentially eliminating the need for shoofly tracks. The AECOM engineers pointed out, however, that in the past, even on projects where only excavation under the tracks was done (such as Jefferson Ave. in Redwood City), there was still a shoofly track needed for safety reasons of excavating beneath an active rail line. Further information regarding the need for shoofly tracks for this concept would be needed to compare the potential cost of this concept relative to the existing alternatives proposed for Meadow and Charleston.

This alternative could potentially have a shorter construction period and have less disruption overall relative to other alternatives being considered.

Additional information relating to traffic patterns in the area of Meadow, Charleston and Alma would be necessary to evaluate whether this concept could work and whether there could be any property impacts.



AECOM  
100 West San Fernando  
San Jose, CA 95113  
aecom.com

**Project name:**  
Palo Alto Rail Program Management

**Project ref:**  
60577356

**From:**  
Milette Litzinger

**Date:**  
December 4, 2019

**DRAFT**

**To:**  
Ed Shikada, City Manager  
City of Palo Alto  
250 Hamilton Avenue  
Palo Alto, CA 94301

**CC:**  
Etty Mercurio, AECOM  
John Maher, AECOM  
Peter DeStefano, AECOM  
Gary Black (Hexagon)

## Memo

**Subject:** "New Ideas" from XCAP Technical Working Group

The Expanded Community Advisory Panel (XCAP) received and screened new ideas from the community at their November 13, 2019 Special XCAP meeting. In this meeting, they received New Ideas from five (5) community members. The XCAP voted to push forward ideas from four (4) of the presenters to their Technical Working Group for further review. The New Ideas that were pushed forward are listed below. Full descriptions of the New Ideas can be found under the "November 13, 2019 XCAP Special Meeting" at <https://connectingpaloalto.com/presentations-and-reports/>

- South Tunnel At-Grade Concept (Roland Lebrun)
- Embarcadero/Alma Roundabout and Viaduct (Tony Carrasco)
- Churchill Crossing Concept (Michael Price)
- Charleston/Meadow Underpass Concept (Elizabeth Alexis)

Below is a description of the distinguishing characteristics that AECOM used to review each New Idea and notable impacts related to the following categories:

- Geometrics/Structures
- Right of Way Requirements
- Groundwater/Stormwater Impacts
- Traffic/Access Circulation
- Safe Routes for Ped/Bikes
- Cost Effectiveness

## South Tunnel At-Grade Freight Concept (Roland Lebrun)

This concept is a variation of the South Palo Alto Tunnel At-Grade Freight alternative already being studied. Variations include:

- Begin tunnel 200 feet north of Matadero Creek.
- Reduce spacing between twin bore tunnel to 30 feet.
- Split the two freight tracks, one to each side of the trench/tunnel section

### Geometrics/Structures

- Extensive jet grouting would be required to accommodate the reduced spacing between the twin bore tunnels. impacting underground utilities. A geotechnical investigation is required to define ground improvement measures.
- Construction complications/inefficiencies due to restricted access for portal and boring construction activities.
  - a. The CPUC will not allow private at-grade crossings of the northbound track for construction and maintenance access.
  - b. Caltrain will not allow access across tracks during revenue hours.
- The permanent southbound freight trackway is within 3-feet of the western Caltrain right-of-way line and private properties (homes/backyards). There will be permanent freight train noise and vibration.

### Right of Way Requirements

- Similar to the other South Palo Alto Tunnel alternatives, subsurface acquisitions are required for ground anchors for the trench retaining walls and right of way acquisitions will be required to construct pump stations.

### Groundwater/Stormwater Impacts

- Adobe Creek will be impacted. Matadero Creek will not be impacted.
- Extensive jet grouting will impact ground water flow and containment of existing contaminated plumes.
- Pump station required to dewater the trench and tunnel.
- Numerous regulatory agency approvals required for creek diversions.

### Traffic/Access Circulation

- Alma St. permanently reduced to three lanes at the South Portal.

### Safe Routes for Ped/Bikes

- Pedestrian and bicyclists are separated from passenger train traffic only.

### Cost Effectiveness

- This alternative will still be in the billions of dollars range (greatest level of local funding) and will not eligible for grade separation funding as the at-grade crossing for freight would remain.



## **Embarcadero/Alma Roundabout and Viaduct (Tony Carrasco)**

This concept includes a roundabout at the Embarcadero/Alma, allowing all turning movements to/from Embarcadero and Alma.

### **Geometrics/Structures**

- The rail has to be raised 20+ feet over its current elevation over Embarcadero, creating a 3-level “interchange”. As a result, the rail impacts extend about 1,000 feet further north than the Churchill viaduct.
- The existing rail and road bridges over Embarcadero would have to be demolished and reconstructed to accommodate a wider structure needed for a roundabout.
- The aforementioned wider structure would likely require lowering of Embarcadero itself (doable, but added cost).

### **Right of Way Requirements**

- Right-of-way impacts on the west side are likely (at Palo Alto High School and the Town and Country shopping center).

### **Groundwater/Stormwater Impacts**

- New pump station required at Embarcadero.

### **Traffic/Access Circulation**

- Queues from the left turns onto Kingsley (from SB Alma) could back up into the circulatory roadway of the roundabout, impacting the roundabout itself, in addition to this being a safety issue too (sudden, unexpected stopping of vehicles).
- A private driveway would have to be accessed from the circulatory roadway of the roundabout (done in some cases, but certainly not desirable).
- Merging from the roundabout onto WB Embarcadero is problematic (sight distance is limited, plus there's not much distance to weave into the adjacent lane to make a left turn into the high school).

### **Safe Routes for Ped/Bikes**

- Big roundabouts are typically difficult for ped/bikes to navigate.

### **Cost Effectiveness**

- We have another alternative (the intersection at Kingsley/High) to address traffic circulation at Embarcadero/Alma that functions better and costs much less.

## Churchill Crossing Concept (Michael Price)

This concept partially closes Churchill Avenue, but preserves access to Alma.

### Geometrics/Structures

- The “split” of the roadway on NB Alma and EB Churchill introduces a fixed object in the road (end of the retaining wall), but we should be able to design this so that it’s not a safety hazard.
- The retaining walls on Alma will be tall (~20 feet Max) and will have a tunnel-effect. Providing left and right shoulders would be ideal, especially 8 to 10-foot right shoulders for disabled vehicles, but we may not have room for that.
- Need to evaluate a profile on Churchill to see if there’s an impact to the Churchill/Paly/Castilleja intersection. At first glance, it appears we can avoid lowering this intersection.
- Since there are no ped/bikes on Alma and Churchill (under the tracks), we can be more aggressive with the road profile and use 10-12% Max. This will help reduce the construction limits and cost.
- The bridge geometry and lane configurations need to be hashed out. We’ll need two through lanes on NB Alma.

### Right of Way Requirements

- Potentially none except for Temporary Construction Easements.

### Groundwater/Stormwater Impacts

- Pump Station will be needed to drain the lowered Churchill/Alma intersection.

### Traffic/Access Circulation

- This concept will create circuitous routes for some and introduce more traffic on residential streets.
- Several traffic movements are eliminated... likely to cause driver confusion for those not familiar with the configuration:
  - a. Traffic from WB Churchill must turn right onto NB Alma
  - b. No thru-movement allowed on Churchill
  - c. Traffic from SB Alma cannot make a left onto EB Churchill
  - d. Traffic from NB Mariposa cannot access Churchill (vehicles would have to turn around). Residents on Mariposa (south of Churchill and north of Miramonte) would be forced to travel south, generating more traffic on other Southgate neighborhood streets (Castilleja Ave and Miramonte Ave).
  - e. One private driveway on Churchill (between Castilleja and Mariposa) will front a one-way “frontage” road (traveling north), which will force them to travel north and make a right onto Mariposa to exit the Southgate neighborhood.
  - f. Left turns not allowed from WB Churchill onto Mariposa (same condition as today).

### Safe Routes for Ped/Bikes

- Grade separation for motor vehicles is not ped/bike friendly, so need a separate undercrossing for ped/bikes (similar to the current Option 1 for the Churchill closure). Need more information on the proposed bike/ped at grade concept in this idea.

### Cost Effectiveness

- This idea is more costly than a closure of Churchill, but potentially less costly than the Churchill viaduct.

DRAFT: For Discussion Only

## **Charleston/Meadow Underpass Concept (Elizabeth Alexis)**

This concept provides a grade separation at Charleston and Meadow without raising the tracks.

### **Geometrics/Structures**

- The east/west through movements would pass under two structures (one for the railroad, one for Alma St), similar to Embarcadero today.

### **Right of Way Requirements**

- The presentation infers no property impacts, but the width needed to accommodate the turning movements (the u-turn bay, for example) for truck/buses will likely require sliver takes (at the very least) or complete property acquisitions.
- Slide 8 does not show standard merge distances, so the footprint (along M/C) would likely be much larger than presented on this slide.

### **Groundwater/Stormwater Impacts**

- Same as other underpass options... a pump station will be needed to drain the lowered roads.

### **Traffic/Access Circulation**

- A circuitous route is proposed for EB vehicles on Charleston and Meadow.
- Road geometry would have to be hashed out to ensure queuing of vehicles (for the u-turn movement, for example) does not impact through movements.

### **Safe Routes for Ped/Bikes**

- The "split" of Meadow and Charleston will create a conflict between peds/bikes and motor vehicles, i.e., peds would be on the outside of the road approaching the railroad, but then cross one lane of (moderately high speed) traffic to get to the inside lane (to enter the underpass section of M/C).

### **Cost Effectiveness**

- The property impacts will likely make this concept more costly than the Hybrid alternative, and thus, potentially cost prohibitive.

# **Attachment 2**

## Gaines, Chantal

---

**From:** jtnia@comcast.net  
**Sent:** Friday, December 6, 2019 5:20 PM  
**To:** 'Nadia Naik'; Gaines, Chantal  
**Subject:** Follow-up comments from yesterday's Technical Working Group meeting  
**Attachments:** Factsheet\_PA\_South\_Tunnel\_Opt\_1\_Nov2019.pdf; Regulatory Status of Local Creeks.docx

Nadia,

It was great to meet you and the other Working Group members at yesterday's meeting. Here are a few follow-up comments based on my work experience and knowledge of the City's creeks and storm drain system:

1. The project alternatives that include the obstruction of one or more of the City's creeks are not necessarily fatally flawed, but they introduce large technical challenges and increased risk of threats to public safety (flooding).
2. Although the City's storm drain system includes eight pump stations (the ninth station that I mentioned yesterday is actually owned and maintained by Santa Clara County [Oregon Expressway Underpass]), these involve flows that are an order of magnitude smaller than either Matadero or Adobe Creeks. The largest storm water pump station pumps a 96-inch diameter storm drain into San Francisquito Creek downstream of Highway 101 at a peak rate of 300 cubic feet per second (cfs). As a comparison, the estimated peak (1% or 100-year) flow on Matadero Creek is 2500 cfs and the peak flow on Adobe Creek is 2000 cfs. Storm water pump stations typically handle flows from a localized low point (e.g. a roadway underpass) or a relatively small storm drain tributary area (i.e. up to around 1,500 acres), whereas a creek drains an entire upstream watershed of multiple square miles.
3. The idea of an inverted siphon to carry either creek under a new railroad tunnel or trench is more practical than a pump station, although there are several downsides/risks inherent in this approach. The enormity of the pump station(s) that would be needed to pump the full flow rate of either creek is overwhelming, particularly due to the constrained site conditions in the narrow railroad corridor. A properly-designed inverted siphon would work hydraulically, but it has many downsides. A small pump station to periodically dewater the siphon would likely still be necessary from a maintenance standpoint. The inverted siphon would likely present a difficult maintenance challenge, as it would tend to fill up with debris and sediment that may not be able to be pumped out, but rather would require periodic removal by maintenance crews. There could also be odor problems and accumulation of stagnant anaerobic water, although that could be controlled by periodically pumping out the contents of the siphon. There is also the increased risk due to the potential blockage or other failure of the siphon, which could result in large-scale flooding of upstream areas. The flood risk is exacerbated by the presence of the railroad embankment which prevents the flow of surface waters towards the Bay and has the potential to impound deep ponded water behind it. Impounded water could also potentially find its way into the railroad tunnel, which could overwhelm the relatively small dewatering pumps likely envisioned in the tunnel design. There is some historical precedent that reinforces the concept of this flooding risk. Namely in 1998, there was significant flooding (including the filling of an underground parking structure) along Park Boulevard just south of Page Mill Road that was caused by the overflow of either the storm drain system or Matadero Creek upstream of the railroad tracks. Some of the impounded flood waters also found their way into the Oregon Expressway underpass, worsening the flooding of that facility.

4. Another large challenge to the creek siphon concept would be the permitting & approval process. Needless to say, placing a regional creek into an inverted siphon although not unprecedented is certainly not standard practice. There will likely be strong resistance from the owner of the two subject creeks – the Santa Clara Valley Water District. As was mentioned by the AECOM reps yesterday, the initial response to the idea of an inverted siphon from District staff was negative, and there was a preliminary suggestion that if such a plan were implemented that the District would defer maintenance (and likely liability) to the City. Besides the District, the rerouting of the creek would also require approvals/permits from the Federal Emergency Management Agency, US Army Corps of Engineers Section 404 permit, State Department of Fish and Wildlife Stream Alteration Agreement, and Regional Water Quality Control Board Section 401 Water Quality Certification. I am not sure how these multiple agencies would respond to such a non-standard design concept. There would likely be water quality, flood risk, as well as fish & wildlife concerns expressed. FEMA is very averse to any flood control mechanism that is subject to failure. At the very least, they would require the submittal of a robust and fully-funded Operations and Maintenance Plan to show how a potential blockage of the siphon would be detected and corrected in such a way as to avoid flooding. Several areas along Adobe and Matadero Creeks upstream of the railroad tracks were removed from the FEMA-designated floodplain in the late 1980's-early 1990's as a result of Santa Clara Valley Water District flood control projects. Any risk of returning these areas to the floodplain (which results in federally-mandated flood insurance and restrictions to building improvements/remodels) would create a huge public outcry. Even though there is not a lot (if any) fish & wildlife habitat in the concrete channels of Matadero and Adobe Creek in the vicinity of the railroad tracks, the resource agencies have published "listings of beneficial uses" for these two creeks that will limit the ability to make any design changes that could threaten fish & wildlife habitat. The attached document includes the "listed beneficial uses" for the two creeks in the Regional Board's San Francisco Bay Basin Plan.
5. I have also included an annotated version of the South Palo Alto Tunnel Fact Sheet showing creek segments that closely parallel the railroad tracks and storm drain pipelines and box culverts that either closely parallel the tracks or cross beneath them. I highlight these in order to make AECOM aware of them as potential design challenges (e.g. could these create the need for additional protective shoring during construction and/or additional siphons to accommodate existing flow patterns?). These are in addition to all the other challenges that will be encountered in addressing other utility conflicts with the myriad existing water, gas, sanitary sewer, electric, telephone/cable/communications, fiber optic facilities in the project vicinity.

I hope that this information is helpful to the group. If anyone has questions regarding the City's storm drain system or the local creeks, I would be happy to attempt to answer them as best as I can. Thanks for the opportunity to contribute to the review of this monumental challenge/opportunity facing the City and its residents.

Cheers,  
Joe Teresi  
Retired Civil Engineer  
Retired City of Palo Alto employee

## RAIL FACT SHEETS

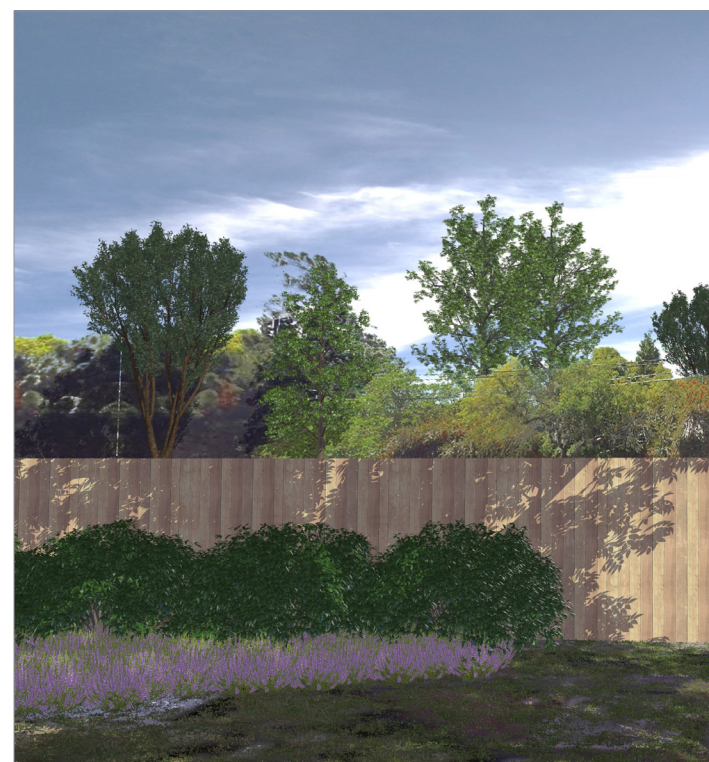
# South Palo Alto Tunnel – Passenger & Freight



Proposed Ground Level View - Looking Southwest Charleston Road Intersection



Proposed Tunnel Aerial View - Looking South



Proposed Backyard View - Looking East Typical Property West of Tracks

### What is a tunnel with passenger and freight?

For the tunnel alternative, the railroad tracks will be lowered in a trench south of Oregon Expressway to approximately Loma Verde Avenue. The twin bore tunnel will begin near Loma Verde Avenue and extend to just south of Charleston Road. The railroad tracks will then be raised in trench to approximately Ferne Avenue. The new electrified southbound railroad tracks will be built at the same horizontal location as the existing railroad track, however, the northbound track will be moved to the east within the limits of the tunnel to accommodate the spacing required between the twin bores. The railroad tracks will carry both passenger and freight trains as it does today.

The roadways at Meadow Drive and Charleston Road remain at their existing grade and will have a similar configuration that exists today with the addition of Class II buffered bike lanes on Charleston Road. This will require expanding the width of the road to maintain bike lanes through the overpass of the railroad.

### By the numbers

- Diameter of twin bores is 34 feet.
- Railroad track is designed for 110 mph.
- Meadow Drive and Charleston Road are designed for 25 mph.
- Maximum grade on railroad is 2%.
- Travel lane widths are 10-12 feet.
- Bike lane widths are 5-6 feet.
- Construction period is approximately 6 years.

### Engineering Challenges

- A non-standard grade of 2% will be required on tracks. Caltrain's preferred maximum grade is 1%.
- Lowering of the tracks will require diversion of Adobe and Matadero creeks, resulting in the need for lift stations/siphons and numerous regulatory agency permits/approvals. Negotiations with the regulatory agencies will be lengthy and difficult since there are other "least impacting" alternatives that could be considered.
- Pump stations will also be needed for dewatering since the tunnel will be below the ground water level.
- Increased long term maintenance costs and risk of flooding due to pump stations.
- Major utility relocations are required for the lowered railroad.

### Neighborhood Considerations

- During construction, Alma Street will be reduced to one lane in each direction from south of Oregon Expressway to Ventura Avenue. From Charleston Road to Ferne Avenue, there will only be one southbound lane.
- The train tracks will be approximately 60 feet below the existing grade in the tunnel section. A high fence will be required along trench walls.
- With grade separations at Meadow Drive and Charleston Road the traffic at nearby intersections is expected to improve.

### Cost Breakdown

Roadway & Railroad Items	\$764M to \$1,146M
Right-of-way & Utilities	\$6M to \$10M
Support Costs	\$236M to \$353M
Escalation from 2018 to 2025 dollars	\$212M to \$318M
<b>TOTAL PROJECT COSTS</b>	<b>\$1,218M to \$1,827M</b>

Preliminary and subject to change. Maintenance costs and relocation of fiber optic lines not included.



Milan Metro Line, Italy

For more Rail Fact Sheets visit:  
<https://connectingpaloalto.com/fact-sheets/>



## Evaluation with City Council-Adopted Criteria

### Facilitate movement across the corridor for all modes of transportation

Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.

### Reduce delay and congestion for vehicular traffic at rail crossings

With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by railroad crossing gates.

### Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles

Pedestrians/cyclists will be separated from train traffic.

### Support continued rail operation and Caltrain service improvements

A temporary railroad track will be required at the boring pit areas to the north and south. A siding track will be relocated north of the California Avenue Caltrain Station. Due to the pump stations, there will be potential risks to train operations due to flooding.

### Finance with feasible funding sources

The tunnel will require the greatest levels of local funding in the form of fees, taxes or special assessments, the feasibility of which are still being studied in the context of overall citywide infrastructure funding needs.

### Reduce rail noise and vibration

Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing electric engines instead of diesel engines will also reduce noise. In the trench section, train noise could reflect off walls and impact properties farther away, which can be mitigated. In the tunnel section, train wheel noise will be contained.

### Minimize visual changes along the corridor

Railroad tracks will be below grade with high fencing at-grade in the trench section. Landscaping options will be limited to plants with shallow roots in areas where ground anchors are required for the trench section.

### Maintain access to neighborhoods, parks, and schools along the corridor while reducing regional traffic on neighborhood streets

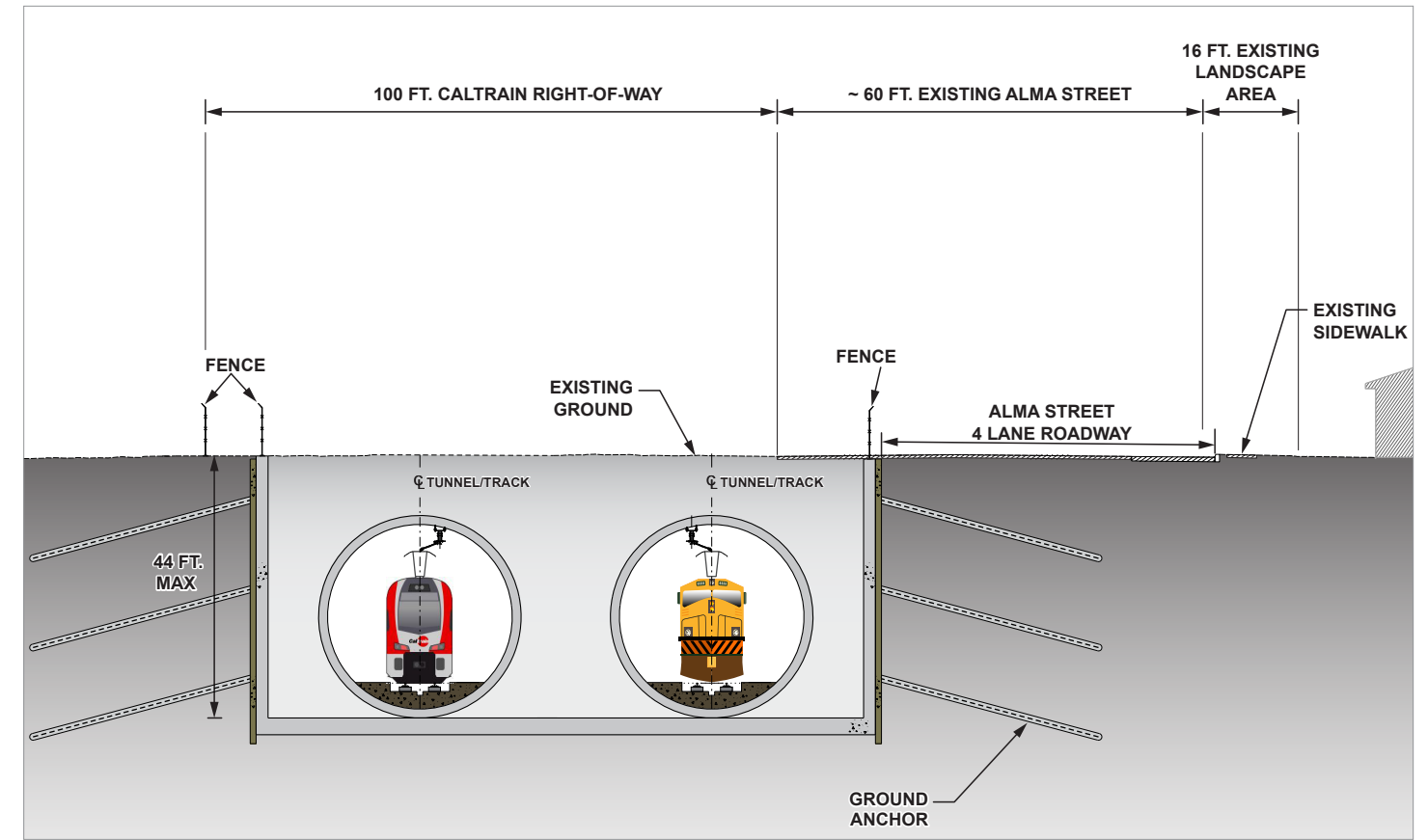
No diversion of regional traffic with construction of a grade separations.

### Minimize right-of-way acquisition

Subsurface acquisitions will be required for the ground anchors for the trench retaining walls and right of way acquisitions will be required to construct pump stations.

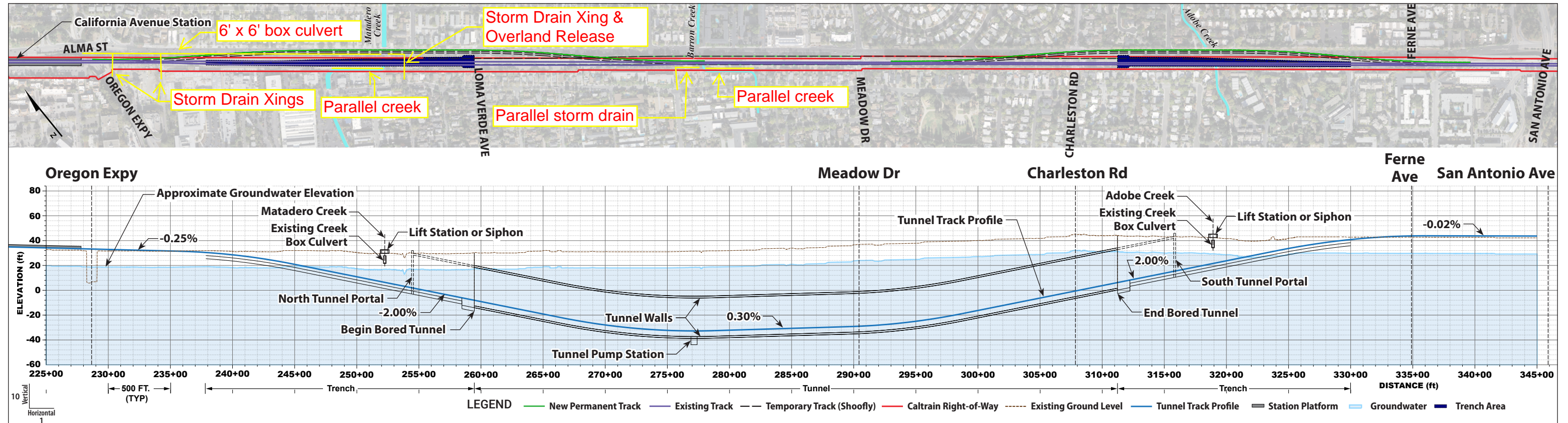
### Minimize disruption and duration of construction

Extended lane reductions on Alma Street are required. Construction would last for approximately 6 years.



Example Section - South Portal Tunnel - Looking North

## Concept Plan and Profile



For more renderings, plans and animations visit: <https://connectingpaloalto.com/renderings-plans-and-animations/>

## Regulatory Status of Local Creeks

Document provided by Joe Teresi, December 2019

### Matadero Creek – Existing Beneficial Uses

- Cold Freshwater Habitat (COLD)
- Warm Freshwater Habitat (WARM)
- Fish Migration (MIGR)
- Fish Spawning (SPWN)
- Preservation of Rare and Endangered Species (RARE)
- Wildlife Habitat (WILD)
- Water Contact Recreation (REC-1)
- Noncontact Water Recreation (REC-2)

### Adobe Creek – Existing Beneficial Uses

- Cold Freshwater Habitat (COLD)
- Warm Freshwater Habitat (WARM)
- Wildlife Habitat (WILD)
- Water Contact Recreation (REC-1)
- Noncontact Water Recreation (REC-2)

### Permitting Agencies for Channel Modifications

- Federal Emergency Management Agency
- Santa Clara Valley Water District
- State Department of Fish & Wildlife Stream Alteration Agreement
- Regional Water Quality Control Board Section 401 Water Quality Cert
- US Army Corps of Engineers Section 404 Permit

# **Attachment 3**

## Gaines, Chantal

---

**From:** Phil Burton <philip-b@comcast.net>  
**Sent:** Thursday, December 12, 2019 12:32 PM  
**To:** 'Nadia Naik'; Gaines, Chantal  
**Subject:** for agenda item #3 - vertical curve and vertical clearance issues  
**Attachments:** Palo Alto Design Criteria 20190807\_FINAL.PDF; Vertical Curve calculations.xlsx; Design Standards for Vertical Clearances for Caltrain Electrification Pr....docx

Chantal,

This email and the attachments should be part of item 3 of the agenda for the next meeting.

The vertical curve issue is the length of the transition between a level grade and a grade of 1% or 2%, as examples. According to the attached document, Palo Alto Design Criteria, Caltrain uses different formulas to calculate the vertical curve transition for passenger and freight trains. The attached spreadsheet, Vertical Curve calculations.xlsx, shows the required transition lengths for passenger trains at 110 mph and freight trains at 50 mph. Note that for a 2% grade, the required transition length is 578' for passenger trains and 1075' for freight trains, almost twice the length required for passenger trains.

At a freight train design speed between 35 and 40 mph, the required freight train transition length would be the same as for passenger trains at 110 mph. While 50 mph may be a reasonable design speed for fast, high-value freight trains operating for long distances, the freight service on the Peninsula is "local" traffic of mostly low-value bulk commodities with some container traffic, and a reasonable lower speed through Palo Alto would not create a big impact on overall running times. It is not even clear that current Union Pacific freight trains even operate over 35 or 40 mph on Caltrain tracks. Temporary or permanent speed restrictions due to local conditions are common on the US rail network.

The issue here is that all the alternatives under consideration, for all three grade crossings, require vertical curve transitions. If the transitions can be shortened to the passenger train length, there could be considerable construction savings. In addition, shoofly track lengths could be shortened. For the South Palo Alto tunnel, it is possible (but I have not verified) that a revised design might avoid the creeks, especially in combination with a smaller tunnel inner diameter

The vertical clearance issue is much harder to pin down because I have not been able to find a single source for this design standard for the spacing between top of rail and the overhead contact wire for power distribution.

I have created a document, Design Standards for Vertical Clearances for Caltrain Electrification, to summarize what I have been able to learn about vertical clearance standards. Clearly the CPUC standard of 34' is not controlling.

Caltrain standard is to design for AAR Plate H, for a max car height of 20' 3".(Association of American Railroads.) A "plate" is a cross-section of a freight car, for various kinds of cars, to ensure that certain kinds of

cars, e.g. normal boxcars or “double stack” shipping container cars, can operate over all most of the mainline freight lines in the US.

In the absence of a Plate H requirement, Caltrain would effectively be operating according to Plate B, a maximum of 15’ 1”. 15’ is also the approximate height of the EMUs that Caltrain is planning to order for electrified service. (need verification of this point). Plate B is sufficient for the hopper and container cars that constitute freight service on Caltrain tracks. Even Plate F may be overdesign for freight train operation on Caltrain tracks.

However, due to existing clearance restrictions and the nature of current rail traffic, it isn’t clear that current freight traffic can even allow double-stack container cars, only normal container cars. Even if clearances were not an issue, there would still be considerable investment at container car loading/unloading locations to support double-stack container shipments. Shipment volumes would probably not justify such investments.

A 5’ reduction in vertical clearance would result in construction cost savings for the Meadow/Charleston trench alternative, and for the South Palo Alto tunnel alternatives due to a potentially smaller tunnel diameter. Further, for all alternatives, the poles needed to support the catenary structure that holds the overhead power contact wire could be lower, with cost and visual impacts.

see p. 5 for vertical curves - differences  
between pax and frt.

**FINAL**

Preliminary Engineering

**Grade Separations**

**Design Criteria**

Palo Alto Rail Program  
Management Services

AECOM Project Reference: 60577356  
City of Palo Alto Contract Number: C18171057

**August 7, 2019**

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## Distribution List

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	X	City of Palo Alto/Ed Shikida, Chantal Gaines
	X	Caltrain/Melissa Reggiardo, Jim Lightbody
	X	AECOM/Ety Mercurio, John Maher, Elliot Wong
	X	AECOM/Millette Litzinger, Peter DeStefano

**Prepared for:**

City of Palo Alto  
Ed Shikida, City Manager  
250 Hamilton Avenue  
Palo Alto, CA 94301

**Prepared by:**

AECOM  
300 Lakeside Drive  
Suite 400  
Oakland  
CA 94612  
aecom.com



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# 1. Introduction

The City of Palo Alto is conducting technical analysis of alternatives coupled with a comprehensive community and stakeholder engagement process aimed at identifying and implementing locally-preferred alternatives for modification to the four existing at-grade crossings in Palo Alto. The four existing at-grade crossings are located at Palo Alto Avenue, Churchill Avenue, Meadow Drive and Charleston Road in Palo Alto.

## 2. Terms and Definitions

This section provides standardized definitions for the terms used in this Design Criteria document. It also identifies frequently used abbreviations and acronyms.

### 2.1 Acronyms

AASHTO	American Association of State Highway and Transportation Officials
APN	Assessor's Parcel Number
AREMA	American Railway Engineering and Maintenance-of-Way Association
CAD	Computer Aided Design
CBC	California Building Code
CBDA	Caltrans Bridge Design Aids Manual
CBDD	Caltrans Bridge Design Details Manual
CGP	Construction General Permit
CHSTP	California High-Speed Train Project
CL	Center line
CPUC	California Public Utilities Commission
CS/SC	Curve-Spiral/Spiral-Curve
CSDC	Caltrans Seismic Design Criteria
DOC	Degree of Curve
EIR/EIS	Environmental Impact Report/Environmental Impact Statement
EP	Edge of Pavement
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration

GAD	Geometric Approval Drawings
GO	General Order
HST	High-Speed Train
PCJPB /JPB	Peninsula Corridor Joint Powers Board
ML	Main Line
MP	Milepost
MSE	<b>Mechanically Stabilized Earth</b>
PC	Point of Curvature
PS	Point of Switch
PT	Point of Tangency
ROW	Right-of-Way
RWQCB	Regional Water Quality Control Board
STA	Station/Stationing
TBD	To be Determined
TCE	Temporary Construction Easement
TOR	Top of Rail
TS/ST	<b>Tangent-Spiral/Spiral-Tangent</b>
UPRR	Union Pacific Railroad

## 3. Design Criteria

### 3.1 Railroad Design Standards

Caltrain has jurisdiction over the railroad right-of-way through the project corridor. UPRR has freight operating rights on the tracks through an agreement with the JPB. The design will comply with the following standards, including all addenda, specifications and recommended practices:

- **Caltrain Design Criteria Manual**
- Caltrain Standard Drawings
- Caltrain Standard Specification
- **Caltrain CADD Manual**
- California Public Utilities Commission General Orders
- American Railway Engineering and Maintenance-of-Way Association Manual for Railway Engineering

- **Federal Railroad Administration Track Safety Standards, Part 213**
- Federal Highway Administration Railroad-Highway Grade Crossing Handbook – for all At-Grade Crossings
- **Union Pacific Railroad Engineering Track Standards – for all Main Line Track Improvements**
- **Union Pacific Railroad Technical Specifications for Construction of Industrial Tracks – for all Industry Track Improvements**

## 3.2 Railroad Design Criteria

The preliminary track design and any temporary track work will be in conformance with **Caltrain Design Criteria Chapter 1 – Design Guidelines, Chapter 2 – Track, Chapter 3 – Station and Facilities**, and not to preclude the California High-Speed Train Project technical memoranda **TM 1.1.21 – Typical Cross Sections for 15% Design, TM 2.1.2 – Alignment Design Standards for High-Speed Train Operation, and TM 2.1.3 Turnouts and Station Tracks** when feasible.

Track alignment, at a minimum, shall be designed for **110 mph for Caltrain EMU**, which corresponds to FRA Class 6 track standards. Upon completion of the track construction, Caltrain will determine the appropriate operating speed. Various railroad design elements will be based on the following design speeds, whichever governs:

- a. **50 mph for freight operations**
- b. 79 mph for passenger operations with existing Caltrain fleet.<sup>1</sup>
- c. 110 mph for High Speed Rail passenger operations when feasible.
- d. 110 mph for passenger operations with future Caltrain EMU fleet.

**No curves with a degree of curvature less than 30 minutes shall be used unless the curve length is greater than 500’.**<sup>1</sup> Overbalance shall be avoided as much as possible considering the four operating scenarios above.

Where physical restrictions prevent the use of the above preferred standards, the design speed will be determined on a case-by-case basis by considering primarily rail car design and safety of operations **with passenger comfort as the secondary consideration**. The design shall meet Federal and State minimum requirements and with approval from the Caltrain Deputy Director of Engineering.

### 3.2.1 Horizontal Track Geometry

#### 3.2.1.1 Track Spacing

The horizontal alignments for main line tracks are stationed along the centerline of track MT1 from San Francisco to San Jose/Lick. Main tracks are spaced a minimum of **15 feet** from track centerline to track centerline.<sup>2 3</sup>

Temporary (shoofly) tracks are spaced a minimum of 14 feet from track centerline to track centerline plus an additional 2 inches per degree of curvature on curves with the same superelevation. Shoofly track spacing from the existing mainline tracks will vary along the shoofly alignment.

#### 3.2.1.2 Horizontal Tangents

**Minimum horizontal tangent lengths between reverse curves** are based on the formula,  $L = 3V$ , as prescribed by Caltrain’s design criteria in Chapter 2, Table 2-2, where L is the tangent length and V is the design speed in miles per hour (mph). For V = 90 mph,  $L_{min} = 270$  feet. For V = 110 mph,  $L_{min} = 330$  feet.

#### 3.2.1.3 Curve Length

Horizontal Curves shall be designed for 110 mph for Caltrain EMU, which corresponds to FRA Class 6 track standards<sup>4</sup>. A higher future design speed of 110 mph shall be considered wherever practicable without being cost

<sup>1</sup> [Caltrain Design Criteria](#) page 2-9.

<sup>2</sup> [Caltrain Design Criteria](#) page 2-11.

<sup>3</sup> California High-Speed Rail Authority [Technical Memorandum 1.1.21](#) (August 20, 2013) page 11

<sup>4</sup> [Caltrain Design Criteria](#) page 2-9

prohibitive, that is, requires additional right-of-way or impacting existing improvements. **The absolute minimum length of circular curve allowed on the main line tracks is 100 feet.**<sup>5</sup>

### 3.2.1.4 Superelevation

The equilibrium superelevation shall be determined by the following equation:

$$E_e = 0.0007 D_c V^2$$

where:  $E_e$  = total superelevation required for equilibrium, in inches.

$V$  = maximum design speed through the curve, in miles per hour (mph)

$D_c$  = degree of curvature, in degree

The total superelevation is expressed as follows:

$$E_e = E_a + E_u$$

where:  $E_a$  = actual superelevation that is applied to the curve

$E_u$  = unbalanced superelevation (amount of superelevation not applied to the curve)

The actual superelevation shall be rounded to the nearest 1/4 inch by the formulas above. For any curve, a 1/2-inch (minimum) superelevation shall be specified. **Super elevation above 5 inches** should be avoided when possible.

Slower speed tracks, such as yard and non-revenue tracks, and curves within special trackwork shall not be superelevated.

Curves within station and grade crossings shall be avoided. They may be superelevated only with the approval from the Caltrain Deputy Director of Engineering.

### 3.2.1.5 Spirals

The standard type of spiral used for all horizontal curves is the **clothoid** type spiral. **Spirals are required for all curves.** Spiral lengths are determined by the maximum of the following formulas and rounded to the nearest 5-feet<sup>6</sup>:

$$L_s = 62 * E_a$$

$$L_s = 1.63 * E_u * V$$

Where:

$L_s$  = Length of spiral

$E_a$  = Actual superelevation ( $E_a \leq 5.0$  inches)

$E_u$  = Unbalanced superelevation

**$E_u$ , Freight = 2.0 inches**

**$E_u$ , Passenger = 3.0 inches**

For Caltrain design speeds > 79 mph,

$E_u \leq 4.5$  inches is acceptable

$E_u \leq 6$  inches may be used with Caltrain approval

$V$  = Design Speed in mph

<sup>5</sup> Caltrain Design Criteria page 2-12 to 2-14.

<sup>6</sup> Caltrain Design Criteria page 2-18.

**Note:** For the design of  $V > 79$  mph, if the above formula creates excessively long spiral that pose challenges due to available ROW, existing infrastructure, etc.; then the following criteria may be considered:

$$L_s > 82.7 * E_a$$

$$L_s > 0.41 * (E_u + 1.5) * V$$

### 3.2.1.6 Shoofly

For the temporary shoofly, the horizontal track geometry will be designed for a maximum operating speed in accordance with Table 2-4, as prescribed in the Caltrain Design Criteria<sup>7</sup> and the current JPB timetable.

## 3.2.2 Vertical Track Geometry

The vertical alignment is defined by the top of rail profile. The profile represents the top of rail (TOR) elevation of the grade rail of track MT1. The TOR elevation of track MT2 is equal to the TOR elevation of track MT1 at points extended from MT1 radially and/or perpendicularly. Grades and lengths of vertical curves vary slightly in order to accommodate the differences in curve lengths of horizontal curves.<sup>8</sup>

### 3.2.2.1 Maximum Profile Grade

The preferred maximum continuous grade along the main line track is 1%. The maximum design gradient, with curve compensation at 0.04% per degree of curve if applicable, for grades up to 2% may be implemented with the approval of the Caltrain Deputy Director of Engineering.

At station platforms, a level gradient is preferred with a maximum grade of up to 1% permitted.

### 3.2.2.2 Vertical Tangents

Mix of pax and firt trains

The minimum length of vertical tangent between vertical curves shall be 330 feet as defined by the following formula<sup>9</sup>:

$$L = 3V$$

Where:

$$V = 110 = \text{Design speed in mph}$$

### 3.2.2.3 Vertical Curve Lengths

Minimum vertical curve lengths shall be determined per the 2014 AREMA Manual for Railway Engineering, Chapter 5, Section 3.6 – Vertical Curves (2002), based on the equation below:

$$L = (D * V^2 * K) / A$$

Additionally, the following equations from CAHSRA Technical Memoranda 2.1.2 shall be considered when determining minimum vertical curve lengths:

$$L = 200 * D$$

$$L = 4.55 * V \text{ (See Note)}$$

**Note:**  $3.52 * V$  is minimum and  $2.64 * V$  is exceptional and requires Caltrain approval.

Where

$$A = \text{Vertical acceleration, in ft/s}^2$$

<sup>7</sup> Caltrain Design Criteria page 2-13 Table 2-4

<sup>8</sup> Caltrain Design Criteria page 2-19

<sup>9</sup> Caltrain Design Criteria page 2-19.

= 0.10 for Freight Train and

= 0.60 for Passenger Train

= 0.90 for High Speed Rail

D = Absolute value of the difference in grades expressed in decimal.

K = 2.15 conversion factor to convert units of L into feet

L = Length of vertical curve in feet

V = Speed of train in mph:

= 50 mph for Freight

= 79 mph for Caltrain with existing fleet

= 110 mph for High Speed Rail

= 110 mph for Caltrain with future EMU fleet

Example:

For an incoming grade of +0.6% and an outgoing grade of -0.7%,

$D = |+0.006 - (-0.007)| = 0.013$ , the minimum length of vertical curve (L) shall be the greater of:

$$L_{\min} \text{ for Freight} = 0.013 * (50)^2 * 2.15 / 0.10 = 699 \text{ feet} \leftarrow \text{Governs}$$

$$L_{\min} \text{ for Caltrain} = 0.013 * (90)^2 * 2.15 / 0.60 = 377 \text{ feet}$$

$$L_{\min} \text{ for High Speed Rail} = 0.013 * (110)^2 * 2.15 / 0.90 = 376 \text{ feet}$$

The absolute minimum length of vertical curve shall be 100 feet. And no vertical curves shall be placed within the limits of special track work, such as turnouts and crossovers.

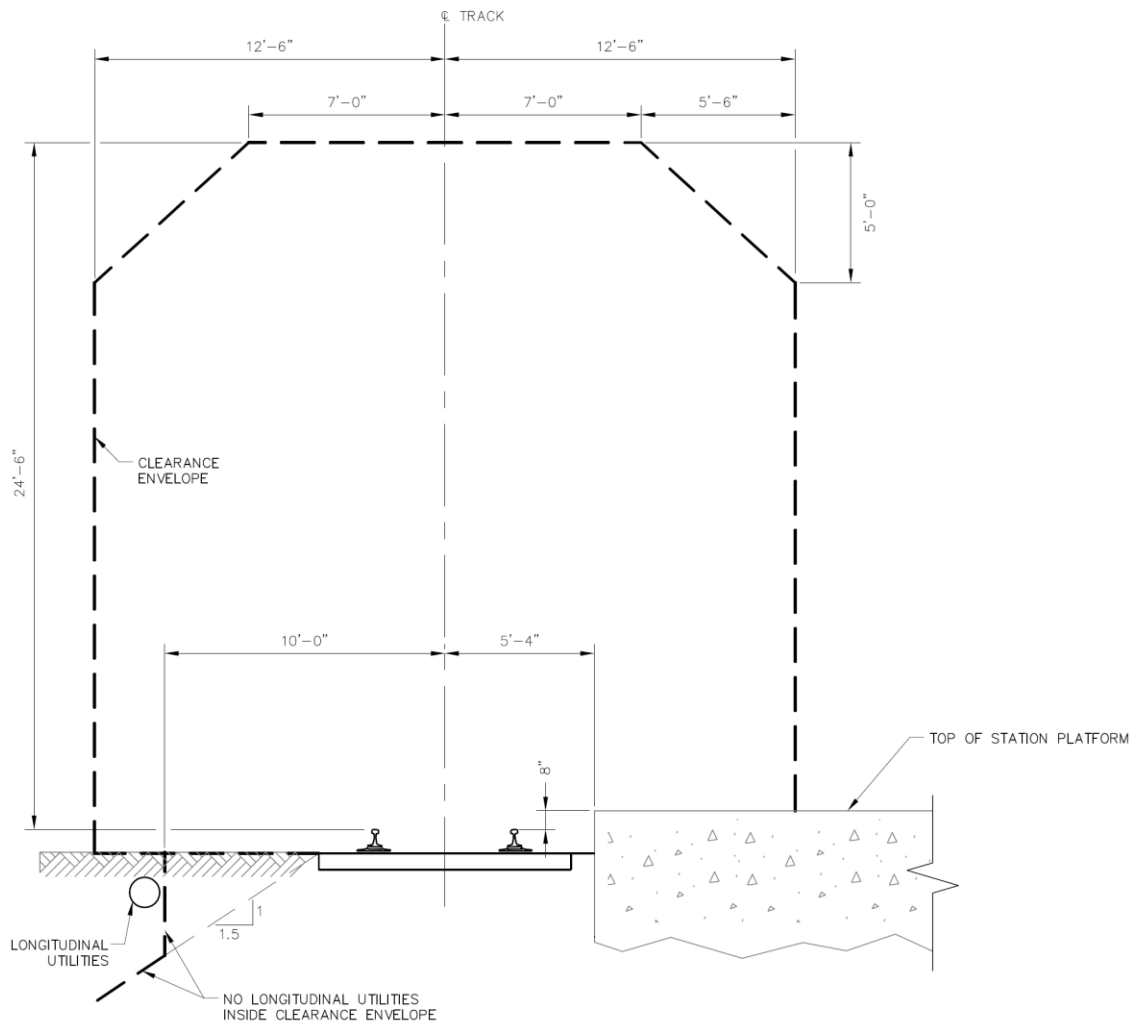
### 3.2.3 Horizontal and Vertical Railroad Clearance

Horizontal clearances shall meet the requirements of California Public Utilities Commission (CPUC) General Order 26-D. Caltrain has additional clearance requirements beyond that of the CPUC, but some allowances will be considered for temporary track conditions (shoofly track) as described in the following sections.



### 3.2.3.1 Horizontal Clearances

The Caltrain standard horizontal track clearance requirements **for structures** shall be 12'-6" from track center line to the face of a temporary or permanent structure as shown in the figure below.



#### CLEARANCE REQUIREMENTS FOR STRUCTURES

1. ALL SIDE CLEARANCE DIMENSIONS ARE FOR TANGENT TRACKS.  
SIDE CLEARANCE FOR CURVE TRACK 2 DEGREE OR SHARPER SHALL  
BE 1'-0" GREATER.

**Figure 1 – Clearance Requirements for Structures**

### 3.2.3.2 Temporary Horizontal Clearance

Temporary track alignments (Shoofly track) on a tangent may use 10'-0" as the minimum clearance from track centerline to the face of any temporary or permanent structures. Temporary curved track alignments may use 11'-0" as the minimum clearance from track centerline to the face of any temporary or permanent structures.

### 3.2.3.3 Vertical Clearance (Underpass)

The minimum vertical clearance required from the surface of the roadway pavement to the soffit (bottom) of the grade separation structure shall be a minimum of 15'-6"<sup>10</sup>.

### 3.2.3.4 Vertical Clearance (Overhead)

The vertical clearance required from the top of rail to the bottom of the grade separation structure is dictated to be 24'-6" per the Caltrain Design Criteria<sup>11</sup>. The figure below from the California High-Speed Train project technical memorandum TM 1.1.21 demonstrates the required vertical clearance needed above top-of-rail (TOR).

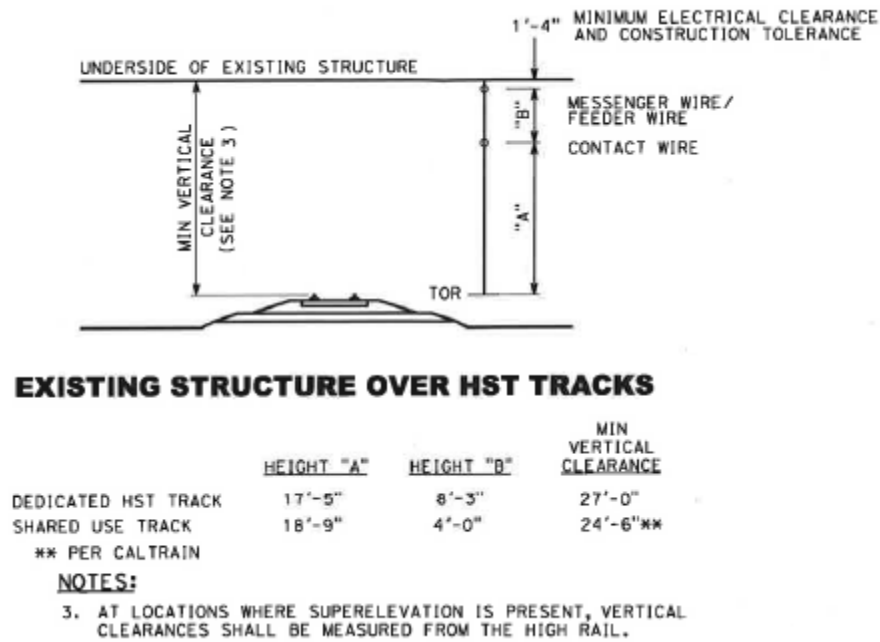


Figure 2 - Required Vertical Clearance over Railroad

<sup>10</sup> PCJPB Standards for Design and Maintenance of Structures, Section 2.4.2, Issue Date: 2003.

<sup>11</sup> Caltrain Design Criteria page 3-9

## 3.2.4 Track Roadbed

The required track roadbed to support the train loads is summarized in Table 1 below

**Table 1. Track Roadbed Criteria**

Criteria	Requirement	Caltrain Reference
<b>Ballast Depth</b>	9" Min.	Std. Dwg SD-2151
Subballast Depth	6" Min.	Std. Dwg SD-2151
Ballast Shoulder	12" Tangent 18" Superelevation	Std. Dwg SD-2151
Subballast Shoulder	2' Min.	Std. Dwg SD-2151
Subgrade Cross Slope	2%	Std. Dwg SD-2151
Embankment Slopes	2:1 Max.	Std. Dwg SD-2151
Cut Slopes	2:1 Max.	Std. Dwg SD-2151
Track Ditch Bottom Width	12" Min.	Std. Dwg SD-2151
Track Ditch Depth	2' Below Subgrade	Std. Dwg SD-2151

## 3.2.5 Caltrain Stations

There are three existing stations within the City of Palo Alto city limits:

- Palo Alto Caltrain Station at University Avenue
- California Avenue Station
- Stanford Home Games Train Station

The alignment of the track geometry may impact these stations and could require these stations to be adjusted and/or re-built with the track work. The design requirements with regards to the track and roadway design are located herein.

### 3.2.5.1 Horizontal & Vertical Clearances

The California Public Utilities Commission (CPUC) General Order #26-D mandates the minimum clearances required. **Caltrain has additional clearance requirements which are more stringent than those mandated by the CPUC.** The more stringent clearance criteria for Caltrain stations are as follows as detailed in the Caltrain Design Criteria.<sup>12</sup>

<sup>12</sup> Caltrain Design Criteria page 3-5 to 3-10

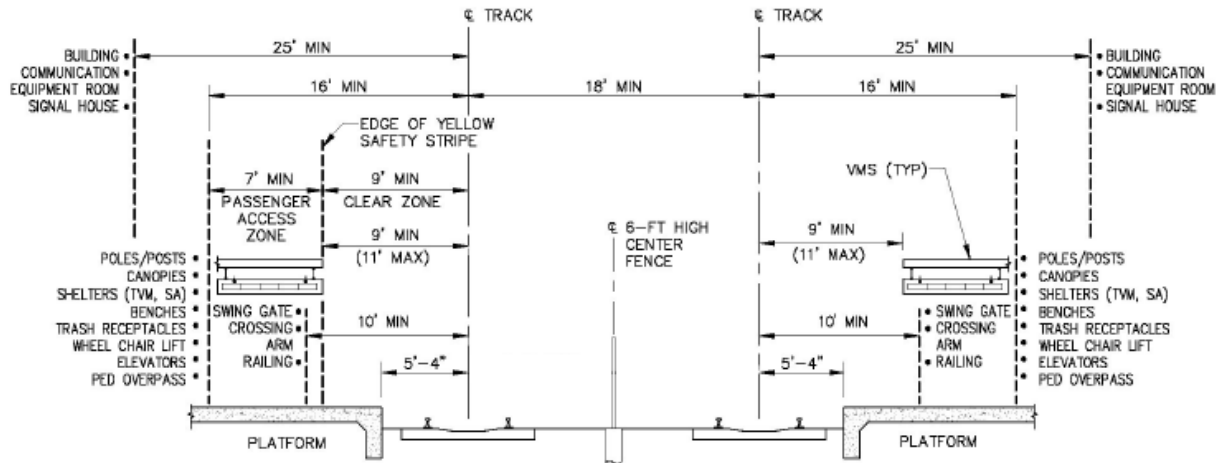


Figure 3 - Caltrain Minimum Clearances at Station Platforms – Outboard Platforms

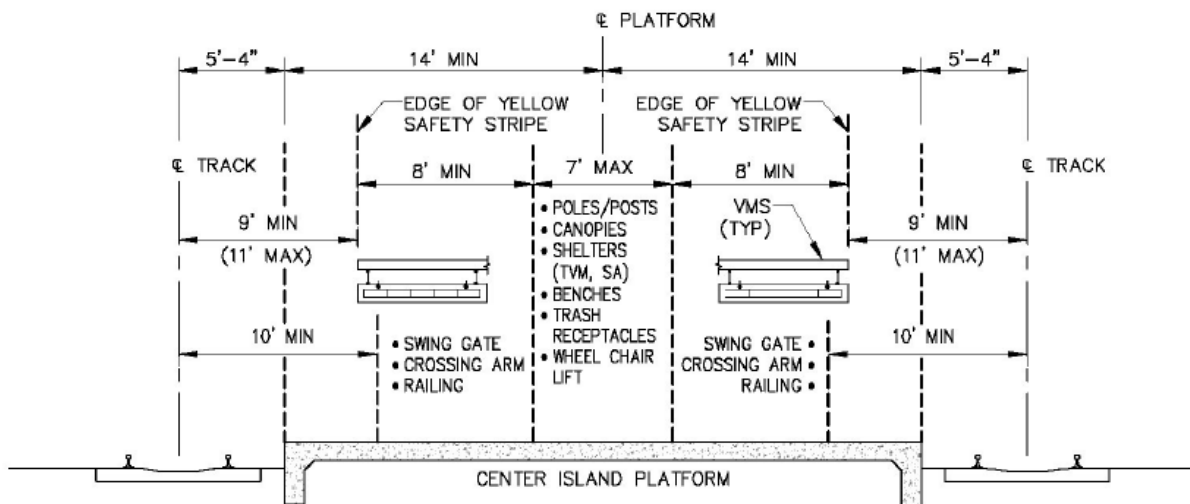


Figure 4 - Caltrain Minimum Clearances at Station Platforms – Center Island Platforms

The Caltrain minimum horizontal clearances listed below are measured from the **centerline** of the closest track:

- a. Permanent Structures: 25 feet
- b. Minor and Auxiliary Structures at Stations: 16 feet
- c. At-grade Pedestrian Crossings: 10 feet
- d. Signal Houses: 16 feet minimum, 25 feet preferred
- e. Variable message signs: 9 feet
- f. Return fence at the ends of a station platform: 9 feet
- g. Right-of-way fence: 12 feet.
- h. Center Fence: 9 feet.

Caltrain minimum vertical clearance (to a structure or obstruction over tracks):<sup>13</sup>

- a. 24 feet – 6 inches from the top of rail

### 3.2.5.2 Station Configuration

There are two preferred layout alternatives for Caltrain station platforms as seen in **Figure 3** and **Figure 4** above. Center island platforms and outboard platforms are defined as:

- a. Center island platforms: Single platforms which service tracks that are located on either side of the platform.
- b. Outboard platforms: Outboard platforms are located on the outside of tracks MT1 and MT2. The two platforms which are located on opposite sides of the main line track from each other service one track each.

### 3.2.5.3 Platform Dimensions

**The platforms are set at 8 inches** above top of rail. The edges of the platforms are located 5 feet 4 inches from the centerline of the nearest track. The criteria for platform dimension are as follows:

- a. **Platform length:** Caltrain train consists are composed of different cars and locomotives, necessitating additional platform lengths. The standard platform length shall be **875 feet** to accommodate a **10-car Electrical Multiple Units (EMU)** consist. See **Figure 3-5** for station "footprint" requirements and platform configurations. Platform design shall consider or not preclude a possible expansion of platform length to **1,000 feet** to accommodate future longer car train consists. At the San Francisco and San Jose Darion terminal stations, the station platforms shall be designed to accommodate **two 10-car EMU consists**.
- b. **Platform width:** The platform shall be a minimum of 18 feet (20 feet preferred) wide for an outboard platform and a minimum of 28 feet (32 feet preferred) wide for a center island platform. The wider center platform is needed to accommodate stairway, ramps, and/or elevator, shelters, and passenger access and circulation safety. A minimum clear walkway width of 7 feet from the edge of the yellow safety stripe shall be maintained for the entire length of the platform for **outboard** platforms.

However, for center island platform, the clear walkway width shall be increased to a minimum 8 feet from the edge of the yellow safety stripe to the platform structures (stairways, elevators).

- c. **Platform longitudinal slope:** The station platforms shall be on a track segment that is tangent and have the same grades as the tracks served. Track grades through station of more than 1 percent shall not be considered.
- d. **Platform cross slope:** This slope is required for **drainage** purposes. The slope shall generally be 1 percent (2 percent maximum, in accordance with ADA Standards) and shall be **sloped away from** the tracks, to minimize the risk for persons in wheelchairs of natural rolling effects toward the tracks. This will also aid in track drainage, by directing the surface water away from the track

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<sup>13</sup> Caltrain Design Criteria page 3-10.

structure. At center island platforms, an underdrain shall be provided at the center of the platform width.

- e. Platform curve: **Curved track** through the station, either horizontally or vertically curved, shall be **avoided**. If unavoidable, the curve shall be as shallow a curve as possible, to no more than 1 degree and 30 minutes, and at either end of the platforms. Platforms on curves shall require prior approval from the Caltrain Deputy Director of Engineering.
- f. Track centers: Track centers at station platforms shall be expanded to a minimum of 18 feet to accommodate **center** fencing, so that the fence is at least 8 feet 6 inches clear from the track center. The center fence shall extend a minimum of 100 feet beyond the ends of the platforms. If there are at-grade pedestrian crossings at the stations, then the fence shall continue to the edge of the crossings, and extend a minimum of 100 feet beyond the at-grade pedestrian crossings.

### 3.2.5.4 Temporary Station

A temporary station is required to be constructed in order to maintain Caltrain service during the construction of the grade separation as part of the construction staging. The temporary platform and final platform minimum design requirements are similar except for two exceptions:<sup>14</sup>

- a. The minimum platform length is 500 feet, with a minimum platform width of 12 feet. This platform length allows for the functional operation of a five-train consist. Additional platform length will be required to accommodate longer train sets when service level is increased in the future.
- b. The platform may be constructed of asphalt concrete to expedite construction. ADA-compliant warning tactile is required at the boarding edge of a platform, except at a holdout rule station. The selected warning tactile material shall be compatible with the material used for platform construction.

## 3.3 Roadway Design Criteria

### 3.3.1 Design Speed

Roadway geometric features of Palo Alto Avenue, Churchill Avenue, Meadow Drive and Charleston Road will be designed for a speed (V) of **25 mph**.

For V = 25 mph, the minimum **Stopping Sight Distance is 150 feet**.

### 3.3.2 Cross Sectional Elements

Design criteria for cross sectional elements (lane widths, shoulder widths, sidewalk widths, etc.) will be based on the **City of Palo Alto Standard Drawings 201, 201A and 201B (last updated in 2018)**.

This project shall use the following for collector or local streets:

Lane Width = **10 feet** (Minimum) +1 **foot shy distance adjacent to curb or wall**, 12 feet (Preferred)

Right Shoulder/Parking Width (with no bike lane) = 8 feet (measured from Edge of Traveled Way (ETW) to flow line of gutter or face of barrier)

Sidewalk Width = **5.5 feet** (Minimum, includes curb width) adjacent to road, 5 feet (Minimum) with landscape buffer from road

Bicycle Lane Width= 5 feet (Minimum), 6 feet (Preferred)

Crosswalk Width = 10 feet

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<sup>14</sup> Caltrain Design Criteria page 3-15

The minimum roadway cross slope will be based on the City of Palo Alto Standard Drawings 201, 201A and 201B.

### 3.3.3 Vertical Clearance of Underpasses

Minimum Vertical Clearance of Railroad Structure over Local Roads = 15'-6"

Minimum Vertical Clearance of Railroad Structure over Pedestrian/Bicycle Path = 10'-0"

### 3.3.4 Profile Grade

The maximum profile grade of the roadway shall be 8%. The minimum profile grade of the roadway shall be 0.2%. The maximum profile grade of a separate bicycle/pedestrian path, where the path does not follow the profile of the roadway, shall be 5%.

### 3.3.5 Crest Vertical Curves

Crest vertical curves will be designed based on the design speed and sight distance described in Section 3.3.1. A driver's eye height of 3.5 feet and an object height of 6 inches will be used.

### 3.3.6 Sag Vertical Curves

Sag vertical curves will be designed for driver comfort in lieu of headlight sight distance. Lighting on all sag vertical curves is expected and assumed. AASHTO's formula for passenger comfort on sag vertical curves is:

$$L = A \cdot V^2 / 46.5$$

Where

L = Length of Vertical Curve

V = Design Speed in mph

A = Absolute Value of Algebraic Grade Difference of the incoming/outgoing grades (in percent)

$$k = L/A = V^2/46.5 = 25^2/46.5 = 13.44$$

Example:

For an incoming grade of -8% and an outgoing grade of +8%,  $A = |-8 - 8| = 16\%$ , the minimum length of vertical curve (L) shall be:

$$L_{\min} = k \cdot A = 13.44 \cdot 16 = 215 \text{ feet}$$

### 3.3.7 Minimum Vertical Curve Length

No vertical curves shall be less than 50 feet.

### 3.3.8 Permanent and Temporary Signing & Pavement Delineation

Signing, pavement delineation and temporary traffic control devices will be designed in accordance to the November 7, 2014 edition of the California MUTCD.

### 3.3.9 Other Roadway Design Criteria

The cut/fill slope will be 1:2 or flatter.

Americans with Disabilities Act (ADA) curb ramps will be designed as shown on City of Palo Alto Standard Drawings 101, 102, 103, and 104.

Storage/Turn Length = As per Traffic Operations Analysis Report

Design Turning Vehicles = Fire Truck (Pumper), Garbage Truck (Heavy)

Driveways will be based on the City of Palo Alto Standard Drawings 121 to 125.

Curb return radius = As per truck turns and intersection needs

## 3.4 Structural

Structures and bridges supporting railroad shall be designed according to the PCJPB Standard for Design and Maintenance of Structures, and the AREMA Manual for Railway Engineering.

### 3.4.1 Structure Depth

Roadway profiles will be based on an assumed structure depth of 5 feet for Railroad<sup>15</sup> bridge structures. Railway profiles will be based on an assumed structure depth of 5 feet for Roadway<sup>16</sup> bridge structures. Structure Depth for other structures such as drainage culverts will be evaluated on a case-by-case basis and will be based on initial geotechnical evaluation of the site conditions.

## 3.5 Railroad Signals

The alternative analysis may require the adjustment of the existing signals to match the changes in elevation of the tracks required to achieve the grade separation. More detailed criteria, such as for **Positive Train Control** and revised braking calculations, would need to be developed during the next phase of design.

### 3.5.1 Signal Placement

**Ground signals are 22 feet in height** measured from the existing grade to the top of the signal. Signal cantilever and bridge structures are designed to have a 28 feet clearance from TOR. **Dwarf signals** have a horizontal clearance of 6' from the centerline of the closest track. Although the CPUC general orders allow dwarf signals 36 inches or less above TOR, the Caltrain Design Criteria mandates the dwarf signals to be 34 inches or less above the TOR.<sup>17</sup>

For Ground Signal foundation and signal placement, Standard Drawings SD-5108 and SD-5201 will be used.

For Signal Bridge placement, Standard Drawing SD-5209 will be used.

For Signal Cantilever placement, Standard Drawing SD-5210 will be used.

## 3.6 Construction Staging

Construction of the grade separation will require temporary shoofly tracks around the limits of the construction zone in order to keep all Caltrain tracks fully operational at all times and shall cause no interruption to the **Caltrain/UP/HSR** operation during construction, except for approved construction windows during cut over operations.

The shoofly tracks will include a temporary at-grade crossing at Palo Alto Avenue, Churchill Avenue, Meadow Drive and Charleston Road.

Retaining walls and/or temporary shoring shall be used, where required, to prevent any conflicts between the construction activities of the track structures and the active shoofly tracks.

---

<sup>15</sup> For the purpose of this document, the structure depth is defined as the dimension from top of rail to the bottom of soffit.

<sup>16</sup> For the purpose of this document, the structure depth is defined as the dimension from top of roadway surface to the bottom of soffit.

<sup>17</sup> Caltrain Design Criteria page 5-7.



Traffic handling of vehicular traffic on the local streets will be evaluated for the preferred alternative. Existing turning movements, access to existing properties will be considered and maintained to the greatest extent possible.

## 3.7 25 kV AC Railroad Electrification System

### 3.7.1 General Requirements and Definitions

Caltrain is undertaking the Peninsula Corridor Electrification Project, which will electrify the portion of the Caltrain Corridor between San Francisco and San Jose (approximately between San Francisco milepost (MP) 0.0 to the Southbound Home Signals at C.P. Lick, Caltrain MP 50.94/Union Pacific MP 51.64).

- All grade separation alternatives shall assume the 25 kV AC Electrification Systems will be in operation during construction. Considerations shall be given to the **planning-level cost estimates to** maintain continuous operations of the live electrified railroad with minimum impacts.
- **25 kV AC Electrification System:** The Overhead Contact System, Negative Feeders, and Traction Power Return System used to power electrified trains in the Electrified JPB Rail Right-of-Way. Traction power Substations, Switching Stations, Paralleling Stations and electrical supply stations are also included in this definition.
- **Overhead Contact System (OCS):** The OCS comprises the aerial supply system that delivers 25 kV traction power from the Substations to the Pantographs of the electric trains, and includes the Catenary System Messenger and Contact Wires, feeder, auxiliary wires and hangers, associated Supports and structures (including poles, portals, headspans and their foundations), manual and/or motor operated isolators, insulators, Phase Breaks, conductor terminations and tensioning devices, downguys, and other overhead line hardware and fittings.

### 3.7.2 Clearances

Clearances for the OCS, per SED-2 CPUC requirements for Caltrain Electrification are as follows:

- Structure Limit: 6'-0" minimum clear from the back (field side) of OCS Pole the face of any structure
- Vegetation Growth Limit: No vegetation shall overhang beyond the vegetation trim lines (as shown in Figure 3) or exist within 10'-0" of OCS or other electrical equipment.
- Track Clearance: Horizontal clearance shall be between 10' (minimum) and 12' (preferred) as measured from the track centerline to the face (track side) of OCS poles or other OCS and electrical equipment.
- Contact Wire Height: The contact wire height will be 22 feet above the top of rail.

There are further clearance requirements set forth in SED-2 beyond those listed above. The entirety of the SED-2 shall be taken into consideration during design.

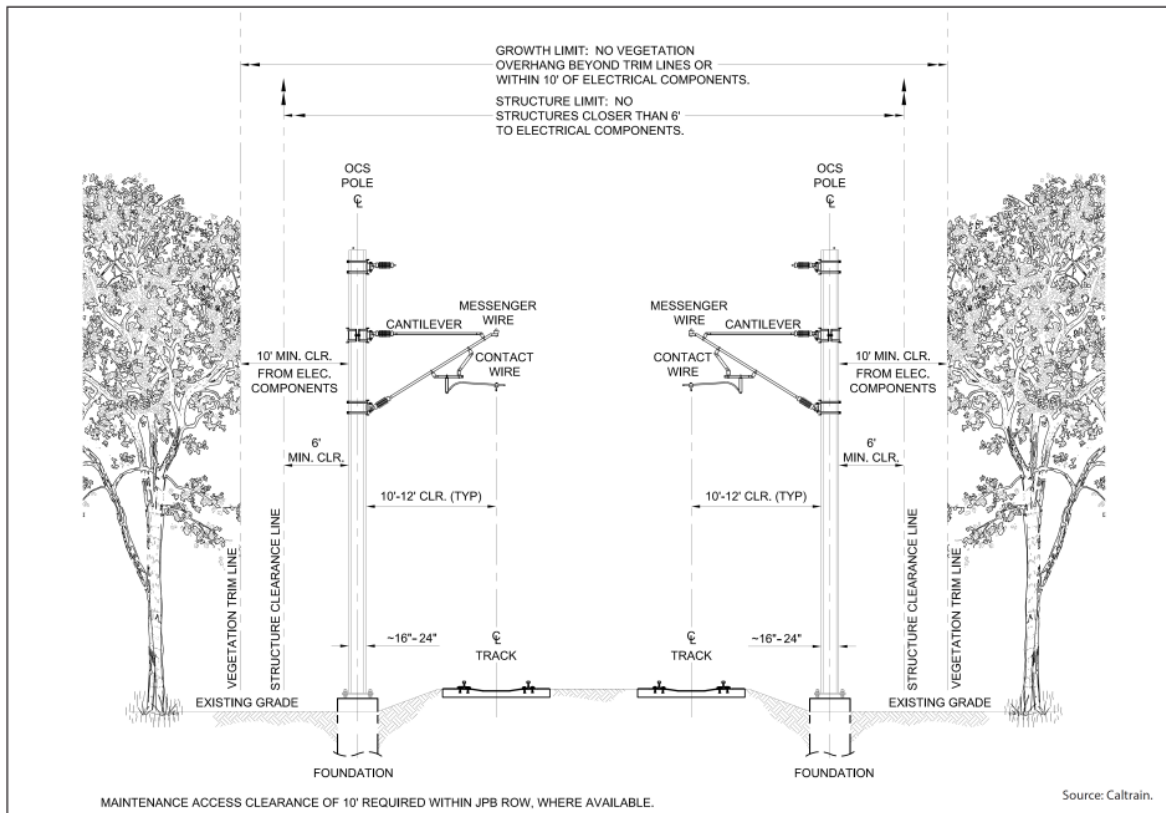


Figure 5 - Caltrain OCS Clearances

## Vertical Curve Calculations By Phil Burton

$$L = (D * V_{\text{squared}} * K) / A$$

Ref: Palo Alto Design Criteria 20190807\_FINAL.pdf, p. 13

### At 2.0% vertical grade

	D	V (mph)	Vsquared	K	A-passenger	A-freight	L-passenger	L-freight
passenger	0.02	110	12100	2.15	0.9		578	
freight @ 50 mph	0.02	50	2500	2.15		0.1		1075
freight @ 40 mph	0.02	40	1600	2.15		0.1		688
freight @ 35 mph	0.02	35	1225	2.15		0.1		527

### At 1.4% vertical grade

	D	V (mph)	Vsquared	K	A-passenger	A-freight	L-passenger	L-freight
passenger	0.014	110	12100	2.15	0.9		405	
freight @ 50 mph	0.014	50	2500	2.15		0.1		753
freight @ 40 mph	0.014	40	1600	2.15		0.1		482
freight @ 35 mph	0.014	35	1225	2.15		0.1		369

### At 1.0% vertical grade

	D	V (mph)	Vsquared	K	A-passenger	A-freight	L-passenger	L-freight
passenger	0.01	110	12100	2.15	0.9		289	
freight @ 50 mph	0.01	50	2500	2.15		0.1		538
freight @ 40 mph	0.01	40	1600	2.15		0.1		344
freight @ 35 mph	0.01	35	1225	2.15		0.1		263

# Design Standards for Vertical Clearances for Caltrain Electrification Project

## AAR Plates (plates not shown do not exist)

AAR Plate	Car Max Height	Notes
B	15' 1"	Unrestricted interchange service standard
C	15' 6"	Limited interchange service standard (will clear 95% of total rail mileage)
D	--	information for obtaining the maximum allowable width of cars, other than at the centerline of the car, to allow for unrestricted Plate B and limited Plate C, H, J and K interchange service.
E	15' 9"	Limited interchange service
F	17' 0"	Limited interchange service
H	20' 3"	Limited interchange service Double-stack container cars
J		Limited interchange service Conventional 19' autorack cars
K	20' 3"	Limited interchange service 20' 3" autorack cars
	15' 1"	Unrestricted* diagram for single loads, without end overhang, on open top cars. Presumably flat cars and gondola cars

A post on the Caltrain website, **Engineering Standards 2011**, includes a drawing for AAR Plates F and H. The Caltrain drawing SD-2001 for Plates F and H adds a 6" cushion to the AAR Plates.

For most of the freight cars operating in current Union Pacific freight services, plate B and (no letter) apply.

## Relevant Caltrain Standards

Note that existing overpasses impose a \_\_\_ clearance.

CPUC Order 95 standards for vertical clearance. See line 2. Note that Caltrain will be electrified at 25 KV 60 Hz. See Column F.

**TABLE 1: CPUC GENERAL ORDER 95 BASIC MINIMUM ALLOWABLE VERTICAL CLEARANCE OF WIRES ABOVE RAILROADS, THOROUGHFARES, POLES, BUILDINGS, STRUCTURES OR OTHER OBJECTS**

CASE NO.	NATURE OF CLEARANCE	A SPAN WIRES (OTHER THAN TROLLEY SPAN WIRES) OVERHEAD GUYS AND MESSENGERS	B COMMUNICATION CONDUCTORS (INCLUDING OPEN WIRE, CABLES & SERVICE DROPS), SUPPLY SERVICE DROPS OF 0-750 VOLTS	C TROLLEY CONTACT, FEEDER AND SPAN WIRES, 0-5,000 VOLTS	D SUPPLY CONDUCTORS OF 0-750 VOLTS & SUPPLY CABLES	E SUPPLY CONDUCTORS & SUPPLY CABLES, 750-22,500 VOLTS	F SUPPLY CONDUCTORS & SUPPLY CABLES, 22.5-300 KV	G SUPPLY CONDUCTORS & SUPPLY CABLES, 300-550 KV (mm)
1	CROSSING ABOVE TRACKS OF RAILROADS WHICH TRANSPORT OR PROPOSE TO TRANSPORT FREIGHT CARS (MAXIMUM HEIGHT 15-FT, 6-INCH) WHERE NOT OPERATED BY OVERHEAD CONTACT WIRES.	25-FT	25-FT	22.5-FT	25-FT	28-FT	34-FT	34-FT
2	CROSSING OR PARALLELING ABOVE TRACKS OF RAILROAD OPERATED BY OVERHEAD TROLLEYS.	26-FT	26-FT	19-FT	27-FT	30-FT	34-FT	34-FT
3	CROSSING OR ALONG THOROUGHFARES IN URBAN DISTRICTS OR	18-FT	18-FT	19-FT	20-FT	25-FT	30-FT	30-FT

From the Wikipedia article [https://en.wikipedia.org/wiki/Electrification\\_of\\_Caltrain](https://en.wikipedia.org/wiki/Electrification_of_Caltrain).

*Contact wire height is planned to vary between 16 to 23 feet (4.9 to 7.0 m), depending on overhead clearance required, with the messenger wire another 2 to 5 feet (0.61 to 1.52 m) above that, and pole height will vary between 30 to 50 feet (9.1 to 15.2 m). Nominal clearance under the contact wire will be 23 feet (7.0 m) to accommodate freight and non-electrified passenger rail service.*

From the Caltrain website,

[http://www.caltrain.com/Assets/Peninsula+Rail+Program/Electrification+2025/EA-DEIR-04-2004/Chapter\\_2\\_WEB.pdf](http://www.caltrain.com/Assets/Peninsula+Rail+Program/Electrification+2025/EA-DEIR-04-2004/Chapter_2_WEB.pdf)

*Clearances for maintenance and operation of the OCS will be designed to allow for existing freight railroad clearances and operations; the OCS, however, may have to be de-energized at some overhead bridge locations in order to operate certain freight trains over the JPB-owned portion of the right-of-way during non-passenger revenue hours. OCS installation on the segments of the UPRR-owned right-of-way would be designed to provide clearance parameters to permit American Association of Railroads (AAR) Plate H freight operations at all times under the energized conductors. (See Figures 2.3-1 through 2.3-3)*



AECOM  
100 West San Fernando  
San Jose, CA 95113  
aecom.com

**Project name:**  
Palo Alto Rail Program Management

**Project ref:**  
60577356

**From:**  
Milette Litzinger

**Date:**  
December 17, 2019 (Update from 12/5 version)

**To:**  
Ed Shikada, City Manager  
City of Palo Alto  
250 Hamilton Avenue  
Palo Alto, CA 94301

**CC:**  
Etty Mercurio, AECOM  
John Maher, AECOM  
Peter DeStefano, AECOM  
Gary Black (Hexagon)

**DRAFT**

# Memo

**Subject:** "New Ideas" from XCAP Technical Working Group

- The Expanded Community Advisory Panel (XCAP) received and screened new ideas from the community at their November 13, 2019 Special XCAP meeting. In this meeting, they received New Ideas from five (5) community members. The XCAP voted to push forward ideas from four (4) of the presenters to their Technical Working Group for further review. The New Ideas that were pushed forward are listed below. Full descriptions of the New Ideas can be found under the "November 13, 2019 XCAP Special Meeting" at <https://connectingpaloalto.com/presentations-and-reports/>
- South Tunnel At-Grade Concept (Roland Lebrun)
- Embarcadero/Alma Roundabout and Viaduct (Tony Carrasco)
- Churchill Crossing Concept (Michael Price)
- Charleston/Meadow Underpass Concept (Elizabeth Alexis)

Below is a description of the distinguishing characteristics that AECOM used to review each New Idea and notable impacts related to the following categories:

- Geometrics/Structures
- Right of Way Requirements
- Groundwater/Stormwater Impacts
- Traffic/Access Circulation
- Safe Routes for Ped/Bikes
- Cost Effectiveness

**Attachments:**

- Churchill Crossing Concept, Typical Section
- Churchill Crossing Concept, Layout
- Charleston/Meadow Underpass Concept, Typical Section
- Charleston/Meadow Underpass Concept, Layout

## **South Tunnel At-Grade Freight Concept (Roland Lebrun)**

This concept is a variation of the South Palo Alto Tunnel At-Grade Freight alternative already being studied. Variations include:

- Begin tunnel 200 feet north of Matadero Creek.
- Reduce spacing between twin bore tunnel to 30 feet.
- Split the two freight tracks, one to each side of the trench/tunnel section

### **Geometrics/Structures**

- Extensive jet grouting would be required to accommodate the reduced spacing between the twin bore tunnels. impacting underground utilities. A geotechnical investigation is required to define ground improvement measures.
- Construction complications/inefficiencies due to restricted access for portal and boring construction activities.
  - a. The CPUC will not allow private at-grade crossings of the northbound track for construction and maintenance access.
  - b. Caltrain will not allow access across tracks during revenue hours.
- The permanent southbound freight trackway is within 3-feet of the western Caltrain right-of-way line and private properties (homes/backyards). There will be permanent freight train noise and vibration.

### **Right of Way Requirements**

- Similar to the other South Palo Alto Tunnel alternatives, subsurface acquisitions are required for ground anchors for the trench retaining walls and right of way acquisitions will be required to construct pump stations.

### **Groundwater/Stormwater Impacts**

- Adobe Creek will be impacted. Matadero Creek will not be impacted.
- Extensive jet grouting will impact ground water flow and containment of existing contaminated plumes.
- Pump station required to dewater the trench and tunnel.
- Numerous regulatory agency approvals required for creek diversions.

### **Traffic/Access Circulation**

- Alma St. permanently reduced to three lanes at the South Portal.

### **Safe Routes for Ped/Bikes**

- Pedestrian and bicyclists are separated from passenger train traffic only.

### **Cost Effectiveness**

- This alternative will still be in the billions of dollars range (greatest level of local funding) and will not eligible for grade separation funding as the at-grade crossing for freight would remain.

## **Embarcadero/Alma Roundabout and Viaduct (Tony Carrasco)**

This concept includes a roundabout at the Embarcadero/Alma, allowing all turning movements to/from Embarcadero and Alma.

### **Geometrics/Structures**

- The rail has to be raised 20+ feet over its current elevation over Embarcadero, creating a 3-level “interchange”. As a result, the rail impacts extend about 1,000 feet further north than the Churchill viaduct.
- The existing rail and road bridges over Embarcadero would have to be demolished and reconstructed to accommodate a wider structure needed for a roundabout.
- The aforementioned wider structure would likely require lowering of Embarcadero itself (doable, but added cost).

### **Right of Way Requirements**

- Right-of-way impacts on the west side are likely (at Palo Alto High School and the Town and Country shopping center).

### **Groundwater/Stormwater Impacts**

- New pump station required at Embarcadero.

### **Traffic/Access Circulation**

- Queues from the left turns onto Kingsley (from SB Alma) could back up into the circulatory roadway of the roundabout, impacting the roundabout itself, in addition to this being a safety issue too (sudden, unexpected stopping of vehicles).
- A private driveway would have to be accessed from the circulatory roadway of the roundabout (done in some cases, but certainly not desirable).
- Merging from the roundabout onto WB Embarcadero is problematic (sight distance is limited, plus there's not much distance to weave into the adjacent lane to make a left turn into the high school).

### **Safe Routes for Ped/Bikes**

- Big roundabouts are typically difficult for ped/bikes to navigate.

### **Cost Effectiveness**

- We have another alternative (the intersection at Kingsley/High) to address traffic circulation at Embarcadero/Alma that functions better and costs much less.



## Churchill Crossing Concept (Michael Price)

This concept partially closes Churchill Avenue, but preserves access to Alma. A typical section and a schematic layout of this concept are attached.

### Geometrics/Structures

- The “split” of the roadway on NB Alma and EB Churchill introduces a fixed object in the road (end of the retaining wall), but we should be able to design this so that it’s not a safety hazard.
- The retaining walls on Alma will be tall (~20 feet Max) and will have a tunnel-effect. Providing left and right shoulders would be ideal, especially 8 to 10-foot right shoulders for disabled vehicles. **To provide an 8-foot right shoulder on NB Alma St (connecting to Churchill Ave in the underpass), the landscaping strip on the east side of Alma St will have to be removed. This will reduce the setback distance from the curb line for many homes fronting Alma by approximately 9.5 feet.**
- Need to evaluate a profile on Churchill to see if there’s an impact to the Churchill/Paly/Castilleja intersection. At first glance, it appears we can avoid lowering this intersection.
- Since there are no ped/bikes on Alma and Churchill (under the tracks), we can be more aggressive with the road profile and use 10-12% Max. This will help reduce the construction limits and cost.
- The bridge geometry and lane configurations need to be hashed out. We’ll need two through lanes on NB Alma.
- **The sight distance at the T-intersection of Churchill and Alma will be less-than-standard for vehicles making rights/lefts onto Alma from EB Churchill. This is mainly due to very little space available for a right shoulder on SB Alma.**

### Right of Way Requirements

- Temporary Construction Easements (TCEs) **will be required.**
- **Full acquisitions likely not required, but partial/sliver residential takes potentially needed along Alma St and potentially a home on the east side of Mariposa Ave.**
- **Curb setback distances must be reduced for homes along Alma St, as noted above.**
- **Potential minor relocation of the ped/bike trail on the north side of Churchill (between Castilleja Ave and the railroad).**
- **The far-right lane on SB Alma St will encroach inside Caltrain’s R/W. This will have to be reviewed/approved by Caltrain.**

### Groundwater/Stormwater Impacts

- Pump Station will be needed to drain the lowered Churchill/Alma intersection.

### Traffic/Access Circulation

- This concept will create circuitous routes for some and introduce more traffic on residential streets.
- Several traffic movements are eliminated... likely to cause driver confusion for those not familiar with the configuration:
  - a. Traffic from WB Churchill must turn right onto NB Alma
  - b. No thru-movement allowed on Churchill
  - c. Traffic from SB Alma cannot make a left onto EB Churchill
  - d. Traffic from NB Mariposa cannot access Churchill (vehicles would have to turn around). Residents on Mariposa (south of Churchill and north of Miramonte) would be forced to travel south, generating more traffic on other Southgate neighborhood streets (Castilleja Ave and Miramonte Ave).

- e. One private driveway on Churchill (between Castilleja and Mariposa) will front a one-way “frontage” road (traveling north), which will force them to travel north and make a right onto Mariposa to exit the Southgate neighborhood.
- f. Left turns not allowed from WB Churchill onto Mariposa (same condition as today).
- g. The left turn movements to/from Kellogg Ave and Coleridge Ave will have to be prohibited because drivers trying to make a left turn onto Alma will not have adequate sight distance to approaching vehicles traveling on NB and SB Alma St, respectively. A concrete barrier will likely be placed at these locations to prohibit the left-turn movements at each intersection.

### **Safe Routes for Ped/Bikes**

- Grade separation for motor vehicles is not ped/bike friendly, so need a separate undercrossing for ped/bikes (similar to the current Option 1 for the Churchill closure).

### **Stage Construction**

- This alternative would likely reduce Alma St to two lanes (one lane in each direction) with no access to the west side of the tracks for a lengthy duration during construction while the underpass and a lowered Alma/Churchill are built. Unless Caltrain accepts top-down construction or some other non-traditional construction method, shoofly tracks will also be required.

### **Cost Effectiveness**

- This idea is more costly than a closure of Churchill, but potentially less costly than the Churchill viaduct.

## Charleston/Meadow Underpass Concept (Elizabeth Alexis)

This concept provides a grade separation at Charleston and Meadow without raising the tracks. A typical section and a schematic layout of this concept are attached.

### Geometrics/Structures

- The east/west through movements would pass under two structures (one for the railroad, one for Alma St), similar to Embarcadero today.

### Right of Way Requirements

- The presentation infers no property impacts, but the width needed to accommodate the turning movements (the u-turn bay, for example) for truck/buses will likely require sliver takes (at the very least) or complete property acquisitions. A 2-lane roundabout (~172-foot outside diameter, including sidewalks) would be required to accommodate the additional traffic and turning movements. The roundabout's footprint would require full property acquisitions.
- Slide 8 does not show standard merge distances, so the footprint (along M/C) would likely be much larger than presented on this slide.
- The existing width of Charleston on the east side of the tracks (from back of sidewalk to back of sidewalk) is approximately 85 feet. To obtain an adequate cross section of the frontage roads and underpass, we need approximately 95 feet of width, which will require a sliver acquisitions on each side of the road (see x-section). The curb setback distance for the homes on the south side Charleston would be reduced by ~ 16 feet.
- The width of Charleston on the west side of the tracks is even more narrow, thus, having greater impact on private properties.
- The width of Meadow on the east side of the tracks is only ~ 62 feet (back of sidewalk to back of sidewalk), making the same configuration on Meadow less feasible.

### Groundwater/Stormwater Impacts

- Same as other underpass options... a pump station will be needed to drain the lowered roads.

### Traffic/Access Circulation

- A circuitous route is proposed for EB vehicles on Charleston and Meadow.
- Traffic on NB and SB Alma St destined for El Camino Real and other locations on the west side of the tracks would also have to traverse a circuitous route. In the NB direction, drivers will likely opt for Ely PI to access Charleston via Mumford PI to avoid any backups on Alma St, thus generating more traffic on residential streets.
- Road geometry would have to be hashed out to ensure queuing of vehicles (for the u-turn movement, for example) does not impact through movements.

### Safe Routes for Ped/Bikes

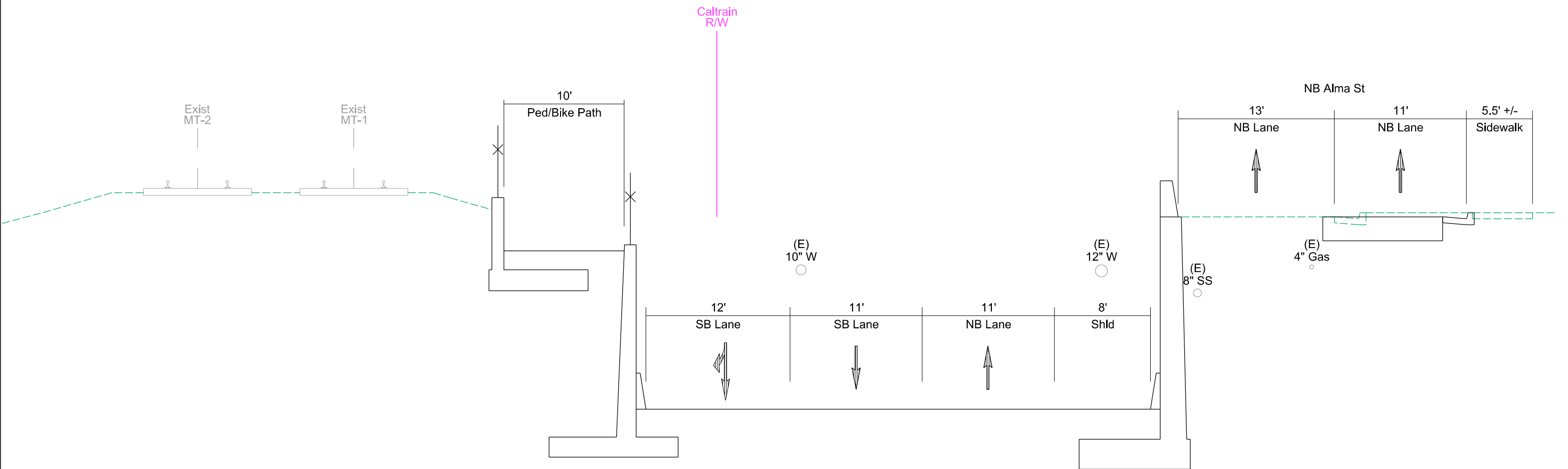
- The "split" of Meadow and Charleston will create a conflict between peds/bikes and motor vehicles, i.e., peds would be on the outside of the road approaching the railroad, but then cross one lane of (moderately high speed) traffic to get to the inside lane (to enter the underpass section of M/C).

## **Cost Effectiveness**

- The property impacts will likely make this concept more costly than the Hybrid alternative, and thus, potentially cost prohibitive.

DRAFT: For Discussion Only

Price - Typical Section for Churchill Concept



Typical Section  
Alma St (North of Churchill Ave)

Kellogg Ave

Churchill Ave

Coleridge Ave

Price - Churchill Underpass Layout

Ped/Bike Bridge

Alma St

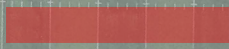
Caltrain R/W

Mariposa Ave

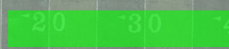
Paly Rd

Castilleja Ave

Legend



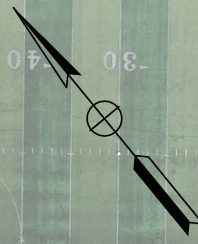
Encroachment inside Caltrain R/W



Sliver Takes and/or TCEs

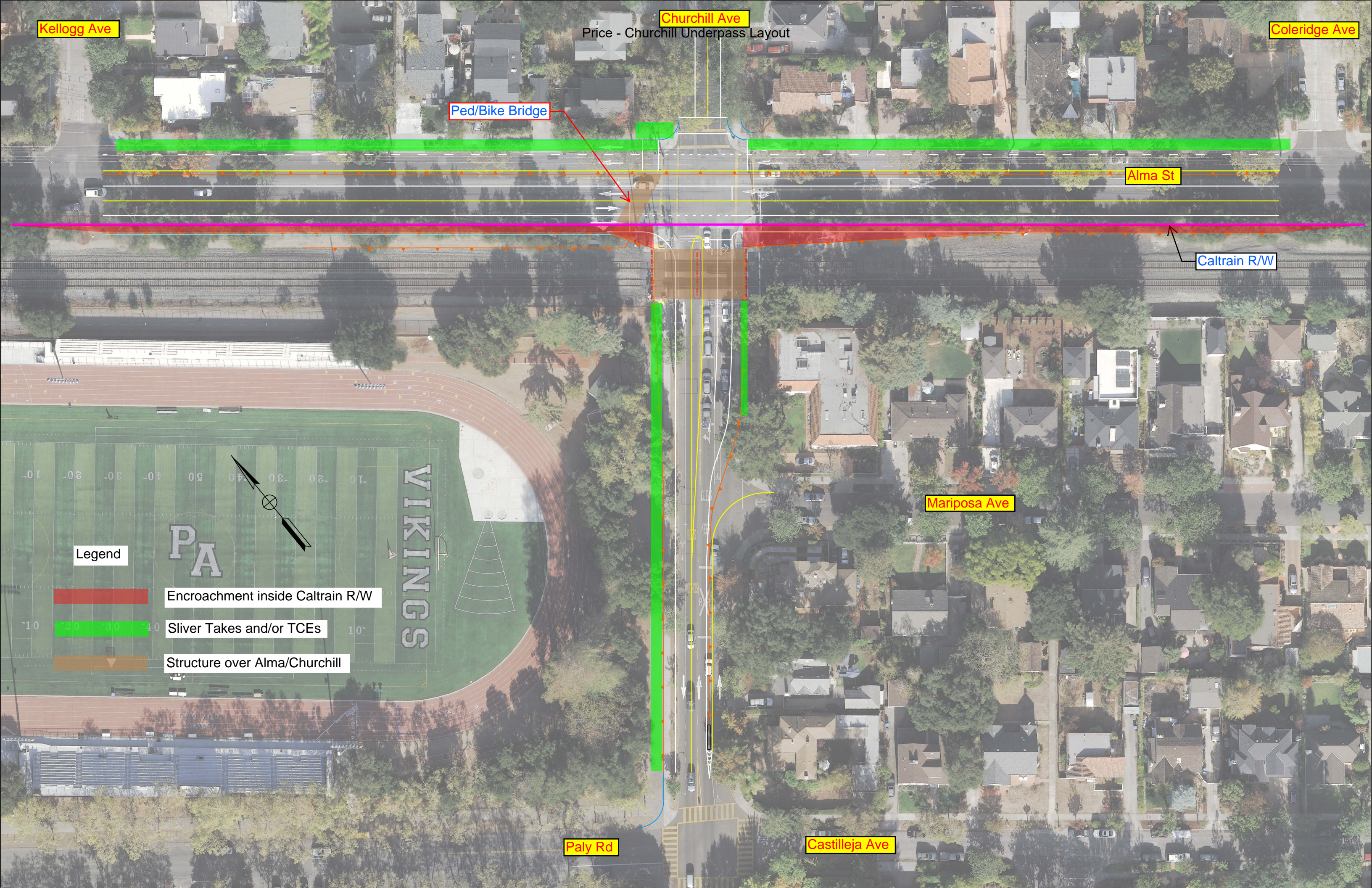


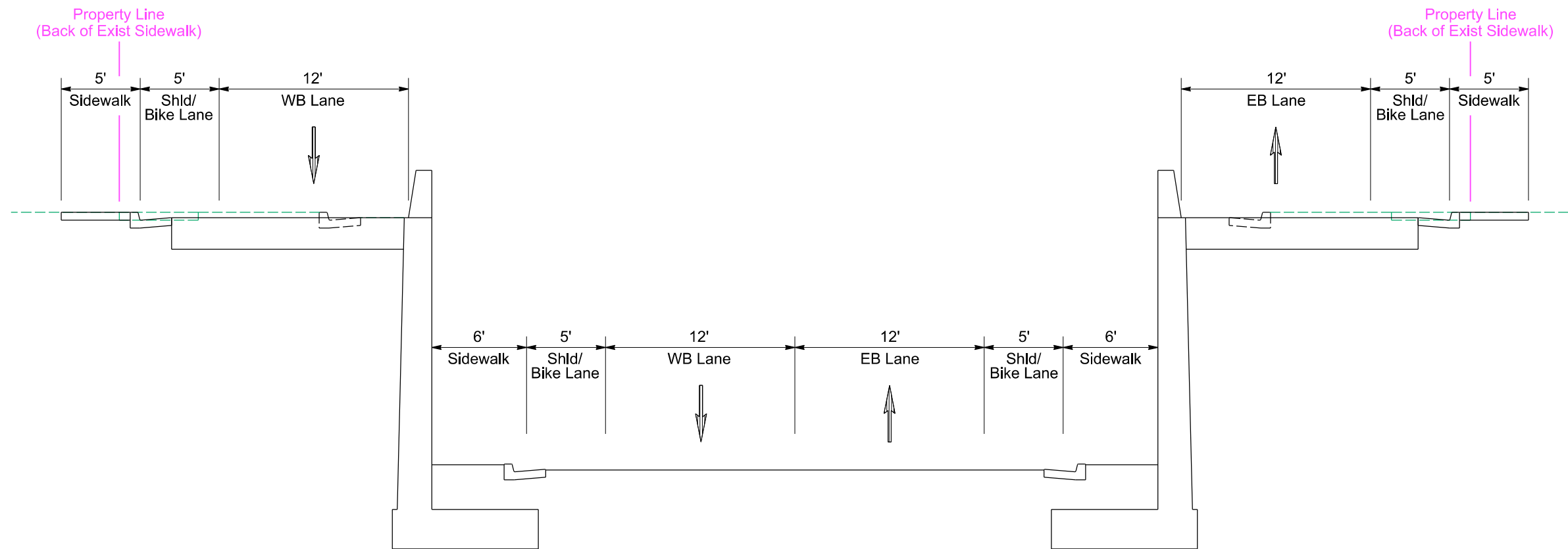
Structure over Alma/Churchill



PA

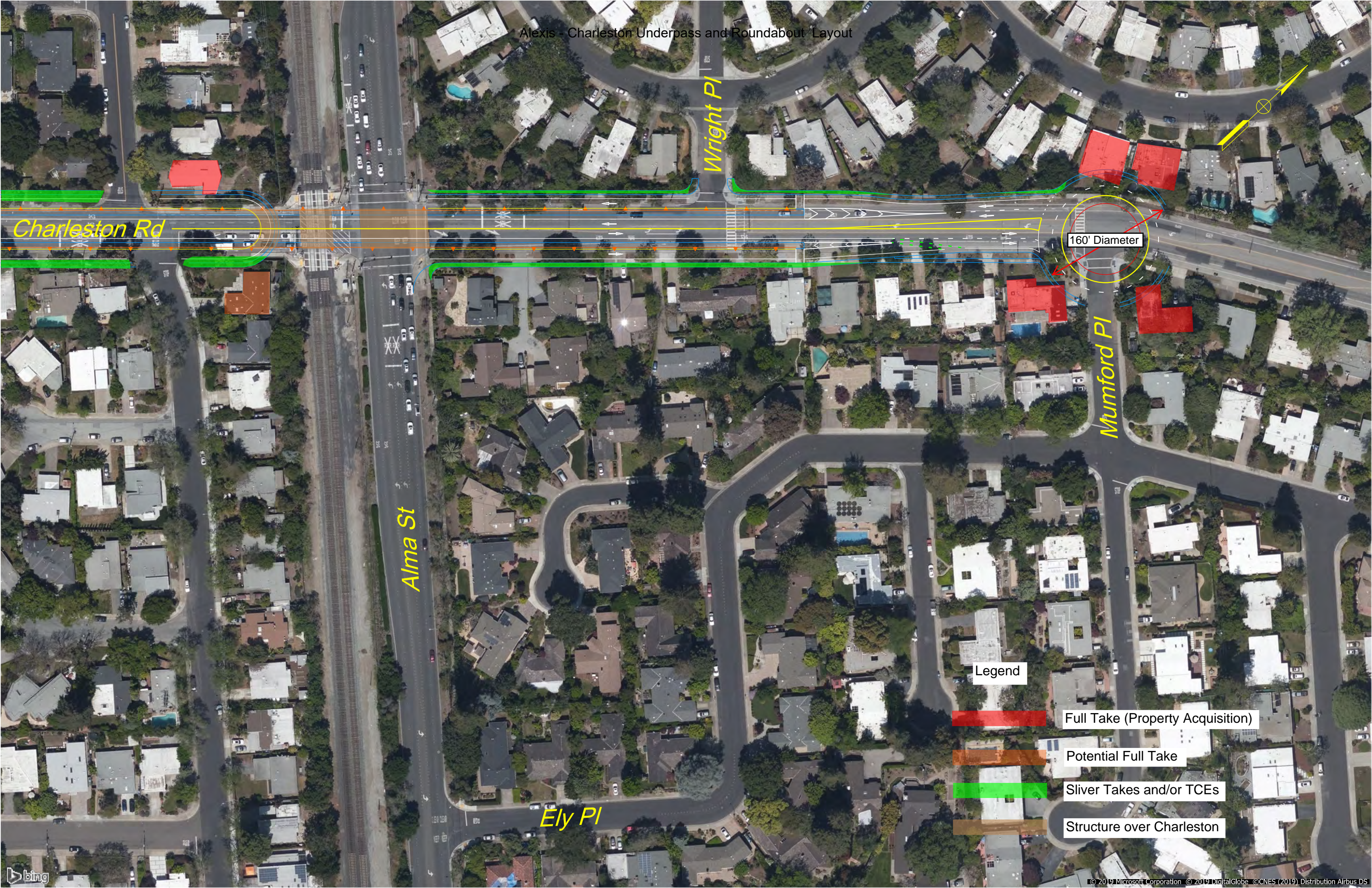
VIKINGS





Typical Section  
Charleston Rd (East of Alma St)

Alexis - Charleston Underpass and Roundabout Layout



Charleston Rd

Wright Pl




160 Diameter

Mumford Pl

Alma St

Ely Pl

Legend

-  Full Take (Property Acquisition)
-  Potential Full Take
-  Sliver Takes and/or TCEs
-  Structure over Charleston



December 18, 2019

XCAP Meeting

**Item #3: Discussion: Update from Technical Working Group Regarding Review of New Ideas/Iterations with Volunteer Civil Engineers and AECOM**

**Overview of Attachments for this Item:**

Item #3 has three (3) attachments, each with sub-attachments. The list of attachments and sub-attachments is included below:

**Attachment 1:** Memo from Nadia Naik with Technical Working Group Summary Notes

Attachment 1a: Memo from AECOM to the Technical Working Group from Dec. 5, 2019

**Attachment 2:** Email Memo from Retired Civil Engineer, Joe Teresi

Attachment 2a: Copy of the South Palo Alto Tunnel Fact Sheet

Attachment 2b: Regulatory Status of Local Creeks (from Joe Teresi)

**Attachment 3:** Email Memo from XCAP Member, Phil Burton

Attachment 3a: Palo Alto Design Criteria Report

Attachment 3b: Phil's Calculations for Vertical Curve

Attachment 3c: Design Standards for Vertical Clearances for Caltrain Electrification Project

If you have any questions, please contact staff at [transportation@cityofpaloalto.org](mailto:transportation@cityofpaloalto.org).

# **Attachment 1**

**To:** Expanded Community Advisory Panel (XCAP)  
**From:** Nadia Naik, Chair  
**Date:** December 12, 2019  
**Subject:** Notes and Update from Technical Working Group Regarding Review of New Ideas/Iterations with Volunteer Civil Engineers and AECOM  
**Agenda Item:** This relates to Agenda Item #3 on the December 18 XCAP Agenda

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### **XCAP Summary Meeting Notes**

**Date:** December 5, 2019  
**Location:** City Hall-1st Floor-City Council Conference Room

**Attendees:**

**City Staff:** Ed Shikada, Philip Kamhi, Chantal Gaines

**AECOM:** Ety Mercurio, Millette Litzinger, Peter DeStefano, John Maher

**Hexagon (Traffic):** Gary Black

**Volunteer Civil Engineers:** Sreedhar Rao, Joe Teresi, Edgar Ugarte, Ron Owes

**XCAP Tech Working Group:** Tony Carrasco, Phil Burton, Keith Reckdahl, Larry Klein, Nadia Naik

---

The XCAP Technical Working Group, the volunteer Civil Engineers and the AECOM team discussed with City Staff the new ideas previously presented at the XCAP meeting. In addition to the information presented in AECOM's memo (see attached), the group had the following observations:

#### **South Tunnel At-Grade Concept (Roland Lebrun)**

The idea was ultimately considered an iteration on an existing alternative/idea which has already been studied by AECOM. The group noted that if the XCAP/City Council recommended pursuing the South Palo Alto Tunnel option further, more detailed evaluation of the benefits presented by this iteration could be considered at that time.

#### **Embarcadero / Alma Roundabout and Viaduct (Tony Carrasco)**

This proposed idea was considered a new alternative with two options:

**Option 1:** placing a viaduct above the existing Embarcadero grade separation and using today's existing structure to create a roundabout.

**Option 2:** removing the existing Embarcadero grade separation, filling in the underpass, creating a new on-grade roundabout and building a viaduct over the roundabout.

Both options require a viaduct and would either a) require rebuilding the existing Embarcadero grade separation (Option 1) or b) demolishing the existing Embarcadero grade separation and filling in the underpass (Option 2).

The on-grade roundabout (Option 2) would require further study (for design, capacity) but could provide significantly more flexibility in mitigating traffic in the area.

It was noted that this concept could be considered for further study, but the cost of either option would likely be higher than the cost of each of the existing Churchill alternatives (viaduct and closure).

### **Churchill Crossing Concept (Mike Price)**

This concept was considered a new alternative that, if technically feasible, could be a cheaper alternative than a viaduct, but more expensive than the closure of Churchill.

There were some technical concerns related to road geometry (can it be engineered to allow enough space for buses to turn; is there enough space on the road; etc.) that need further evaluation. AECOM will try to come back with these quick checks prior to the December 18, 2019 XCAP Meeting.

### **Charleston/Meadow Underpass Concept (Elizabeth Alexis)**

This concept was considered a new iteration on an idea that was previously discarded (underpass). The group recognized that this concept requires further work to flesh out key components, but that it should be studied due to the potential benefits.

Significant cost savings compared to other alternatives are possible given that the train tracks do not move, thereby potentially eliminating the need for shoofly tracks. The AECOM engineers pointed out, however, that in the past, even on projects where only excavation under the tracks was done (such as Jefferson Ave. in Redwood City), there was still a shoofly track needed for safety reasons of excavating beneath an active rail line. Further information regarding the need for shoofly tracks for this concept would be needed to compare the potential cost of this concept relative to the existing alternatives proposed for Meadow and Charleston.

This alternative could potentially have a shorter construction period and have less disruption overall relative to other alternatives being considered.

Additional information relating to traffic patterns in the area of Meadow, Charleston and Alma would be necessary to evaluate whether this concept could work and whether there could be any property impacts.



AECOM  
100 West San Fernando  
San Jose, CA 95113  
aecom.com

**Project name:**  
Palo Alto Rail Program Management

**Project ref:**  
60577356

**From:**  
Milette Litzinger

**Date:**  
December 4, 2019

**DRAFT**

**To:**  
Ed Shikada, City Manager  
City of Palo Alto  
250 Hamilton Avenue  
Palo Alto, CA 94301

**CC:**  
Etty Mercurio, AECOM  
John Maher, AECOM  
Peter DeStefano, AECOM  
Gary Black (Hexagon)

## Memo

**Subject:** "New Ideas" from XCAP Technical Working Group

The Expanded Community Advisory Panel (XCAP) received and screened new ideas from the community at their November 13, 2019 Special XCAP meeting. In this meeting, they received New Ideas from five (5) community members. The XCAP voted to push forward ideas from four (4) of the presenters to their Technical Working Group for further review. The New Ideas that were pushed forward are listed below. Full descriptions of the New Ideas can be found under the "November 13, 2019 XCAP Special Meeting" at <https://connectingpaloalto.com/presentations-and-reports/>

- South Tunnel At-Grade Concept (Roland Lebrun)
- Embarcadero/Alma Roundabout and Viaduct (Tony Carrasco)
- Churchill Crossing Concept (Michael Price)
- Charleston/Meadow Underpass Concept (Elizabeth Alexis)

Below is a description of the distinguishing characteristics that AECOM used to review each New Idea and notable impacts related to the following categories:

- Geometrics/Structures
- Right of Way Requirements
- Groundwater/Stormwater Impacts
- Traffic/Access Circulation
- Safe Routes for Ped/Bikes
- Cost Effectiveness

## South Tunnel At-Grade Freight Concept (Roland Lebrun)

This concept is a variation of the South Palo Alto Tunnel At-Grade Freight alternative already being studied. Variations include:

- Begin tunnel 200 feet north of Matadero Creek.
- Reduce spacing between twin bore tunnel to 30 feet.
- Split the two freight tracks, one to each side of the trench/tunnel section

### Geometrics/Structures

- Extensive jet grouting would be required to accommodate the reduced spacing between the twin bore tunnels. impacting underground utilities. A geotechnical investigation is required to define ground improvement measures.
- Construction complications/inefficiencies due to restricted access for portal and boring construction activities.
  - a. The CPUC will not allow private at-grade crossings of the northbound track for construction and maintenance access.
  - b. Caltrain will not allow access across tracks during revenue hours.
- The permanent southbound freight trackway is within 3-feet of the western Caltrain right-of-way line and private properties (homes/backyards). There will be permanent freight train noise and vibration.

### Right of Way Requirements

- Similar to the other South Palo Alto Tunnel alternatives, subsurface acquisitions are required for ground anchors for the trench retaining walls and right of way acquisitions will be required to construct pump stations.

### Groundwater/Stormwater Impacts

- Adobe Creek will be impacted. Matadero Creek will not be impacted.
- Extensive jet grouting will impact ground water flow and containment of existing contaminated plumes.
- Pump station required to dewater the trench and tunnel.
- Numerous regulatory agency approvals required for creek diversions.

### Traffic/Access Circulation

- Alma St. permanently reduced to three lanes at the South Portal.

### Safe Routes for Ped/Bikes

- Pedestrian and bicyclists are separated from passenger train traffic only.

### Cost Effectiveness

- This alternative will still be in the billions of dollars range (greatest level of local funding) and will not eligible for grade separation funding as the at-grade crossing for freight would remain.

## **Embarcadero/Alma Roundabout and Viaduct (Tony Carrasco)**

This concept includes a roundabout at the Embarcadero/Alma, allowing all turning movements to/from Embarcadero and Alma.

### **Geometrics/Structures**

- The rail has to be raised 20+ feet over its current elevation over Embarcadero, creating a 3-level “interchange”. As a result, the rail impacts extend about 1,000 feet further north than the Churchill viaduct.
- The existing rail and road bridges over Embarcadero would have to be demolished and reconstructed to accommodate a wider structure needed for a roundabout.
- The aforementioned wider structure would likely require lowering of Embarcadero itself (doable, but added cost).

### **Right of Way Requirements**

- Right-of-way impacts on the west side are likely (at Palo Alto High School and the Town and Country shopping center).

### **Groundwater/Stormwater Impacts**

- New pump station required at Embarcadero.

### **Traffic/Access Circulation**

- Queues from the left turns onto Kingsley (from SB Alma) could back up into the circulatory roadway of the roundabout, impacting the roundabout itself, in addition to this being a safety issue too (sudden, unexpected stopping of vehicles).
- A private driveway would have to be accessed from the circulatory roadway of the roundabout (done in some cases, but certainly not desirable).
- Merging from the roundabout onto WB Embarcadero is problematic (sight distance is limited, plus there's not much distance to weave into the adjacent lane to make a left turn into the high school).

### **Safe Routes for Ped/Bikes**

- Big roundabouts are typically difficult for ped/bikes to navigate.

### **Cost Effectiveness**

- We have another alternative (the intersection at Kingsley/High) to address traffic circulation at Embarcadero/Alma that functions better and costs much less.

## Churchill Crossing Concept (Michael Price)

This concept partially closes Churchill Avenue, but preserves access to Alma.

### Geometrics/Structures

- The “split” of the roadway on NB Alma and EB Churchill introduces a fixed object in the road (end of the retaining wall), but we should be able to design this so that it’s not a safety hazard.
- The retaining walls on Alma will be tall (~20 feet Max) and will have a tunnel-effect. Providing left and right shoulders would be ideal, especially 8 to 10-foot right shoulders for disabled vehicles, but we may not have room for that.
- Need to evaluate a profile on Churchill to see if there’s an impact to the Churchill/Paly/Castilleja intersection. At first glance, it appears we can avoid lowering this intersection.
- Since there are no ped/bikes on Alma and Churchill (under the tracks), we can be more aggressive with the road profile and use 10-12% Max. This will help reduce the construction limits and cost.
- The bridge geometry and lane configurations need to be hashed out. We’ll need two through lanes on NB Alma.

### Right of Way Requirements

- Potentially none except for Temporary Construction Easements.

### Groundwater/Stormwater Impacts

- Pump Station will be needed to drain the lowered Churchill/Alma intersection.

### Traffic/Access Circulation

- This concept will create circuitous routes for some and introduce more traffic on residential streets.
- Several traffic movements are eliminated... likely to cause driver confusion for those not familiar with the configuration:
  - a. Traffic from WB Churchill must turn right onto NB Alma
  - b. No thru-movement allowed on Churchill
  - c. Traffic from SB Alma cannot make a left onto EB Churchill
  - d. Traffic from NB Mariposa cannot access Churchill (vehicles would have to turn around). Residents on Mariposa (south of Churchill and north of Miramonte) would be forced to travel south, generating more traffic on other Southgate neighborhood streets (Castilleja Ave and Miramonte Ave).
  - e. One private driveway on Churchill (between Castilleja and Mariposa) will front a one-way “frontage” road (traveling north), which will force them to travel north and make a right onto Mariposa to exit the Southgate neighborhood.
  - f. Left turns not allowed from WB Churchill onto Mariposa (same condition as today).

### Safe Routes for Ped/Bikes

- Grade separation for motor vehicles is not ped/bike friendly, so need a separate undercrossing for ped/bikes (similar to the current Option 1 for the Churchill closure). Need more information on the proposed bike/ped at grade concept in this idea.

### Cost Effectiveness



- This idea is more costly than a closure of Churchill, but potentially less costly than the Churchill viaduct.

DRAFT: For Discussion Only

## **Charleston/Meadow Underpass Concept (Elizabeth Alexis)**

This concept provides a grade separation at Charleston and Meadow without raising the tracks.

### **Geometrics/Structures**

- The east/west through movements would pass under two structures (one for the railroad, one for Alma St), similar to Embarcadero today.

### **Right of Way Requirements**

- The presentation infers no property impacts, but the width needed to accommodate the turning movements (the u-turn bay, for example) for truck/buses will likely require sliver takes (at the very least) or complete property acquisitions.
- Slide 8 does not show standard merge distances, so the footprint (along M/C) would likely be much larger than presented on this slide.

### **Groundwater/Stormwater Impacts**

- Same as other underpass options... a pump station will be needed to drain the lowered roads.

### **Traffic/Access Circulation**

- A circuitous route is proposed for EB vehicles on Charleston and Meadow.
- Road geometry would have to be hashed out to ensure queuing of vehicles (for the u-turn movement, for example) does not impact through movements.

### **Safe Routes for Ped/Bikes**

- The "split" of Meadow and Charleston will create a conflict between peds/bikes and motor vehicles, i.e., peds would be on the outside of the road approaching the railroad, but then cross one lane of (moderately high speed) traffic to get to the inside lane (to enter the underpass section of M/C).

### **Cost Effectiveness**

- The property impacts will likely make this concept more costly than the Hybrid alternative, and thus, potentially cost prohibitive.

# **Attachment 2**

## Gaines, Chantal

---

**From:** jtnia@comcast.net  
**Sent:** Friday, December 6, 2019 5:20 PM  
**To:** 'Nadia Naik'; Gaines, Chantal  
**Subject:** Follow-up comments from yesterday's Technical Working Group meeting  
**Attachments:** Factsheet\_PA\_South\_Tunnel\_Opt\_1\_Nov2019.pdf; Regulatory Status of Local Creeks.docx

Nadia,

It was great to meet you and the other Working Group members at yesterday's meeting. Here are a few follow-up comments based on my work experience and knowledge of the City's creeks and storm drain system:

1. The project alternatives that include the obstruction of one or more of the City's creeks are not necessarily fatally flawed, but they introduce large technical challenges and increased risk of threats to public safety (flooding).
2. Although the City's storm drain system includes eight pump stations (the ninth station that I mentioned yesterday is actually owned and maintained by Santa Clara County [Oregon Expressway Underpass]), these involve flows that are an order of magnitude smaller than either Matadero or Adobe Creeks. The largest storm water pump station pumps a 96-inch diameter storm drain into San Francisquito Creek downstream of Highway 101 at a peak rate of 300 cubic feet per second (cfs). As a comparison, the estimated peak (1% or 100-year) flow on Matadero Creek is 2500 cfs and the peak flow on Adobe Creek is 2000 cfs. Storm water pump stations typically handle flows from a localized low point (e.g. a roadway underpass) or a relatively small storm drain tributary area (i.e. up to around 1,500 acres), whereas a creek drains an entire upstream watershed of multiple square miles.
3. The idea of an inverted siphon to carry either creek under a new railroad tunnel or trench is more practical than a pump station, although there are several downsides/risks inherent in this approach. The enormity of the pump station(s) that would be needed to pump the full flow rate of either creek is overwhelming, particularly due to the constrained site conditions in the narrow railroad corridor. A properly-designed inverted siphon would work hydraulically, but it has many downsides. A small pump station to periodically dewater the siphon would likely still be necessary from a maintenance standpoint. The inverted siphon would likely present a difficult maintenance challenge, as it would tend to fill up with debris and sediment that may not be able to be pumped out, but rather would require periodic removal by maintenance crews. There could also be odor problems and accumulation of stagnant anaerobic water, although that could be controlled by periodically pumping out the contents of the siphon. There is also the increased risk due to the potential blockage or other failure of the siphon, which could result in large-scale flooding of upstream areas. The flood risk is exacerbated by the presence of the railroad embankment which prevents the flow of surface waters towards the Bay and has the potential to impound deep ponded water behind it. Impounded water could also potentially find its way into the railroad tunnel, which could overwhelm the relatively small dewatering pumps likely envisioned in the tunnel design. There is some historical precedent that reinforces the concept of this flooding risk. Namely in 1998, there was significant flooding (including the filling of an underground parking structure) along Park Boulevard just south of Page Mill Road that was caused by the overflow of either the storm drain system or Matadero Creek upstream of the railroad tracks. Some of the impounded flood waters also found their way into the Oregon Expressway underpass, worsening the flooding of that facility.

4. Another large challenge to the creek siphon concept would be the permitting & approval process. Needless to say, placing a regional creek into an inverted siphon although not unprecedented is certainly not standard practice. There will likely be strong resistance from the owner of the two subject creeks – the Santa Clara Valley Water District. As was mentioned by the AECOM reps yesterday, the initial response to the idea of an inverted siphon from District staff was negative, and there was a preliminary suggestion that if such a plan were implemented that the District would defer maintenance (and likely liability) to the City. Besides the District, the rerouting of the creek would also require approvals/permits from the Federal Emergency Management Agency, US Army Corps of Engineers Section 404 permit, State Department of Fish and Wildlife Stream Alteration Agreement, and Regional Water Quality Control Board Section 401 Water Quality Certification. I am not sure how these multiple agencies would respond to such a non-standard design concept. There would likely be water quality, flood risk, as well as fish & wildlife concerns expressed. FEMA is very averse to any flood control mechanism that is subject to failure. At the very least, they would require the submittal of a robust and fully-funded Operations and Maintenance Plan to show how a potential blockage of the siphon would be detected and corrected in such a way as to avoid flooding. Several areas along Adobe and Matadero Creeks upstream of the railroad tracks were removed from the FEMA-designated floodplain in the late 1980's-early 1990's as a result of Santa Clara Valley Water District flood control projects. Any risk of returning these areas to the floodplain (which results in federally-mandated flood insurance and restrictions to building improvements/remodels) would create a huge public outcry. Even though there is not a lot (if any) fish & wildlife habitat in the concrete channels of Matadero and Adobe Creek in the vicinity of the railroad tracks, the resource agencies have published "listings of beneficial uses" for these two creeks that will limit the ability to make any design changes that could threaten fish & wildlife habitat. The attached document includes the "listed beneficial uses" for the two creeks in the Regional Board's San Francisco Bay Basin Plan.
5. I have also included an annotated version of the South Palo Alto Tunnel Fact Sheet showing creek segments that closely parallel the railroad tracks and storm drain pipelines and box culverts that either closely parallel the tracks or cross beneath them. I highlight these in order to make AECOM aware of them as potential design challenges (e.g. could these create the need for additional protective shoring during construction and/or additional siphons to accommodate existing flow patterns?). These are in addition to all the other challenges that will be encountered in addressing other utility conflicts with the myriad existing water, gas, sanitary sewer, electric, telephone/cable/communications, fiber optic facilities in the project vicinity.

I hope that this information is helpful to the group. If anyone has questions regarding the City's storm drain system or the local creeks, I would be happy to attempt to answer them as best as I can. Thanks for the opportunity to contribute to the review of this monumental challenge/opportunity facing the City and its residents.

Cheers,  
Joe Teresi  
Retired Civil Engineer  
Retired City of Palo Alto employee

## RAIL FACT SHEETS

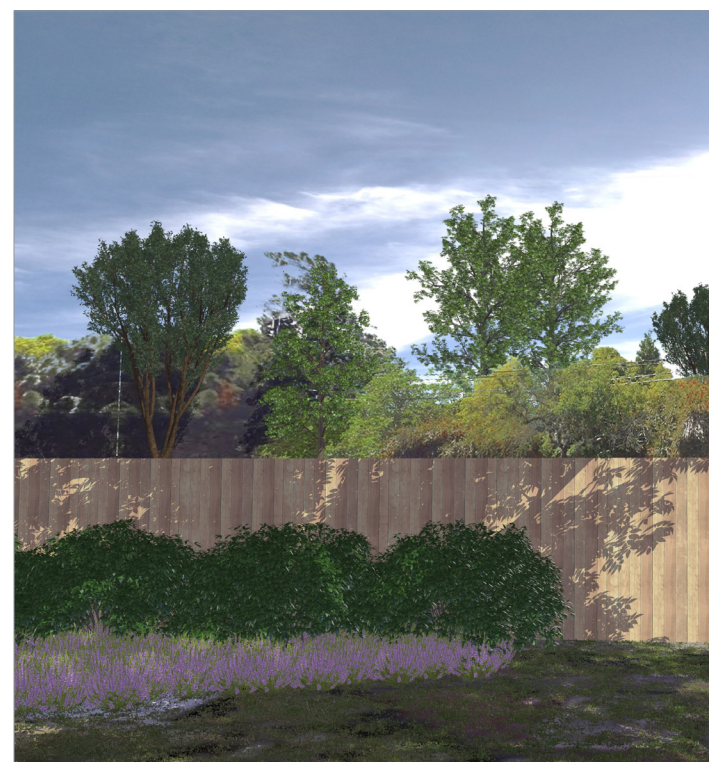
# South Palo Alto Tunnel – Passenger & Freight



Proposed Ground Level View - Looking Southwest Charleston Road Intersection



Proposed Tunnel Aerial View - Looking South



Proposed Backyard View - Looking East Typical Property West of Tracks

### What is a tunnel with passenger and freight?

For the tunnel alternative, the railroad tracks will be lowered in a trench south of Oregon Expressway to approximately Loma Verde Avenue. The twin bore tunnel will begin near Loma Verde Avenue and extend to just south of Charleston Road. The railroad tracks will then be raised in trench to approximately Ferne Avenue. The new electrified southbound railroad tracks will be built at the same horizontal location as the existing railroad track, however, the northbound track will be moved to the east within the limits of the tunnel to accommodate the spacing required between the twin bores. The railroad tracks will carry both passenger and freight trains as it does today.

The roadways at Meadow Drive and Charleston Road remain at their existing grade and will have a similar configuration that exists today with the addition of Class II buffered bike lanes on Charleston Road. This will require expanding the width of the road to maintain bike lanes through the overpass of the railroad.

### By the numbers

- Diameter of twin bores is 34 feet.
- Railroad track is designed for 110 mph.
- Meadow Drive and Charleston Road are designed for 25 mph.
- Maximum grade on railroad is 2%.
- Travel lane widths are 10-12 feet.
- Bike lane widths are 5-6 feet.
- Construction period is approximately 6 years.

### Engineering Challenges

- A non-standard grade of 2% will be required on tracks. Caltrain's preferred maximum grade is 1%.
- Lowering of the tracks will require diversion of Adobe and Matadero creeks, resulting in the need for lift stations/siphons and numerous regulatory agency permits/approvals. Negotiations with the regulatory agencies will be lengthy and difficult since there are other "least impacting" alternatives that could be considered.
- Pump stations will also be needed for dewatering since the tunnel will be below the ground water level.
- Increased long term maintenance costs and risk of flooding due to pump stations.
- Major utility relocations are required for the lowered railroad.

### Neighborhood Considerations

- During construction, Alma Street will be reduced to one lane in each direction from south of Oregon Expressway to Ventura Avenue. From Charleston Road to Ferne Avenue, there will only be one southbound lane.
- The train tracks will be approximately 60 feet below the existing grade in the tunnel section. A high fence will be required along trench walls.
- With grade separations at Meadow Drive and Charleston Road the traffic at nearby intersections is expected to improve.

### Cost Breakdown

Roadway & Railroad Items	\$764M to \$1,146M
Right-of-way & Utilities	\$6M to \$10M
Support Costs	\$236M to \$353M
Escalation from 2018 to 2025 dollars	\$212M to \$318M
<b>TOTAL PROJECT COSTS</b>	<b>\$1,218M to \$1,827M</b>

Preliminary and subject to change. Maintenance costs and relocation of fiber optic lines not included.



Milan Metro Line, Italy

For more Rail Fact Sheets visit:  
<https://connectingpaloalto.com/fact-sheets/>

## Evaluation with City Council-Adopted Criteria

### Facilitate movement across the corridor for all modes of transportation

Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.

### Reduce delay and congestion for vehicular traffic at rail crossings

With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by railroad crossing gates.

### Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles

Pedestrians/cyclists will be separated from train traffic.

### Support continued rail operation and Caltrain service improvements

A temporary railroad track will be required at the boring pit areas to the north and south. A siding track will be relocated north of the California Avenue Caltrain Station. Due to the pump stations, there will be potential risks to train operations due to flooding.

### Finance with feasible funding sources

The tunnel will require the greatest levels of local funding in the form of fees, taxes or special assessments, the feasibility of which are still being studied in the context of overall citywide infrastructure funding needs.

### Reduce rail noise and vibration

Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing electric engines instead of diesel engines will also reduce noise. In the trench section, train noise could reflect off walls and impact properties farther away, which can be mitigated. In the tunnel section, train wheel noise will be contained.

### Minimize visual changes along the corridor

Railroad tracks will be below grade with high fencing at-grade in the trench section. Landscaping options will be limited to plants with shallow roots in areas where ground anchors are required for the trench section.

### Maintain access to neighborhoods, parks, and schools along the corridor while reducing regional traffic on neighborhood streets

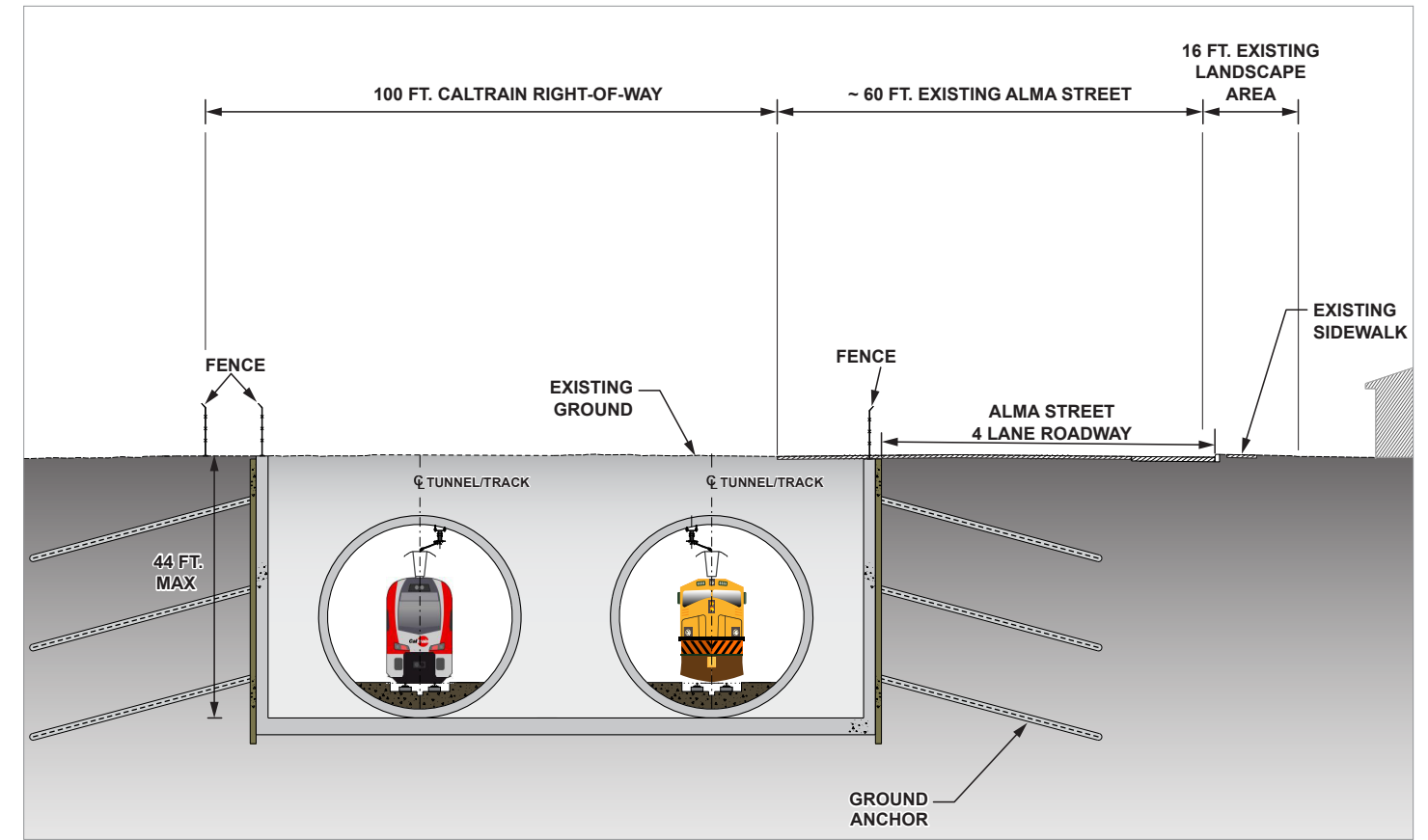
No diversion of regional traffic with construction of a grade separations.

### Minimize right-of-way acquisition

Subsurface acquisitions will be required for the ground anchors for the trench retaining walls and right of way acquisitions will be required to construct pump stations.

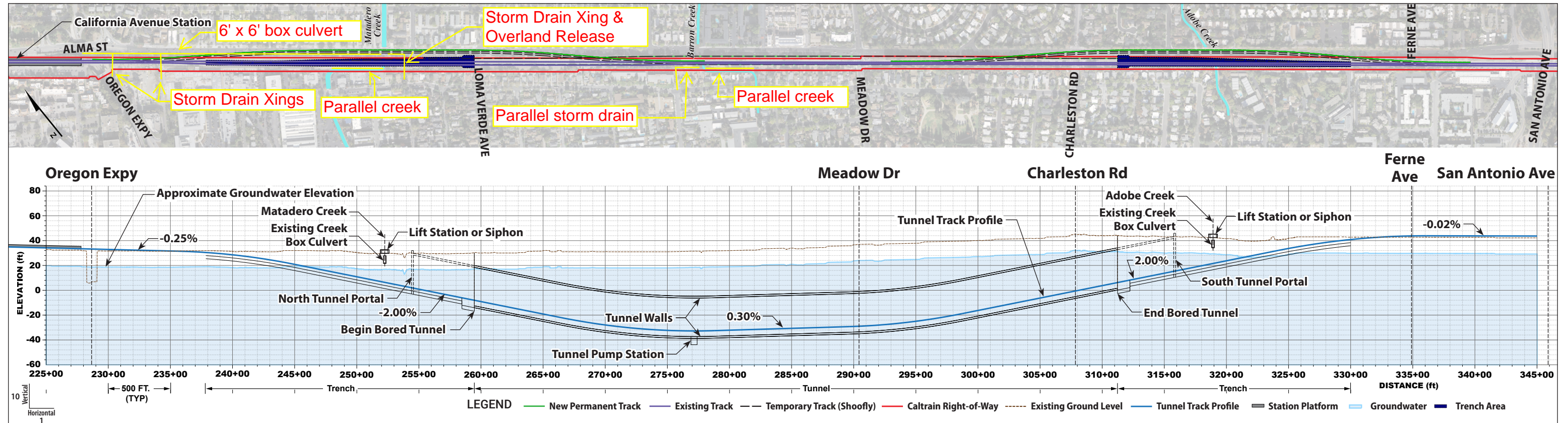
### Minimize disruption and duration of construction

Extended lane reductions on Alma Street are required. Construction would last for approximately 6 years.



Example Section - South Portal Tunnel - Looking North

## Concept Plan and Profile



For more renderings, plans and animations visit: <https://connectingpaloalto.com/renderings-plans-and-animations/>

## Regulatory Status of Local Creeks

Document provided by Joe Teresi, December 2019

### Matadero Creek – Existing Beneficial Uses

- Cold Freshwater Habitat (COLD)
- Warm Freshwater Habitat (WARM)
- Fish Migration (MIGR)
- Fish Spawning (SPWN)
- Preservation of Rare and Endangered Species (RARE)
- Wildlife Habitat (WILD)
- Water Contact Recreation (REC-1)
- Noncontact Water Recreation (REC-2)

### Adobe Creek – Existing Beneficial Uses

- Cold Freshwater Habitat (COLD)
- Warm Freshwater Habitat (WARM)
- Wildlife Habitat (WILD)
- Water Contact Recreation (REC-1)
- Noncontact Water Recreation (REC-2)

### Permitting Agencies for Channel Modifications

- Federal Emergency Management Agency
- Santa Clara Valley Water District
- State Department of Fish & Wildlife Stream Alteration Agreement
- Regional Water Quality Control Board Section 401 Water Quality Cert
- US Army Corps of Engineers Section 404 Permit



# **Attachment 3**

## Gaines, Chantal

---

**From:** Phil Burton <philip-b@comcast.net>  
**Sent:** Thursday, December 12, 2019 12:32 PM  
**To:** 'Nadia Naik'; Gaines, Chantal  
**Subject:** for agenda item #3 - vertical curve and vertical clearance issues  
**Attachments:** Palo Alto Design Criteria 20190807\_FINAL.PDF; Vertical Curve calculations.xlsx; Design Standards for Vertical Clearances for Caltrain Electrification Pr....docx

Chantal,

This email and the attachments should be part of item 3 of the agenda for the next meeting.

The vertical curve issue is the length of the transition between a level grade and a grade of 1% or 2%, as examples. According to the attached document, Palo Alto Design Criteria, Caltrain uses different formulas to calculate the vertical curve transition for passenger and freight trains. The attached spreadsheet, Vertical Curve calculations.xlsx, shows the required transition lengths for passenger trains at 110 mph and freight trains at 50 mph. Note that for a 2% grade, the required transition length is 578' for passenger trains and 1075' for freight trains, almost twice the length required for passenger trains.

At a freight train design speed between 35 and 40 mph, the required freight train transition length would be the same as for passenger trains at 110 mph. While 50 mph may be a reasonable design speed for fast, high-value freight trains operating for long distances, the freight service on the Peninsula is "local" traffic of mostly low-value bulk commodities with some container traffic, and a reasonable lower speed through Palo Alto would not create a big impact on overall running times. It is not even clear that current Union Pacific freight trains even operate over 35 or 40 mph on Caltrain tracks. Temporary or permanent speed restrictions due to local conditions are common on the US rail network.

The issue here is that all the alternatives under consideration, for all three grade crossings, require vertical curve transitions. If the transitions can be shortened to the passenger train length, there could be considerable construction savings. In addition, shoofly track lengths could be shortened. For the South Palo Alto tunnel, it is possible (but I have not verified) that a revised design might avoid the creeks, especially in combination with a smaller tunnel inner diameter

The vertical clearance issue is much harder to pin down because I have not been able to find a single source for this design standard for the spacing between top of rail and the overhead contact wire for power distribution.

I have created a document, Design Standards for Vertical Clearances for Caltrain Electrification, to summarize what I have been able to learn about vertical clearance standards. Clearly the CPUC standard of 34' is not controlling.

Caltrain standard is to design for AAR Plate H, for a max car height of 20' 3".(Association of American Railroads.) A "plate" is a cross-section of a freight car, for various kinds of cars, to ensure that certain kinds of

cars, e.g. normal boxcars or “double stack” shipping container cars, can operate over all most of the mainline freight lines in the US.

In the absence of a Plate H requirement, Caltrain would effectively be operating according to Plate B, a maximum of 15’ 1”. 15’ is also the approximate height of the EMUs that Caltrain is planning to order for electrified service. (need verification of this point). Plate B is sufficient for the hopper and container cars that constitute freight service on Caltrain tracks. Even Plate F may be overdesign for freight train operation on Caltrain tracks.

However, due to existing clearance restrictions and the nature of current rail traffic, it isn’t clear that current freight traffic can even allow double-stack container cars, only normal container cars. Even if clearances were not an issue, there would still be considerable investment at container car loading/unloading locations to support double-stack container shipments. Shipment volumes would probably not justify such investments.

A 5’ reduction in vertical clearance would result in construction cost savings for the Meadow/Charleston trench alternative, and for the South Palo Alto tunnel alternatives due to a potentially smaller tunnel diameter. Further, for all alternatives, the poles needed to support the catenary structure that holds the overhead power contact wire could be lower, with cost and visual impacts.

see p. 5 for vertical curves - differences  
between pax and frt.

**FINAL**

Preliminary Engineering

**Grade Separations**

**Design Criteria**

Palo Alto Rail Program  
Management Services

AECOM Project Reference: 60577356  
City of Palo Alto Contract Number: C18171057

**August 7, 2019**

## Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	10/8/2018	Draft	10/8/2018	Millette Litzinger	Deputy Project Manager
1	8/7/2019	Final	8/7/2019	Ety Mercurio	Project Manager

## Distribution List

# Hard Copies	PDF Required	Company Name / Contact
	X	City of Palo Alto/Ed Shikida, Chantal Gaines
	X	Caltrain/Melissa Reggiardo, Jim Lightbody
	X	AECOM/Ety Mercurio, John Maher, Elliot Wong
	X	AECOM/Millette Litzinger, Peter DeStefano

**Prepared for:**

City of Palo Alto  
Ed Shikida, City Manager  
250 Hamilton Avenue  
Palo Alto, CA 94301

**Prepared by:**

AECOM  
300 Lakeside Drive  
Suite 400  
Oakland  
CA 94612  
aecom.com

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# 1. Introduction

The City of Palo Alto is conducting technical analysis of alternatives coupled with a comprehensive community and stakeholder engagement process aimed at identifying and implementing locally-preferred alternatives for modification to the four existing at-grade crossing in Palo Alto. The four existing at-grade crossings are located at Palo Alto Avenue, Churchill Avenue, Meadow Drive and Charleston Road in Palo Alto.

## 2. Terms and Definitions

This section provides standardized definitions for the terms used in this Design Criteria document. It also identifies frequently used abbreviations and acronyms.

### 2.1 Acronyms

AASHTO	American Association of State Highway and Transportation Officials
APN	Assessor's Parcel Number
AREMA	American Railway Engineering and Maintenance-of-Way Association
CAD	Computer Aided Design
CBC	California Building Code
CBDA	Caltrans Bridge Design Aids Manual
CBDD	Caltrans Bridge Design Details Manual
CGP	Construction General Permit
CHSTP	California High-Speed Train Project
CL	Center line
CPUC	California Public Utilities Commission
CS/SC	Curve-Spiral/Spiral-Curve
CSDC	Caltrans Seismic Design Criteria
DOC	Degree of Curve
EIR/EIS	Environmental Impact Report/Environmental Impact Statement
EP	Edge of Pavement
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration

GAD	Geometric Approval Drawings
GO	General Order
HST	High-Speed Train
PCJPB /JPB	Peninsula Corridor Joint Powers Board
ML	Main Line
MP	Milepost
MSE	<b>Mechanically Stabilized Earth</b>
PC	Point of Curvature
PS	Point of Switch
PT	Point of Tangency
ROW	Right-of-Way
RWQCB	Regional Water Quality Control Board
STA	Station/Stationing
TBD	To be Determined
TCE	Temporary Construction Easement
TOR	Top of Rail
TS/ST	<b>Tangent-Spiral/Spiral-Tangent</b>
UPRR	Union Pacific Railroad

## 3. Design Criteria

### 3.1 Railroad Design Standards

Caltrain has jurisdiction over the railroad right-of-way through the project corridor. UPRR has freight operating rights on the tracks through an agreement with the JPB. The design will comply with the following standards, including all addenda, specifications and recommended practices:

- **Caltrain Design Criteria Manual**
- Caltrain Standard Drawings
- Caltrain Standard Specification
- **Caltrain CADD Manual**
- California Public Utilities Commission General Orders
- American Railway Engineering and Maintenance-of-Way Association Manual for Railway Engineering

- **Federal Railroad Administration Track Safety Standards, Part 213**
- Federal Highway Administration Railroad-Highway Grade Crossing Handbook – for all At-Grade Crossings
- **Union Pacific Railroad Engineering Track Standards – for all Main Line Track Improvements**
- **Union Pacific Railroad Technical Specifications for Construction of Industrial Tracks – for all Industry Track Improvements**

## 3.2 Railroad Design Criteria

The preliminary track design and any temporary track work will be in conformance with **Caltrain Design Criteria Chapter 1 – Design Guidelines, Chapter 2 – Track, Chapter 3 – Station and Facilities**, and not to preclude the California High-Speed Train Project technical memoranda **TM 1.1.21 – Typical Cross Sections for 15% Design, TM 2.1.2 – Alignment Design Standards for High-Speed Train Operation, and TM 2.1.3 Turnouts and Station Tracks** when feasible.

Track alignment, at a minimum, shall be designed for **110 mph for Caltrain EMU**, which corresponds to FRA Class 6 track standards. Upon completion of the track construction, Caltrain will determine the appropriate operating speed. Various railroad design elements will be based on the following design speeds, whichever governs:

- a. **50 mph for freight operations**
- b. 79 mph for passenger operations with existing Caltrain fleet.<sup>1</sup>
- c. 110 mph for High Speed Rail passenger operations when feasible.
- d. 110 mph for passenger operations with future Caltrain EMU fleet.

**No curves with a degree of curvature less than 30 minutes shall be used unless the curve length is greater than 500’.**<sup>1</sup> Overbalance shall be avoided as much as possible considering the four operating scenarios above.

Where physical restrictions prevent the use of the above preferred standards, the design speed will be determined on a case-by-case basis by considering primarily rail car design and safety of operations **with passenger comfort as the secondary consideration**. The design shall meet Federal and State minimum requirements and with approval from the Caltrain Deputy Director of Engineering.

### 3.2.1 Horizontal Track Geometry

#### 3.2.1.1 Track Spacing

The horizontal alignments for main line tracks are stationed along the centerline of track MT1 from San Francisco to San Jose/Lick. Main tracks are spaced a minimum of **15 feet** from track centerline to track centerline.<sup>2 3</sup>

Temporary (shoofly) tracks are spaced a minimum of 14 feet from track centerline to track centerline plus an additional 2 inches per degree of curvature on curves with the same superelevation. Shoofly track spacing from the existing mainline tracks will vary along the shoofly alignment.

#### 3.2.1.2 Horizontal Tangents

**Minimum horizontal tangent lengths between reverse curves** are based on the formula,  $L = 3V$ , as prescribed by Caltrain’s design criteria in Chapter 2, Table 2-2, where L is the tangent length and V is the design speed in miles per hour (mph). For V = 90 mph,  $L_{min} = 270$  feet. For V = 110 mph,  $L_{min} = 330$  feet.

#### 3.2.1.3 Curve Length

Horizontal Curves shall be designed for 110 mph for Caltrain EMU, which corresponds to FRA Class 6 track standards<sup>4</sup>. A higher future design speed of 110 mph shall be considered wherever practicable without being cost

<sup>1</sup> [Caltrain Design Criteria](#) page 2-9.

<sup>2</sup> [Caltrain Design Criteria](#) page 2-11.

<sup>3</sup> California High-Speed Rail Authority [Technical Memorandum 1.1.21](#) (August 20, 2013) page 11

<sup>4</sup> [Caltrain Design Criteria](#) page 2-9

prohibitive, that is, requires additional right-of-way or impacting existing improvements. **The absolute minimum length of circular curve allowed on the main line tracks is 100 feet.**<sup>5</sup>

### 3.2.1.4 Superelevation

The equilibrium superelevation shall be determined by the following equation:

$$E_e = 0.0007 D_c V^2$$

where:  $E_e$  = total superelevation required for equilibrium, in inches.

$V$  = maximum design speed through the curve, in miles per hour (mph)

$D_c$  = degree of curvature, in degree

The total superelevation is expressed as follows:

$$E_e = E_a + E_u$$

where:  $E_a$  = actual superelevation that is applied to the curve

$E_u$  = unbalanced superelevation (amount of superelevation not applied to the curve)

The actual superelevation shall be rounded to the nearest 1/4 inch by the formulas above. For any curve, a 1/2-inch (minimum) superelevation shall be specified. **Super elevation above 5 inches** should be avoided when possible.

Slower speed tracks, such as yard and non-revenue tracks, and curves within special trackwork shall not be superelevated.

Curves within station and grade crossings shall be avoided. They may be superelevated only with the approval from the Caltrain Deputy Director of Engineering.

### 3.2.1.5 Spirals

The standard type of spiral used for all horizontal curves is the **clothoid** type spiral. **Spirals are required for all curves.** Spiral lengths are determined by the maximum of the following formulas and rounded to the nearest 5-feet<sup>6</sup>:

$$L_s = 62 * E_a$$

$$L_s = 1.63 * E_u * V$$

Where:

$L_s$  = Length of spiral

$E_a$  = Actual superelevation ( $E_a \leq 5.0$  inches)

$E_u$  = Unbalanced superelevation

**$E_u$ , Freight = 2.0 inches**

**$E_u$ , Passenger = 3.0 inches**

For Caltrain design speeds > 79 mph,

$E_u \leq 4.5$  inches is acceptable

$E_u \leq 6$  inches may be used with Caltrain approval

$V$  = Design Speed in mph

<sup>5</sup> Caltrain Design Criteria page 2-12 to 2-14.

<sup>6</sup> Caltrain Design Criteria page 2-18.

**Note:** For the design of  $V > 79$  mph, if the above formula creates excessively long spiral that pose challenges due to available ROW, existing infrastructure, etc.; then the following criteria may be considered:

$$L_s > 82.7 * E_a$$

$$L_s > 0.41 * (E_u + 1.5) * V$$

### 3.2.1.6 Shoofly

For the temporary shoofly, the horizontal track geometry will be designed for a maximum operating speed in accordance with Table 2-4, as prescribed in the Caltrain Design Criteria<sup>7</sup> and the current JPB timetable.

## 3.2.2 Vertical Track Geometry

The vertical alignment is defined by the top of rail profile. The profile represents the top of rail (TOR) elevation of the grade rail of track MT1. The TOR elevation of track MT2 is equal to the TOR elevation of track MT1 at points extended from MT1 radially and/or perpendicularly. Grades and lengths of vertical curves vary slightly in order to accommodate the differences in curve lengths of horizontal curves.<sup>8</sup>

### 3.2.2.1 Maximum Profile Grade

The preferred maximum continuous grade along the main line track is 1%. The maximum design gradient, with curve compensation at 0.04% per degree of curve if applicable, for grades up to 2% may be implemented with the approval of the Caltrain Deputy Director of Engineering.

At station platforms, a level gradient is preferred with a maximum grade of up to 1% permitted.

### 3.2.2.2 Vertical Tangents

Mix of pax and firt trains

The minimum length of vertical tangent between vertical curves shall be 330 feet as defined by the following formula<sup>9</sup>:

$$L = 3V$$

Where:

$$V = 110 = \text{Design speed in mph}$$

### 3.2.2.3 Vertical Curve Lengths

Minimum vertical curve lengths shall be determined per the 2014 AREMA Manual for Railway Engineering, Chapter 5, Section 3.6 – Vertical Curves (2002), based on the equation below:

$$L = (D * V^2 * K) / A$$

Additionally, the following equations from CAHSRA Technical Memoranda 2.1.2 shall be considered when determining minimum vertical curve lengths:

$$L = 200 * D$$

$$L = 4.55 * V \text{ (See Note)}$$

**Note:**  $3.52 * V$  is minimum and  $2.64 * V$  is exceptional and requires Caltrain approval.

Where

$$A = \text{Vertical acceleration, in ft/s}^2$$

<sup>7</sup> Caltrain Design Criteria page 2-13 Table 2-4

<sup>8</sup> Caltrain Design Criteria page 2-19

<sup>9</sup> Caltrain Design Criteria page 2-19.

= 0.10 for Freight Train and

= 0.60 for Passenger Train

= 0.90 for High Speed Rail

D = Absolute value of the difference in grades expressed in decimal.

K = 2.15 conversion factor to convert units of L into feet

L = Length of vertical curve in feet

V = Speed of train in mph:

= 50 mph for Freight

= 79 mph for Caltrain with existing fleet

= 110 mph for High Speed Rail

= 110 mph for Caltrain with future EMU fleet

Example:

For an incoming grade of +0.6% and an outgoing grade of -0.7%,

$D = |+0.006 - (-0.007)| = 0.013$ , the minimum length of vertical curve (L) shall be the greater of:

$$L_{\min} \text{ for Freight} = 0.013 * (50)^2 * 2.15 / 0.10 = 699 \text{ feet} \leftarrow \text{Governs}$$

$$L_{\min} \text{ for Caltrain} = 0.013 * (90)^2 * 2.15 / 0.60 = 377 \text{ feet}$$

$$L_{\min} \text{ for High Speed Rail} = 0.013 * (110)^2 * 2.15 / 0.90 = 376 \text{ feet}$$

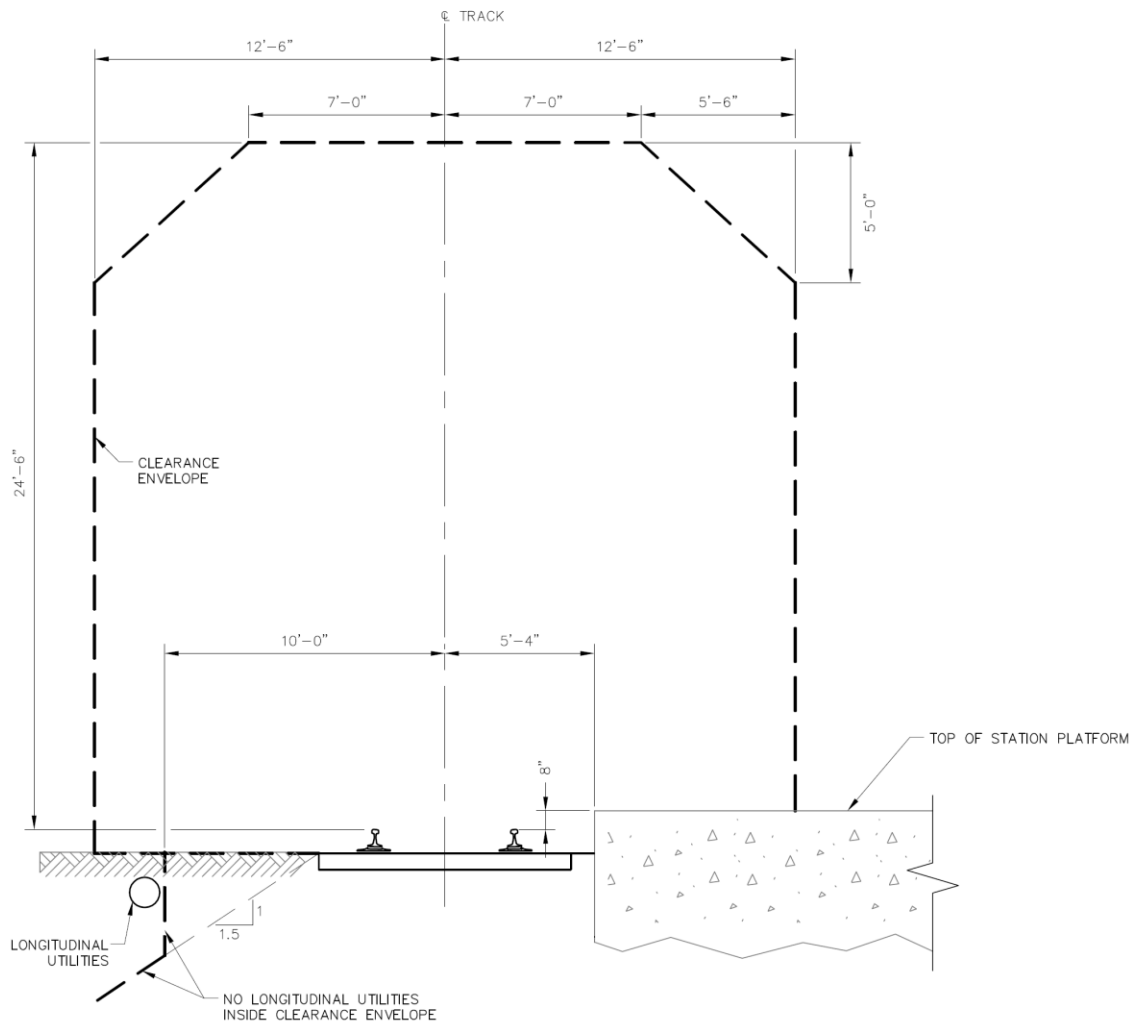
The absolute minimum length of vertical curve shall be 100 feet. And no vertical curves shall be placed within the limits of special track work, such as turnouts and crossovers.

### 3.2.3 Horizontal and Vertical Railroad Clearance

Horizontal clearances shall meet the requirements of California Public Utilities Commission (CPUC) General Order 26-D. Caltrain has additional clearance requirements beyond that of the CPUC, but some allowances will be considered for temporary track conditions (shoofly track) as described in the following sections.

### 3.2.3.1 Horizontal Clearances

The Caltrain standard horizontal track clearance requirements **for structures** shall be 12'-6" from track center line to the face of a temporary or permanent structure as shown in the figure below.



#### CLEARANCE REQUIREMENTS FOR STRUCTURES

1. ALL SIDE CLEARANCE DIMENSIONS ARE FOR TANGENT TRACKS.  
SIDE CLEARANCE FOR CURVE TRACK 2 DEGREE OR SHARPER SHALL  
BE 1'-0" GREATER.

**Figure 1 – Clearance Requirements for Structures**

### 3.2.3.2 Temporary Horizontal Clearance

Temporary track alignments (Shoofly track) on a tangent may use 10'-0" as the minimum clearance from track centerline to the face of any temporary or permanent structures. Temporary curved track alignments may use 11'-0" as the minimum clearance from track centerline to the face of any temporary or permanent structures.

### 3.2.3.3 Vertical Clearance (Underpass)

The minimum vertical clearance required from the surface of the roadway pavement to the soffit (bottom) of the grade separation structure shall be a minimum of 15'-6"<sup>10</sup>.

### 3.2.3.4 Vertical Clearance (Overhead)

The vertical clearance required from the top of rail to the bottom of the grade separation structure is dictated to be 24'-6" per the Caltrain Design Criteria<sup>11</sup>. The figure below from the California High-Speed Train project technical memorandum TM 1.1.21 demonstrates the required vertical clearance needed above top-of-rail (TOR).

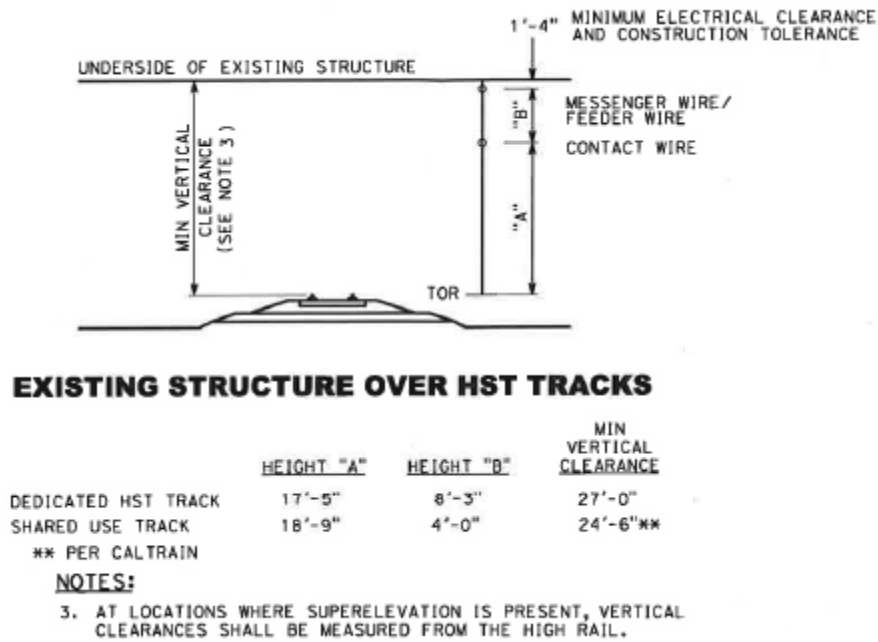


Figure 2 - Required Vertical Clearance over Railroad

<sup>10</sup> PCJPB Standards for Design and Maintenance of Structures, Section 2.4.2, Issue Date: 2003.

<sup>11</sup> Caltrain Design Criteria page 3-9



### 3.2.4 Track Roadbed

The required track roadbed to support the train loads is summarized in Table 1 below

**Table 1. Track Roadbed Criteria**

Criteria	Requirement	Caltrain Reference
<b>Ballast Depth</b>	9" Min.	Std. Dwg SD-2151
Subballast Depth	6" Min.	Std. Dwg SD-2151
Ballast Shoulder	12" Tangent 18" Superelevation	Std. Dwg SD-2151
Subballast Shoulder	2' Min.	Std. Dwg SD-2151
Subgrade Cross Slope	2%	Std. Dwg SD-2151
Embankment Slopes	2:1 Max.	Std. Dwg SD-2151
Cut Slopes	2:1 Max.	Std. Dwg SD-2151
Track Ditch Bottom Width	12" Min.	Std. Dwg SD-2151
Track Ditch Depth	2' Below Subgrade	Std. Dwg SD-2151

### 3.2.5 Caltrain Stations

There are three existing stations within the City of Palo Alto city limits:

- Palo Alto Caltrain Station at University Avenue
- California Avenue Station
- Stanford Home Games Train Station

The alignment of the track geometry may impact these stations and could require these stations to be adjusted and/or re-built with the track work. The design requirements with regards to the track and roadway design are located herein.

#### 3.2.5.1 Horizontal & Vertical Clearances

The California Public Utilities Commission (CPUC) General Order #26-D mandates the minimum clearances required. **Caltrain has additional clearance requirements which are more stringent than those mandated by the CPUC.** The more stringent clearance criteria for Caltrain stations are as follows as detailed in the Caltrain Design Criteria.<sup>12</sup>

<sup>12</sup> Caltrain Design Criteria page 3-5 to 3-10

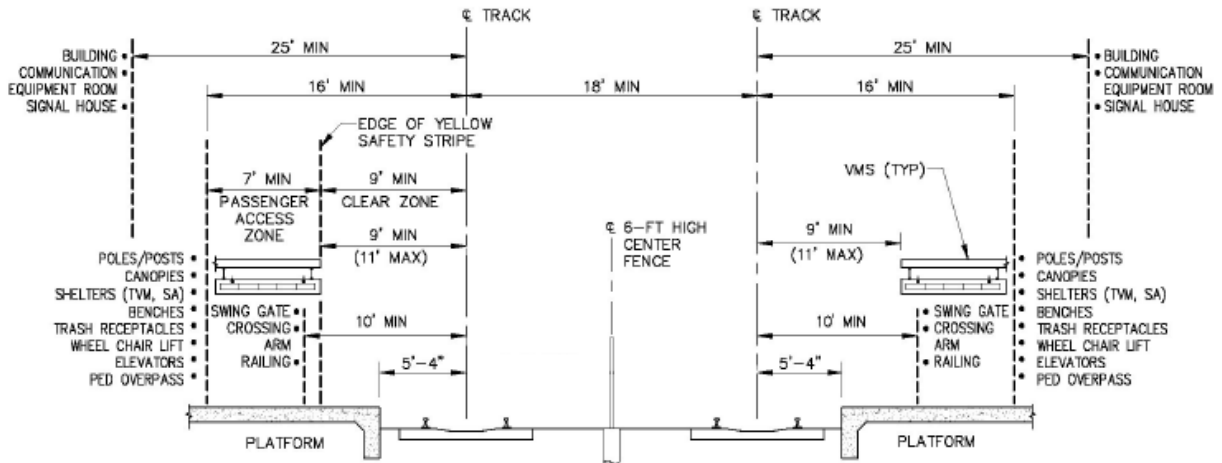


Figure 3 - Caltrain Minimum Clearances at Station Platforms – Outboard Platforms

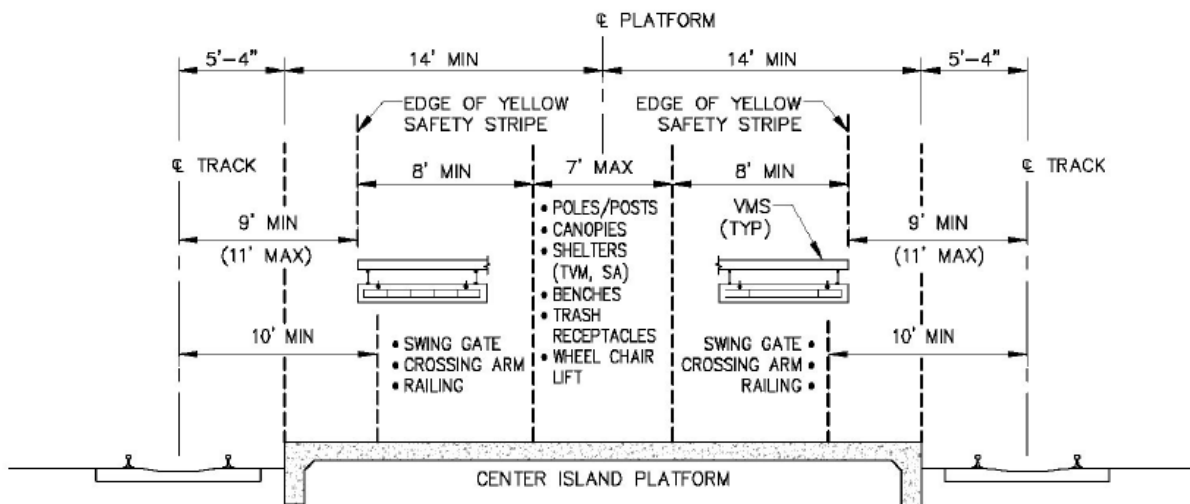


Figure 4 - Caltrain Minimum Clearances at Station Platforms – Center Island Platforms

The Caltrain minimum horizontal clearances listed below are measured from the **centerline** of the closest track:

- a. Permanent Structures: 25 feet
- b. Minor and Auxiliary Structures at Stations: 16 feet
- c. At-grade Pedestrian Crossings: 10 feet
- d. Signal Houses: 16 feet minimum, 25 feet preferred
- e. Variable message signs: 9 feet
- f. Return fence at the ends of a station platform: 9 feet
- g. Right-of-way fence: 12 feet.
- h. Center Fence: 9 feet.

Caltrain minimum vertical clearance (to a structure or obstruction over tracks):<sup>13</sup>

- a. 24 feet – 6 inches from the top of rail

### 3.2.5.2 Station Configuration

There are two preferred layout alternatives for Caltrain station platforms as seen in **Figure 3** and **Figure 4** above. Center island platforms and outboard platforms are defined as:

- a. Center island platforms: Single platforms which service tracks that are located on either side of the platform.
- b. Outboard platforms: Outboard platforms are located on the outside of tracks MT1 and MT2. The two platforms which are located on opposite sides of the main line track from each other service one track each.

### 3.2.5.3 Platform Dimensions

**The platforms are set at 8 inches** above top of rail. The edges of the platforms are located 5 feet 4 inches from the centerline of the nearest track. The criteria for platform dimension are as follows:

- a. **Platform length:** Caltrain train consists are composed of different cars and locomotives, necessitating additional platform lengths. The standard platform length shall be **875 feet** to accommodate a **10-car Electrical Multiple Units (EMU)** consist. See **Figure 3-5** for station "footprint" requirements and platform configurations. Platform design shall consider or not preclude a possible expansion of platform length to **1,000 feet** to accommodate future longer car train consists. At the San Francisco and San Jose Darion terminal stations, the station platforms shall be designed to accommodate **two 10-car EMU consists**.
- b. **Platform width:** The platform shall be a minimum of 18 feet (20 feet preferred) wide for an outboard platform and a minimum of 28 feet (32 feet preferred) wide for a center island platform. The wider center platform is needed to accommodate stairway, ramps, and/or elevator, shelters, and passenger access and circulation safety. A minimum clear walkway width of 7 feet from the edge of the yellow safety stripe shall be maintained for the entire length of the platform for **outboard** platforms.

However, for center island platform, the clear walkway width shall be increased to a minimum 8 feet from the edge of the yellow safety stripe to the platform structures (stairways, elevators).

- c. **Platform longitudinal slope:** The station platforms shall be on a track segment that is tangent and have the same grades as the tracks served. Track grades through station of more than 1 percent shall not be considered.
- d. **Platform cross slope:** This slope is required for **drainage** purposes. The slope shall generally be 1 percent (2 percent maximum, in accordance with ADA Standards) and shall be **sloped away from** the tracks, to minimize the risk for persons in wheelchairs of natural rolling effects toward the tracks. This will also aid in track drainage, by directing the surface water away from the track

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<sup>13</sup> Caltrain Design Criteria page 3-10.

structure. At center island platforms, an underdrain shall be provided at the center of the platform width.

- e. Platform curve: **Curved track** through the station, either horizontally or vertically curved, shall be **avoided**. If unavoidable, the curve shall be as shallow a curve as possible, to no more than 1 degree and 30 minutes, and at either end of the platforms. Platforms on curves shall require prior approval from the Caltrain Deputy Director of Engineering.
- f. Track centers: Track centers at station platforms shall be expanded to a minimum of 18 feet to accommodate **center** fencing, so that the fence is at least 8 feet 6 inches clear from the track center. The center fence shall extend a minimum of 100 feet beyond the ends of the platforms. If there are at-grade pedestrian crossings at the stations, then the fence shall continue to the edge of the crossings, and extend a minimum of 100 feet beyond the at-grade pedestrian crossings.

### 3.2.5.4 Temporary Station

A temporary station is required to be constructed in order to maintain Caltrain service during the construction of the grade separation as part of the construction staging. The temporary platform and final platform minimum design requirements are similar except for two exceptions:<sup>14</sup>

- a. The minimum platform length is 500 feet, with a minimum platform width of 12 feet. This platform length allows for the functional operation of a five-train consist. Additional platform length will be required to accommodate longer train sets when service level is increased in the future.
- b. The platform may be constructed of asphalt concrete to expedite construction. ADA-compliant warning tactile is required at the boarding edge of a platform, except at a holdout rule station. The selected warning tactile material shall be compatible with the material used for platform construction.

## 3.3 Roadway Design Criteria

### 3.3.1 Design Speed

Roadway geometric features of Palo Alto Avenue, Churchill Avenue, Meadow Drive and Charleston Road will be designed for a speed (V) of **25 mph**.

For V = 25 mph, the minimum **Stopping Sight Distance is 150 feet**.

### 3.3.2 Cross Sectional Elements

Design criteria for cross sectional elements (lane widths, shoulder widths, sidewalk widths, etc.) will be based on the **City of Palo Alto Standard Drawings 201, 201A and 201B (last updated in 2018)**.

This project shall use the following for collector or local streets:

Lane Width = **10 feet** (Minimum) +1 **foot shy distance adjacent to curb or wall**, 12 feet (Preferred)

Right Shoulder/Parking Width (with no bike lane) = 8 feet (measured from Edge of Traveled Way (ETW) to flow line of gutter or face of barrier)

Sidewalk Width = **5.5 feet** (Minimum, includes curb width) adjacent to road, 5 feet (Minimum) with landscape buffer from road

Bicycle Lane Width= 5 feet (Minimum), 6 feet (Preferred)

Crosswalk Width = 10 feet

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<sup>14</sup> Caltrain Design Criteria page 3-15

The minimum roadway cross slope will be based on the City of Palo Alto Standard Drawings 201, 201A and 201B.

### 3.3.3 Vertical Clearance of Underpasses

Minimum Vertical Clearance of Railroad Structure over Local Roads = 15'-6"

Minimum Vertical Clearance of Railroad Structure over Pedestrian/Bicycle Path = 10'-0"

### 3.3.4 Profile Grade

The maximum profile grade of the roadway shall be 8%. The minimum profile grade of the roadway shall be 0.2%. The maximum profile grade of a separate bicycle/pedestrian path, where the path does not follow the profile of the roadway, shall be 5%.

### 3.3.5 Crest Vertical Curves

Crest vertical curves will be designed based on the design speed and sight distance described in Section 3.3.1. A driver's eye height of 3.5 feet and an object height of 6 inches will be used.

### 3.3.6 Sag Vertical Curves

Sag vertical curves will be designed for driver comfort in lieu of headlight sight distance. Lighting on all sag vertical curves is expected and assumed. AASHTO's formula for passenger comfort on sag vertical curves is:

$$L = A \cdot V^2 / 46.5$$

Where

L = Length of Vertical Curve

V = Design Speed in mph

A = Absolute Value of Algebraic Grade Difference of the incoming/outgoing grades (in percent)

$$k = L/A = V^2/46.5 = 25^2/46.5 = 13.44$$

Example:

For an incoming grade of -8% and an outgoing grade of +8%,  $A = |-8 - 8| = 16\%$ , the minimum length of vertical curve (L) shall be:

$$L_{\min} = k \cdot A = 13.44 \cdot 16 = 215 \text{ feet}$$

### 3.3.7 Minimum Vertical Curve Length

No vertical curves shall be less than 50 feet.

### 3.3.8 Permanent and Temporary Signing & Pavement Delineation

Signing, pavement delineation and temporary traffic control devices will be designed in accordance to the November 7, 2014 edition of the California MUTCD.

### 3.3.9 Other Roadway Design Criteria

The cut/fill slope will be 1:2 or flatter.

Americans with Disabilities Act (ADA) curb ramps will be designed as shown on City of Palo Alto Standard Drawings 101, 102, 103, and 104.

Storage/Turn Length = As per Traffic Operations Analysis Report

Design Turning Vehicles = Fire Truck (Pumper), Garbage Truck (Heavy)

Driveways will be based on the City of Palo Alto Standard Drawings 121 to 125.

Curb return radius = As per truck turns and intersection needs

## 3.4 Structural

Structures and bridges supporting railroad shall be designed according to the PCJPB Standard for Design and Maintenance of Structures, and the AREMA Manual for Railway Engineering.

### 3.4.1 Structure Depth

Roadway profiles will be based on an assumed structure depth of 5 feet for Railroad<sup>15</sup> bridge structures. Railway profiles will be based on an assumed structure depth of 5 feet for Roadway<sup>16</sup> bridge structures. Structure Depth for other structures such as drainage culverts will be evaluated on a case-by-case basis and will be based on initial geotechnical evaluation of the site conditions.

## 3.5 Railroad Signals

The alternative analysis may require the adjustment of the existing signals to match the changes in elevation of the tracks required to achieve the grade separation. More detailed criteria, such as for **Positive Train Control** and revised braking calculations, would need to be developed during the next phase of design.

### 3.5.1 Signal Placement

**Ground signals are 22 feet in height** measured from the existing grade to the top of the signal. Signal cantilever and bridge structures are designed to have a 28 feet clearance from TOR. **Dwarf signals** have a horizontal clearance of 6' from the centerline of the closest track. Although the CPUC general orders allow dwarf signals 36 inches or less above TOR, the Caltrain Design Criteria mandates the dwarf signals to be 34 inches or less above the TOR.<sup>17</sup>

For Ground Signal foundation and signal placement, Standard Drawings SD-5108 and SD-5201 will be used.

For Signal Bridge placement, Standard Drawing SD-5209 will be used.

For Signal Cantilever placement, Standard Drawing SD-5210 will be used.

## 3.6 Construction Staging

Construction of the grade separation will require temporary shoofly tracks around the limits of the construction zone in order to keep all Caltrain tracks fully operational at all times and shall cause no interruption to the **Caltrain/UP/HSR** operation during construction, except for approved construction windows during cut over operations.

The shoofly tracks will include a temporary at-grade crossing at Palo Alto Avenue, Churchill Avenue, Meadow Drive and Charleston Road.

Retaining walls and/or temporary shoring shall be used, where required, to prevent any conflicts between the construction activities of the track structures and the active shoofly tracks.

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<sup>15</sup> For the purpose of this document, the structure depth is defined as the dimension from top of rail to the bottom of soffit.

<sup>16</sup> For the purpose of this document, the structure depth is defined as the dimension from top of roadway surface to the bottom of soffit.

<sup>17</sup> Caltrain Design Criteria page 5-7.

Traffic handling of vehicular traffic on the local streets will be evaluated for the preferred alternative. Existing turning movements, access to existing properties will be considered and maintained to the greatest extent possible.

## 3.7 25 kV AC Railroad Electrification System

### 3.7.1 General Requirements and Definitions

Caltrain is undertaking the Peninsula Corridor Electrification Project, which will electrify the portion of the Caltrain Corridor between San Francisco and San Jose (approximately between San Francisco milepost (MP) 0.0 to the Southbound Home Signals at C.P. Lick, Caltrain MP 50.94/Union Pacific MP 51.64).

- All grade separation alternatives shall assume the 25 kV AC Electrification Systems will be in operation during construction. Considerations shall be given to the **planning-level cost estimates to** maintain continuous operations of the live electrified railroad with minimum impacts.
- **25 kV AC Electrification System:** The Overhead Contact System, Negative Feeders, and Traction Power Return System used to power electrified trains in the Electrified JPB Rail Right-of-Way. Traction power Substations, Switching Stations, Paralleling Stations and electrical supply stations are also included in this definition.
- **Overhead Contact System (OCS):** The OCS comprises the aerial supply system that delivers 25 kV traction power from the Substations to the Pantographs of the electric trains, and includes the Catenary System Messenger and Contact Wires, feeder, auxiliary wires and hangers, associated Supports and structures (including poles, portals, headspans and their foundations), manual and/or motor operated isolators, insulators, Phase Breaks, conductor terminations and tensioning devices, downguys, and other overhead line hardware and fittings.

### 3.7.2 Clearances

Clearances for the OCS, per SED-2 CPUC requirements for Caltrain Electrification are as follows:

- Structure Limit: 6'-0" minimum clear from the back (field side) of OCS Pole the face of any structure
- Vegetation Growth Limit: No vegetation shall overhang beyond the vegetation trim lines (as shown in Figure 3) or exist within 10'-0" of OCS or other electrical equipment.
- Track Clearance: Horizontal clearance shall be between 10' (minimum) and 12' (preferred) as measured from the track centerline to the face (track side) of OCS poles or other OCS and electrical equipment.
- Contact Wire Height: The contact wire height will be 22 feet above the top of rail.

There are further clearance requirements set forth in SED-2 beyond those listed above. The entirety of the SED-2 shall be taken into consideration during design.

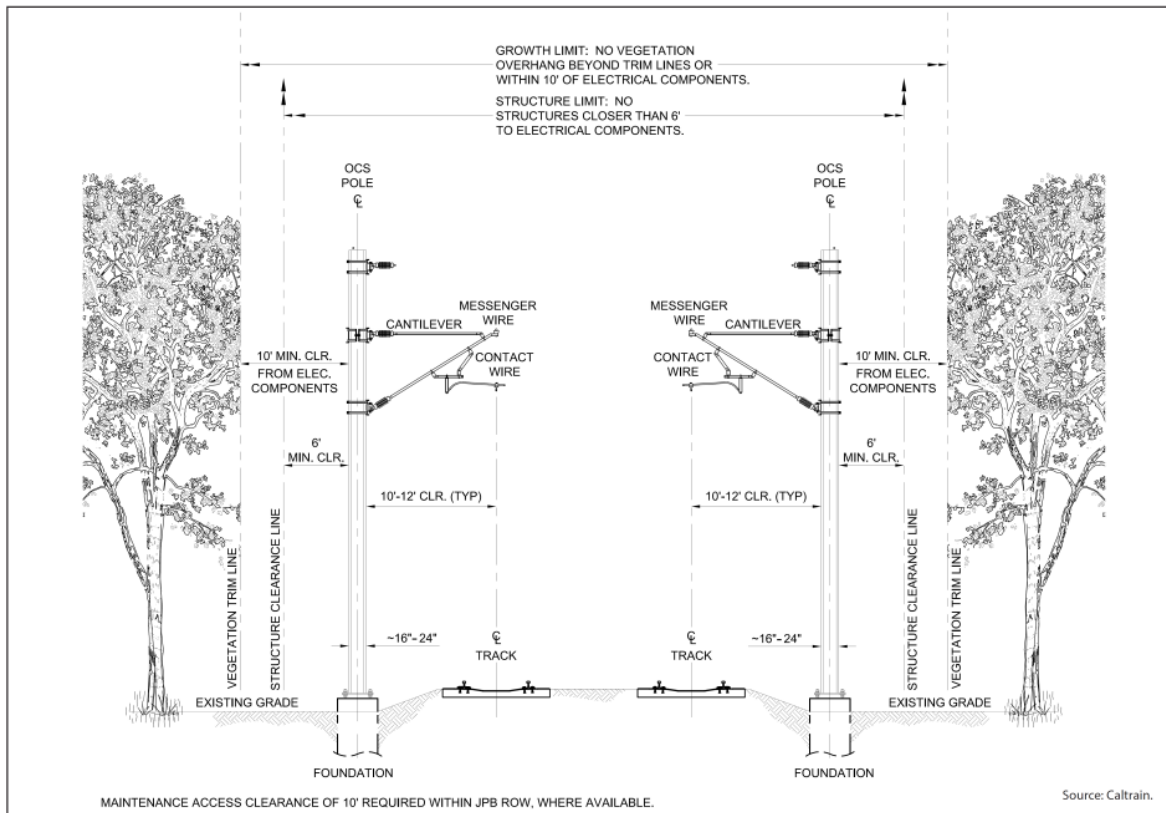


Figure 5 - Caltrain OCS Clearances



## Vertical Curve Calculations

By Phil Burton

$$L = (D * V_{\text{squared}} * K) / A$$

Ref: Palo Alto Design Criteria 20190807\_FINAL.pdf, p. 13

### At 2.0% vertical grade

	D	V (mph)	Vsquared	K	A-passenger	A-freight	L-passenger	L-freight
passenger	0.02	110	12100	2.15	0.9		578	
freight @ 50 mph	0.02	50	2500	2.15		0.1		1075
freight @ 40 mph	0.02	40	1600	2.15		0.1		688
freight @ 35 mph	0.02	35	1225	2.15		0.1		527

### At 1.4% vertical grade

	D	V (mph)	Vsquared	K	A-passenger	A-freight	L-passenger	L-freight
passenger	0.014	110	12100	2.15	0.9		405	
freight @ 50 mph	0.014	50	2500	2.15		0.1		753
freight @ 40 mph	0.014	40	1600	2.15		0.1		482
freight @ 35 mph	0.014	35	1225	2.15		0.1		369

### At 1.0% vertical grade

	D	V (mph)	Vsquared	K	A-passenger	A-freight	L-passenger	L-freight
passenger	0.01	110	12100	2.15	0.9		289	
freight @ 50 mph	0.01	50	2500	2.15		0.1		538
freight @ 40 mph	0.01	40	1600	2.15		0.1		344
freight @ 35 mph	0.01	35	1225	2.15		0.1		263

# Design Standards for Vertical Clearances for Caltrain Electrification Project

## AAR Plates (plates not shown do not exist)

AAR Plate	Car Max Height	Notes
B	15' 1"	Unrestricted interchange service standard
C	15' 6"	Limited interchange service standard (will clear 95% of total rail mileage)
D	--	information for obtaining the maximum allowable width of cars, other than at the centerline of the car, to allow for unrestricted Plate B and limited Plate C, H, J and K interchange service.
E	15' 9"	Limited interchange service
F	17' 0"	Limited interchange service
H	20' 3"	Limited interchange service Double-stack container cars
J		Limited interchange service Conventional 19' autorack cars
K	20' 3"	Limited interchange service 20' 3" autorack cars
	15' 1"	Unrestricted* diagram for single loads, without end overhang, on open top cars. Presumably flat cars and gondola cars

A post on the Caltrain website, **Engineering Standards 2011**, includes a drawing for AAR Plates F and H. The Caltrain drawing SD-2001 for Plates F and H adds a 6" cushion to the AAR Plates.

For most of the freight cars operating in current Union Pacific freight services, plate B and (no letter) apply.

## Relevant Caltrain Standards

Note that existing overpasses impose a \_\_\_ clearance.

CPUC Order 95 standards for vertical clearance. See line 2. Note that Caltrain will be electrified at 25 KV 60 Hz. See Column F.

**TABLE 1: CPUC GENERAL ORDER 95 BASIC MINIMUM ALLOWABLE VERTICAL CLEARANCE OF WIRES ABOVE RAILROADS, THOROUGHFARES, POLES, BUILDINGS, STRUCTURES OR OTHER OBJECTS**

CASE NO.	NATURE OF CLEARANCE	A SPAN WIRES (OTHER THAN TROLLEY SPAN WIRES) OVERHEAD GUYS AND MESSENGERS	B COMMUNICATION CONDUCTORS (INCLUDING OPEN WIRE, CABLES & SERVICE DROPS), SUPPLY SERVICE DROPS OF 0-750 VOLTS	C TROLLEY CONTACT, FEEDER AND SPAN WIRES, 0-5,000 VOLTS	D SUPPLY CONDUCTORS OF 0-750 VOLTS & SUPPLY CABLES	E SUPPLY CONDUCTORS & SUPPLY CABLES, 750-22,500 VOLTS	F SUPPLY CONDUCTORS & SUPPLY CABLES, 22.5-300 KV	G SUPPLY CONDUCTORS & SUPPLY CABLES, 300-550 KV (mm)
1	CROSSING ABOVE TRACKS OF RAILROADS WHICH TRANSPORT OR PROPOSE TO TRANSPORT FREIGHT CARS (MAXIMUM HEIGHT 15-FT, 6-INCH) WHERE NOT OPERATED BY OVERHEAD CONTACT WIRES.	25-FT	25-FT	22.5-FT	25-FT	28-FT	34-FT	34-FT
2	CROSSING OR PARALLELING ABOVE TRACKS OF RAILROAD OPERATED BY OVERHEAD TROLLEYS.	26-FT	26-FT	19-FT	27-FT	30-FT	34-FT	34-FT
3	CROSSING OR ALONG THOROUGHFARES IN URBAN DISTRICTS OR	18-FT	18-FT	19-FT	20-FT	25-FT	30-FT	30-FT

From the Wikipedia article [https://en.wikipedia.org/wiki/Electrification\\_of\\_Caltrain](https://en.wikipedia.org/wiki/Electrification_of_Caltrain).

*Contact wire height is planned to vary between 16 to 23 feet (4.9 to 7.0 m), depending on overhead clearance required, with the messenger wire another 2 to 5 feet (0.61 to 1.52 m) above that, and pole height will vary between 30 to 50 feet (9.1 to 15.2 m). Nominal clearance under the contact wire will be 23 feet (7.0 m) to accommodate freight and non-electrified passenger rail service.*

From the Caltrain website,

[http://www.caltrain.com/Assets/Peninsula+Rail+Program/Electrification+2025/EA-DEIR-04-2004/Chapter\\_2\\_WEB.pdf](http://www.caltrain.com/Assets/Peninsula+Rail+Program/Electrification+2025/EA-DEIR-04-2004/Chapter_2_WEB.pdf)

*Clearances for maintenance and operation of the OCS will be designed to allow for existing freight railroad clearances and operations; the OCS, however, may have to be de-energized at some overhead bridge locations in order to operate certain freight trains over the JPB-owned portion of the right-of-way during non-passenger revenue hours. OCS installation on the segments of the UPRR-owned right-of-way would be designed to provide clearance parameters to permit American Association of Railroads (AAR) Plate H freight operations at all times under the energized conductors. (See Figures 2.3-1 through 2.3-3)*



## Memorandum

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**Date:** August 13, 2020

**To:** Mr. Ed Shikada, City of Palo Alto  
**CC:** Ms. Millette Litzinger, AECOM

**From:** Gary Black, Trisha Dudala

**Subject:** Churchill, Meadow and Charleston Grade Separation Traffic Analysis

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## Introduction

The Caltrain Electrification project will increase the frequency of trains through Palo Alto. The gate downtime at at-grade crossings is expected to be as high as 45 seconds per 3 minutes. The three at-grade crossings included in the Connecting Palo Alto study are located on Churchill Avenue, Meadow Drive, and Charleston Road. This report summarizes the findings of the traffic operations analysis that was conducted for alternatives that would provide grade separation at the three at-grade crossings. These alternatives were selected for further evaluation by the City and the XCAP.

This study analyzes traffic operations during the weekday AM (7-9) and PM (4-6) peak commute hours under existing and future (Year 2030) conditions. The analysis was conducted using the simulation software VISSIM by PTV Vision, and Synchro/SimTraffic by Trafficware. Traffic conditions at the study intersections were evaluated using level of service (LOS). Level of service is a qualitative description of operating conditions ranging from LOS A, or free-flow conditions with little or no delay, to LOS F, or jammed conditions with excessive delays. The acceptable LOS in the City of Palo Alto is LOS D or better for signalized and unsignalized intersections.

## Bicycle and Pedestrian Circulation

The traffic study focuses on vehicular traffic operations at Churchill Avenue, Meadow Drive, and Charleston Road for the alternatives. However, bicycle and pedestrian circulation has been accounted for in the traffic analysis. All alternatives have been designed to be consistent with the City's safe routes to schools plan. The design drawings show all planned sidewalks and bicycle lanes/paths.

## Churchill Avenue Alternatives

Existing AM and PM peak hour traffic counts and future volumes for the Alma Street/Churchill Avenue intersection were obtained from the 2018 counts and 2030 forecasts presented in the *Draft Churchill Closure* report by TJKM. A comparison of AM and PM peak hour delays at the Alma and Churchill Avenue for the three alternatives with existing traffic volumes are shown in Table 1 and with Year 2030 volumes are shown in Table 2. As shown in Table 1, the intersection of Alma and Churchill currently operates at LOS F during the AM peak hour and LOS E during the PM peak hour. With future traffic volumes (see Table 2) the intersection would operate at LOS F during both the AM and PM peak hours and with electrification, the intersection would continue to operate at

unacceptable LOS F during both the AM and PM peak hours. The electrification would increase the number of trains and the downtime at the at-grade crossing which would cause the intersection delay to increase.

### **Churchill Closure**

This analysis scenario evaluated the impacts of the closure of Churchill Avenue across the railroad tracks. With the closure of Churchill Avenue west of the railroad tracks, Churchill Avenue would no longer provide an east-west connection for vehicles across Alma Street. Figures 1A and 1B shows the conceptual intersection layout and rendering of the intersection, developed by AECOM. As shown in Table 1 and Table 2, the intersection of Alma and Churchill Avenue would operate at an acceptable LOS C during both the AM and PM peak hours with existing and future traffic volumes with the Churchill closure. However, this alternative would cause the existing traffic using the Churchill railroad crossing to reroute to other crossings, creating traffic impacts on Embarcadero Road and on Oregon Expressway/Page Mill Road. These impacts and mitigation measures were the subject of a separate traffic study prepared by Hexagon and included in Appendix A.

### **Churchill Viaduct**

Under this alternative, an elevated structure (viaduct) would carry the railroad tracks over Churchill Avenue, and Churchill would continue to provide an east-west connection for pedestrians, bicycles and vehicles. Figure 2 illustrates the conceptual rendering of the intersection, developed by AECOM. As shown in Table 1, the intersection of Alma and Churchill Avenue would operate at LOS D during both the AM and PM peak hours with existing traffic volumes. The improvement in LOS would be due to the train interruption being eliminated. With future traffic volumes (see Table 2), the intersection would operate at LOS D during the AM peak hour and LOS E during the PM peak hour.

The reduction in delay due to the elimination of gate down time could lead to an increase in traffic volume on Churchill Avenue. Of particular concern is the residential portion of Churchill Avenue, which is east of Alma Street. Hexagon calculated the additional intersection capacity that would result from the elimination of gate down time. The increase in capacity could result in about 100 additional vehicles per day using Churchill Avenue east of Alma Street. This represents a 5% increase in traffic. It should be noted that the additional capacity would primarily occur during the peak AM and PM commute hours. During the off-peak hours, there is much less gate down time because of many fewer trains.

### **Churchill Partial Underpass**

This alternative proposes to separate Caltrain from Churchill Avenue but preserve access to Alma street by keeping Churchill Avenue partially open via a modified underpass. It requires lowering both Churchill and Alma to allow the western portion of Churchill to pass underneath the Caltrain tracks, while keeping the eastern portion of Churchill at grade. The most significant traffic-flow change is that no through traffic would be possible on Churchill Avenue across Alma Street. This alternative also would separate the bicycle and pedestrian traffic crossing Alma Street from vehicular traffic by providing a bridge over Churchill Avenue that connects to the bike trail next to Palo Alto High School. Figures 3A and 3B illustrates the conceptual intersection layout and renderings of the intersection, developed by AECOM.

Because through traffic and some turning movements at Churchill would not be possible, some traffic would reroute to other streets. The following traffic movements would need to reroute (see Figures 4A, 4B, 4C and 4D):

- Eastbound through traffic on Churchill – 90% of the traffic is expected to reroute to turn left on Alma and travel north to use Embarcadero Road or one of the neighborhood cross streets. 10% of the traffic is expected to turn right at Alma and use one of the neighborhood cross streets.
- Westbound through traffic on Churchill Avenue – All traffic is expected to make a right turn on Alma and travel north to use Embarcadero Road.
- Westbound left-turn traffic on Churchill Avenue – All traffic is expected to use another of the neighborhood streets to access Alma.
- Southbound left-turn traffic on Alma Street – All traffic is expected to turn left into one of the other neighborhood streets.

As shown in Table 1 and Table 2, the signalized intersection of Alma Street and Churchill Avenue would operate at acceptable LOS C or better during both the AM and PM peak hour periods with the existing and future traffic volumes.

**Table 1  
Alma and Churchill Grade Separation Alternatives – Existing Traffic Volumes**

	Traffic Operations (Existing Traffic Volumes)															
	No Improvements (No Electrification) <sup>1</sup>				Churchill Closure <sup>2</sup>				Viaduct <sup>3</sup>				Partial Underpass <sup>4</sup>			
	AM		PM		AM		PM		AM		PM		AM		PM	
	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS
Alma Street & Churchill Avenue	88.9	F	66.67	E	23.58	C	28.23	C	45.39	D	42.73	D	15.62	B	21.66	C

**Notes:-**

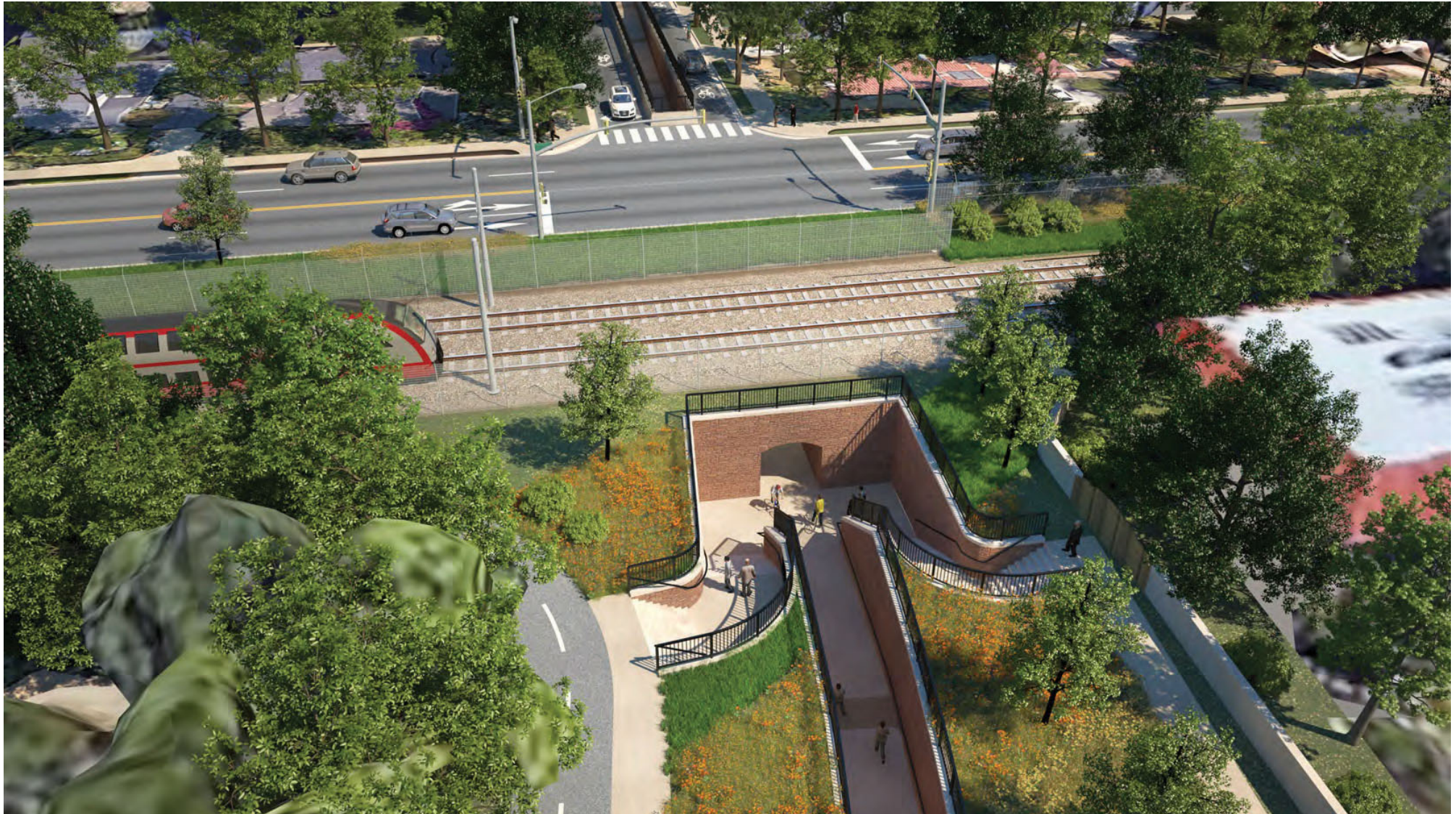
1. All turning movements permitted. Analysis assumes 8 trains per hour under existing conditions. Traffic analysis was conducted using PTV Vissim software.
2. The following turning movements would not be possible;- left-turn, right-turn and through traffic from eastbound Churchill, through traffic from westbound Churchill, northbound left-turns and southbound right-turn from Alma. Traffic analysis was conducted using PTV Vissim software.
3. All turning movements permitted. Traffic analysis was conducted using PTV Vissim software.
4. The following turning movements would not be possible;- eastbound and westbound through traffic on Churchill Avenue across Alma Street, left-turn from westbound Churchill, and left-turn from southbound Alma. Traffic analysis was conducted using SimTraffic.

**Table 2  
Alma and Churchill Grade Separation Alternatives – Future Traffic Volumes**

	Traffic Operations (Year 2030 Traffic Volumes)																			
	No Improvements (No Electrification) <sup>1</sup>				No Improvements (With Electrification) <sup>2</sup>				Churchill Closure <sup>3</sup>				Viaduct <sup>4</sup>				Partial Underpass <sup>5</sup>			
	AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS
Alma Street & Churchill Avenue	118.5	F	90	F	173.5	F	178.5	F	25.1	C	30.6	C	48.4	D	56.77	E	15.65	B	30.97	C

**Notes:-**

1. All turning movements permitted. Analysis assumes 8 trains per hour with no electrification. Traffic analysis was conducted using PTV Vissim software.
2. All turning movements permitted. Analysis assumes 14 trains per hour with electrification. Traffic analysis was conducted using PTV Vissim software.
3. The following turning movements would not be possible;- left-turn, right-turn and through traffic from eastbound Churchill, through traffic from westbound Churchill, northbound left-turns and southbound right-turn from Alma. Traffic analysis was conducted using PTV Vissim software.
4. All turning movements permitted. Traffic analysis was conducted using PTV Vissim software.
5. The following turning movements would not be possible;- eastbound and westbound through traffic on Churchill Avenue across Alma Street, left-turn from westbound Churchill, and left-turn from southbound Alma. Traffic analysis was conducted using SimTraffic.



Preliminary Layout shown based on early concepts  
(subject to change)

**Figure 1A**  
**Churchill Closure Rendering 1**





Preliminary Layout shown based on early concepts  
(subject to change)

**Figure 1B**  
**Churchill Closure Rendering 2**



Preliminary Layout shown based on early concepts  
(subject to change)

**Figure 2**  
**Churchill Viaduct Rendering**



Preliminary Layout shown based on early concepts  
(subject to change)

**Figure 3A**  
**Churchill Partial Underpass Intersection Layout**



Preliminary Layout shown based on early concepts  
(subject to change)

**Figure 3B**  
**Churchill Partial Underpass Rendering**



**Figure 4A**  
**Churchill Ave/Alma St AM and PM Peak-Hour Diversions (Partial Underpass Alternative)**



**Figure 4B**  
**Churchill Ave/Alma St AM and PM Peak-Hour Diversions (Partial Underpass Alternative)**



**Figure 4C**  
**Churchill Ave/Alma St AM and PM Peak-Hour Diversions (Partial Underpass Alternative)**



**Figure 4D**  
**Churchill Ave/Alma St AM and PM Peak-Hour Diversions (Partial Underpass Alternative)**



## Meadow Drive and Charleston Road Alternatives

Existing AM and PM peak hour traffic counts for the Alma Street/Meadow Drive and Alma Street/Charleston Road were conducted in October 2019 (see Appendix B). Future traffic volumes for these two study intersections were obtained from the *Palo Alto Comprehensive Plan Update* prepared by Hexagon in January 2016. For the at-grade crossings at Meadow Drive and Charleston Road, two alternatives were evaluated as described below. A comparison of AM and PM peak hour delays at the Alma/Meadow and Alma/Charleston for the two alternatives with existing traffic volumes are shown in Table 3 and with future traffic volumes are shown in Table 4. As shown in Table 3, the Alma/Meadow intersection currently operates at LOS F during the AM peak hour and LOS E during the PM peak hour. The intersection of Alma/Charleston operates at LOS F during both the AM and PM peak hours. With future traffic volumes (see Table 4), the analysis shows that both the Meadow and Charleston intersections would operate at LOS F during the AM and PM peak hours. With electrification, the analysis shows that both intersections would continue to operate at unacceptable LOS F during the AM and PM peak hours with future traffic volumes.

### Meadow and Charleston Viaduct

Under this alternative, an elevated structure (viaduct) would carry the railroad over both Meadow Drive and Charleston Road. Meadow and Charleston would continue to provide east-west connections for pedestrians, bicycles and vehicles. Figure 5 illustrates the conceptual rendering of the Meadow Drive viaduct and Figure 6 illustrates the conceptual rendering of the Charleston Road viaduct.

#### Alma Street and Meadow Drive Intersection

As shown in Tables 3 and 4, the intersection of Alma and Meadow would operate at LOS D during both the AM and PM peak hours with existing traffic volumes. With future traffic volumes, this intersection would operate at LOS E during the AM peak hour and LOS F during the PM peak hour with the viaduct.

#### Alma Street and Charleston Road Intersection

The analysis shows that the intersection of Alma and Charleston would operate at LOS E during the AM peak hour and LOS D during the PM peak hour with existing traffic volumes (see Table 3). With future traffic volumes, this intersection would operate at LOS F during both the AM and PM peak hours with the viaduct (see Table 4).

There are no feasible improvements that would mitigate the traffic operations under future traffic volumes to acceptable levels.

### Meadow and Charleston Trench

Under this alternative, the railroad tracks would be fully lowered in a trench, and the roadways would remain at grade. Meadow and Charleston would continue to provide east-west connections for pedestrians, bicycles, and vehicles. The traffic impacts for this alternative would be similar to the viaduct alternative.

**Table 3  
Meadow and Charleston Grade Separation Alternatives – Existing Traffic Volumes**

Traffic Operations (Existing Traffic Volumes)										
No Improvements										
(No Electrification) <sup>1</sup>										
Viaduct <sup>2</sup>										
	Traffic Control	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	
<b><u>Meadow Drive</u></b>										
	Alma Street & Meadow Drive	Signal	81.34	F	64.43	E	52.00	D	47.36	D
<b><u>Charleston Road</u></b>										
	Alma Street & Charleston Road	Signal	123.06	F	101.40	F	60.93	E	51.59	D
<b>Notes:-</b>										
1. All turning movements permitted. Analysis assumes 8 trains per hour under existing conditions. Traffic analysis was conducted using SimTraffic.										
2. All turning movements permitted. Traffic analysis was conducted using SimTraffic.										

**Table 4  
Meadow and Charleston Grade Separation Alternatives – Future Traffic Volumes**

Traffic Operations (Year 2030 Traffic Volumes)														
	Traffic Control	No Improvements (No Electrification) <sup>1</sup>				No Improvements (With Electrification) <sup>2</sup>				Viaduct <sup>3</sup>				
		AM		PM		AM		PM		AM		PM		
		Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	
<b>Meadow Drive</b>														
	Alma Street & Meadow Drive	Signal	215.03	F	318.96	F	318.39	F	502.87	F	68.93	E	238.26	F
<b>Charleston Road</b>														
	Alma Street & Charleston Road	Signal	330.72	F	330.31	F	421.58	F	535.47	F	114.94	F	274.50	F
<b>Notes:-</b>														
1. All turning movements permitted. Analysis assumes 8 trains per hour with no electrification. Traffic analysis was conducted using SimTraffic.														
2. All turning movements permitted. Analysis assumes 14 trains per hour with electrification. Traffic analysis was conducted using SimTraffic.														
3. All turning movements permitted. Traffic analysis was conducted using SimTraffic.														



Preliminary Layout shown based on early concepts  
(subject to change)

**Figure 5**  
**Meadow Drive Viaduct Rendering**



Preliminary Layout shown based on early concepts  
(subject to change)

**Figure 6**  
**Charleston Road Viaduct Rendering**

### **Meadow and Charleston Hybrid**

Under this alternative, the railroad track would be slightly raised, and the roadway would be slightly lowered. Meadow and Charleston would continue to provide east-west connections for pedestrians, bicycles, and vehicles. The traffic impacts for this alternative would be similar to the viaduct alternative.

### **South Palo Alto Tunnel – Passenger and Freight**

Under this alternative, both the passenger trains and the freight trains would be accommodated within an underground tunnel. The traffic impacts for this alternative would be similar to the viaduct alternative.

### **South Palo Alto Tunnel – At-Grade Freight**

Under this alternative, the passenger trains would use an underground tunnel and the freight trains would continue to operate at grade. Also, Alma Street would be reduced to one lane in each direction between approximately El Dorado-Loma Verde and Charleston-Greenmeadow Way. As a result, the traffic impacts under this alternative would be worse than the viaduct, trench, hybrid and tunnel (with passenger and freight) alternatives.

### **Meadow and Charleston Partial Underpass – With U-Turn at Alma Village Circle**

This alternative proposes to keep the Caltrain tracks at grade and lower Meadow Drive and Charleston Road to go under the tracks and under Alma Road. Figures 7A and 7B illustrates the conceptual intersection layout and rendering of the Meadow Drive partial underpass and Figures 8A and 8B illustrates the conceptual intersection layout and rendering of the Charleston Road partial underpass. This alternative was analyzed only for future conditions (see Table 5).

### **Alma Street and Alma Village Circle**

A U-turn lane would be constructed on northbound Alma at the existing signalized intersection of Alma Street and Alma Village Circle. Alma Village Circle is located approximately 600 feet to the north of Meadow Drive. The U-turn lane would allow northbound traffic on Alma Street to access Meadow Drive by making a U-turn at the Alma Village Circle and using the proposed southbound Alma Street off-ramp to Meadow Drive. Due to the close spacing between the proposed Alma Street on-ramp from Meadow Drive and Alma Village Circle, traffic from westbound Meadow would not be able to access the U-turn lane to go southbound on Alma.

### **Alma Street and Meadow Drive Intersection**

For the most part, this alternative has Meadow Drive passing under Alma Street, with a couple of connections. Southbound left-turns and right-turns from Alma to Meadow Drive will be accommodated by an off-ramp from Alma Street to Meadow Drive with a traffic signal. Also, westbound right-turns from Meadow Drive to northbound Alma Street would be accommodate by a ramp. A U-turn lane would be constructed on northbound Alma at the existing signalized intersection of Alma Street and Alma Village Circle to facilitate turning movements from northbound Alma to Meadow Drive. Alma Village Circle is located approximately 600 feet to the north of Meadow Drive. The U-turn lane would allow northbound traffic on Alma Street to access Meadow Drive by making a U-turn at the Alma Village Circle and using the proposed southbound Alma Street off-ramp to Meadow Drive. Due to the close spacing between the proposed Alma Street on-ramp from Meadow Drive and Alma Village Circle, traffic from westbound Meadow would not be able to access the U-turn lane to go southbound on Alma. Westbound left-turns and eastbound

right-turns from Meadow to southbound Alma would reroute to other locations (see Figures 9A and 9B).

Three options as described below were analyzed for the northbound and southbound ramp intersections at Meadow Drive (see Table 5).

- Option 1 – Traffic signal at the Alma southbound off-ramp and no control at the Alma northbound off-ramp. Left-turning traffic from eastbound Meadow would have to find gaps in the uncontrolled traffic flow on westbound Meadow.
- Option 2 – Traffic signal at the Alma southbound off-ramp and an all-way stop control at the Alma northbound on-ramp.
- Option 3 – Traffic signals at both the southbound off-ramp and northbound on-ramp.

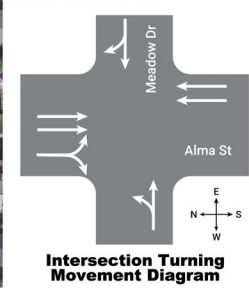
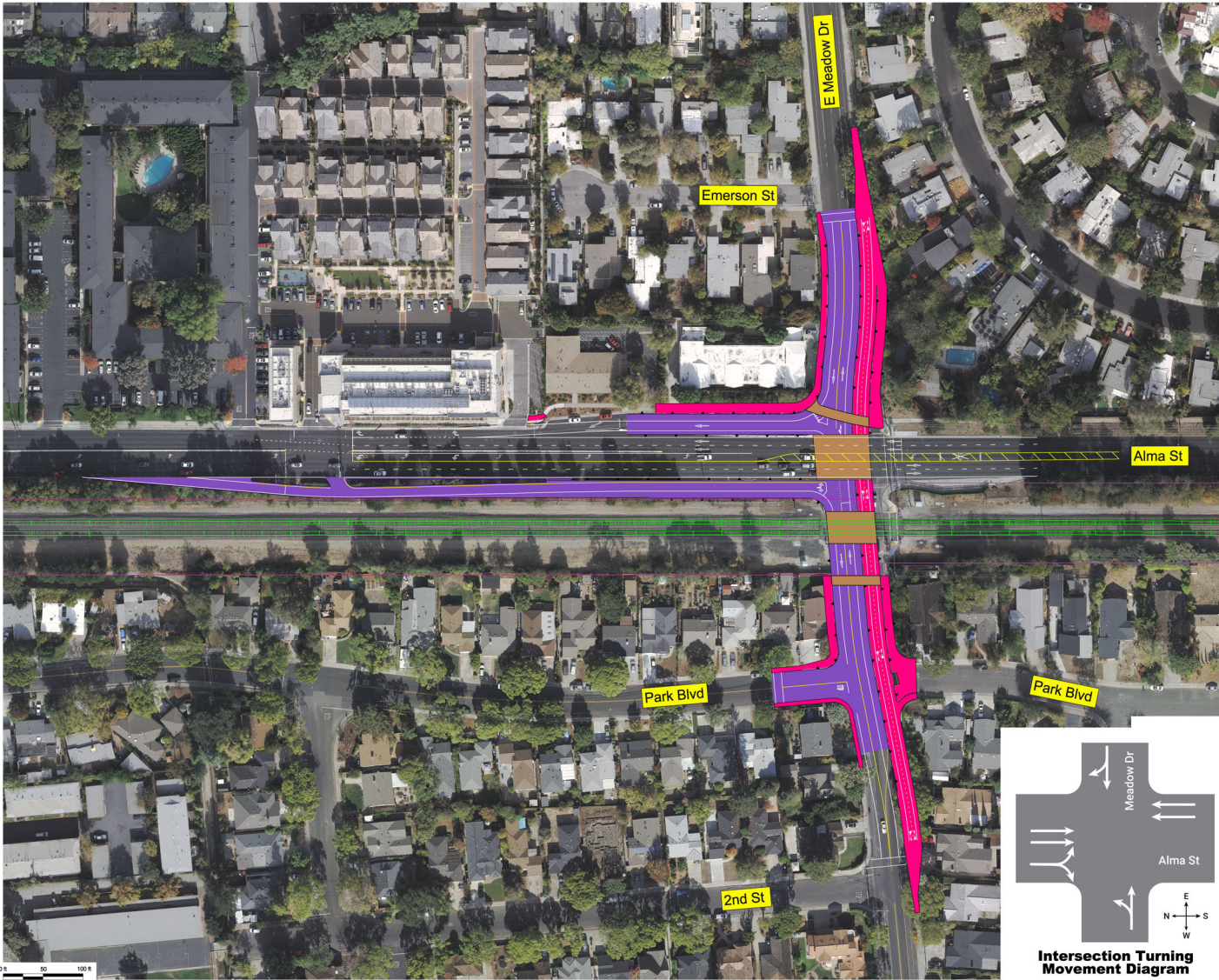
### **Alma Street and Charleston Road Intersection**

At the Alma/Charleston intersection, some turning movements would be cut off at the intersection itself but would be accommodated via a two-lane roundabout that would be provided on Charleston Road at Mumford Place, east of Alma Street (see Figures 10A, 10B and 10C). Two ramps and two traffic signals would be provided to connect Charleston Road to Alma Street. The signal to the north would facilitate turning movements from westbound Charleston to northbound and southbound Alma Street. The signal to the south would facilitate southbound left-turns and northbound right turns from Alma Street to eastbound Charleston Road. The design also includes a ramp connection from eastbound Charleston to southbound Alma Street.

As shown in Table 5, the analysis shows that the intersection of Alma Street and Alma Village Circle would operate at acceptable LOS B during both the AM and PM peak hours with future traffic volumes.

At the Alma/Meadow intersection, the analysis shows that both the ramps from southbound Alma to Meadow and from Meadow to northbound Alma would operate at acceptable LOS B or better during the AM and PM peak hours with future traffic volumes. Where the northbound on-ramp would merge onto Alma Street, the analysis shows that the on-ramp approach would operate at LOS E during the AM peak hour, as traffic merging onto Alma Street would have to find gaps in the uncontrolled traffic flow on northbound Alma, which is the peak direction.

The analysis shows that the two signalized intersections at Alma/Charleston would operate at LOS C or better during both the AM and PM peak hours under future conditions. Where the on-ramp from eastbound Charleston would merge onto southbound Alma Street, the analysis shows that the on-ramp approach would operate at LOS E during the PM peak hour under future traffic conditions, as traffic merging onto Alma Street would have to find gaps in the uncontrolled traffic flow on southbound Alma, which is the peak direction. The analysis shows that the two-lane roundabout at Charleston/Mumford would operate at acceptable levels of service during both the AM and PM peak hours under existing and future conditions.



Preliminary Layout shown based on early concepts (subject to change)

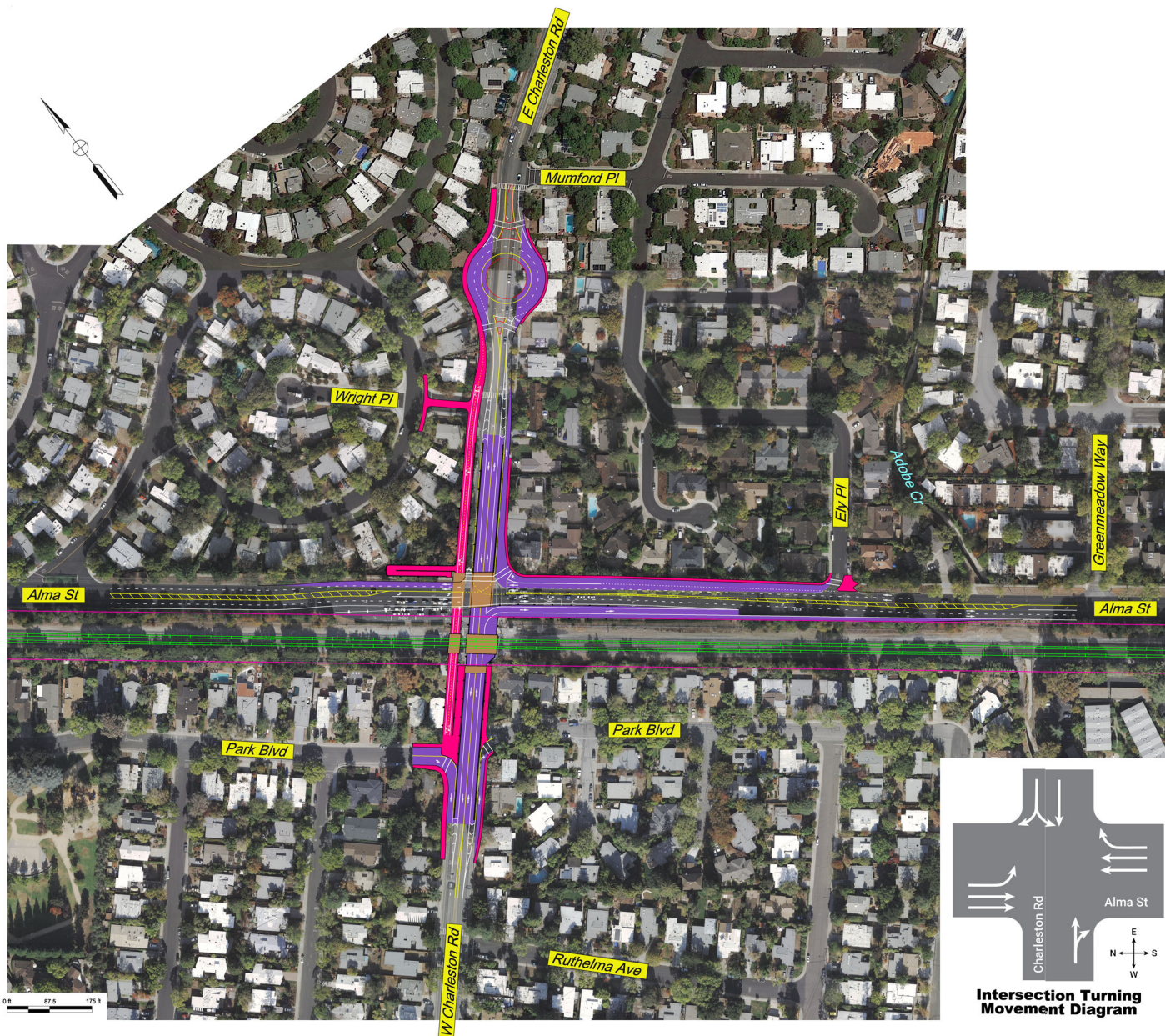
Figure 7A  
Meadow Drive Partial Underpass Intersection Layout





Preliminary Layout shown based on early concepts  
(subject to change)

**Figure 7B**  
**Meadow Drive Partial Underpass Rendering**



Preliminary Layout shown based on early concepts  
(subject to change)

**Figure 8A**  
**Charleston Road Partial Underpass Intersection Layout**



Preliminary Layout shown based on early concepts  
(subject to change)

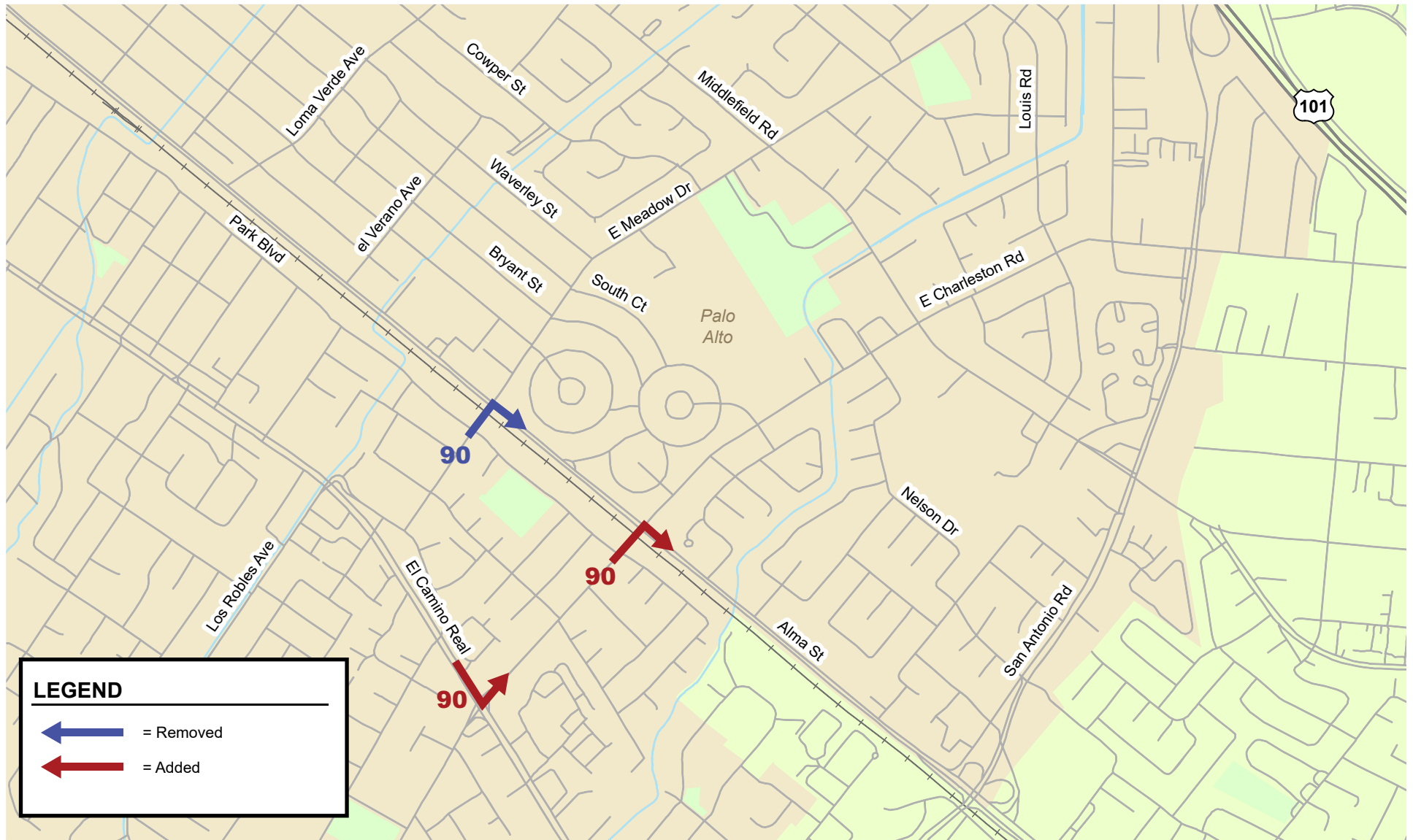
**Figure 8B**  
**Charleston Road Partial Underpass Rendering**

**Table 5  
Meadow and Charleston Partial Underpass with U-Turn at Alma Village Circle – Future Traffic Volumes**

Traffic Operations (Year 2030 Traffic Volumes) - Partial Underpass															
	Traffic Control	Option 1				Option 2				Option 3					
		AM		PM		AM		PM		AM		PM			
		Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS		
<b>Alma Village Circle</b>	Signal	18.84	B	19.37	B	Signal	18.38	B	20.1	B	Signal	18.86	B	20.7	B
<b>Meadow Drive</b>															
Alma Street SB Off-Ramp & Meadow Drive	Signal	10.92	B	11.94	B	Signal	12.11	B	14.91	B	Signal	13.47	B	14.43	B
Alma Street On-Ramp & Meadow Drive	Uncontrolled	5.10	A	5.10	A	AWSC	7.90	A	7.90	A	Signal	9.50	A	9.90	B
Meadow to NB Alma (On-Ramp)	Yield	35.80	E	27.00	D	Yield	35.10	E	28.20	D	Yield	37.30	E	28.60	D
<b>Charleston Road</b>															
Alma Street & Charleston Road (N)	Signal	13.61	B	25.97	C	Signal	18.23	B	26.36	C	Signal	14.90	B	27.40	C
Alma Street & Charleston Road (S)	Signal	20.75	C	19.24	B	Signal	20.25	C	19.61	C	Signal	21.24	C	19.30	C
EB Charleston to SB Alma (On-Ramp)	Yield	8.60	A	38.90	E	Yield	9.80	A	38.40	E	Yield	9.00	A	38.50	E
Mumford Place & Charleston Road	Roundabout	6.08	A	9.71	A	Roundabout	6.15	A	11.94	B	Roundabout	5.88	A	11.11	B
<b>Notes:-</b>															
<i>AWSC - All Way Stop Controlled</i>															
1. Option 1 - At the Meadow Dr and Alma NB-On Ramp intersection, analysis assumes through traffic on Meadow does not stop. Left-turns from Meadow to Alma northbound would yield to westbound traffic on Meadow. The delay for the eastbound left-turns is shown in the table.															
2. Option 2 - At the Meadow Dr and Alma NB-On Ramp intersection, analysis assumes an all-way stop control.															
3. Option 3 - At the Meadow Dr and Alma NB-On Ramp intersection, analysis assumes a traffic signal.															
4. The following turning movements are restricted at Alma/Meadow and Alma/Charleston due to the partial underpass.															
- Alma/Meadows - right-turn from eastbound Meadow, left-turn from westbound Meadow, left-turn and right-turn from northbound Alma.															
- Alma/Charleston - left-turn from eastbound Charleston, left-turn from northbound Alma, right-turn from southbound Alma.															
5. The analysis assumes a northbound U-turn lane at Alma/Alma Village Circle signal to allow northbound traffic on Alma Street to make a U-turn and use the southbound off-ramp to Meadow Drive.															



**Figure 9A**  
**E Meadow Dr/Alma St AM and PM Peak-Hour Diversions (Partial Underpass Alternative)**



**Figure 9B**  
**E Meadow Dr/Alma St AM and PM Peak-Hour Diversions (Partial Underpass Alternative)**



**Figure 10A**  
**Charleston Rd/Alma St Turning Movements Via Roundabout (Partial Underpass Alternative)**



**Figure 10B**  
**Charleston Rd/Alma St Turning Movements Via Roundabout (Partial Underpass Alternative)**





**Figure 10C**  
**Charleston Rd/Alma St Turning Movements Via Roundabout (Partial Underpass Alternative)**

## Appendices

Appendix A – Churchill Closure Traffic Study

Appendix B – Meadow and Charleston Traffic Counts

Appendix C – Synchro Existing and Future Traffic Volumes

Appendix A  
Churchill Closure Traffic Study



## Memorandum

**Date:** November 26, 2019

**To:** City of Palo Alto  
**CC:** Ms. Millette Litzinger, AECOM

**From:** Gary Black, Trisha Dudala

**Subject:** Traffic Analysis of Potential Closure of Churchill Avenue at Alma Street

## Summary

The Caltrain Electrification project will increase the frequency of trains through Palo Alto. As a result, the City of Palo Alto is considering closing the Churchill Avenue railroad crossing as part of the Connecting Palo Alto grade separation study. This report describes the results of the traffic impact analysis for the “Do Nothing” alternative and closure of Churchill Avenue at the railroad crossing. The study looked at traffic impacts during the weekday AM (7-9) and PM (4-6) peak commute hours. It is during these hours that the roadways generally experience the most traffic congestion. The analysis was conducted using the simulation software VISSIM by PTV Vision, which has the ability to analyze signal pre-emption.

The analysis of the “Do Nothing” alternative for the at-grade rail crossing at the Alma Street and Churchill Avenue intersection showed that the delays incurred by certain turning movements would be significantly high resulting in longer vehicular queues during the AM peak hour and PM peak hours under existing and Year 2030 conditions with the increase in frequency of trains attributed to the proposed Caltrain electrification.

The analysis of the potential Churchill Avenue closure at the railroad tracks showed that the diverted vehicular traffic volumes from Churchill Avenue would cause significant impacts to six intersections in the study area. Mitigations were identified for all six intersections, and with the implementation of these mitigation measures, the analysis showed that traffic impacts from the potential Churchill closure would be adequately mitigated during both the AM and PM peak hours under existing and Year 2030 traffic conditions.

A report was prepared by TJKM (*Draft Traffic Impact Study Report, Churchill Avenue Closure, August 7, 2019*) that analyzed the closure of Churchill Avenue (included in the appendix). The study determined that several intersections in the study area would have significant traffic operational impacts. The analysis discussed in this report uses much of the data from the TJKM report. However, this report identifies alternative mitigation for the potential impacts at the Embarcadero & Alma interchange.



## Alma Street and Churchill Avenue Intersection – Traffic Analysis

### Existing Conditions Analysis

The existing conditions analysis was conducted based on existing peak hour traffic volumes, existing lane geometries, existing signal timings, and the number of trains during the peak hours as described below.

#### Existing Lane Geometry and Traffic Volumes

Separate left turn lanes are provided on Alma Street in both the northbound and southbound directions to Churchill Avenue (see Figure 1). In addition, there is a southbound right turn lane on Alma Street to westbound Churchill Avenue (toward the high school). Eastbound Churchill Avenue has a separate right turn lane and a shared through/left turn lane at Alma Street. Westbound Churchill Avenue at Alma Street has one all-movement lane and another lane that allows on-street parking. Parking is prohibited from 7-8 AM, and through traffic is prohibited 7:45 to 8:30 AM Monday through Friday. Therefore, during the peak school time in the morning, westbound Churchill Avenue essentially has one left turn lane and one right turn lane. Churchill Avenue operates with split phase signal timing.

AM and PM peak hour turning movement counts for vehicles, pedestrians, and bicycles were conducted at the Alma/Churchill intersection in December 2018 when schools were in session. These counts are shown on Figure 1. As shown on Figure 1, a total of 2,592 vehicles and approximately 400 bicycles and pedestrians were counted during the AM peak hour and a total of 3,312 vehicles and approximately 80 bicycles and pedestrians were counted during the PM peak hour.

These counts were verified with more recent counts conducted on October 1<sup>st</sup>, 2019 (see Table 1). As shown in Table 1, the December 2018 counts were found to be 5% and 10% higher during the AM and PM peak hours, respectively. Therefore, these counts were used for the analysis of the Churchill closure.

**Table 1**  
**Alma Street and Churchill Avenue – Existing Volume Comparison**

	AM Peak Hour				PM Peak Hour			
	Thursday 12/6/18 Counts	Tuesday 10/1/2019 Counts	Difference	% Difference	Thursday 12/6/18 Counts	Tuesday 10/1/2019 Counts	Difference	% Difference
<b>Total</b>	<b>2,592</b>	<b>2,474</b>	<b>-118</b>	<b>-5%</b>	<b>3312</b>	<b>2973</b>	<b>-339</b>	<b>-10%</b>

Alma Street and Churchill Avenue Closure

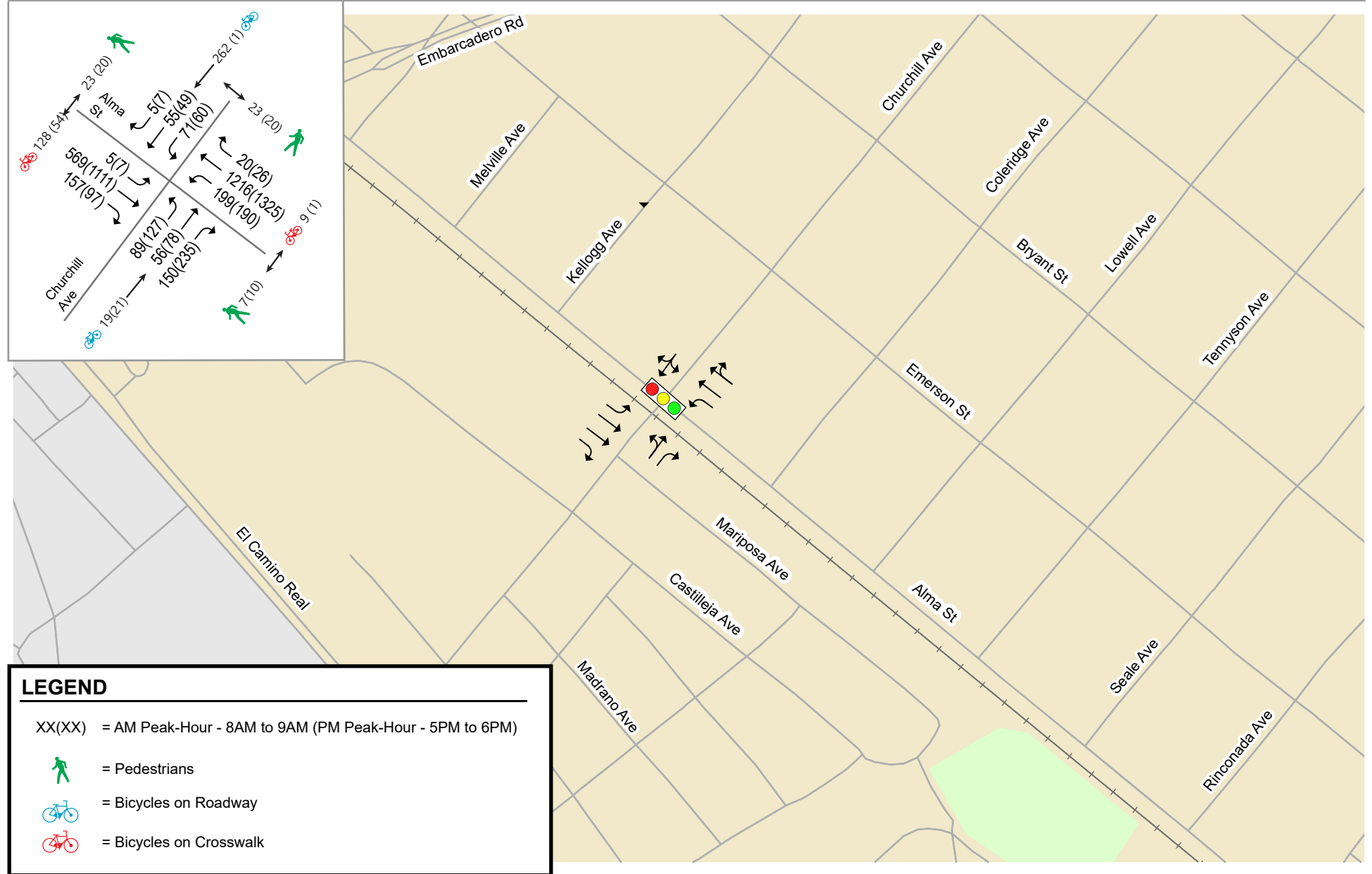


Figure 1  
Alma Street and Churchill Avenue Existing Lane Geometry and Traffic Volumes

## **Signal Timings**

The existing signal timing data at the Alma and Churchill intersection were obtained from the City of Palo Alto. Additional information regarding turn restrictions during certain time periods was obtained from field observations. The Alma and Churchill intersection currently operates at 150- second (2 ½ minutes) and 180- second (3 minutes) cycle lengths during the AM and PM peak hours, respectively. Also, through traffic on westbound Churchill is prohibited (via signage installed at the intersection) during the morning school peak hour that occurs between 7:45 – 8:30 AM.

## **Signal Pre-emption and Number of Trains**

As the Churchill Avenue railroad crossing is located only 25 feet to the west of Alma Street, the intersection of Alma Street and Churchill Avenue is equipped to receive a traffic preemption signal when there is a train detection. This is a special control mode in the traffic signal controller designed to start up and clear any vehicular traffic on the roadway approach crossing the railroad tracks. Before the train approaches the intersection, eastbound vehicular queues on Churchill Avenue between the railroad gate and Alma street are cleared. Only through traffic on Alma street, which does not conflict with the railroad movement, receives a green light for the duration of the train movement. A gate closure time of 45 seconds was assumed based on field observations. This calculates to an effective gate closure time of 360 seconds (6 minutes) during the peak hours, which is 10% of the peak hours.

Based on the number of gate closures observed during the field visit, the existing conditions analysis assumed a total of 8 trains (4 northbound and 4 southbound) during each of the AM and PM peak hours. Based on the current Caltrain schedule, there can be up to 10 trains in the peak hour. Because the actual train spacing varies daily, the analysis assumed a constant time interval between consecutive trains, which calculates to one train every 7 ½ minutes. This represents average conditions. Occasionally trains arrive closer together, which creates longer delays, or more spread out, which creates shorter delays.

## **Field Observations**

### **AM Peak Hour**

During the AM peak, long vehicular queues were observed for the northbound left-turn movement on Alma Street and also on westbound Churchill Avenue. Vehicles in the northbound left-turn lane frequently extended out of the left-turn pocket, into the adjacent through lane, because of signal preemption and because of the school traffic. Palo Alto High School is located on the northwest quadrant of Alma Street and Churchill Avenue, and during the school peak hour, which starts around 8 AM, it was observed that vehicular queues from Palo Alto High School frequently extended up to Alma Street. As a result, during some cycles, the northbound left-turning vehicles could not turn on green. After pre-emption, vehicles in the north-bound left-turn lane have to wait for approximately two minutes before receiving the green signal. As a result, queues for the northbound left-turn movement frequently extended past Tennyson Avenue and did not clear in one signal cycle. Vehicular queues on westbound Churchill frequently extended past Emerson Street. No turn lanes are provided on westbound Churchill Avenue. Although through traffic is restricted during the AM school peak hour, the right turning traffic has to yield to a high number of bicycles and pedestrians crossing the north leg of this intersection, resulting in long vehicular queues.

**PM Peak Hour**

During the PM peak hour, long vehicular queues were observed on eastbound Churchill Avenue. Queues frequently extended past Madrono Avenue due to signal preemption. Vehicular queues on eastbound Churchill Avenue could not clear in one signal cycle.

**Caltrain Electrification Under “Do Nothing” Alternative**

This analysis scenario describes the impact of the proposed electrification on existing traffic conditions at Alma Street and Churchill Avenue. As Caltrain begins to modernize, it is expected that the number of trains will increase from 8 trains to 12 trains during both the AM and PM peak hours (based on the Caltrain Electrification EIR). This calculates to one train every five minutes. With a gate closure time of 45 seconds for every train crossing, a total gate closure time of 540 seconds (9 minutes) during peak hours is expected with electrification, which is 15% of the peak hour time. Table 2 below summarizes AM and PM peak hour intersection delays and levels of service at the Alma Street and Churchill Avenue intersection under existing conditions and with the proposed electrification with Churchill open.

**Table 2  
Alma and Churchill Intersection Delay and Levels of Service – Existing Conditions**

	Alma/Churchill - Delay (LOS) Existing Conditions									
	AM					PM				
	Existing		Electrification			Existing		Electrification		
	Delay (Secs)	LOS	Delay (Secs)	LOS	% Increase	Delay (Secs)	LOS	Delay (Secs)	LOS	% Increase
Average Intersection Delay	88.9	F	127.86	F	44%	66.67	E	92.44	F	39%

Notes -  
Existing Conditions - 8 trains in AM peak hour and 8 trains during the PM peak hour  
Caltrain Electrification - 12 trains during the AM and PM peak hours.

As shown in Table 2, the analysis shows that under existing conditions the intersection of Alma Street and Churchill Avenue currently operates at an unacceptable LOS F during the AM peak hour and LOS E during the PM peak hour. With the proposed Caltrain electrification, the analysis shows that the delay would increase by 44% during the AM peak hour and by 39% during the PM peak hour. The intersection would operate at LOS F during both the AM and PM peak hours with the proposed electrification.

Table 3 summarizes AM and PM peak hour intersection delays and levels of service at the Alma and Churchill intersection under Year 2030 traffic conditions without and with the electrification. Year 2030 traffic volumes were obtained from the Palo Alto Travel Demand Forecasting Model.



**Table 3  
Alma and Churchill Intersection Delay and Levels of Service – Year 2030 conditions**

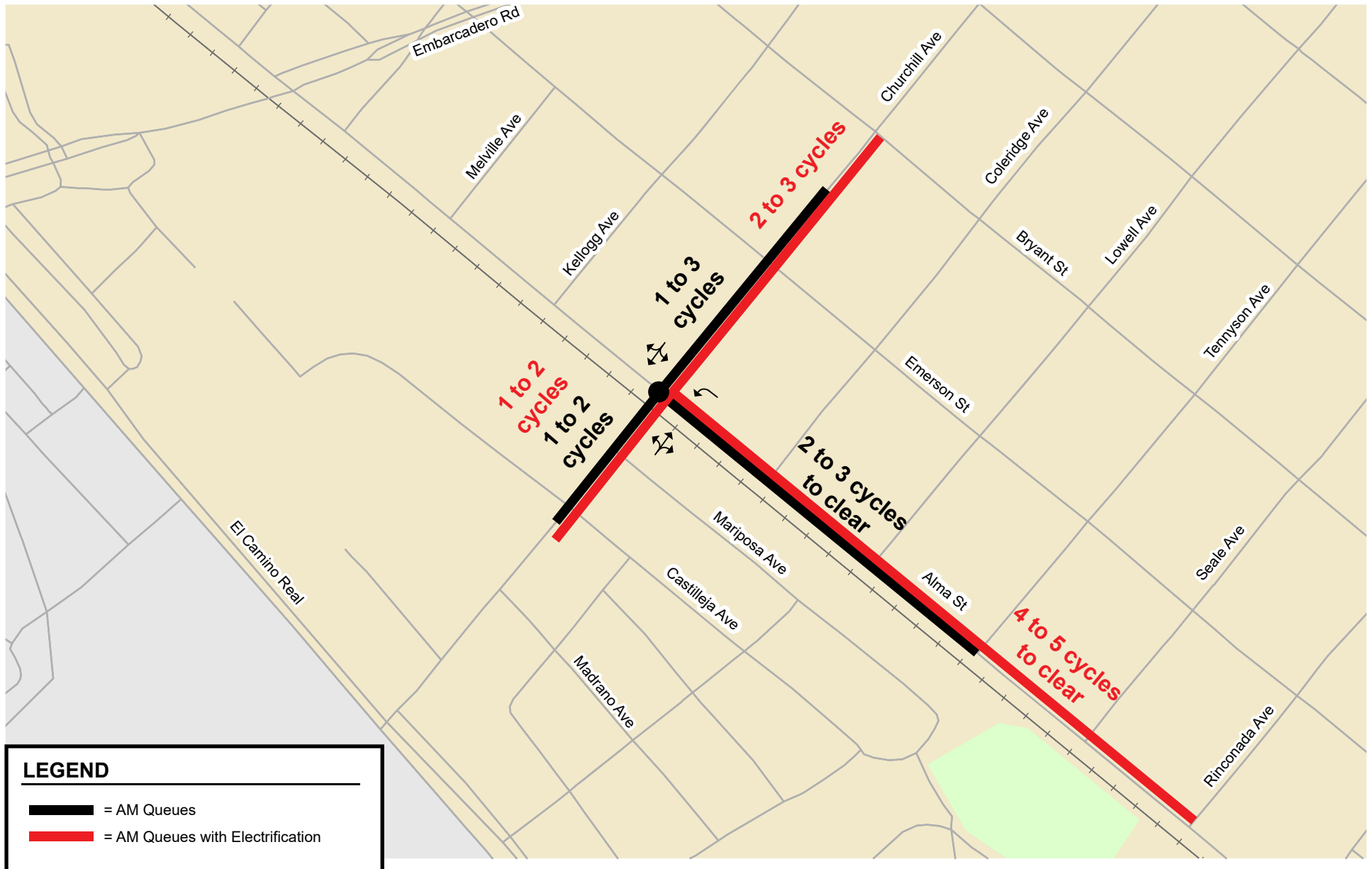
	Alma/Churchill - Delay (LOS) Year 2030 Conditions									
	AM					PM				
	No Electrification		Electrification			No Electrification		Electrification		
	Delay (Secs)	LOS	Delay (Secs)	LOS	% Increase	Delay (Secs)	LOS	Delay (Secs)	LOS	% Increase
Average Intersection Delay	118.5	F	157.27	F	33%	89.99	F	110.02	F	22%
Notes -										
No Electrification Conditions - 8 trains in AM peak hour and 8 trains during the PM peak hour										
Caltrain Electrification - 12 trains during the AM and PM peak hours.										

As shown in Table 3, under Year 2030 traffic conditions, the intersection of Alma and Churchill Avenue would continue to operate at unacceptable LOS F during both the AM and PM peak hours without the electrification. The analysis shows that the delays would be 25% to 30% higher than existing conditions. With the proposed electrification, the delays are expected to increase by an additional 20% to 30%.

Figure 2 and Figure 3 show a comparison of vehicular queues under existing conditions and with the proposed electrification (with existing traffic volumes) during the AM and PM peak hours, respectively.

As shown on Figure 2, the analysis shows that during the AM peak hour, the northbound left-turn movement would be significantly impacted with the increase in the frequency of trains with the proposed electrification. The analysis shows that the average queue would increase by approximately 25 vehicles and queues would frequently extend past Rinconada Avenue. It would take approximately four to five signal cycles (10 to 12 minutes) for the northbound left-turn to clear.

As shown on Figure 3, during the PM peak hour, the analysis shows that the increase in the frequency of trains would cause the vehicular queue on eastbound Churchill Avenue to extend beyond El Camino Real and potentially affect traffic operations at the El Camino Real and Churchill Avenue intersection. As a result, the analysis shows that it would take 3 to 5 signal cycles for traffic to clear on eastbound Churchill Avenue.



**Figure 2**  
**Alma Street and Churchill Avenue Vehicular Queues - Existing and “Do Nothing” Alternative (AM Peak-Hour)**



**Figure 3**  
**Alma Street and Churchill Avenue Vehicular Queues - Existing and "Do Nothing" Alternative (PM Peak-Hour)**

## **Complete Churchill Closure**

This analysis scenario describes the impacts of the closure of Churchill Avenue near the railroad tracks and the impact on the surrounding roadway system. With the closure of Churchill Avenue, the intersection geometry of Alma Street/Churchill Avenue is proposed to undergo the following changes: the northbound left-turn lane is proposed to be removed, the southbound left-turn lane and southbound right-turn lane are also proposed to be removed, and the left most through lane is to be converted to a shared left-through lane. Pedestrian and bicycle connections would be maintained with an undercrossing. A pedestrian/bicycle overcrossing would be undesirable because the bottom of the overcrossing would need to be 24'6" above the track, resulting in approaches that would be extensively long. Figures 4, 5, and 6 illustrate the conceptual intersection layout and renderings of the intersection, all developed by AECOM.

### **Origin-Destination Analysis**

In order to evaluate existing trip patterns that currently use Churchill Avenue, an origin-destination (O-D) analysis was conducted within the study area by TJKM. The objective of this task was to determine how traffic would be rerouted with Churchill closed. Data for a typical Tuesday, Wednesday, and Thursday for the morning and afternoon hours during 2017 while schools in Palo Alto were in session (using the Street Light Data platform) was used for evaluating trip patterns through the Alma Street and Churchill Avenue intersection. StreetLight data represent movements tracking cell phones. Cell phone companies supply anonymized data about the origins, destinations, and routes of people using cell phones. Any time a geo-based app on the phone is enabled, the movement of that phone is tracked. While not all people have cell phones or have apps running, the data are aggregated from thousands of users over time and provide a good representation of travel patterns.

### **Redistribution of Trips**

As a result of the proposed Churchill closure, existing trips that are currently using the Churchill railroad crossing would use alternative roadways in the study area. Based on existing traffic counts, there are approximately 706 vehicles in the AM peak hour and 776 vehicles in the PM peak hour that would be rerouted. These trips were rerouted to alternative roadways based on the O-D study. Figure 7A illustrates the redistribution of eastbound Churchill trips, and Figure 7B illustrates the redistribution of westbound Churchill trips in the study area.

### **Intersection Impacts**

The TJKM study analyzed the impact of Churchill Avenue closure on the surrounding roadway network. A total of 24 intersections were analyzed. Note that the intersection of the Town & Country driveway with Embarcadero Road was not included in the study. The operation of that section of Embarcadero Road is controlled by the intersection with El Camino Real. The driveway intersection, which also serves Palo Alto High School, has relatively light traffic compared to El Camino Real.

Traffic conditions at the study intersections were evaluated using level of service (LOS). Level of service is a qualitative description of operating conditions ranging from LOS A, or free-flow conditions with little or no delay, to LOS F, or jammed conditions with excessive delays. The acceptable LOS in the City of Palo Alto is LOS D or better for non-CMP signalized intersections. The City has adopted LOS E as the acceptable standard for Congestion Management Program (CMP) intersections, consistent with VTA guidelines. The City does not have an official standard for unsignalized but typically identifies impacts if a project would increase delay by at least 4 seconds and the intersection meets the peak-hour volume signal warrant.

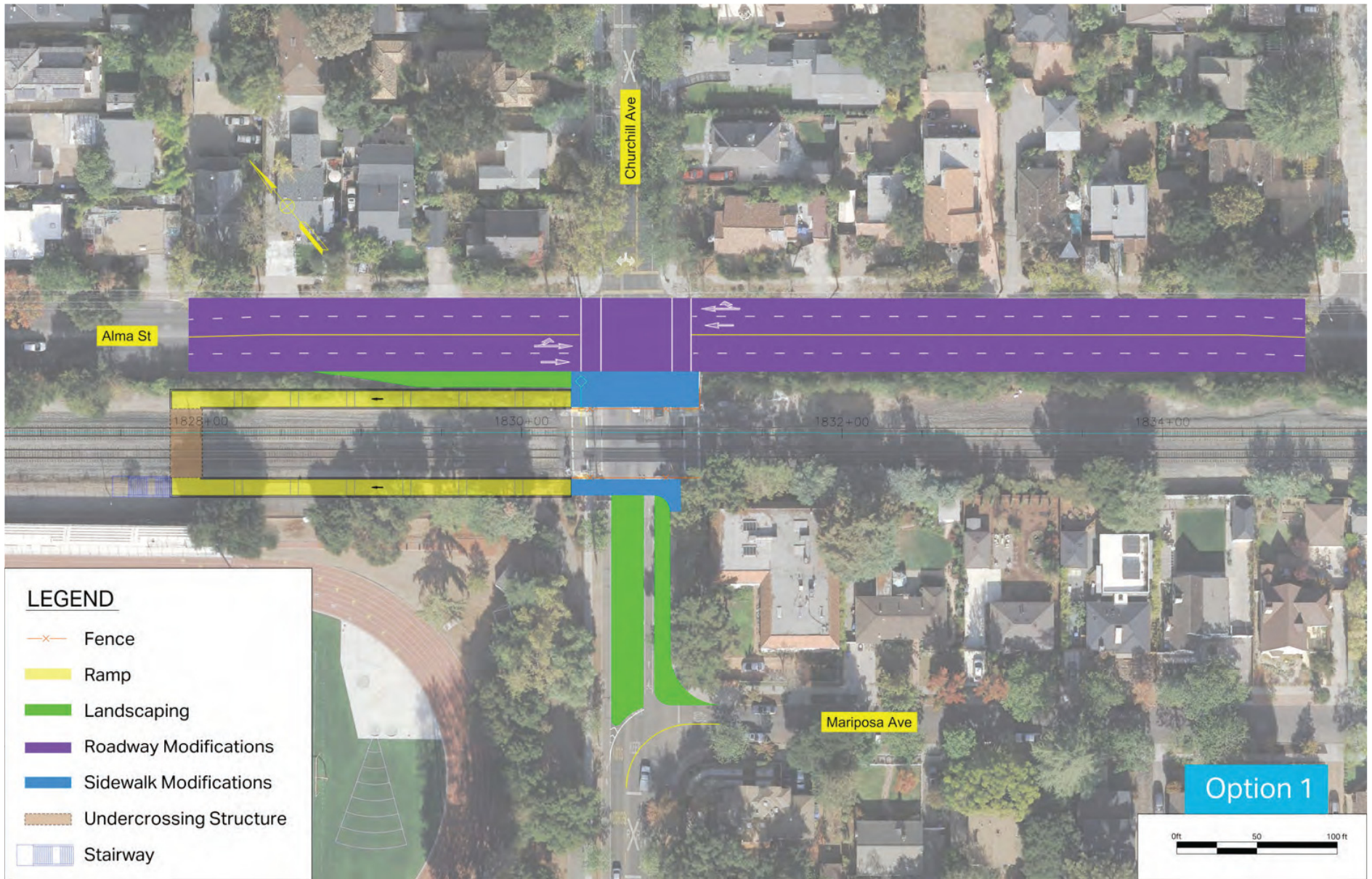
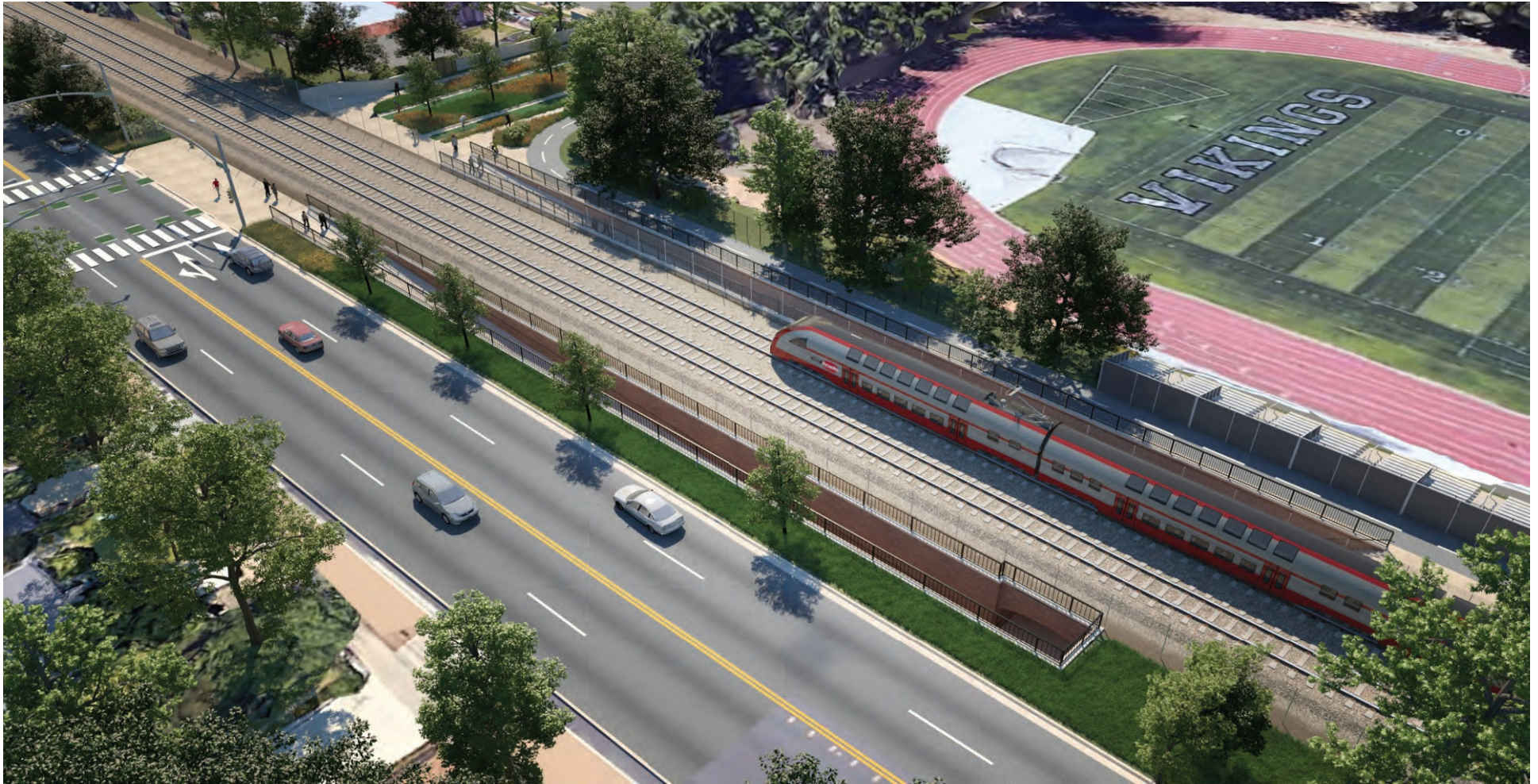


Figure 4  
Alma Street and Churchill Avenue - Conceptual Layout



**Figure 5**  
**Alma Street and Churchill Avenue - Conceptual Rendering 1**



**Figure 6**  
**Alma Street and Churchill Avenue - Conceptual Rendering 2**

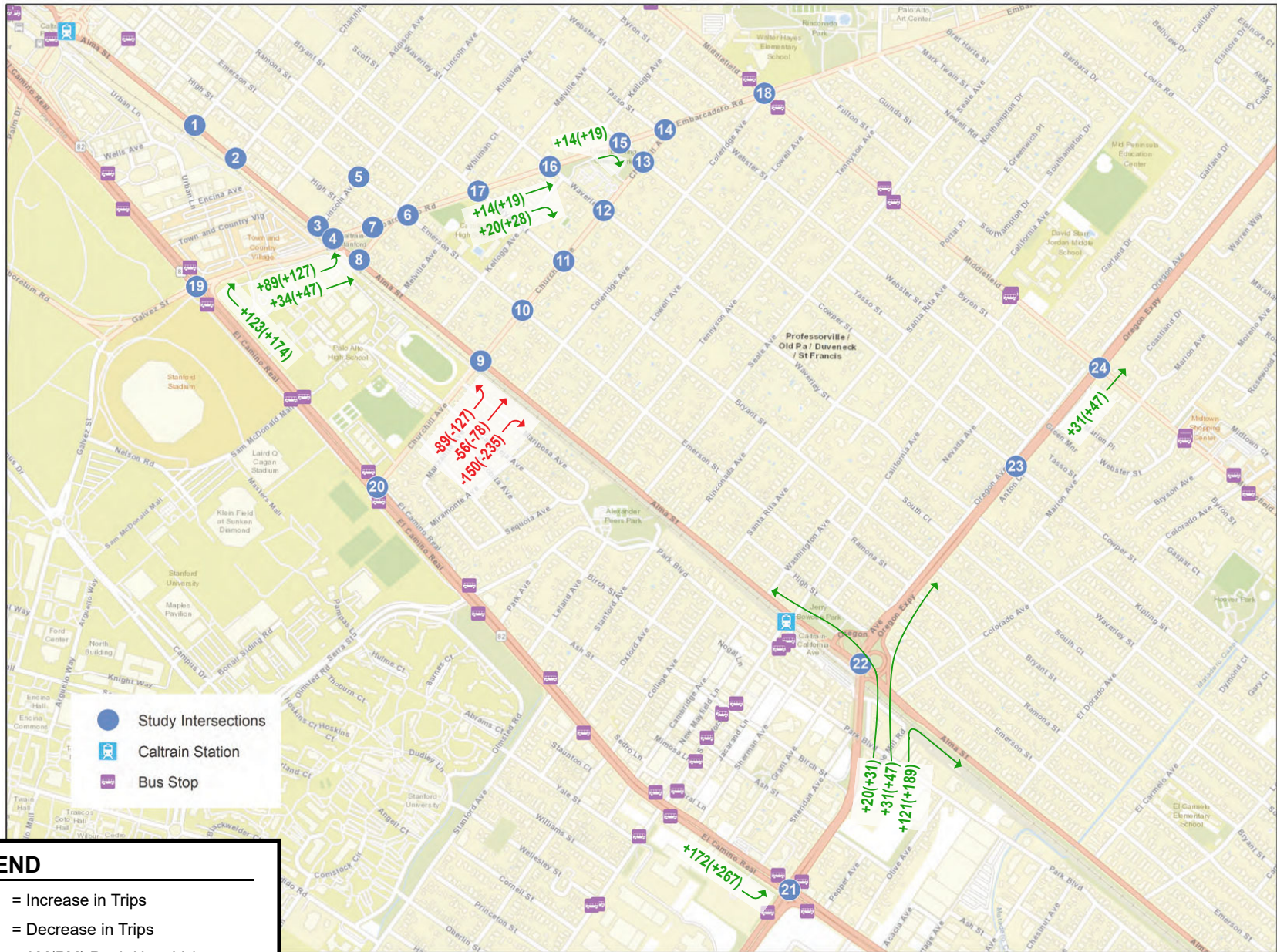


Figure 7A  
Redistribution of Eastbound Churchill Avenue Trips



Alma Street and Churchill Avenue Closure

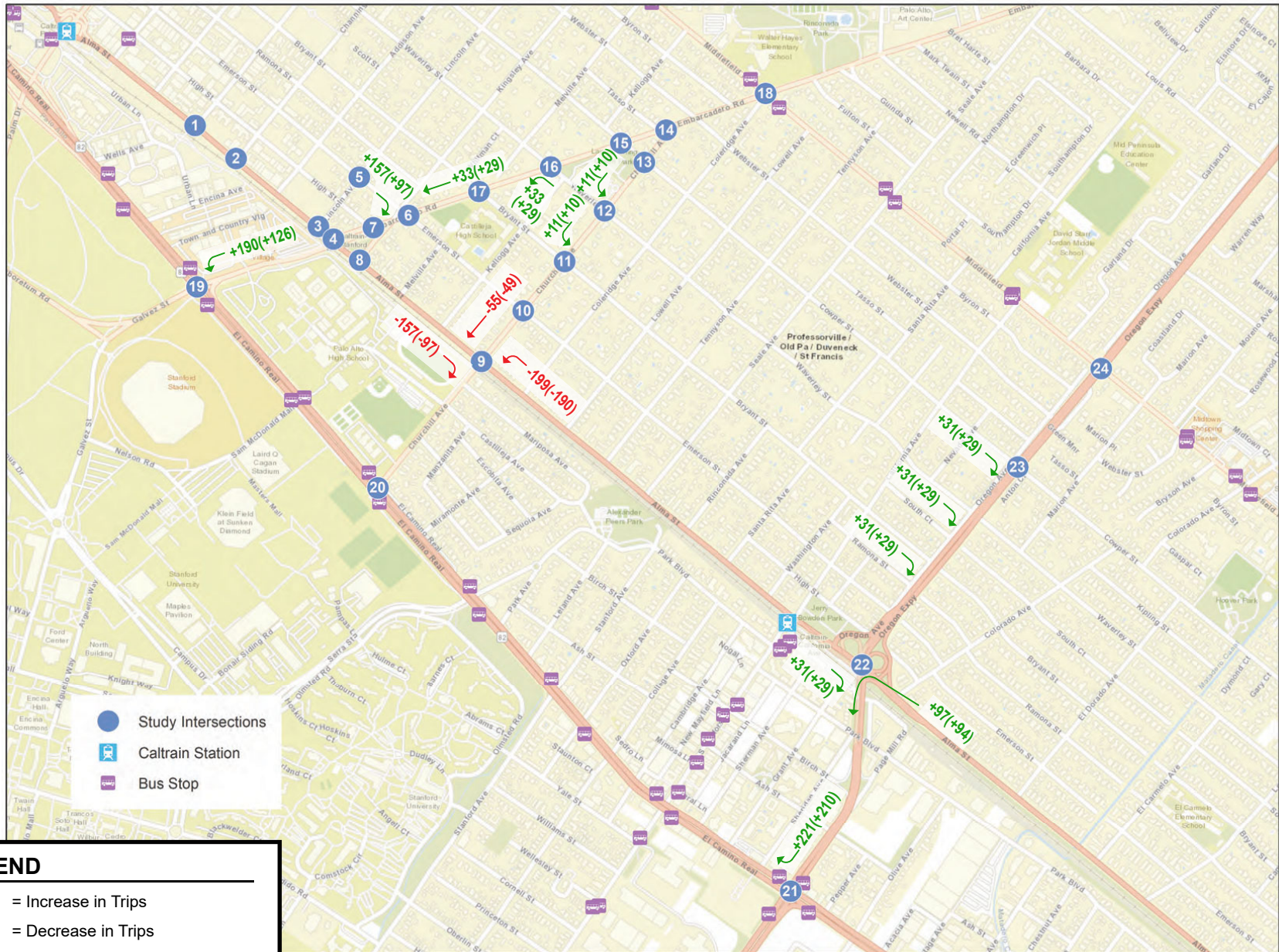


Figure 7B  
Redistribution of Westbound Churchill Avenue Trips

The TJKM study determined that the closure of the Churchill Avenue railroad crossing would create significant impacts at eight of the study intersections. Hexagon disagrees with two of the impacts, but agrees that the following six intersections and would experience unacceptable levels of service as a result of the reassigned traffic under existing conditions and under future year 2030 traffic conditions (see Table 4):

1. Alma Street/Lincoln Avenue
2. Alma Street/Embarcadero Road
3. Alma Street/Kingsley Avenue
4. El Camino Real/Embarcadero Road (CMP)
5. El Camino Real/Oregon Expressway-Page Mill Road (CMP)
6. Alma Street/Oregon Expressway

**Table 4  
Churchill Closure – Impacted Intersection Levels of Service**

#	Intersection	Peak Hour	Traffic Control	Churchill Closure					
				Existing		Existing		Year 2030	
				Avg. Delay (sec.)	LOS	Avg. Delay (sec.)	LOS	Avg. Delay (sec.)	LOS
1	Alma St & Lincoln Ave	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>
2	Alma St & Embarcadero Rd	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>
3	Alma St & Kingsley Ave	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>
4	El Camino Real/Embarcadero Rd*	AM	Signal	60.3	E	<b>&gt;80</b>	<b>F</b>	<b>&gt;80</b>	<b>F</b>
		PM		67.0	E	<b>&gt;80</b>	<b>F</b>	<b>&gt;80</b>	<b>F</b>
5	El Camino Real/Oregon Expwy-Page Mill Rd*	AM	Signal	72.9	E	<b>&gt;80</b>	<b>F</b>	<b>&gt;80</b>	<b>F</b>
		PM		66.4	E	<b>&gt;80</b>	<b>F</b>	<b>&gt;80</b>	<b>F</b>
6A	Alma St & Oregon Expwy WB Off Ramp (Oregon Av)	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>
6B	Alma St & Oregon Expwy EB Off Ramp	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>	<b>&gt;=50</b>	<b>F</b>

**Notes:**  
1. \*CMP Intersection.  
2. Average delay is reported for the worst approach at one-way stop intersections.  
3. Bold indicates substandard intersection level of service.

### **Mitigation Measures**

Potential mitigation measures were identified for the intersections that were shown to be impacted as described below.

#### **Alma Street Intersections (# 1, 2 and 3)**

With the closure of Churchill Avenue, some traffic would be rerouted to Embarcadero Road. However, the connections for some of the turning movements between Alma Street and Embarcadero Road are circuitous. Traffic from Alma Street that wants to head west on Embarcadero Road must use Lincoln Avenue to Emerson Street. The amount of traffic going “around the block” to access Embarcadero from Alma would increase by 157 vehicles during the AM peak hour and 97 vehicles during the PM peak hour. Due to the close spacing, intersections 1, 2 and 3 could be mitigated as a group with the following recommendations (see Figures 8). These improvements are different from the mitigations identified in the TJKM report.

- Restrict the intersection of Alma Street/Lincoln Street to right-in/right-out only movements.

- Divert left-turning traffic off of Lincoln Avenue by adding a left-turn lane to the Embarcadero Road slip ramp to facilitate left-turns onto Alma Street.
- Install traffic signals at the Alma Street/Embarcadero Road slip ramp and Alma Street/Kingsley Avenue with one controller.
- Install a traffic signal at the Embarcadero Road/Kingsley Avenue intersection to allow left-turns from Kingsley Street onto westbound Embarcadero Road.
- Provide a 75 to 100-foot left-turn pocket on southbound Alma Street at Kingsley Avenue.
- Provide two northbound travel lanes on northbound Alma Street at Kingsley Avenue.

Providing two northbound travel lanes on Alma Street at Kingsley Avenue would require widening of the Alma Street bridge over Embarcadero Road, as the existing width of the bridge can only accommodate three travel lanes on Alma Street. Widening would require extensive modification or potential replacement of the existing bridge structure. No additional right-of-way is needed on Alma Street, south of Embarcadero Road.

These improvements would provide a direct connection between Alma Street and Embarcadero Road. Diverted traffic from southbound Alma Street (157 AM peak hour trips and 97 PM peak hour trips) would not have to use local streets to access Embarcadero Road. In addition, existing traffic on northbound Alma Street (approximately 70 vehicles during the AM peak hour and 75 vehicles during the PM peak hour) would no longer have to go around the block (Lincoln to Emerson) to travel west on Embarcadero. This traffic on Alma would make a right-turn at Kingsley and a left-turn at the proposed traffic signal at Embarcadero Road.

With the proposed improvements, the analysis shows that intersections 1, 2 and 3 would operate at acceptable levels of service during the AM and PM peak hours under existing (see Table 5) and Year 2030 traffic volumes (see Table 6).

Note that Figure 8 show a conceptual design of potential improvements at the Embarcadero Road and Alma Street interchange. If this project were to be pursued, many design details would need to be worked out with regard to maintaining access to existing residential driveways on Embarcadero Road, Kingsley Street, High Street, and the Embarcadero slip ramp.

#### **El Camino Real & Embarcadero Road (Intersection 4)**

The analysis showed that at the CMP intersection of El Camino Real/Embarcadero Road, significant traffic impacts would occur due to reassigned traffic. It is recommended that an additional westbound left-turn lane and a northbound right-turn lane be provided along with signal optimization at this intersection (see Figure 9). With these improvements, the intersection of El Camino Real and Embarcadero Road would operate at acceptable LOS E during both peak hours under existing and Year 2030 traffic volumes.

#### **El Camino Real & Page Mill Road/Oregon Expressway (Intersection 5)**

At the CMP intersection of El Camino Real/Oregon Expressway-Page Mill Road, the traffic analysis identified significant traffic impacts due to reassigned traffic. The report recommended a westbound right-turn lane from Oregon Expressway to northbound El Camino Real along with optimizing the signal timing (see Figure 10). With these improvements, the intersection would operate at acceptable levels of service during the AM and PM peak hours under existing conditions. Under Year 2030 traffic conditions, the analysis shows that the intersection would continue to operate at unacceptable LOS F with the proposed improvements. However, the intersection delay during both

the AM and PM peak hours is projected to be lower than the intersection delay without these improvements.

### Alma Street & Oregon Expressway (Intersections 6A and 6B)

The traffic analysis identified significant impacts to the intersections of Alma Street/Oregon Expressway with the reassignment. The analysis determined that these intersections currently meet the peak hour signal warrant and recommends traffic signals at both the on and off ramps (see Figure 11). With the proposed traffic signals at both the ramp locations, the intersections of Alma Street and Oregon Expressway are projected to operate at acceptable LOS C or better during both peak hours under existing and Year 2030 traffic conditions.

**Table 5**  
**Churchill Closure – Mitigated Intersection Levels of Service under Existing Conditions**

#	Intersection	Peak Hour	Churchill Closure - Existing Conditions					
			No Improvements			With Improvements		
			Traffic Control	Avg. Delay (sec.)	LOS	Traffic Control	Avg. Delay (sec.)	LOS
1	Alma Street & Lincoln Avenue	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	One-Way	5.7	A
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	Stop	21.1	C
2	Alma Street & Embarcadero Road	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	Signal	4.8	A
		PM	Stop	<b>&gt;=50</b>	<b>F</b>		3.0	A
3	Alma Street & Kingsley Avenue	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	Signal	13.3	B
		PM	Stop	<b>&gt;=50</b>	<b>F</b>		18.3	B
4	El Camino Real/Embarcadero Rd*	AM	Signal	<b>&gt;80</b>	<b>F</b>	Signal	67.1	E
		PM		<b>&gt;80</b>	<b>F</b>		61.1	E
5	El Camino Real/Oregon Expwy-Page Mill Rd*	AM	Signal	<b>&gt;80</b>	<b>F</b>	Signal	72.5	E
		PM		<b>&gt;80</b>	<b>F</b>		73.5	E
6A	Alma St & Oregon Expwy WB Off Ramp (Oregon Ave)	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	Signal	6	A
		PM	Stop	<b>&gt;=50</b>	<b>F</b>		6.7	A
6B	Alma St & Oregon Expwy EB Off Ramp	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	Signal	17.9	B
		PM	Stop	<b>&gt;=50</b>	<b>F</b>		16.0	B

Notes:

1. Average delay is reported for the worst approach at one-way stop intersections.
2. Bold indicates substandard intersection level of service.

**Table 6  
Churchill Closure – Mitigated Intersection Levels of Service under Year 2030 Conditions**

#	Intersection	Churchill Closure - Year 2030 Conditions						
		Peak Hour	No Improvements			With Improvements		
			Traffic Control	Avg. Delay (sec.)	LOS	Traffic Control	Avg. Delay (sec.)	LOS
1	Alma Street & Lincoln Avenue	AM	One-Way	>=50	F	One-Way	14.4	B
		PM	Stop	>=50	F	Stop	15.2	C
2	Alma Street & Embarcadero Road	AM	One-Way	>=50	F	Signal	4	A
		PM	Stop	>=50	F	Signal	3.6	A
3	Alma Street & Kingsley Avenue	AM	One-Way	>=50	F	Signal	13.0	B
		PM	Stop	>=50	F	Signal	14.8	B
4	El Camino Real/Embarcadero Rd*	AM	Signal	>80	F	Signal	73.6	E
		PM	Signal	>80	F	Signal	76.2	E
5	El Camino Real/Oregon Expwy-Page Mill Rd*	AM	Signal	>80 (120.3)	F	Signal	>80 (91.8)	F
		PM	Signal	>80 (108.4)	F	Signal	>80 (92.7)	F
6A	Alma St & Oregon Expwy WB Off Ramp (Oregon Ave)	AM	One-Way	>=50	F	Signal	7.8	A
		PM	Stop	>=50	F	Signal	9.1	A
6B	Alma St & Oregon Expwy EB Off Ramp	AM	One-Way	>=50	F	Signal	24.9	C
		PM	Stop	>=50	F	Signal	21.5	C

Notes:

1. Average delay is reported for the worst approach at one-way stop intersections.
2. Bold indicates substandard intersection level of service.

**Impacts to University Avenue**

University Avenue is located approximately one mile north of the Alma Street and Churchill Avenue intersection. During the peak hours, University Avenue is more congested than the parallel arterials of Embarcadero Road and Oregon Expressway. Figure 12 shows that University Avenue at Woodland Avenue typically is operating at LOS F during the PM peak hour compared to LOS E on Oregon Expressway and LOS D/E on Embarcadero Road near to US101. Due to the existing congestion on University Avenue, trips from the potential Churchill closure much more likely would be rerouted to Embarcadero Road or Oregon Expressway. The potential Churchill Avenue closure is not likely to impact traffic operations along University Avenue.

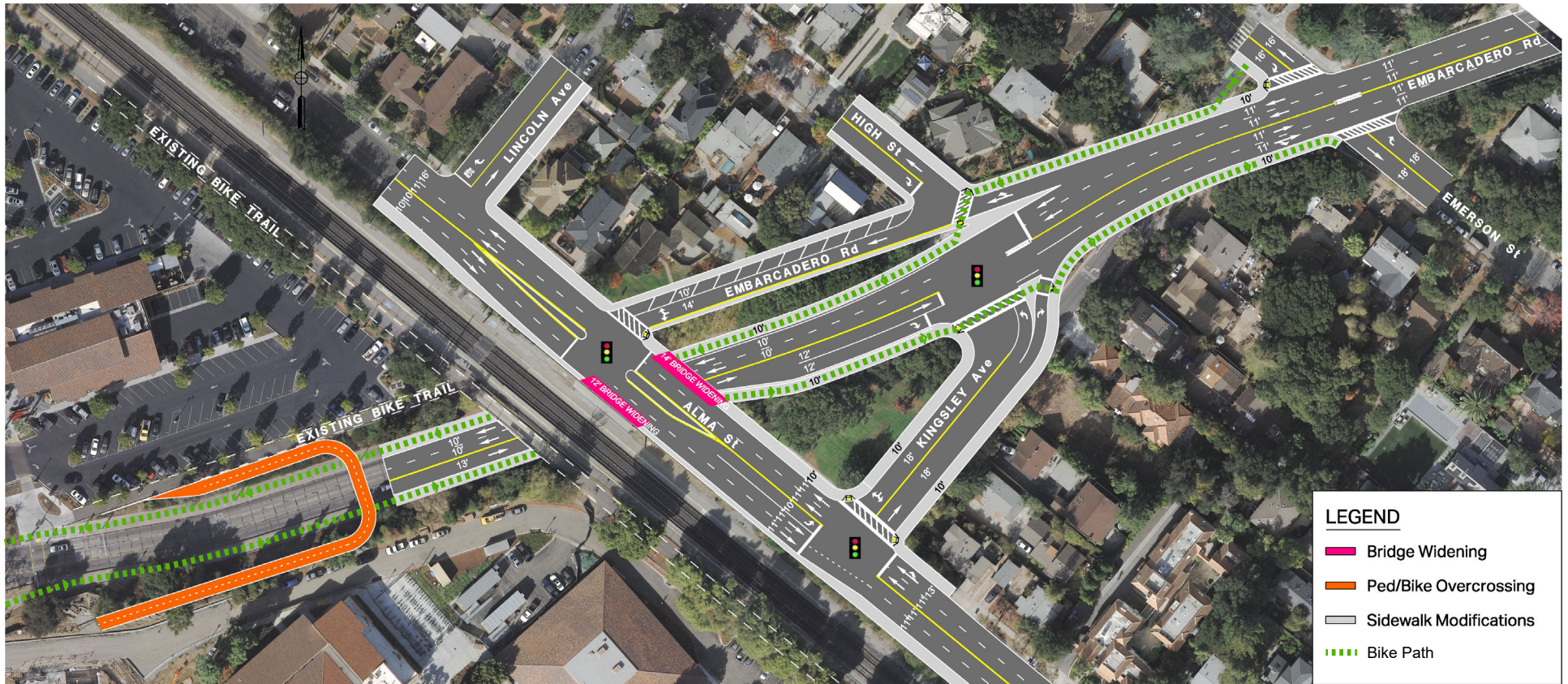
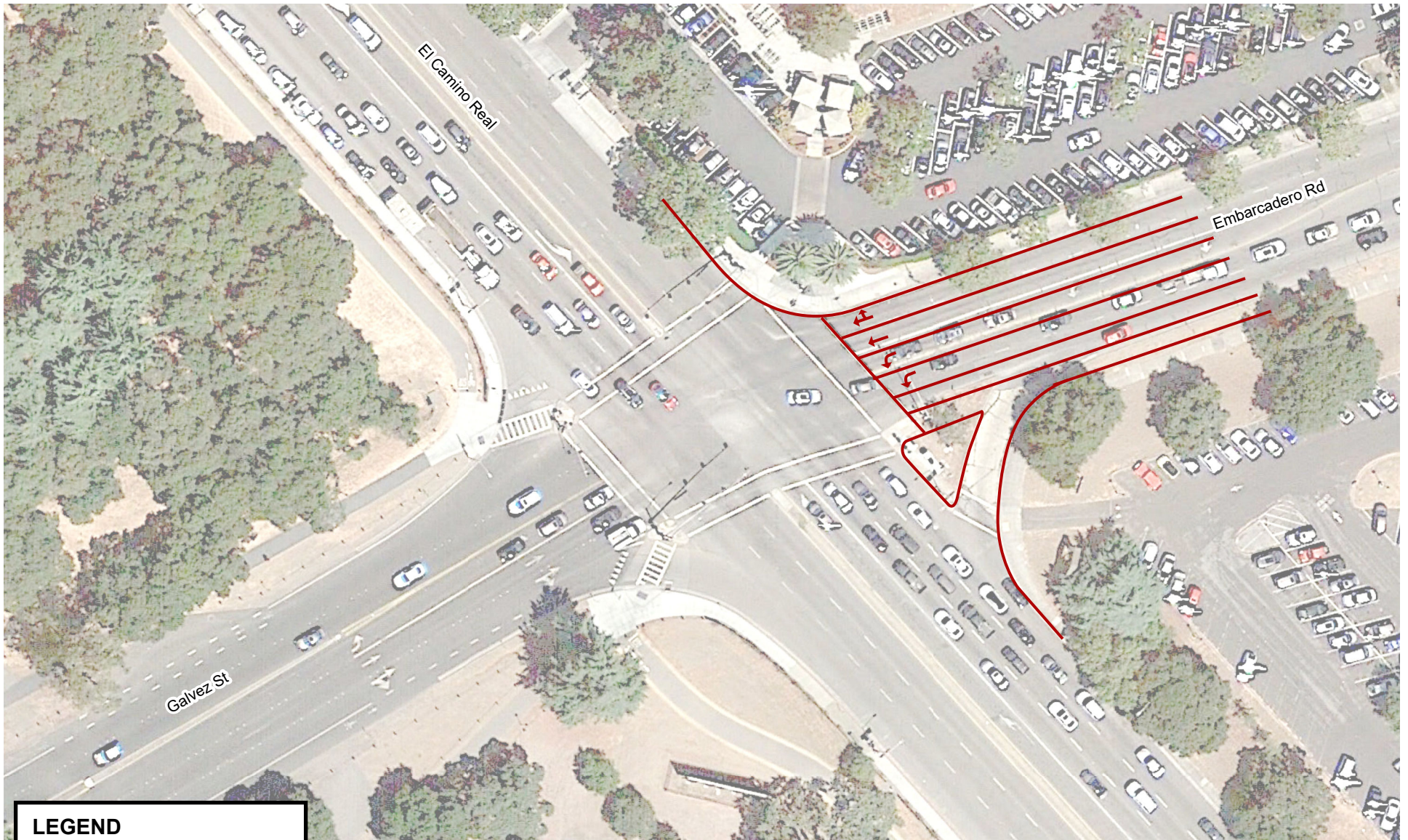



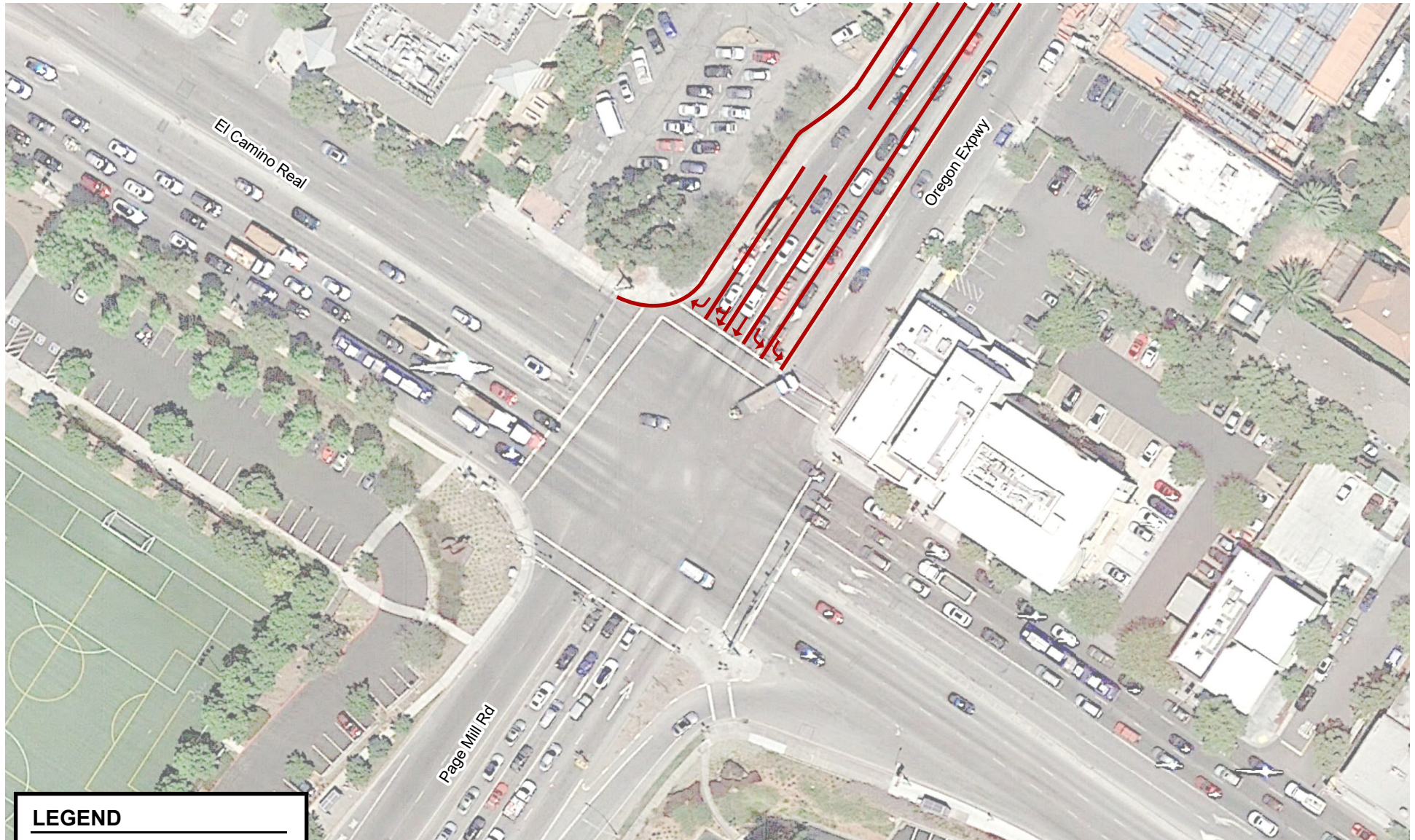
Figure 8  
Embarcadero/High/Kingsley Improvements



**LEGEND**

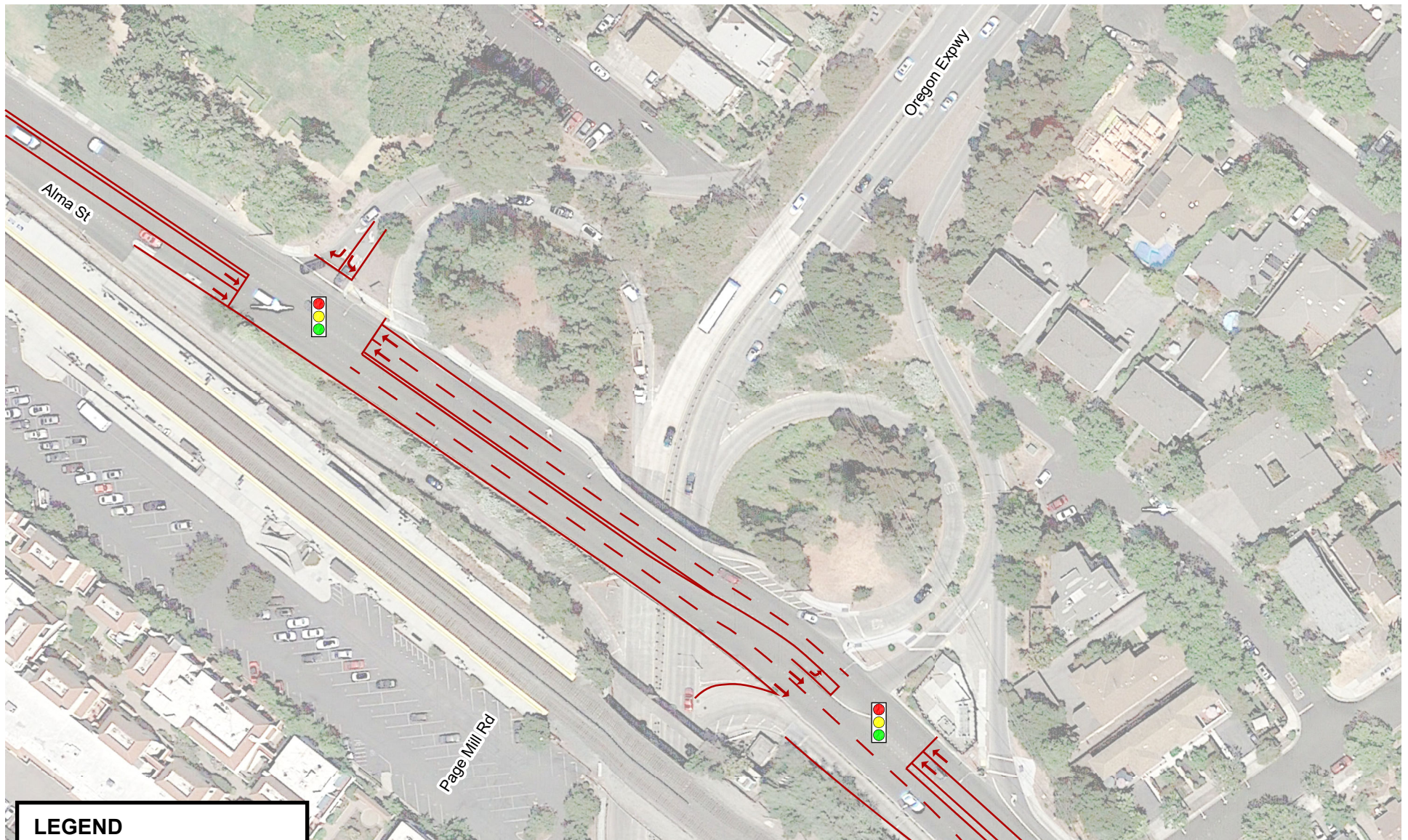
 = Proposed Layout

**Figure 9**  
**El Camino Real and Embarcadero Road Improvements**



**Figure 10**  
**El Camino Real and Page Mill Road/Oregon Expressway Improvements**





**LEGEND**

— = Proposed Layout

**Figure 11**  
**Alma Street and Oregon Expressway Improvements**

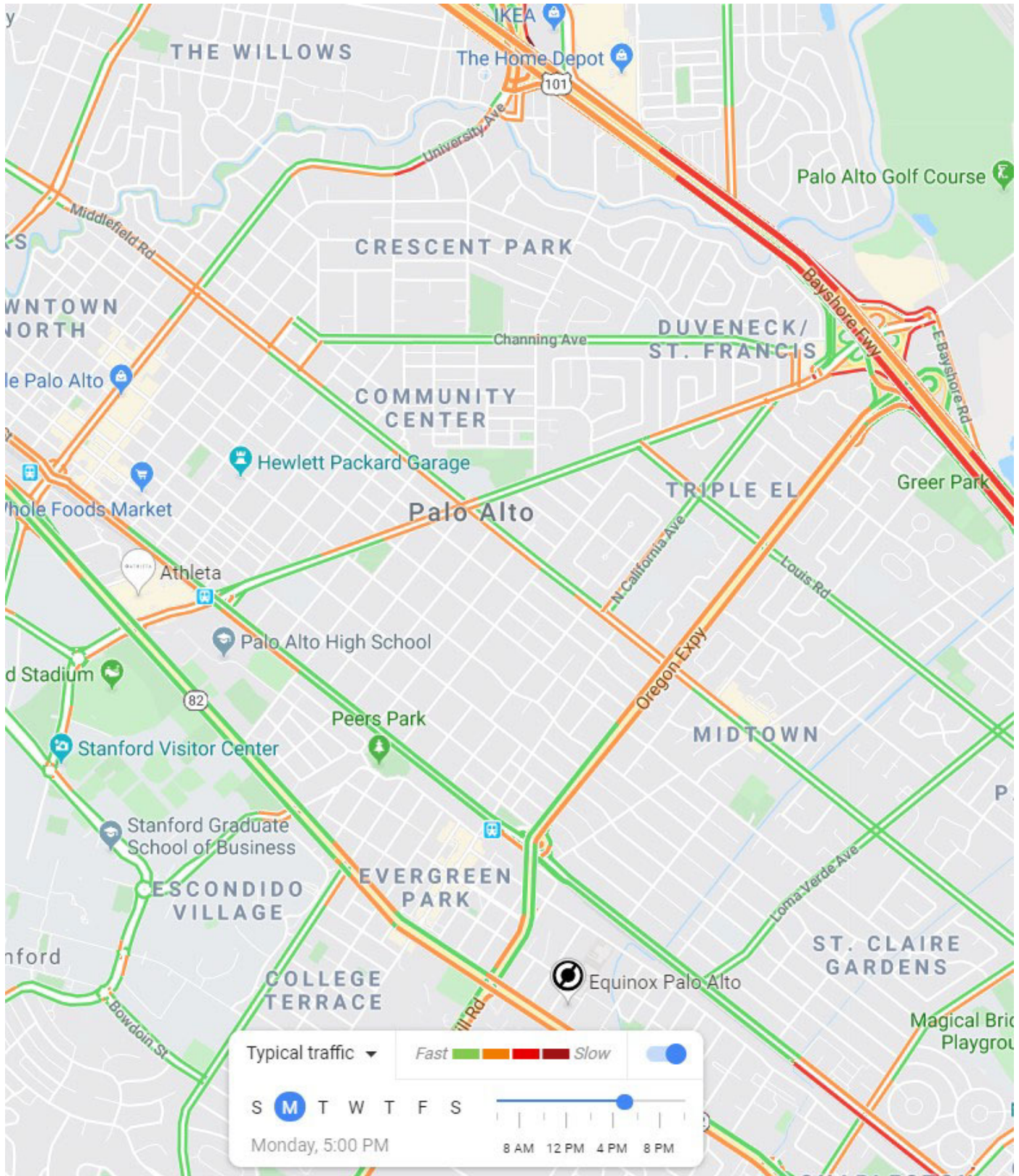


Figure 12  
Typical 5PM Traffic

## **Potential Closure of E. Meadow Drive**

A qualitative analysis was conducted for the potential closure of E. Meadow Drive at the railroad tracks. It is estimated that E. Meadow Drive has a volume of approximately 1,000 vehicles crossing the tracks during the weekday AM and PM peak hours (based on a 2013 peak hour traffic count of 800-900 vehicles). With the closure of E. Meadow Drive, vehicular traffic would be diverted onto the Charleston Road railroad crossing. According to traffic studies conducted in 2013, the intersections of El Camino Real/Charleston Road and Alma Street/Charleston Road were operating at high LOS D. It is likely that operations have degraded since then. The additional traffic on Charleston Road from the proposed closure of E. Meadow Drive would cause these intersections to operate at unacceptable levels of service. Therefore, closure of the E. Meadow Drive railroad crossing is not recommended.

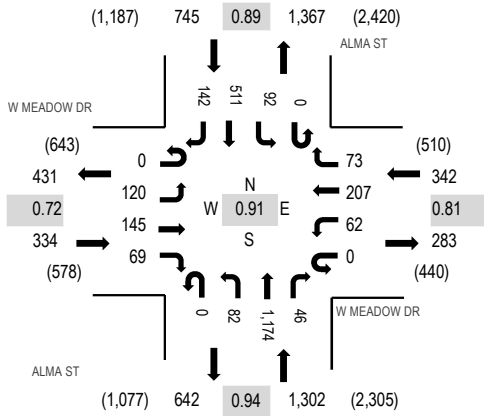
Appendix B  
Meadow and Charleston Traffic Counts



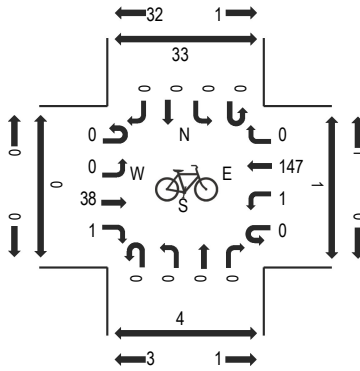
(303) 216-2439  
www.alltrafficdata.net

Location: 5 ALMA ST & W MEADOW DR AM  
Date: Tuesday, January 28, 2020  
Peak Hour: 07:45 AM - 08:45 AM  
Peak 15-Minutes: 08:00 AM - 08:15 AM

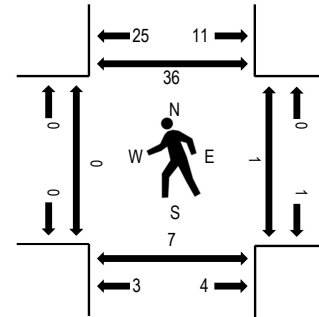
### Peak Hour - Motorized Vehicles



### Peak Hour - Bicycles



### Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

### Traffic Counts - Motorized Vehicles

Interval Start Time	W MEADOW DR Eastbound				W MEADOW DR Westbound				ALMA ST Northbound				ALMA ST Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North
7:00 AM	0	16	17	7	0	9	7	5	0	16	159	6	0	4	46	14	306	1,877	0	0	0	0
7:15 AM	0	18	15	12	0	11	10	11	0	12	217	7	0	6	55	8	382	2,322	0	1	0	0
7:30 AM	0	25	11	22	0	9	28	14	0	15	272	6	0	18	86	14	520	2,568	0	1	1	4
7:45 AM	0	41	53	22	0	13	37	11	0	17	288	9	0	35	107	36	669	2,723	0	0	1	19
8:00 AM	0	38	37	14	0	11	76	20	0	29	297	15	0	31	135	48	751	2,703	0	0	3	10
8:15 AM	0	21	30	13	0	18	47	16	0	17	271	13	0	13	132	37	628		0	0	1	6
8:30 AM	0	20	25	20	0	20	47	26	0	19	318	9	0	13	137	21	675		0	1	2	1
8:45 AM	0	39	41	21	0	9	42	13	0	21	264	8	0	18	148	25	649		0	1	1	2

### Peak Rolling Hour Flow Rates

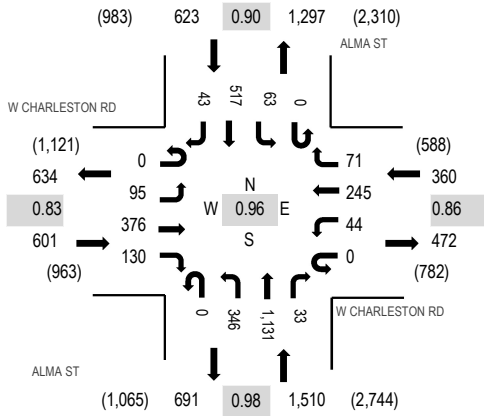
Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	4
Lights	0	118	145	67	0	62	199	70	0	82	1,138	46	0	92	499	141	2,659
Mediums	0	2	0	2	0	0	8	3	0	0	34	0	0	0	10	1	60
Total	0	120	145	69	0	62	207	73	0	82	1,174	46	0	92	511	142	2,723



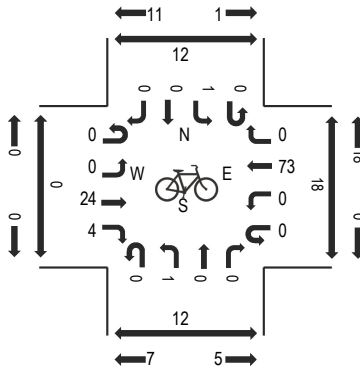
(303) 216-2439  
www.alltrafficdata.net

Location: 9 ALMA ST & W CHARLESTON RD AM  
Date: Tuesday, January 28, 2020  
Peak Hour: 08:00 AM - 09:00 AM  
Peak 15-Minutes: 08:45 AM - 09:00 AM

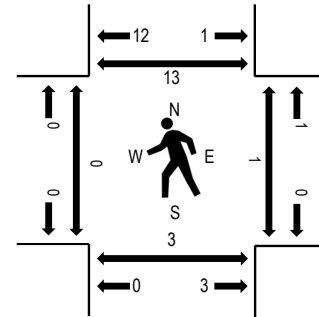
### Peak Hour - Motorized Vehicles



### Peak Hour - Bicycles



### Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

### Traffic Counts - Motorized Vehicles

Interval Start Time	W CHARLESTON RD Eastbound				W CHARLESTON RD Westbound				ALMA ST Northbound				ALMA ST Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North
	7:00 AM	0	6	35	10	0	1	31	10	0	63	180	6	0	8	42			3	395	2,184	0
7:15 AM	0	15	49	12	0	2	34	9	0	69	198	7	0	12	67	4	478	2,593	0	3	2	0
7:30 AM	0	12	59	24	0	3	42	18	0	89	261	6	0	14	91	10	629	2,839	0	1	2	5
7:45 AM	0	19	96	25	0	10	51	17	0	81	268	6	0	12	87	10	682	2,971	0	4	1	9
8:00 AM	0	19	95	42	0	13	74	18	0	105	280	2	0	9	140	7	804	3,094	0	0	0	9
8:15 AM	0	28	70	28	0	13	53	26	0	72	296	7	0	12	111	8	724		0	0	1	1
8:30 AM	0	21	88	28	0	6	52	17	0	77	285	13	0	21	138	15	761		0	1	1	2
8:45 AM	0	27	123	32	0	12	66	10	0	92	270	11	0	21	128	13	805		0	0	1	1

### Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	2	0	0	0	2	1	0	0	2	0	0	1	3	0	11
Lights	0	94	363	127	0	44	231	64	0	338	1,109	32	0	61	505	43	3,011
Mediums	0	1	11	3	0	0	12	6	0	8	20	1	0	1	9	0	72
Total	0	95	376	130	0	44	245	71	0	346	1,131	33	0	63	517	43	3,094



Location: 5 ALMA ST & W MEADOW DR PM

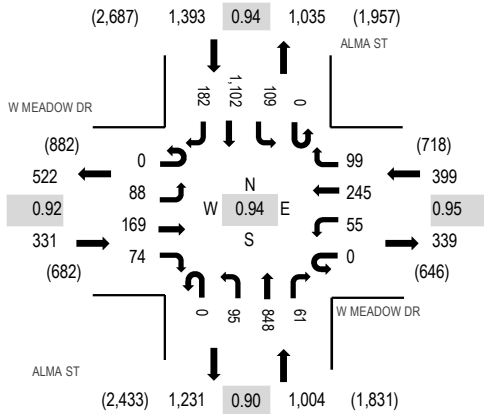
Date: Tuesday, January 28, 2020

Peak Hour: 05:00 PM - 06:00 PM

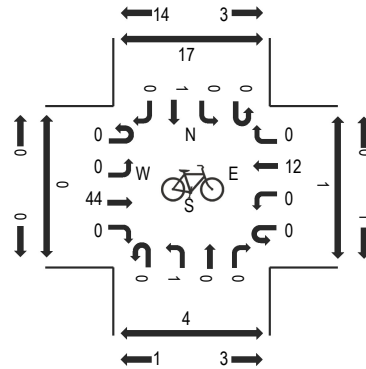
Peak 15-Minutes: 05:15 PM - 05:30 PM

(303) 216-2439  
www.alltrafficdata.net

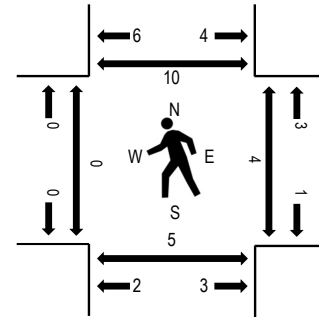
### Peak Hour - Motorized Vehicles



### Peak Hour - Bicycles



### Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

### Traffic Counts - Motorized Vehicles

Interval Start Time	W MEADOW DR Eastbound				W MEADOW DR Westbound				ALMA ST Northbound				ALMA ST Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North
4:00 PM	0	33	46	15	0	17	36	18	0	9	152	10	0	26	267	30	659	2,791	0	0	4	4
4:15 PM	0	31	41	18	0	14	44	26	0	17	194	17	0	25	300	36	763	2,851	0	1	2	7
4:30 PM	0	25	25	22	0	11	52	22	0	15	190	9	0	24	255	35	685	2,923	0	0	0	4
4:45 PM	0	28	41	26	0	14	48	17	0	12	186	16	0	27	243	26	684	3,049	0	0	1	3
5:00 PM	0	19	32	20	0	15	50	26	0	19	174	13	0	31	274	46	719	3,127	0	1	2	1
5:15 PM	0	16	46	18	0	13	72	20	0	22	240	18	0	36	278	56	835		0	0	0	4
5:30 PM	0	26	52	18	0	16	54	28	0	30	229	18	0	17	286	37	811		0	2	0	1
5:45 PM	0	27	39	18	0	11	69	25	0	24	205	12	0	25	264	43	762		0	1	3	4

### Peak Rolling Hour Flow Rates

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lights	0	88	169	74	0	55	245	99	0	95	847	61	0	107	1,096	182	3,118
Mediums	0	0	0	0	0	0	0	0	0	0	1	0	0	2	6	0	9
Total	0	88	169	74	0	55	245	99	0	95	848	61	0	109	1,102	182	3,127



(303) 216-2439  
www.alltrafficdata.net

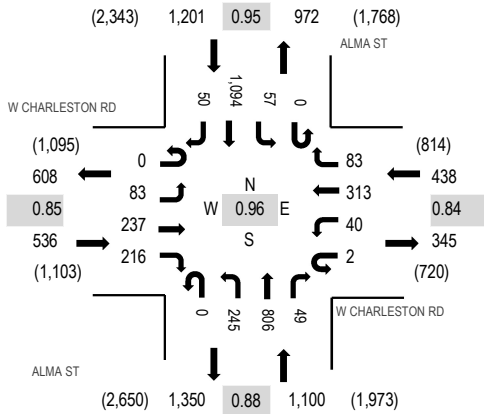
Location: 9 ALMA ST & W CHARLESTON RD PM

Date: Tuesday, January 28, 2020

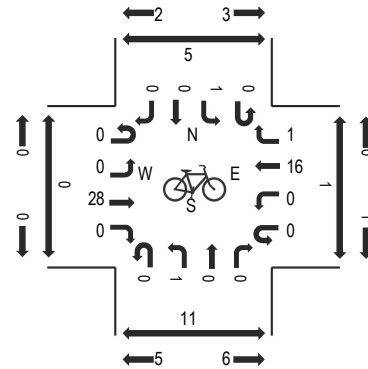
Peak Hour: 05:00 PM - 06:00 PM

Peak 15-Minutes: 05:45 PM - 06:00 PM

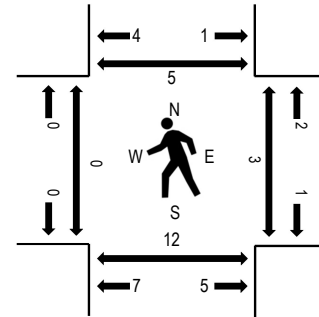
**Peak Hour - Motorized Vehicles**



**Peak Hour - Bicycles**



**Peak Hour - Pedestrians**



Note: Total study counts contained in parentheses.

**Traffic Counts - Motorized Vehicles**

Interval Start Time	W CHARLESTON RD Eastbound				W CHARLESTON RD Westbound				ALMA ST Northbound				ALMA ST Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North
4:00 PM	0	11	55	36	0	11	49	14	0	59	168	9	0	11	286	7	716	2,958	0	0	0	6
4:15 PM	0	20	94	61	0	14	88	29	0	44	145	13	0	21	209	8	746	3,007	0	1	0	1
4:30 PM	0	24	51	51	0	9	55	17	0	37	161	3	0	16	294	10	728	3,109	0	0	0	3
4:45 PM	0	18	76	70	0	1	78	11	0	46	178	10	0	16	258	6	768	3,194	0	0	3	1
5:00 PM	0	18	56	56	2	9	80	21	0	42	176	8	0	14	277	6	765	3,275	0	1	0	3
5:15 PM	0	16	62	50	0	8	59	23	0	51	246	17	0	9	297	10	848		0	1	3	1
5:30 PM	0	25	60	62	0	13	90	27	0	85	177	11	0	12	234	17	813		0	0	1	0
5:45 PM	0	24	59	48	0	10	84	12	0	67	207	13	0	22	286	17	849		0	1	8	1

**Peak Rolling Hour Flow Rates**

Vehicle Type	Eastbound				Westbound				Northbound				Southbound				Total
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lights	0	83	233	214	2	40	310	83	0	241	805	49	0	57	1,090	49	3,256
Mediums	0	0	4	2	0	0	3	0	0	4	1	0	0	0	4	1	19
Total	0	83	237	216	2	40	313	83	0	245	806	49	0	57	1,094	50	3,275



Appendix C  
Synchro Existing and Future Traffic Volumes

**Churchill Underpass Existing AM Volumes**

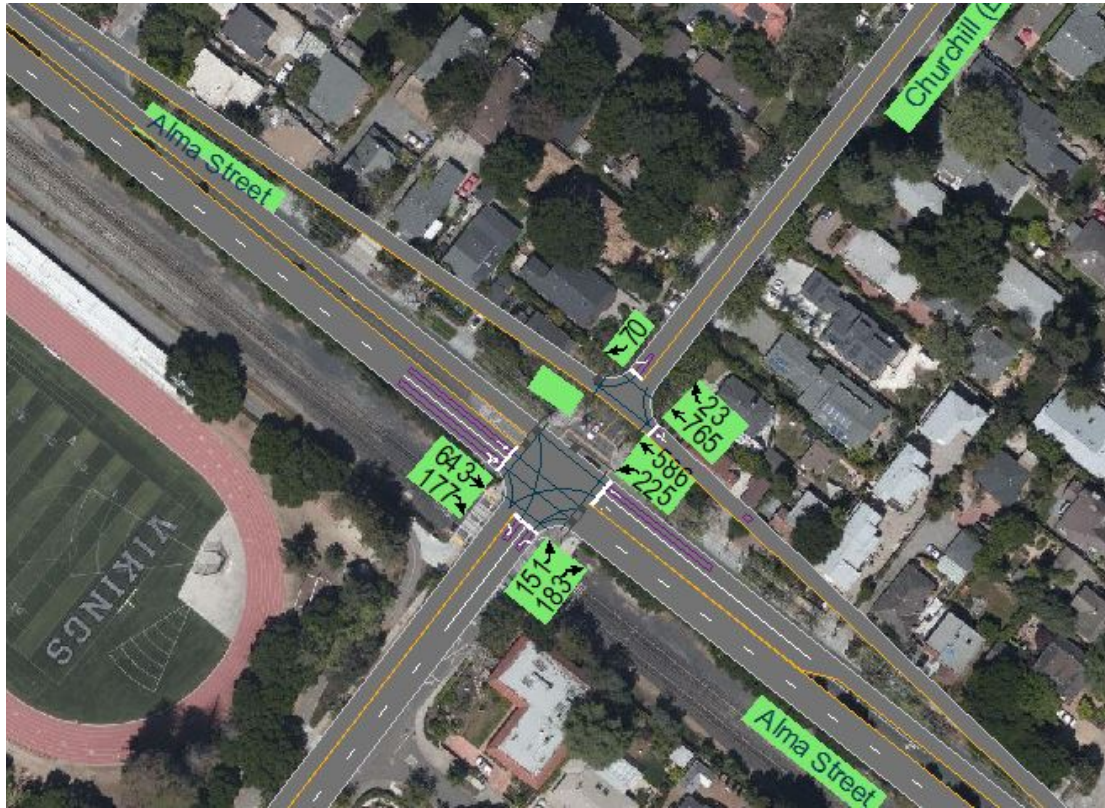


**Churchill Underpass Existing PM Volumes**

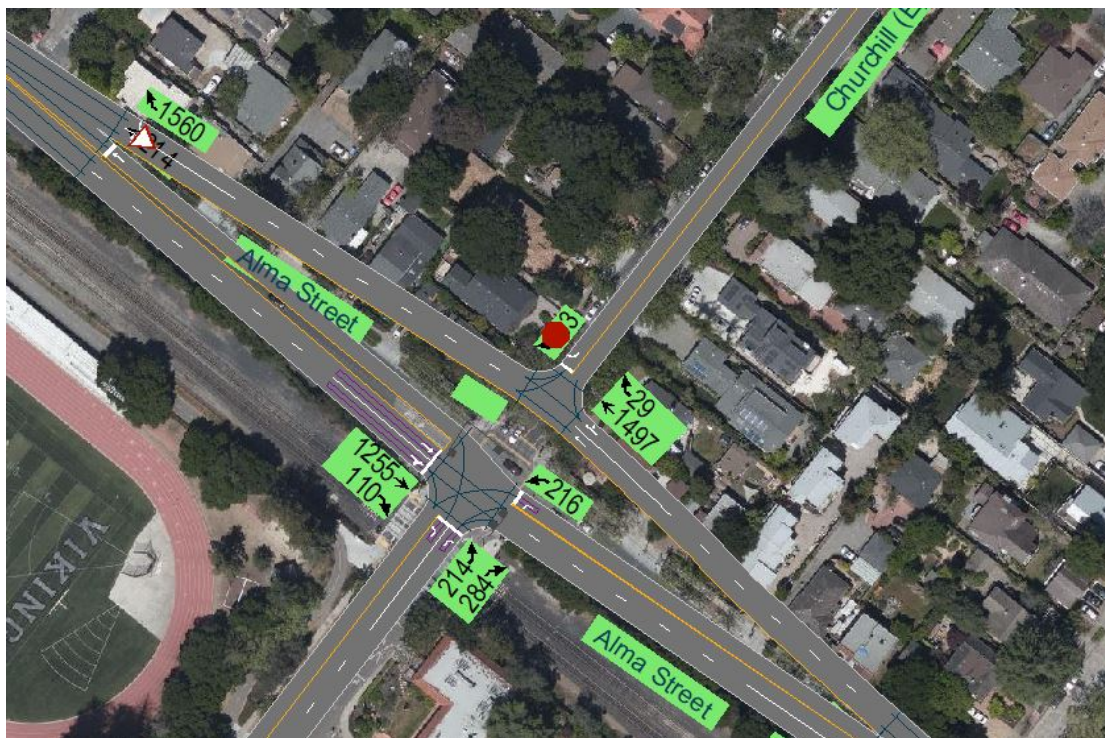


*Note: - These exhibits are to show traffic volume only and are not accurate for the geometric design.*

**Churchill Underpass 2030 AM Volumes**



**Churchill Underpass 2030 PM Volumes**



*Note: - These exhibits are to show traffic volume only and are not accurate for the geometric design.*

**Meadows Drive Viaduct Existing AM Volumes**



**Meadows Drive Viaduct Existing PM Volumes**



*Note: - These exhibits are to show traffic volume only and are not accurate for the geometric design.*

Meadows Drive Viaduct 2030 AM Volumes



Meadows Drive Viaduct 2030 PM Volumes



Note: - These exhibits are to show traffic volume only and are not accurate for the geometric design.

Charleston Road Viaduct Existing AM Volumes



Charleston Road Viaduct Existing PM Volumes



Note: - These exhibits are to show traffic volume only and are not accurate for the geometric design.

Charleston Road Viaduct 2030 AM Volumes



Charleston Road Viaduct 2030 PM Volumes



Note: - These exhibits are to show traffic volume only and are not accurate for the geometric design.

Meadows Drive & Alma Village Pkwy Partial Underpass 2030 AM Volumes



Note: - These exhibits are to show traffic volume only and are not accurate for the geometric design.

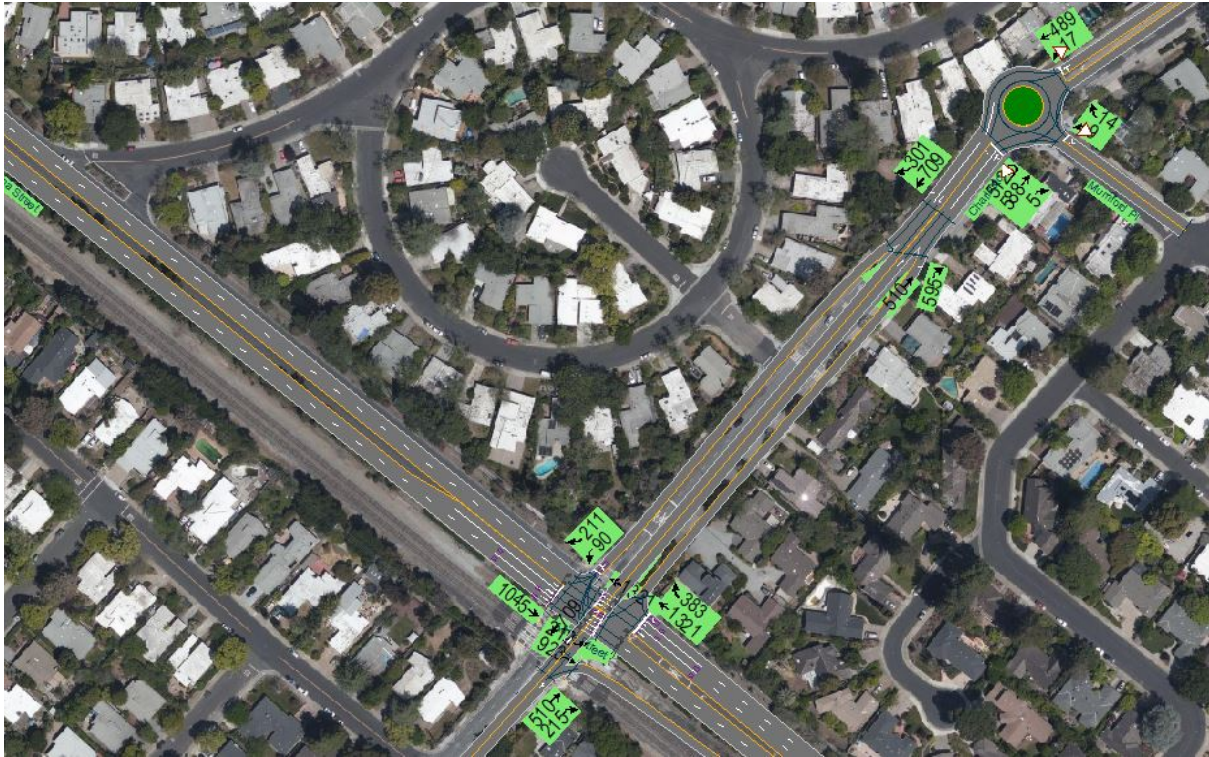


**Meadows Drive & Alma Village Pkwy Partial Underpass 2030 PM Volumes**

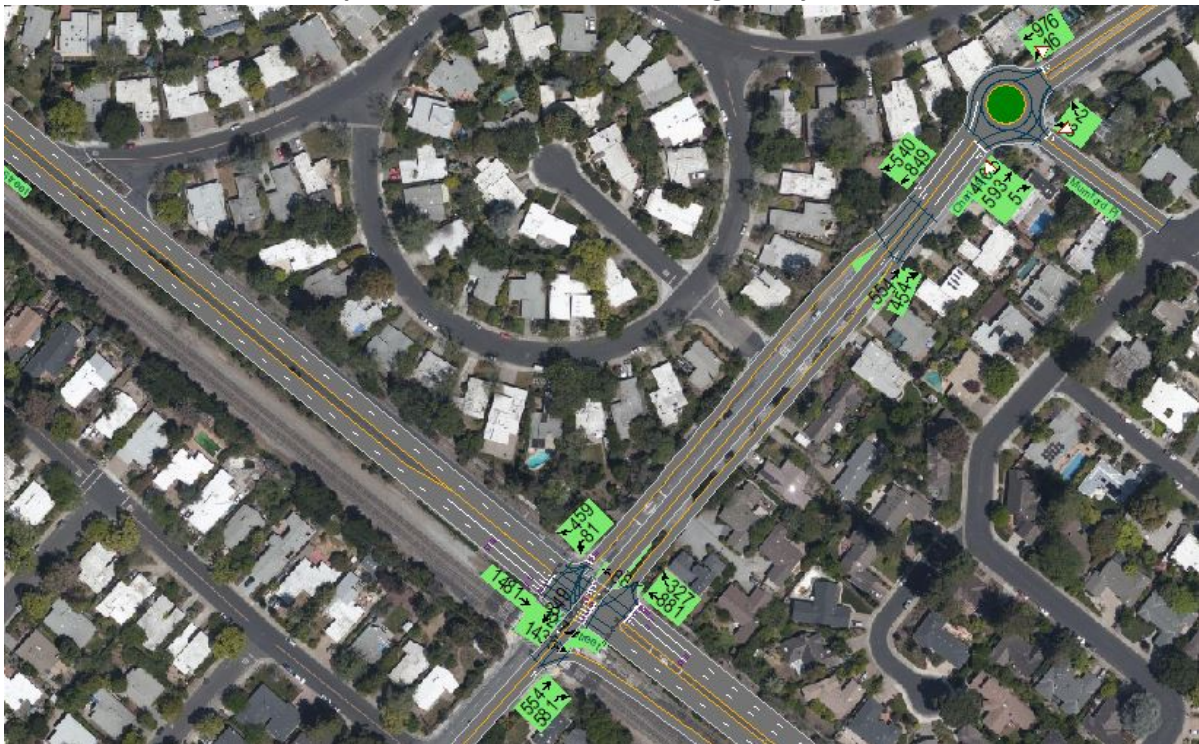


*Note: - These exhibits are to show traffic volume only and are not accurate for the geometric design.*

**Charleston Rd Partial Underpass with U-Turn at Alma Village Pkwy 2030 AM Volumes**



**Charleston Rd Partial Underpass with U-Turn at Alma Village Pkwy 2030 PM Volumes**



*Note: - These exhibits are to show traffic volume only and are not accurate for the geometric design.*

Draft Traffic Impact Study Report

## Churchill Avenue Closure

City of Palo Alto, California

August 07, 2019



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- Appendix B – Traffic Counts
- Appendix C – Origin-Destination Data
- Appendix D – Existing Conditions Synchro Reports
- Appendix E – Existing Plus Project Synchro Reports

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Appendix G – Existing Plus Project Conditions with Mitigations Synchro Reports

Appendix H – Cumulative Conditions (2030) Synchro Reports

Appendix I – Cumulative (2030) Plus Project Conditions Synchro Reports

Appendix J – Cumulative (2030) Plus Project Conditions with Mitigations Synchro Reports

Appendix K – Alma Street and Embarcadero Road Conceptual Improvements

## EXECUTIVE SUMMARY

This report describes the results of the Traffic Impact Study for the proposed closure of Churchill Avenue near the at-grade crossing to begin the construction of a grade-separated crossing as Caltrain begins to modernize and the California High Speed Rail is proposed to use the existing Caltrain right-of-way.

To evaluate the impacts on the transportation infrastructure due to the rerouted traffic from the intersection of Alma Street/Churchill Avenue, the study intersections were evaluated in accordance with the standards set forth by the level of service (LOS) policies of the City of Palo Alto and the Santa Clara Valley Transportation Authority (VTA).

This report contains a summary of the roadway network near the vicinity of Churchill Avenue, as well as existing pedestrian, bicycle, and transit facilities. Methods used for existing conditions analysis include data collection and development of traffic simulation models using Synchro software to report existing level of service (LOS), delay, and 95th percentile queue at the selected study intersections. The following sections of the report explain the analysis methodology and results in detail. Data collected for the analyses and traffic simulation model outputs are provided in the appendices.

Average daily traffic (ADT) and intersection turning movement counts (TMC) were collected for existing conditions during a typical weekday with normal weather conditions and when schools were in session.

Roadway System operations were evaluated under the following scenarios:

### Existing Conditions

Under this scenario, several intersections operate with unacceptable level-of-service (LOS) E/F (Palo Alto or VTA CMP) during both a.m. and p.m. peak hours, which are listed below.

- Alma Street/Lincoln Avenue (all peak hours)
- Alma Street/Embarcadero Road (all peak hours)
- Alma Street/Kingsley Avenue (all peak hours)
- Alma Street/Churchill Avenue (a.m. peak hour)
- Embarcadero Road/Cowper Street (all peak hours)
- Embarcadero Road/Middlefield Road (a.m. peak hour)
- El Camino Real/Churchill Avenue (p.m. peak hour)
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue) (all peak hours)
- Alma Street/Oregon Expressway EB Off Ramp (all peak hours)

Consequently, several 95<sup>th</sup> percentile queue lengths exceeded existing storage lengths. In addition to the LOS and 95<sup>th</sup> percentile queue length analysis, an Origin-Destination (O-D) study was conducted to determine the percentage of traffic that uses Churchill Avenue to cut across the City of Palo Alto. The results of the O-D study suggest that several zones make up the majority of traffic that uses Churchill Avenue to cut across the City. Detailed results are explained in the following sections of the report.

### Existing Plus Project Conditions

The closure of Churchill Avenue is expected to reroute 706 vehicles in the a.m. peak and 776 vehicles in the p.m. peak period. Under this scenario, many of the same intersections in Existing Conditions continue



to operate with unacceptable LOS and several major intersections, such as El Camino Real/Embarcadero Road and El Camino Real/Oregon Expressway-Page Mill Road, degrade to unacceptable LOS during both a.m. and p.m. peak hours. However, mitigation measures presented for the intersections that are operating at unacceptable LOS are upgraded to acceptable LOS thresholds.

While the proposed underpass at Churchill Avenue is constructed, pedestrians and bicyclists will have to use other crossings within the study area to cross the Caltrain train tracks. Other crossings include the California Avenue Bike/Pedestrian Underpass and the Embarcadero Road underpass. Both crossings are less than a mile from Churchill Avenue, however the travel time for pedestrians and bicyclists will increase during construction. Transit impacts will be seen at the intersections where there is a degradation of LOS due to the rerouting of traffic.

### **Cumulative (2030) Conditions**

Under this scenario, the study intersections that operate at unacceptable LOS are:

- Alma Street/Lincoln Avenue (all peak hours)
- Alma Street/Embarcadero Road (all peak hours)
- Alma Street/Kingsley Avenue (all peak hours)
- Embarcadero Road/Cowper Street (all peak hours)
- Middlefield Road/Embarcadero Road (a.m. peak hour)
- El Camino Real/Embarcadero Road (p.m. peak hour)
- El Camino Real/Churchill Avenue (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road (a.m. peak hour)
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue) (all peak hours)
- Alma Street/Oregon Expressway EB Off Ramp (all peak hours)
- Oregon Expressway/Middlefield Road (all peak hours)

### **Cumulative (2030) Plus Project Conditions**

Under this scenario, the intersections listed above in the Cumulative Conditions section continue to operate at an unacceptable LOS due to the added delay caused by rerouted traffic. Pedestrian, bicycle, and transit impacts are expected to be similar to Existing Plus Project Conditions.

Analysis on the mitigation measures for the intersections impacted by the rerouted traffic show that Alma Street/Lincoln Avenue, Alma Street/Embarcadero Road, Alma Street/Kingsley Avenue, Embarcadero Road/Cowper Street, El Camino Real/Embarcadero Road, Alma Street/Oregon Expressway WB Off Ramp, and Alma Street/Oregon Expressway EB Off Ramp upgrade to acceptable LOS and delay thresholds. Although the LOS is still unacceptable for El Camino Real/Oregon Expressway-Page Mill Road, the delay is significantly decreased when the mitigation is applied. Similarly, the delay for the intersection of Oregon Expressway/Middlefield Road is reduced when the mitigation is applied, but only for the a.m. peak period.

### **TIRE Index**

The TIRE Index analysis for Existing Plus Project Conditions and Cumulative Plus Project indicates that the segments of Emerson Street from Channing Avenue to Addison Avenue and Emerson Street from Lincoln

Avenue to Kingsley Avenue would be impacted by the rerouted traffic caused by the closure of Churchill Avenue.

## PROJECT OVERVIEW

The City of Palo Alto is considering to close Churchill Avenue near the at-grade crossing to begin the construction of a grade-separated crossing as Caltrain begins to modernize and the California High Speed Rail is proposed to use the existing Caltrain right-of-way. The City would like to evaluate key intersections that would be impacted by the eventual closure of Churchill Avenue near the Caltrain grade crossing.

This report contains the results of the existing conditions analysis from the *Final Existing Conditions Report (February 2019)* for the Palo Alto Rail Program Management, which was conducted by TJKM.

As a part of the project, TJKM collected intersection TMC at key study locations for the a.m. and p.m. peak period, ADT counts for focused roadways within the study area, and an Origin-Destination (O-D) study. This report summarizes the data collected, results of the analysis conducted for all scenarios, including LOS and delay, 95<sup>th</sup> percentile queue lengths at each study intersection, results of the O-D study, and results of the TIRE analysis.

## STUDY INTERSECTIONS AND SCENARIOS

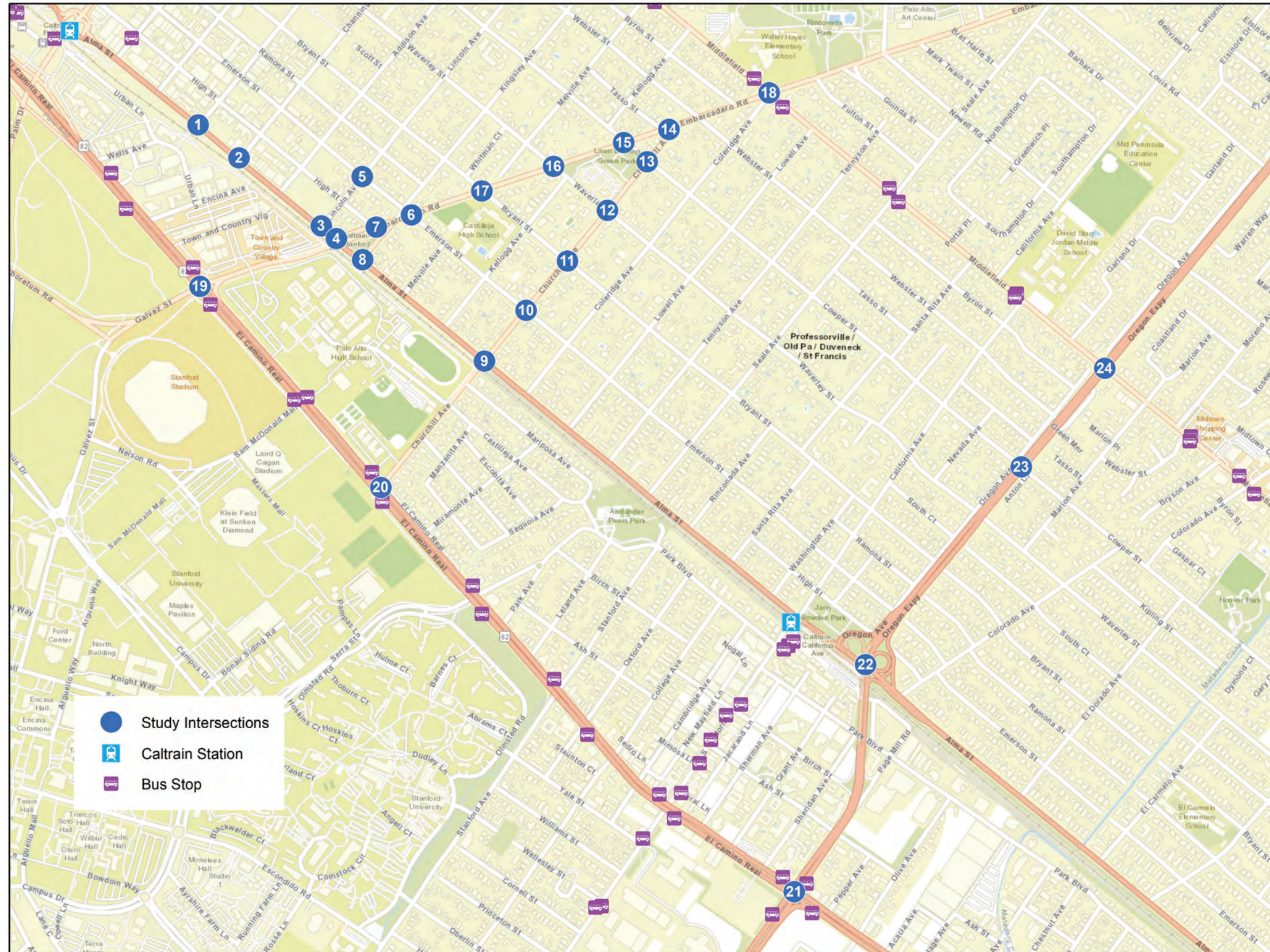
The study intersections selected for the project are listed below and illustrated in **Figure 1**.

1. Alma Street/Homer Avenue (Signalized)
2. Alma Street/Channing Avenue (No Control)
3. Alma Street/Lincoln Avenue (One-Way Stop Control)
4. Alma Street/Embarcadero Road (One-Way Stop Control)
5. Emerson Street/Lincoln Avenue (All-Way Stop Control)
6. Emerson Street/Embarcadero Road (One-Way Stop Control)
7. Embarcadero Road/High Street (One-Way Stop Control)
8. Alma Street/Kingsley Avenue (One-Way Stop Control)
9. Alma Street/Churchill Avenue (Signalized)
10. Churchill Avenue/Emerson Street (All-Way Stop Control)
11. Churchill Avenue/Bryant Street (Two-Way Stop Control)
12. Churchill Avenue/Waverly Street (All-Way Stop Control)
13. Churchill Avenue/Cowper Street (All-Way Stop Control)
14. Churchill Avenue/Embarcadero Road (One-Way Stop Control)
15. Embarcadero Road/Cowper Street (Two-Way Stop Control)
16. Embarcadero Road/Waverly Street (Signalized)
17. Embarcadero Road/Bryant Street (Signalized)
18. Middlefield Road/Embarcadero Road (Signalized)
19. El Camino Real/Embarcadero Road (Signalized)
20. El Camino Real/Churchill Avenue (Signalized)
21. El Camino Real/Oregon Expressway-Page Mill Road (Signalized)
22. Alma Street/Oregon Expressway (Stop Controlled for Off Ramps)
23. Oregon Expressway/Cowper Street (Signalized)
24. Oregon Expressway/Middlefield Road (Signalized)

The four project scenarios were analyzed and are listed below:

- 1. Existing Conditions** – This scenario evaluates the study intersections based on existing traffic volumes, lane geometries, and traffic controls. Under this scenario, Churchill Avenue remains open to all traffic.
- 2. Existing Plus Project Conditions** – This scenario evaluates the study intersections with existing lane geometry and traffic controls. The southbound right-turn, northbound left-turn, westbound through, and all eastbound movements were restricted at the intersection of Alma Street/Churchill Avenue. Based on the study area and existing traffic patterns, traffic volumes for the restricted movements were rerouted.
- 3. Cumulative (2030) Conditions** – This scenario evaluates the study intersections with the traffic volumes projected to the year 2030. An annual growth rate of 1% was applied to the traffic volumes in the study area. Under this scenario, Churchill Avenue will remain open to all traffic.
- 4. Cumulative (2030) Plus Project Conditions** – This scenario is similar to the Existing Plus Churchill Avenue Closure. An annual growth rate of 1% was applied to the traffic volumes in the study after the restricted movements were rerouted.

# Vicinity Map



**STUDY METHODOLOGY**

**LEVEL OF SERVICE (LOS) ANALYSIS METHODOLOGY**

LOS is a standard measure of traffic service along a roadway or at an intersection. It ranges from A to F, with LOS A being best and LOS F being worst. In very general terms, LOS A, B, and C indicate conditions where traffic can move relatively freely. LOS D describes conditions where delay is more noticeable and average travel speeds are more unstable. LOS E indicates significant delays and average travel speeds vary greatly and are unpredictable; traffic volumes are generally at, or close to, capacity. Finally, LOS F characterizes traffic flow at very slow speeds (stop-and-go) and significant delays with queuing at unsignalized intersections, which typically means traffic demand on the roadway exceeds the roadway's capacity.

The *Highway Capacity Manual (HCM) 2000* is the standard reference published by the Transportation Research Board, and contains the specific criteria and methods to be used in assessing LOS. There are several software packages that have been developed to implement HCM. In this study, Synchro Software was used to calculate the LOS at the study intersections.

Signalized intersection LOS is based on the capacity of the intersection as a whole and average delay experienced by a driver. Unsignalized intersection LOS is defined by the average delay experienced by a driver for the minor approach worst movement or major approach critical movement. **Tables 1 and 2** provide the relationship between LOS rating and delay for signalized and unsignalized intersections respectively.

**Table 1: Signalized Intersection LOS Criteria**

<i>Level of Service</i>	<i>Description</i>	<i>Average Control Delay (Seconds Per Vehicle)</i>
A	Operations with very low delay occurring with favorable progression &/or short cycle lengths.	≤ 10.0
B	Operations with low delay occurring with good progression &/or short cycle lengths.	10.1 to 20.0
C	Operations with average delays resulting from fair progression &/or longer cycle lengths. Individual cycle failures begin to appear.	20.1 to 35.0
D	Operations with longer delays due to a combination of unfavorable progression, long cycle lengths, &/or high volume-to-capacity (V/C) ratios. Many vehicles stop & individual cycle failures are noticeable.	35.1 to 55.0
E	Operations with high delay values indicating poor progression, long cycle lengths & high V/C ratios. Individual cycle failures are frequent occurrences. This is considered to be the limit of acceptable delay.	55.1 to 80.0
F	Operation with delays unacceptable to most drivers occurring due to oversaturation, poor progression, or very long cycle lengths.	> 80.0

Source: Transportation Research Board, 2000 Highway Capacity Manual

**Table 2: Unsignalized Intersection LOS Criteria**

<i>Level of Service</i>	<i>Description</i>	<i>Average Control Delay (Seconds Per Vehicle)</i>
A	Little or no delays	≤ 10.0
B	Short traffic delays	10.1 to 15.0
C	Average traffic delays	15.1 to 25.0
D	Long traffic delays	25.1 to 35.0
E	Very long traffic delays	35.1 to 50.0
F	Extreme traffic delays with intersection capacity exceeded (for an all-stop), or with approach/turn movement capacity exceeded (for a side street stop controlled intersection)	> 50.0

Source: Transportation Research Board, 2000 Highway Capacity Manual

**SIGNIFICANT IMPACT CRITERIA/LEVEL OF SERVICE STANDARDS**

**Signalized Intersections**

In general, the LOS standard (minimum acceptable operations for signalized intersections in the City of Palo Alto is LOS D or better. The City has also adopted LOS as the minimum overall performance measure for Congestion Management Program (CMP) monitored roadways (e.g., Middlefield Road/Oregon Expressway, El Camino Real/Oregon Expressway-Page Mill Road, and El Camino Real/Embarcadero Road), consistent with VTA guidelines.

According to the City of Palo Alto, a projected-generated increase in traffic is considered to have a significant impact at a signalized intersection if it meets any of the following criteria:

- If the intersection operations degrade from an acceptable level (LOS D or better) to an unacceptable level (LOS E or F); *or*
- If the critical delay increase by four seconds or more, or the volume-to-capacity (V/C) ratio increases by more than 0.01 or more at intersections with unacceptable operations (LOS E or F)

The City of Palo Alto considers a significant impact to be satisfactorily mitigated when the measure implemented would restore LOS to baseline conditions or better.

**Unsignalized Intersections**

LOS D is used as the minimum acceptable operating level at unsignalized intersections. A project-generated increase in traffic is considered to have a significant impact if intersection operations degrades to LOS E or LOS F *and* the intersection satisfies the peak hour signal warrants from the California Manual of Uniform Traffic Control Devices (CA MUTCD).

The City considers a significant impact to be satisfactorily mitigated when the measure implemented would restore LOS to background conditions or better.

### VTA CMP Intersections

The LOS standard for CMP intersections is LOS E. The projected-generated increase in traffic is considered to have significant impact at a CMP intersection if it meets any of the following criteria:

- If intersection operations degrade from an acceptable level (LOS E or better) to an unacceptable level (LOS F)
- If the critical delay increases by more than four seconds *and* the V/C ratio increases by 0.01 or more at intersections with unacceptable operations (LOS F).
- The V/C ratio increases by 0.01 or more at an intersection with unacceptable operations (LOS F) when the change in critical delay is negative (i.e., decreases). This can occur if the critical movements change.

### Pedestrian and Bicycle Impact Criteria

The City of Palo Alto *Comprehensive Plan* describes related policies necessary to ensure that pedestrian and bicycle facilities are safe and effective for City residents. Based on the *Comprehensive Plan* as a guide, significant impacts to these facilities would occur when a project or an element of a project:

- Creates a hazardous condition that currently does not exist for pedestrians and bicyclists, or otherwise interferes with pedestrian or bicycle accessibility to the site and adjoining areas; or
- Conflicts with an existing or planned pedestrian or bicycle facility; or
- Conflicts with policies related to bicycle and pedestrian activity adopted by the City of Palo Alto, Santa Clara County, VTA, or Caltrans for their respective facilities in the study area.

### Transit Impact Criteria

Significant impacts to transit service would occur if the project or any part of the project:

- Creates demand for public transit services above the capacity which is provided, or planned;
- Disrupts existing transit services or facilities including disruptions caused by proposed project driveways on transit streets and impacts to transit stops/shelters; and impacts to transit operations from traffic improvements proposed or resulting from a project.
- Conflicts with an existing or planned transit facility; or
- Conflicts with transit policies adopted by the City of Palo Alto, Santa Clara County, VTA, or Caltrans for their respective facilities in the study area.



### TRAFFIC INFUSION ON RESIDENTIAL ENVIRONMENT (TIRE)

Residential areas tend to be especially sensitive to traffic because relatively small increases in traffic can impact the livability of the neighborhood. TIRE is the measure of traffic impact on residents along a roadway. The TIRE Index is derived from a theory by D.K. Goodrich, based on work by Professor Appleyard of the University of California at Berkeley, and by Buchanan of the Ministry of Transport, England. TIRE is based on the hypothesis that a given increase in traffic volume has a greater impact on the residential environment along a roadway with a low traffic volume, than along a roadway with a high pre-existing volume. TIRE represents the effect of traffic on the safety and comfort of human activities, such as walking, bicycling, and playing on or near a roadway, and on the freedom to maneuver personal autos in and out of residential driveways.

The TIRE index is based on daily traffic conditions and uses average daily traffic (ADT) volumes to determine the amount of daily traffic that could be added to a roadway before residents would perceive the increase in traffic. The amount of daily traffic that can be added before residents would notice directly correlates to the amount of daily traffic already present on the roadway. The TIRE Index scale ranges from zero to five, depending on daily traffic volume. An index of zero represents the least infusion of traffic. An index of five represents the greatest traffic volume, and thereby the poorest residential environment. A roadway with a TIRE value of three or greater is considered to exhibit a significantly impaired residential environment. The projected difference between a pre and post-project TIRE value is the predicted impact of the project on a residential environment. Any projected change of 0.1 or greater would be noticeable to residents. An increase in index of 0.1 corresponds to an approximate increase in ADT of between 20% and 30%. **Appendix A** contains a detailed description of the TIRE index methodology. **Table 3** provides the TIRE Index thresholds for different ADT ranges.

**Table 3: TIRE Index Thresholds based on ADT**

Existing Volume Range (Vehicles Per Day)	TIRE Index	Minimum Daily Traffic Volume Increase to Produce	
		a 0.1 Change in the TIRE Index	a 0.2 Change in the TIRE Index
29-35	1.5	+6	+15
36-44	1.6	+8	+20
45-56	1.7	+10	+25
57-70	1.8	+13	+32
71-89	1.9	+17	+41
90-110	2.0	+22	+52
111-140	2.1	+29	+65
141-180	2.2	+40	+80
181-220	2.3	+52	+100
221-280	2.4	+65	+125
281-350	2.5	+79	+160
351-450	2.6	+97	+205
451-560	2.7	+114	+260
561-710	2.8	+140	+330
711-890	2.9	+170	+415
891-1,100	3.0	+220	+520
1,101-1,400	3.1	+290	+650
1,401-1,800	3.2	+380	+800
1,801-2,200	3.3	+500	+1,000
2,201-2,800	3.4	+650	+1,300
2,801-3,500	3.5	+825	+1,700
3,501-4,500	3.6	+1,025	+2,200
4,501-5,600	3.7	+1,250	+2,800
5,601-7,100	3.8	+1,500	+3,500
7,101-8,900	3.9	+1,800	+4,300
8,901-11,000	4.0	+2,300	+5,300
11,001-14,000	4.1	+3,000	+6,500
14,001-18,000	4.2	+4,000	+8,000
18,001-22,000	4.3	+5,200	+10,000
22,001-28,000	4.4	+6,600	+13,000
28,001-35,000	4.5	+8,200	+17,000
35,000-45,000	4.6	+10,000	+22,000
45,001-56,000	4.7	+12,200	+28,000
56,001-71,000	4.8	+14,800	+35,000
71,001-89,000	4.9	+18,000	+43,000

Source: Goodrich Traffic Group, based on curve shapes found in work by Donald Appleyard at the University of California, Berkeley and in consideration of earlier thoughts by Buchanan of the Ministry of Transport, England.

## EXISTING CONDITIONS

### EXISTING ROADWAY NETWORK

The roads in the City of Palo Alto within the project vicinity can be divided into three classifications: local/collector, residential arterial, and arterial. Key roadways within the project vicinity are described below:

**Alma Street** is classified as a north-south arterial which extends from Homer Avenue and Oregon Expressway. Alma Street is primarily 4-lanes wide and the speed limit within the project vicinity ranges from 25-35 mph. Alma Street also runs adjacent and parallel to Caltrain's right-of-way.

**Churchill Avenue** is classified as an east-west 2-lane local/collector street with limits from Embarcadero Road to El Camino Real. The posted speed limit is 25 mph. Churchill Avenue is currently an at-grade crossing with the Caltrain corridor.

**El Camino Real** is also classified as a north-south arterial which runs from Embarcadero Road to Oregon Expressway. Within this segment, El Camino Real is primarily 6-lanes wide with a posted speed limit ranging from 35-40 mph.

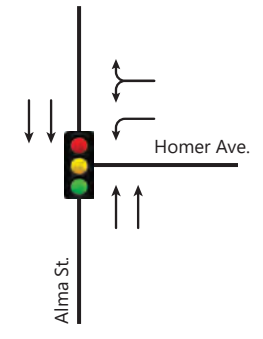
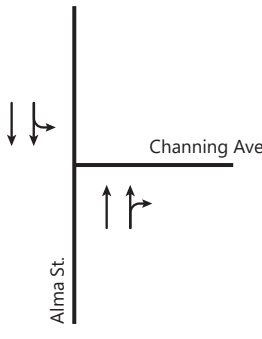
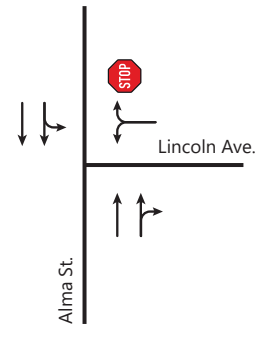
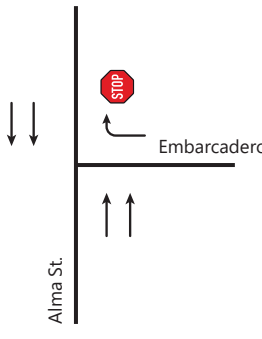
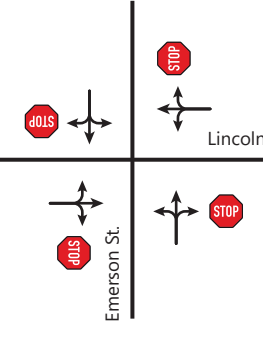
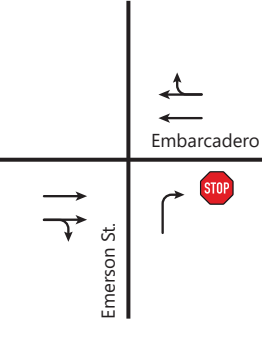
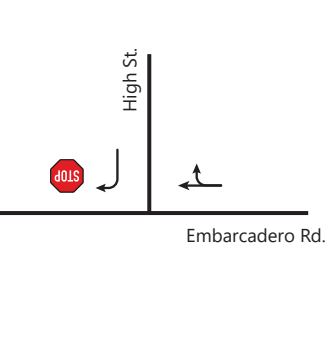
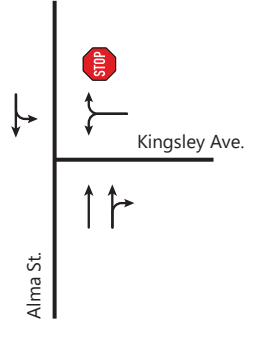
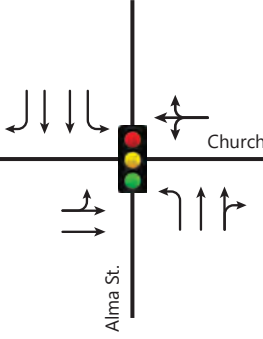
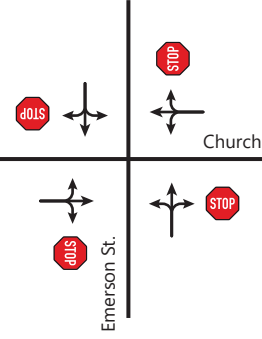
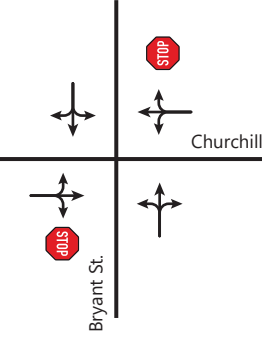
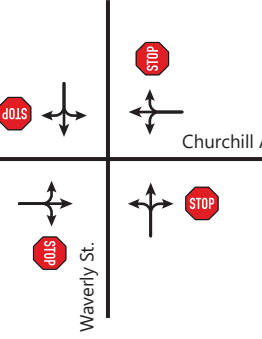
**Embarcadero Road** is classified as an east-west residential arterial stretching from Middlefield Road in the East and El Camino Real in the West. This arterial also provides connectivity to US 101. In this segment, Embarcadero Road consists of 4-lanes with a posted speed limit of 25 mph. Embarcadero Road is currently a grade-separated rail-crossing for vehicles, pedestrians, and bicycles.

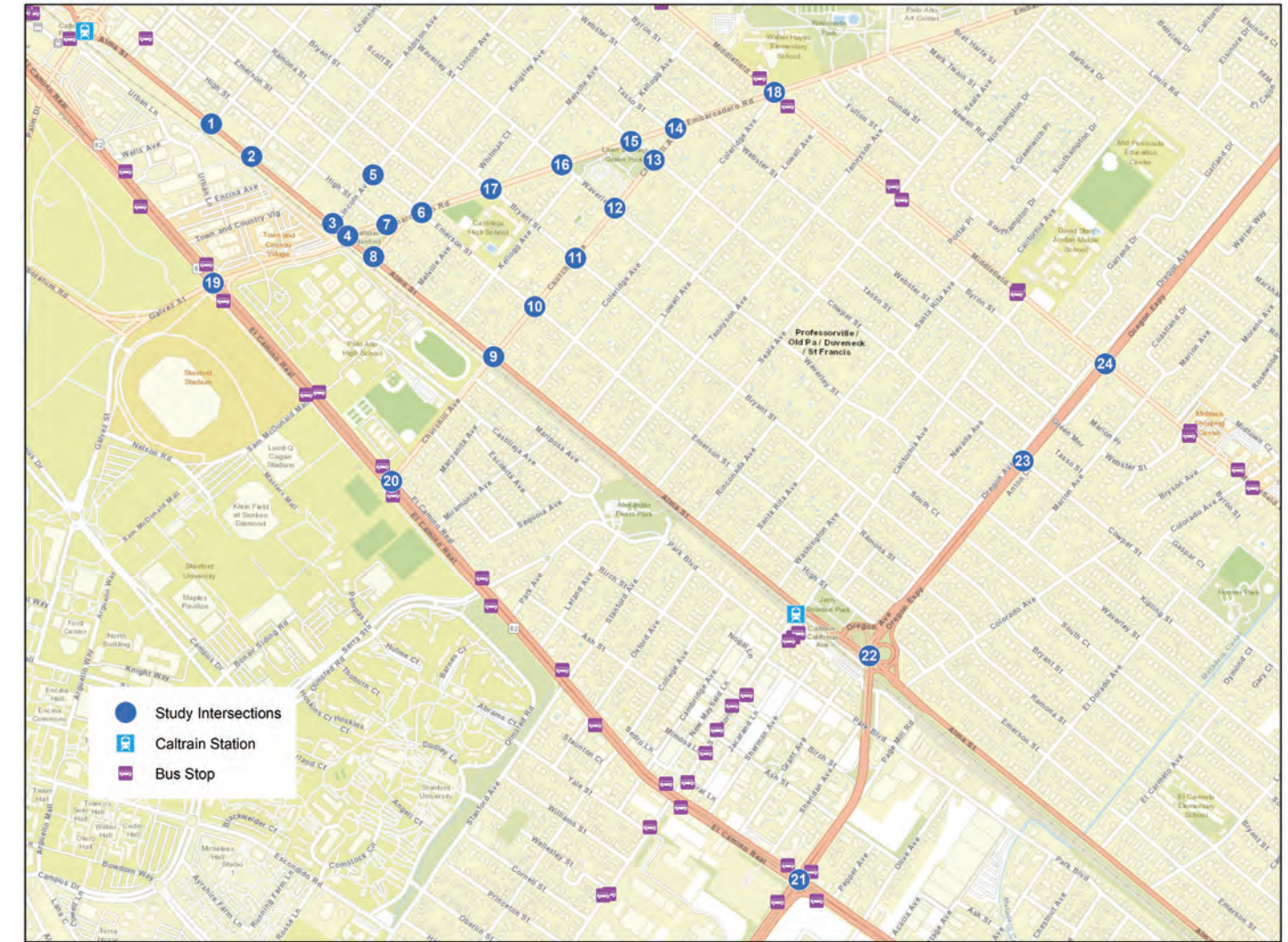
**Middlefield Road** is classified as a north-south residential arterial with limits from Embarcadero Road and Oregon Expressway within the project vicinity. Middlefield Road primarily consists of 2-lanes with a posted speed limit of 25 mph.

**Oregon Expressway** is classified as an east-west expressway that runs from Middlefield Road and El Camino Real within the project vicinity. This expressway also connects residents to US 101 in the east and I-280 in the west. Oregon Expressway consists of 4-lanes with a posted speed limit of 35 mph. Oregon Expressway is currently a grade-separated crossing primarily for vehicles.

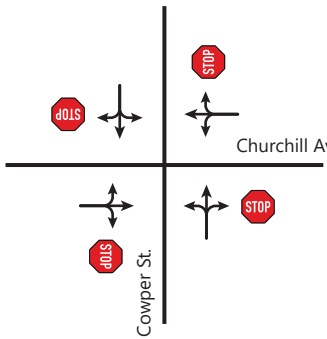
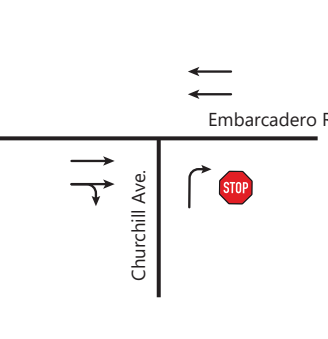
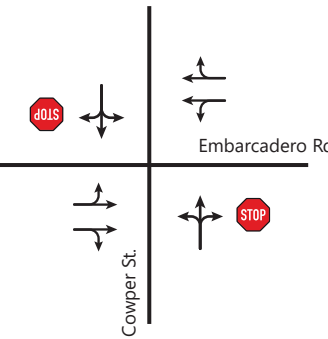
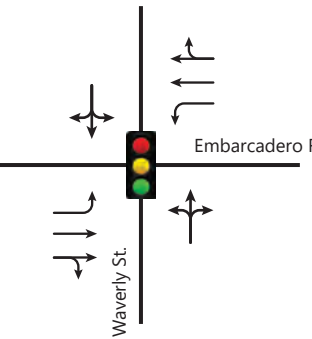
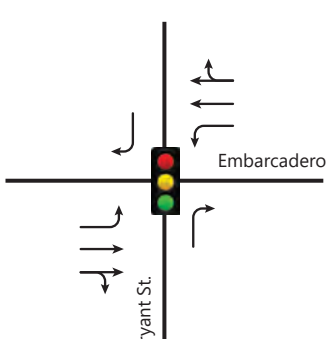
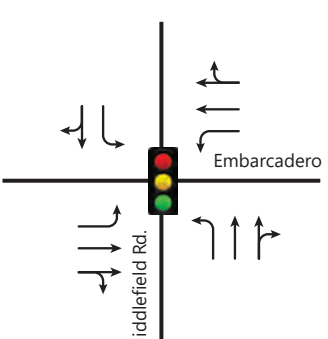
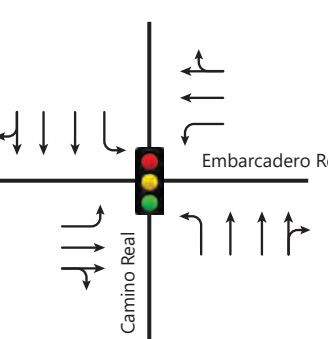
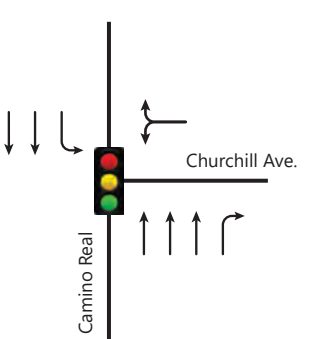
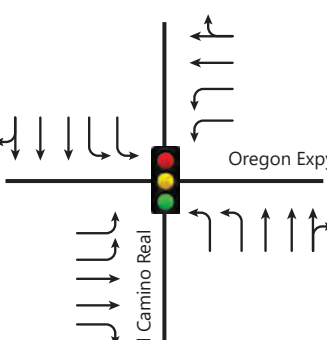
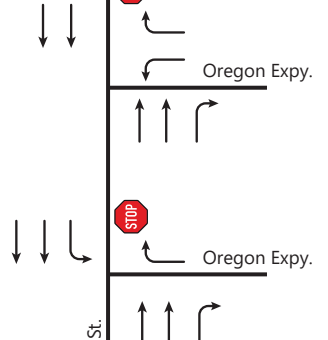
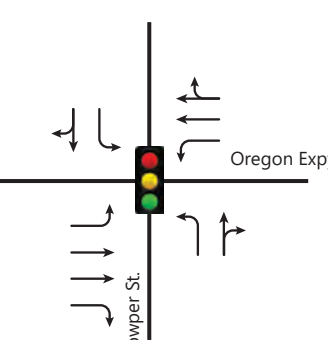
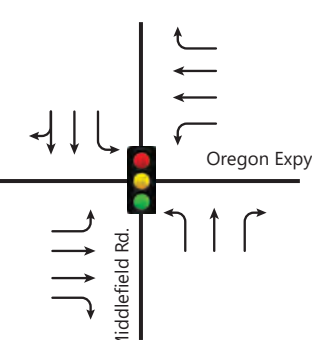
**Figures 2a** and **2b** illustrates the existing lane geometry and traffic controls at the study intersections.

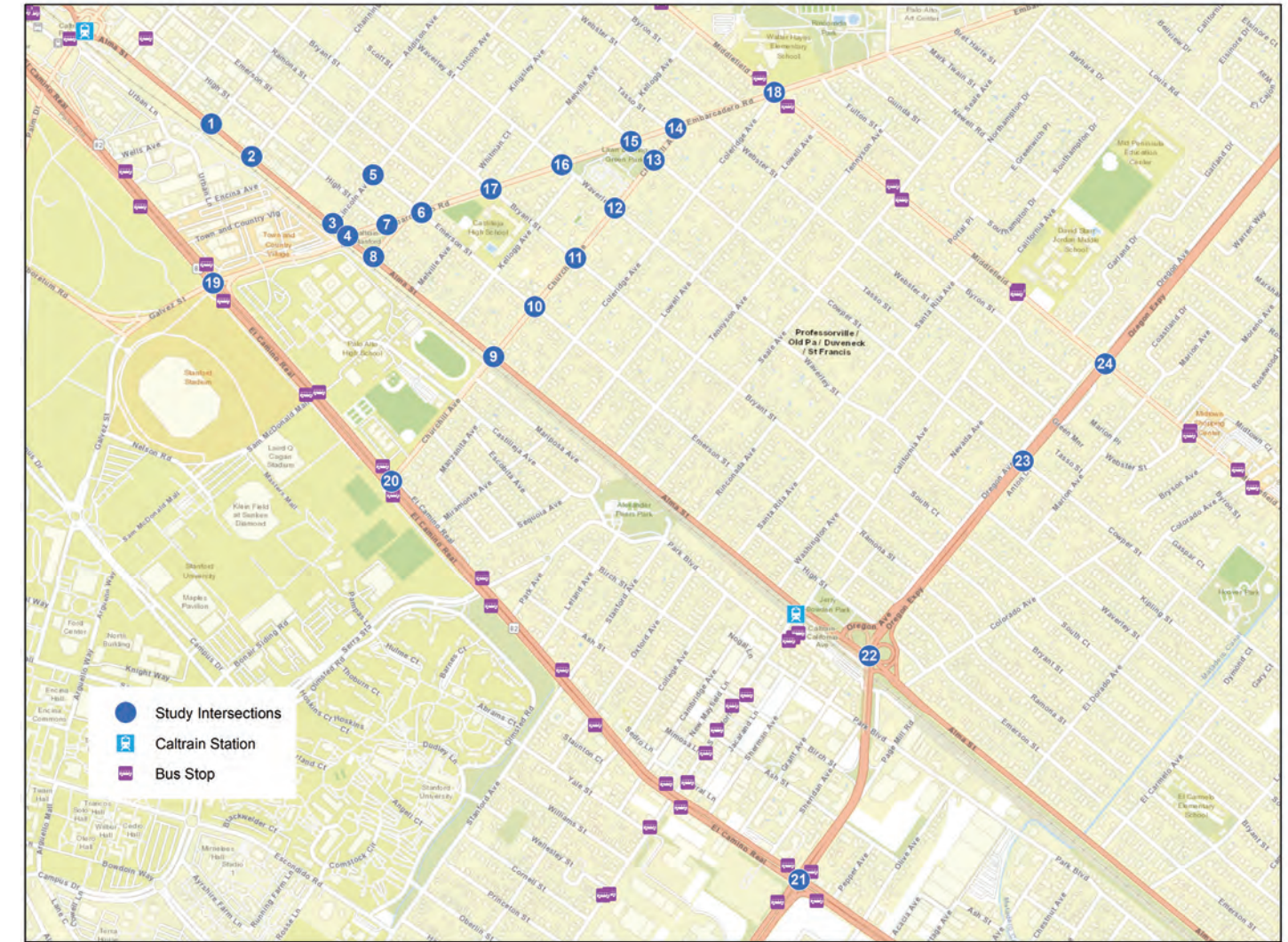
# Existing Lane Geometry and Traffic Controls

<p><b>Intersection #1</b> Alma St. / Homer Ave.</p> 	<p><b>Intersection #2</b> Alma St. / Channing Ave.</p> 	<p><b>Intersection #3</b> Alma St. / Lincoln Ave.</p> 	<p><b>Intersection #4</b> Alma St. / Embarcadero Rd.</p> 
<p><b>Intersection #5</b> Emerson St. / Lincoln Ave.</p> 	<p><b>Intersection #6</b> Emerson St. / Embarcadero Rd.</p> 	<p><b>Intersection #7</b> Embarcadero Rd. / High St.</p> 	<p><b>Intersection #8</b> Alma St. / Kingsley Ave.</p> 
<p><b>Intersection #9</b> Alma St. / Churchill Ave.</p> 	<p><b>Intersection #10</b> Emerson St. / Churchill Ave.</p> 	<p><b>Intersection #11</b> Bryant St. / Churchill Ave.</p> 	<p><b>Intersection #12</b> Waverly St. / Churchill Ave.</p> 



# Existing Lane Geometry and Traffic Controls

<p><b>Intersection #13</b> Cowper St. / Churchill Ave.</p> 	<p><b>Intersection #14</b> Churchill Ave. / Embarcadero Rd.</p> 	<p><b>Intersection #15</b> Cowper St. / Embarcadero Rd.</p> 	<p><b>Intersection #16</b> Waverly St. / Embarcadero Rd.</p> 
<p><b>Intersection #17</b> Bryant St. / Embarcadero Rd.</p> 	<p><b>Intersection #18</b> Middlefield Rd. / Embarcadero Rd.</p> 	<p><b>Intersection #19</b> El Camino Real / Embarcadero Rd.</p> 	<p><b>Intersection #20</b> El Camino Real / Churchill Ave.</p> 
<p><b>Intersection #21</b> El Camino Real / Oregon Expy.</p> 	<p><b>Intersection #22</b> Alma St. / Oregon Expy.</p> 	<p><b>Intersection #23</b> Cowper St. / Oregon Expy.</p> 	<p><b>Intersection #24</b> Middlefield Rd. / Oregon Expy.</p> 



### EXISTING PEDESTRIAN FACILITIES

Walkability is defined as the ability to travel easily and safely between various origins and destinations without having to rely on automobiles or other motorized travel. The ideal “walkable” community includes wide sidewalks, a mix of land uses such as residential, employment, and shopping opportunities, a limited number of conflict points with vehicle traffic, and easy access to transit facilities and services.

Pedestrian facilities are comprised of crosswalks, sidewalks, pedestrian signals, and off-street paths, which provide safe and convenient routes for pedestrians to access the destinations such as institutions, businesses, public transportation, and recreation facilities. In the study area, crosswalks are primarily located at the signalized intersections chosen for the study. There is continuous pedestrian connection along majority of the arterials and local streets within the study area. Pedestrians are able to cross the Caltrain tracks along Churchill Avenue (at-grade crossing), Embarcadero Road (below-grade crossing), and the California Avenue Bike/Pedestrian Underpass. **Figure 3** illustrates the existing pedestrian facilities within the project area.

### EXISTING BICYCLE FACILITIES

The City of Palo Alto Bicycle & Pedestrian Transportation Plan (July 2012) provides a list of existing and proposed bicycle facilities in the City of Palo Alto. It also contains the policy vision, design guidance, and specific recommendations to guide the development of pedestrian and bicycle facilities. Bicycle facilities include the following:

- **Bike Paths (Class I):** These provide a completely separate right of way for the exclusive use of bicycles and pedestrians with minimal roadway crossings.
- **Bike Lanes (Class II):** These provide a striped lane and signage for one-way bike travel on a street or highway and are designed for the exclusive use of cyclists with certain exceptions. For instance, right-turning vehicles must merge into the lane before turning.
- **Bike Routes/Bicycle Boulevards (Class III):** Bike routes may be identified on a local residential or collector street when the travel lane is wide enough and the traffic volume is low enough to allow both cyclists and motor vehicles. They are designated for bicycle use by signs or other markers and may not include additional pavement width for cyclists. Bicycle boulevards, a subset of Class III facilities, are signed, shared roadways with especially low motor vehicle volume, such that motorists passing bicyclists can use the full width of the roadway. In addition, all the unwarranted “stop” signs are removed from the boulevard and placed on cross streets, improving bicyclists’ average speed by minimizing unneeded stops.
- **Protected On-street Bike Lane/Cycletracks (Class IV):** A Class IV bikeway, known as a cycletrack or protected bike lane, is an on-street bike lane that is physically separated from motor-vehicle traffic by a vertical separation, such as a raised curb, bollards, or car parking. A protected bikeway is similar to a Class II buffered bike lane, but provides the vertical physical barrier, separation and associated comfort a user can experience on a Class I path.





Class I facilities exist in the form of the Embarcadero Bike Path which runs parallel to the Caltrain tracks from Palo Alto Caltrain Station to Churchill Avenue. The Homer Avenue Tunnel provides an east-west

connectivity across the train tracks, giving pedestrians and bicycles access to Downtown Palo Alto, Palo Alto Medical Foundation, Town & Country Shopping Center, and Palo Alto High School.

# Existing Pedestrian Facilities



## LEGEND

-  — Intersection
-  — Existing sidewalk
-  — No sidewalk
-  — Crosswalk



Class II bicycle facilities are the most common bicycle facility within the study area. The segments on which the facilities exist are listed below.

- Addison Avenue, from Bryant Street to Webster Street
- Churchill Avenue, from Bryant Street to El Camino Real
- Coleridge Avenue, from Embarcadero Road to Bryan Street
- N. California Avenue, from Middlefield Road to Alma Street
- Park Boulevard, from California Avenue to study area limits
- Stanford Avenue, from El Camino Real to study area limits
- California Avenue, from El Camino Real to study area limits

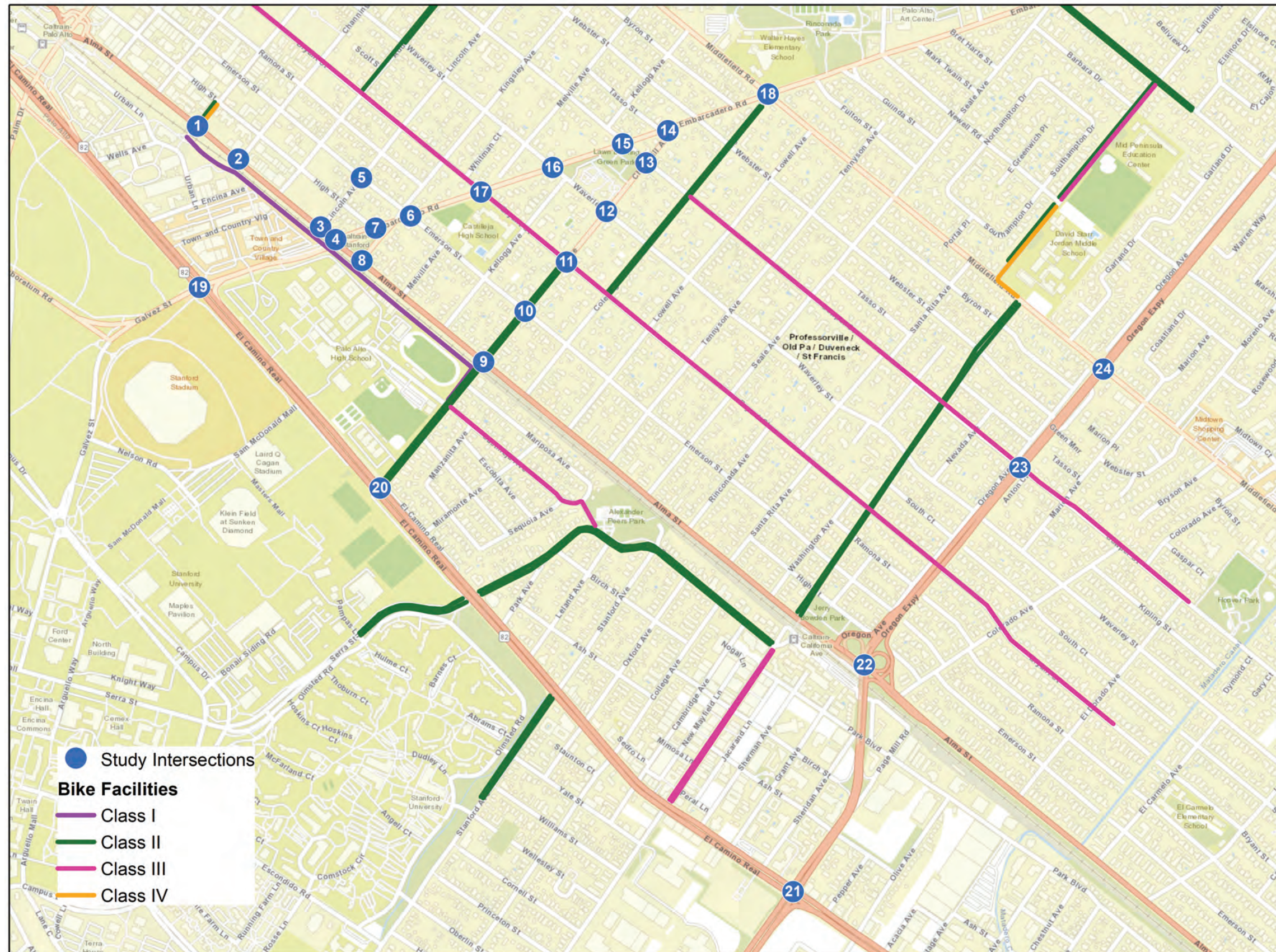
Class III bicycle facilities are present on Cowper Street from Coleridge Avenue to Oregon Expressway, Castilleja Avenue from Churchill Avenue to Park Boulevard, California Avenue from Park Boulevard to El Camino Real, and Bryant Street from Oregon Expressway to project study area limits. There is a Class IV bicycle facility located along N. California Avenue that runs until the intersection of Middlefield Road and N. California Avenue. The Homer Avenue Tunnel also provides bicycles with access to the protected contra-flow bike lane on Homer Avenue that runs from Alma Street to High Street. **Figure 4** illustrates the existing bicycle facilities in the study area.

### EXISTING TRANSIT FACILITIES

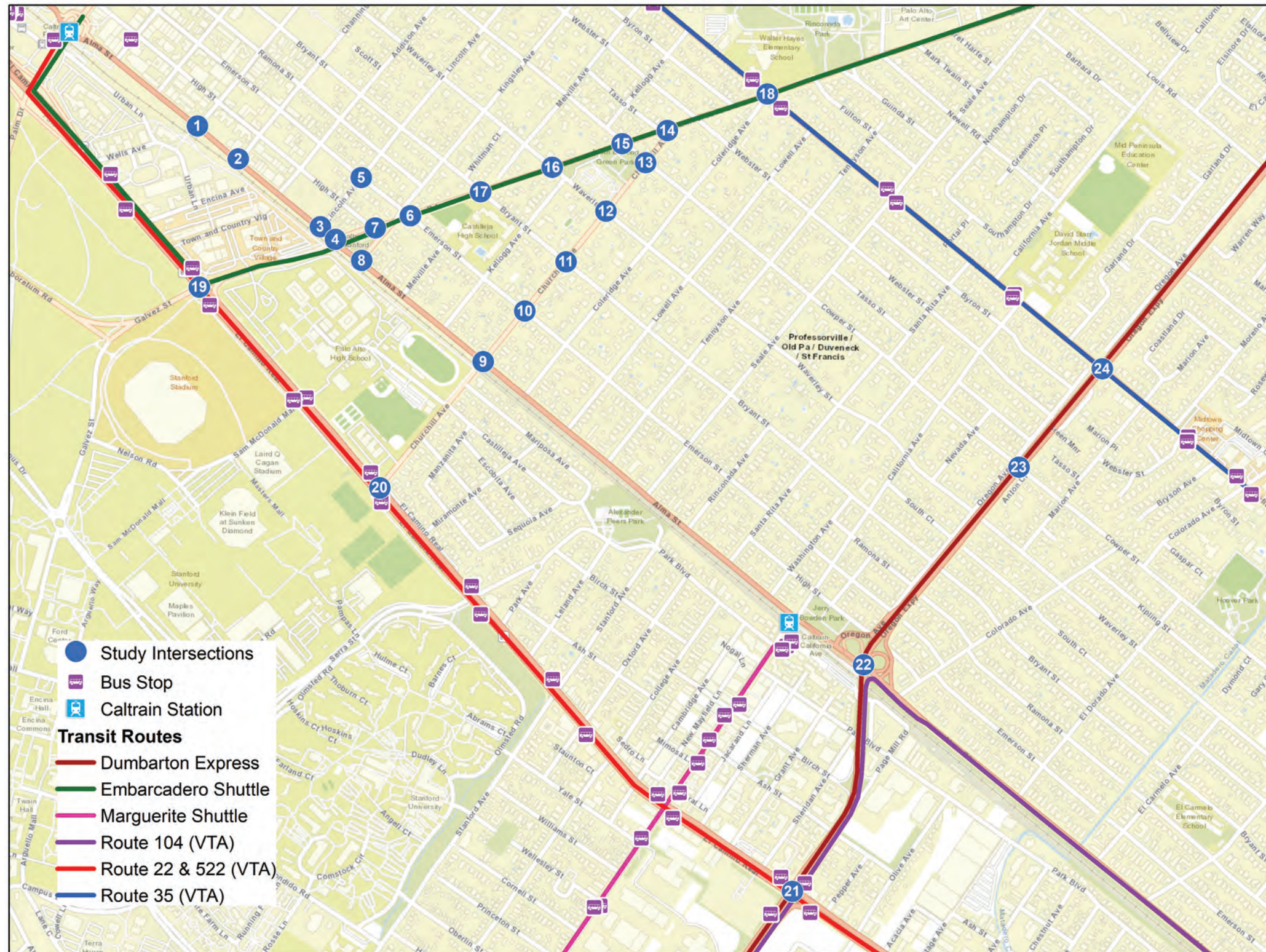
Valley Transportation Authority (VTA) operates bus service in Palo Alto. Commuter rail service (Caltrain) is provided from San Francisco to Gilroy by the Peninsula Joint Powers Board. Dumbarton Express, Marguerite Shuttle, and Embarcadero Shuttle are other transit service that operate within the study area. There are no buses that currently use the Churchill Avenue-Caltrain grade crossing to connect riders from the western part of the City to the eastern part.

There are currently 16 bus stops along El Camino Real, 11 bus stops along Middlefield Road, 4 bus stops along Embarcadero Road within the study area. **Figure 5** illustrates the existing transit facilities. **Table 4** describes the services and frequency during the week and weekend for buses that operate within the study area and **Table 5** describes the services provided by Caltrain.

# Existing Bicycle Facilities



# Existing Transit Facilities



**Table 4: Existing Transit Services**

Route	From	To	Weekdays		Weekends	
			Operating Hours	Headway (minutes)	Operating Hours	Headway (minutes)
22	Palo Alto Transit Center	Eastridge Transit Center	24	15	24	15
522 (limited)	Palo Alto Transit Center	Eastridge Transit Center	5:30 a.m. – 12:00 a.m.	10-20 (varies)	6:00 a.m. – 11:45 p.m.	10-20 (varies)
35	Downtown Mountain View	Stanford Shopping Center	6:20 a.m. – 10:00 p.m.	30	8:15 a.m. – 9:00 p.m.	45-60 (varies)
104	Penitencia Creek Transit Center	Palo Alto	5:50 a.m. – 6:20 p.m.	30	No Service	No Service
DB1 (Dumbarton Express)	Union City BART	Stanford Research Park	5:30 a.m. – 8:30 p.m.	20-60 (varies)	No Service	No Service
Embarcadero Shuttle	Downtown Palo Alto	Palo Alto Tech Center	7:00 a.m. – 7:15 p.m.	15-30 (varies)	No Service	No Service

Source: VTA, Dumbarton Express, and City of Palo Alto websites.

**Table 5: Existing Services Provided by Caltrain**

Route	From	To	Weekdays		Weekends	
			Operating Hours	Headway (minutes)	Operating Hours	Headway (minutes)
Caltrain California Avenue	San Francisco	Gilroy	4:30 a.m. – 1:40 a.m.	20-60	7:00 a.m. – 1:40 a.m.	60

Source: Caltrain website.

### DATA COLLECTION

#### AVERAGE DAILY TRAFFIC (ADT) DATA

With the input from the Palo Alto community and City Staff, TJKM collected 7-day, 24-hour bi-directional traffic volume tube counts from Wednesday, November 28, 2018 to Tuesday, December 4, 2018 at the following 17 locations:

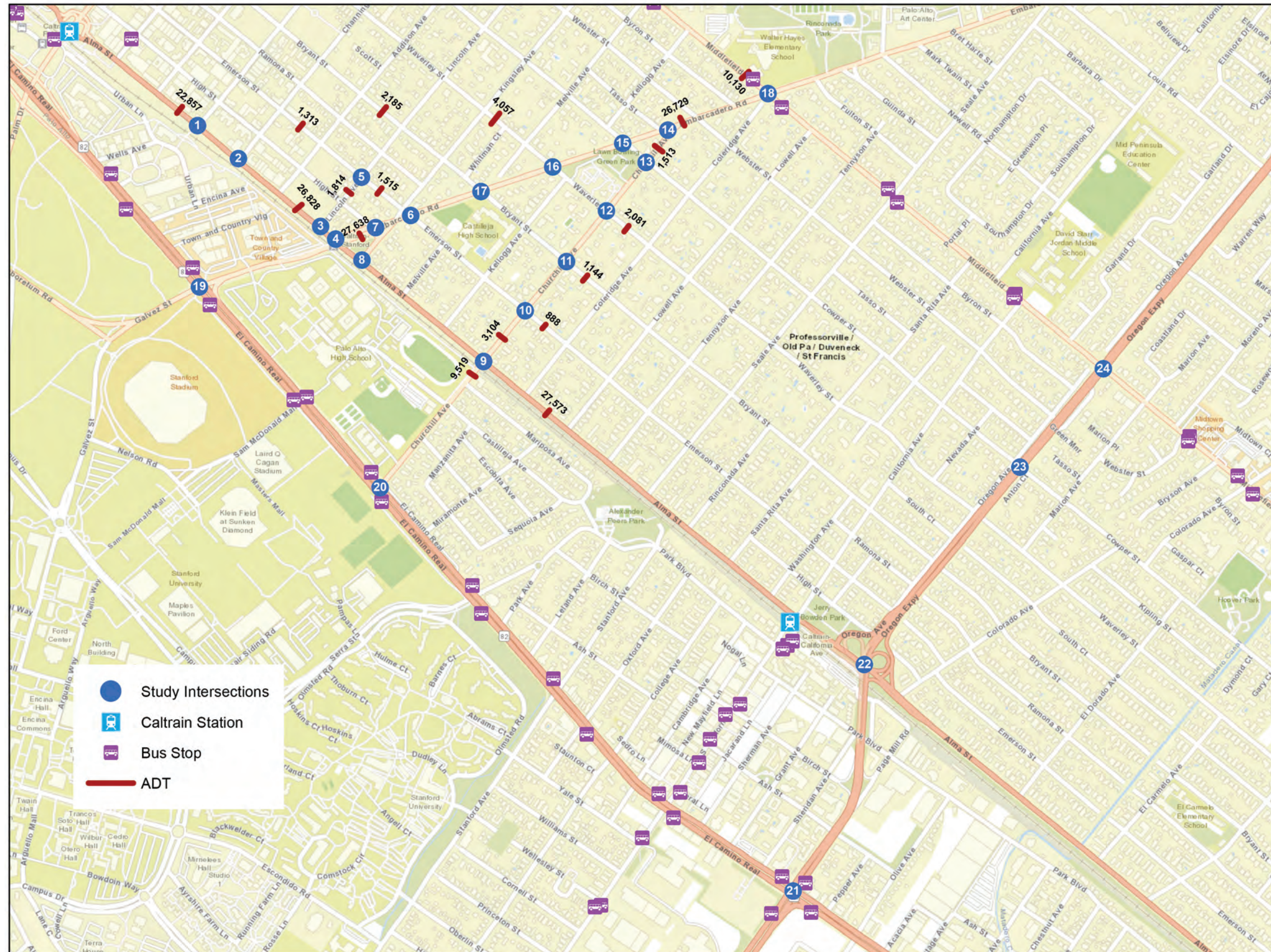
1. Alma Street, between Forest Avenue and Homer Avenue
2. Emerson Street, between Channing Avenue and Addison Avenue
3. Alma Street, between Addison Avenue and Lincoln Avenue
4. Bryant Street, between Addison Avenue and Lincoln Avenue
5. Waverly Street, between Kingsley Avenue and Whitman Court
6. Embarcadero Road, between High Street and Alma Street
7. Middlefield Road, between Walter Hays Elementary School and Embarcadero Road
8. Embarcadero Road, between Webster Street and Tasso Street
9. Churchill Avenue, between Tasso Street and Cowper Street
10. Waverly Street, between Churchill Avenue and Coleridge Avenue
11. Bryant Street, between Churchill Avenue and Coleridge Avenue
12. Emerson Street, between Churchill Avenue and Coleridge Avenue
13. Churchill Avenue, between Alma Street and Emerson Street
14. Alma Street, between Coleridge Avenue and Lowell Avenue
15. Churchill Avenue, between Mariposa Avenue and Train Tracks
16. Lincoln Street, between High Street and Emerson Street
17. Emerson Street, between Lincoln Avenue and Kingsley Avenue

**Table 6** summarizes the 24-hour traffic volumes (vehicles per day (vpd)) collected, **Figure 6** illustrates the ADT volumes, and **Appendix B** contains the raw data.

**Table 6: Average Weekday Daily Traffic Summary for Existing Conditions**

<i>Location</i>	<i>NB Average Volumes (vpd)</i>	<i>SB Average Volumes (vpd)</i>	<i>Total (vpd)</i>
Alma Street, Between Forest Avenue and Homer Avenue	9,783	13,074	22,857
Emerson Street, Between Channing Avenue and Addison Avenue	628	685	1,313
Alma Street, Between Addison Avenue and Lincoln Avenue	14,780	12,048	26,828
Bryant Street, Between Addison Avenue and Lincoln Avenue	673	1,482	2,155
Waverly Street, Between Kingsley Avenue and Whitman Court	1,558	2,499	4,057
Middlefield Road, Between Walter Hays Elementary School and Embarcadero Road	4,516	5,614	10,130
Waverly Street, Between Churchill Avenue and Coleridge Avenue	1,054	1,027	2,081
Bryant Street, Between Churchill Avenue and Coleridge Avenue	654	490	1,144
Emerson Street, Between Churchill Avenue and Coleridge Avenue	442	446	888
Alma Street, Between Coleridge Avenue and Lowell Avenue	14,942	12,631	27,573
Emerson Street, Between Lincoln Avenue and Kingsley Avenue	1,099	416	1,515
<i>Location</i>	<i>EB Average Volumes (vpd)</i>	<i>WB Average Volumes (vpd)</i>	<i>Total (vpd)</i>
Embarcadero Road, Between High Street and Alma Street	15,252	12,386	27,638
Embarcadero Road, Between Webster Street and Tasso Street	13,380	13,349	26,729
Churchill Avenue, Between Tasso Street and Cowper Street	1,015	498	1,513
Churchill Avenue, Between Alma Street and Emerson St	1,574	1,530	3,104
Churchill Avenue, Between Mariposa Avenue and Train Tracks	4,287	5,232	9,519
Lincoln Avenue, Between High Street and Emerson Street	1,107	707	1,814

# Average Daily Traffic Volumes Map



### INTERSECTION TURNING MOVEMENT COUNTS (TMC)

On Thursday, December 6, 2018, TJKM collected intersection TMC for vehicles, pedestrians, and bicycles at the 24 study intersections for the weekday a.m. (7:30 a.m. – 9:30 a.m.) and p.m. (4:30 p.m. – 6:30 p.m.) peak periods, based on recommendations from City staff. TMC data was collected on a typical weekday when all schools within the study area were in session. **Figure 7a** and **7b** illustrates existing traffic volumes at all study intersections. **Figure 8a** and **8b** illustrates existing pedestrian and bicycle volumes at all study intersections. **Appendix B** contains the TMC data collected for all of the study intersections.

### EXISTING SIGNAL TIMING

TJKM obtained the existing traffic signal timing sheets and phasing diagrams for the intersections of El Camino Real/Embarcadero Road, El Camino Real/Churchill Avenue, and El Camino Real/Oregon Expressway from Caltrans. TJKM also obtained traffic signal timing sheets from the City of Palo Alto for the intersections of Alma Street/Homer Avenue, Embarcadero Road/Bryant Street, Embarcadero Road/Waverly Street, Embarcadero Road/Middlefield Road, and Alma Street/Churchill Avenue. Additionally, TJKM obtained the timing sheets for Oregon Expressway/Cowper Street and Oregon Expressway/Middlefield Road from the County of Santa Clara. The timing sheets will be used for existing conditions analysis.

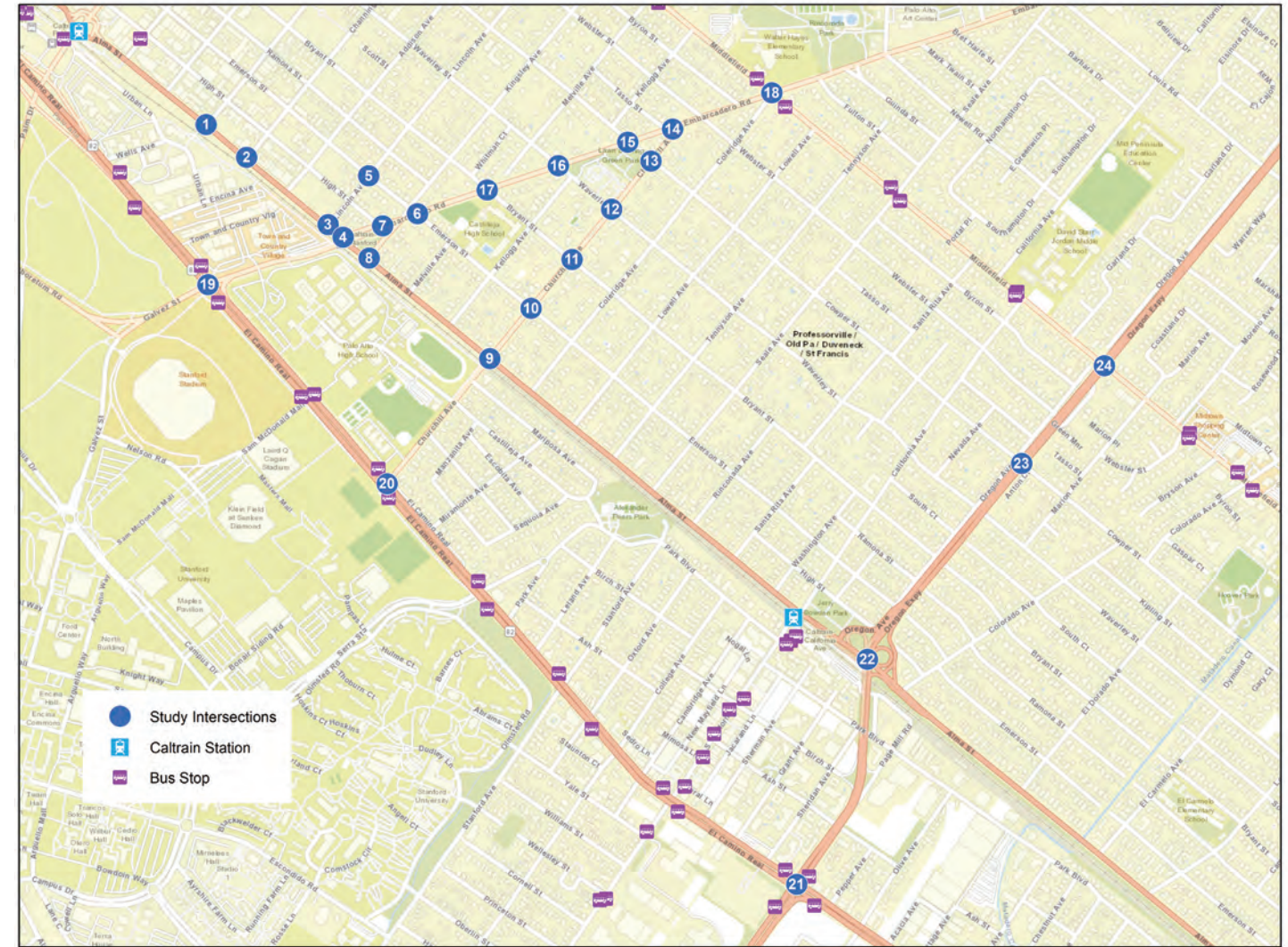
### ORIGIN-DESTINATION (O-D) DATA

TJKM used the StreetLight Data<sup>®</sup> platform, which utilizes big data for evaluating trip patterns within the study area. TJKM processed data for 2017 for the months that school was in session (average of February, March, April, May, August, September, October, and November) for the morning (6 a.m. to 10 a.m.) and afternoon hours (3 p.m. to 7 p.m.). StreetLight Data<sup>®</sup> provides attributes for all months of the year, including historical data up to 2014, depending on the analysis conducted. For the purpose of this study, only the data on a typical Tuesday, Wednesday, and Thursday during the aforementioned months was used. **Appendix C** contains processed O-D data obtained from StreetLight Data<sup>®</sup> platform for the project.



# Existing Conditions Peak Hour Traffic Volumes

<p><b>Intersection #1</b> Alma St. / Homer Ave.</p>	<p><b>Intersection #2</b> Alma St. / Channing Ave.</p>	<p><b>Intersection #3</b> Alma St. / Lincoln Ave.</p>	<p><b>Intersection #4</b> Alma St. / Embarcadero Rd.</p>
<p><b>Intersection #5</b> Emerson St. / Lincoln Ave.</p>	<p><b>Intersection #6</b> Emerson St. / Embarcadero Rd.</p>	<p><b>Intersection #7</b> Embarcadero Rd. / High St.</p>	<p><b>Intersection #8</b> Alma St. / Kingsley Ave.</p>
<p><b>Intersection #9</b> Alma St. / Churchill Ave.</p>	<p><b>Intersection #10</b> Emerson St. / Churchill Ave.</p>	<p><b>Intersection #11</b> Bryant St. / Churchill Ave.</p>	<p><b>Intersection #12</b> Waverly St. / Churchill Ave.</p>

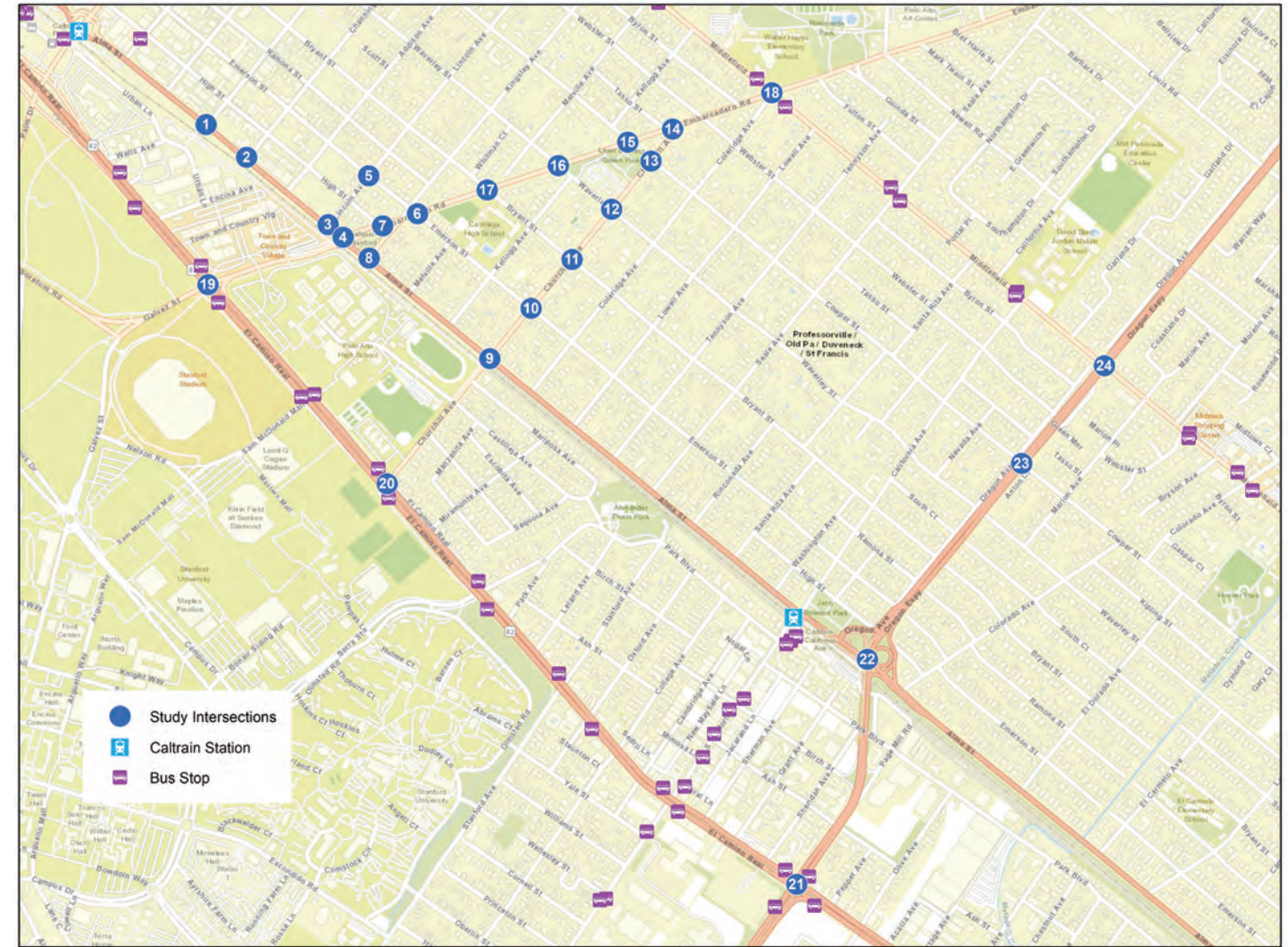


## LEGEND

XX (XX) — AM (PM) Peak Hour Volumes

# Existing Conditions Peak Hour Traffic Volumes

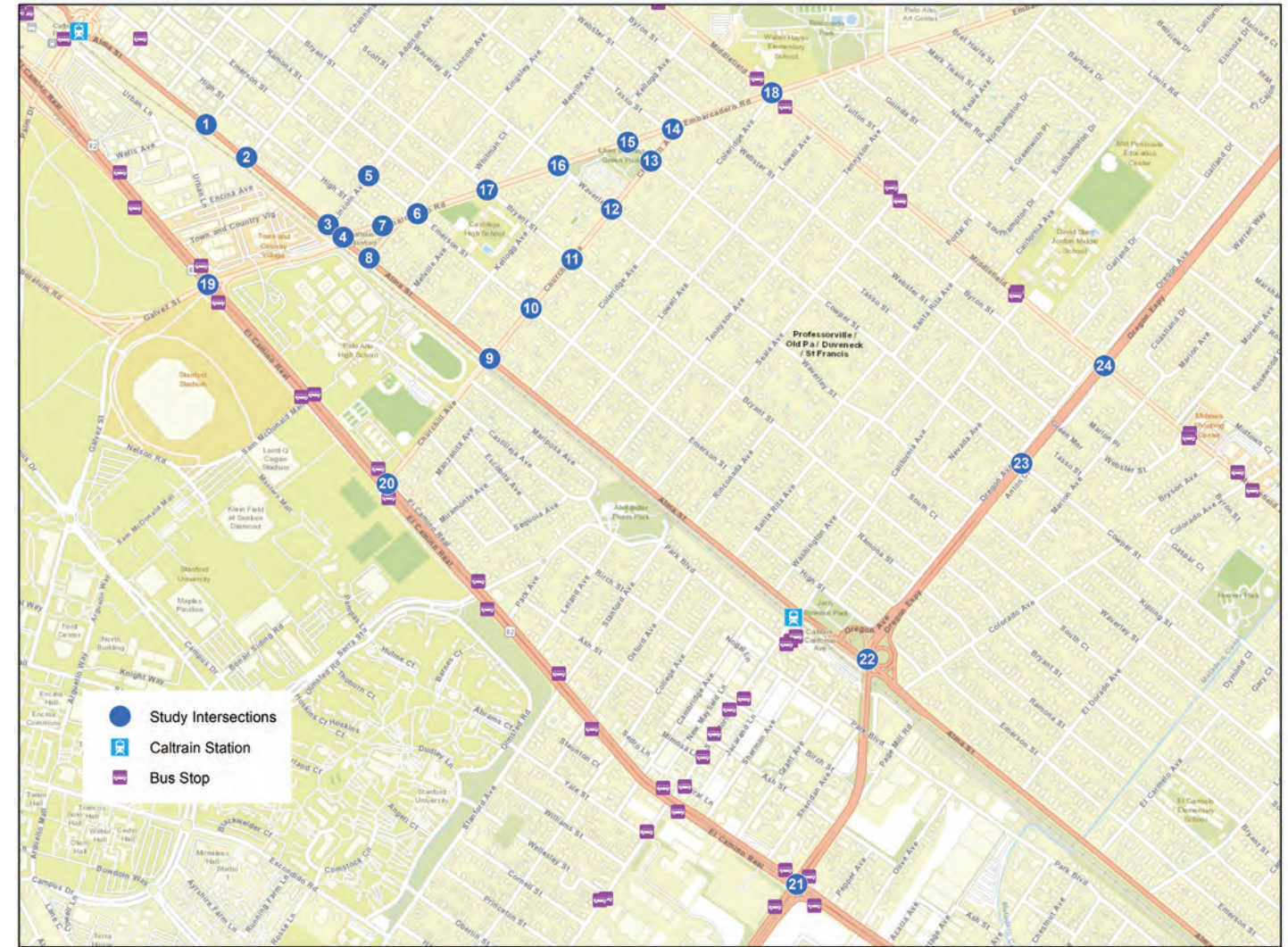
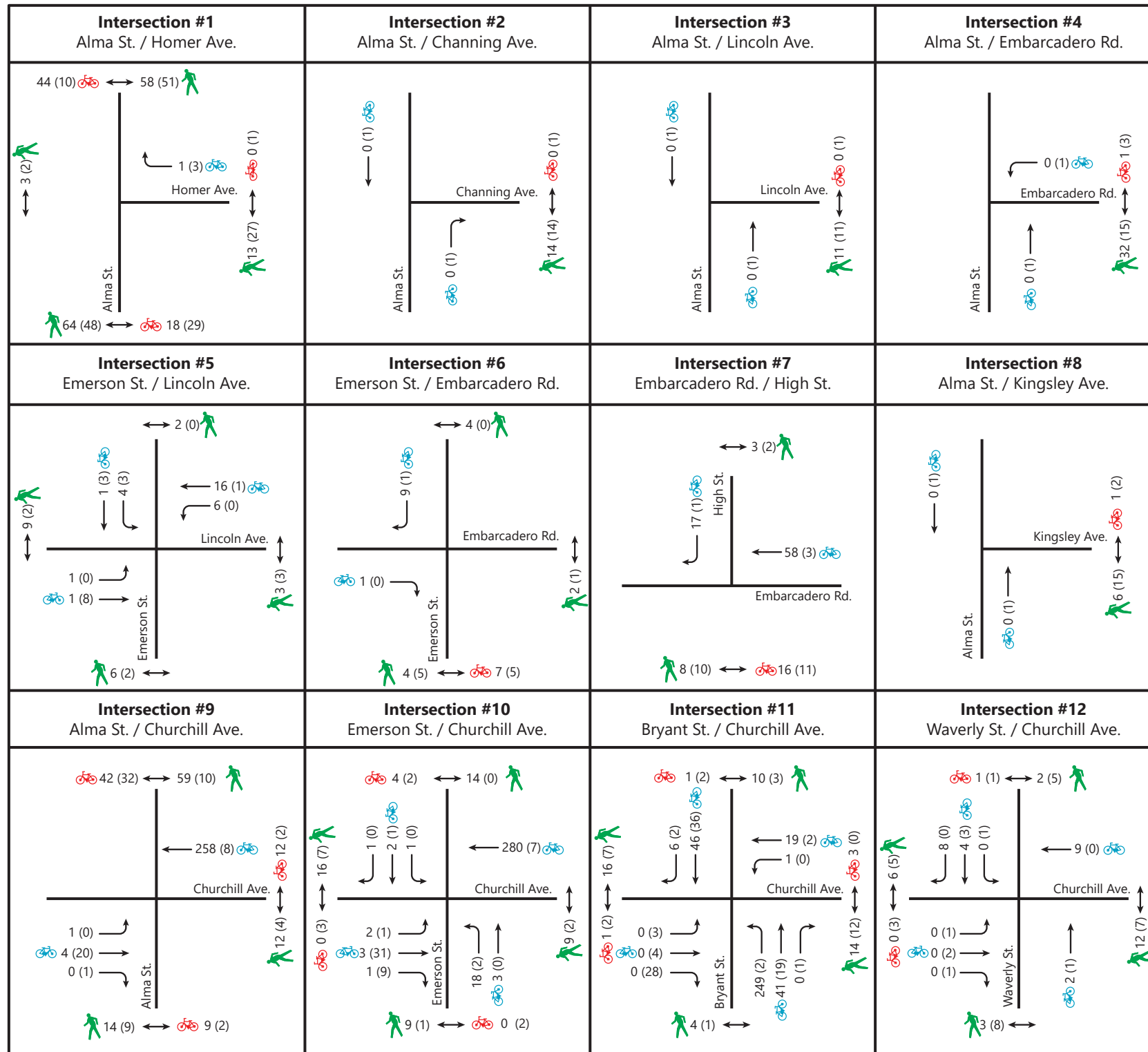
<p><b>Intersection #13</b> Cowper St. / Churchill Ave.</p>	<p><b>Intersection #14</b> Churchill Ave. / Embarcadero Rd.</p>	<p><b>Intersection #15</b> Cowper St. / Embarcadero Rd.</p>	<p><b>Intersection #16</b> Waverly St. / Embarcadero Rd.</p>
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## LEGEND

XX (XX) — AM (PM) Peak Hour Volumes

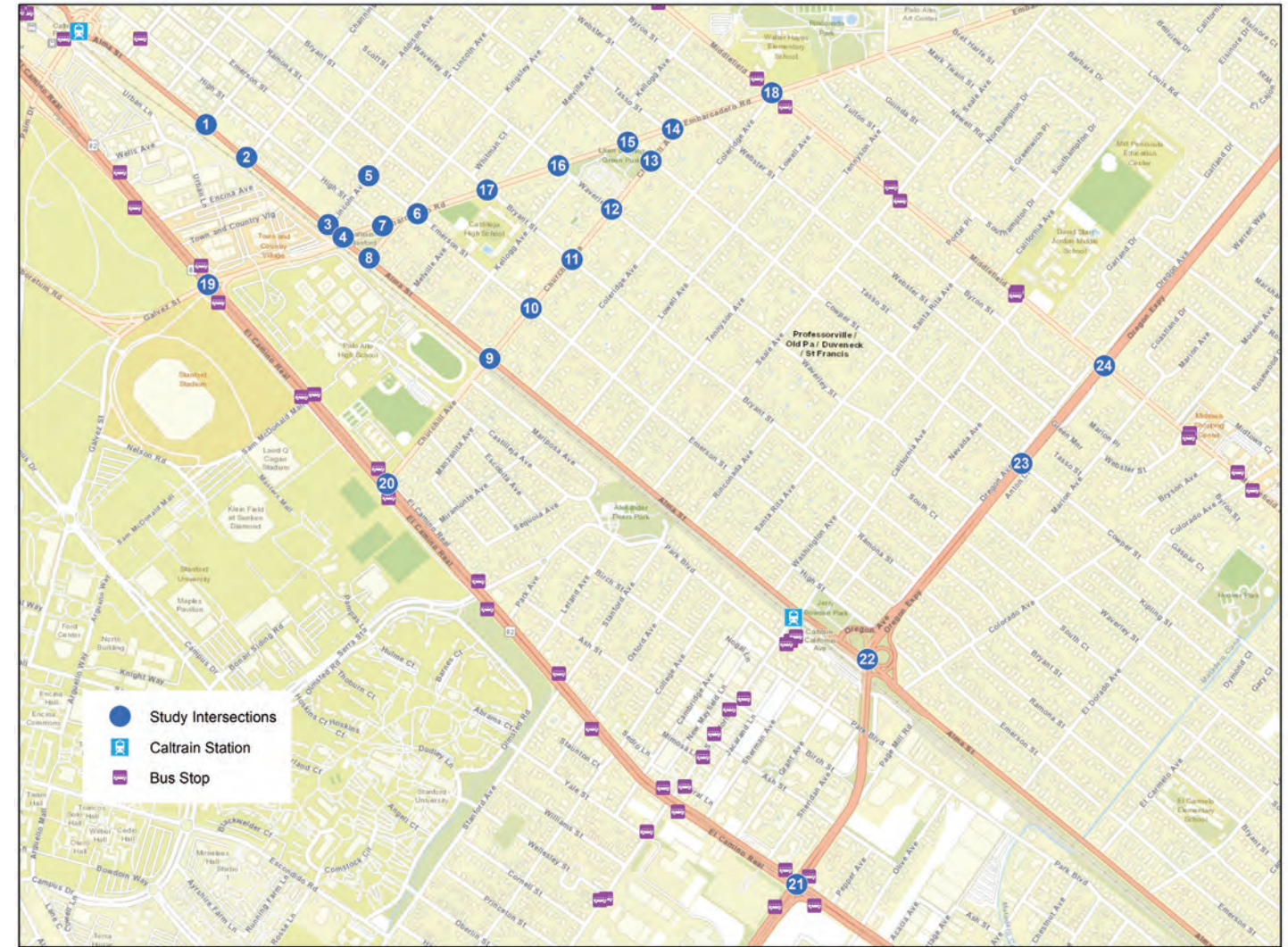
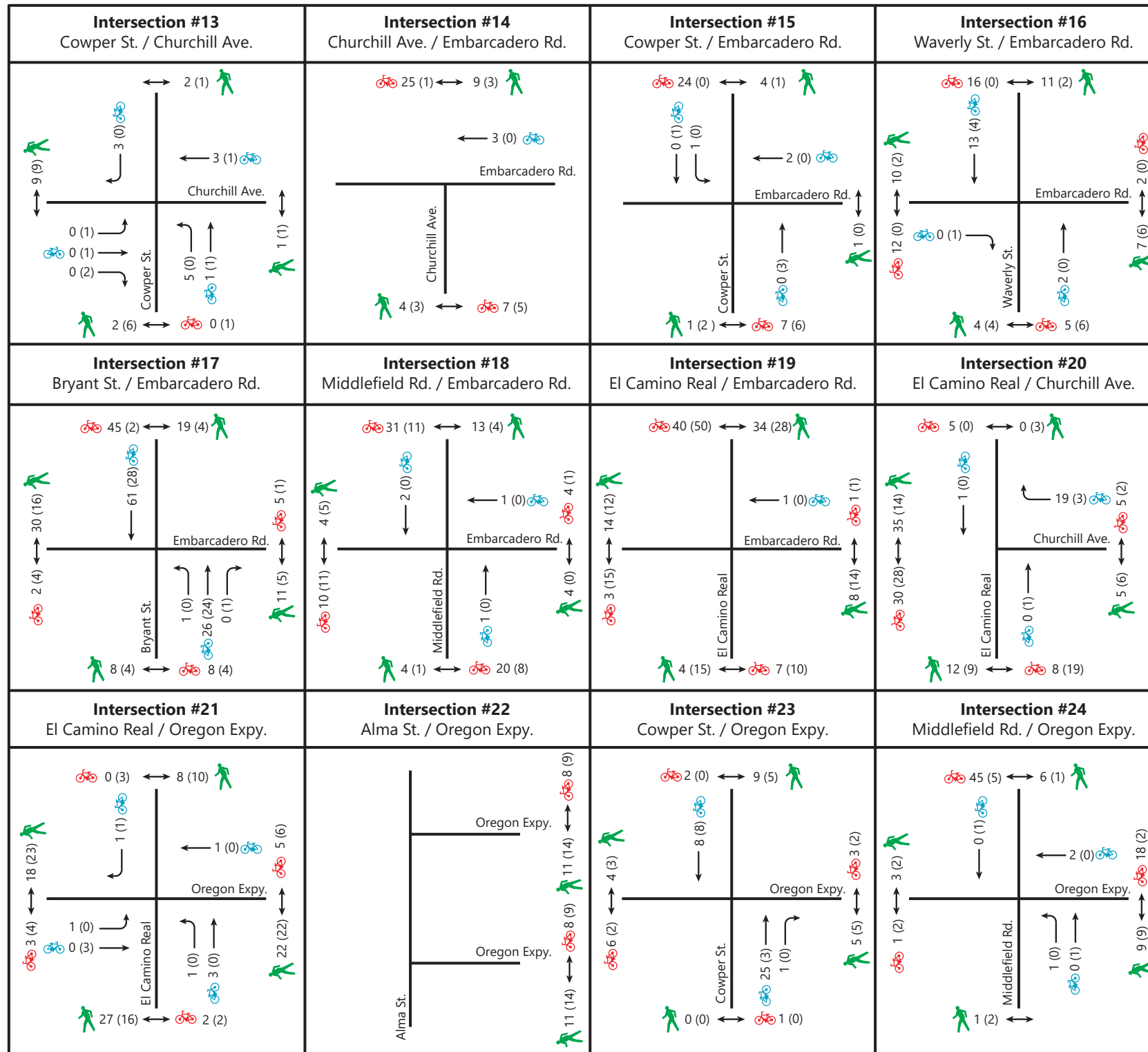
# Existing Peak Hour Pedestrian and Bicycle Volumes



## LEGEND

- XX (XX) — AM (PM) Peak Hour Volumes
- Pedestrians
- Bicycles on Roadway
- Bicycles on Crosswalk

# Existing Peak Hour Pedestrian and Bicycle Volumes



## LEGEND

- XX (XX) — AM (PM) Peak Hour Volumes
- Pedestrians
- Bicycles on Crosswalk
- Bicycles on Roadway

### EXISTING CONDITIONS LOS & 95<sup>TH</sup> PERCENTILE QUEUE LENGTH ANALYSIS

The Existing Conditions (2018) scenario evaluates all study intersections with existing lane geometry, traffic controls, and traffic volumes. The results of the LOS and delay analysis and 95<sup>th</sup> percentile queue length in feet (ft.) analysis, using Synchro software, are summarized in **Tables 7** and **8** respectively.

**Appendix D** contains the HCM 2000 Synchro LOS and queues reports for all study intersections. It should be noted that the intersections of Alma Street/Channing Avenue, Embarcadero Street/Emerson Street, and Embarcadero Road/High Street could not be evaluated under HCM 2000 methodology due to the lane geometry and intersection control. The following intersections operate with unacceptable LOS based on City Standards and the Congestion Management Program (CMP):

- Alma Street/Lincoln Avenue (all peak hours)
- Alma Street/Embarcadero Road (all peak hours)
- Alma Street/Kingsley Avenue (all peak hours)
- Alma Street/Churchill Avenue (a.m. peak hour)
- Embarcadero Road/Cowper Street (all peak hours)
- Embarcadero Road/Middlefield Road (a.m. peak hour)\*
- El Camino Real/Churchill Avenue (p.m. peak hour)
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue) (all peak hours)
- Alma Street/Oregon Expressway EB Off Ramp (all peak hours)

Note: \*LOS reflects pedestrian-scramble phase during 30 minutes of the peak hour.

Table 7: Existing Conditions LOS & Delay

#	Study Intersections	Control	Peak Hour	Existing Conditions	
				Average Delay <sup>1</sup> (sec)	LOS
1	Alma Street/Homer Avenue	Signalized	A.M.	19.7	B
			P.M.	20.9	C
3	Alma Street/Lincoln Avenue	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
4	Alma Street/Embarcadero Road	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
5	Emerson Street/Lincoln Avenue	All-Way Stop	A.M.	8.7	A
			P.M.	8.0	A
8	Alma Street/Kingsley Avenue	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
9	Alma Street/Churchill Avenue	Signalized	A.M.	>80.0	F
			P.M.	44.3	D
10	Churchill Avenue/Emerson Street	All-Way Stop	A.M.	8.9	A
			P.M.	8.1	A
11	Churchill Avenue/Bryant Street	Two-Way Stop	A.M.	11.7	B
			P.M.	10.6	B
12	Churchill Avenue/Waverly Street	All-Way Stop	A.M.	8.7	A
			P.M.	8.5	A
13	Churchill Avenue/Cowper Street	All-Way Stop	A.M.	7.7	A
			P.M.	7.8	A
14	Churchill Avenue/Embarcadero Road	One-Way Stop	A.M.	9.7	A
			P.M.	9.8	A
15	Embarcadero Road/Cowper Street	Two-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
16	Embarcadero Road/Waverly Street	Signalized	A.M.	29.5	C
			P.M.	47.7	D
17	Embarcadero Road/Bryant Street	Signalized	A.M.	14.5	B
			P.M.	7.2	A
18	Middlefield Road/Embarcadero Road	Signalized	A.M.	>80.0	F
			P.M.	38.1	D
19	El Camino Real/Embarcadero Road	Signalized	A.M.	60.3	E
			P.M.	67.0	E
20	El Camino Real/Churchill Avenue	Signalized	A.M.	42.1	D
			P.M.	63.4	E
21	El Camino Real/Oregon Expressway-Page Mill Road	Signalized	A.M.	72.9	E
			P.M.	66.4	E
22a	Alma Street/Oregon Expressway WB Off Ramp (Oregon Ave)	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
22b	Alma Street/Oregon Expressway EB Off Ramp	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
23	Oregon Expressway/Cowper Street	Signalized	A.M.	28.0	C

#	Study Intersections	Control	Peak Hour	Existing Conditions	
				Average Delay <sup>1</sup> (sec)	LOS
			P.M.	17.0	B
24	Oregon Expressway/Middlefield Road	Signalized	A.M.	62.1	E
			P.M.	55.6	E

Notes:

<sup>1</sup>Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

Delay is reported as >50.0 for unsignalized intersections with LOS F and >80.0 for signalized intersections consistent with HCM 2000 methodology.

**Bold** indicates unacceptable LOS.

**Table 8** summarizes the 95<sup>th</sup> percentile queue lengths for all approach movements at the study intersections for the weekday a.m. and p.m. peak hour. Existing conditions queue length analysis resulted in several intersections with 95<sup>th</sup> percentile queue lengths exceeding storage capacity.

Based on Synchro analysis results, intersections where queue lengths exceed the existing storage lengths are listed below:

- Alma Street/Churchill Avenue for NBL (all peak hours)
- Embarcadero Road/Waverly Street for EBL (p.m. peak hour)
- Embarcadero Road/Bryant Street for EBL (p.m. peak hour)
- Embarcadero Road/Middlefield Road for WBL (p.m. peak hour), NBL and SBL (all peak hours)
- El Camino Real/Embarcadero Road for WBL (all peak hours), NBL (a.m. peak hour), and SBL (all peak hours)
- El Camino Real/Churchill Avenue for NBR (all peak hours) and SBL (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road for WBL (all peak hours) and SBL (p.m. peak hour)
- Oregon Expressway/Middlefield Road for EBR (all peak hours), NBL (all peak hours), and SBL (a.m. peak hour)

**Table 8: Existing Conditions 95th Percentile Queue Lengths (ft.)**

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Existing Conditions	
				A.M.	P.M.
1	Alma Street/Homer Avenue (Signalized)	WBL	-	100	189
		NBT	-	327	343
		SBT	-	154	277
3	Alma Street/Lincoln Avenue (One-Way Stop Control)	WBLR	-	105	154
		NBT	-	<25	<25
		NBTL	-	<25	<25
		SBTL	-	<25	<25
		SBT	-	<25	<25
4	Alma Street/Embarcadero Road (One-Way Stop Control)	WBR	-	245	293
		NBT	-	<25	<25
		SBT	-	<25	<25
8	Alma Street/Kingsley Avenue (One-Way Stop Control)	WBL	-	38	143
		NBT	-	<25	<25
		SBT	-	<25	<25
9	Alma Street/Churchill Avenue (Signalized)	EBT	-	274	335
		EBR	-	37	82
		WBT	-	#269	191
		NBL	300	<b>#654</b>	<b>#407</b>
		NBT	-	620	840
		SBL	60	27	29
		SBT	-	225	681
		SBR	100	57	62
11	Churchill Avenue/Bryant Street (Two-Way Stop Control)	EBLTR	-	<25	<25
		WBLTR	-	<25	<25
		NBLTR	-	<25	<25
		SBLTR	-	<25	<25
14	Churchill Avenue54/Embarcadero Road (One-Way Stop Control)	EBT	-	<25	<25
		EBTR	-	<25	<25
		WBLT	-	<25	<25
		WBT	-	<25	<25
		NBR	-	<25	<25
15	Embarcadero Road/Cowper Street (Two-Way Stop Control)	EBLT	-	<25	<25
		EBTR	-	<25	<25
		WBLT	-	<25	<25
		WBTR	-	<25	<25
		NBLTR	-	26	29
		SBLTR	-	63	40
16	Embarcadero Road/Waverly Street (Signalized)	EBL	95	#92	<b>#187</b>
		EBT	-	356	#518
		WBL	75	39	38
		WBT	-	424	372
		NBT	-	119	73
		SBT	-	172	124
17	Embarcadero Road/Bryant Street (Signalized)	EBL	80	29	<b>106</b>
		EBT	-	203	244
		WBL	60	m44	m4
		WBT	-	m464	390



#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Existing Conditions	
				A.M.	P.M.
18	Embarcadero Road/Middlefield Road (Signalized)	NBR	-	<25	<25
		SBR	-	<25	<25
		EBL	115	78	66
		EBT	-	#687	#517
		WBL	100	90	<b>111</b>
		WBT	-	#817	392
		NBL	115	<b>#245</b>	<b>134</b>
		NBT	-	198	179
		SBL	100	<b>174</b>	<b>#190</b>
		SBT	-	334	#426
19	El Camino Real/Embarcadero Road (Signalized)	EBL	-	113	#349
		EBT	-	157	#426
		WBL	200	<b>#290</b>	<b>#409</b>
		WBT	-	345	353
		NBL	382	<b>m#424</b>	m#326
		NBT	-	348	m198
		SBL	300	<b>#509</b>	<b>#462</b>
20	El Camino Real/Churchill Avenue (Signalized)	SBT	-	401	515
		WBL	-	#457	#542
		NBT	-	#824	#989
		NBR	100	<b>194</b>	<b>194</b>
		SBL	170	m128	<b>m320</b>
21	El Camino Real/Oregon Expressway-Page Mill Road (Signalized)	SBT	-	489	m556
		EBL	350	#307	237
		EBT	-	508	668
		EBR	-	132	219
		WBL	100	<b>188</b>	<b>278</b>
		WBT	-	794	642
		NBL	300	253	147
		NBT	-	#945	#655
		SBL	350	247	<b>#413</b>
22a	Alma Street/Oregon Expressway WB Ramps (Oregon Ave) (One-Way Stop Control)	SBT	-	300	631
		SBR	350	98	95
		WBL	-	26	106
		WBR	-	25	<25
		NBT	-	<25	<25
		NBR	-	<25	<25
22b	Alma Street/Oregon Expressway EB Ramps (One-Way Stop Control)	SBT	-	<25	<25
		SBL	-	<25	<25
		NBR	-	<25	<25
		NBT	-	<25	<25
		WBR	-	253	263
23	Oregon Expressway/Cowper Street (Signalized)	SBL	-	<25	<25
		EBL	115	48	60
		EBT	-	785	771
		EBR	50	<25	26
		WBL	115	m27	m40

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Existing Conditions	
				A.M.	P.M.
		WBT	-	m825	807
		NBL	-	#185	84
		NBT	-	106	55
		SBL	-	60	29
		SBT	-	73	86
24	Oregon Expressway/Middlefield Road (Signalized)	EBL	360	m#191	#260
		EBT	-	#844	421
		EBR	100	<b>m147</b>	<b>146</b>
		WBL	390	182	#305
		WBT	-	#774	559
		WBR	100	<25	<25
		NBL	230	<b>#489</b>	<b>#375</b>
		NBT	-	#534	#782
		NBR	-	95	77
		SBL	145	<b>154</b>	91
		SBT	-	235	348

Notes:

EB, WB, NB, SB – Eastbound, Westbound, Northbound, Southbound respectively.

L, T, R – Left, Through, Right respectively.

Queue lengths taken from Synchro reports.

#: 95<sup>th</sup> percentile volume exceeds capacity, queue may be longer.

m: Volume for 95<sup>th</sup> percentile queue is metered by upstream signal.

**Bold** indicates queue lengths exceeding existing storage capacity.

## PEDESTRIAN AND BICYCLE FACILITIES

### Pedestrian Facilities

In the study area, Alma Street provides a sidewalk on the eastern side of the arterial with a width ranging from six to twelve feet. The intersections of Alma Street/Churchill Avenue and Alma Street/Homer Avenue provides pedestrians with marked crosswalks and pedestrian signal heads. Other locations along Alma Street where pedestrians are provided marked crosswalks are at Addison Avenue, Kellogg Avenue, Coleridge Avenue, Lowell Avenue, Tennyson Avenue, Seale Avenue, N. California Avenue, and Oregon Expressway EB and WB On/Off Ramps. Out of the 23 intersections along Alma Street in the study area, 19 of those intersections provide pedestrians with ADA compliant curb-ramps. Majority of these ADA compliant curb-ramps are located south of Embarcadero Road.

Churchill Avenue provides pedestrians with sidewalks on the northern and southern side of the arterial with a width of about six feet. Marked crosswalks are provided at the intersections at Alma Street/Churchill Avenue and Churchill Avenue/Castilleja Avenue. Locations where pedestrians are provided with ADA compliant curb-ramps include the intersections of Churchill Avenue/El Camino Real, Churchill Avenue/Madrono Avenue, Churchill Avenue/Castilleja Avenue, Churchill Avenue/Emerson Street, Churchill Avenue/Bryant Street, and Churchill Avenue/Waverly Street.

In the study area, Embarcadero Road provides pedestrians with sidewalks on the northern and southern side of the arterial with widths ranging from six to ten feet. Marked crosswalks are provided for pedestrians at the intersections of Middlefield Road, Waverly Street, Bryant Street, High Street, Palo Alto High School, and El Camino Real. The signalized intersections of Embarcadero Road/El Camino Real, Embarcadero Road/Palo Alto High School, Embarcadero Road/Bryant Street, Embarcadero Road/Waverly Street, and Embarcadero Road/Middlefield road provide pedestrian signal heads. ADA compliant curb-ramps are provided at Middlefield Road, Waverly Street, Palo Alto High School, and El Camino Real.

El Camino Real provides sidewalks with widths that are about six feet on both the eastern and western sides of the arterial. Marked crosswalks and pedestrian signal heads are provided at the study intersections of El Camino Real/Embarcadero Road, El Camino Real/Churchill Avenue, and El Camino Real/Oregon Expressway-Page Mill Road. ADA compliant curb-ramps are provided at El Camino Real/Embarcadero Road, El Camino Real/Churchill Avenue and at the southeast corner of El Camino Real/Oregon Expressway-Page Mill Road.

Oregon Expressway provides sidewalks with ranging widths of six to ten feet from El Camino Real to Birch Street on both the northern and southern side of the arterial. Also, a sidewalk is present along Oregon Avenue, which runs adjacent to Oregon Expressway and is separated by a ten-foot wide median. Additionally, a sidewalk is provided on the southern side of Oregon Expressway from Waverly Street to Middlefield Road. Marked crosswalks and ADA compliant curb-ramps are provided at the intersections at El Camino Real, Bryant Street, Cowper Street, and Middlefield Road. Pedestrian signal heads are provided at the previously mentioned intersections with the exception of Waverly Street, which is unsignalized.

### **Bicycle Facilities**

The Embarcadero Bike Path is the only Class I facility in the study area. This particular path runs from the Palo Alto Caltrain Station to Churchill Avenue and allows pedestrians to utilize the path as well. With an approximate width of twelve feet, bicyclists and pedestrians are able to use the path unimpeded by vehicular traffic and intersection controls to access Palo Medical Foundation, Town & Country Village Shopping Center, and Palo Alto High School. Connection to the Homer Avenue Tunnel also provides access to Downtown Palo Alto.

The Class II facilities along Churchill Avenue, Coleridge Avenue, N. California Avenue, Park Boulevard, Stanford Avenue, and Addison Avenue are primarily six feet wide with no buffers from the travel lanes. Each facility has the appropriate striping to clearly indicate it as a Class II facility. The Class III facilities/Bicycle Boulevards on Bryant Street, Castilleja Avenue, and Cowper Street provide signage that identify it as a Class III facility and provide wayfinding signs to direct bicyclists to various locations around the city.

The Class IV facilities along Homer Avenue and N. California Avenue are separated from vehicular traffic by approximately a three foot buffer. The facility along Homer Avenue is an approximately six feet wide contra-flow bike lane that connects bicyclists from Homer Avenue Tunnel to Downtown Palo Alto. The Class IV facility along N. California Avenue/Middlefield road is an approximately six feet wide two-way

cycle track that allows bicyclists to safely continue their route on the Class II facilities provided on N. California Avenue.

### ORIGIN-DESTINATION (O-D) ANALYSIS

StreetLight Data® platform, which utilizes big data for evaluating trip patterns within a study area was used for the O-D analysis for this project. The objective of this task was to determine the percentage of traffic that uses Churchill Avenue to cut across the City of Palo Alto. To capture this “cut-through” movement we identified and strategically placed origin and destination zones surrounding the study area. As mentioned in the Data Collection section of this report, TJKM processed the data for a typical Tuesday, Wednesday, and Thursday for the morning and afternoon hours during 2017 while schools in Palo Alto were in session.

The origins and destination zones used for the study are listed below:

1. Alma Street, north of Embarcadero Road
2. Alma Street, south of Oregon Expressway
3. Bryant Street, north of Oregon Expressway
4. Bryant Street, south of Embarcadero Road
5. Cowper Street, north of Embarcadero Road
6. Cowper Street, north of Oregon Expressway
7. El Camino Real, north of Embarcadero Road
8. El Camino Real, south of Oregon Expressway/Page Mill Road
9. Embarcadero Road, east of Middlefield Road
10. Embarcadero Road, west of El Camino Real
11. Emerson Street, south of Embarcadero Road
12. Middlefield Road, north of Embarcadero Road
13. Middlefield Road, north of Oregon Expressway
14. Page Mill Road, west of El Camino Real
15. Serra Street, west of El Camino Real
16. Stanford Avenue, west of El Camino Real
17. Waverly Street, north of Embarcadero Road
18. Waverly Street, north of Oregon Expressway
19. Webster Street, north of Embarcadero Road

**Table 9** indicates the results of the O-D study conducted and **Figure 9a** and **9b** illustrates the results.

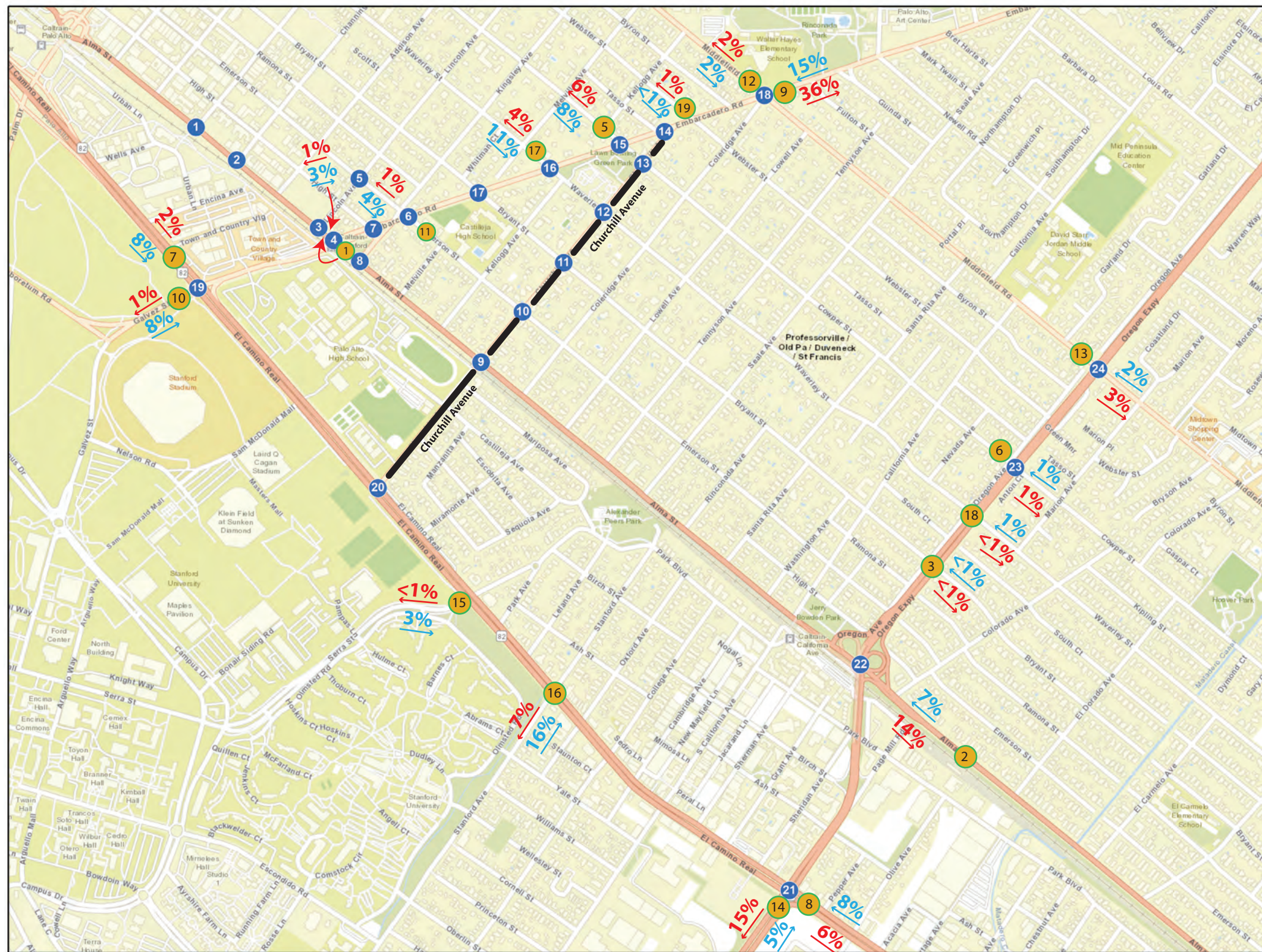
The results of the O-D study suggest that during the a.m. time period, majority of trips (42%) are originating from zones 16, 9, and 17 where each zone contributes approximately 16%, 15% and 11% respectively of total originating trips. Furthermore, during the same time period majority (65%) of the trips are destined for zones 9, 14, and 2 with each zone attracting approximately 36%, 15%, and 14% of total trips.

In the p.m. period, over a third of captured trips (37%) are originating from zones 2, 9, and 7 where each zone contributes 13%, 12% and 12%, respectively, of total originating trips. Additionally, during the same time period, majority (63%) of the trips are destined for zones 9, 2, and 5 with each zone attracting approximately 36%, 20% and 7% respectively of total trips.

Table 9: Origin-Destination Results

#	Origin-Destination Zones	Time Period	Percentage of Trips Originating from Zone	Percentage of Trips Destined to Zone
1	Alma Street, north of Embarcadero Road	A.M.	3%	1%
		P.M.	6%	2%
2	Alma Street, south of Oregon Expressway	A.M.	7%	14%
		P.M.	13%	20%
3	Bryant Street, north of Oregon Expressway	A.M.	<1%	<1%
		P.M.	<1%	<1%
4	Bryant Street, south of Embarcadero Road	A.M.	-	-
		P.M.	<1%	<1%
5	Cowper Street, north of Embarcadero Road	A.M.	8%	6%
		P.M.	11%	7%
6	Cowper Street, north of Oregon Expressway	A.M.	1%	1%
		P.M.	1%	4%
7	El Camino Real, north of Embarcadero Road	A.M.	8%	2%
		P.M.	12%	3%
8	El Camino Real, south of Oregon Expressway/Page Mill Road	A.M.	8%	6%
		P.M.	4%	5%
9	Embarcadero Road, east of Middlefield Road	A.M.	15%	36%
		P.M.	12%	36%
10	Embarcadero Road, west of El Camino Real	A.M.	8%	1%
		P.M.	3%	<1%
11	Emerson Street, south of Embarcadero Road	A.M.	4%	1%
		P.M.	2%	1%
12	Middlefield Road, north of Embarcadero Road	A.M.	2%	2%
		P.M.	2%	2%
13	Middlefield Road, north of Oregon Expressway	A.M.	2%	3%
		P.M.	3%	6%
14	Page Mill Road, west of El Camino Real	A.M.	5%	15%
		P.M.	5%	2%
15	Serra Street, west of El Camino Real	A.M.	3%	<1%
		P.M.	6%	1%
16	Stanford Avenue, west of El Camino Real	A.M.	16%	7%
		P.M.	7%	3%
17	Waverly Street, north of Embarcadero Road	A.M.	11%	4%
		P.M.	10%	6%
18	Waverly Street, north of Oregon Expressway	A.M.	1%	<1%
		P.M.	1%	1%
19	Webster Street, north of Embarcadero Road	A.M.	<1%	1%
		P.M.	<1%	2%

# Origin-Destination Analysis Through Churchill Avenue - A.M. Results

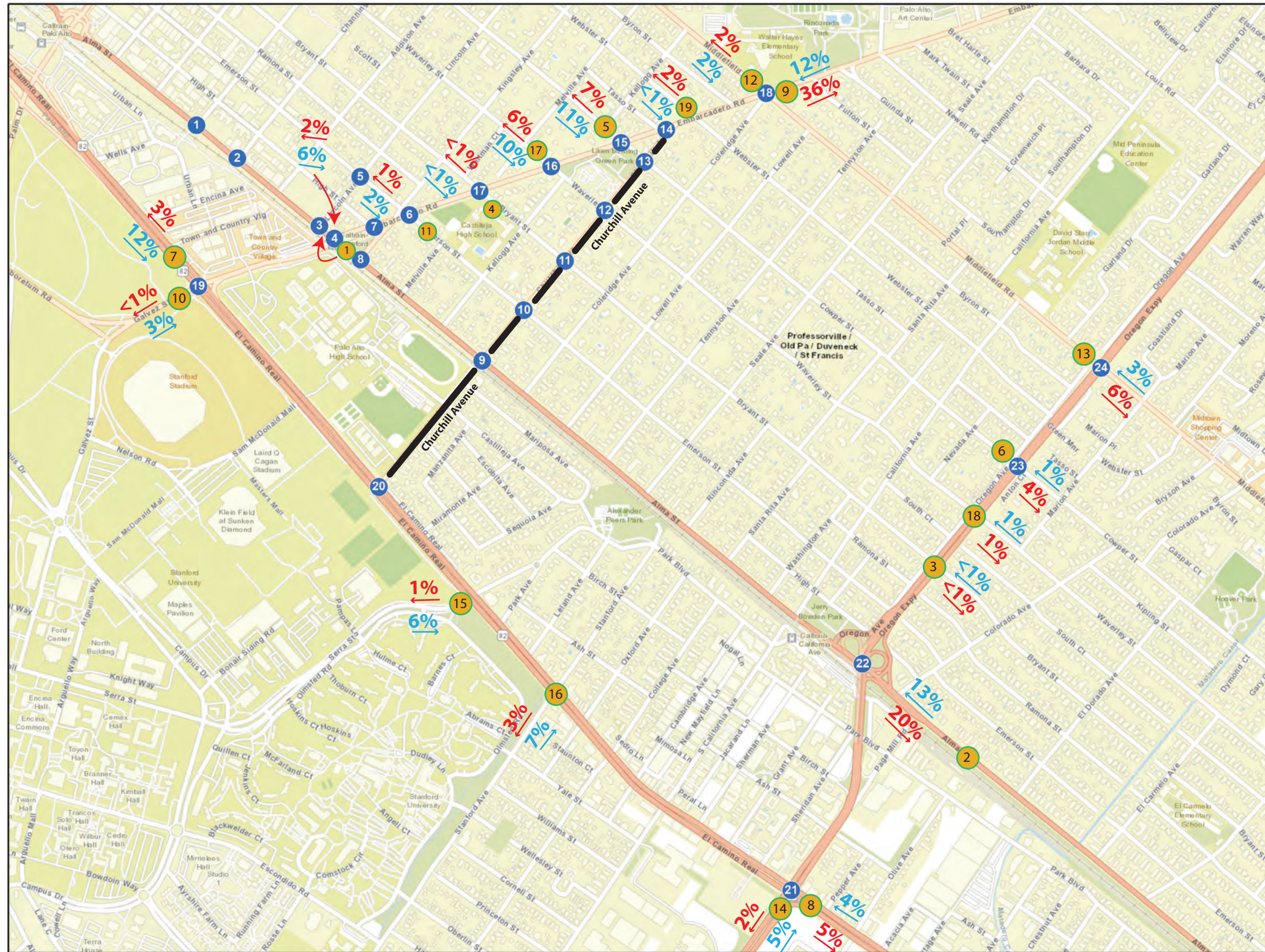


## LEGEND

- XX% Origin
- XX% Destination
- X O/D Zones



# Origin-Destination Analysis Through Churchill Avenue - P.M. Results



## LEGEND

- XX% Origin
- XX% Destination
- X O/D Zones





### EXISTING PLUS PROJECT CONDITIONS

This analysis scenario presents the impacts of the closure of Churchill Avenue near the railroad tracks at the study intersections and surrounding roadway system. This scenario is similar to Existing Conditions, but with the addition of traffic from the closure of Churchill Avenue.

#### Existing Plus Project Improvements

With the closure of Churchill Avenue, the intersection geometry of Alma Street/Churchill Avenue is proposed to undergo the following changes: With the full closure of the west leg of the intersection, the northbound left-turn lane is proposed to be removed. The southbound left-turn lane and southbound right-turn lane are also proposed to be removed and the left most through lane is to be converted to a shared left-through lane. **Figure 10, 11, and 12** illustrates the conceptual intersection layout and renderings of the intersection, all developed and prepared by AECOM.

#### PROJECT TRIP DISTRIBUTION AND ASSIGNMENT

Trip distribution is a process that determines what proportion of vehicles would be expected to travel between a project site and various destinations outside the project study area. The process of trip assignment determines the various routes that vehicles would take from the project site to each destination using trip distribution. In this case, it is the existing traffic that is being rerouted on alternate roadways in the study area due to the Churchill Avenue closure. Trip distribution assumptions for the proposed project were developed based on the Travel Demand Model and the O-D Study conducted. In total, there are approximately 706 vehicles in the a.m. peak and 776 vehicles in the p.m. peak period that will be rerouted. **Figure 13** illustrates the trip distribution percentages developed for the closure of Churchill Avenue. **Figure 14a and 14b** illustrates the rerouted traffic volumes due to the closure of Churchill Avenue and **Figure 15a and 15b** illustrates the total traffic demands under the Churchill Avenue closure for the a.m. and p.m. peak hours.

#### EXISTING (2018) PLUS PROJECT CONDITIONS LOS & 95<sup>TH</sup> PERCENTILE QUEUE LENGTH ANALYSIS

This scenario evaluates the study intersections with existing lane geometry and traffic controls. The southbound right-turn, northbound left-turn, westbound through, and all eastbound movements were rerouted at the intersection of Alma Street/Churchill Avenue.

Existing signal timings were maintained for signalized intersections under this scenario similar to existing conditions. The results of the LOS, delay and 95<sup>th</sup> percentile queue length in feet (ft.) analysis using Synchro software are summarized in **Tables 10 and 11** respectively. **Appendix E** contains Synchro reports for all study intersections.

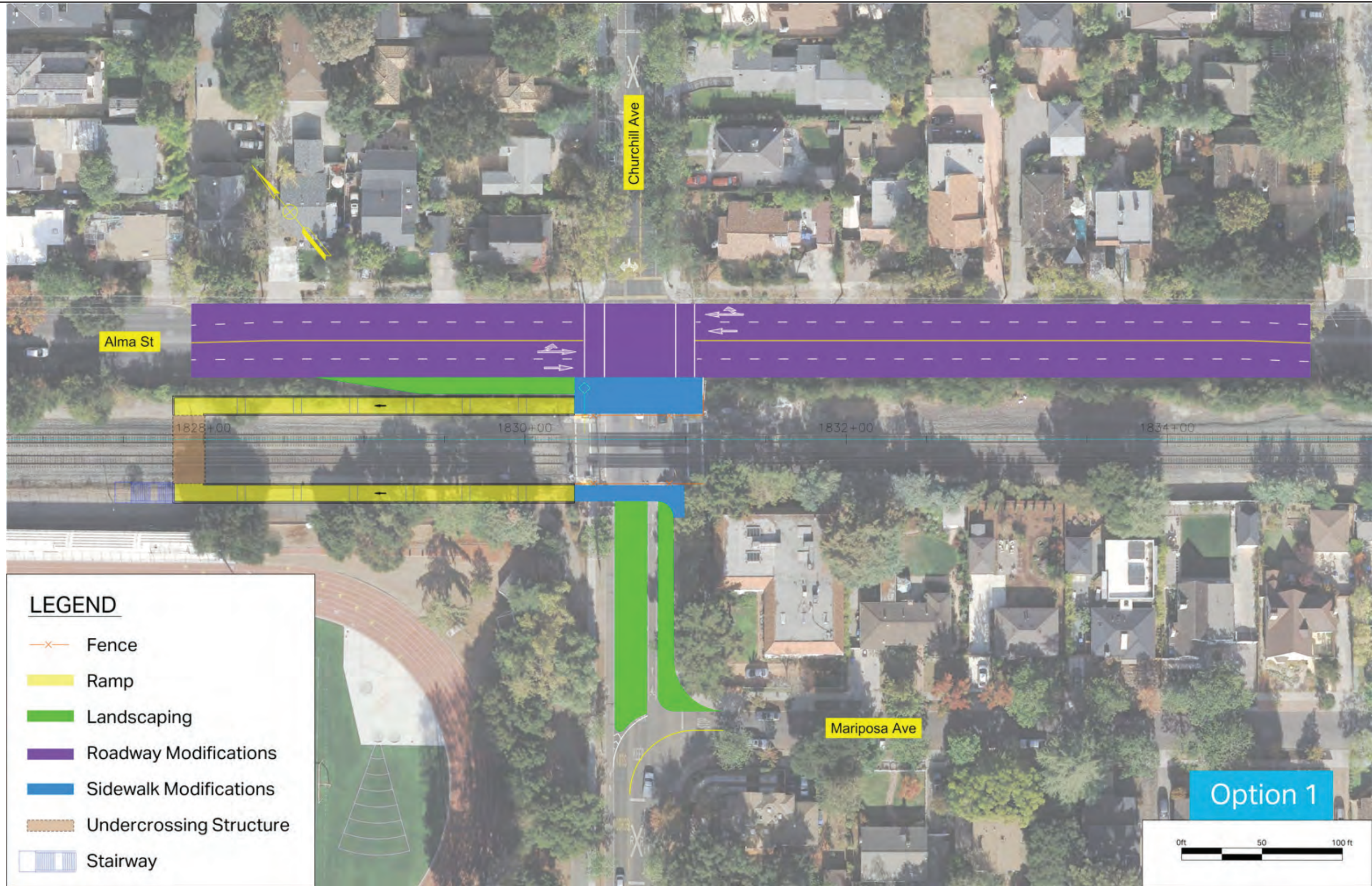
The following intersections operate with unacceptable LOS based on City Standards and the Congestion Management Program (CMP):

- Alma Street/Lincoln Avenue (all peak hours)
- Alma Street/Embarcadero Road (all peak hours)
- Alma Street/Kingsley Avenue (all peak hours)

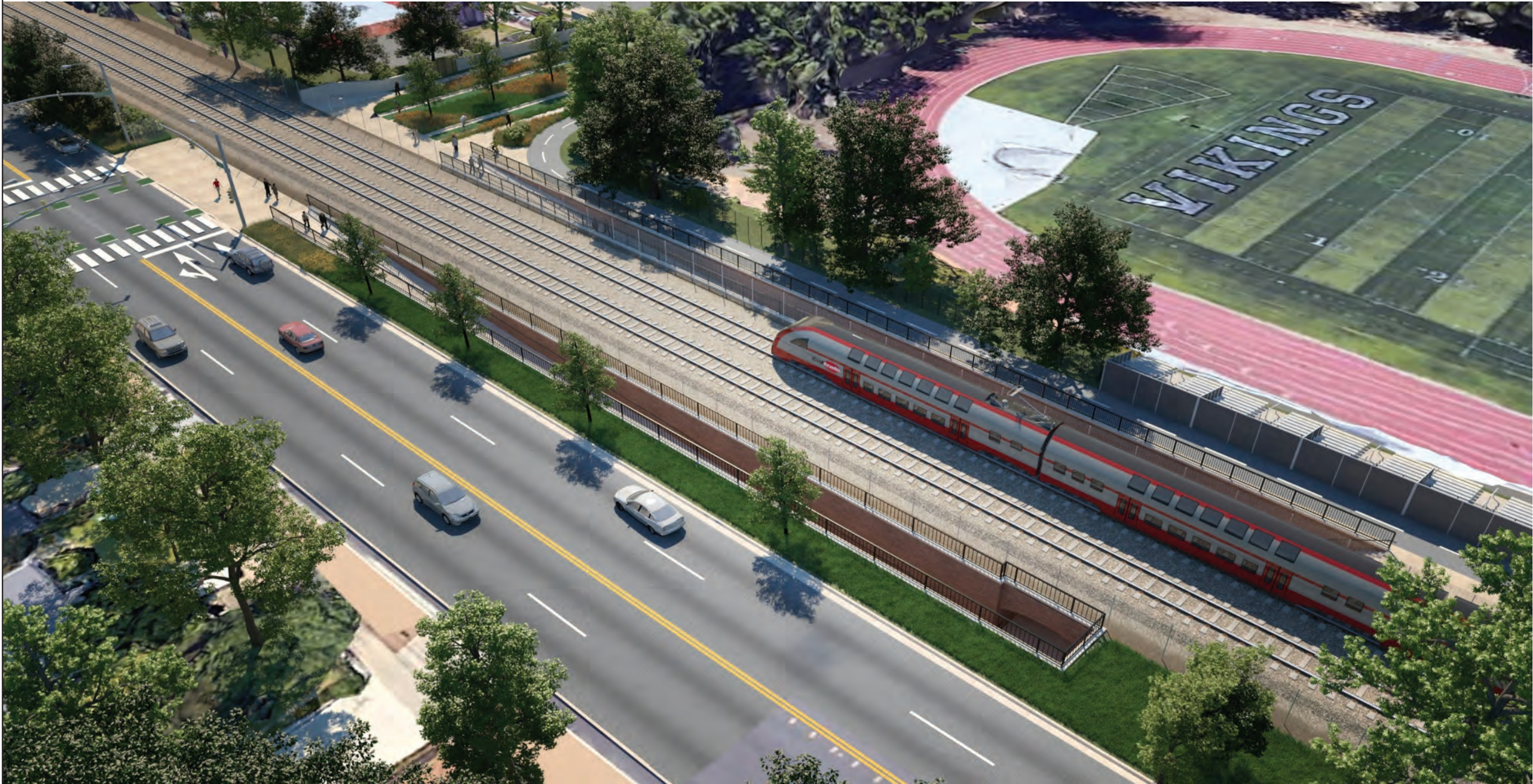
- Embarcadero Road/Cowper Street (all peak hours)
- Middlefield Road/Embarcadero Road (a.m. peak hour)\*
- El Camino Real/Embarcadero Road (all peak hours)
- El Camino Real/Churchill Avenue (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road (all peak hours)
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue) (all peak hours)
- Alma Street/Oregon Expressway EB Off Ramp (all peak hours)

Note: \*LOS reflects pedestrian-scramble phase during 30 minutes of the a.m. peak hour.

# Alma Street/Churchill Avenue Conceptual Layout



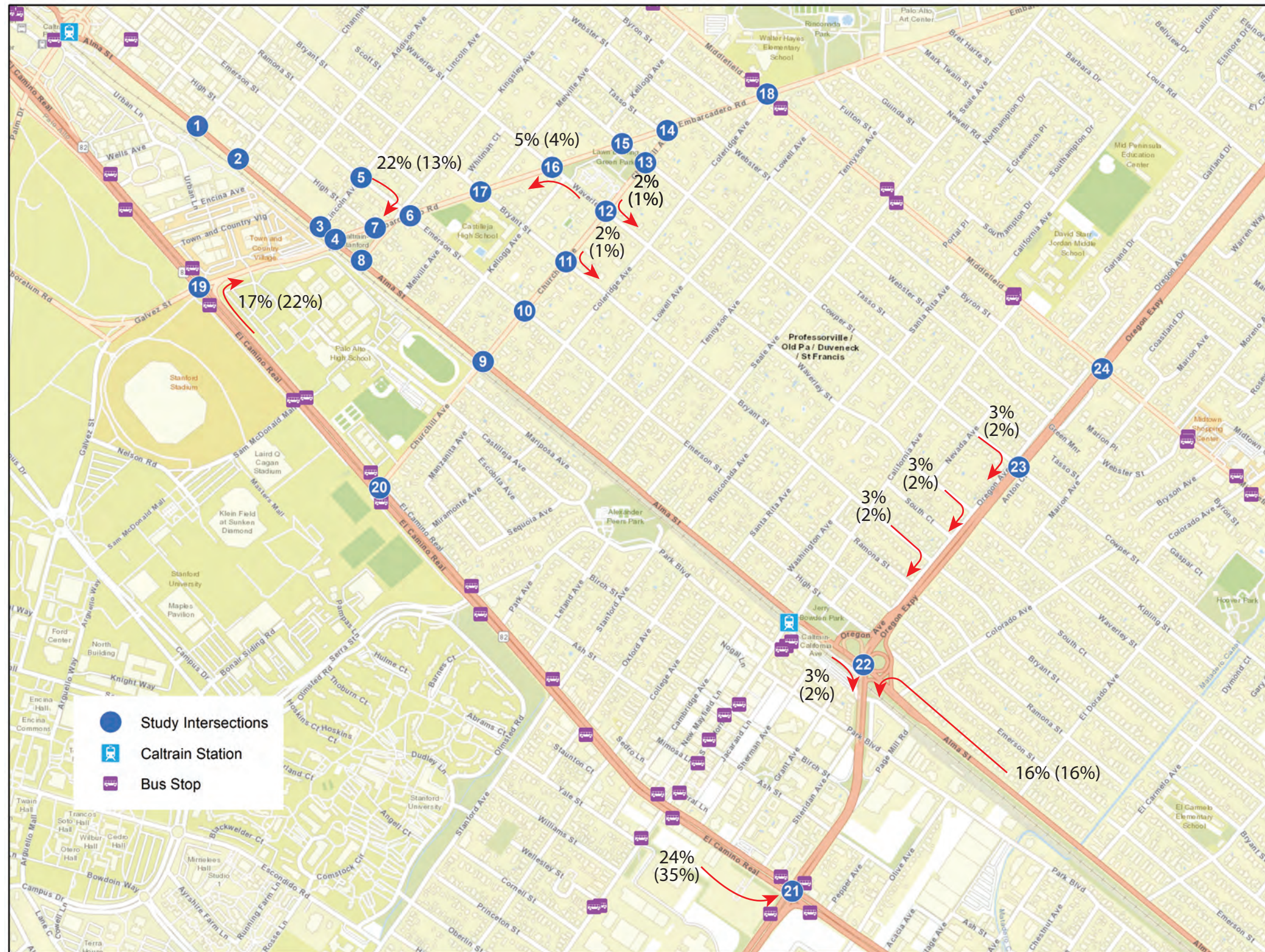
# Alma Street/Churchill Avenue Conceptual Rendering



# Alma Street/Churchill Avenue Conceptual Rendering



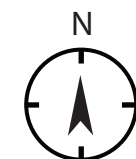
# Trip Distribution



## LEGEND

**XX%** AM Trip %

**(XX%)** PM Trip %

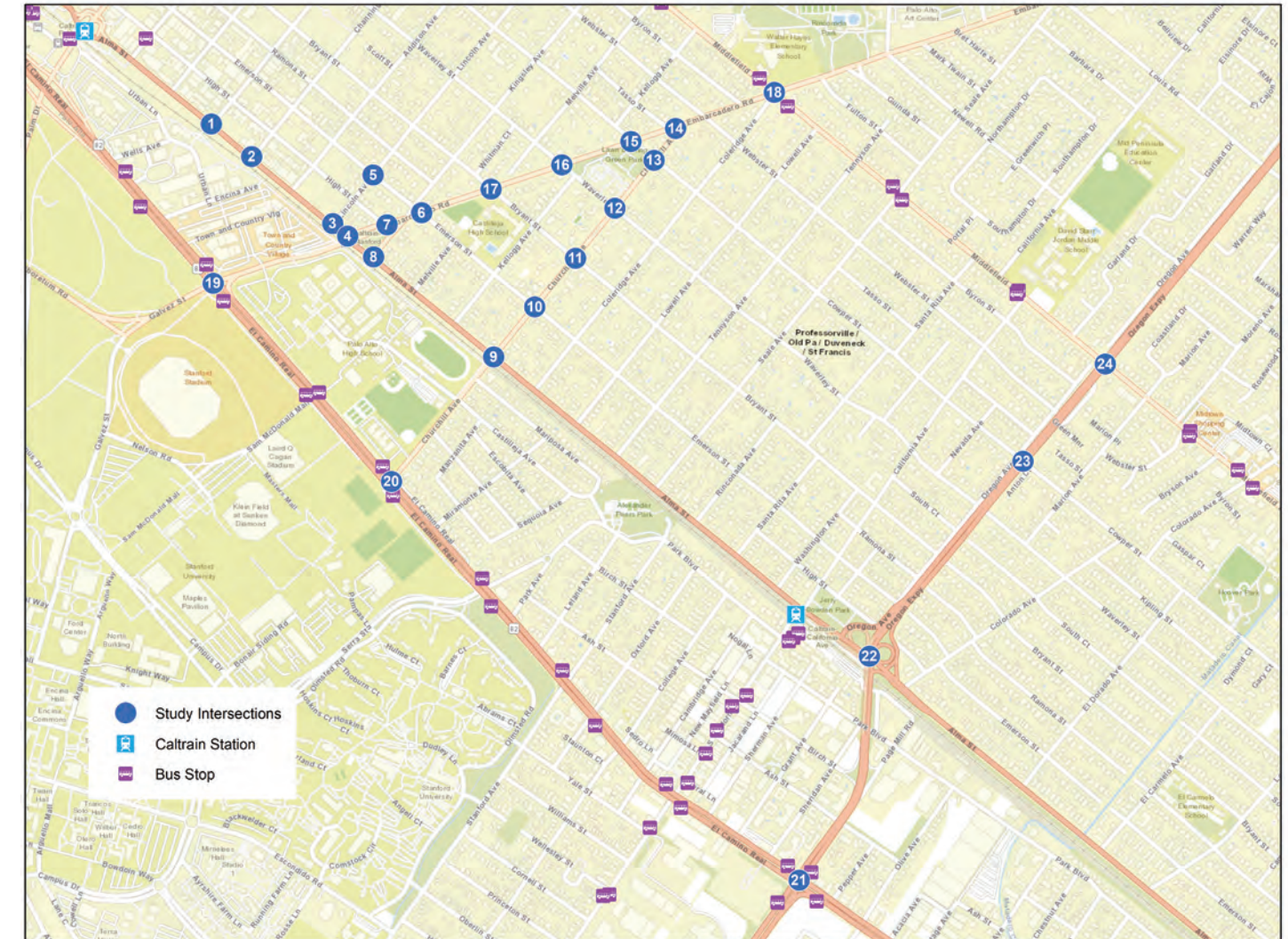


# Rerouted Trips during Churchill Avenue Closure

Intersection #1 Alma St. / Homer Ave.	Intersection #2 Alma St. / Channing Ave.	Intersection #3 Alma St. / Lincoln Ave.	Intersection #4 Alma St. / Embarcadero Rd.
Intersection #5 Emerson St. / Lincoln Ave.	Intersection #6 Emerson St. / Embarcadero Rd.	Intersection #7 Embarcadero Rd. / High St.	Intersection #8 Alma St. / Kingsley Ave.
Intersection #9 Alma St. / Churchill Ave.	Intersection #10 Emerson St. / Churchill Ave.	Intersection #11 Bryant St. / Churchill Ave.	Intersection #12 Waverly St. / Churchill Ave.

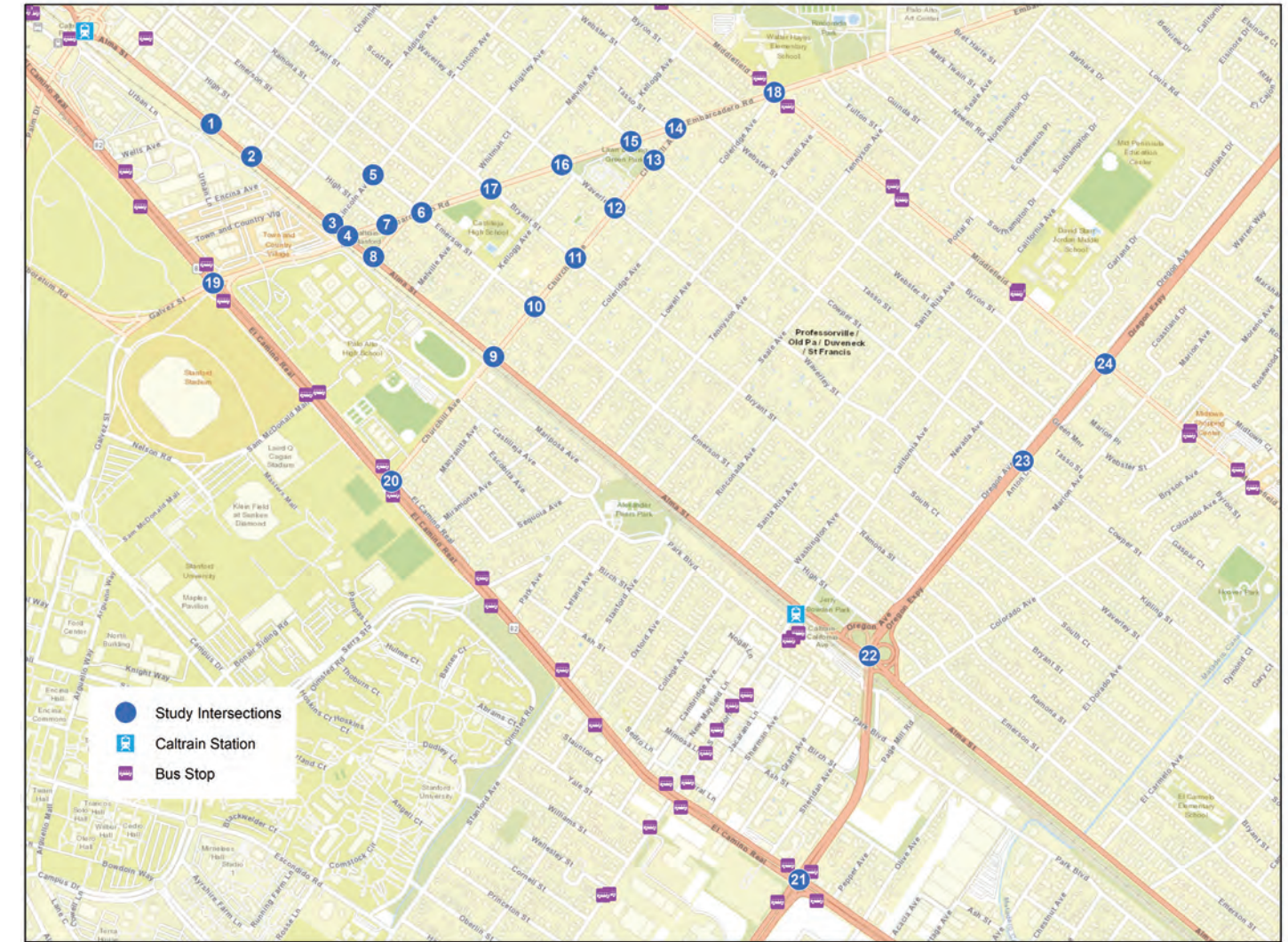
## LEGEND

- +XX — Increase in Trip Volume
- XX — Decrease in Trip Volume
- Indicates Restricted Movement
- XX (XX) — AM (PM) Peak Hour Volumes



# Rerouted Trips during Churchill Avenue Closure

Intersection #13 Cowper St. / Churchill Ave.	Intersection #14 Churchill Ave. / Embarcadero Rd.	Intersection #15 Cowper St. / Embarcadero Rd.	Intersection #16 Waverly St. / Embarcadero Rd.
Intersection #17 Bryant St. / Embarcadero Rd.	Intersection #18 Middlefield Rd. / Embarcadero Rd.	Intersection #19 El Camino Real / Embarcadero Rd.	Intersection #20 El Camino Real / Churchill Ave.
Intersection #21 El Camino Real / Oregon Expy.	Intersection #22 Alma St. / Oregon Expy.	Intersection #23 Cowper St. / Oregon Expy.	Intersection #24 Middlefield Rd. / Oregon Expy.



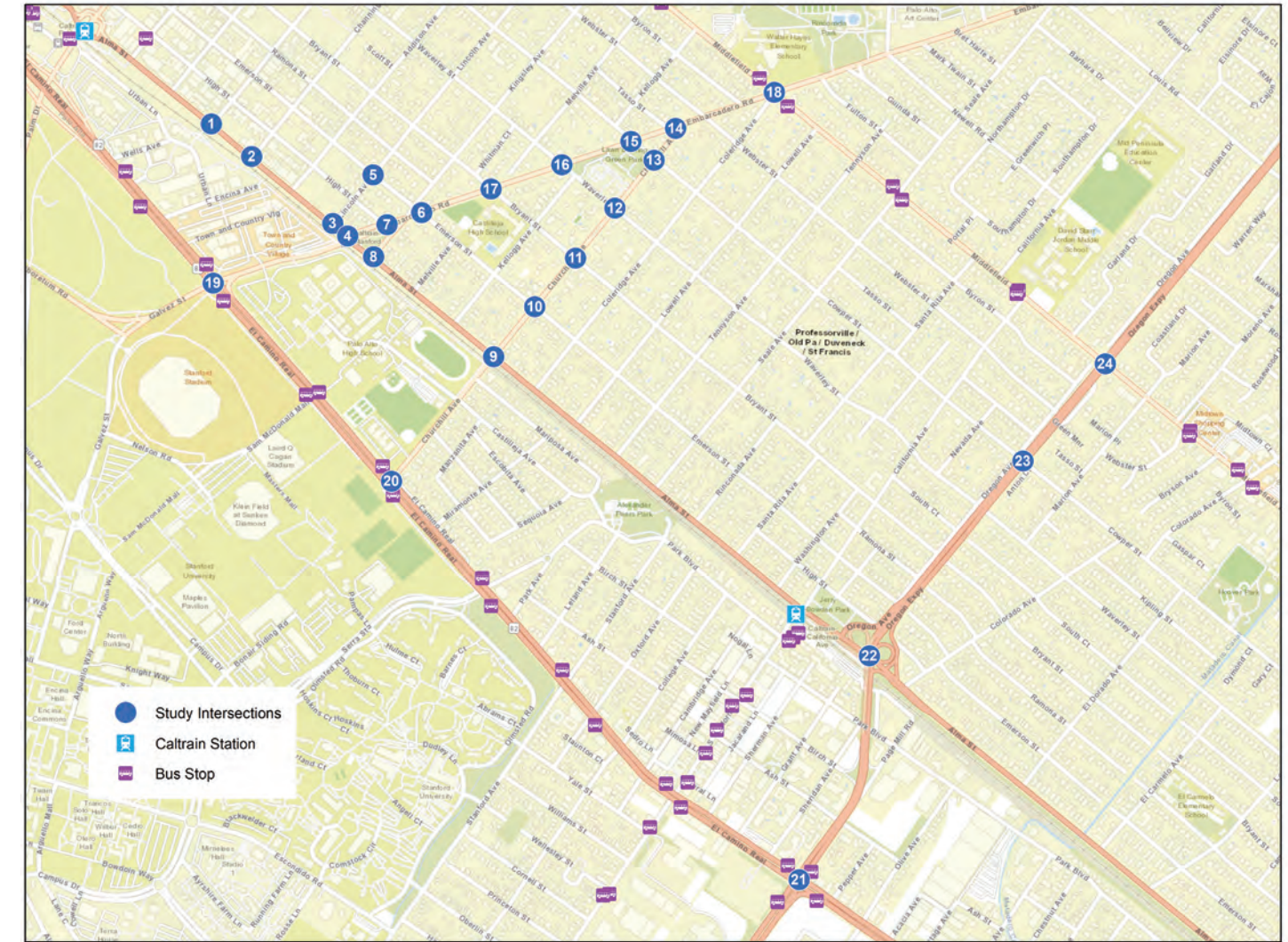
## LEGEND

- +XX — Increase in Trip Volume
- XX — Decrease in Trip Volume
- Indicates Restricted Movement
- XX (XX) — AM (PM) Peak Hour Volumes



# Existing Plus Churchill Avenue Closure Traffic Volumes

Intersection #1 Alma St. / Homer Ave.	Intersection #2 Alma St. / Channing Ave.	Intersection #3 Alma St. / Lincoln Ave.	Intersection #4 Alma St. / Embarcadero Rd.
Intersection #5 Emerson St. / Lincoln Ave.	Intersection #6 Emerson St. / Embarcadero Rd.	Intersection #7 Embarcadero Rd. / High St.	Intersection #8 Alma St. / Kingsley Ave.
Intersection #9 Alma St. / Churchill Ave.	Intersection #10 Emerson St. / Churchill Ave.	Intersection #11 Bryant St. / Churchill Ave.	Intersection #12 Waverly St. / Churchill Ave.



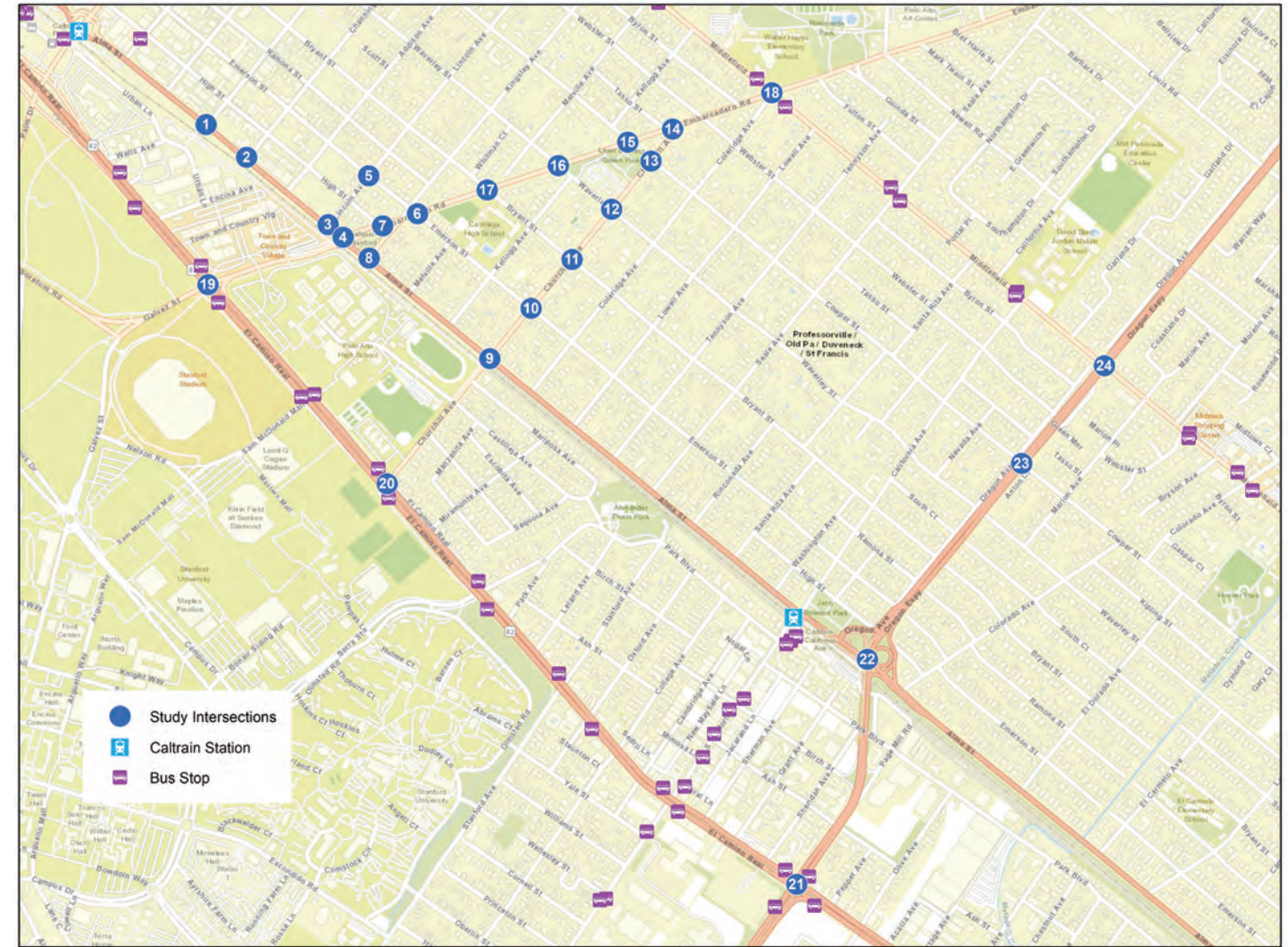
## LEGEND

XX (XX) — AM (PM) Peak Hour Volumes

↑↑↑ — Indicates Restricted Movement

# Existing Plus Churchill Avenue Closure Traffic Volumes

<p><b>Intersection #13</b> Cowper St. / Churchill Ave.</p>	<p><b>Intersection #14</b> Churchill Ave. / Embarcadero Rd.</p>	<p><b>Intersection #15</b> Cowper St. / Embarcadero Rd.</p>	<p><b>Intersection #16</b> Waverly St. / Embarcadero Rd.</p>
<p><b>Intersection #17</b> Bryant St. / Embarcadero Rd.</p>	<p><b>Intersection #18</b> Middlefield Rd. / Embarcadero Rd.</p>	<p><b>Intersection #19</b> El Camino Real / Embarcadero Rd.</p>	<p><b>Intersection #20</b> El Camino Real / Churchill Ave.</p>
<p><b>Intersection #21</b> El Camino Real / Oregon Expy.</p>	<p><b>Intersection #22</b> Alma St. / Oregon Expy.</p>	<p><b>Intersection #23</b> Cowper St. / Oregon Expy.</p>	<p><b>Intersection #24</b> Middlefield Rd. / Oregon Expy.</p>



## LEGEND

XX (XX) — AM (PM) Peak Hour Volumes

↑↑↑ — Indicates Restricted Movement

**Table 10: Existing Plus Project Conditions LOS & Delay**

#	Study Intersections	Control	Peak Hour	Existing Plus Project Conditions	
				Average Delay <sup>1</sup> (sec)	LOS
1	Alma Street/Homer Avenue	Signalized	A.M.	19.7	B
			P.M.	20.9	C
3	Alma Street/Lincoln Avenue	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
4	Alma Street/Embarcadero Road	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
5	Emerson Street/Lincoln Avenue	All-Way Stop	A.M.	12.0	B
			P.M.	8.7	A
8	Alma Street/Kingsley Avenue	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
9	Alma Street/Churchill Avenue	Signalized	A.M.	9.2	A
			P.M.	8.8	A
10	Churchill Avenue/Emerson Street	All-Way Stop	A.M.	8.6	A
			P.M.	8.0	A
11	Churchill Avenue/Bryant Street	Two-Way Stop	A.M.	11.6	B
			P.M.	10.6	B
12	Churchill Avenue/Waverly Street	All-Way Stop	A.M.	9.0	A
			P.M.	8.7	A
13	Churchill Avenue/Cowper Street	All-Way Stop	A.M.	7.7	A
			P.M.	7.8	A
14	Churchill Avenue/Embarcadero Road	One-Way Stop	A.M.	9.7	A
			P.M.	9.9	A
15	Embarcadero Road/Cowper Street	Two-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
16	Embarcadero Road/Waverly Street	Signalized	A.M.	29.4	C
			P.M.	49.7	D
17	Embarcadero Road/Bryant Street	Signalized	A.M.	14.2	B
			P.M.	7.3	A
18	Middlefield Road/Embarcadero Road	Signalized	A.M.	>80.0	F
			P.M.	38.1	D
19	El Camino Real/Embarcadero Road	Signalized	A.M.	>80.0	F
			P.M.	>80.0	F
20	El Camino Real/Churchill Avenue	Signalized	A.M.	40.9	D
			P.M.	62.6	E
21	El Camino Real/Oregon Expressway-Page Mill Road	Signalized	A.M.	>80.0	F
			P.M.	>80.0	F
22a	Alma Street/Oregon Expressway WB Off Ramp (Oregon Ave)	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
22b	Alma Street/Oregon Expressway EB Off Ramp	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F

#	Study Intersections	Control	Peak Hour	Existing Plus Project Conditions	
				Average Delay <sup>1</sup> (sec)	LOS
23	Oregon Expressway/Cowper Street	Signalized	A.M.	29.3	C
			P.M.	18.2	B
24	Oregon Expressway/Middlefield Road	Signalized	A.M.	62.9	E
			P.M.	56.1	E

Notes:

<sup>1</sup>Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

Delay is reported as >50.0 for unsignalized intersections with LOS F and >80.0 for signalized intersections consistent with HCM 2000 methodology.

**Bold** indicates unacceptable LOS.

**Table 11** summarizes the 95<sup>th</sup> percentile queue lengths for all approach movements at the study intersections for the weekday a.m. and p.m. peak hour. Existing Plus Project queue length analysis resulted in several intersections with 95<sup>th</sup> percentile queue lengths exceeding storage capacity.

Based on Synchro analysis results, intersections where queue lengths exceed the existing storage lengths are listed below:

- Embarcadero Road/Waverly Street for EBL (p.m. peak hour)
- Embarcadero Road/Bryant Street for EBL (p.m. peak hour)
- Embarcadero Road/Middlefield Road for WBL (p.m. peak hour), NBL and SBL (all peak hours)
- El Camino Real/Embarcadero Road for WBL (all peak hours), NBL (a.m. peak hour), and SBL (all peak hours)
- El Camino Real/Churchill Avenue for NBR (all peak hours) and SBL (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road for WBL (all peak hours) and SBL (all peak hours)
- Oregon Expressway/Middlefield Road for EBR (all peak hours), NBL (all peak hours), and SBL (a.m. peak hour)

**Table 11: Existing Plus Project 95th Percentile Queue Lengths (ft.)**

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Existing Plus Churchill Avenue Closure Conditions	
				A.M.	P.M.
1	Alma Street/Homer Avenue (Signalized)	WBL	-	100	189
		NBT	-	327	343
		SBT	-	154	277
3	Alma Street/Lincoln Avenue (One-Way Stop Control)	WBLR	-	106	166
		NBT	-	<25	<25
		NBTL	-	<25	<25
		SBTL	-	<25	<25
		SBT	-	<25	<25
4	Alma Street/Embarcadero Road (One-Way Stop Control)	WBR	-	277	338
		NBT	-	<25	<25
		SBT	-	<25	<25
8	Alma Street/Kingsley Avenue (One-Way Stop Control)	WBL	-	228	513
		NBT	-	<25	<25
		SBT	-	<25	<25
9	Alma Street/Churchill Avenue (Signalized)	EBT	-	-	-
		EBR	-	-	-
		WBT	-	125	105
		NBL	-	-	-
		NBT	-	284	331
		SBL	-	-	-
		SBT	-	106	244
		SBR	-	-	-
11	Churchill Avenue/Bryant Street (Two-Way Stop Control)	EBLTR	-	<25	<25
		WBLTR	-	<25	<25
		NBLTR	-	<25	<25
		SBLTR	-	<25	<25
14	Churchill Avenue54/Embarcadero Road (One-Way Stop Control)	EBT	-	<25	<25
		EBTR	-	<25	<25
		WBLT	-	<25	<25
		WBT	-	<25	<25
		NBR	-	<25	<25
15	Embarcadero Road/Cowper Street (Two-Way Stop Control)	EBLT	-	<25	<25
		EBTR	-	<25	<25
		WBLT	-	<25	<25
		WBTR	-	<25	<25
		NBLTR	-	26	29
		SBLTR	-	64	41
16	Embarcadero Road/Waverly Street (Signalized)	EBL	95	m#87	<b>#186</b>
		EBT	-	367	#543
		WBL	75	40	38
		WBT	-	424	372
		NBT	-	148	90
		SBT	-	173	125
17	Embarcadero Road/Bryant Street (Signalized)	EBL	80	29	<b>110</b>
		EBT	-	213	261

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Existing Plus Churchill Avenue Closure Conditions	
				A.M.	P.M.
		WBL	60	m43	m4
		WBT	-	m477	391
		NBR	-	<25	<25
		SBR	-	<25	<25
18	Embarcadero Road/Middlefield Road (Signalized)	EBL	115	78	66
		EBT	-	#687	#517
		WBL	100	90	<b>111</b>
		WBT	-	#817	392
		NBL	115	<b>#245</b>	<b>134</b>
		NBT	-	198	179
		SBL	100	<b>174</b>	<b>#190</b>
19	El Camino Real/Embarcadero Road (Signalized)	EBL	-	113	#349
		EBT	-	157	#426
		WBL	200	<b>#747</b>	<b>#714</b>
		WBT	-	345	353
		NBL	382	<b>m#424</b>	m#340
		NBT	-	375	m#323
		SBL	300	<b>#509</b>	<b>#462</b>
20	El Camino Real/Churchill Avenue (Signalized)	EBL	-	#457	#542
		NBT	-	#824	#989
		NBR	100	<b>194</b>	<b>194</b>
		SBL	170	m104	<b>m295</b>
		SBT	-	m437	m484
21	El Camino Real/Oregon Expressway-Page Mill Road (Signalized)	EBL	350	#325	237
		EBT	-	508	668
		EBR	-	132	219
		WBL	100	<b>188</b>	<b>278</b>
		WBT	-	#1016	#907
		NBL	300	253	147
		NBT	-	#945	#655
		SBL	350	<b>#480</b>	<b>#797</b>
		SBT	-	300	631
22a	Alma Street/Oregon Expressway WB Ramps (Oregon Ave) (One-Way Stop Control)	SBR	350	98	95
		WBL	-	27	108
		WBR	-	25	<25
		NBT	-	<25	<25
		NBR	-	<25	<25
		SBT	-	<25	<25
22b	Alma Street/Oregon Expressway EB Ramps (One-Way Stop Control)	SBTR	-	<25	<25
		WBR	-	347	381
		NBT	-	<25	<25
		NBR	-	<25	<25
		SBL	-	26	<25
23		SBT	-	<25	<25
		EBL	115	48	60

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Existing Plus Churchill Avenue Closure Conditions	
				A.M.	P.M.
	Oregon Expressway/Cowper Street (Signalized)	EBT	-	815	817
		EBR	50	<25	26
		WBL	115	m27	m40
		WBT	-	m825	807
		NBL	-	#185	84
		NBT	-	106	55
		SBL	-	60	29
		SBT	-	88	104
24	Oregon Expressway/Middlefield Road (Signalized)	EBL	360	m#175	#260
		EBT	-	#881	486
		EBR	100	<b>m141</b>	<b>146</b>
		WBL	390	182	#305
		WBT	-	#774	559
		WBR	100	<25	<25
		NBL	230	<b>#489</b>	<b>#375</b>
		NBT	-	#534	#782
		NBR	-	95	77
		SBL	145	<b>154</b>	91
SBT	-	235	348		

Notes:

- EB, WB, NB, SB – Eastbound, Westbound, Northbound, Southbound respectively.
- L, T, R – Left, Through, Right respectively.
- Queue lengths taken from Synchro reports.
- #: 95<sup>th</sup> percentile volume exceeds capacity, queue may be longer.
- m: Volume for 95<sup>th</sup> percentile queue is metered by upstream signal.
- Bold** indicates queue lengths exceeding existing storage capacity.

## PEDESTRIAN, BICYCLE, AND TRANSIT IMPACTS

### Pedestrian Impacts

Under existing conditions, pedestrians are able to cross the Churchill Avenue grade crossing by using the provided pedestrian facilities at and near the signalized intersection of Alma Street/Churchill Avenue. Pedestrians are provided with marked crosswalks to cross Alma Street and the train tracks. Currently, approximately 73 pedestrians in the a.m. peak period cross Alma Street at Churchill Avenue and it is assumed that majority of the 73 pedestrians will also cross the train tracks. In the p.m. peak period, 19 pedestrians cross Alma Street and it is assumed that the pedestrians also cross the train tracks. While the proposed underpass at Churchill Avenue is constructed, pedestrians will have to utilize other pedestrian facilities near the vicinity.

One alternative pedestrians can use if Churchill Avenue is closed is the California Avenue Bike/Pedestrian Underpass that is approximately 0.66 miles south of Alma Street/Churchill Avenue. Alternatively, pedestrians can use the Embarcadero Road underpass that is approximately 0.30 miles north of Alma Street/Churchill Avenue. The detour will ultimately increase the travel time of pedestrians who use the

Churchill Avenue grade crossing to access Palo Alto High School, El Camino Field, and Stanford University. Providing wayfinding signs can assist pedestrians with navigating through the study area and using the alternative crossings previously mentioned.

### **Bicycle Impacts**

Similar to the pedestrians, bicycles are able to cross the Churchill Avenue grade crossing by using the provided bicycle facilities at and near the signalized intersection of Alma Street/Churchill Avenue. Bicycles are provided with Class II facilities to cross Alma Street and the train tracks. Currently, a total of 314 bicycles in the a.m. peak period cross Alma Street at Churchill Avenue and it is assumed that majority of the 314 bicycles will also cross the train tracks. In the p.m. peak period, 63 bicycles cross Alma Street and it is assumed that the bicycles also cross the train tracks. Similar to pedestrians, bicyclists will have to utilize other bicycle facilities to cross the train tracks while the proposed underpass at Churchill Avenue is constructed.

Bicyclists can elect to use the California Avenue Bike/Pedestrian Underpass that is approximately 0.66 miles south of Alma Street/Churchill Avenue. Alternatively, bicyclists can use the Embarcadero Road underpass that is approximately 0.30 miles north of Alma Street/Churchill Avenue. The detour will increase the travel time of bicyclists who use the Churchill Avenue grade crossing to access Palo Alto High School, El Camino Field, and Stanford University. Similar to pedestrians, providing wayfinding signs can assist bicyclists with navigating through the study area and using the alternative crossings previously mentioned.

### **Transit Impacts**

Currently, there are no bus routes that use Churchill Avenue to cross the Caltrain train tracks. However, the closure of Churchill Avenue will cause the existing volumes that cross Churchill Avenue to use alternate routes, which will increase the delay at the intersections where buses are present. Routes that will be affected due to the rerouting of traffic will be VTA Route 22 and 522, VTA Route 104, Dumbarton Express, and the Embarcadero Shuttle.

### **MITIGATION MEASURES**

Based on the LOS and delay analyses conducted at the study intersections, it was observed that several intersections would be impacted by the closure of Churchill Avenue during the Existing Plus Project scenario in both a.m. and p.m. peak periods. The intersections that experience an increase in delay or degrade from acceptable LOS to unacceptable LOS under the Existing Plus Project scenario:

- Alma Street/Lincoln Avenue
- Alma Street/Embarcadero Road
- Alma Street/Kingsley Avenue
- Embarcadero Road/Cowper Street
- El Camino Real/Embarcadero Road
- El Camino Real/Oregon Expressway-Page Mill Road
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue)
- Alma Street/Oregon Expressway EB Off Ramp



While introducing the potential mitigation measures, it should be noted that the intersections of Alma Street/Lincoln Avenue, Alma Street/Embarcadero Road, and Alma Street/Kingsley Avenue were mitigated as a group since individual mitigations did not provide as much benefit as group mitigation. Potential mitigation measures to alleviate the delay experienced at the intersections during the Existing Plus Project scenario could include the following:

1. At Alma Street/Lincoln Avenue, convert the westbound approach into a right-turn only lane and divert the left-turn movement onto Embarcadero Road. Additionally, at Alma Street/Embarcadero Road, convert the westbound movement from a right-turn only lane into a right-turn lane and left-turn lane. This would require the removal of a few parking spaces, restriping of the westbound approach, and signaling the intersection of Alma Street/Embarcadero Road. Finally, the intersection of Alma Street/Kingsley Avenue would also be signalized. Both of these newly signalized intersections would operate on one controller. Both intersections of Alma Street/Embarcadero Road and Alma Street/Kingsley Avenue satisfy the peak hour signal warrants. Signal warrant sheets can be found in **Appendix F**.
2. At Embarcadero Road/Cowper Street, convert the northbound and southbound approaches into a right turn only lane and divert the through and left turn movements to the adjacent signalized intersection of Embarcadero Road/Waverly Street. Appropriate signing and striping would be required for the northbound and southbound approaches of Cowper Street.
3. At El Camino Real/Embarcadero Road, installing an additional westbound left-turn lane and an exclusive northbound right-turn lane. Changing the lane geometry of this intersection would also require optimization of the signal timings.
4. At El Camino Real/Oregon Expressway-Page Mill Road, installing a westbound right-turn lane from Oregon Expressway to El Camino Real and optimizing the signal timings would mitigate the additional delay caused by the project.
5. At Alma Street/Oregon Expressway WB Off Ramp and Alma Street/Oregon Expressway EB Off Ramp, signalizing both off ramps operating with one controller. Under this scenario, Alma Street/Oregon Expressway EB Off Ramp satisfies the peak hour signal warrant. Signal warrant sheets can be found in **Appendix F**.

TJKM evaluated the mitigation measures at the above intersections to ascertain the impact on LOS and delay. Based on the analysis conducted for the mitigation measures at the above intersections, all intersections upgrade to acceptable LOS and delay thresholds. **Table 12** summarizes the LOS and delay for the mitigation measures presented. **Appendix G** contains the Synchro LOS reports.

**Table 12: Existing Plus Project with Mitigation LOS & Delay**

#	Study Intersections	Existing Control	Peak Hour	Existing Conditions		Existing Plus Project		Existing Plus Project with Mitigations	
				Delay	LOS	Delay	LOS	Delay	LOS
3	Alma Street/Lincoln Avenue	One-Way Stop	A.M.	>50.0	F	>50.0	F	17.5	C
			P.M.	>50.0	F	>50.0	F	19.4	C
4	Alma Street/Embarcadero Road	One-Way Stop	A.M.	>50.0	F	>50.0	F	25.1	C
			P.M.	>50.0	F	>50.0	F	30.7	C
8	Alma Street/Kingsley Avenue	One-Way Stop	A.M.	>50.0	F	>50.0	F	23.6	C
			P.M.	>50.0	F	>50.0	F	28.3	C
15	Embarcadero Road/Cowper Street	One-Way Stop	A.M.	>50.0	F	>50.0	F	14.9	B
			P.M.	>50.0	F	>50.0	F	11.8	B
19	El Camino Real/Embarcadero Road	Signalized	A.M.	60.3	E	>80.0	F	67.1	E
			P.M.	67.0	E	>80.0	F	61.1	E
21	El Camino Real/Oregon Expressway-Page Mill Road	Signalized	A.M.	72.9	E	>80.0	F	72.5	E
			P.M.	66.4	E	>80.0	F	73.5	E
22a	Alma Street/Oregon Expressway WB Off Ramp (Oregon Ave)	One-Way Stop	A.M.	>50.0	F	>50.0	F	6.0	A
			P.M.	>50.0	F	>50.0	F	6.7	A
22b	Alma Street/Oregon Expressway EB Off Ramp	One-Way Stop	A.M.	>50.0	F	>50.0	F	17.9	B
			P.M.	>50.0	F	>50.0	F	16.0	B

Notes:

<sup>1</sup>Delay: Overall intersection delay in seconds per vehicle for signalized intersections.

Delay for minor approach worst movement or major approach critical movements at unsignalized one-way stop controlled intersections.

Delay is reported as >50.0 for unsignalized intersections with LOS F and >80.0 for signalized intersections consistent with HCM 2000 methodology.

**Bold** indicates unacceptable LOS.

## CUMULATIVE (2030) CONDITIONS

This section details expected traffic conditions at the study intersections under Cumulative Year 2030 (No Project) Conditions. This analysis scenario is defined as baseline conditions without the proposed project in year 2030. The Cumulative Year 2030 traffic volumes were estimated using the City of Palo Alto Travel Demand Forecasting Model, as well as input from City staff. Based on the model and input from City staff, a growth rate of 1% was applied to existing volumes. **Figures 16a** and **16b** summarize the peak hour intersection traffic demands for Cumulative Conditions (2030).

### Cumulative Roadway Improvements

The improvements at the intersections listed below are planned and funded. Therefore, the intersections were analyzed based on the listed modifications:

- El Camino Real/Oregon Expressway-Page Mill Road – extending the westbound left turn lanes from westbound Oregon Expressway to southbound El Camino Real.

## CUMULATIVE (2030) CONDITIONS LOS & 95<sup>TH</sup> PERCENTILE QUEUE LENGTH ANALYSIS

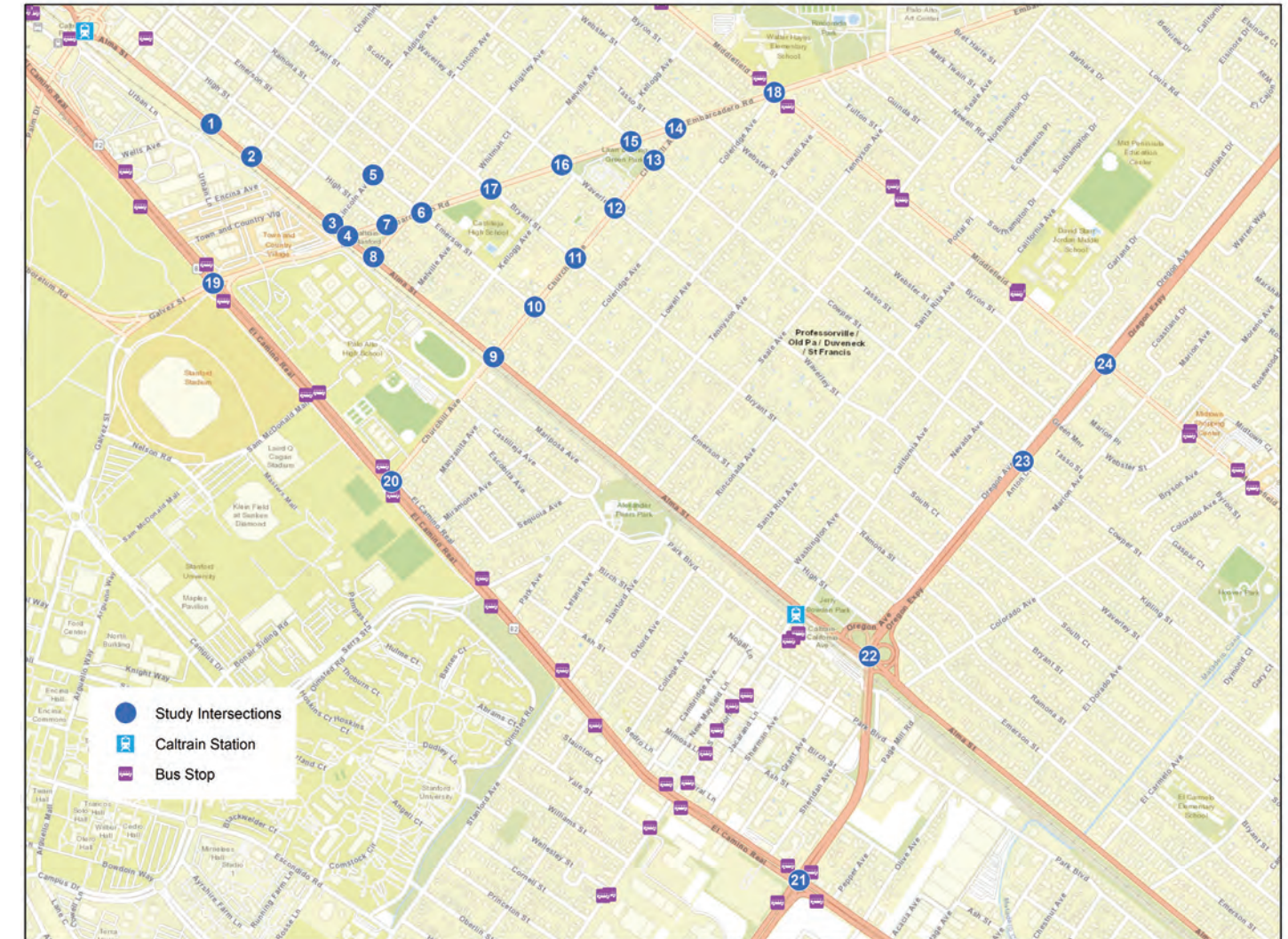
Existing signal timings were optimized for signalized intersections under this scenario. The results of the LOS and delay analysis and 95<sup>th</sup> percentile queue length in feet (ft.) analysis, using Synchro software, are summarized in **Tables 13** and **14** respectively. **Appendix H** contains the Synchro reports for all study intersections. The following intersections operate with unacceptable LOS based on City Standards and the Congestion Management Program (CMP):

- Alma Street/Lincoln Avenue (all peak hours)
- Alma Street/Embarcadero Road (all peak hours)
- Alma Street/Kingsley Avenue (all peak hours)
- Embarcadero Road/Cowper Street (all peak hours)
- Middlefield Road/Embarcadero Road (a.m. peak hour)\*
- El Camino Real/Embarcadero Road (p.m. peak hour)
- El Camino Real/Churchill Avenue (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road (a.m. peak hour)
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue) (all peak hours)
- Alma Street/Oregon Expressway EB Off Ramp (all peak hours)
- Oregon Expressway/Middlefield Road (all peak hours)

Note: \*LOS reflects pedestrian-scramble phase during 30 minutes of the a.m. peak hour.

# Cumulative Conditions (2030) Peak Hour Traffic Volumes

Intersection #1 Alma St. / Homer Ave.	Intersection #2 Alma St. / Channing Ave.	Intersection #3 Alma St. / Lincoln Ave.	Intersection #4 Alma St. / Embarcadero Rd.
Intersection #5 Emerson St. / Lincoln Ave.	Intersection #6 Emerson St. / Embarcadero Rd.	Intersection #7 Embarcadero Rd. / High St.	Intersection #8 Alma St. / Kingsley Ave.
Intersection #9 Alma St. / Churchill Ave.	Intersection #10 Emerson St. / Churchill Ave.	Intersection #11 Bryant St. / Churchill Ave.	Intersection #12 Waverly St. / Churchill Ave.

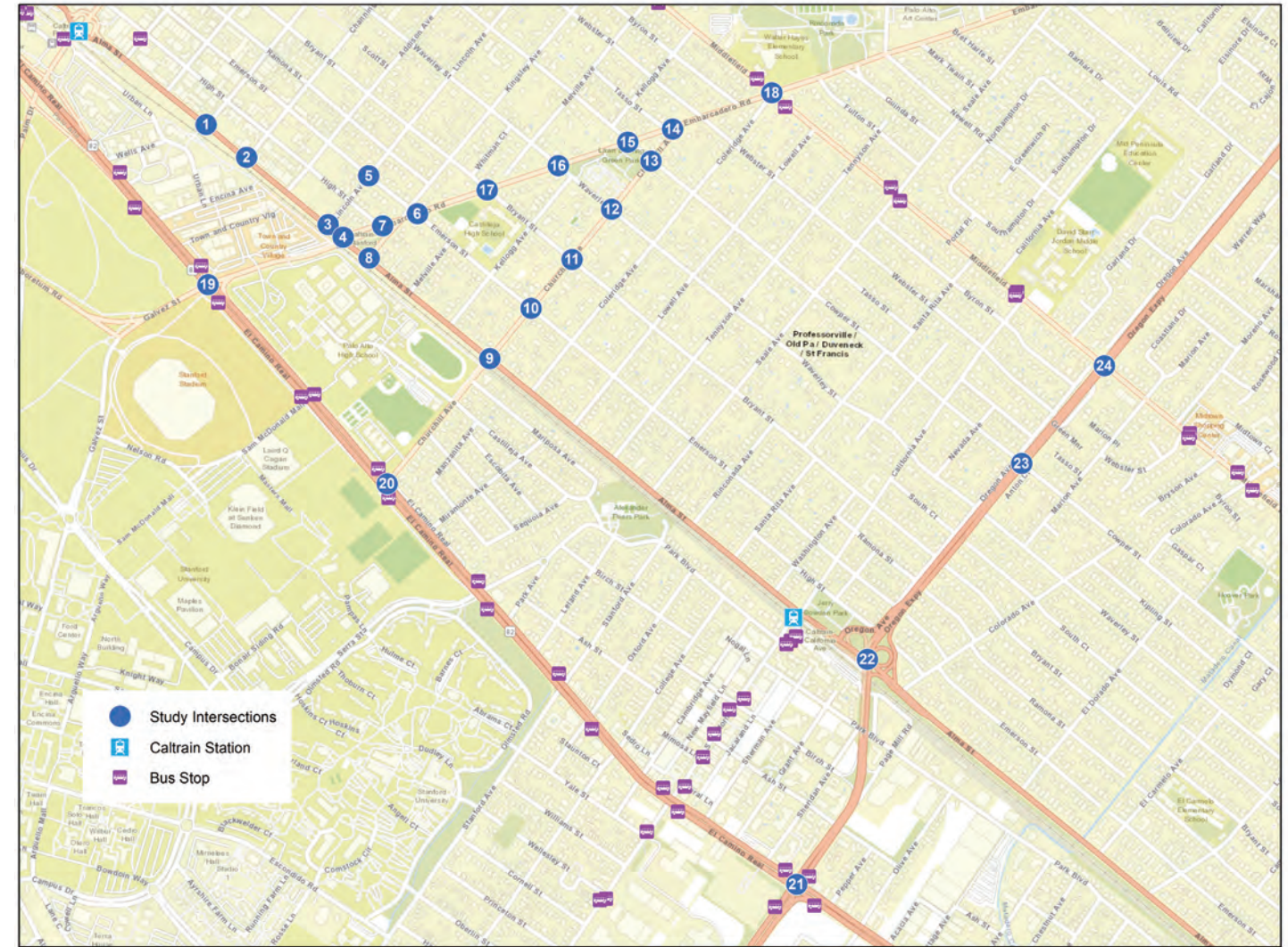


## LEGEND

XX (XX) — AM (PM) Peak Hour Volumes

# Cumulative Conditions (2030) Peak Hour Traffic Volumes

<p><b>Intersection #13</b> Cowper St. / Churchill Ave.</p>	<p><b>Intersection #14</b> Churchill Ave. / Embarcadero Rd.</p>	<p><b>Intersection #15</b> Cowper St. / Embarcadero Rd.</p>	<p><b>Intersection #16</b> Waverly St. / Embarcadero Rd.</p>
<p><b>Intersection #17</b> Bryant St. / Embarcadero Rd.</p>	<p><b>Intersection #18</b> Middlefield Rd. / Embarcadero Rd.</p>	<p><b>Intersection #19</b> El Camino Real / Embarcadero Rd.</p>	<p><b>Intersection #20</b> El Camino Real / Churchill Ave.</p>
<p><b>Intersection #21</b> El Camino Real / Oregon Expy.</p>	<p><b>Intersection #22</b> Alma St. / Oregon Expy.</p>	<p><b>Intersection #23</b> Cowper St. / Oregon Expy.</p>	<p><b>Intersection #24</b> Middlefield Rd. / Oregon Expy.</p>



## LEGEND

XX (XX) — AM (PM) Peak Hour Volumes

Table 13: Cumulative Conditions (2030) LOS & Delay

#	Study Intersections	Control	Peak Hour	Cumulative Conditions	
				Average Delay <sup>1</sup> (sec)	LOS
1	Alma Street/Homer Avenue	Signalized	A.M.	20.8	C
			P.M.	27.2	C
3	Alma Street/Lincoln Avenue	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
4	Alma Street/Embarcadero Road	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
5	Emerson Street/Lincoln Avenue	All-Way Stop	A.M.	8.5	A
			P.M.	7.9	A
8	Alma Street/Kingsley Avenue	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
9	Alma Street/Churchill Avenue	Signalized	A.M.	42.4	D
			P.M.	49.3	D
10	Churchill Avenue/Emerson Street	All-Way Stop	A.M.	8.6	A
			P.M.	8.2	A
11	Churchill Avenue/Bryant Street	Two-Way Stop	A.M.	10.9	B
			P.M.	10.6	A
12	Churchill Avenue/Waverly Street	All-Way Stop	A.M.	8.5	A
			P.M.	8.7	A
13	Churchill Avenue/Cowper Street	All-Way Stop	A.M.	7.7	A
			P.M.	7.8	A
14	Churchill Avenue/Embarcadero Road	One-Way Stop	A.M.	9.6	A
			P.M.	9.6	A
15	Embarcadero Road/Cowper Street	Two-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
16	Embarcadero Road/Waverly Street	Signalized	A.M.	26.1	C
			P.M.	23.8	C
17	Embarcadero Road/Bryant Street	Signalized	A.M.	12.6	B
			P.M.	7.1	A
18	Middlefield Road/Embarcadero Road	Signalized	A.M.	>80.0	F
			P.M.	43.4	D
19	El Camino Real/Embarcadero Road	Signalized	A.M.	70.6	E
			P.M.	>80.0	F
20	El Camino Real/Churchill Avenue	Signalized	A.M.	53.1	D
			P.M.	>80.0	F
21	El Camino Real/Oregon Expressway-Page Mill Road	Signalized	A.M.	>80.0	F
			P.M.	76.8	E
22a	Alma Street/Oregon Expressway WB Off Ramp (Oregon Ave)	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
22b	Alma Street/Oregon Expressway EB Off Ramp	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
23	Oregon Expressway/Cowper Street	Signalized	A.M.	25.2	C

#	Study Intersections	Control	Peak Hour	Cumulative Conditions	
				Average Delay <sup>1</sup> (sec)	LOS
			P.M.	18.8	B
24	Oregon Expressway/Middlefield Road	Signalized	A.M.	> <b>80.0</b>	<b>F</b>
			P.M.	> <b>80.0</b>	<b>F</b>

Notes:

<sup>1</sup>Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

Delay is reported as >50.0 for unsignalized intersections with LOS F and >80.0 for signalized intersections consistent with HCM 2000 methodology.

**Bold** indicates unacceptable LOS.

**Table 14** summarizes the 95<sup>th</sup> percentile queue lengths for all approach movements at the study intersections for the weekday a.m. and p.m. peak hour. Cumulative conditions queue length analysis resulted in several intersections with 95<sup>th</sup> percentile queue lengths exceeding storage capacity.

Based on Synchro analysis results, intersections where queue lengths exceed the existing storage lengths are listed below:

- Alma Street/Churchill Avenue for NBL (all peak hours) and SBR (a.m. peak hour)
- Embarcadero Road/Waverly Street for EBL (p.m. peak hour)
- Embarcadero Road/Bryant Street for EBL (p.m. peak hour)
- Embarcadero Road/Middlefield Road for WBL (all peak hours), NBL and SBL (all peak hours)
- El Camino Real/Embarcadero Road for WBL (all peak hours), NBL (a.m. peak hour), and SBL (all peak hours)
- El Camino Real/Churchill Avenue for NBR (p.m. peak hour) and SBL (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road for EBL (a.m. peak hour), WBL (all peak hours), and SBL (p.m. peak hour)
- Oregon Expressway/Middlefield Road for EBL (p.m. peak hour), EBR (all peak hours), WBL (p.m. peak hour), NBL (all peak hours), and SBL (a.m. peak hour)

**Table 14: Cumulative Conditions 95th Percentile Queue Lengths (ft.)**

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Cumulative Conditions	
				A.M.	P.M.
1	Alma Street/Homer Avenue (Signalized)	WBL	-	127	#237
		NBT	-	382	410
		SBT	-	170	326
3	Alma Street/Lincoln Avenue (One-Way Stop Control)	WBLR	-	166	175
		NBT	-	<25	<25
		NBTL	-	<25	<25
		SBTL	-	<25	<25
		SBT	-	<25	<25
4	Alma Street/Embarcadero Road (One-Way Stop Control)	WBR	-	315	269
		NBT	-	<25	<25
		SBT	-	<25	<25
8	Alma Street/Kingsley Avenue (One-Way Stop Control)	WBL	-	55	182
		NBT	-	<25	<25
		SBT	-	<25	<25
9	Alma Street/Churchill Avenue (Signalized)	EBT	-	300	#460
		EBR	-	80	102
		WBT	-	279	256
		NBL	300	<b>388</b>	<b>#440</b>
		NBT	-	863	1008
		SBL	60	28	34
		SBT	-	416	908
11	Churchill Avenue/Bryant Street (Two-Way Stop Control)	SBR	100	<b>156</b>	67
		EBLTR	-	<25	<25
		WBLTR	-	<25	<25
		NBLTR	-	<25	<25
14	Churchill Avenue/Embarcadero Road (One-Way Stop Control)	SBLTR	-	<25	<25
		EBT	-	<25	<25
		EBTR	-	<25	<25
		WBLT	-	<25	<25
		WBT	-	<25	<25
15	Embarcadero Road/Cowper Street (Two-Way Stop Control)	NBR	-	<25	<25
		EBLT	-	<25	<25
		EBTR	-	<25	<25
		WBLT	-	<25	<25
		WBTR	-	<25	<25
16	Embarcadero Road/Waverly Street (Signalized)	NBLTR	-	<25	30
		SBLTR	-	58	43
		EBL	95	79	<b>104</b>
		EBT	-	464	416
		WBL	75	30	25
		WBT	-	361	272
17	Embarcadero Road/Bryant Street (Signalized)	NBT	-	195	141
		SBT	-	263	251
		EBL	80	37	<b>145</b>
		EBT	-	239	288
		WBL	60	m61	m7



#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Cumulative Conditions	
				A.M.	P.M.
		WBT	-	500	338
		NBR	-	<25	<25
		SBR	-	<25	<25
18	Embarcadero Road/Middlefield Road (Signalized)	EBL	115	#95	73
		EBT	-	#664	486
		WBL	100	<b>#124</b>	<b>#166</b>
		WBT	-	#814	392
		NBL	115	<b>#352</b>	<b>#210</b>
		NBT	-	227	212
		SBL	100	<b>#275</b>	<b>#267</b>
		SBT	-	#426	#505
19	El Camino Real/Embarcadero Road (Signalized)	EBL	-	127	#387
		EBT	-	168	#475
		WBL	200	<b>#385</b>	<b>#488</b>
		WBT	-	382	402
		NBL	382	<b>m#401</b>	m250
		NBT	-	m#657	m324
		SBL	300	<b>#505</b>	<b>#525</b>
		SBT	-	502	#705
20	El Camino Real/Churchill Avenue (Signalized)	WBL	-	#594	#682
		NBT	-	#842	#1031
		NBR	100	189	<b>196</b>
		SBL	170	m#154	<b>m#371</b>
		SBT	-	m563	m643
21	El Camino Real/Oregon Expressway-Page Mill Road (Signalized)	EBL	350	<b>#393</b>	#324
		EBT	-	682	#889
		EBR	-	178	274
		WBL	100	<b>210</b>	<b>#367</b>
		WBT	-	#1150	#764
		NBL	300	281	#179
		NBT	-	#878	#657
		SBL	350	#342	<b>#503</b>
		SBT	-	311	641
22a	Alma Street/Oregon Expressway WB Ramps (Oregon Ave) (One-Way Stop Control)	SBR	350	137	84
		WBL	-	38	138
		WBR	-	35	31
		NBT	-	<25	<25
		NBR	-	<25	<25
		SBT	-	<25	<25
22b	Alma Street/Oregon Expressway EB Ramps (One-Way Stop Control)	SBTR	-	<25	<25
		WBR	-	410	448
		NBT	-	<25	<25
		NBR	-	<25	<25
		SBL	-	31	<25
23	Oregon Expressway/Cowper Street (Signalized)	SBT	-	<25	<25
		EBL	115	53	66
		EBT	-	#1048	#1008
		EBR	50	<25	34

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Cumulative Conditions	
				A.M.	P.M.
		WBL	115	m26	m42
		WBT	-	m#872	m837
		NBL	-	#250	100
		NBT	-	114	63
		SBL	-	74	33
		SBT	-	82	88
24	Oregon Expressway/Middlefield Road (Signalized)	EBL	360	m#245	<b>m#371</b>
		EBT	-	#998	#855
		EBR	100	<b>m167</b>	<b>217</b>
		WBL	390	#310	<b>#417</b>
		WBT	-	#1036	#765
		WBR	100	<25	<25
		NBL	230	<b>#606</b>	<b>#462</b>
		NBT	-	514	687
		NBR	-	119	81
		SBL	145	<b>#187</b>	104
SBT	-	225	344		

Notes:

EB, WB, NB, SB – Eastbound, Westbound, Northbound, Southbound respectively.

L, T, R – Left, Through, Right respectively.

Queue lengths taken from Synchro reports.

#: 95<sup>th</sup> percentile volume exceeds capacity, queue may be longer.

m: Volume for 95<sup>th</sup> percentile queue is metered by upstream signal.

**Bold** indicates queue lengths exceeding existing storage capacity.

### CUMULATIVE (2030) PLUS PROJECT CONDITIONS

This scenario is similar to the Cumulative Conditions, with the addition of rerouted traffic from the closure of Churchill Avenue. Trip distribution and assignment for the proposed project are identical to that assumed under Existing Plus Project Conditions. **Figures 17a** and **17b** illustrates the projected rerouted trips due to the closure of Churchill Avenue and **Figures 18a** and **18b** illustrates the total traffic demand under the Cumulative Plus Project scenario for the a.m. and p.m. peak hours.

### CUMULATIVE (2030) PLUS PROJECT LOS & 95<sup>TH</sup> PERCENTILE QUEUE LENGTH ANALYSIS

Existing signal timings were optimized for signalized intersections under this scenario. The proposed intersection geometry of Alma Street/Churchill Avenue that was previously discussed in the Existing Plus Project scenario will also be analyzed in this scenario. The results of the LOS, delay and 95<sup>th</sup> percentile queue length in feet (ft.) analysis using Synchro software are summarized in **Tables 15** and **16** respectively. **Appendix I** contains Synchro reports for all study intersections.

The following intersections operate with unacceptable LOS based on City Standards and the Congestion Management Program (CMP):

- Alma Street/Lincoln Avenue (all peak hours)
- Alma Street/Embarcadero Road (all peak hours)
- Alma Street/Kingsley Avenue (all peak hours)
- Embarcadero Road/Cowper Street (all peak hours)
- Middlefield Road/Embarcadero Road (a.m. peak hour)\*
- El Camino Real/Embarcadero Road (all peak hours)
- El Camino Real/Churchill Avenue (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road (all peak hours)
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue) (all peak hours)
- Alma Street/ Oregon Expressway EB Off Ramp (all peak hours)
- Oregon Expressway/Middlefield Road (all peak hours)

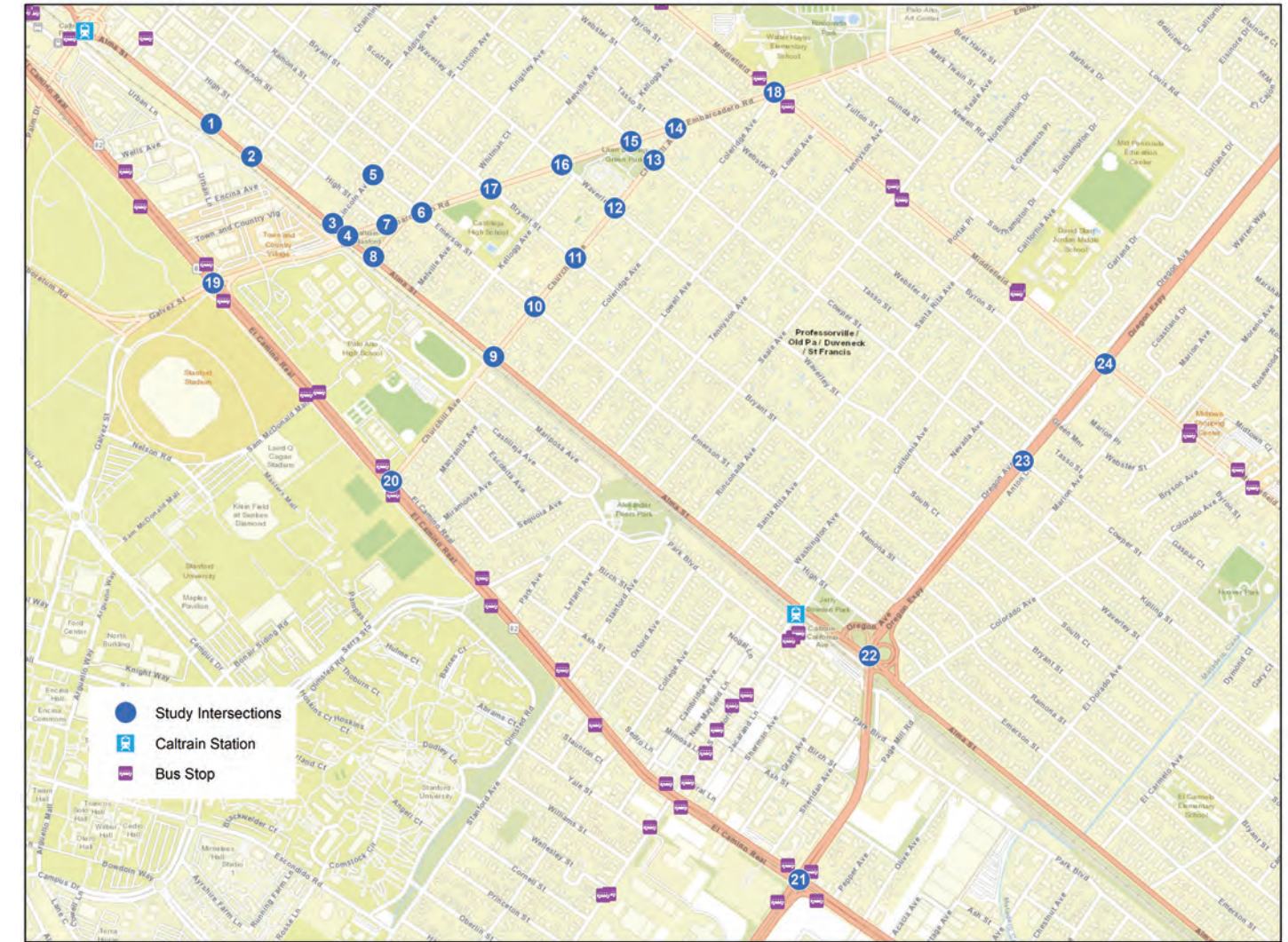
Note: \*LOS reflects pedestrian-scramble phase during 30 minutes of the a.m. peak hour.

# Rerouted Trips during Cumulative Plus Churchill Avenue Closure

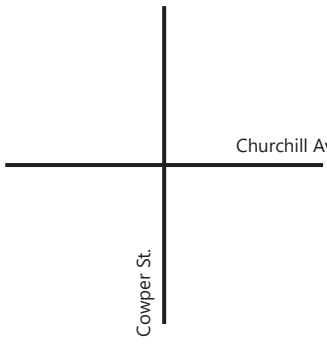
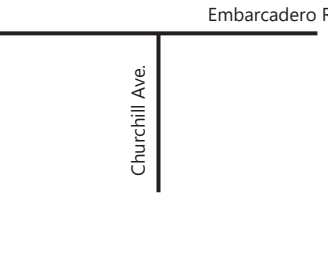
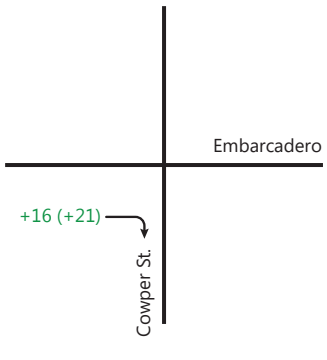
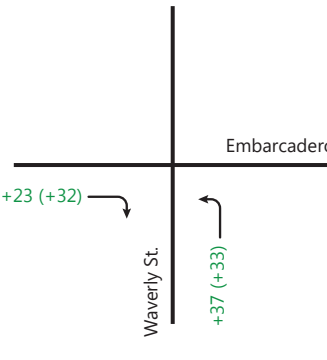
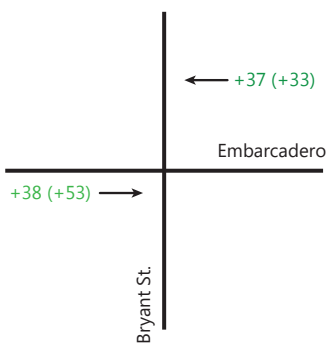
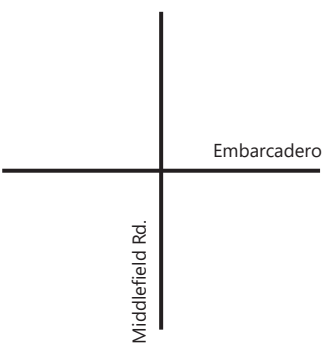
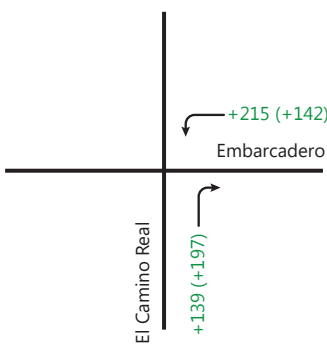
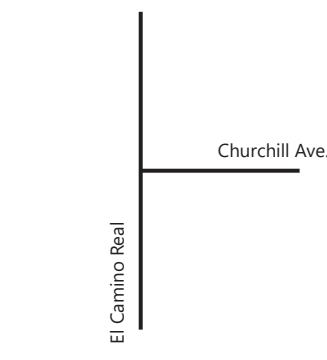
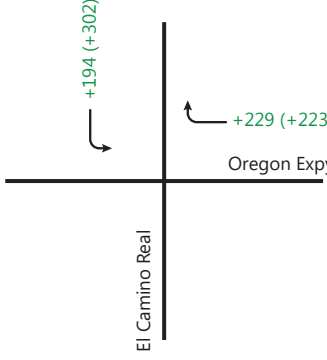
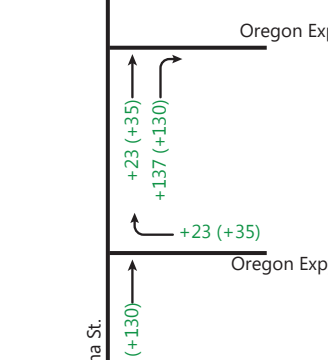
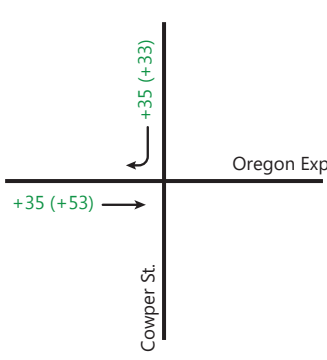
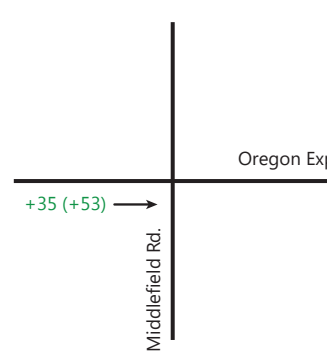
Intersection #1 Alma St. / Homer Ave.	Intersection #2 Alma St. / Channing Ave.	Intersection #3 Alma St. / Lincoln Ave.	Intersection #4 Alma St. / Embarcadero Rd.
Intersection #5 Emerson St. / Lincoln Ave.	Intersection #6 Emerson St. / Embarcadero Rd.	Intersection #7 Embarcadero Rd. / High St.	Intersection #8 Alma St. / Kingsley Ave.
Intersection #9 Alma St. / Churchill Ave.	Intersection #10 Emerson St. / Churchill Ave.	Intersection #11 Bryant St. / Churchill Ave.	Intersection #12 Waverly St. / Churchill Ave.

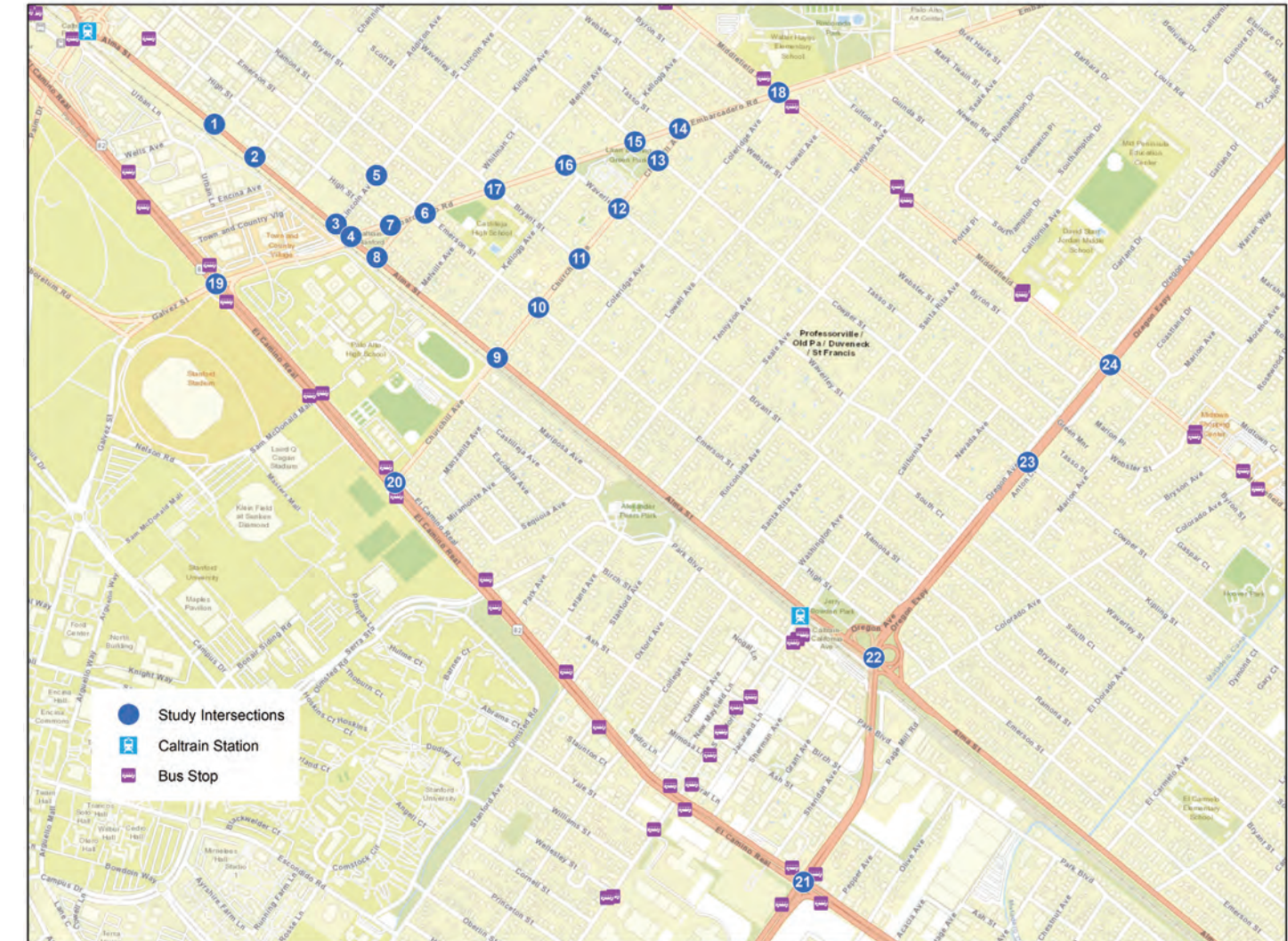
## LEGEND

- +XX — Increase in Trip Volume
- XX — Decrease in Trip Volume
- Indicates Restricted Movement
- XX (XX) — AM (PM) Peak Hour Volumes



# Rerouted Trips during Cumulative Plus Churchill Avenue Closure

<p><b>Intersection #13</b> Cowper St. / Churchill Ave.</p> 	<p><b>Intersection #14</b> Churchill Ave. / Embarcadero Rd.</p> 	<p><b>Intersection #15</b> Cowper St. / Embarcadero Rd.</p> 	<p><b>Intersection #16</b> Waverly St. / Embarcadero Rd.</p> 
<p><b>Intersection #17</b> Bryant St. / Embarcadero Rd.</p> 	<p><b>Intersection #18</b> Middlefield Rd. / Embarcadero Rd.</p> 	<p><b>Intersection #19</b> El Camino Real / Embarcadero Rd.</p> 	<p><b>Intersection #20</b> El Camino Real / Churchill Ave.</p> 
<p><b>Intersection #21</b> El Camino Real / Oregon Expy.</p> 	<p><b>Intersection #22</b> Alma St. / Oregon Expy.</p> 	<p><b>Intersection #23</b> Cowper St. / Oregon Expy.</p> 	<p><b>Intersection #24</b> Middlefield Rd. / Oregon Expy.</p> 

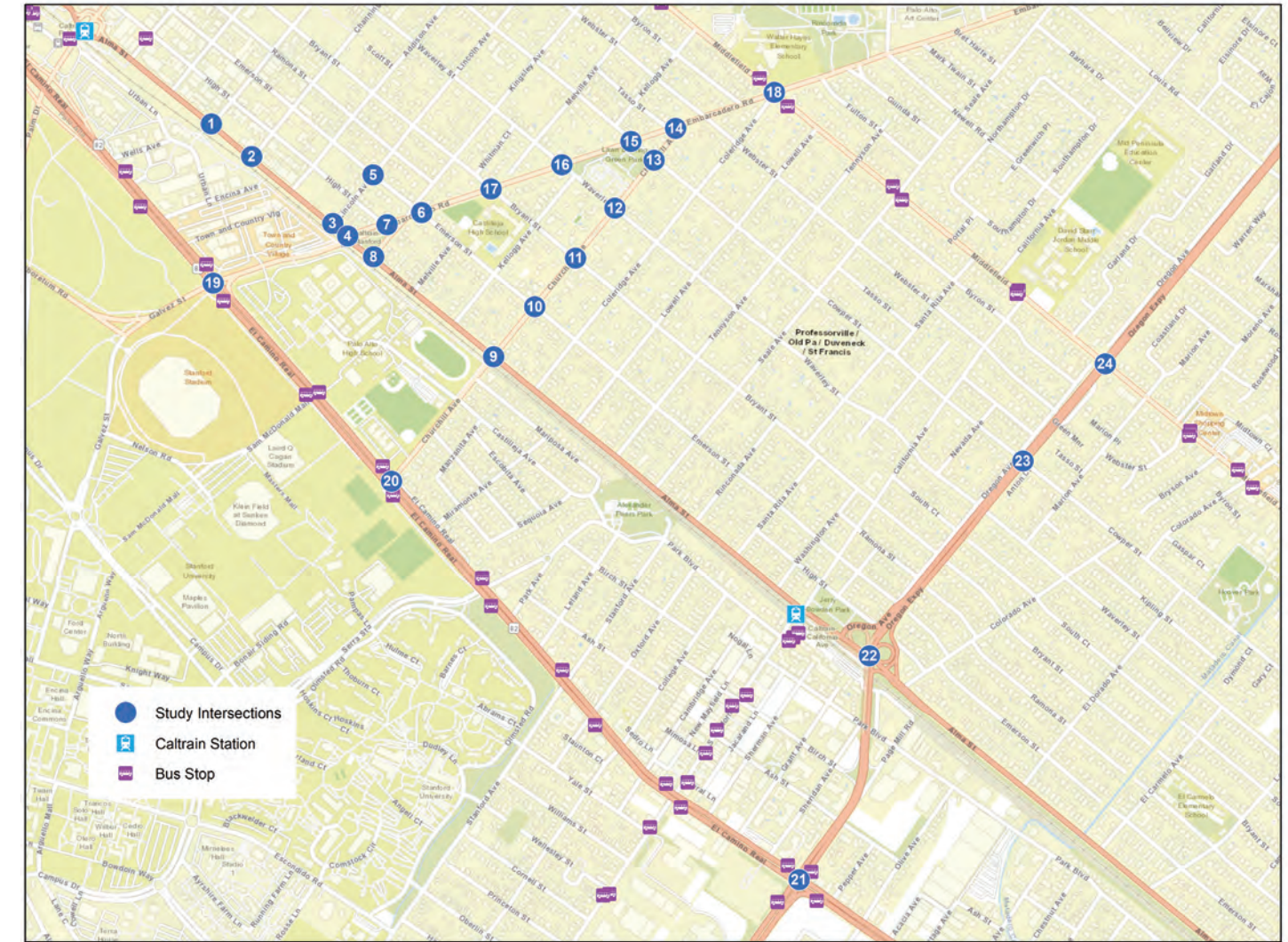


## LEGEND

- +XX — Increase in Trip Volume
- XX — Decrease in Trip Volume
- ↑ ↑ ↑ — Indicates Restricted Movement
- XX (XX) — AM (PM) Peak Hour Volumes

# Cumulative Plus Churchill Avenue Closure Traffic Volumes

Intersection #1 Alma St. / Homer Ave.	Intersection #2 Alma St. / Channing Ave.	Intersection #3 Alma St. / Lincoln Ave.	Intersection #4 Alma St. / Embarcadero Rd.
Intersection #5 Emerson St. / Lincoln Ave.	Intersection #6 Emerson St. / Embarcadero Rd.	Intersection #7 Embarcadero Rd. / High St.	Intersection #8 Alma St. / Kingsley Ave.
Intersection #9 Alma St. / Churchill Ave.	Intersection #10 Emerson St. / Churchill Ave.	Intersection #11 Bryant St. / Churchill Ave.	Intersection #12 Waverly St. / Churchill Ave.



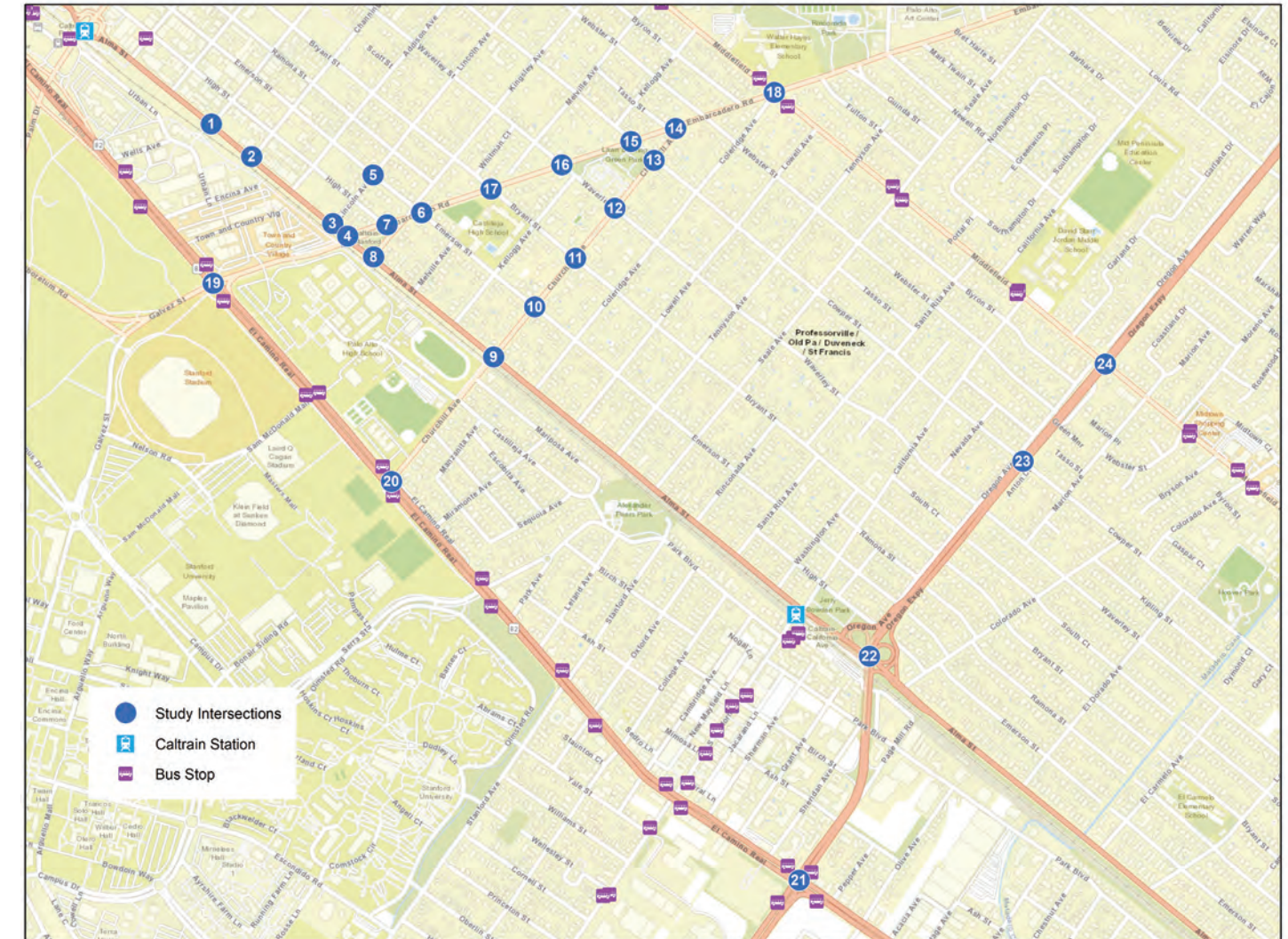
## LEGEND

XX (XX) — AM (PM) Peak Hour Volumes

↑↑↑ — Indicates Restricted Movement

# Cumulative Plus Churchill Avenue Closure Traffic Volumes

<p><b>Intersection #13</b> Cowper St. / Churchill Ave.</p>	<p><b>Intersection #14</b> Churchill Ave. / Embarcadero Rd.</p>	<p><b>Intersection #15</b> Cowper St. / Embarcadero Rd.</p>	<p><b>Intersection #16</b> Waverly St. / Embarcadero Rd.</p>
<p><b>Intersection #17</b> Bryant St. / Embarcadero Rd.</p>	<p><b>Intersection #18</b> Middlefield Rd. / Embarcadero Rd.</p>	<p><b>Intersection #19</b> El Camino Real / Embarcadero Rd.</p>	<p><b>Intersection #20</b> El Camino Real / Churchill Ave.</p>
<p><b>Intersection #21</b> El Camino Real / Oregon Expy.</p>	<p><b>Intersection #22</b> Alma St. / Oregon Expy.</p>	<p><b>Intersection #23</b> Cowper St. / Oregon Expy.</p>	<p><b>Intersection #24</b> Middlefield Rd. / Oregon Expy.</p>



## LEGEND

XX (XX) — AM (PM) Peak Hour Volumes

↑↑↑ — Indicates Restricted Movement

Table 15: Cumulative (2030) Plus Project LOS & Delay

#	Study Intersections	Control	Peak Hour	Cumulative Plus Project	
				Average Delay <sup>1</sup> (sec)	LOS
1	Alma Street/Homer Avenue	Signalized	A.M.	20.8	C
			P.M.	27.2	C
3	Alma Street/Lincoln Avenue	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
4	Alma Street/Embarcadero Road	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
5	Emerson Street/Lincoln Avenue	All-Way Stop	A.M.	9.9	A
			P.M.	8.7	A
8	Alma Street/Kingsley Avenue	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
9	Alma Street/Churchill Avenue	Signalized	A.M.	9.3	A
			P.M.	8.6	A
10	Churchill Avenue/Emerson Street	All-Way Stop	A.M.	8.3	A
			P.M.	8.1	A
11	Churchill Avenue/Bryant Street	Two-Way Stop	A.M.	10.8	B
			P.M.	10.6	A
12	Churchill Avenue/Waverly Street	All-Way Stop	A.M.	8.7	A
			P.M.	8.9	A
13	Churchill Avenue/Cowper Street	All-Way Stop	A.M.	7.7	A
			P.M.	7.8	A
14	Churchill Avenue/Embarcadero Road	One-Way Stop	A.M.	9.6	A
			P.M.	9.7	A
15	Embarcadero Road/Cowper Street	Two-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
16	Embarcadero Road/Waverly Street	Signalized	A.M.	24.2	C
			P.M.	24.9	C
17	Embarcadero Road/Bryant Street	Signalized	A.M.	14.1	B
			P.M.	7.2	A
18	Middlefield Road/Embarcadero Road	Signalized	A.M.	>80.0	F
			P.M.	43.4	D
19	El Camino Real/Embarcadero Road	Signalized	A.M.	>80.0	F
			P.M.	>80.0	F
20	El Camino Real/Churchill Avenue	Signalized	A.M.	50.8	D
			P.M.	>80.0	F
21	El Camino Real/Oregon Expressway-Page Mill Road	Signalized	A.M.	>80.0	F
			P.M.	>80.0	F
22a	Alma Street/Oregon Expressway WB Off Ramp (Oregon Ave)	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
22b	Alma Street/Oregon Expressway EB Off Ramp	One-Way Stop	A.M.	>50.0	F
			P.M.	>50.0	F
23	Oregon Expressway/Cowper Street	Signalized	A.M.	26.1	C



#	Study Intersections	Control	Peak Hour	Cumulative Plus Project	
				Average Delay <sup>1</sup> (sec)	LOS
			P.M.	20.1	C
24	Oregon Expressway/Middlefield Road	Signalized	A.M.	> <b>80.0</b>	<b>F</b>
			P.M.	> <b>80.0</b>	<b>F</b>

Notes:

<sup>1</sup>Delay: Overall intersection delay in seconds per vehicle for signalized and unsignalized all-way stop controlled intersections. Delay for minor approach worst movement or major approach critical movements at unsignalized one-way and two-way stop controlled intersections.

Delay is reported as >50.0 for unsignalized intersections with LOS F and >80.0 for signalized intersections consistent with HCM 2000 methodology.

**Bold** indicates unacceptable LOS.

**Table 16** summarizes the 95<sup>th</sup> percentile queue lengths for all approach movements at the study intersections for the weekday a.m. and p.m. peak hour. Cumulative conditions queue length analysis resulted in several intersections with 95<sup>th</sup> percentile queue lengths exceeding storage capacity.

Based on Synchro analysis results, intersections where queue lengths exceed the existing storage lengths are listed below:

- Embarcadero Road/Waverly Street for EBL (p.m. peak hour)
- Embarcadero Road/Bryant Street for EBL (p.m. peak hour)
- Embarcadero Road/Middlefield Road for WBL (p.m. peak hour), NBL and SBL (all peak hours)
- El Camino Real/Embarcadero Road for WBL (all peak hours), NBL (a.m. peak hour), and SBL (all peak hours)
- El Camino Real/Churchill Avenue for NBR (all peak hours) and SBL (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road for EBL (all peak hours), WBL (all peak hours), and SBL (all peak hours)
- Oregon Expressway/Middlefield Road for EBL (p.m. peak hour), EBR (all peak hours), WBL (p.m. peak hour), NBL (all peak hours), and SBL (a.m. peak hour)

**Table 16: Cumulative (2030) Plus Project 95th Percentile Queue Lengths (ft.)**

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Cumulative Plus Project	
				A.M.	P.M.
1	Alma Street/Homer Avenue (Signalized)	WBL	-	127	#237
		NBT	-	382	410
		SBT	-	170	326
3	Alma Street/Lincoln Avenue (One-Way Stop Control)	WBLR	-	168	184
		NBT	-	<25	<25
		NBTL	-	<25	<25
		SBTL	-	<25	<25
		SBT	-	<25	<25
4	Alma Street/Embarcadero Road (One-Way Stop Control)	WBR	-	345	307
		NBT	-	<25	<25
		SBT	-	<25	<25
8	Alma Street/Kingsley Avenue (One-Way Stop Control)	WBL	-	292	Err
		NBT	-	<25	<25
		SBT	-	<25	<25
9	Alma Street/Churchill Avenue (Signalized)	EBT	-	-	-
		EBR	-	-	-
		WBT	-	141	122
		NBL	-	-	-
		NBT	-	338	397
		SBL	-	-	-
		SBT	-	121	296
11	Churchill Avenue/Bryant Street (Two-Way Stop Control)	EBLTR	-	<25	<25
		WBLTR	-	<25	<25
		NBLTR	-	<25	<25
		SBLTR	-	<25	<25
14	Churchill Avenue/Embarcadero Road (One-Way Stop Control)	EBT	-	<25	<25
		EBTR	-	<25	<25
		WBLT	-	<25	<25
		WBT	-	<25	<25
		NBR	-	<25	<25
15	Embarcadero Road/Cowper Street (Two-Way Stop Control)	EBLT	-	<25	<25
		EBTR	-	<25	<25
		WBLT	-	<25	<25
		WBTR	-	<25	<25
		NBLTR	-	<25	30
16	Embarcadero Road/Waverly Street (Signalized)	SBLTR	-	58	44
		EBL	95	m78	<b>108</b>
		EBT	-	428	442
		WBL	75	34	26
		WBT	-	392	278
		NBT	-	229	172
17	Embarcadero Road/Bryant Street (Signalized)	SBT	-	245	249
		EBL	80	38	<b>154</b>
		EBT	-	252	308
		WBL	60	m57	m7

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Cumulative Plus Project	
				A.M.	P.M.
		WBT	-	511	345
		NBR	-	<25	<25
		SBR	-	<25	<25
18	Embarcadero Road/Middlefield Road (Signalized)	EBL	115	#95	73
		EBT	-	#664	486
		WBL	100	#124	#166
		WBT	-	#814	392
		NBL	115	#352	#210
		NBT	-	227	212
		SBL	100	#275	#267
		SBT	-	#426	#505
19	El Camino Real/Embarcadero Road (Signalized)	EBL	-	119	#339
		EBT	-	168	#475
		WBL	200	#775	#769
		WBT	-	374	397
		NBL	382	m#463	m266
		NBT	-	m#785	m#911
		SBL	300	#588	#537
20	El Camino Real/Churchill Avenue (Signalized)	SBT	-	#575	#769
		WBL	-	#594	#704
		NBT	-	#842	#1005
		NBR	100	189	191
		SBL	170	m102	m#307
21	El Camino Real/Oregon Expressway-Page Mill Road (Signalized)	SBT	-	m513	m562
		EBL	350	#434	#370
		EBT	-	690	#934
		EBR	-	181	276
		WBL	100	211	#383
		WBT	-	#1453	#1081
		NBL	300	281	164
		NBT	-	#934	#718
		SBL	350	#556	#805
22a	Alma Street/Oregon Expressway WB Ramps (Oregon Ave) (One-Way Stop Control)	SBT	-	308	628
		SBR	350	171	79
		WBL	-	39	140
		WBR	-	36	32
		NBT	-	<25	<25
		NBR	-	<25	<25
22b	Alma Street/Oregon Expressway EB Ramps (One-Way Stop Control)	SBT	-	<25	<25
		SBTR	-	<25	<25
		WBR	-	533	614
		NBT	-	<25	<25
		NBR	-	<25	<25
23	Oregon Expressway/Cowper Street (Signalized)	SBL	-	36	<25
		SBT	-	<25	<25
		EBL	115	53	66
		EBT	-	#1087	#1068
		EBR	50	<25	34

#	Study Intersection	Lane Group	Storage Length per lane (ft.)	Cumulative Plus Project	
				A.M.	P.M.
		WBL	115	m26	m43
		WBT	-	m#886	m852
		NBL	-	#255	101
		NBT	-	114	63
		SBL	-	74	33
		SBT	-	102	108
24	Oregon Expressway/Middlefield Road (Signalized)	EBL	360	m#238	<b>m#362</b>
		EBT	-	#1038	#891
		EBR	100	<b>m162</b>	<b>209</b>
		WBL	390	#310	<b>#429</b>
		WBT	-	#1036	#740
		WBR	100	<25	<25
		NBL	230	<b>#606</b>	<b>#474</b>
		NBT	-	511	#705
		NBR	-	122	82
		SBL	145	<b>#194</b>	104
SBT	-	225	344		

Notes:

- EB, WB, NB, SB – Eastbound, Westbound, Northbound, Southbound respectively.
- L, T, R – Left, Through, Right respectively.
- Queue lengths taken from Synchro reports.
- #: 95<sup>th</sup> percentile volume exceeds capacity, queue may be longer.
- m: Volume for 95<sup>th</sup> percentile queue is metered by upstream signal.
- Bold** indicates queue lengths exceeding existing storage capacity.

### PEDESTRIAN, BICYCLE AND TRANSIT IMPACTS

The impact of the closure of Churchill Avenue to pedestrian, bicycle, and transit are discussed in the Existing Plus Project Conditions, and the results are expected to be similar under this scenario.

### MITIGATION MEASURES

Based on the LOS and delay analyses conducted at the study intersections, it was observed that all of the intersections impacted by the closure of Churchill Avenue in the Existing Plus Project scenario would also be impacted in the Cumulative Plus Project scenario. Additionally, the intersection of Oregon Expressway/Middlefield Road would be impacted in the Cumulative Plus Project scenario. Below are the list of intersections that are impacted by the closure of Churchill Avenue.

- Alma Street/Lincoln Avenue
- Alma Street/Embarcadero Road
- Alma Street/Kingsley Avenue
- Embarcadero Road/Cowper Street
- El Camino Real/Embarcadero Road
- El Camino Real/Oregon Expressway-Page Mill Road
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue)

- Alma Street/Oregon Expressway EB Off Ramp
- Oregon Expressway/Middlefield Road

The same mitigation measures discussed in the Existing Plus Project section would be utilized for the first 8 intersections in the list. Below is the potential mitigation measure to alleviate the delay experienced at Oregon Expressway/Middlefield Road:

1. Convert the southbound shared through/right lane into an exclusive right turn lane and convert the northbound right-turn lane into a shared through/right lane. Additionally, add an additional northbound receiving for a short distance and then merge the two lanes into one. Finally, optimize the signal timings and modify the signal phasing to include overlaps for the southbound right-turn and eastbound right-turn.

TJKM evaluated the mitigation measures at the above intersections to ascertain the impact on LOS and delay. **Table 17** summarizes the LOS and delay for the mitigation measures presented. **Appendix J** contains the Synchro LOS reports.

**Table 17: Existing Plus Project with Mitigation LOS & Delay**

#	Study Intersections	Existing Control	Peak Hour	Cumulative Conditions		Cumulative Plus Project		Cumulative Plus Project with Mitigations	
				Delay	LOS	Delay	LOS	Delay	LOS
3	Alma Street/Lincoln Avenue	One-Way Stop	A.M.	>50.0	F	>50.0	F	20.1	C
			P.M.	>50.0	F	>50.0	F	22.4	C
4	Alma Street/Embarcadero Road	One-Way Stop	A.M.	>50.0	F	>50.0	F	51.3	D
			P.M.	>50.0	F	>50.0	F	54.9	D
8	Alma Street/Kingsley Avenue	One-Way Stop	A.M.	>50.0	F	>50.0	F	43.4	D
			P.M.	>50.0	F	>50.0	F	52.3	D
15	Embarcadero Road/Cowper Street	One-Way Stop	A.M.	>50.0	F	>50.0	F	14.7	B
			P.M.	>50.0	F	>50.0	F	12.3	B
19	El Camino Real/Embarcadero Road	Signalized	A.M.	70.6	E	>80.0	F	73.6	E
			P.M.	>80.0	F	>80.0	F	76.2	E
21	El Camino Real/Oregon Expressway-Page Mill Road	Signalized	A.M.	>80.0	F	120.3	F	91.8	F
			P.M.	76.8	E	108.4	F	92.7	F
22a	Alma Street/Oregon Expressway WB Off Ramp (Oregon Ave)	One-Way Stop	A.M.	>50.0	F	>50.0	F	7.8	A
			P.M.	>50.0	F	>50.0	F	9.1	A
22b	Alma Street/Oregon Expressway EB Off Ramp	One-Way Stop	A.M.	>50.0	F	>50.0	F	24.9	C
			P.M.	>50.0	F	>50.0	F	21.5	C
24	Oregon Expressway/Middlefield Road	Signalized	A.M.	>80.0	F	104.0	F	93.7	F
			P.M.	>80.0	F	85.9	F	88.6	F

Notes:

<sup>1</sup>Delay: Overall intersection delay in seconds per vehicle for signalized intersections.

Delay for minor approach worst movement or major approach critical movements at unsignalized one-way stop controlled

intersections.

Delay is reported as >50.0 for unsignalized intersections with LOS F and >80.0 for signalized intersections consistent with HCM 2000 methodology.

**Bold** indicates unacceptable LOS.

Based on the analysis of the proposed mitigations, it was observed that the intersections of Alma Street/Lincoln Avenue, Alma Street/Embarcadero Road, Alma Street/Kingsley Avenue, Embarcadero Road/Cowper Street, El Camino Real/Embarcadero Road, Alma Street/Oregon Expressway WB Off Ramp, and Alma Street/Oregon Expressway EB Off Ramp upgrade to acceptable LOS and delay thresholds with the mitigations applied. Although the LOS is still unacceptable for El Camino Real/Oregon Expressway-Page Mill Road, the delay is significantly decrease when the mitigation is applied. Similarly, the delay for the intersection of Oregon Expressway/Middlefield Road is reduced when the mitigation is applied, but only for the a.m. peak period.

### **Alma Street/Embarcadero Road Concepts**

In addition to the mitigation measures developed for the impacted intersections, TJKM developed near term and long term improvements for Alma Street/Embarcadero Road and the surrounding vicinity. Conceptual drawings can be seen in **Appendix K**. The near term improvement is the mitigation that is described in the Existing Plus Project and Cumulative Plus Project scenarios, which is signalizing the intersections of Alma Street/Embarcadero Road and Alma Street/Kingsley Avenue. The long term improvement is constructing a new Embarcadero Road westbound off ramp and an eastbound on/off ramp that converges onto Alma Street. It should be noted that the conceptual drawings are for discussion purposes only and that the cost and feasibility of these improvements has not been developed yet.

**TIRE INDEX (TRAFFIC INFUSION ON RESIDENTIAL ENVIRONMENT) ANALYSIS**

ADT for seventeen roadway segments were collected, as mentioned in the Data Collection section of the report. A TIRE analysis for Existing Plus Project Conditions and Cumulative Plus Project Conditions was conducted. The results of the TIRE analysis for the Existing Plus Project and Cumulative Plus Project are shown in **Table 18** and **19**, respectively.

The results indicated that the Churchill Avenue Closure will not significantly impact majority of the segments chosen for the study. However, the segments of Emerson Street from Channing Avenue to Addison Avenue and Emerson Street from Lincoln Avenue and Kingsley Avenue will be significantly impacted in both the Existing Plus Project and Cumulative Plus Project conditions. Potential mitigation measures include speed humps, speed tables, chokers, bulb-outs, etc. However, TJKM will collaborate with the City and community to determine which traffic calming measure is most feasible for these roadway segments.

**Table 18: TIRE Analysis – Existing Plus Project**

Segment	Existing		Project Trips <sup>1</sup>	0.1 Change in TIRE Index	
	ADT	TIRE Index		Volume	Impact
Alma Street from Forest Avenue to Homer Avenue	22,857	4.4	0	6,600	No
Emerson Street from Channing Avenue to Addison Avenue	1,313	3.1	1,270	290	Yes
Alma Street from Addison Avenue to Lincoln Avenue	26,828	4.4	0	6,600	No
Bryant Street from Addison Avenue to Lincoln Avenue	2,155	3.3	0	500	No
Waverly Street from Kingsley Avenue to Whitman Court	4,057	3.6	0	1,025	No
Middlefield Road from Walter Hays Elementary School Entrance to Embarcadero Road	10,130	4.0	0	2,300	No
Waverly Street from Churchill Avenue and Coleridge Avenue	2,081	3.3	105	500	No
Bryant Street from Churchill Avenue to Coleridge Avenue	1,144	3.1	105	290	No
Emerson Street from Churchill Avenue to Coleridge Avenue	888	2.9	0	170	No
Alma Street from Coleridge Avenue to Lowell Avenue	27,573	4.4	0	6,600	No
Emerson Street from Lincoln Avenue and Kingsley Avenue	1,515	3.2	1,270	380	Yes
Embarcadero Road from High Street and Alma Street	27,638	4.4	1,580	6,600	No
Embarcadero Road from Webster Street to Tasso Street	26,729	4.4	0	6,600	No
Churchill Avenue from Tasso Street to Cowper Street	1,513	3.2	0	380	No
Churchill Avenue from Alma Street to Emerson Street	3,104	3.5	0	825	No

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Segment	Existing		Project Trips <sup>1</sup>	0.1 Change in TIRE Index	
	ADT	TIRE Index		Volume	Impact
Churchill Avenue from Mariposa Avenue and Caltrain Train Tracks	9,519	4.0	0	2,300	No
Lincoln Avenue from High Street to Emerson Street	1,814	3.3	0	500	No

Notes:

<sup>1</sup>Project Trips determined by rerouting of vehicles during Churchill Avenue Closure. Project Trips = (A.M. + P.M. Peak Hour Trips)\*5

**Table 19: TIRE Analysis – Cumulative (2030) Plus Project**

Segment	Cumulative		Project Trips <sup>2</sup>	0.1 Change in TIRE Index	
	ADT <sup>1</sup>	TIRE Index		Volume	Impact
Alma Street from Forest Avenue to Homer Avenue	25,756	4.4	0	6,600	No
Emerson Street from Channing Avenue to Addison Avenue	1,480	3.2	1,431	380	Yes
Alma Street from Addison Avenue to Lincoln Avenue	30,230	4.5	0	8,200	No
Bryant Street from Addison Avenue to Lincoln Avenue	2,428	3.4	0	650	No
Waverly Street from Kingsley Avenue to Whitman Court	4,572	3.7	0	1,250	No
Middlefield Road from Walter Hays Elementary School Entrance to Embarcadero Road	11,415	4.1	0	3,000	No
Waverly Street from Churchill Avenue and Coleridge Avenue	2,345	3.4	118	650	No
Bryant Street from Churchill Avenue to Coleridge Avenue	1,289	3.1	118	290	No
Emerson Street from Churchill Avenue to Coleridge Avenue	1,001	3.0	0	220	No
Alma Street from Coleridge Avenue to Lowell Avenue	31,070	4.5	0	8,200	No
Emerson Street from Lincoln Avenue and Kingsley Avenue	1,707	3.2	1,431	380	Yes
Embarcadero Road from High Street and Alma Street	31,143	4.5	1,780	8,200	No
Embarcadero Road from Webster Street to Tasso Street	30,119	4.5	0	8,200	No
Churchill Avenue from Tasso Street to Cowper Street	1,705	3.2	0	380	No
Churchill Avenue from Alma Street to Emerson Street	3,498	3.6	0	1,025	No
Churchill Avenue from Mariposa Avenue and Caltrain Train Tracks	10,726	4.1	0	3,000	No
Lincoln Avenue from High Street to Emerson Street	2,044	3.3	0	500	No

Notes:

<sup>1</sup>Existing ADT Projected to Year 2030 Conditions.

<sup>2</sup>Existing Project Trips Projected to Year 2030 Conditions.



### CONCLUSION

This project evaluates traffic operations within the City of Palo Alto for Existing, Existing Plus Project, Cumulative, and Cumulative Plus Project Conditions and determines the impact the possible closure of the Churchill Avenue-Caltrain at-grade rail crossing will have on the neighboring streets and intersections within the vicinity of the closure.

#### Existing Traffic Conditions

Under this scenario, the following intersections operate with unacceptable LOS based on City of Palo Alto Standards and Congestion Management Program (CMP):

- Alma Street/Lincoln Avenue (all peak hours)
- Alma Street/Embarcadero Road (all peak hours)
- Alma Street/Kingsley Avenue (all peak hours)
- Alma Street/Churchill Avenue (a.m. peak hour)
- Embarcadero Road/Cowper Street (all peak hours)
- Embarcadero Road/Middlefield Road (a.m. peak hour)
- El Camino Real/Churchill Avenue (p.m. peak hour)
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue) (all peak hours)
- Alma Street/Oregon Expressway EB Off Ramp (all peak hours)

Synchro analysis was conducted to determine the 95<sup>th</sup> percentile queue lengths at the study intersections. Intersections where queue lengths exceed the existing storage lengths are listed below:

- Alma Street/Churchill Avenue for NBL (all peak hours)
- Embarcadero Road/Waverly Street for EBL (p.m. peak hour)
- Embarcadero Road/Bryant Street for EBL (p.m. peak hour)
- Embarcadero Road/Middlefield Road for WBL (p.m. peak hour), NBL and SBL (all peak hours)
- El Camino Real/Embarcadero Road for WBL (all peak hours), NBL (a.m. peak hour), and SBL (all peak hours)
- El Camino Real/Churchill Avenue for NBR (all peak hours) and SBL (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road for WBL (all peak hours) and SBL (p.m. peak hour)
- Oregon Expressway/Middlefield Road for EBR (all peak hours), NBL (all peak hours), and SBL (a.m. peak hour)

The results of the O-D study suggest that during the a.m. time period, majority of trips (42%) are originating from zones 16, 9, and 17 where each zone contributes approximately 16%, 15% and 11% respectively of total originating trips. Furthermore, during the same time period majority (65%) of the trips are destined for zones 9, 14, and 2 with each zone attracting approximately 36%, 15%, and 14% of total trips. In the p.m. period, over a third of captured trips (37%) are originating from zones 2, 9, and 7 where each zone contributes 13%, 12% and 12%, respectively, of total originating trips. Additionally, during the same time period, majority (63%) of the trips are destined for zones 9, 2, and 5 with each zone attracting approximately 36%, 20% and 7% respectively of total trips.

### Existing Plus Project Traffic Conditions

Under this scenario, the intersections listed above continue to operate at an unacceptable LOS with the exception of Alma Street/Churchill Alma. However with the rerouting of traffic, the intersections of El Camino Real/Embarcadero Road and El Camino Real/Oregon Expressway-Page Mill Road both degrade to unacceptable LOS during both a.m. and p.m. peak hours.

While the proposed underpass at Churchill Avenue is constructed, pedestrians and bicyclists will have to use other crossings within the study area to cross the Caltrain train tracks. Other crossings include the California Avenue Bike/Pedestrian Underpass and the Embarcadero Road underpass. Both crossings are less than a mile from Churchill Avenue, however the travel time for pedestrians and bicyclists will increase as a result of the closure. Transit impacts will be seen at the intersections where there is a degradation of LOS due to the rerouting of traffic.

The mitigation measures presented in the report upgrade the intersections that are impacted by the closure of Churchill Avenue to acceptable LOS and delay thresholds.

### Cumulative Traffic Conditions (2030)

Under this scenario, the study intersections that operate at unacceptable LOS are:

- Alma Street/Lincoln Avenue (all peak hours)
- Alma Street/Embarcadero Road (all peak hours)
- Alma Street/Kingsley Avenue (all peak hours)
- Embarcadero Road/Cowper Street (all peak hours)
- Middlefield Road/Embarcadero Road (a.m. peak hour)
- El Camino Real/Embarcadero Road (p.m. peak hour)
- El Camino Real/Churchill Avenue (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road (a.m. peak hour)
- Alma Street/Oregon Expressway WB Off Ramp (Oregon Avenue) (all peak hours)
- Alma Street/Oregon Expressway EB Off Ramp (all peak hours)
- Oregon Expressway/Middlefield Road (all peak hours)

Intersections where queue lengths exceed storage lengths under the Cumulative Conditions scenario are listed below:

- Alma Street/Churchill Avenue for NBL (all peak hours) and SBR (a.m. peak hour)
- Embarcadero Road/Waverly Street for EBL (p.m. peak hour)
- Embarcadero Road/Bryant Street for EBL (p.m. peak hour)
- Embarcadero Road/Middlefield Road for WBL (all peak hours), NBL and SBL (all peak hours)
- El Camino Real/Embarcadero Road for WBL (all peak hours), NBL (a.m. peak hour), and SBL (all peak hours)
- El Camino Real/Churchill Avenue for NBR (p.m. peak hour) and SBL (p.m. peak hour)
- El Camino Real/Oregon Expressway-Page Mill Road for EBL (a.m. peak hour), WBL (all peak hours), and SBL (p.m. peak hour)

- Oregon Expressway/Middlefield Road for EBL (p.m. peak hour), EBR (all peak hours), WBL (p.m. peak hour), NBL (all peak hours), and SBL (a.m. peak hour)

### **Cumulative (2030) Plus Project Traffic Conditions**

Under this scenario, the intersections listed above in the Cumulative Conditions section continue to operate at an unacceptable LOS due to the added delay caused by the rerouted traffic. Pedestrian, bicycle, and transit impacts are expected to be similar to Existing Plus Project Conditions.

Analysis on the mitigation measures for the intersections impacted by the rerouted traffic show that Alma Street/Lincoln Avenue, Alma Street/Embarcadero Road, Alma Street/Kingsley Avenue, Embarcadero Road/Cowper Street, El Camino Real/Embarcadero Road, Alma Street/Oregon Expressway WB Off Ramp, and Alma Street/Oregon Expressway EB Off Ramp upgrade to acceptable LOS and delay thresholds. Although the LOS is still unacceptable for El Camino Real/Oregon Expressway-Page Mill Road, the delay is significantly decrease when the mitigation is applied. Similarly, the delay for the intersection of Oregon Expressway/Middlefield Road is reduced when the mitigation is applied, but only for the a.m. peak period.

### **TIRE Index**

The TIRE Index analysis for Existing Plus Project Conditions and Cumulative (2030) Plus Project indicates that the segments of Emerson Street from Channing Avenue to Addison Avenue and Emerson Street from Lincoln Avenue to Kingsley Avenue would be impacted by the rerouted traffic caused by the closure of Churchill Avenue.

## Appendix A – TIRE Index Methodology

## TRAFFIC INFUSION ON RESIDENTIAL ENVIRONMENT (TIRE)

TIRE is a measure of the impact of traffic on residents along a street. The TIRE Index Scale ranges from 0 to 5 depending on daily traffic volume. An index of 0 represents the least infusion of traffic. An index of 5 represents the greatest traffic volume, and thereby the poorest residential environment.

### TIRE Index Scale

0	1	2	3	4	5
Very Low	Low	Moderate	High	Very High	

Typical street types associated with the various index levels are shown below:

### TIRE Index Levels

<u>TIRE Index</u>	<u>Daily Traffic Volume</u>	<u>Residential Environment Typical of:</u>
0	1	
		A cul-de-sac street with one home
1	10	
		A cul-de-sac street with two homes
2	100	
		A two-lane minor street
3	1,000	
		A two-lane collector or arterial street
4	10,000	
		A two to six-lane arterial street
5	100,000	

The TIRE Index is derived from a theory by D.K. Goodrich based on work by Appleyard of the University of California at Berkeley, and by Buchanan of the Ministry of Transport, England. TIRE is based on the hypothesis that a given increase in traffic volume has a greater impact on residential environment along a residential street with a low traffic volume than along a street with a high pre-existing volume. TIRE effects are separate from noise and air pollution impacts. TIRE represents the effect of traffic on the safety and comfort of human activities such as walking, bicycling and playing on or near a street and on the freedom to maneuver personal autos in and out of residential driveways.

The TIRE Index table gives TIRE values associated with various daily traffic volume ranges. The mathematical relationships are logarithmic. A street with a TIRE value of 3 or greater is considered to function primarily as a traffic street and to exhibit significantly impaired residential environment. The projected difference between a pre and post-project TIRE value is the predicted impact of the project on residential environment. Any projected change of 0.1 or greater would be noticeable to residents.

**Table 1  
TIRE Index**

Existing Volume Range (Vehicles Per Day)	TIRE Index	Minimum Daily Traffic Volume Increase to Produce	
		a 0.1 Change in the TIRE Index	a 0.2 Change in the TIRE Index
29-35	1.5	+6	+15
36-44	1.6	+8	+20
45-56	1.7	+10	+25
57-70	1.8	+13	+32
71-89	1.9	+17	+41
90-110	2.0	+22	+52
111-140	2.1	+29	+65
141-180	2.2	+40	+80
181-220	2.3	+52	+100
221-280	2.4	+65	+125
281-350	2.5	+79	+160
351-450	2.6	+97	+205
451-560	2.7	+114	+260
561-710	2.8	+140	+330
711-890	2.9	+170	+415
891-1,100	3.0	+220	+520
1,101-1,400	3.1	+290	+650
1,401-1,800	3.2	+380	+800
1,801-2,200	3.3	+500	+1,000
2,201-2,800	3.4	+650	+1,300
2,801-3,500	3.5	+825	+1,700
3,501-4,500	3.6	+1,025	+2,200
4,501-5,600	3.7	+1,250	+2,800
5,601-7,100	3.8	+1,500	+3,500
7,101-8,900	3.9	+1,800	+4,300
8,901-11,000	4.0	+2,300	+5,300
11,001-14,000	4.1	+3,000	+6,500
14,001-18,000	4.2	+4,000	+8,000
18,001-22,000	4.3	+5,200	+10,000
22,001-28,000	4.4	+6,600	+13,000
28,001-35,000	4.5	+8,200	+17,000
35,000-45,000	4.6	+10,000	+22,000
45,001-56,000	4.7	+12,200	+28,000
56,001-71,000	4.8	+14,800	+35,000
71,001-89,000	4.9	+18,000	+43,000

Source: Goodrich Traffic Group, based on curve shapes found in work by Donald Appleyard at the University of California at Berkeley and consideration of earlier thoughts by Buchanan of the Ministry of Transport, England.

## Appendix B – Traffic Counts

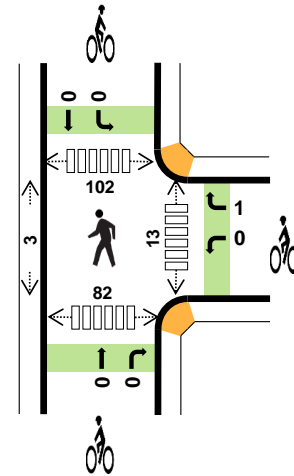
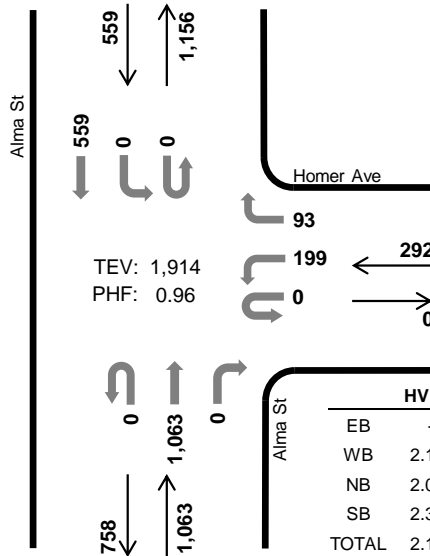
- ADT Counts
- Turning Movement Vehicles, Bicyclists and Pedestrian Counts

### Alma St Homer Ave



Peak Hour

Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 8:00 AM to 9:00 AM



	HV %:	PHF
EB	-	-
WB	2.1%	0.85
NB	2.0%	0.94
SB	2.3%	0.84
TOTAL	2.1%	0.96

#### Two-Hour Count Summaries

Interval Start	0				Homer Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	0	0	0	0	41	0	18	0	0	243	0	0	0	104	0	406	0	
7:45 AM	0	0	0	0	0	54	0	12	0	0	255	0	0	0	143	0	464	0	
8:00 AM	0	0	0	0	0	50	0	36	0	0	242	0	0	0	166	0	494	0	
8:15 AM	0	0	0	0	0	50	0	15	0	0	265	0	0	0	116	0	446	1,810	
8:30 AM	0	0	0	0	0	54	0	22	0	0	274	0	0	0	146	0	496	1,900	
8:45 AM	0	0	0	0	0	45	0	20	0	0	282	0	0	0	131	0	478	1,914	
9:00 AM	0	0	0	0	0	45	0	17	0	0	223	0	0	0	128	0	413	1,833	
9:15 AM	0	0	0	0	0	34	0	25	0	0	221	0	0	0	115	0	395	1,782	
Count Total	0	0	0	0	0	373	0	165	0	0	2,005	0	0	0	1,049	0	3,592	0	
Peak Hour	All	0	0	0	0	0	199	0	93	0	0	1,063	0	0	0	559	0	1,914	0
	HV	0	0	0	0	0	3	0	3	0	0	21	0	0	0	13	0	40	0
	HV%	-	-	-	-	-	2%	-	3%	-	-	2%	-	-	-	2%	-	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	2	5	2	9	0	1	0	0	1	3	1	14	11	29
7:45 AM	0	1	5	6	12	0	0	0	0	0	3	1	13	7	24
8:00 AM	0	1	5	1	7	0	0	0	0	0	3	0	33	22	58
8:15 AM	0	1	6	5	12	0	0	0	0	0	4	0	24	27	55
8:30 AM	0	2	8	3	13	0	1	0	0	1	4	3	30	17	54
8:45 AM	0	2	2	4	8	0	0	0	0	0	2	0	15	16	33
9:00 AM	0	4	2	4	10	0	0	0	0	0	2	0	21	7	30
9:15 AM	0	1	3	2	6	0	0	0	0	0	2	1	30	4	37
Count Total	0	14	36	27	77	0	2	0	0	2	23	6	180	111	320
Peak Hr	0	6	21	13	40	0	1	0	0	1	13	3	102	82	200



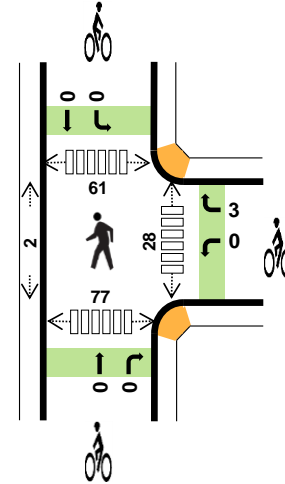
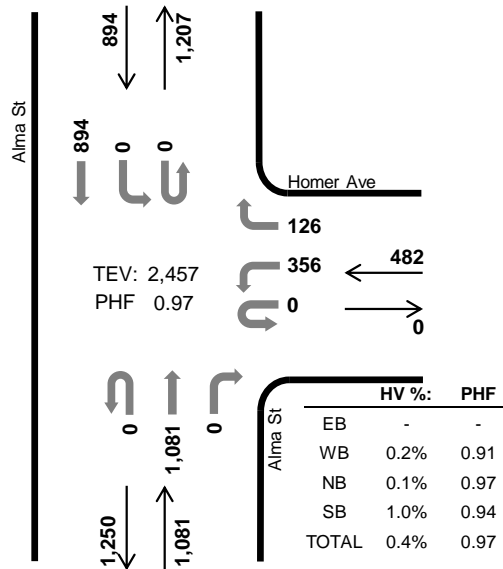
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																			
Interval Start	0				Homer Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	0	0	0	0	2	0	0	0	0	0	5	0	0	0	2	0	9	0
7:45 AM	0	0	0	0	0	1	0	0	0	0	0	5	0	0	0	6	0	12	0
8:00 AM	0	0	0	0	0	1	0	0	0	0	0	5	0	0	0	1	0	7	0
8:15 AM	0	0	0	0	0	0	0	0	1	0	0	6	0	0	0	5	0	12	40
8:30 AM	0	0	0	0	0	2	0	0	0	0	0	8	0	0	0	3	0	13	44
8:45 AM	0	0	0	0	0	0	0	2	0	0	2	0	0	0	4	0	8	40	
9:00 AM	0	0	0	0	0	1	0	3	0	0	2	0	0	0	4	0	10	43	
9:15 AM	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	2	6	37	
Count Total	0	0	0	0	0	8	0	6	0	0	36	0	0	0	27	0	77	0	
Peak Hour	0	0	0	0	0	3	0	3	0	0	21	0	0	0	13	0	40	0	
<b>Two-Hour Count Summaries - Bikes</b>																			
Interval Start	0			Homer Ave			Alma St			Alma St			15-min Total	Rolling One Hour					
	Eastbound			Westbound			Northbound			Southbound									
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT							
7:30 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
8:30 AM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
Count Total	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	
Peak Hour	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																			

### Alma St Homer Ave



Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:30 PM to 6:30 PM



#### Two-Hour Count Summaries

Interval Start	0				Homer Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	0	0	0	71	0	29	0	0	243	0	0	0	232	0	575	0	
4:45 PM	0	0	0	0	0	90	0	26	0	0	193	0	0	0	255	0	564	0	
5:00 PM	0	0	0	0	0	110	0	34	0	0	214	0	0	0	252	0	610	0	
5:15 PM	0	0	0	0	0	79	0	35	0	0	263	0	0	0	213	0	590	2,339	
5:30 PM	0	0	0	0	0	85	0	40	0	0	257	0	0	0	215	0	597	2,361	
5:45 PM	0	0	0	0	0	84	0	25	0	0	275	0	0	0	238	0	622	2,419	
6:00 PM	0	0	0	0	0	101	0	31	0	0	279	0	0	0	220	0	631	2,440	
6:15 PM	0	0	0	0	0	86	0	30	0	0	270	0	0	0	221	0	607	2,457	
Count Total	0	0	0	0	0	706	0	250	0	0	1,994	0	0	0	1,846	0	4,796	0	
Peak Hour	All	0	0	0	0	0	356	0	126	0	0	1,081	0	0	0	894	0	2,457	0
	HV	0	0	0	0	0	1	0	0	0	0	1	0	0	0	9	0	11	0
	HV%	-	-	-	-	-	0%	-	0%	-	-	0%	-	-	-	1%	-	0%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	0	1	1	2	0	0	0	0	0	3	0	18	11	32
4:45 PM	0	0	2	3	5	0	0	0	0	0	13	0	30	16	59
5:00 PM	0	0	2	2	4	0	0	0	0	0	9	0	30	9	48
5:15 PM	0	0	2	1	3	0	1	0	0	1	3	0	14	13	30
5:30 PM	0	0	0	3	3	0	1	0	0	1	9	0	12	24	45
5:45 PM	0	0	0	1	1	0	2	0	0	2	3	1	12	16	32
6:00 PM	0	1	0	2	3	0	0	0	0	0	10	0	12	19	41
6:15 PM	0	0	1	3	4	0	0	0	0	0	6	1	25	18	50
Count Total	0	1	8	16	25	0	4	0	0	4	56	2	153	126	337
Peak Hr	0	1	1	9	11	0	3	0	0	3	28	2	61	77	168

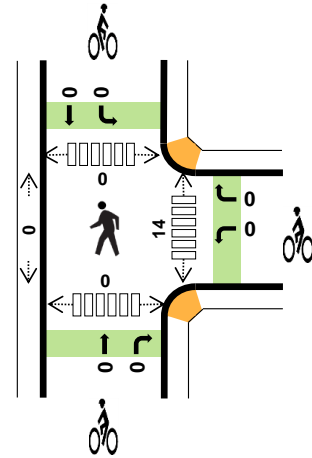
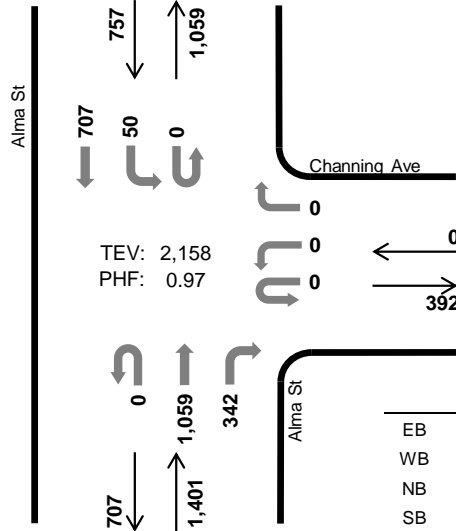
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Homer Ave				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	2	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	5	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	4	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	3	14
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>15</b>
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	11
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>3</b>	<b>10</b>
6:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	4	11
Count Total	0	0	0	0	0	1	0	0	0	0	8	0	0	0	16	0	25	0
Peak Hour	0	0	0	0	0	1	0	0	0	0	1	0	0	0	9	0	11	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Homer Ave			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>2</b>
5:45 PM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	4
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Count Total	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0
Peak Hour	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

# Alma St Channing Ave



Peak Hour

Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 8:00 AM to 9:00 AM



	HV %:	PHF
EB	-	-
WB	-	-
NB	1.6%	0.98
SB	2.1%	0.89
TOTAL	1.8%	0.97

## Two-Hour Count Summaries

Interval Start	0				Channing Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	0	0	0	0	0	0	0	0	0	247	39	0	6	141	0	433	0	
7:45 AM	0	0	0	0	0	0	0	0	0	0	273	61	0	8	187	0	529	0	
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>244</b>	<b>87</b>	<b>0</b>	<b>12</b>	<b>201</b>	<b>0</b>	<b>544</b>	<b>0</b>	
8:15 AM	0	0	0	0	0	0	0	0	0	0	268	84	0	11	156	0	519	2,025	
<b>8:30 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>279</b>	<b>80</b>	<b>0</b>	<b>14</b>	<b>186</b>	<b>0</b>	<b>559</b>	<b>2,151</b>	
8:45 AM	0	0	0	0	0	0	0	0	0	0	268	91	0	13	164	0	536	2,158	
9:00 AM	0	0	0	0	0	0	0	0	0	0	223	69	0	11	163	0	466	2,080	
9:15 AM	0	0	0	0	0	0	0	0	0	0	222	85	0	9	140	0	456	2,017	
Count Total	0	0	0	0	0	0	0	0	0	0	2,024	596	0	84	1,338	0	4,042	0	
Peak Hour	All	0	0	0	0	0	0	0	0	0	0	1,059	342	0	50	707	0	2,158	0
	HV	0	0	0	0	0	0	0	0	0	0	19	4	0	1	15	0	39	0
	HV%	-	-	-	-	-	-	-	-	-	-	2%	1%	-	2%	2%	-	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	0	6	5	11	0	0	0	0	0	4	0	0	0	4
7:45 AM	0	0	6	6	12	0	0	0	0	0	7	0	0	0	7
8:00 AM	0	0	5	2	7	0	0	0	0	0	1	0	0	0	1
8:15 AM	0	0	8	5	13	0	0	0	0	0	4	0	0	0	4
<b>8:30 AM</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>6</b>	<b>13</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>
8:45 AM	0	0	3	3	6	0	0	0	0	0	1	0	0	0	1
9:00 AM	0	0	2	5	7	0	0	0	0	0	4	0	0	0	4
9:15 AM	0	0	2	3	5	0	0	0	0	0	3	0	0	0	3
Count Total	0	0	39	35	74	0	0	0	0	0	32	0	0	0	32
Peak Hr	0	0	23	16	39	0	0	0	0	0	14	0	0	0	14

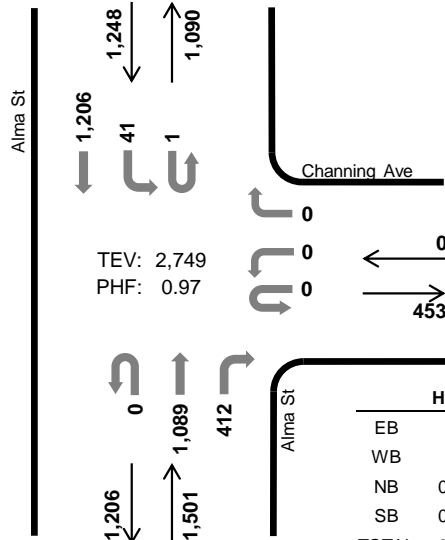
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Channing Ave				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	5	1	0	0	5	0	11	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	4	2	0	1	5	0	12	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	4	1	0	0	2	0	7	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	6	2	0	0	5	0	13	43
8:30 AM	0	0	0	0	0	0	0	0	0	0	7	0	0	1	5	0	13	45
8:45 AM	0	0	0	0	0	0	0	0	0	0	2	1	0	0	3	0	6	39
9:00 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	0	7	39
9:15 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	5	31
Count Total	0	0	0	0	0	0	0	0	0	0	32	7	0	2	33	0	74	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	19	4	0	1	15	0	39	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Channing Ave			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Alma St Channing Ave

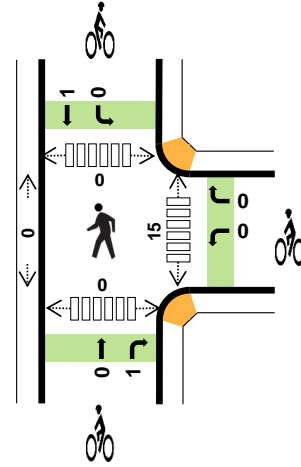


Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:30 PM to 6:30 PM



	HV %:	PHF
EB	-	-
WB	-	-
NB	0.1%	0.96
SB	0.7%	0.98
TOTAL	0.4%	0.97



#### Two-Hour Count Summaries

Interval Start	0				Channing Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	0	0	0	0	0	0	0	0	231	66	0	4	294	0	595	0	
4:45 PM	0	0	0	0	0	0	0	0	0	0	190	79	1	11	336	0	617	0	
5:00 PM	0	0	0	0	0	0	0	0	0	0	227	91	0	16	347	0	681	0	
5:15 PM	0	0	0	0	0	0	0	1	1	0	255	112	0	10	280	0	659	2,552	
5:30 PM	0	0	0	0	0	0	0	0	0	0	266	93	0	9	297	0	665	2,622	
5:45 PM	0	0	0	0	0	0	0	0	0	0	269	113	0	9	303	0	694	2,699	
6:00 PM	0	0	0	0	0	0	0	0	0	0	283	107	0	7	313	0	710	2,728	
6:15 PM	0	0	0	0	0	0	0	0	0	0	271	99	1	16	293	0	680	2,749	
Count Total	0	0	0	0	0	0	0	1	1	0	1,992	760	2	82	2,463	0	5,301	0	
Peak Hour	All	0	0	0	0	0	0	0	0	0	0	1,089	412	1	41	1,206	0	2,749	0
	HV	0	0	0	0	0	0	0	0	0	0	1	0	0	0	9	0	10	0
	HV%	-	-	-	-	-	-	-	-	-	-	0%	0%	0%	0%	1%	-	0%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	0	1	1	2	0	0	0	0	0	4	0	0	0	4
4:45 PM	0	0	2	3	5	0	0	0	0	0	6	0	0	0	6
5:00 PM	0	0	2	2	4	0	0	0	0	0	6	0	0	0	6
5:15 PM	0	0	2	1	3	0	0	0	1	1	2	0	0	0	2
5:30 PM	0	0	0	2	2	0	0	0	0	0	5	0	0	0	5
5:45 PM	0	0	0	1	1	0	0	0	0	0	2	0	0	0	2
6:00 PM	0	0	0	3	3	0	0	0	0	0	5	0	0	0	5
6:15 PM	0	0	1	3	4	0	0	1	1	2	3	0	0	0	3
Count Total	0	0	8	16	24	0	0	1	2	3	33	0	0	0	33
Peak Hr	0	0	1	9	10	0	0	1	1	2	15	0	0	0	15

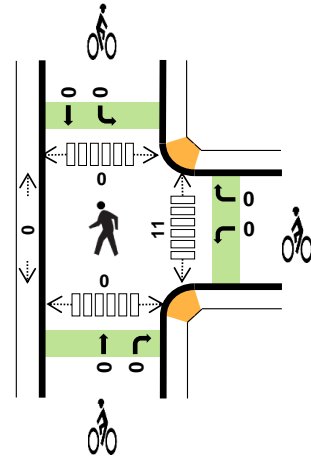
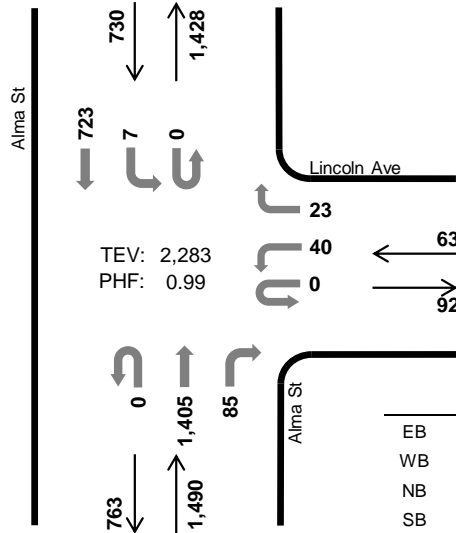
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Channing Ave				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	2	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	5	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	4	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	3	14
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>14</b>
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	10
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>9</b>
6:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	4	10
Count Total	0	0	0	0	0	0	0	0	0	0	8	0	0	0	16	0	24	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	1	0	0	0	9	0	10	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Channing Ave			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
6:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	2	2
Count Total	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	3	3	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	2	0
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

## Alma St Lincoln Ave



Peak Hour

Date: 12-06-2018  
 Count Period: 7:30 AM to 9:30 AM  
 Peak Hour: 8:00 AM to 9:00 AM



	HV %:	PHF
EB	-	-
WB	1.6%	0.93
NB	1.6%	0.97
SB	2.3%	0.92
TOTAL	1.8%	0.99

### Two-Hour Count Summaries

Interval Start	0				Lincoln Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	0	0	0	0	7	0	7	0	0	272	17	0	1	134	0	438	0	
7:45 AM	0	0	0	0	0	8	0	3	0	0	336	19	0	1	188	0	555	0	
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>334</b>	<b>31</b>	<b>0</b>	<b>1</b>	<b>198</b>	<b>0</b>	<b>579</b>	<b>0</b>	
8:15 AM	0	0	0	0	0	11	0	5	0	0	359	24	0	2	165	0	566	2,138	
8:30 AM	0	0	0	0	0	9	0	6	0	0	347	10	0	3	187	0	562	2,262	
8:45 AM	0	0	0	0	0	12	0	5	0	0	365	20	0	1	173	0	576	2,283	
9:00 AM	0	0	0	0	0	4	0	2	0	0	302	6	0	3	165	0	482	2,186	
9:15 AM	0	0	0	0	0	3	0	0	0	0	313	16	0	0	139	0	471	2,091	
Count Total	0	0	0	0	0	62	0	35	0	0	2,628	143	0	12	1,349	0	4,229	0	
Peak Hour	All	0	0	0	0	0	40	0	23	0	0	1,405	85	0	7	723	0	2,283	0
	HV	0	0	0	0	0	0	0	1	0	0	24	0	0	1	16	0	42	0
	HV%	-	-	-	-	-	0%	-	4%	-	-	2%	0%	-	14%	2%	-	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	0	5	4	9	0	0	0	1	1	2	0	0	0	2
7:45 AM	0	1	7	6	14	0	0	0	0	0	3	0	0	0	3
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>2</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
8:15 AM	0	0	7	6	13	0	0	0	0	0	2	0	0	0	2
8:30 AM	0	0	8	4	12	0	0	0	0	0	4	0	0	0	4
8:45 AM	0	1	4	5	10	0	0	0	0	0	1	0	0	0	1
9:00 AM	0	1	2	5	8	0	0	0	0	0	2	0	0	0	2
9:15 AM	0	0	3	3	6	0	0	0	0	0	3	0	0	0	3
Count Total	0	3	41	35	79	0	0	0	1	1	21	0	0	0	21
Peak Hr	0	1	24	17	42	0	0	0	0	0	11	0	0	0	11



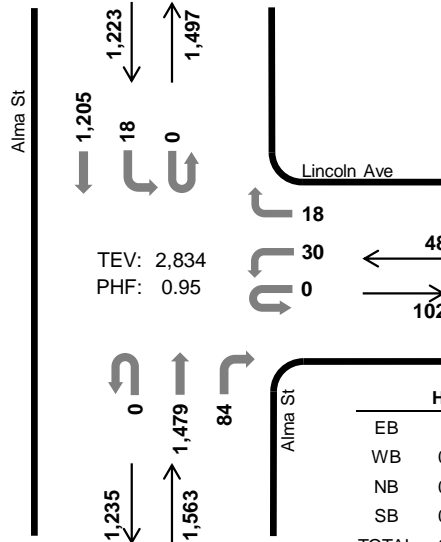
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Lincoln Ave				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	4	1	0	0	4	0	9	0
7:45 AM	0	0	0	0	0	1	0	0	0	0	6	1	0	0	6	0	14	0
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>7</b>	<b>0</b>
8:15 AM	0	0	0	0	0	0	0	0	0	0	7	0	0	1	5	0	13	43
8:30 AM	0	0	0	0	0	0	0	0	0	0	8	0	0	0	4	0	12	46
8:45 AM	0	0	0	0	0	0	0	1	0	0	4	0	0	0	5	0	10	42
9:00 AM	0	0	0	0	0	1	0	0	0	0	2	0	0	0	5	0	8	43
9:15 AM	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	6	36
Count Total	0	0	0	0	0	2	0	1	0	0	39	2	0	1	34	0	79	0
Peak Hour	0	0	0	0	0	0	0	1	0	0	24	0	0	1	16	0	42	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Lincoln Ave			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0		
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>		
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	
Peak Hour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Alma St Lincoln Ave



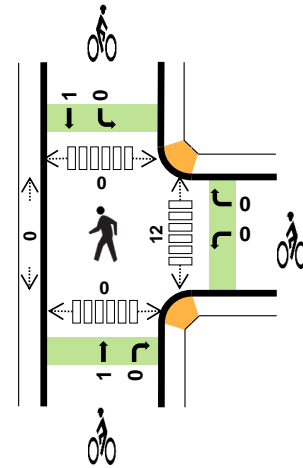
Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:30 PM to 6:30 PM



TEV: 2,834  
PHF: 0.95

	HV %:	PHF
EB	-	-
WB	0.0%	0.75
NB	0.1%	0.94
SB	0.7%	0.95
TOTAL	0.3%	0.95



#### Two-Hour Count Summaries

Interval Start	0				Lincoln Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	0	0	0	9	0	0	0	0	309	14	0	0	306	0	638	0	
4:45 PM	0	0	0	0	0	11	0	4	0	0	252	22	0	1	330	0	620	0	
5:00 PM	0	0	0	0	0	4	0	3	0	0	317	23	0	2	350	0	699	0	
5:15 PM	0	0	0	0	0	10	0	5	0	0	366	14	0	5	288	0	688	2,645	
5:30 PM	0	0	0	0	0	8	0	3	0	0	354	15	0	2	296	0	678	2,685	
5:45 PM	0	0	0	0	0	8	0	8	0	0	373	18	0	11	294	0	712	2,777	
6:00 PM	0	0	0	0	0	3	0	3	0	0	389	28	0	1	320	0	744	2,822	
6:15 PM	0	0	0	0	0	11	0	4	0	0	363	23	0	4	295	0	700	2,834	
Count Total	0	0	0	0	0	64	0	30	0	0	2,723	157	0	26	2,479	0	5,479	0	
Peak Hour	All	0	0	0	0	0	30	0	18	0	0	1,479	84	0	18	1,205	0	2,834	0
	HV	0	0	0	0	0	0	0	0	0	0	1	0	0	1	7	0	9	0
	HV%	-	-	-	-	-	0%	-	0%	-	-	0%	0%	-	6%	1%	-	0%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	1	1	1	3	0	0	0	0	0	2	0	0	0	2
4:45 PM	0	0	2	3	5	0	0	0	0	0	3	0	0	0	3
5:00 PM	0	0	2	2	4	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	2	1	3	0	0	1	1	2	1	0	0	0	1
5:30 PM	0	0	0	2	2	0	0	0	0	0	7	0	0	0	7
5:45 PM	0	0	0	1	1	0	0	0	0	0	2	0	0	0	2
6:00 PM	0	0	0	2	2	0	0	0	0	0	2	0	0	0	2
6:15 PM	0	0	1	3	4	0	0	1	1	2	1	0	0	0	1
Count Total	0	1	8	15	24	0	0	2	2	4	18	0	0	0	18
Peak Hr	0	0	1	8	9	0	0	1	1	2	12	0	0	0	12

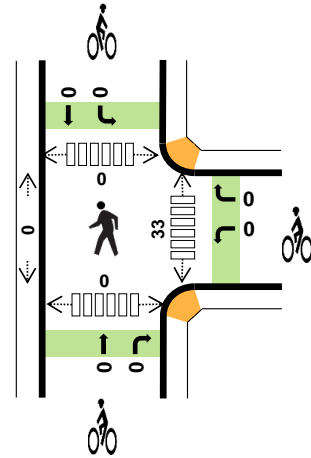
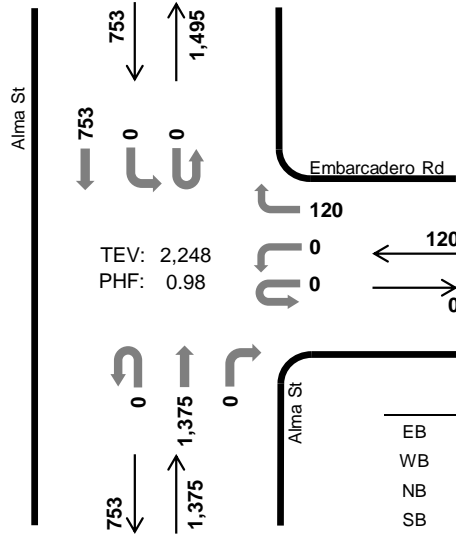
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																			
Interval Start	0				Lincoln Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	3	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	5	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	4	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	3	15
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>14</b>
<b>5:45 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>10</b>
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>8</b>
<b>6:15 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>4</b>	<b>9</b>	
Count Total	0	0	0	0	0	1	0	0	0	0	0	8	0	0	1	14	0	24	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	7	0	9	0
<b>Two-Hour Count Summaries - Bikes</b>																			
Interval Start	0			Lincoln Ave			Alma St			Alma St			15-min Total	Rolling One Hour					
	Eastbound			Westbound			Northbound			Southbound									
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT							
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	2	2
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>5:45 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>6:15 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>2</b>
Count Total	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	4	0	0
Peak Hour	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	0	0
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																			

# Alma St Embarcadero Rd



Peak Hour

Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 8:00 AM to 9:00 AM



	HV %:	PHF
EB	-	-
WB	0.0%	0.83
NB	1.8%	0.95
SB	2.0%	0.90
TOTAL	1.8%	0.98

## Two-Hour Count Summaries

Interval Start	0				Embarcadero Rd				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	0	0	0	0	0	0	30	0	0	275	0	0	0	145	0	450	0	
7:45 AM	0	0	0	0	0	0	0	32	0	0	315	0	0	0	201	0	548	0	
8:00 AM	0	0	0	0	0	0	0	36	0	0	313	0	0	0	209	0	558	0	
8:15 AM	0	0	0	0	0	0	0	23	0	0	359	0	0	0	168	0	550	2,106	
8:30 AM	0	0	0	0	0	0	0	32	0	0	343	0	0	0	200	0	575	2,231	
8:45 AM	0	0	0	0	0	0	0	29	0	0	360	0	0	0	176	0	565	2,248	
9:00 AM	0	0	0	0	0	0	0	36	0	0	267	0	0	0	169	0	472	2,162	
9:15 AM	0	0	0	0	0	0	0	25	0	0	302	0	0	0	146	0	473	2,085	
Count Total	0	0	0	0	0	0	0	243	0	0	2,534	0	0	0	1,414	0	4,191	0	
Peak Hour	All	0	0	0	0	0	0	0	120	0	0	1,375	0	0	0	753	0	2,248	0
	HV	0	0	0	0	0	0	0	0	0	0	25	0	0	0	15	0	40	0
	HV%	-	-	-	-	-	-	-	0%	-	-	2%	-	-	-	2%	-	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	0	6	4	10	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	2	5	8	15	0	0	0	0	0	5	0	0	0	5
8:00 AM	0	0	5	2	7	0	0	0	0	0	18	0	0	0	18
8:15 AM	0	0	8	4	12	0	0	0	0	0	9	0	0	0	9
8:30 AM	0	0	8	4	12	0	0	0	0	0	5	0	0	0	5
8:45 AM	0	0	4	5	9	0	0	0	0	0	1	0	0	0	1
9:00 AM	0	0	2	6	8	0	0	0	0	0	2	0	0	0	2
9:15 AM	0	1	1	3	5	0	0	0	0	0	4	0	0	0	4
Count Total	0	3	39	36	78	0	0	0	0	0	44	0	0	0	44
Peak Hr	0	0	25	15	40	0	0	0	0	0	33	0	0	0	33

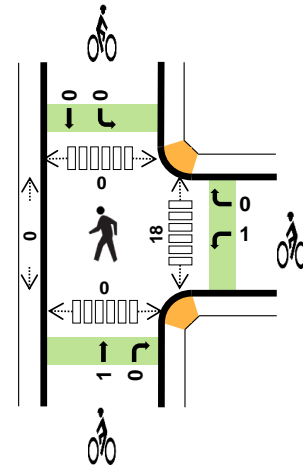
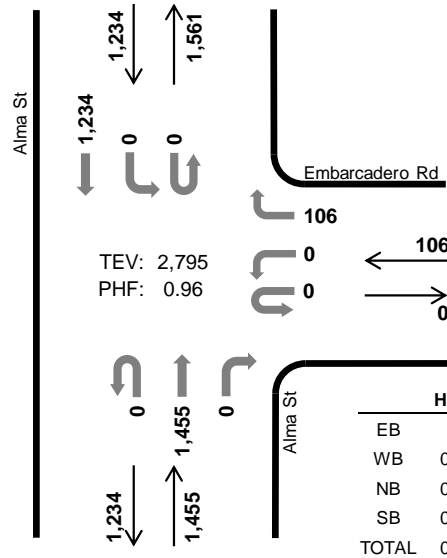
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Embarcadero Rd				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	6	0	0	0	4	0	10	0
7:45 AM	0	0	0	0	0	0	0	2	0	0	5	0	0	0	8	0	15	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	0	2	0	7	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	8	0	0	0	4	0	12	44
8:30 AM	0	0	0	0	0	0	0	0	0	0	8	0	0	0	4	0	12	46
8:45 AM	0	0	0	0	0	0	0	0	0	0	4	0	0	0	5	0	9	40
9:00 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	6	0	8	41
9:15 AM	0	0	0	0	0	0	0	1	0	0	1	0	0	0	3	0	5	34
Count Total	0	0	0	0	0	0	0	3	0	0	39	0	0	0	36	0	78	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	25	0	0	0	15	0	40	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Embarcadero Rd			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Alma St Embarcadero Rd



Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:30 PM to 6:30 PM



	HV %:	PHF
EB	-	-
WB	0.0%	0.66
NB	0.1%	0.98
SB	0.6%	0.98
TOTAL	0.3%	0.96

#### Two-Hour Count Summaries

Interval Start	0				Embarcadero Rd				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	0	0	0	0	0	26	0	0	272	0	0	0	314	0	612	0	
4:45 PM	0	0	0	0	0	0	0	19	0	0	258	0	0	0	348	0	625	0	
5:00 PM	0	0	0	0	0	0	0	19	0	0	341	0	0	0	353	0	713	0	
5:15 PM	0	0	0	0	0	0	0	23	0	0	360	0	0	0	295	0	678	2,628	
5:30 PM	0	0	0	0	0	0	0	21	0	0	351	0	0	0	303	0	675	2,691	
5:45 PM	0	0	0	0	0	0	0	20	0	0	360	0	0	0	314	0	694	2,760	
6:00 PM	0	0	0	0	0	0	0	40	0	0	373	0	0	0	312	0	725	2,772	
6:15 PM	0	0	0	0	0	0	0	25	0	0	371	0	0	0	305	0	701	2,795	
Count Total	0	0	0	0	0	0	0	193	0	0	2,686	0	0	0	2,544	0	5,423	0	
Peak Hour	All	0	0	0	0	0	0	0	106	0	0	1,455	0	0	0	1,234	0	2,795	0
	HV	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7	0	8	0
	HV%	-	-	-	-	-	-	-	0%	-	-	0%	-	-	-	1%	-	0%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

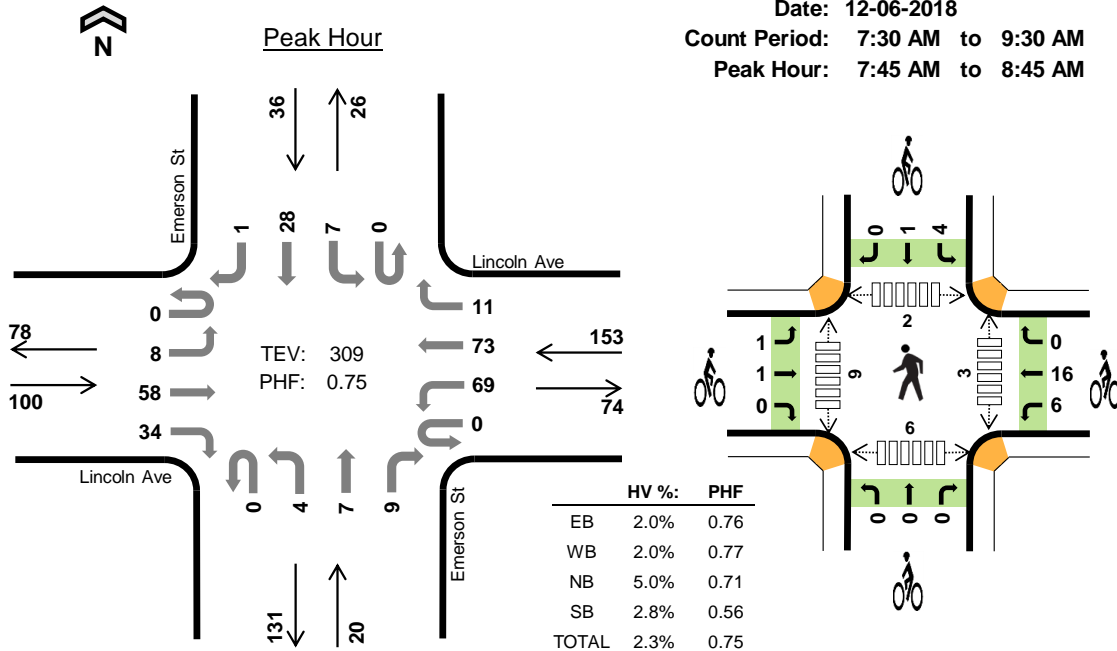
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	0	1	2	3	0	0	0	0	0	4	0	0	0	4
4:45 PM	0	0	2	3	5	0	0	0	0	0	1	0	0	0	1
5:00 PM	0	0	2	2	4	0	0	0	0	0	2	0	0	0	2
5:15 PM	0	0	2	1	3	0	0	0	1	1	1	0	0	0	1
5:30 PM	0	0	0	2	2	0	0	0	0	0	8	0	0	0	8
5:45 PM	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4
6:00 PM	0	0	0	2	2	0	0	0	0	0	4	0	0	0	4
6:15 PM	0	0	1	3	4	0	1	1	0	2	2	0	0	0	2
Count Total	0	0	8	15	23	0	1	1	1	3	26	0	0	0	26
Peak Hr	0	0	1	7	8	0	1	1	0	2	18	0	0	0	18

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Embarcadero Rd				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	3	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	5	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	4	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	3	15
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>14</b>
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>7</b>
6:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	4	8
Count Total	0	0	0	0	0	0	0	0	0	0	8	0	0	0	15	0	23	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7	0	8	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Embarcadero Rd			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
6:15 PM	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	2	2	2
Count Total	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	3	3	0
Peak Hour	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	2	2	0
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

# Emerson St Lincoln Ave



Date: 12-06-2018  
 Count Period: 7:30 AM to 9:30 AM  
 Peak Hour: 7:45 AM to 8:45 AM



### Two-Hour Count Summaries

Interval Start	Lincoln Ave Eastbound				Lincoln Ave Westbound				Emerson St Northbound				Emerson St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	1	8	8	0	15	12	4	0	0	3	0	0	1	1	2	55	0	
7:45 AM	0	2	13	8	0	20	13	1	0	0	1	3	0	0	4	1	66	0	
8:00 AM	0	1	20	12	0	16	30	4	0	0	1	3	0	5	11	0	103	0	
8:15 AM	0	2	19	8	0	19	16	4	0	3	2	2	0	1	5	0	81	305	
8:30 AM	0	3	6	6	0	14	14	2	0	1	3	1	0	1	8	0	59	309	
8:45 AM	0	3	11	14	0	12	15	2	0	1	3	0	0	1	2	0	64	307	
9:00 AM	0	1	6	5	0	3	3	1	0	0	1	3	0	0	7	3	33	237	
9:15 AM	0	0	10	5	0	1	2	1	0	1	8	1	0	2	8	0	39	195	
Count Total	0	13	93	66	0	100	105	19	0	6	22	13	0	11	46	6	500	0	
Peak Hour	All	0	8	58	34	0	69	73	11	0	4	7	9	0	7	28	1	309	0
	HV	0	0	2	0	0	1	1	1	0	0	0	1	0	0	1	0	7	0
	HV%	-	0%	3%	0%	-	1%	1%	9%	-	0%	0%	11%	-	0%	4%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
7:45 AM	1	2	0	0	3	1	4	0	1	6	0	3	1	1	5
8:00 AM	0	0	0	0	0	0	9	0	3	12	2	3	0	1	6
8:15 AM	0	0	1	1	2	0	6	0	0	6	1	1	1	2	5
8:30 AM	1	1	0	0	2	1	3	0	1	5	0	2	0	2	4
8:45 AM	0	0	0	0	0	0	1	0	0	1	0	2	4	1	7
9:00 AM	0	0	0	2	2	0	0	1	0	1	0	3	4	1	8
9:15 AM	0	0	0	0	0	1	0	0	0	1	0	0	0	2	2
Count Total	2	3	1	3	9	3	23	1	5	32	3	15	10	11	39
Peak Hour	2	3	1	1	7	2	22	0	5	29	3	9	2	6	20



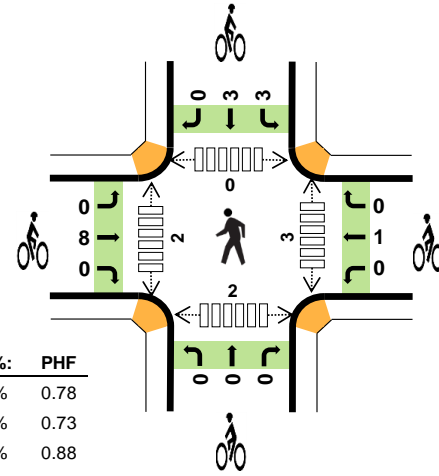
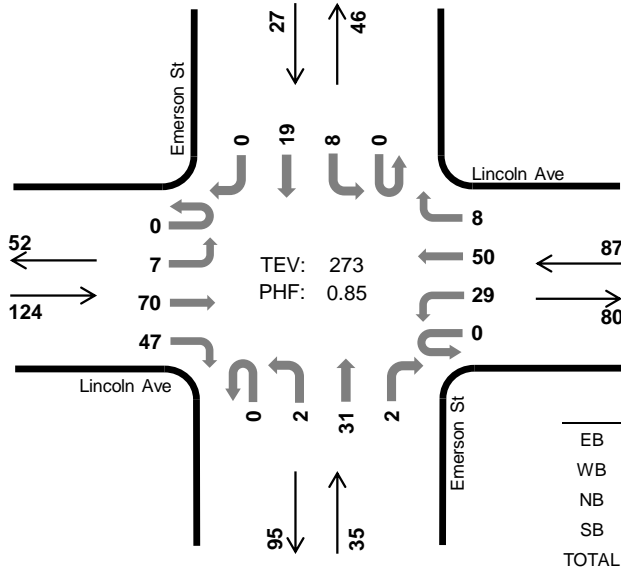
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Lincoln Ave				Lincoln Ave				Emerson St				Emerson St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7:45 AM	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	3	
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	
8:30 AM	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2	
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	
9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Count Total	0	0	2	0	0	1	1	1	0	0	0	1	0	0	1	2	9	
Peak Hour	0	0	2	0	0	1	1	1	0	0	0	1	0	0	1	0	7	
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Lincoln Ave			Lincoln Ave			Emerson St			Emerson St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
7:45 AM	0	1	0	0	4	0	0	0	0	0	0	0	1	0	0	6		
8:00 AM	0	0	0	5	4	0	0	0	0	0	0	3	0	0	0	12		
8:15 AM	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	6		
8:30 AM	1	0	0	1	2	0	0	0	0	0	0	1	0	0	0	5		
8:45 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1		
9:00 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1		
9:15 AM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
Count Total	2	1	0	7	16	0	0	0	1	0	0	4	1	0	0	32		
Peak Hour	1	1	0	6	16	0	0	0	0	0	0	4	1	0	0	29		
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Emerson St Lincoln Ave



Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:30 PM to 6:30 PM



	HV %:	PHF
EB	1.6%	0.78
WB	0.0%	0.73
NB	0.0%	0.88
SB	0.0%	0.84
TOTAL	0.7%	0.85

#### Two-Hour Count Summaries

Interval Start	Lincoln Ave Eastbound				Lincoln Ave Westbound				Emerson St Northbound				Emerson St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	1	9	5	0	10	12	1	0	1	4	0	0	1	7	2	53	0	
4:45 PM	0	0	14	11	0	7	11	4	0	0	4	1	0	5	4	2	63	0	
5:00 PM	0	0	15	8	0	9	6	3	0	0	4	1	0	0	2	0	48	0	
5:15 PM	0	0	14	13	0	13	10	3	0	0	7	1	0	2	1	1	65	229	
5:30 PM	0	4	12	7	0	3	12	1	0	0	8	0	0	2	4	0	53	229	
5:45 PM	0	1	14	13	0	13	13	4	0	0	5	2	0	2	5	0	72	238	
6:00 PM	0	2	23	15	0	6	17	1	0	0	10	0	0	2	4	0	80	270	
6:15 PM	0	0	21	12	0	7	8	2	0	2	8	0	0	2	6	0	68	273	
Count Total	0	8	122	84	0	68	89	19	0	3	50	5	0	16	33	5	502	0	
Peak Hour	All	0	7	70	47	0	29	50	8	0	2	31	2	0	8	19	0	273	0
	HV	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0
	HV%	-	0%	1%	2%	-	0%	0%	0%	-	0%	0%	0%	-	0%	0%	-	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

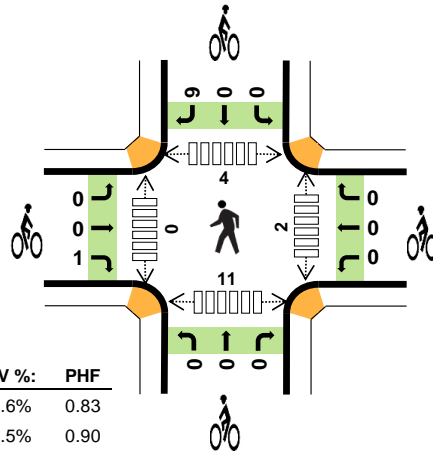
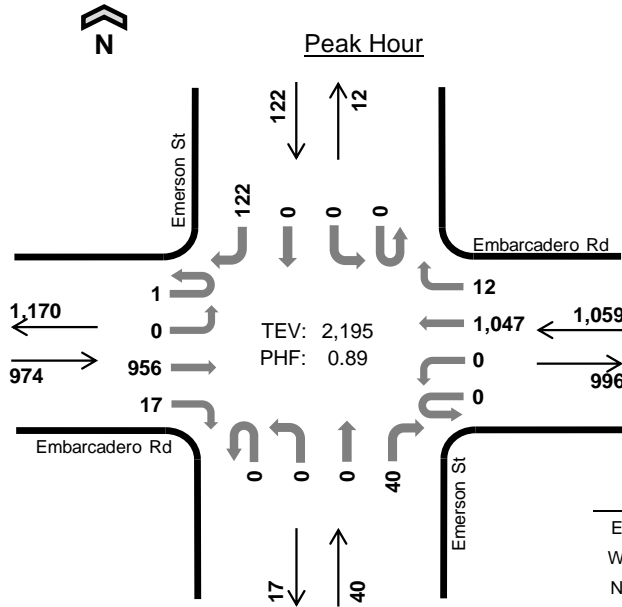
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	1	0	0	1	1	1	0	0	2	4	1	0	2	7
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	2	0	0	1	3	2	2	1	2	7
5:15 PM	0	0	0	0	0	2	1	2	0	5	1	1	0	0	2
5:30 PM	0	0	0	0	0	3	0	0	3	6	0	0	0	1	1
5:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
6:00 PM	1	0	0	0	1	3	0	0	2	5	0	0	0	0	0
6:15 PM	1	0	0	0	1	2	1	0	1	4	2	2	0	1	5
Count Total	2	1	0	0	3	13	3	2	7	25	10	6	1	6	23
Peak Hour	2	0	0	0	2	8	1	0	6	15	3	2	0	2	7

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Lincoln Ave				Lincoln Ave				Emerson St				Emerson St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
6:15 PM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Count Total	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	3	0
Peak Hour	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Lincoln Ave			Lincoln Ave			Emerson St			Emerson St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2	0		
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
5:00 PM	0	2	0	0	0	0	0	0	0	0	0	1	0	3	0			
5:15 PM	1	1	0	0	1	0	0	1	1	0	0	0	0	5	10			
5:30 PM	0	3	0	0	0	0	0	0	0	0	1	2	0	6	14			
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14			
6:00 PM	0	3	0	0	0	0	0	0	0	0	2	0	0	5	16			
6:15 PM	0	2	0	0	1	0	0	0	0	0	0	1	0	4	15			
Count Total	1	12	0	0	2	1	0	1	1	3	4	0	25	0				
Peak Hour	0	8	0	0	1	0	0	0	0	3	3	0	15	0				
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

## Emerson St Embarcadero Rd



Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 7:30 AM to 8:30 AM



	HV %:	PHF
EB	1.6%	0.83
WB	2.5%	0.90
NB	0.0%	0.56
SB	0.8%	0.78
TOTAL	2.0%	0.89

### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Emerson St Northbound				Emerson St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	1	0	217	0	0	0	275	3	0	0	0	5	0	0	0	21	522	0	
7:45 AM	0	0	292	3	0	0	272	1	0	0	0	18	0	0	0	31	617	0	
8:00 AM	0	0	233	6	0	0	291	3	0	0	0	12	0	0	0	39	584	0	
8:15 AM	0	0	214	8	0	0	209	5	0	0	0	5	0	0	0	31	472	2,195	
8:30 AM	0	0	185	3	0	0	224	3	0	0	0	14	0	0	0	28	457	2,130	
8:45 AM	0	0	177	5	0	0	232	3	0	0	0	5	0	0	0	29	451	1,964	
9:00 AM	0	0	163	3	0	0	224	3	0	0	0	4	0	0	0	11	408	1,788	
9:15 AM	0	0	190	2	0	0	214	9	0	0	0	1	0	0	0	14	430	1,746	
Count Total	1	0	1,671	30	0	0	1,941	30	0	0	0	64	0	0	0	204	3,941	0	
Peak Hour	All	1	0	956	17	0	0	1,047	12	0	0	0	40	0	0	0	122	2,195	0
	HV	0	0	15	1	0	0	26	1	0	0	0	0	0	0	0	1	44	0
	HV%	0%	-	2%	6%	-	-	2%	8%	-	-	-	0%	-	-	-	1%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

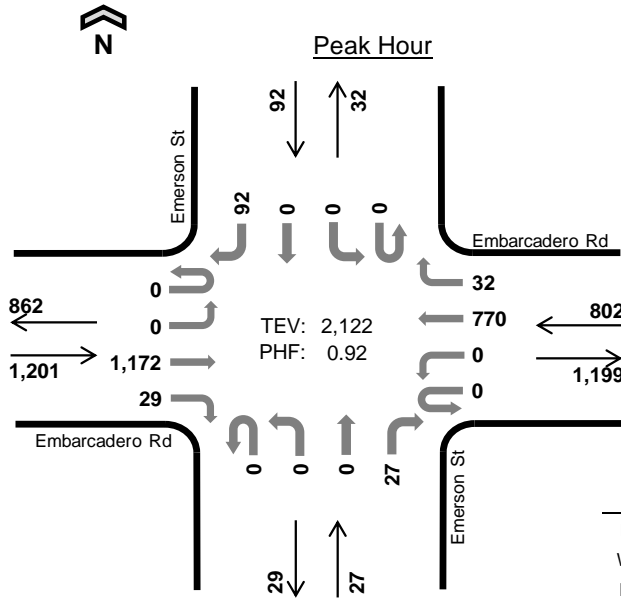
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	4	6	0	0	10	0	0	0	0	0	0	0	2	0	2
7:45 AM	6	7	0	0	13	1	0	0	2	3	0	0	0	5	5
8:00 AM	3	7	0	0	10	0	0	0	6	6	1	0	1	4	6
8:15 AM	3	7	0	1	11	0	0	0	1	1	1	0	1	2	4
8:30 AM	6	7	0	1	14	0	0	0	2	2	0	0	1	2	3
8:45 AM	7	6	0	0	13	0	1	0	0	1	2	0	1	1	4
9:00 AM	5	8	0	0	13	0	0	0	0	0	0	0	0	3	3
9:15 AM	6	7	0	0	13	0	2	0	0	2	0	0	0	2	2
Count Total	40	55	0	2	97	1	3	0	11	15	4	0	6	19	29
Peak Hour	16	27	0	1	44	1	0	0	9	10	2	0	4	11	17

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Emerson St				Emerson St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	4	0	0	0	6	0	0	0	0	0	0	0	0	0	10	0
7:45 AM	0	0	6	0	0	0	7	0	0	0	0	0	0	0	0	0	13	0
8:00 AM	0	0	2	1	0	0	7	0	0	0	0	0	0	0	0	0	10	0
8:15 AM	0	0	3	0	0	0	6	1	0	0	0	0	0	0	0	1	11	44
8:30 AM	0	0	6	0	0	0	7	0	0	0	0	0	0	0	0	1	14	48
8:45 AM	0	0	7	0	0	0	6	0	0	0	0	0	0	0	0	0	13	48
9:00 AM	0	0	5	0	0	0	8	0	0	0	0	0	0	0	0	0	13	51
9:15 AM	0	0	6	0	0	0	7	0	0	0	0	0	0	0	0	0	13	53
Count Total	0	0	39	1	0	0	54	1	0	0	0	0	0	0	0	2	97	0
Peak Hour	0	0	15	1	0	0	26	1	0	0	0	0	0	0	0	1	44	0

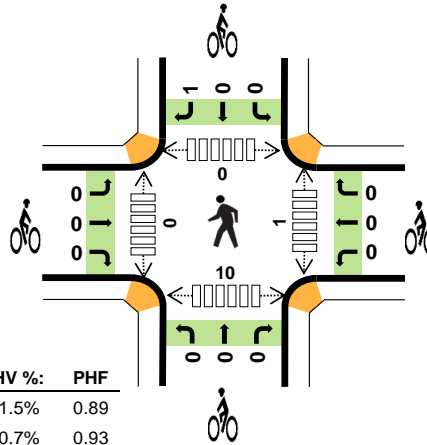
<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Embarcadero Rd			Embarcadero Rd			Emerson St			Emerson St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
7:45 AM	0	0	1	0	0	0	0	0	0	0	0	2	3	0			
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	6	6	0			
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	1	1	10			
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	2	2	12			
8:45 AM	0	0	0	0	1	0	0	0	0	0	0	0	1	10			
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	4			
9:15 AM	0	0	0	0	2	0	0	0	0	0	0	0	2	5			
Count Total	0	0	1	0	3	0	0	0	0	0	0	11	15	0			
Peak Hour	0	0	1	0	0	0	0	0	0	0	0	9	10	0			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

## Emerson St Embarcadero Rd



Date: 12-06-2018  
 Count Period: 4:30 PM to 6:30 PM  
 Peak Hour: 5:30 PM to 6:30 PM



	HV %:	PHF
EB	1.5%	0.89
WB	0.7%	0.93
NB	0.0%	0.68
SB	1.1%	0.82
TOTAL	1.2%	0.92

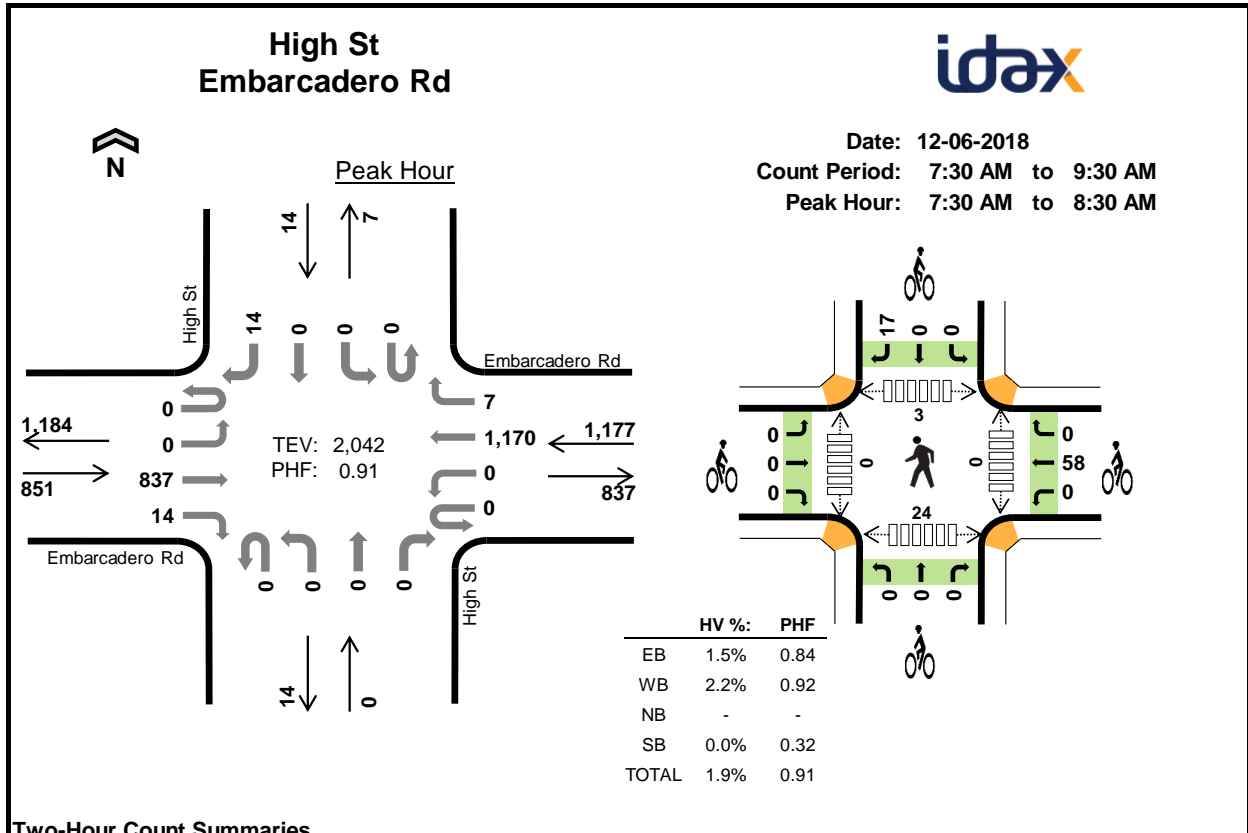
### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Emerson St Northbound				Emerson St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	300	12	0	0	160	4	0	1	0	4	0	0	0	18	499	0	
4:45 PM	0	0	281	7	0	0	145	5	0	0	0	1	0	0	0	22	461	0	
5:00 PM	0	0	272	10	0	0	168	3	0	0	0	2	0	0	0	20	475	0	
5:15 PM	0	0	264	10	0	0	192	7	0	0	0	2	0	0	0	25	500	1,935	
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>327</b>	<b>10</b>	<b>0</b>	<b>0</b>	<b>207</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>9</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>15</b>	<b>576</b>	<b>2,012</b>	
5:45 PM	0	0	275	7	0	0	199	5	0	0	0	6	0	0	0	28	520	2,071	
6:00 PM	0	0	279	7	0	0	197	10	0	0	0	2	0	0	0	25	520	2,116	
6:15 PM	0	0	291	5	0	0	167	9	0	0	0	10	0	0	0	24	506	2,122	
Count Total	0	0	2,289	68	0	0	1,435	51	0	1	0	36	0	0	0	177	4,057	0	
Peak Hour	All	0	0	1,172	29	0	0	770	32	0	0	0	27	0	0	0	92	2,122	0
	HV	0	0	18	0	0	0	6	0	0	0	0	0	0	0	0	1	25	0
	HV%	-	-	2%	0%	-	-	1%	0%	-	-	-	0%	-	-	-	1%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	4	1	1	0	6	0	0	0	0	0	1	0	1	3	5
4:45 PM	10	0	0	0	10	0	0	0	0	0	0	0	1	2	3
5:00 PM	4	4	0	0	8	0	0	0	0	0	0	0	0	2	2
5:15 PM	7	1	0	0	8	0	1	0	0	1	0	0	1	5	6
<b>5:30 PM</b>	<b>4</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>3</b>
5:45 PM	5	0	0	0	5	0	0	0	0	0	0	0	0	3	3
6:00 PM	3	3	0	0	6	0	0	0	0	0	0	0	0	3	3
6:15 PM	6	2	0	1	9	0	0	0	0	0	0	0	0	2	2
Count Total	43	12	1	1	57	0	1	0	1	2	2	0	3	22	27
Peak Hour	18	6	0	1	25	0	0	0	1	1	1	0	0	10	11

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Emerson St				Emerson St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	4	0	0	0	1	0	0	0	0	1	0	0	0	0	6	0
4:45 PM	0	0	8	2	0	0	0	0	0	0	0	0	0	0	0	0	10	0
5:00 PM	0	0	3	1	0	0	4	0	0	0	0	0	0	0	0	0	8	0
5:15 PM	0	0	7	0	0	0	1	0	0	0	0	0	0	0	0	0	8	32
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>31</b>
5:45 PM	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	26
6:00 PM	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	6	24
6:15 PM	0	0	6	0	0	0	2	0	0	0	0	0	0	0	0	1	9	25
Count Total	0	0	40	3	0	0	12	0	0	0	0	1	0	0	0	1	57	0
Peak Hour	0	0	18	0	0	0	6	0	0	0	0	0	0	0	0	1	25	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Embarcadero Rd			Embarcadero Rd			Emerson St			Emerson St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:15 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>2</b>	
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
Count Total	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2	0	
Peak Hour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		



**Two-Hour Count Summaries**

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				High St Northbound				High St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	0	175	1	0	0	295	2	0	0	0	0	0	0	0	0	473	0	
7:45 AM	0	0	251	2	0	0	304	0	0	0	0	0	0	0	0	1	558	0	
8:00 AM	0	0	204	4	0	0	316	4	0	0	0	0	0	0	0	11	539	0	
8:15 AM	0	0	207	7	0	0	255	1	0	0	0	0	0	0	0	2	472	2,042	
8:30 AM	0	0	168	6	0	0	248	1	0	0	0	0	0	0	0	4	427	1,996	
8:45 AM	0	0	156	5	0	0	255	2	0	0	0	0	0	0	0	0	418	1,856	
9:00 AM	0	0	154	4	0	0	233	3	0	0	0	0	0	0	0	1	395	1,712	
9:15 AM	0	0	164	3	0	0	226	1	0	0	0	0	0	0	0	1	395	1,635	
Count Total	0	0	1,479	32	0	0	2,132	14	0	0	0	0	0	0	0	20	3,677	0	
Peak Hour	All	0	0	837	14	0	0	1,170	7	0	0	0	0	0	0	0	14	2,042	0
	HV	0	0	13	0	0	0	26	0	0	0	0	0	0	0	0	0	39	0
	HV%	-	-	2%	0%	-	-	2%	0%	-	-	-	-	-	-	-	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	4	6	0	0	10	0	1	0	0	1	0	0	2	0	2
7:45 AM	6	6	0	0	12	0	3	0	0	3	0	0	1	7	8
8:00 AM	2	8	0	0	10	0	30	0	9	39	0	0	0	14	14
8:15 AM	1	6	0	0	7	0	24	0	8	32	0	0	0	3	3
8:30 AM	7	7	0	0	14	0	6	0	2	8	0	0	1	3	4
8:45 AM	7	6	0	0	13	0	3	0	3	6	0	0	0	4	4
9:00 AM	5	7	0	0	12	0	1	0	1	2	0	0	0	1	1
9:15 AM	6	7	0	0	13	0	3	0	0	3	0	0	0	3	3
Count Total	38	53	0	0	91	0	71	0	23	94	0	0	4	35	39
Peak Hour	13	26	0	0	39	0	58	0	17	75	0	0	3	24	27



<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				High St				High St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	4	0	0	0	6	0	0	0	0	0	0	0	0	0	10	0
7:45 AM	0	0	6	0	0	0	6	0	0	0	0	0	0	0	0	0	12	0
8:00 AM	0	0	2	0	0	0	8	0	0	0	0	0	0	0	0	0	10	0
8:15 AM	0	0	1	0	0	0	6	0	0	0	0	0	0	0	0	0	7	39
8:30 AM	0	0	7	0	0	0	7	0	0	0	0	0	0	0	0	0	14	43
8:45 AM	0	0	7	0	0	0	6	0	0	0	0	0	0	0	0	0	13	44
9:00 AM	0	0	5	0	0	0	7	0	0	0	0	0	0	0	0	0	12	46
9:15 AM	0	0	6	0	0	0	7	0	0	0	0	0	0	0	0	0	13	52
Count Total	0	0	38	0	0	0	53	0	0	0	0	0	0	0	0	0	91	0
Peak Hour	0	0	13	0	0	0	26	0	0	0	0	0	0	0	0	0	39	0

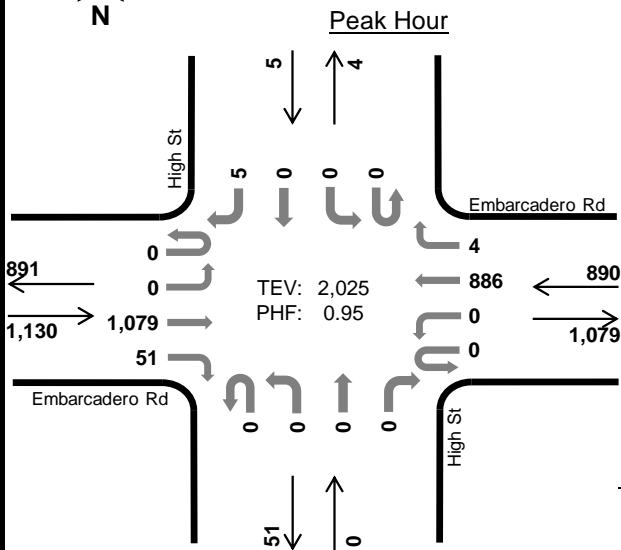
<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Embarcadero Rd			Embarcadero Rd			High St			High St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
7:30 AM	0	0	0	0	1	0	0	0	0	0	0	0	1	0			
7:45 AM	0	0	0	0	3	0	0	0	0	0	0	0	3	0			
8:00 AM	0	0	0	0	30	0	0	0	0	0	0	9	39	0			
8:15 AM	0	0	0	0	24	0	0	0	0	0	0	8	32	75			
8:30 AM	0	0	0	0	6	0	0	0	0	0	0	2	8	82			
8:45 AM	0	0	0	0	3	0	0	0	0	0	0	3	6	85			
9:00 AM	0	0	0	0	1	0	0	0	0	0	0	1	2	48			
9:15 AM	0	0	0	0	3	0	0	0	0	0	0	0	3	19			
Count Total	0	0	0	0	71	0	0	0	0	0	0	23	94	0			
Peak Hour	0	0	0	0	58	0	0	0	0	0	0	17	75	0			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

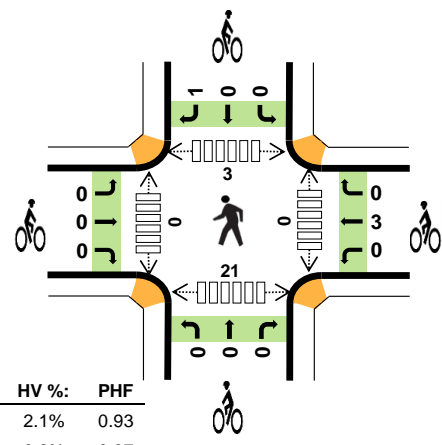
# High St Embarcadero Rd



Date: 12-06-2018  
 Count Period: 4:30 PM to 6:30 PM  
 Peak Hour: 5:15 PM to 6:15 PM



TEV: 2,025  
 PHF: 0.95



	HV %:	PHF
EB	2.1%	0.93
WB	0.8%	0.97
NB	-	-
SB	0.0%	0.42
TOTAL	1.5%	0.95

### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				High St Northbound				High St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	297	29	0	0	177	2	0	0	0	0	0	0	0	2	507	0	
4:45 PM	0	0	270	22	0	0	167	0	0	0	0	0	0	0	0	0	459	0	
5:00 PM	0	0	261	22	0	0	185	0	0	0	0	0	0	0	0	1	469	0	
5:15 PM	0	0	253	8	0	0	214	1	0	0	0	0	0	0	0	0	476	1,911	
5:30 PM	0	0	294	9	0	0	228	1	0	0	0	0	0	0	0	0	532	1,936	
5:45 PM	0	0	261	15	0	0	222	1	0	0	0	0	0	0	0	2	501	1,978	
6:00 PM	0	0	271	19	0	0	222	1	0	0	0	0	0	0	0	3	516	2,025	
6:15 PM	0	0	266	14	0	0	185	3	0	0	0	0	0	0	0	2	470	2,019	
Count Total	0	0	2,173	138	0	0	1,600	9	0	0	0	0	0	0	0	10	3,930	0	
Peak Hour	All	0	0	1,079	51	0	0	886	4	0	0	0	0	0	0	0	5	2,025	0
	HV	0	0	24	0	0	0	7	0	0	0	0	0	0	0	0	0	31	0
	HV%	-	-	2%	0%	-	-	1%	0%	-	-	-	-	-	-	0%	-	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	4	1	0	0	5	0	0	0	0	0	0	0	1	6	7
4:45 PM	8	0	0	0	8	0	0	0	1	1	0	0	2	5	7
5:00 PM	3	3	0	0	6	0	0	0	0	0	0	0	1	8	9
5:15 PM	7	2	0	0	9	0	0	0	1	1	0	0	0	9	9
5:30 PM	5	1	0	0	6	0	1	0	0	1	0	0	1	5	6
5:45 PM	7	1	0	0	8	0	0	0	0	0	0	0	1	4	5
6:00 PM	5	3	0	0	8	0	2	0	0	2	0	0	1	3	4
6:15 PM	6	3	0	0	9	0	0	0	1	1	0	0	1	4	5
Count Total	45	14	0	0	59	0	3	0	3	6	0	0	8	44	52
Peak Hour	24	7	0	0	31	0	3	0	1	4	0	0	3	21	24

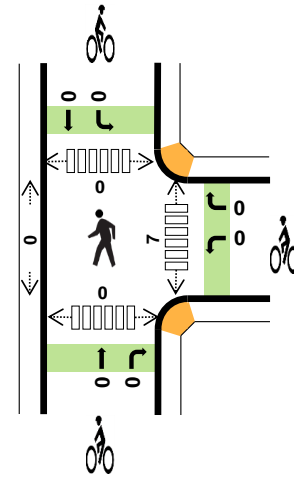
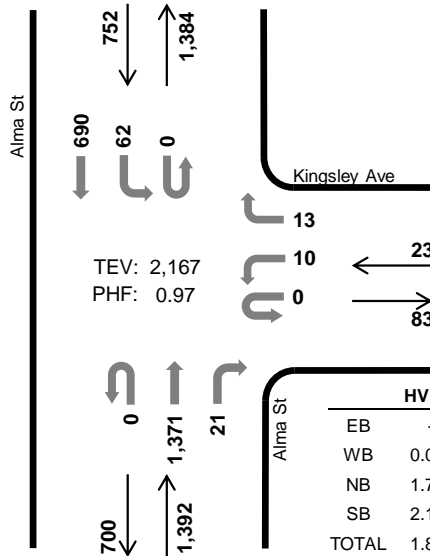
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				High St				High St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	5	0
4:45 PM	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0
5:00 PM	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	6	0
5:15 PM	0	0	7	0	0	0	2	0	0	0	0	0	0	0	0	0	9	28
5:30 PM	0	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	6	29
5:45 PM	0	0	7	0	0	0	1	0	0	0	0	0	0	0	0	0	8	29
6:00 PM	0	0	5	0	0	0	3	0	0	0	0	0	0	0	0	0	8	31
6:15 PM	0	0	6	0	0	0	3	0	0	0	0	0	0	0	0	0	9	31
Count Total	0	0	45	0	0	0	14	0	0	0	0	0	0	0	0	0	59	0
Peak Hour	0	0	24	0	0	0	7	0	0	0	0	0	0	0	0	0	31	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Embarcadero Rd			Embarcadero Rd			High St			High St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	
5:30 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	3	
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	
6:00 PM	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	4	
6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	4	
Count Total	0	0	0	0	0	3	0	0	0	0	0	1	0	2	0	6	0	
Peak Hour	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	4	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Alma St Kingsley Ave



Peak Hour

Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 8:00 AM to 9:00 AM



	HV %:	PHF
EB	-	-
WB	0.0%	0.82
NB	1.7%	0.96
SB	2.1%	0.90
TOTAL	1.8%	0.97

#### Two-Hour Count Summaries

Interval Start	0				Kingsley Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	0	0	0	0	0	0	0	0	0	280	12	0	30	114	0	436	0	
7:45 AM	0	0	0	0	0	1	0	0	0	0	307	14	0	38	166	0	526	0	
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>311</b>	<b>5</b>	<b>0</b>	<b>20</b>	<b>189</b>	<b>0</b>	<b>530</b>	<b>0</b>	
8:15 AM	0	0	0	0	0	4	0	3	0	0	356	5	0	8	160	0	536	2,028	
<b>8:30 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>348</b>	<b>5</b>	<b>0</b>	<b>19</b>	<b>181</b>	<b>0</b>	<b>559</b>	<b>2,151</b>	
8:45 AM	0	0	0	0	0	2	0	3	0	0	356	6	0	15	160	0	542	2,167	
9:00 AM	0	0	0	0	0	2	0	2	0	0	264	4	0	11	159	0	442	2,079	
9:15 AM	0	0	0	0	0	1	0	3	0	0	294	7	0	24	121	0	450	1,993	
Count Total	0	0	0	0	0	14	0	18	0	0	2,516	58	0	165	1,250	0	4,021	0	
Peak Hour	All	0	0	0	0	0	10	0	13	0	0	1,371	21	0	62	690	0	2,167	0
	HV	0	0	0	0	0	0	0	0	0	0	24	0	0	3	13	0	40	0
	HV%	-	-	-	-	-	0%	-	0%	-	-	2%	0%	-	5%	2%	-	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	0	5	4	9	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	8	7	15	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	5	2	7	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	0	7	5	12	0	0	0	0	0	0	0	0	0	0
<b>8:30 AM</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>4</b>	<b>12</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
8:45 AM	0	0	4	5	9	0	0	0	0	0	3	0	0	0	3
9:00 AM	0	0	2	6	8	0	0	0	0	0	1	0	0	0	1
9:15 AM	0	0	2	3	5	0	0	0	0	0	3	0	0	0	3
Count Total	0	0	41	36	77	0	0	0	0	0	11	0	0	0	11
Peak Hr	0	0	24	16	40	0	0	0	0	0	7	0	0	0	7

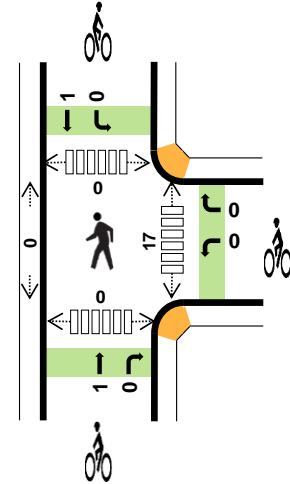
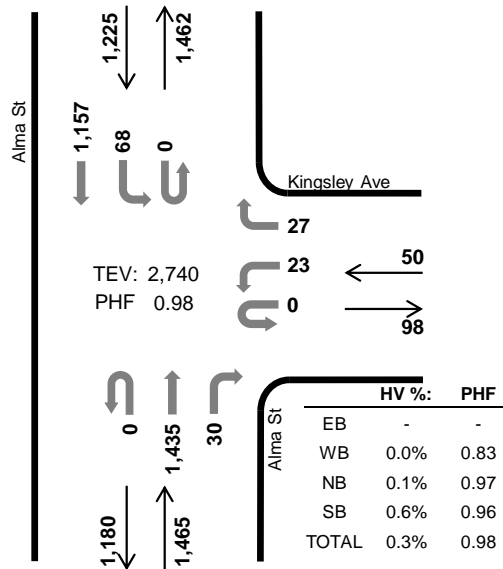
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Kingsley Ave				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	1	3	0	9	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	7	1	0	0	7	0	15	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	1	1	0	7	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	7	0	0	2	3	0	12	43
8:30 AM	0	0	0	0	0	0	0	0	0	0	8	0	0	0	4	0	12	46
8:45 AM	0	0	0	0	0	0	0	0	0	0	4	0	0	0	5	0	9	40
9:00 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	6	0	8	41
9:15 AM	0	0	0	0	0	0	0	0	0	0	2	0	0	1	2	0	5	34
Count Total	0	0	0	0	0	0	0	0	0	0	40	1	0	5	31	0	77	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	24	0	0	3	13	0	40	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Kingsley Ave			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Alma St Kingsley Ave



Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:30 PM to 6:30 PM



	HV %:	PHF
EB	-	-
WB	0.0%	0.83
NB	0.1%	0.97
SB	0.6%	0.96
TOTAL	0.3%	0.98

#### Two-Hour Count Summaries

Interval Start	0				Kingsley Ave				Alma St				Alma St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	0	0	0	21	0	7	0	0	259	1	0	13	302	0	603	0	
4:45 PM	0	0	0	0	0	15	0	7	0	0	250	4	0	13	335	0	624	0	
5:00 PM	0	0	0	0	0	11	0	8	0	0	336	5	0	9	340	0	709	0	
5:15 PM	0	0	0	0	0	4	0	5	0	0	358	7	0	14	280	0	668	2,604	
5:30 PM	0	0	0	0	0	4	0	4	0	0	348	14	0	23	276	0	669	2,670	
5:45 PM	0	0	0	0	0	5	0	10	0	0	352	5	0	14	296	0	682	2,728	
6:00 PM	0	0	0	0	0	6	0	8	0	0	364	3	0	13	306	0	700	2,719	
6:15 PM	0	0	0	0	0	8	0	5	0	0	371	8	0	18	279	0	689	2,740	
Count Total	0	0	0	0	0	74	0	54	0	0	2,638	47	0	117	2,414	0	5,344	0	
Peak Hour	All	0	0	0	0	0	23	0	27	0	0	1,435	30	0	68	1,157	0	2,740	0
	HV	0	0	0	0	0	0	0	0	0	0	1	0	0	1	6	0	8	0
	HV%	-	-	-	-	-	0%	-	0%	-	-	0%	0%	-	1%	1%	-	0%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

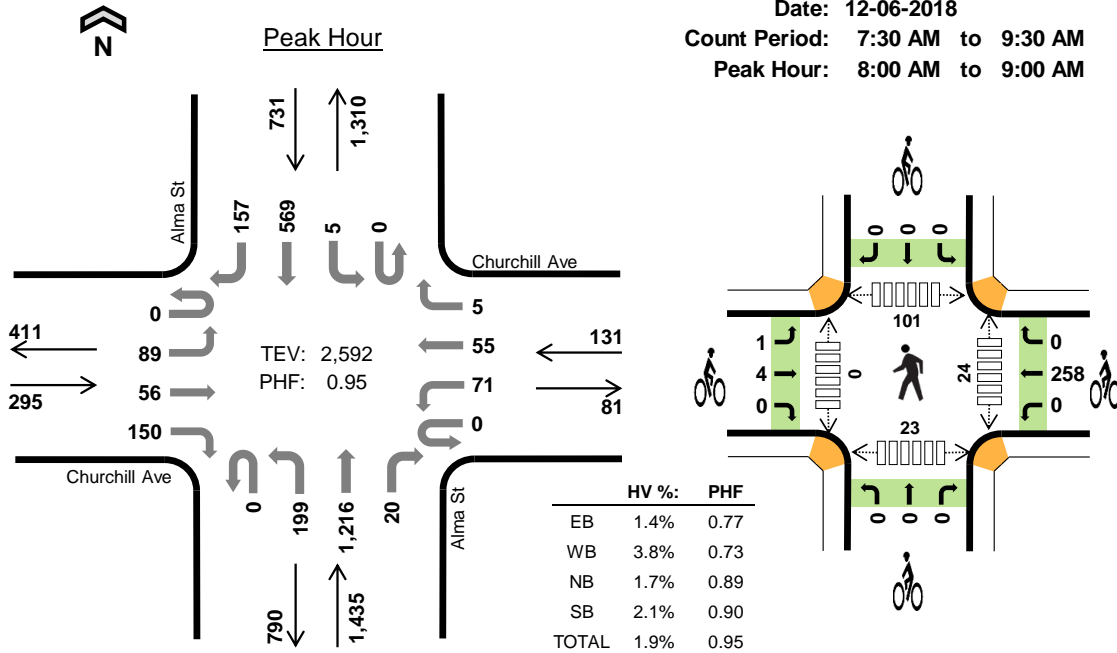
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	0	2	2	4	0	0	0	0	0	3	0	0	0	3
4:45 PM	0	0	4	3	7	0	0	0	0	0	2	0	0	0	2
5:00 PM	0	0	2	2	4	0	0	0	0	0	1	0	0	0	1
5:15 PM	0	0	2	1	3	0	0	0	1	1	1	0	0	0	1
5:30 PM	0	0	0	2	2	0	0	0	0	0	7	0	0	0	7
5:45 PM	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4
6:00 PM	0	0	0	2	2	0	0	0	0	0	4	0	0	0	4
6:15 PM	0	0	1	3	4	0	0	1	1	2	2	0	0	0	2
Count Total	0	0	11	15	26	0	0	1	2	3	24	0	0	0	24
Peak Hr	0	0	1	7	8	0	0	1	1	2	17	0	0	0	17

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Kingsley Ave				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0	4	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	2	2	0	0	3	0	7	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	4	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	3	18
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>16</b>
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>7</b>
6:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	4	8
Count Total	0	0	0	0	0	0	0	0	0	0	8	3	0	1	14	0	26	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	1	0	0	1	6	0	8	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Kingsley Ave			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<b>6:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
6:15 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	2
Count Total	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	3	0	0
Peak Hour	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	0	0
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

# Alma St Churchill Ave



Date: 12-06-2018  
 Count Period: 7:30 AM to 9:30 AM  
 Peak Hour: 8:00 AM to 9:00 AM



### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Alma St Northbound				Alma St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	9	6	26	0	7	10	1	0	56	248	9	0	1	78	14	465	0	
7:45 AM	0	15	17	36	0	16	8	0	0	62	310	10	0	3	141	31	649	0	
<b>8:00 AM</b>	<b>0</b>	<b>16</b>	<b>17</b>	<b>35</b>	<b>0</b>	<b>21</b>	<b>3</b>	<b>2</b>	<b>0</b>	<b>61</b>	<b>285</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>138</b>	<b>65</b>	<b>649</b>	<b>0</b>	
8:15 AM	0	33	16	47	0	22	8	1	0	43	301	2	0	1	144	38	656	2,419	
8:30 AM	0	21	9	32	0	15	28	2	0	34	298	2	0	0	135	30	606	2,560	
<b>8:45 AM</b>	<b>0</b>	<b>19</b>	<b>14</b>	<b>36</b>	<b>0</b>	<b>13</b>	<b>16</b>	<b>0</b>	<b>0</b>	<b>61</b>	<b>332</b>	<b>10</b>	<b>0</b>	<b>4</b>	<b>152</b>	<b>24</b>	<b>681</b>	<b>2,592</b>	
9:00 AM	0	25	18	25	0	14	15	0	0	55	253	6	0	0	140	20	571	2,514	
9:15 AM	0	17	8	28	0	5	9	1	0	40	286	1	0	1	106	23	525	2,383	
Count Total	0	155	105	265	0	113	97	7	0	412	2,313	46	0	10	1,034	245	4,802	0	
Peak Hour	All	0	89	56	150	0	71	55	5	0	199	1,216	20	0	5	569	157	2,592	0
	HV	0	2	0	2	0	0	5	0	0	5	19	0	0	0	12	3	48	0
	HV%	-	2%	0%	1%	-	0%	9%	0%	-	3%	2%	0%	-	0%	2%	2%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	0	5	2	7	0	1	0	0	1	0	0	2	0	2
7:45 AM	1	0	7	8	16	8	13	0	0	21	1	0	11	11	23
<b>8:00 AM</b>	<b>1</b>	<b>0</b>	<b>6</b>	<b>2</b>	<b>9</b>	<b>2</b>	<b>165</b>	<b>0</b>	<b>0</b>	<b>167</b>	<b>15</b>	<b>0</b>	<b>41</b>	<b>11</b>	<b>67</b>
8:15 AM	1	0	6	3	10	1	81	0	0	82	7	0	38	10	55
8:30 AM	1	1	8	4	14	1	8	0	0	9	1	0	10	1	12
<b>8:45 AM</b>	<b>1</b>	<b>4</b>	<b>4</b>	<b>6</b>	<b>15</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>1</b>	<b>0</b>	<b>12</b>	<b>1</b>	<b>14</b>
9:00 AM	0	1	2	5	8	1	7	0	0	8	2	0	1	3	6
9:15 AM	2	1	2	4	9	1	7	0	0	8	3	0	10	4	17
Count Total	7	7	40	34	88	15	286	0	0	301	30	0	125	41	196
Peak Hour	4	5	24	15	48	5	258	0	0	263	24	0	101	23	148



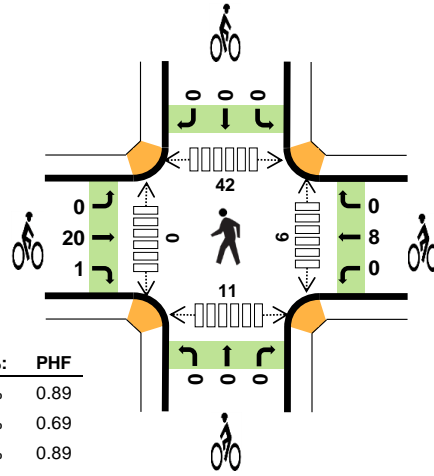
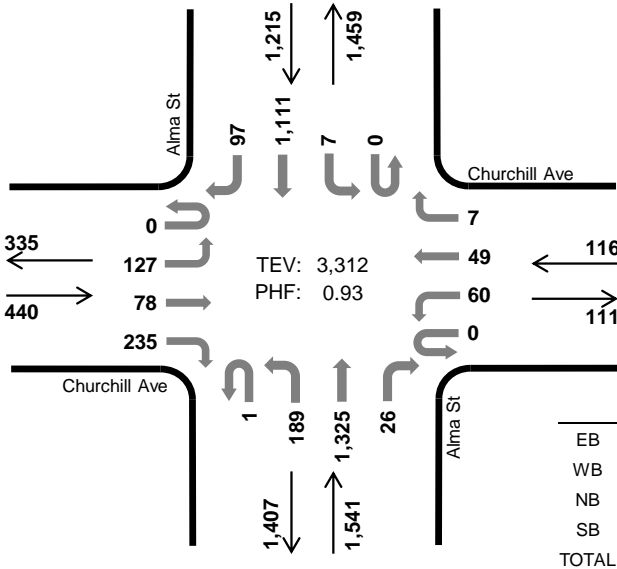
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	5	0	0	0	2	0	7	0
7:45 AM	0	1	0	0	0	0	0	0	0	0	7	0	0	0	8	0	16	0
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>9</b>	<b>0</b>
8:15 AM	0	1	0	0	0	0	0	0	0	2	4	0	0	0	3	0	10	42
8:30 AM	0	0	0	1	0	0	1	0	0	1	7	0	0	0	3	1	14	49
<b>8:45 AM</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>1</b>	<b>15</b>	<b>48</b>
9:00 AM	0	0	0	0	0	0	1	0	0	0	2	0	0	0	3	2	8	47
9:15 AM	0	2	0	0	0	0	1	0	0	2	0	0	0	0	3	1	9	46
Count Total	0	5	0	2	0	0	7	0	0	7	33	0	0	0	28	6	88	0
<b>Peak Hour</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>19</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>12</b>	<b>3</b>	<b>48</b>	<b>0</b>
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Churchill Ave			Churchill Ave			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0		
7:45 AM	0	8	0	0	13	0	0	0	0	0	0	0	0	0	21	0		
<b>8:00 AM</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>165</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>167</b>	<b>0</b>		
8:15 AM	0	1	0	0	81	0	0	0	0	0	0	0	0	0	82	271		
8:30 AM	1	0	0	0	8	0	0	0	0	0	0	0	0	0	9	279		
<b>8:45 AM</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>263</b>		
9:00 AM	0	1	0	0	7	0	0	0	0	0	0	0	0	0	8	104		
9:15 AM	0	1	0	0	7	0	0	0	0	0	0	0	0	0	8	30		
Count Total	1	14	0	0	286	0	0	0	0	0	0	0	0	0	301	0		
<b>Peak Hour</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>258</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>263</b>	<b>0</b>		
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Alma St Churchill Ave



Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:15 PM to 6:15 PM



	HV %:	PHF
EB	0.5%	0.89
WB	1.7%	0.69
NB	0.1%	0.89
SB	0.4%	0.93
TOTAL	0.3%	0.93

#### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Alma St Northbound				Alma St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	12	16	75	0	12	7	0	0	40	273	5	0	2	307	27	776	0	
4:45 PM	0	16	22	85	0	22	19	0	0	59	231	9	0	1	297	24	785	0	
5:00 PM	0	22	19	76	0	11	12	3	0	48	297	10	0	5	311	27	841	0	
5:15 PM	0	38	28	46	0	11	14	2	1	40	299	7	0	1	275	26	788	3,190	
5:30 PM	0	37	21	66	0	17	9	1	0	55	325	8	0	2	240	21	802	3,216	
5:45 PM	0	18	16	62	0	23	16	3	0	31	333	8	0	2	296	27	835	3,266	
6:00 PM	0	34	13	61	0	9	10	1	0	63	368	3	0	2	300	23	887	3,312	
6:15 PM	0	34	20	65	0	14	21	1	0	44	326	2	0	1	228	32	788	3,312	
Count Total	0	211	155	536	0	119	108	11	1	380	2,452	52	0	16	2,254	207	6,502	0	
Peak Hour	All	0	127	78	235	0	60	49	7	1	189	1,325	26	0	7	1,111	97	3,312	0
	HV	0	0	1	1	0	0	2	0	0	0	2	0	0	0	5	0	11	0
	HV%	-	0%	1%	0%	-	0%	4%	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

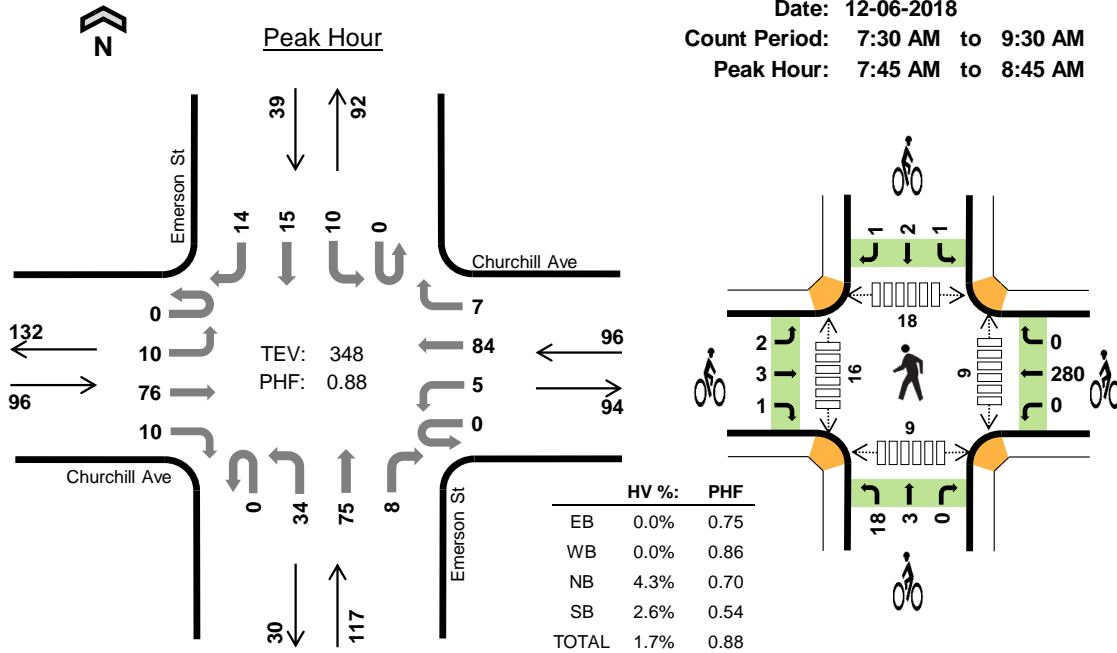
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	1	2	2	5	4	3	0	0	7	0	0	10	2	12
4:45 PM	1	1	2	4	8	7	0	0	0	7	2	1	7	2	12
5:00 PM	0	1	2	2	5	8	2	0	0	10	1	0	11	2	14
5:15 PM	0	0	2	1	3	5	1	0	0	6	4	0	11	2	17
5:30 PM	1	1	0	2	4	4	3	0	0	7	2	0	12	2	16
5:45 PM	1	1	0	0	2	4	2	0	0	6	0	0	11	2	13
6:00 PM	0	0	0	2	2	8	2	0	0	10	0	0	8	5	13
6:15 PM	0	1	1	1	3	5	1	0	0	6	0	0	6	6	12
Count Total	3	6	9	14	32	45	14	0	0	59	9	1	76	23	109
Peak Hour	2	2	2	5	11	21	8	0	0	29	6	0	42	11	59

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	1	0	0	0	2	0	0	0	2	0	5	0
4:45 PM	0	0	0	1	0	0	1	0	0	1	1	0	0	0	4	0	8	0
5:00 PM	0	0	0	0	0	0	1	0	0	0	2	0	0	0	1	1	5	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	3	21
5:30 PM	0	0	0	1	0	0	1	0	0	0	0	0	0	0	2	0	4	20
5:45 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	14
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	11
6:15 PM	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	3	11
Count Total	0	0	1	2	0	0	6	0	0	1	8	0	0	0	13	1	32	0
Peak Hour	0	0	1	1	0	0	2	0	0	0	2	0	0	0	5	0	11	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Churchill Ave			Churchill Ave			Alma St			Alma St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	4	0	0	3	0	0	0	0	0	0	0	0	0	0	7	0	
4:45 PM	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	
5:00 PM	0	8	0	0	2	0	0	0	0	0	0	0	0	0	0	10	0	
5:15 PM	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	6	30	
5:30 PM	0	4	0	0	3	0	0	0	0	0	0	0	0	0	0	7	30	
5:45 PM	0	4	0	0	2	0	0	0	0	0	0	0	0	0	0	6	29	
6:00 PM	0	7	1	0	2	0	0	0	0	0	0	0	0	0	0	10	29	
6:15 PM	0	5	0	0	1	0	0	0	0	0	0	0	0	0	0	6	29	
Count Total	0	44	1	0	14	0	0	0	0	0	0	0	0	0	0	59	0	
Peak Hour	0	20	1	0	8	0	0	0	0	0	0	0	0	0	0	29	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Emerson St Churchill Ave



Date: 12-06-2018  
 Count Period: 7:30 AM to 9:30 AM  
 Peak Hour: 7:45 AM to 8:45 AM



#### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Emerson St Northbound				Emerson St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	1	14	0	0	0	17	4	0	1	4	1	0	2	1	3	48	0	
<b>7:45 AM</b>	<b>0</b>	<b>5</b>	<b>24</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>22</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>18</b>	<b>3</b>	<b>0</b>	<b>6</b>	<b>9</b>	<b>3</b>	<b>99</b>	<b>0</b>	
8:00 AM	0	2	23	3	0	1	12	3	0	16	24	2	0	2	4	4	96	0	
8:15 AM	0	3	15	3	0	3	24	1	0	6	16	2	0	0	2	3	78	321	
8:30 AM	0	0	14	1	0	0	26	0	0	10	17	1	0	2	0	4	75	348	
8:45 AM	1	1	18	3	0	1	23	3	0	1	6	3	0	0	3	2	65	314	
9:00 AM	0	0	20	4	0	0	19	2	0	6	2	1	0	0	4	2	60	278	
9:15 AM	0	0	8	2	0	0	14	1	0	2	2	1	0	1	1	13	45	245	
Count Total	1	12	136	19	0	6	157	17	0	44	89	14	0	13	24	34	566	0	
Peak Hour	All	0	10	76	10	0	5	84	7	0	34	75	8	0	10	15	14	348	0
	HV	0	0	0	0	0	0	0	0	0	1	4	0	0	1	0	0	6	0
	HV%	-	0%	0%	0%	-	0%	0%	0%	-	3%	5%	0%	-	10%	0%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	0	0	1	1	0	1	2	0	3	0	1	0	0	1
<b>7:45 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>27</b>	<b>3</b>	<b>3</b>	<b>35</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>6</b>	<b>13</b>
8:00 AM	0	0	1	0	1	3	205	15	0	223	3	8	12	0	23
8:15 AM	0	0	1	0	1	1	40	0	0	41	2	2	1	1	6
8:30 AM	0	0	3	0	3	0	8	3	1	12	1	3	4	2	10
8:45 AM	0	2	1	1	4	2	4	1	0	7	1	0	2	1	4
9:00 AM	0	0	0	0	0	1	8	0	0	9	0	1	0	2	3
9:15 AM	0	1	0	0	1	2	5	1	0	8	1	0	5	2	8
Count Total	0	3	6	3	12	11	298	25	4	338	11	18	25	14	68
Peak Hour	0	0	5	1	6	6	280	21	4	311	9	16	18	9	52

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Emerson St				Emerson St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
<b>7:45 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>
8:00 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	4
8:30 AM	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3	6
8:45 AM	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	1	4	9
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
9:15 AM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	8
Count Total	0	0	0	0	0	0	3	0	0	2	4	0	0	2	0	1	12	0
<b>Peak Hour</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>0</b>

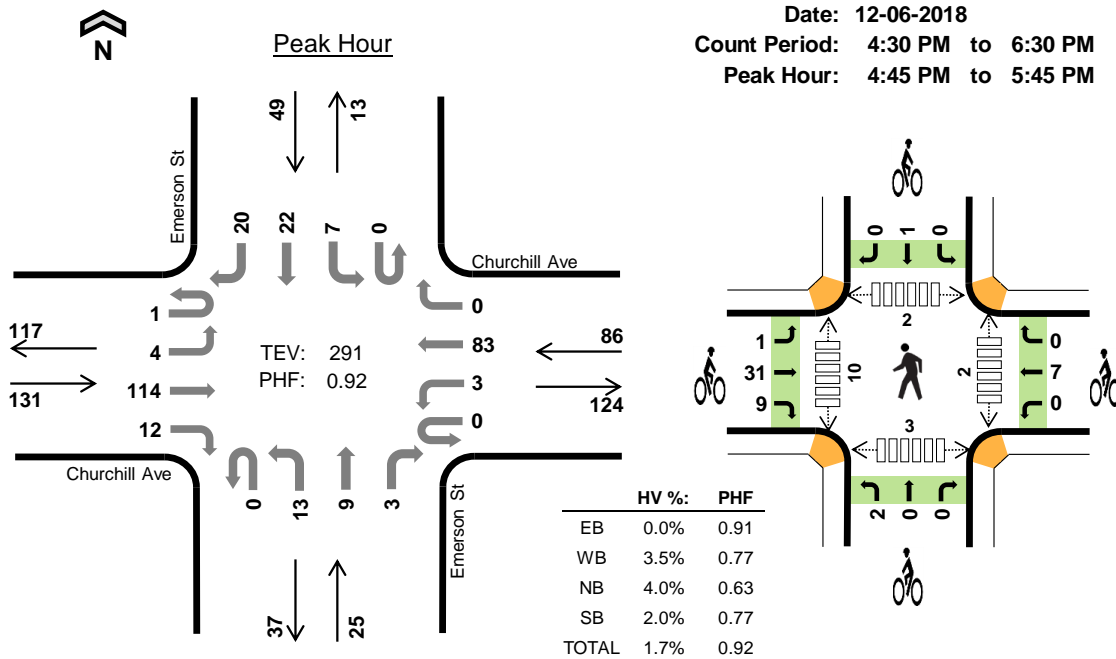
<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Churchill Ave			Churchill Ave			Emerson St			Emerson St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
7:30 AM	0	0	0	0	1	0	2	0	0	0	0	0	3	0			
<b>7:45 AM</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>27</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>35</b>	<b>0</b>			
8:00 AM	1	2	0	0	205	0	15	0	0	0	0	0	223	0			
8:15 AM	1	0	0	0	40	0	0	0	0	0	0	0	41	302			
8:30 AM	0	0	0	0	8	0	2	1	0	0	1	0	12	311			
8:45 AM	0	2	0	0	4	0	1	0	0	0	0	0	7	283			
9:00 AM	0	1	0	0	8	0	0	0	0	0	0	0	9	69			
9:15 AM	0	2	0	0	5	0	1	0	0	0	0	0	8	36			
Count Total	2	8	1	0	298	0	22	3	0	1	2	1	338	0			
<b>Peak Hour</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>280</b>	<b>0</b>	<b>18</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>311</b>	<b>0</b>			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

### Emerson St Churchill Ave



Date: 12-06-2018  
 Count Period: 4:30 PM to 6:30 PM  
 Peak Hour: 4:45 PM to 5:45 PM



#### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Emerson St Northbound				Emerson St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	18	4	0	0	22	2	0	3	1	1	0	0	6	8	65	0	
<b>4:45 PM</b>	<b>1</b>	<b>0</b>	<b>28</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>28</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>6</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>3</b>	<b>5</b>	<b>79</b>	<b>0</b>	
5:00 PM	0	1	30	5	0	1	13	0	0	4	3	2	0	3	4	5	71	0	
5:15 PM	0	3	30	0	0	0	20	0	0	3	0	0	0	1	6	4	67	282	
5:30 PM	0	0	26	5	0	2	22	0	0	3	0	0	0	1	9	6	74	291	
5:45 PM	1	1	19	5	0	1	27	1	0	6	5	1	0	2	6	3	78	290	
6:00 PM	0	2	14	1	0	1	17	2	0	5	1	1	0	2	2	7	55	274	
6:15 PM	0	3	19	1	0	0	25	0	0	2	2	1	0	1	4	6	64	271	
Count Total	2	10	184	23	0	5	174	5	0	29	18	7	0	12	40	44	553	0	
Peak Hour	All	1	4	114	12	0	3	83	0	0	13	9	3	0	7	22	20	291	0
	HV	0	0	0	0	0	0	3	0	0	0	1	0	0	1	0	0	5	0
	HV%	0%	0%	0%	0%	-	0%	4%	-	-	0%	11%	0%	-	14%	0%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	1	0	0	1	8	3	0	1	12	3	3	4	3	13
<b>4:45 PM</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>9</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>11</b>	<b>1</b>	<b>5</b>	<b>0</b>	<b>1</b>	<b>7</b>
5:00 PM	0	1	0	1	2	13	1	0	1	15	0	3	1	0	4
5:15 PM	0	0	0	0	0	9	2	1	0	12	0	2	0	2	4
5:30 PM	0	1	0	0	1	10	3	0	0	13	1	0	1	0	2
5:45 PM	1	1	0	0	2	12	2	1	0	15	4	1	1	1	7
6:00 PM	0	1	0	0	1	11	1	1	1	14	2	1	1	2	6
6:15 PM	0	1	0	0	1	8	1	0	0	9	1	4	2	0	7
Count Total	1	7	1	1	10	80	14	4	3	101	12	19	10	9	50
Peak Hour	0	3	1	1	5	41	7	2	1	51	2	10	2	3	17

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Emerson St				Emerson St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
<b>4:45 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>
5:00 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
5:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5
5:45 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	5
6:00 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	4
6:15 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5
Count Total	0	0	1	0	0	0	7	0	0	0	1	0	0	1	0	0	10	0
<b>Peak Hour</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>

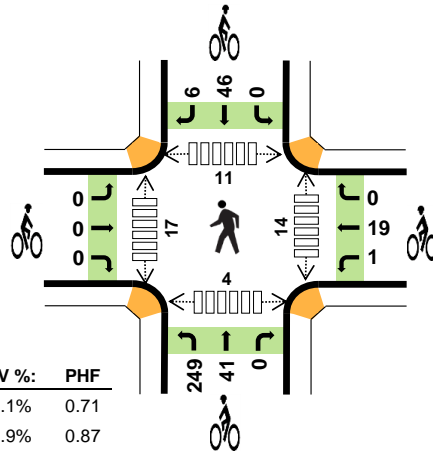
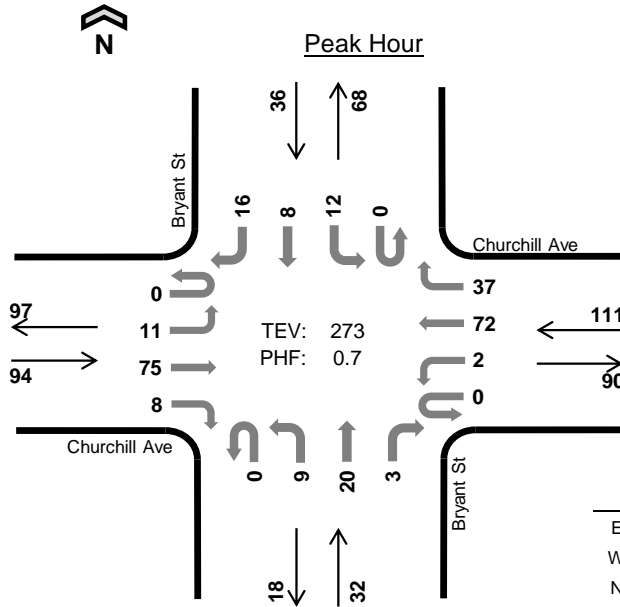
<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Churchill Ave			Churchill Ave			Emerson St			Emerson St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
4:30 PM	0	7	1	0	3	0	0	0	0	0	0	1	12	0			
<b>4:45 PM</b>	<b>0</b>	<b>7</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>11</b>	<b>0</b>			
5:00 PM	0	11	2	0	1	0	0	0	0	0	1	0	15	0			
5:15 PM	1	5	3	0	2	0	1	0	0	0	0	0	12	50			
5:30 PM	0	8	2	0	3	0	0	0	0	0	0	0	13	51			
5:45 PM	0	12	0	0	2	0	1	0	0	0	0	0	15	55			
6:00 PM	0	9	2	0	1	0	0	1	0	0	1	0	14	54			
6:15 PM	0	4	4	0	1	0	0	0	0	0	0	0	9	51			
Count Total	1	63	16	0	14	0	3	1	0	0	2	1	101	0			
<b>Peak Hour</b>	<b>1</b>	<b>31</b>	<b>9</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>51</b>	<b>0</b>			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

### Bryant St Churchill Ave



Date: 12-06-2018  
 Count Period: 7:30 AM to 9:30 AM  
 Peak Hour: 7:45 AM to 8:45 AM



	HV %:	PHF
EB	1.1%	0.71
WB	0.9%	0.87
NB	3.1%	0.57
SB	0.0%	0.47
TOTAL	1.1%	0.70

#### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Bryant St Northbound				Bryant St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	1	2	12	1	0	0	17	2	0	0	4	0	0	1	4	2	46	0	
<b>7:45 AM</b>	<b>0</b>	<b>9</b>	<b>22</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>15</b>	<b>17</b>	<b>0</b>	<b>1</b>	<b>12</b>	<b>1</b>	<b>0</b>	<b>5</b>	<b>5</b>	<b>9</b>	<b>98</b>	<b>0</b>	
8:00 AM	0	1	23	5	0	0	11	12	0	2	6	1	0	4	1	5	71	0	
8:15 AM	0	0	16	1	0	1	23	6	0	4	1	1	0	2	1	0	56	271	
8:30 AM	0	1	14	0	0	1	23	2	0	2	1	0	0	1	1	2	48	273	
8:45 AM	0	0	19	2	0	1	20	0	0	3	3	4	0	1	3	2	58	233	
9:00 AM	0	0	21	0	0	0	18	1	0	1	2	1	0	4	6	4	58	220	
9:15 AM	1	0	7	3	0	1	14	1	0	0	3	1	0	4	3	0	38	202	
Count Total	2	13	134	14	0	4	141	41	0	13	32	9	0	22	24	24	473	0	
Peak Hour	All	0	11	75	8	0	2	72	37	0	9	20	3	0	12	8	16	273	0
	HV	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	3	0
	HV%	-	0%	1%	0%	-	0%	0%	3%	-	0%	5%	0%	-	0%	0%	0%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	1	0	0	0	1	0	1	9	16	26	0	1	0	0	1
<b>7:45 AM</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>41</b>	<b>28</b>	<b>71</b>	<b>6</b>	<b>9</b>	<b>4</b>	<b>0</b>	<b>19</b>
8:00 AM	0	0	1	0	1	0	15	189	9	213	5	2	1	1	9
8:15 AM	0	0	0	0	0	0	3	43	4	50	2	3	2	1	8
8:30 AM	0	0	0	0	0	0	0	17	11	28	1	3	4	2	10
8:45 AM	0	2	0	0	2	2	0	15	11	28	1	3	2	2	8
9:00 AM	0	0	0	0	0	1	1	17	2	21	4	3	0	0	7
9:15 AM	0	1	0	0	1	2	3	12	2	19	0	0	0	4	4
Count Total	2	4	1	0	7	5	25	343	83	456	19	24	13	10	66
Peak Hour	1	1	1	0	3	0	20	290	52	362	14	17	11	4	46



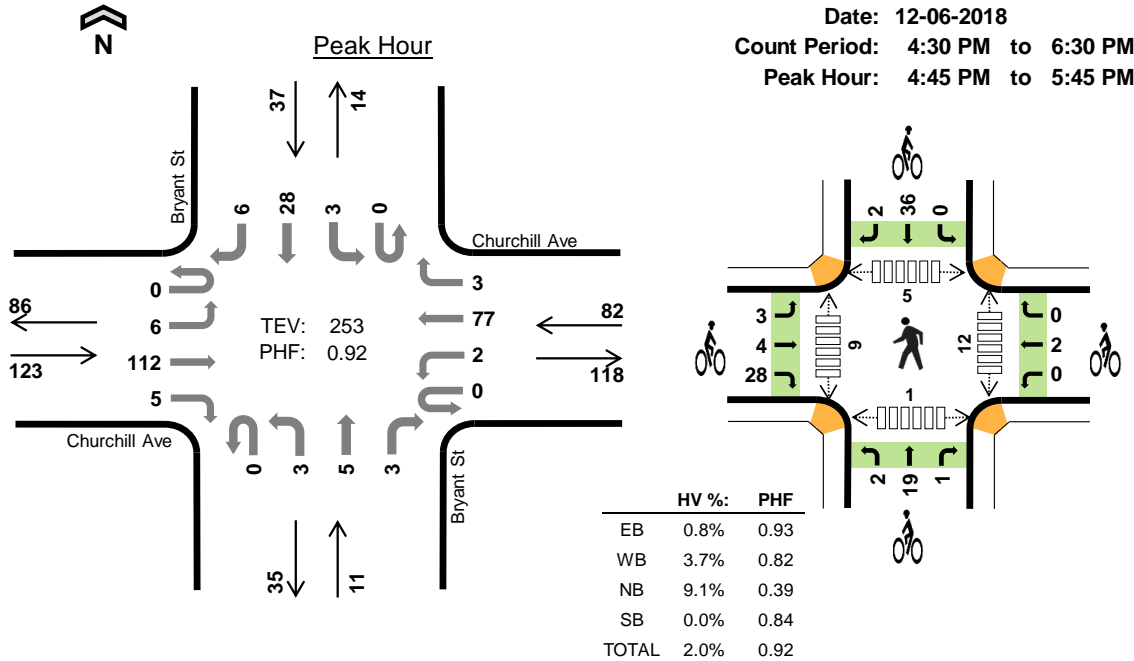
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Bryant St				Bryant St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<b>7:45 AM</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>
8:00 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
8:45 AM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	3
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
9:15 AM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	3
Count Total	0	0	2	0	0	0	3	1	0	0	1	0	0	0	0	0	7	0
<b>Peak Hour</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>

<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Churchill Ave			Churchill Ave			Bryant St			Bryant St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
7:30 AM	0	0	0	0	1	0	0	9	0	0	16	0	26	0			
<b>7:45 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>27</b>	<b>14</b>	<b>0</b>	<b>0</b>	<b>26</b>	<b>2</b>	<b>71</b>	<b>0</b>			
8:00 AM	0	0	0	1	14	0	182	7	0	0	6	3	213	0			
8:15 AM	0	0	0	0	3	0	31	12	0	0	3	1	50	360			
8:30 AM	0	0	0	0	0	0	9	8	0	0	11	0	28	362			
8:45 AM	1	0	1	0	0	0	3	12	0	0	9	2	28	319			
9:00 AM	0	1	0	1	0	0	7	10	0	0	2	0	21	127			
9:15 AM	0	0	2	1	2	0	2	10	0	0	2	0	19	96			
Count Total	1	1	3	3	22	0	261	82	0	0	75	8	456	0			
<b>Peak Hour</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>19</b>	<b>0</b>	<b>249</b>	<b>41</b>	<b>0</b>	<b>0</b>	<b>46</b>	<b>6</b>	<b>362</b>	<b>0</b>			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

### Bryant St Churchill Ave



#### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Bryant St Northbound				Bryant St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	3	15	2	0	0	18	0	0	4	4	1	0	0	11	2	60	0	
<b>4:45 PM</b>	<b>0</b>	<b>1</b>	<b>29</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>24</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>9</b>	<b>2</b>	<b>69</b>	<b>0</b>	
5:00 PM	0	4	27	2	0	0	15	0	0	0	2	0	0	2	7	0	59	0	
5:15 PM	0	0	32	0	0	1	16	1	0	0	0	0	0	0	6	2	58	246	
5:30 PM	0	1	24	2	0	0	22	2	0	2	3	2	0	1	6	2	67	253	
5:45 PM	0	2	20	1	0	2	23	0	0	2	2	0	0	0	3	2	57	241	
6:00 PM	0	4	11	1	0	0	18	1	0	1	1	0	0	1	5	2	45	227	
6:15 PM	0	1	19	2	0	0	22	3	0	1	2	0	0	0	2	0	52	221	
Count Total	0	16	177	11	0	4	158	7	0	11	14	4	0	4	49	12	467	0	
Peak Hour	All	0	6	112	5	0	2	77	3	0	3	5	3	0	3	28	6	253	0
	HV	0	0	1	0	0	0	3	0	0	0	1	0	0	0	0	0	5	0
	HV%	-	0%	1%	0%	-	0%	4%	0%	-	0%	20%	0%	-	0%	0%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	1	0	0	1	8	0	8	13	29	5	10	2	0	17
<b>4:45 PM</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>7</b>	<b>0</b>	<b>7</b>	<b>14</b>	<b>28</b>	<b>5</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>8</b>
5:00 PM	1	1	1	0	3	12	0	6	5	23	2	2	1	0	5
5:15 PM	0	0	0	0	0	7	2	4	10	23	2	3	1	1	7
5:30 PM	0	1	0	0	1	9	0	5	9	23	3	2	2	0	7
5:45 PM	1	1	0	1	3	12	0	9	10	31	1	4	1	2	8
6:00 PM	0	1	0	0	1	8	1	5	7	21	0	0	1	0	1
6:15 PM	0	2	0	0	2	6	0	3	7	16	1	2	1	0	4
Count Total	2	8	1	1	12	69	3	47	75	194	19	25	10	3	57
Peak Hour	1	3	1	0	5	35	2	22	38	97	12	9	5	1	27

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Bryant St				Bryant St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
<b>4:45 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>
5:00 PM	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	3	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
5:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5
5:45 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	3	7
6:00 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5
6:15 PM	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2	7
Count Total	0	0	2	0	0	0	7	1	0	0	1	0	0	0	1	0	12	0
<b>Peak Hour</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>

<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Churchill Ave			Churchill Ave			Bryant St			Bryant St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
4:30 PM	0	2	6	0	0	0	1	7	0	0	12	1	29	0			
<b>4:45 PM</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>14</b>	<b>0</b>	<b>28</b>	<b>0</b>			
5:00 PM	1	0	11	0	0	0	0	5	1	0	5	0	23	0			
5:15 PM	1	1	5	0	2	0	1	3	0	0	10	0	23	103			
5:30 PM	0	2	7	0	0	0	0	5	0	0	7	2	23	97			
5:45 PM	4	0	8	0	0	0	2	7	0	0	10	0	31	100			
6:00 PM	2	1	5	0	1	0	0	5	0	0	7	0	21	98			
6:15 PM	1	2	3	0	0	0	0	3	0	0	6	1	16	91			
Count Total	10	9	50	0	3	0	5	41	1	0	71	4	194	0			
<b>Peak Hour</b>	<b>3</b>	<b>4</b>	<b>28</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>19</b>	<b>1</b>	<b>0</b>	<b>36</b>	<b>2</b>	<b>97</b>	<b>0</b>			

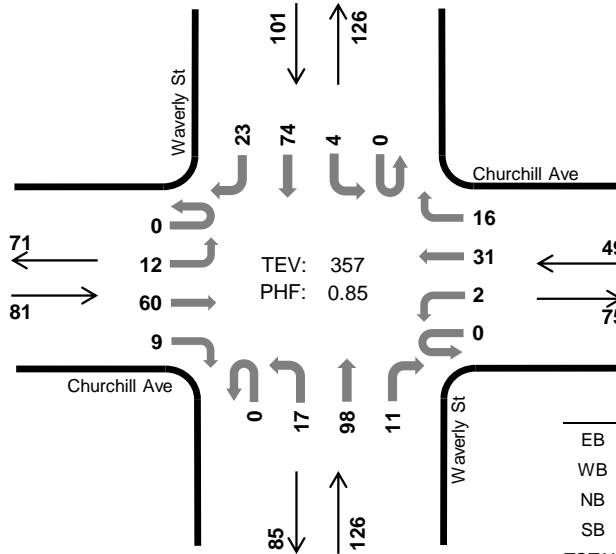
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

# Waverly St Churchill Ave

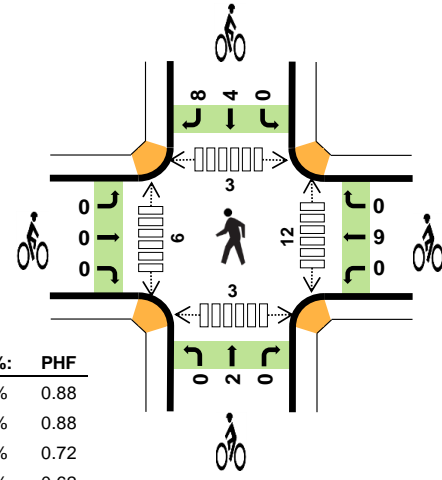


Peak Hour

Date: 12-12-2018  
Count Period: 7:00 AM to 9:00 AM  
Peak Hour: 7:30 AM to 8:30 AM



TEV: 357  
PHF: 0.85



	HV %:	PHF
EB	2.5%	0.88
WB	0.0%	0.88
NB	0.8%	0.72
SB	1.0%	0.62
TOTAL	1.1%	0.85

### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Waverly St Northbound				Waverly St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:00 AM	0	0	13	0	0	0	11	4	0	1	15	0	0	2	4	7	57	0	
7:15 AM	0	2	14	1	0	0	4	2	0	1	34	1	0	0	21	5	85	0	
<b>7:30 AM</b>	<b>0</b>	<b>2</b>	<b>18</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>4</b>	<b>8</b>	<b>0</b>	<b>10</b>	<b>32</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>20</b>	<b>4</b>	<b>105</b>	<b>0</b>	
7:45 AM	0	3	18	2	0	1	4	6	0	1	27	2	0	2	30	9	105	352	
8:00 AM	0	3	8	1	0	0	11	0	0	1	20	2	0	1	10	3	60	355	
8:15 AM	0	4	16	3	0	0	12	2	0	5	19	5	0	0	14	7	87	357	
8:30 AM	0	3	14	1	0	0	8	4	0	3	17	1	0	1	10	5	67	319	
8:45 AM	0	1	14	1	0	1	11	1	0	0	12	1	0	3	6	6	57	271	
Count Total	0	18	115	12	0	3	65	27	0	22	176	14	0	10	115	46	623	0	
Peak Hour	All	0	12	60	9	0	2	31	16	0	17	98	11	0	4	74	23	357	0
	HV	0	0	2	0	0	0	0	0	0	1	0	0	0	0	1	0	4	0
	HV%	-	0%	3%	0%	-	0%	0%	0%	-	6%	0%	0%	-	0%	1%	0%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

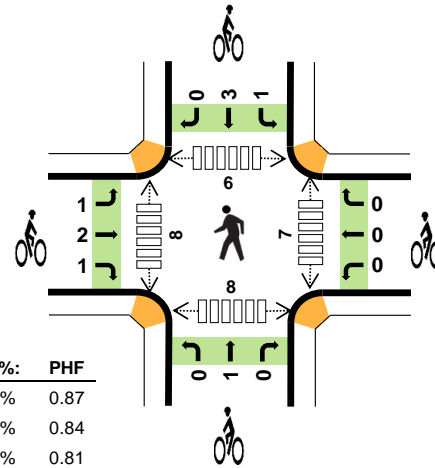
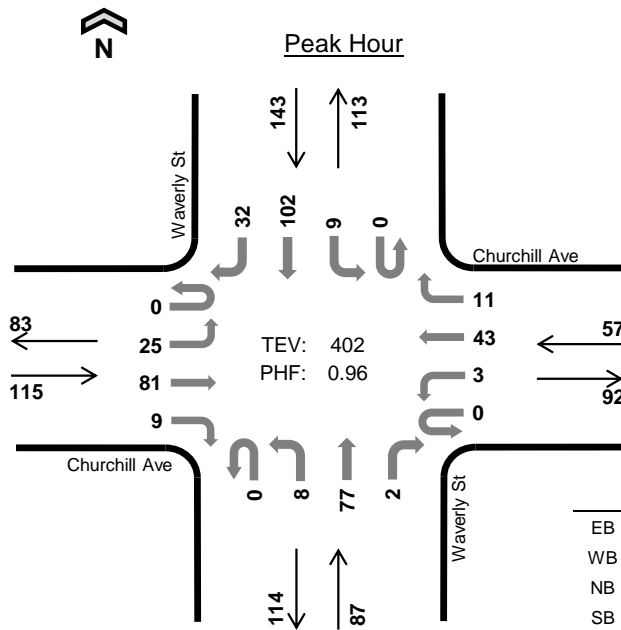
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	0	0	1	0	1	0	2	0	1	3	0	1	0	0	1
7:15 AM	1	0	0	0	1	0	2	1	2	5	0	2	0	0	2
<b>7:30 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>9</b>	<b>16</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>2</b>
7:45 AM	0	0	0	0	0	0	0	0	2	2	5	5	1	1	12
8:00 AM	1	0	1	0	2	0	0	2	0	2	1	1	0	0	2
8:15 AM	1	0	0	0	1	0	2	0	1	3	5	0	1	2	8
8:30 AM	0	3	0	0	3	0	0	1	1	2	0	0	0	2	2
8:45 AM	2	0	0	0	2	1	0	1	2	4	0	1	1	2	4
Count Total	5	3	2	1	11	1	13	5	18	37	12	10	4	7	33
Peak Hour	2	0	1	1	4	0	9	2	12	23	12	6	3	3	24

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Waverly St				Waverly St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
7:15 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<b>7:30 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
8:00 AM	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	2	4
8:15 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4
8:30 AM	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	6
8:45 AM	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8
Count Total	0	0	5	0	0	0	3	0	0	1	1	0	0	0	1	0	11	0
<b>Peak Hour</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>0</b>
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Churchill Ave			Churchill Ave			Waverly St			Waverly St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:00 AM	0	0	0	0	2	0	0	0	0	1	0	0	3	0				
7:15 AM	0	0	0	0	0	2	0	1	0	0	2	0	5	0				
<b>7:30 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>6</b>	<b>16</b>	<b>0</b>				
7:45 AM	0	0	0	0	0	0	0	0	0	0	1	1	2	26				
8:00 AM	0	0	0	0	0	0	0	0	2	0	0	0	2	25				
8:15 AM	0	0	0	0	2	0	0	0	0	0	0	1	3	23				
8:30 AM	0	0	0	0	0	0	0	1	0	0	0	1	2	9				
8:45 AM	1	0	0	0	0	0	0	0	1	0	1	0	4	11				
Count Total	1	0	0	0	11	2	0	1	4	0	2	7	9	37	0			
<b>Peak Hour</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>9</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>8</b>	<b>23</b>	<b>0</b>			
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

## Waverly St Churchill Ave



Date: 12-12-2018  
Count Period: 4:00 PM to 6:00 PM  
Peak Hour: 4:15 PM to 5:15 PM



	HV %:	PHF
EB	3.5%	0.87
WB	1.8%	0.84
NB	1.1%	0.81
SB	0.0%	0.97
TOTAL	1.5%	0.96

### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Waverly St Northbound				Waverly St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:00 PM	0	6	22	2	0	1	5	2	0	1	13	1	0	2	30	9	94	0	
4:15 PM	0	4	27	2	0	0	8	5	0	2	19	0	0	1	24	10	102	0	
4:30 PM	0	8	16	1	0	3	7	2	0	0	23	1	0	4	23	10	98	0	
4:45 PM	0	7	17	3	0	0	15	2	0	3	23	1	0	2	26	6	105	399	
5:00 PM	0	6	21	3	0	0	13	2	0	3	12	0	0	2	29	6	97	402	
5:15 PM	0	7	11	1	0	0	12	1	0	3	20	1	0	1	25	8	90	390	
5:30 PM	0	7	9	1	0	1	7	4	0	1	17	2	0	0	21	8	78	370	
5:45 PM	0	4	19	2	0	0	10	4	0	4	25	0	0	1	21	12	102	367	
Count Total	0	49	142	15	0	5	77	22	0	17	152	6	0	13	199	69	766	0	
Peak Hour	All	0	25	81	9	0	3	43	11	0	8	77	2	0	9	102	32	402	0
	HV	0	0	4	0	0	0	1	0	0	1	0	0	0	0	0	0	6	0
	HV%	-	0%	5%	0%	-	0%	2%	0%	-	13%	0%	0%	-	0%	0%	0%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

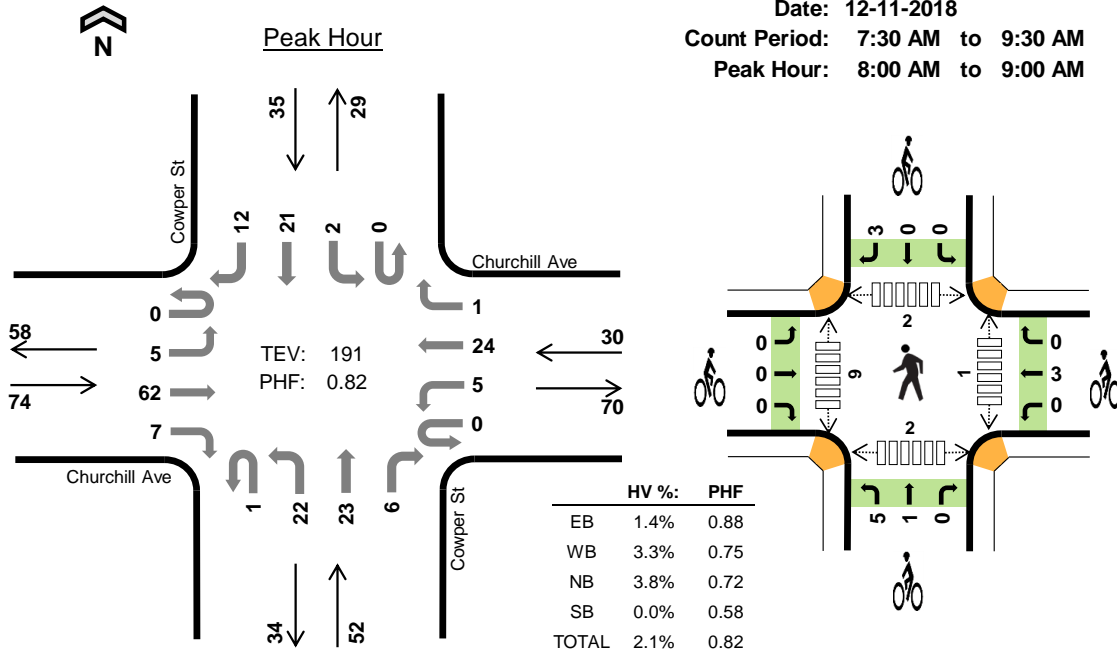
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	0	1	0	1	2	2	0	2	2	6	0	5	2	2	9
4:15 PM	3	0	1	0	4	1	0	0	0	1	3	2	0	3	8
4:30 PM	0	0	0	0	0	1	0	0	1	2	3	4	5	4	16
4:45 PM	1	0	0	0	1	1	0	0	2	3	1	2	1	1	5
5:00 PM	0	1	0	0	1	1	0	1	1	3	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	2	2	0	0	0	4	4
5:30 PM	1	1	0	0	2	0	0	0	0	0	1	2	5	0	8
5:45 PM	0	0	1	0	1	1	0	1	1	3	0	0	0	0	0
Count Total	5	3	2	1	11	7	0	4	9	20	8	15	13	14	50
Peak Hour	4	1	1	0	6	4	0	1	4	9	7	8	6	8	29

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Waverly St				Waverly St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2	0
4:15 PM	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	4	0
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7
5:00 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	6
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
5:30 PM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	4
5:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	4
Count Total	0	0	5	0	0	0	3	0	0	1	1	0	0	0	1	0	11	0
Peak Hour	0	0	4	0	0	0	1	0	0	1	0	0	0	0	0	0	6	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Churchill Ave			Churchill Ave			Waverly St			Waverly St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:00 PM	0	1	1	0	0	0	0	2	0	0	1	1	6	0				
4:15 PM	0	0	1	0	0	0	0	0	0	0	0	0	1	0				
4:30 PM	0	1	0	0	0	0	0	0	0	0	1	0	2	0				
4:45 PM	1	0	0	0	0	0	0	0	0	0	1	1	3	12				
5:00 PM	0	1	0	0	0	0	0	1	0	0	1	0	3	9				
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	2	2	10				
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	8				
5:45 PM	0	1	0	0	0	0	0	1	0	0	0	1	3	8				
Count Total	1	4	2	0	0	0	0	4	0	1	4	4	20	0				
Peak Hour	1	2	1	0	0	0	0	1	0	1	3	0	9	0				
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Cowper St Churchill Ave



Date: 12-11-2018  
 Count Period: 7:30 AM to 9:30 AM  
 Peak Hour: 8:00 AM to 9:00 AM



#### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Cowper St Northbound				Cowper St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	1	11	2	0	1	11	0	0	5	1	2	0	0	1	3	38	0	
7:45 AM	0	1	11	2	0	4	6	0	0	7	1	0	0	1	3	1	37	0	
<b>8:00 AM</b>	<b>0</b>	<b>3</b>	<b>16</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>5</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>6</b>	<b>6</b>	<b>58</b>	<b>0</b>	
8:15 AM	0	2	15	3	0	3	5	0	0	4	8	1	0	1	11	3	56	189	
8:30 AM	0	0	18	2	0	0	6	0	1	5	3	1	0	0	1	1	38	189	
8:45 AM	0	0	13	0	0	0	9	1	0	3	7	1	0	0	3	2	39	191	
9:00 AM	0	1	13	1	0	0	4	0	0	1	3	0	0	0	0	2	25	158	
9:15 AM	0	1	13	2	0	0	7	1	0	5	9	2	0	0	2	1	43	145	
Count Total	0	9	110	14	0	10	52	2	1	40	37	10	0	3	27	19	334	0	
Peak Hour	All	0	5	62	7	0	5	24	1	1	22	23	6	0	2	21	12	191	0
	HV	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	4	0
	HV%	-	0%	0%	14%	-	0%	4%	0%	0%	5%	4%	0%	-	0%	0%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	0	0	0	0	1	0	0	0	1	0	1	0	2	3
7:45 AM	2	0	0	0	2	1	0	1	0	2	0	3	0	1	4
<b>8:00 AM</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>2</b>	<b>8</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>2</b>
8:15 AM	0	0	0	0	0	0	1	0	1	2	0	2	0	0	2
8:30 AM	1	0	2	0	3	0	0	1	0	1	1	2	0	0	3
8:45 AM	0	0	0	0	0	0	0	1	0	1	0	4	2	1	7
9:00 AM	0	0	0	0	0	0	0	2	1	3	1	1	0	0	2
9:15 AM	0	0	1	0	1	1	0	0	0	1	0	2	0	0	2
Count Total	3	1	3	0	7	3	3	9	4	19	2	16	2	5	25
Peak Hour	1	1	2	0	4	0	3	6	3	12	1	9	2	2	14

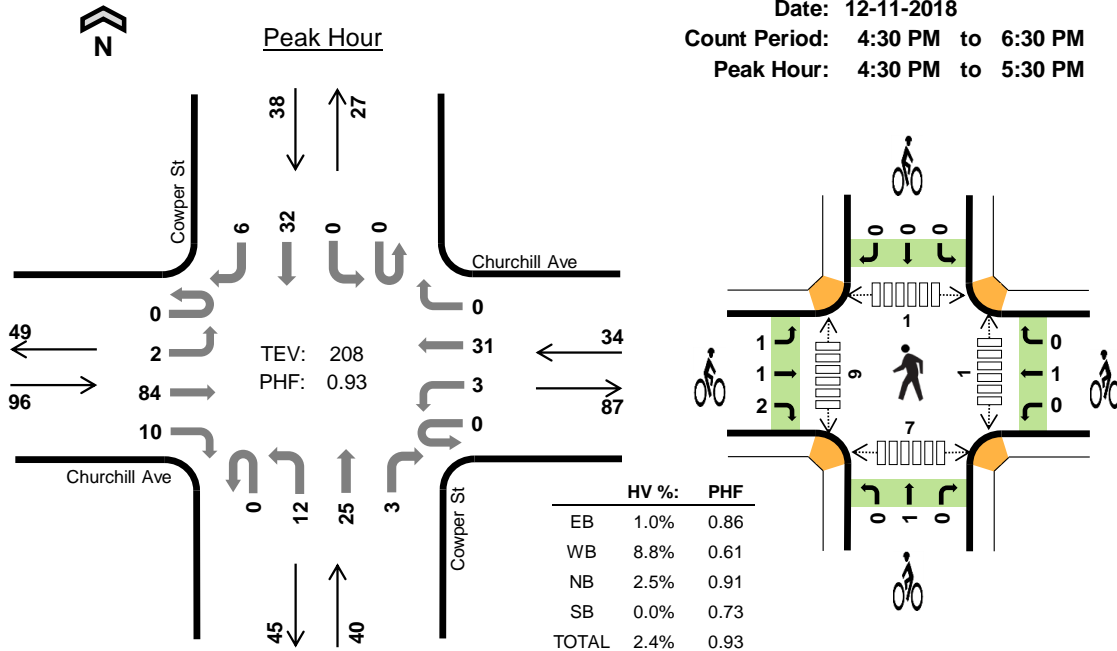


<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Cowper St				Cowper St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
8:30 AM	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	3	6
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
9:15 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	4
Count Total	0	0	2	1	0	0	1	0	0	2	1	0	0	0	0	0	7	0
Peak Hour	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	4	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Churchill Ave			Churchill Ave			Cowper St			Cowper St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0			
7:45 AM	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0			
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>8</b>	<b>0</b>				
8:15 AM	0	0	0	0	1	0	0	0	0	0	0	1	2	13				
8:30 AM	0	0	0	0	0	0	1	0	0	0	0	0	1	13				
8:45 AM	0	0	0	0	0	0	1	0	0	0	0	0	1	12				
9:00 AM	0	0	0	0	0	0	0	2	0	0	1	0	3	7				
9:15 AM	0	0	1	0	0	0	0	0	0	0	0	0	1	6				
Count Total	0	0	3	0	3	0	6	3	0	0	1	3	19	0				
Peak Hour	0	0	0	0	3	0	5	1	0	0	0	3	12	0				
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Cowper St Churchill Ave



Date: 12-11-2018  
 Count Period: 4:30 PM to 6:30 PM  
 Peak Hour: 4:30 PM to 5:30 PM



#### Two-Hour Count Summaries

Interval Start	Churchill Ave Eastbound				Churchill Ave Westbound				Cowper St Northbound				Cowper St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	2	18	3	0	2	5	0	0	4	7	0	0	0	7	1	49	0	
4:45 PM	0	0	18	3	0	0	14	0	0	2	6	0	0	0	10	3	56	0	
5:00 PM	0	0	23	1	0	0	5	0	0	3	6	2	0	0	8	1	49	0	
5:15 PM	0	0	25	3	0	1	7	0	0	3	6	1	0	0	7	1	54	208	
5:30 PM	0	0	13	2	0	0	10	0	0	1	3	0	0	0	7	2	38	197	
5:45 PM	0	2	10	2	0	3	8	0	0	5	5	0	0	0	6	2	43	184	
6:00 PM	0	0	11	1	0	0	8	0	0	4	5	4	0	1	7	0	41	176	
6:15 PM	0	2	9	2	0	2	9	0	0	1	3	0	0	0	2	1	31	153	
Count Total	0	6	127	17	0	8	66	0	0	23	41	7	0	1	54	11	361	0	
Peak Hour	All	0	2	84	10	0	3	31	0	0	12	25	3	0	0	32	6	208	0
	HV	0	1	0	0	0	0	3	0	0	0	0	1	0	0	0	0	5	0
	HV%	-	50%	0%	0%	-	0%	10%	-	-	0%	0%	33%	-	-	0%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	1	0	0	0	1	1	0	1	0	2	0	0	1	1	2
4:45 PM	0	2	0	0	2	1	0	0	0	1	1	2	0	4	7
5:00 PM	0	0	1	0	1	0	0	0	0	0	0	6	0	2	8
5:15 PM	0	1	0	0	1	2	1	0	0	3	0	1	0	0	1
5:30 PM	0	1	1	0	2	1	0	2	0	3	0	1	0	0	1
5:45 PM	1	0	0	0	1	1	0	0	1	2	0	0	0	4	4
6:00 PM	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1
6:15 PM	0	2	0	0	2	2	0	0	0	2	0	0	0	0	0
Count Total	2	7	2	0	11	8	1	3	1	13	1	11	1	11	24
Peak Hour	1	3	1	0	5	4	1	1	0	6	1	9	1	7	18

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Churchill Ave				Churchill Ave				Cowper St				Cowper St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
4:45 PM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
5:15 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5
5:30 PM	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	2	6
5:45 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
6:00 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	5
6:15 PM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	6
Count Total	0	1	1	0	0	0	7	0	0	0	1	1	0	0	0	0	11	0
Peak Hour	0	1	0	0	0	0	3	0	0	0	0	1	0	0	0	0	5	0

<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Churchill Ave			Churchill Ave			Cowper St			Cowper St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
4:30 PM	0	0	1	0	0	0	0	1	0	0	0	0	2	0			
4:45 PM	0	1	0	0	0	0	0	0	0	0	0	0	1	0			
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
5:15 PM	1	0	1	0	1	0	0	0	0	0	0	0	3	6			
5:30 PM	0	1	0	0	0	0	1	1	0	0	0	0	3	7			
5:45 PM	0	1	0	0	0	0	0	0	0	0	1	0	2	8			
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	8			
6:15 PM	2	0	0	0	0	0	0	0	0	0	0	0	2	7			
Count Total	3	3	2	0	1	0	1	2	0	0	1	0	13	0			
Peak Hour	1	1	2	0	1	0	0	1	0	0	0	0	6	0			

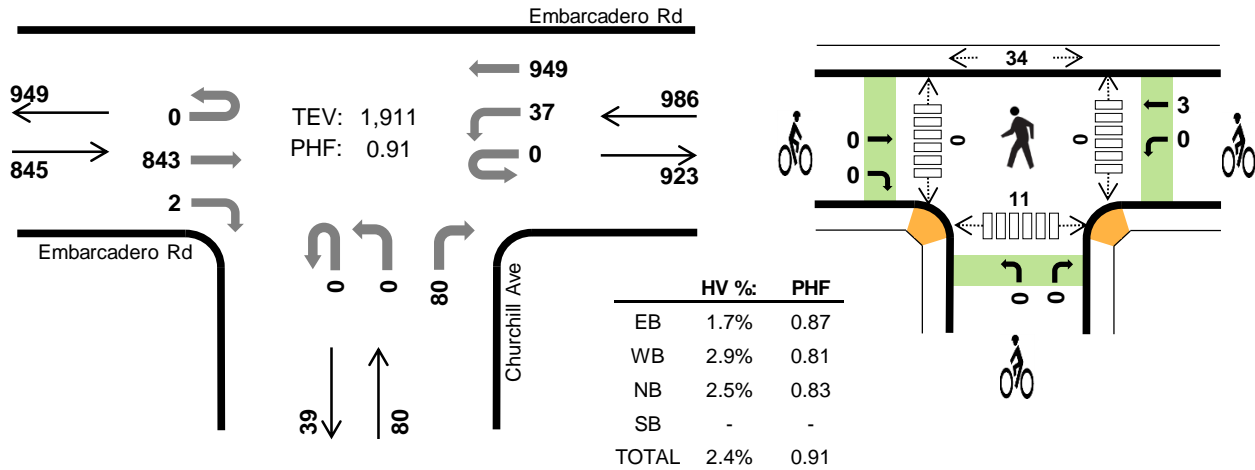
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

# Churchill Ave Embarcadero Rd



Peak Hour

Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 7:30 AM to 8:30 AM



## Two-Hour Count Summaries

Interval Start	Embarcadero Rd				Embarcadero Rd				Churchill Ave				0				15-min Total	Rolling One Hour	
	Eastbound		Westbound		Northbound		Southbound		UT		LT		TH		RT				
7:30 AM	0	0	199	0	0	14	290	0	0	0	0	15	0	0	0	0	518	0	
7:45 AM	0	0	242	0	0	9	254	0	0	0	0	19	0	0	0	0	524	0	
8:00 AM	0	0	213	2	0	3	222	0	0	0	0	22	0	0	0	0	462	0	
8:15 AM	0	0	189	0	0	11	183	0	0	0	0	24	0	0	0	0	407	1,911	
8:30 AM	0	0	169	3	0	9	203	0	0	0	0	10	0	0	0	0	394	1,787	
8:45 AM	0	0	182	0	0	11	217	0	0	0	0	22	0	0	0	0	432	1,695	
9:00 AM	0	0	189	0	0	6	218	0	0	0	0	18	0	0	0	0	431	1,664	
9:15 AM	0	0	196	0	0	9	226	0	0	0	0	10	0	0	0	0	441	1,698	
Count Total	0	0	1,579	5	0	72	1,813	0	0	0	0	140	0	0	0	0	3,609	0	
Peak Hour	All	0	0	843	2	0	37	949	0	0	0	0	80	0	0	0	0	1,911	0
	HV	0	0	14	0	0	1	28	0	0	0	0	2	0	0	0	0	45	0
	HV%	-	-	2%	0%	-	3%	3%	-	-	-	-	3%	-	-	-	-	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	2	7	1	0	10	0	0	0	0	0	0	0	3	0	3
7:45 AM	4	7	1	0	12	0	0	0	0	0	0	0	4	3	7
8:00 AM	4	8	0	0	12	0	0	0	0	0	0	0	17	7	24
8:15 AM	4	7	0	0	11	0	3	0	0	3	0	0	10	1	11
8:30 AM	6	6	0	0	12	0	0	0	0	0	0	0	2	0	2
8:45 AM	7	8	0	0	15	0	0	0	0	0	0	0	2	0	2
9:00 AM	7	8	0	0	15	0	0	0	0	0	0	0	1	1	2
9:15 AM	6	8	0	0	14	0	1	0	0	1	0	0	1	1	2
Count Total	40	59	2	0	101	0	4	0	0	4	0	0	40	13	53
Peak Hr	14	29	2	0	45	0	3	0	0	3	0	0	34	11	45

**Two-Hour Count Summaries - Heavy Vehicles**

Interval Start	Embarcadero Rd				Embarcadero Rd				Churchill Ave				0				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	2	0	0	0	7	0	0	0	0	1	0	0	0	0	10	0
7:45 AM	0	0	4	0	0	0	7	0	0	0	0	1	0	0	0	0	12	0
8:00 AM	0	0	4	0	0	0	8	0	0	0	0	0	0	0	0	0	12	0
8:15 AM	0	0	4	0	0	1	6	0	0	0	0	0	0	0	0	0	11	45
8:30 AM	0	0	6	0	0	1	5	0	0	0	0	0	0	0	0	0	12	47
8:45 AM	0	0	7	0	0	0	8	0	0	0	0	0	0	0	0	0	15	50
9:00 AM	0	0	7	0	0	0	8	0	0	0	0	0	0	0	0	0	15	53
9:15 AM	0	0	6	0	0	1	7	0	0	0	0	0	0	0	0	0	14	56
Count Total	0	0	40	0	0	3	56	0	0	0	0	2	0	0	0	0	101	0
Peak Hour	0	0	14	0	0	1	28	0	0	0	0	2	0	0	0	0	45	0

**Two-Hour Count Summaries - Bikes**

Interval Start	Embarcadero Rd			Embarcadero Rd			Churchill Ave			0			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	0	0	0	3	0	0	0	0	0	0	0	3	3
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	3
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	3
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	3
9:15 AM	0	0	0	0	1	0	0	0	0	0	0	0	1	1
Count Total	0	0	0	0	4	0	0	0	0	0	0	0	4	0
Peak Hour	0	0	0	0	3	0	0	0	0	0	0	0	3	0

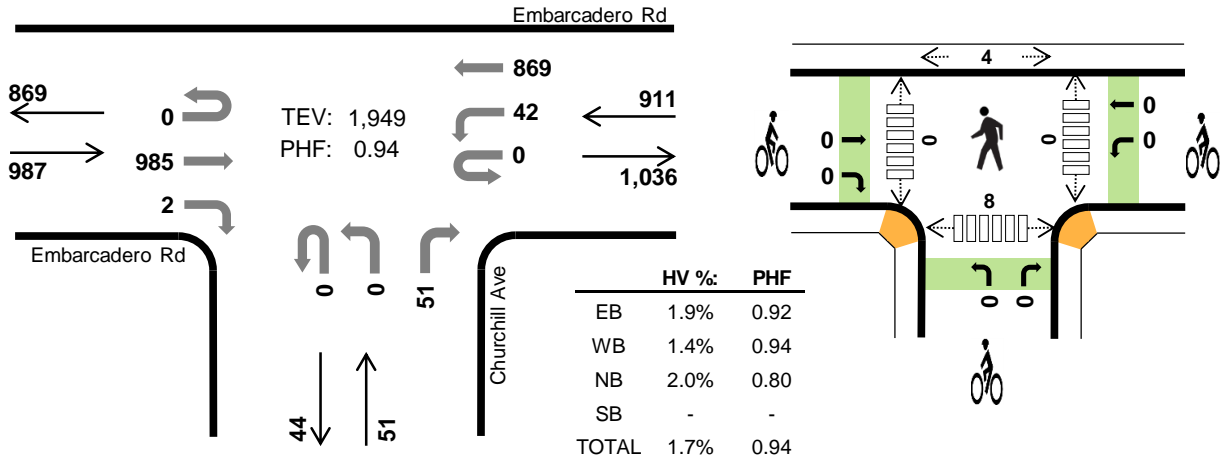
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

# Churchill Ave Embarcadero Rd



Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:30 PM to 6:30 PM



## Two-Hour Count Summaries

Interval Start	Embarcadero Rd				Embarcadero Rd				Churchill Ave				0				15-min Total	Rolling One Hour	
	Eastbound		Westbound		Northbound		Southbound		UT		LT		TH		RT				
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	264	0	0	6	154	0	0	0	0	20	0	0	0	0	444	0	
4:45 PM	0	0	260	1	0	10	164	0	0	0	0	17	0	0	0	0	452	0	
5:00 PM	0	0	239	0	0	8	162	0	0	0	0	22	0	0	0	0	431	0	
5:15 PM	0	0	240	1	0	6	179	0	0	0	0	26	0	0	0	0	452	1,779	
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>268</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>223</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>517</b>	<b>1,852</b>	
5:45 PM	0	0	254	1	0	12	231	0	0	0	0	11	0	0	0	0	509	1,909	
6:00 PM	0	0	209	0	0	9	210	0	0	0	0	16	0	0	0	0	444	1,922	
6:15 PM	0	0	254	1	0	11	205	0	0	0	0	8	0	0	0	0	479	1,949	
Count Total	0	0	1,988	4	0	72	1,528	0	0	0	0	136	0	0	0	0	3,728	0	
Peak Hour	All	0	0	985	2	0	42	869	0	0	0	0	51	0	0	0	0	1,949	0
	HV	0	0	19	0	0	5	8	0	0	0	0	1	0	0	0	0	33	0
	HV%	-	-	2%	0%	-	12%	1%	-	-	-	-	2%	-	-	-	-	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	6	2	0	0	8	0	0	0	0	0	0	0	2	6	8
4:45 PM	9	2	0	0	11	0	0	0	0	0	0	0	0	2	2
5:00 PM	2	5	1	0	8	0	0	0	0	0	0	0	4	0	4
5:15 PM	6	0	0	0	6	0	0	0	0	0	0	0	1	2	3
<b>5:30 PM</b>	<b>4</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>4</b>
5:45 PM	6	1	1	0	8	0	0	0	0	0	0	0	0	1	1
6:00 PM	3	4	0	0	7	0	0	0	0	0	0	0	1	1	2
6:15 PM	6	5	0	0	11	0	0	0	0	0	0	0	1	4	5
Count Total	42	22	2	0	66	0	0	0	0	0	0	0	11	18	29
Peak Hr	19	13	1	0	33	0	0	0	0	0	0	0	4	8	12

**Two-Hour Count Summaries - Heavy Vehicles**

Interval Start	Embarcadero Rd				Embarcadero Rd				Churchill Ave				0				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	6	0	0	0	2	0	0	0	0	0	0	0	0	0	8	0
4:45 PM	0	0	9	0	0	1	1	0	0	0	0	0	0	0	0	0	11	0
5:00 PM	0	0	2	0	0	1	4	0	0	0	0	1	0	0	0	0	8	0
5:15 PM	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6	33
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>32</b>
5:45 PM	0	0	6	0	0	1	0	0	0	0	0	1	0	0	0	0	8	29
6:00 PM	0	0	3	0	0	1	3	0	0	0	0	0	0	0	0	0	7	28
6:15 PM	0	0	6	0	0	2	3	0	0	0	0	0	0	0	0	0	11	33
Count Total	0	0	42	0	0	7	15	0	0	0	0	2	0	0	0	0	66	0
Peak Hour	0	0	19	0	0	5	8	0	0	0	0	1	0	0	0	0	33	0

**Two-Hour Count Summaries - Bikes**

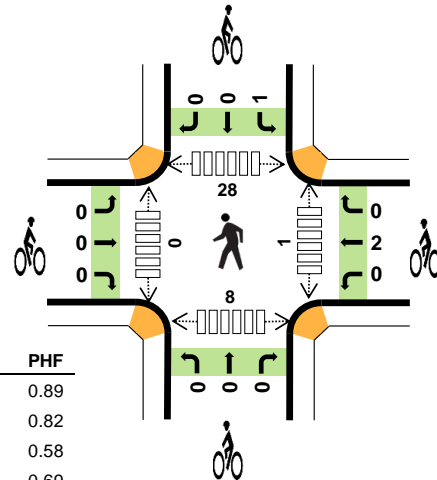
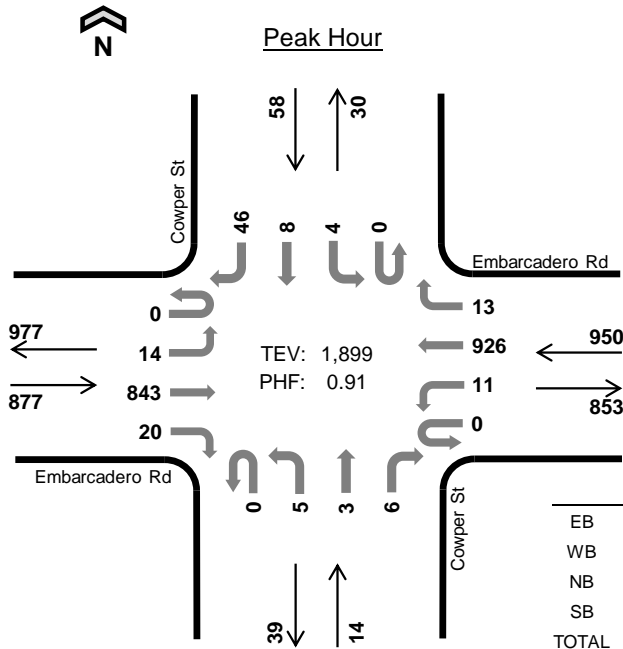
Interval Start	Embarcadero Rd			Embarcadero Rd			Churchill Ave			0			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

### Cowper St Embarcadero Rd



Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 7:30 AM to 8:30 AM



	HV %:	PHF
EB	1.7%	0.89
WB	2.9%	0.82
NB	0.0%	0.58
SB	1.7%	0.69
TOTAL	2.3%	0.91

#### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Cowper St Northbound				Cowper St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	3	197	1	0	2	285	4	0	4	0	2	0	0	1	4	503	0	
7:45 AM	0	2	239	6	0	2	252	2	0	0	2	2	0	1	2	9	519	0	
8:00 AM	0	3	227	6	0	3	216	4	0	1	1	2	0	1	1	19	484	0	
8:15 AM	0	6	180	7	0	4	173	3	0	0	0	0	0	2	4	14	393	1,899	
8:30 AM	0	3	170	2	0	2	195	7	0	0	0	0	0	2	0	5	386	1,782	
8:45 AM	0	0	180	3	1	0	215	5	0	0	1	0	0	4	1	6	416	1,679	
9:00 AM	0	1	187	2	0	1	214	3	0	0	0	0	0	2	0	4	414	1,609	
9:15 AM	0	1	194	1	0	1	219	4	0	1	1	0	0	2	0	5	429	1,645	
Count Total	0	19	1,574	28	1	15	1,769	32	0	6	5	6	0	14	9	66	3,544	0	
Peak Hour	All	0	14	843	20	0	11	926	13	0	5	3	6	0	4	8	46	1,899	0
	HV	0	0	15	0	0	1	27	0	0	0	0	0	0	0	0	1	44	0
	HV%	-	0%	2%	0%	-	9%	3%	0%	-	0%	0%	0%	-	0%	0%	2%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	3	7	0	0	10	0	0	0	0	0	0	0	3	0	3
7:45 AM	4	7	0	0	11	0	0	0	1	1	0	0	3	5	8
8:00 AM	5	8	0	0	13	0	0	0	0	0	1	0	13	2	16
8:15 AM	3	6	0	1	10	0	2	0	0	2	0	0	9	1	10
8:30 AM	6	5	0	0	11	0	0	0	0	0	0	3	2	1	6
8:45 AM	6	8	0	1	15	0	0	0	0	0	0	0	2	0	2
9:00 AM	7	8	0	0	15	0	0	0	1	1	0	0	1	1	2
9:15 AM	6	7	0	0	13	0	1	0	1	2	0	1	2	1	4
Count Total	40	56	0	2	98	0	3	0	3	6	1	4	35	11	51
Peak Hour	15	28	0	1	44	0	2	0	1	3	1	0	28	8	37



<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Cowper St				Cowper St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	3	0	0	0	7	0	0	0	0	0	0	0	0	0	10	0
7:45 AM	0	0	4	0	0	0	7	0	0	0	0	0	0	0	0	0	11	0
8:00 AM	0	0	5	0	0	1	7	0	0	0	0	0	0	0	0	0	13	0
8:15 AM	0	0	3	0	0	0	6	0	0	0	0	0	0	0	0	1	10	44
8:30 AM	0	0	6	0	0	0	5	0	0	0	0	0	0	0	0	0	11	45
8:45 AM	0	0	6	0	0	0	8	0	0	0	0	0	0	1	0	0	15	49
9:00 AM	0	0	7	0	0	0	8	0	0	0	0	0	0	0	0	0	15	51
9:15 AM	0	0	6	0	0	0	7	0	0	0	0	0	0	0	0	0	13	54
Count Total	0	0	40	0	0	1	55	0	0	0	0	0	0	1	0	1	98	0
Peak Hour	0	0	15	0	0	1	27	0	0	0	0	0	0	0	0	1	44	0

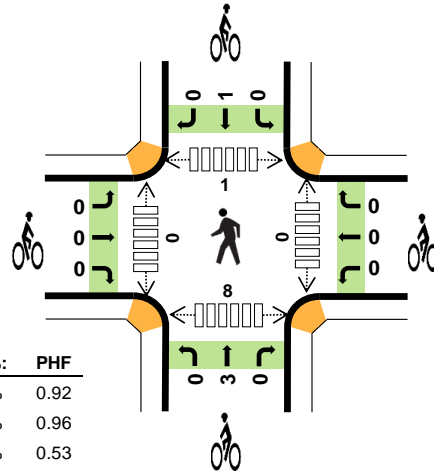
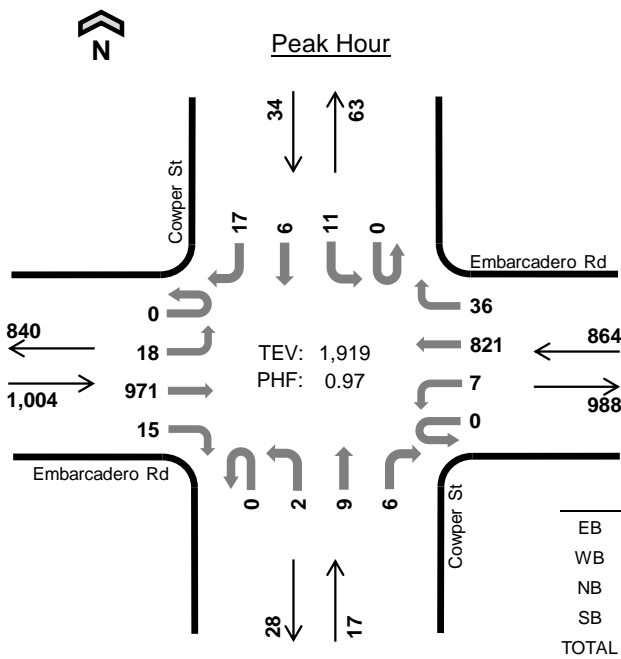
<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Embarcadero Rd			Embarcadero Rd			Cowper St			Cowper St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
7:45 AM	0	0	0	0	0	0	0	0	0	1	0	0	1	0			
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
8:15 AM	0	0	0	0	2	0	0	0	0	0	0	0	2	3			
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	3			
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	2			
9:00 AM	0	0	0	0	0	0	0	0	0	0	1	0	1	3			
9:15 AM	0	0	0	0	1	0	0	0	0	0	1	0	2	3			
Count Total	0	0	0	0	3	0	0	0	0	1	2	0	6	0			
Peak Hour	0	0	0	0	2	0	0	0	0	1	0	0	3	0			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

### Cowper St Embarcadero Rd



Date: 12-06-2018  
 Count Period: 4:30 PM to 6:30 PM  
 Peak Hour: 5:30 PM to 6:30 PM



	HV %:	PHF
EB	2.0%	0.92
WB	0.9%	0.96
NB	5.9%	0.53
SB	0.0%	0.53
TOTAL	1.5%	0.97

#### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Cowper St Northbound				Cowper St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	2	242	1	0	2	152	5	0	3	2	2	0	6	3	8	428	0	
4:45 PM	0	5	249	5	0	2	162	5	0	1	2	4	0	7	8	1	451	0	
5:00 PM	0	5	235	4	0	3	158	4	0	1	3	1	1	5	1	3	424	0	
5:15 PM	0	3	235	4	0	0	171	9	0	1	3	4	0	3	5	6	444	1,747	
5:30 PM	0	4	266	3	0	3	210	6	0	0	1	0	0	0	1	2	496	1,815	
5:45 PM	0	5	248	2	0	3	203	12	0	1	3	4	0	3	4	9	497	1,861	
6:00 PM	0	8	206	6	0	1	217	6	0	0	5	0	0	3	1	1	454	1,891	
6:15 PM	0	1	251	4	0	0	191	12	0	1	0	2	0	5	0	5	472	1,919	
Count Total	0	33	1,932	29	0	14	1,464	59	0	8	19	17	1	32	23	35	3,666	0	
Peak Hour	All	0	18	971	15	0	7	821	36	0	2	9	6	0	11	6	17	1,919	0
	HV	0	0	20	0	0	0	8	0	0	0	1	0	0	0	0	0	29	0
	HV%	-	0%	2%	0%	-	0%	1%	0%	-	0%	11%	0%	-	0%	0%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

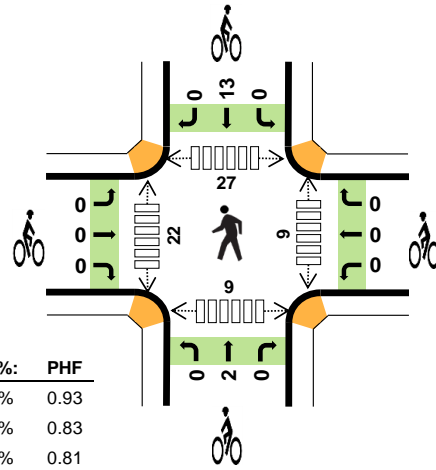
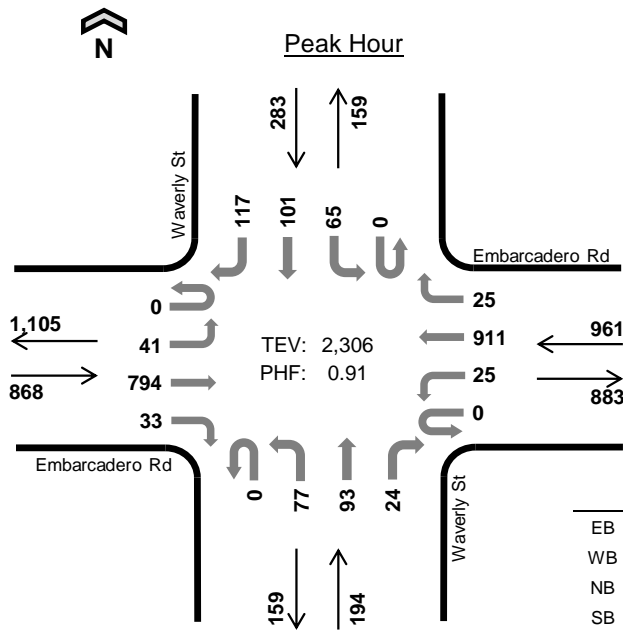
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	3	2	1	0	6	0	0	0	0	0	0	0	0	6	6
4:45 PM	9	1	0	0	10	0	0	1	0	1	0	0	0	1	1
5:00 PM	2	4	0	0	6	0	0	0	0	0	0	0	3	0	3
5:15 PM	6	0	0	0	6	0	0	0	0	0	0	1	1	3	5
5:30 PM	5	2	1	0	8	0	0	1	0	1	0	0	0	2	2
5:45 PM	5	0	0	0	5	0	0	0	0	0	0	0	0	1	1
6:00 PM	3	3	0	0	6	0	0	0	1	1	0	0	1	1	2
6:15 PM	7	3	0	0	10	0	0	2	0	2	0	0	0	4	4
Count Total	40	15	2	0	57	0	0	4	1	5	0	1	5	18	24
Peak Hour	20	8	1	0	29	0	0	3	1	4	0	0	1	8	9

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Cowper St				Cowper St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	3	0	0	0	2	0	0	0	0	1	0	0	0	0	6	0
4:45 PM	0	0	9	0	0	0	1	0	0	0	0	0	0	0	0	0	10	0
5:00 PM	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	6	0
5:15 PM	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6	28
5:30 PM	0	0	5	0	0	0	2	0	0	0	1	0	0	0	0	0	8	30
5:45 PM	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	25
6:00 PM	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	6	25
6:15 PM	0	0	7	0	0	0	3	0	0	0	0	0	0	0	0	0	10	29
Count Total	0	0	40	0	0	0	15	0	0	0	1	1	0	0	0	0	57	0
Peak Hour	0	0	20	0	0	0	8	0	0	0	1	0	0	0	0	0	29	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Embarcadero Rd			Embarcadero Rd			Cowper St			Cowper St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:45 PM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
5:30 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	
6:15 PM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	4	
Count Total	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	5	0	
Peak Hour	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	4	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

## Waverly St Embarcadero Rd



Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 7:30 AM to 8:30 AM



	HV %:	PHF
EB	1.8%	0.93
WB	2.7%	0.83
NB	1.0%	0.81
SB	1.4%	0.78
TOTAL	2.1%	0.91

### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Waverly St Northbound				Waverly St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	1	173	8	0	1	278	10	0	8	3	7	0	16	15	19	539	0	
7:45 AM	0	5	223	5	0	7	247	6	0	17	34	9	0	17	33	32	635	0	
8:00 AM	0	16	212	6	0	9	217	4	0	31	24	4	0	19	24	48	614	0	
8:15 AM	0	19	186	14	0	8	169	5	0	21	32	4	0	13	29	18	518	2,306	
8:30 AM	0	9	142	2	0	2	194	9	0	15	26	6	0	18	21	16	460	2,227	
8:45 AM	0	3	163	3	0	6	206	10	0	14	29	2	0	19	14	14	483	2,075	
9:00 AM	0	4	165	6	0	4	201	11	0	7	9	2	0	18	22	26	475	1,936	
9:15 AM	0	5	179	1	0	3	212	9	0	7	14	3	0	15	19	23	490	1,908	
Count Total	0	62	1,443	45	0	40	1,724	64	0	120	171	37	0	135	177	196	4,214	0	
Peak Hour	All	0	41	794	33	0	25	911	25	0	77	93	24	0	65	101	117	2,306	0
	HV	0	0	15	1	0	0	25	1	0	1	1	0	0	0	4	0	48	0
	HV%	-	0%	2%	3%	-	0%	3%	4%	-	1%	1%	0%	-	0%	4%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	3	7	1	1	12	0	0	0	2	2	2	3	3	0	8
7:45 AM	5	6	0	1	12	0	0	1	1	2	6	3	4	6	19
8:00 AM	5	7	1	0	13	0	0	0	10	10	0	15	10	2	27
8:15 AM	3	6	0	2	11	0	0	1	0	1	1	1	10	1	13
8:30 AM	6	6	2	1	15	0	0	1	0	1	3	1	3	0	7
8:45 AM	5	8	1	0	14	0	0	0	0	0	2	0	2	0	4
9:00 AM	6	8	0	1	15	0	0	3	0	3	3	2	3	1	9
9:15 AM	6	7	1	2	16	0	1	0	3	4	3	4	1	1	9
Count Total	39	55	6	8	108	0	1	6	16	23	20	29	36	11	96
Peak Hour	16	26	2	4	48	0	0	2	13	15	9	22	27	9	67

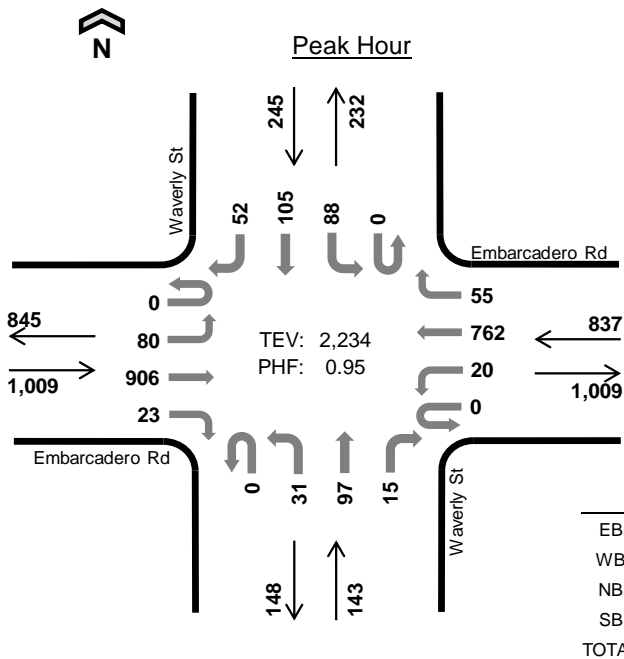
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Waverly St				Waverly St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	3	0	0	0	6	1	0	0	1	0	0	0	1	0	12	0
7:45 AM	0	0	4	1	0	0	6	0	0	0	0	0	0	0	1	0	12	0
8:00 AM	0	0	5	0	0	0	7	0	0	1	0	0	0	0	0	0	13	0
8:15 AM	0	0	3	0	0	0	6	0	0	0	0	0	0	0	2	0	11	48
8:30 AM	0	0	6	0	0	1	5	0	0	0	1	1	0	0	0	1	15	51
8:45 AM	0	0	5	0	0	0	8	0	0	0	1	0	0	0	0	0	14	53
9:00 AM	0	0	6	0	0	0	7	1	0	0	0	0	0	1	0	0	15	55
9:15 AM	0	0	6	0	0	0	7	0	0	0	1	0	0	0	0	2	16	60
Count Total	0	0	38	1	0	1	52	2	0	1	4	1	0	1	4	3	108	0
Peak Hour	0	0	15	1	0	0	25	1	0	1	1	0	0	0	4	0	48	0

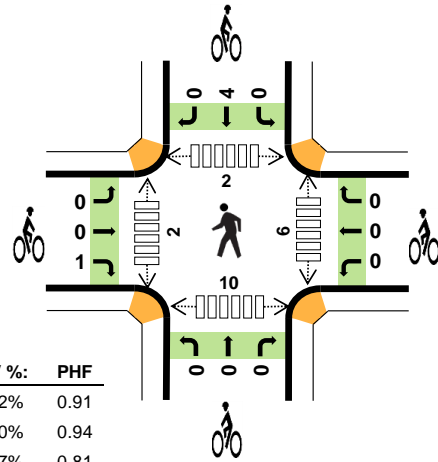
<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Embarcadero Rd			Embarcadero Rd			Waverly St			Waverly St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
7:30 AM	0	0	0	0	0	0	0	0	0	0	2	0	2	0			
7:45 AM	0	0	0	0	0	0	0	1	0	0	1	0	2	0			
8:00 AM	0	0	0	0	0	0	0	0	0	0	10	0	10	0			
8:15 AM	0	0	0	0	0	0	0	1	0	0	0	0	1	15			
8:30 AM	0	0	0	0	0	0	0	1	0	0	0	0	1	14			
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	12			
9:00 AM	0	0	0	0	0	0	0	3	0	0	0	0	3	5			
9:15 AM	0	0	0	0	1	0	0	0	0	0	3	0	4	8			
Count Total	0	0	0	0	1	0	0	6	0	0	16	0	23	0			
Peak Hour	0	0	0	0	0	0	0	2	0	0	13	0	15	0			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

# Waverly St Embarcadero Rd



Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:30 PM to 6:30 PM



	HV %:	PHF
EB	2.2%	0.91
WB	1.0%	0.94
NB	0.7%	0.81
SB	0.8%	0.82
TOTAL	1.5%	0.95

### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Waverly St Northbound				Waverly St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	13	222	4	0	4	145	8	0	9	20	4	0	20	17	13	479	0	
4:45 PM	0	12	246	4	0	10	151	9	0	5	14	1	0	19	30	5	506	0	
5:00 PM	0	15	217	5	0	2	150	10	0	8	15	2	0	24	18	13	479	0	
5:15 PM	0	8	216	6	0	3	168	8	0	12	22	1	0	17	26	20	507	1,971	
<b>5:30 PM</b>	<b>0</b>	<b>18</b>	<b>256</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>196</b>	<b>12</b>	<b>0</b>	<b>10</b>	<b>31</b>	<b>2</b>	<b>0</b>	<b>19</b>	<b>24</b>	<b>9</b>	<b>585</b>	<b>2,077</b>	
5:45 PM	0	28	220	5	0	7	187	11	0	12	25	7	0	24	34	17	577	2,148	
6:00 PM	0	20	202	5	0	5	202	16	0	7	25	3	0	18	27	14	544	2,213	
6:15 PM	0	14	228	9	0	4	177	16	0	2	16	3	0	27	20	12	528	2,234	
Count Total	0	128	1,807	42	0	39	1,376	90	0	65	168	23	0	168	196	103	4,205	0	
Peak Hour	All	0	80	906	23	0	20	762	55	0	31	97	15	0	88	105	52	2,234	0
	HV	0	1	21	0	0	1	7	0	0	0	1	0	0	0	1	1	33	0
	HV%	-	1%	2%	0%	-	5%	1%	0%	-	0%	1%	0%	-	0%	1%	2%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

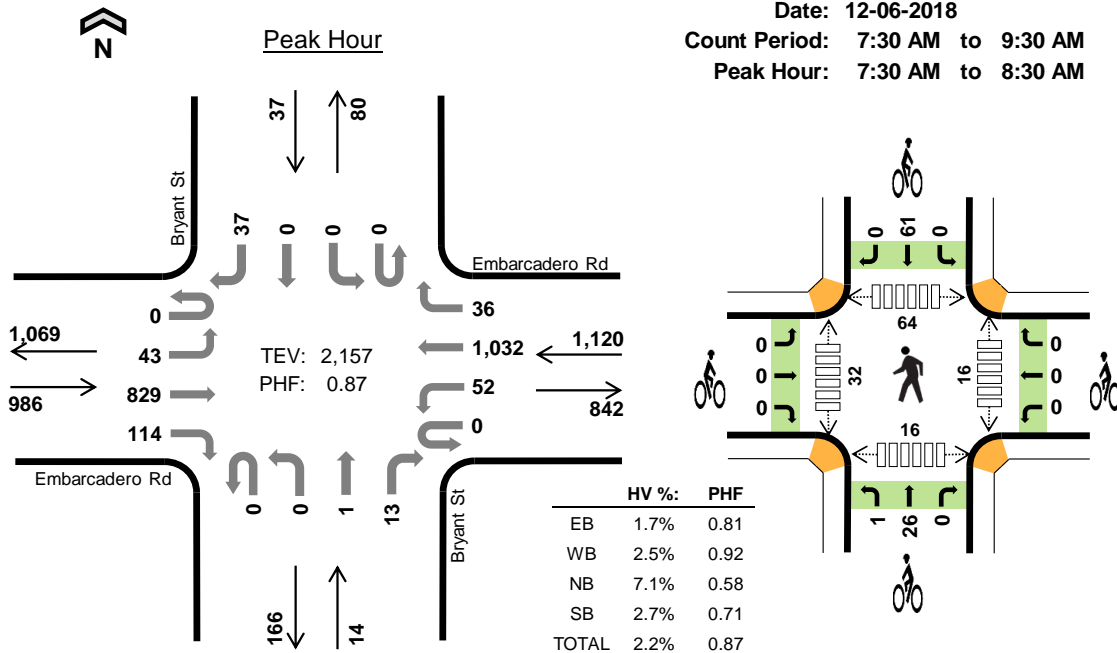
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	4	2	0	0	6	0	0	2	1	3	0	4	0	6	10
4:45 PM	10	1	0	0	11	0	0	0	2	2	7	4	4	0	15
5:00 PM	3	4	0	0	7	0	0	2	1	3	9	2	3	2	16
5:15 PM	6	0	0	0	6	0	0	0	1	1	1	3	1	6	11
<b>5:30 PM</b>	<b>6</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>5</b>	<b>7</b>
5:45 PM	6	0	1	0	7	1	0	0	0	1	2	1	0	1	4
6:00 PM	3	3	0	2	8	0	0	0	3	3	2	0	1	1	4
6:15 PM	7	3	0	0	10	0	0	0	1	1	1	0	1	3	5
Count Total	45	15	1	2	63	1	0	4	9	14	23	15	10	24	72
Peak Hour	22	8	1	2	33	1	0	0	4	5	6	2	2	10	20

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Waverly St				Waverly St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	1	3	0	0	0	1	1	0	0	0	0	0	0	0	0	6	0
4:45 PM	0	1	9	0	0	0	1	0	0	0	0	0	0	0	0	0	11	0
5:00 PM	0	0	2	1	0	0	4	0	0	0	0	0	0	0	0	0	7	0
5:15 PM	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	6	30
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>32</b>
5:45 PM	0	1	5	0	0	0	0	0	0	0	1	0	0	0	0	0	7	28
6:00 PM	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	1	8	29
6:15 PM	0	0	7	0	0	0	3	0	0	0	0	0	0	0	0	0	10	33
Count Total	0	3	40	2	0	1	13	1	0	0	1	0	0	0	1	1	63	0
Peak Hour	0	1	21	0	0	1	7	0	0	0	1	0	0	0	1	1	33	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Embarcadero Rd			Embarcadero Rd			Waverly St			Waverly St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	2	0	0	1	0	3	0				
4:45 PM	0	0	0	0	0	0	0	0	0	0	2	0	2	0				
5:00 PM	0	0	0	0	0	0	0	2	0	0	1	0	3	0				
5:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	1	9				
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>				
5:45 PM	0	0	1	0	0	0	0	0	0	0	0	0	1	5				
6:00 PM	0	0	0	0	0	0	0	0	0	0	3	0	3	5				
6:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	1	5				
Count Total	0	0	1	0	0	0	0	4	0	0	9	0	14	0				
Peak Hour	0	0	1	0	0	0	0	0	0	0	4	0	5	0				
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

# Bryant St Embarcadero Rd



Date: 12-06-2018  
 Count Period: 7:30 AM to 9:30 AM  
 Peak Hour: 7:30 AM to 8:30 AM



### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Bryant St Northbound				Bryant St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	7	176	41	0	22	268	16	0	0	0	0	0	0	0	6	536	0	
7:45 AM	0	9	236	59	0	25	271	8	0	0	1	2	0	0	0	8	619	0	
8:00 AM	0	12	231	11	0	5	283	6	0	0	0	6	0	0	0	13	567	0	
8:15 AM	0	15	186	3	0	0	210	6	0	0	0	5	0	0	0	10	435	2,157	
8:30 AM	0	17	173	8	0	1	209	5	0	0	0	2	0	0	0	8	423	2,044	
8:45 AM	0	15	163	4	0	6	214	7	0	0	0	3	0	0	0	11	423	1,848	
9:00 AM	0	6	166	5	0	3	223	15	0	0	0	3	0	0	1	2	424	1,705	
9:15 AM	0	10	171	4	0	5	218	20	0	0	0	9	0	0	0	8	445	1,715	
Count Total	0	91	1,502	135	0	67	1,896	83	0	0	1	30	0	0	1	66	3,872	0	
Peak Hour	All	0	43	829	114	0	52	1,032	36	0	0	1	13	0	0	0	37	2,157	0
	HV	0	0	16	1	0	0	28	0	0	0	0	1	0	0	0	1	47	0
	HV%	-	0%	2%	1%	-	0%	3%	0%	-	-	0%	8%	-	-	-	3%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	5	6	0	0	11	0	0	2	27	29	0	9	6	0	15
7:45 AM	7	7	0	0	14	0	0	9	28	37	11	13	9	11	44
8:00 AM	2	8	1	1	12	0	0	9	2	11	2	4	35	3	44
8:15 AM	3	7	0	0	10	0	0	7	4	11	3	6	14	2	25
8:30 AM	7	4	0	0	11	0	0	10	11	21	3	3	6	0	12
8:45 AM	7	9	0	0	16	0	0	12	10	22	2	5	2	1	10
9:00 AM	5	7	0	0	12	0	0	10	2	12	2	0	2	1	5
9:15 AM	6	9	1	0	16	0	1	9	2	12	1	0	0	1	2
Count Total	42	57	2	1	102	0	1	68	86	155	24	40	74	19	157
Peak Hour	17	28	1	1	47	0	0	27	61	88	16	32	64	16	128



<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Bryant St				Bryant St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	4	1	0	0	6	0	0	0	0	0	0	0	0	0	11	0
7:45 AM	0	0	7	0	0	0	7	0	0	0	0	0	0	0	0	0	14	0
8:00 AM	0	0	2	0	0	0	8	0	0	0	0	1	0	0	0	1	12	0
8:15 AM	0	0	3	0	0	0	7	0	0	0	0	0	0	0	0	0	10	47
8:30 AM	0	0	7	0	0	0	4	0	0	0	0	0	0	0	0	0	11	47
8:45 AM	0	0	7	0	0	1	8	0	0	0	0	0	0	0	0	0	16	49
9:00 AM	0	1	4	0	0	0	7	0	0	0	0	0	0	0	0	0	12	49
9:15 AM	0	1	5	0	0	1	8	0	0	0	0	1	0	0	0	0	16	55
Count Total	0	2	39	1	0	2	55	0	0	0	0	2	0	0	0	1	102	0
Peak Hour	0	0	16	1	0	0	28	0	0	0	0	1	0	0	0	1	47	0

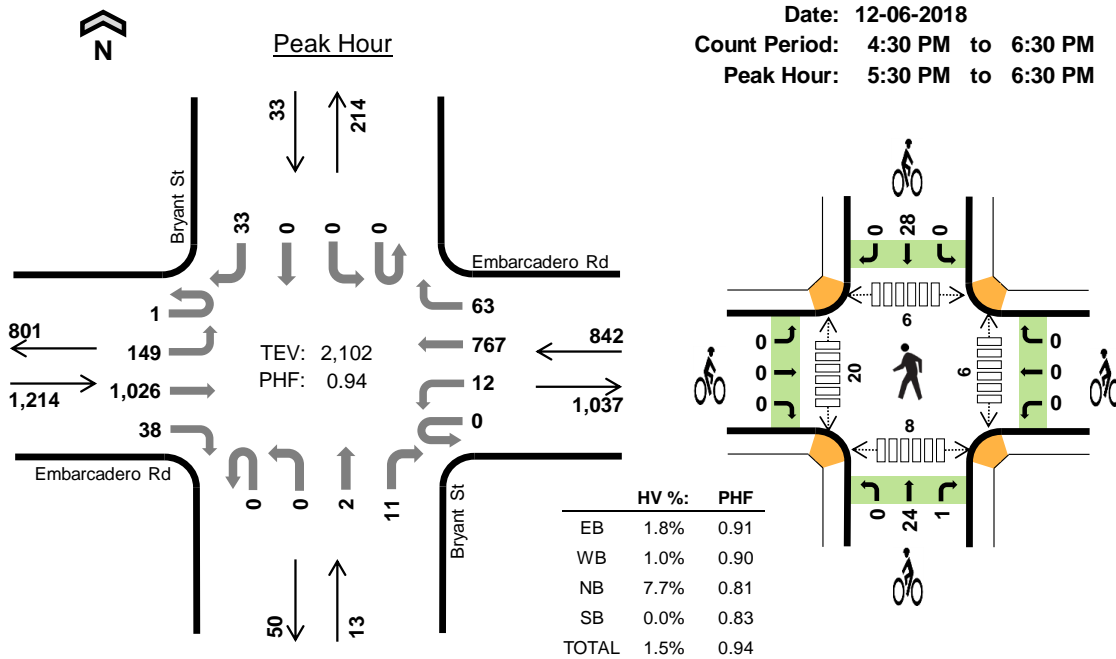
<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Embarcadero Rd			Embarcadero Rd			Bryant St			Bryant St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
7:30 AM	0	0	0	0	0	0	0	2	0	0	27	0	29	0			
7:45 AM	0	0	0	0	0	0	1	8	0	0	28	0	37	0			
8:00 AM	0	0	0	0	0	0	0	9	0	0	2	0	11	0			
8:15 AM	0	0	0	0	0	0	0	7	0	0	4	0	11	88			
8:30 AM	0	0	0	0	0	0	1	9	0	0	11	0	21	80			
8:45 AM	0	0	0	0	0	0	0	12	0	0	10	0	22	65			
9:00 AM	0	0	0	0	0	0	1	9	0	0	2	0	12	66			
9:15 AM	0	0	0	1	0	0	0	9	0	0	2	0	12	67			
Count Total	0	0	0	1	0	0	3	65	0	0	86	0	155	0			
Peak Hour	0	0	0	0	0	0	1	26	0	0	61	0	88	0			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

# Bryant St Embarcadero Rd



Date: 12-06-2018  
 Count Period: 4:30 PM to 6:30 PM  
 Peak Hour: 5:30 PM to 6:30 PM



### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Bryant St Northbound				Bryant St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	35	237	20	0	6	153	6	0	0	0	3	0	0	0	8	468	0	
4:45 PM	0	24	260	13	0	4	136	8	0	0	0	1	0	0	0	10	456	0	
5:00 PM	0	30	226	6	0	3	154	10	0	0	0	3	0	0	0	12	444	0	
5:15 PM	0	34	214	13	0	3	193	6	0	0	0	1	0	0	0	6	470	1,838	
<b>5:30 PM</b>	<b>0</b>	<b>31</b>	<b>289</b>	<b>14</b>	<b>0</b>	<b>3</b>	<b>204</b>	<b>10</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>560</b>	<b>1,930</b>	
5:45 PM	0	31	248	11	0	4	214	16	0	0	0	4	0	0	0	10	538	2,012	
6:00 PM	1	42	229	7	0	2	187	17	0	0	1	2	0	0	0	9	497	2,065	
6:15 PM	0	45	260	6	0	3	162	20	0	0	1	2	0	0	0	8	507	2,102	
Count Total	1	272	1,963	90	0	28	1,403	93	0	0	2	19	0	0	0	69	3,940	0	
Peak Hour	All	1	149	1,026	38	0	12	767	63	0	0	2	11	0	0	0	33	2,102	0
	HV	0	0	22	0	0	0	7	1	0	0	1	0	0	0	0	0	31	0
	HV%	0%	0%	2%	0%	-	0%	1%	2%	-	-	50%	0%	-	-	-	0%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

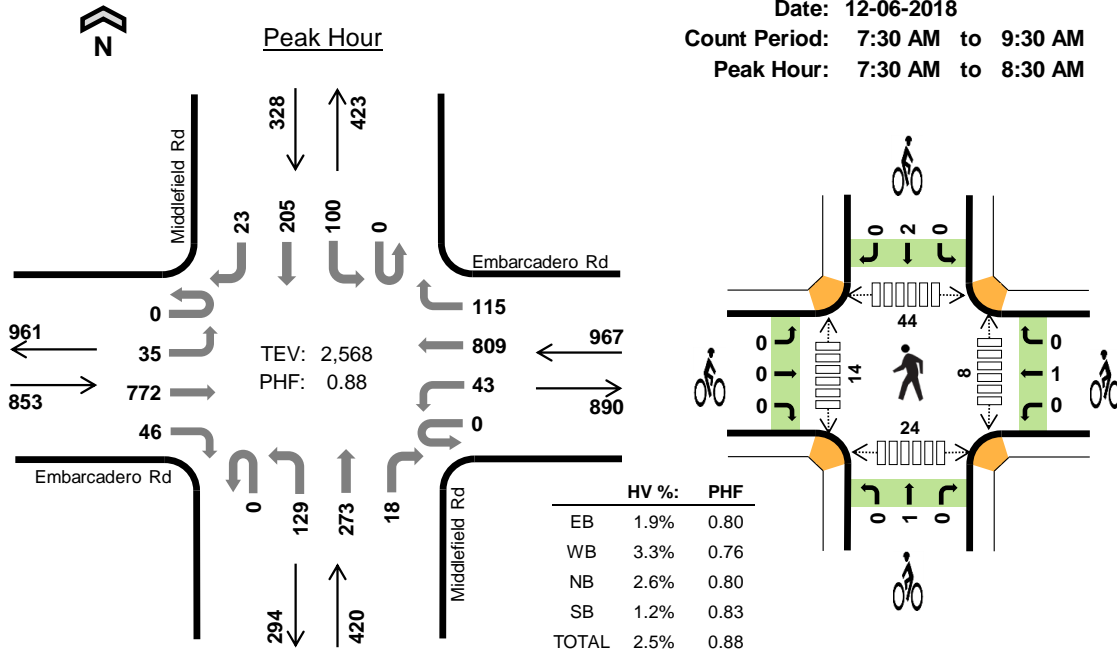
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	6	1	0	0	7	0	0	6	10	16	6	7	2	5	20
4:45 PM	8	1	0	0	9	0	0	7	12	19	4	7	3	0	14
5:00 PM	3	5	0	0	8	0	0	7	6	13	6	5	5	2	18
5:15 PM	6	0	0	0	6	0	0	4	7	11	2	4	1	4	11
<b>5:30 PM</b>	<b>5</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>11</b>	<b>15</b>	<b>3</b>	<b>2</b>	<b>4</b>	<b>2</b>	<b>11</b>
5:45 PM	6	0	0	0	6	0	0	9	9	18	2	6	0	1	9
6:00 PM	5	4	0	0	9	0	0	7	3	10	0	6	1	2	9
6:15 PM	6	3	1	0	10	0	0	5	5	10	1	6	1	3	11
Count Total	45	15	1	0	61	0	0	49	63	112	24	43	17	19	103
Peak Hour	22	8	1	0	31	0	0	25	28	53	6	20	6	8	40

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Bryant St				Bryant St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	5	1	0	0	1	0	0	0	0	0	0	0	0	0	7	0
4:45 PM	0	0	8	0	0	0	1	0	0	0	0	0	0	0	0	0	9	0
5:00 PM	0	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	8	0
5:15 PM	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6	30
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>29</b>
5:45 PM	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6	26
6:00 PM	0	0	5	0	0	0	3	1	0	0	0	0	0	0	0	0	9	27
6:15 PM	0	0	6	0	0	0	3	0	0	0	1	0	0	0	0	0	10	31
Count Total	0	0	44	1	0	0	14	1	0	0	1	0	0	0	0	0	61	0
Peak Hour	0	0	22	0	0	0	7	1	0	0	1	0	0	0	0	0	31	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Embarcadero Rd			Embarcadero Rd			Bryant St			Bryant St			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	6	0	0	10	0	16	0				
4:45 PM	0	0	0	0	0	0	0	7	0	0	12	0	19	0				
5:00 PM	0	0	0	0	0	0	0	6	1	0	6	0	13	0				
5:15 PM	0	0	0	0	0	0	0	4	0	0	7	0	11	59				
<b>5:30 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>11</b>	<b>0</b>	<b>15</b>	<b>58</b>				
5:45 PM	0	0	0	0	0	0	0	9	0	0	9	0	18	57				
6:00 PM	0	0	0	0	0	0	0	7	0	0	3	0	10	54				
6:15 PM	0	0	0	0	0	0	0	4	1	0	5	0	10	53				
Count Total	0	0	0	0	0	0	0	47	2	0	63	0	112	0				
Peak Hour	0	0	0	0	0	0	0	24	1	0	28	0	53	0				
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Middlefield Rd Embarcadero Rd



Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 7:30 AM to 8:30 AM



#### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Middlefield Rd Northbound				Middlefield Rd Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	2	180	9	0	11	279	28	0	24	52	3	0	20	36	8	652	0	
7:45 AM	0	10	240	15	0	12	214	38	0	34	63	3	0	22	70	7	728	0	
8:00 AM	0	8	155	10	0	13	170	24	0	34	68	8	0	28	49	6	573	0	
8:15 AM	0	15	197	12	0	7	146	25	0	37	90	4	0	30	50	2	615	2,568	
8:30 AM	0	13	171	11	0	14	162	16	0	42	90	8	0	30	60	5	622	2,538	
8:45 AM	0	13	164	13	0	14	191	13	0	30	86	9	0	26	81	17	657	2,467	
9:00 AM	0	16	181	12	0	10	207	35	0	19	58	8	0	29	57	4	636	2,530	
9:15 AM	0	6	198	11	0	13	202	30	0	28	37	6	0	25	48	8	612	2,527	
Count Total	0	83	1,486	93	0	94	1,571	209	0	248	544	49	0	210	451	57	5,095	0	
Peak Hour	All	0	35	772	46	0	43	809	115	0	129	273	18	0	100	205	23	2,568	0
	HV	0	0	16	0	0	1	26	5	0	1	10	0	0	0	4	0	63	0
	HV%	-	0%	2%	0%	-	2%	3%	4%	-	1%	4%	0%	-	0%	2%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

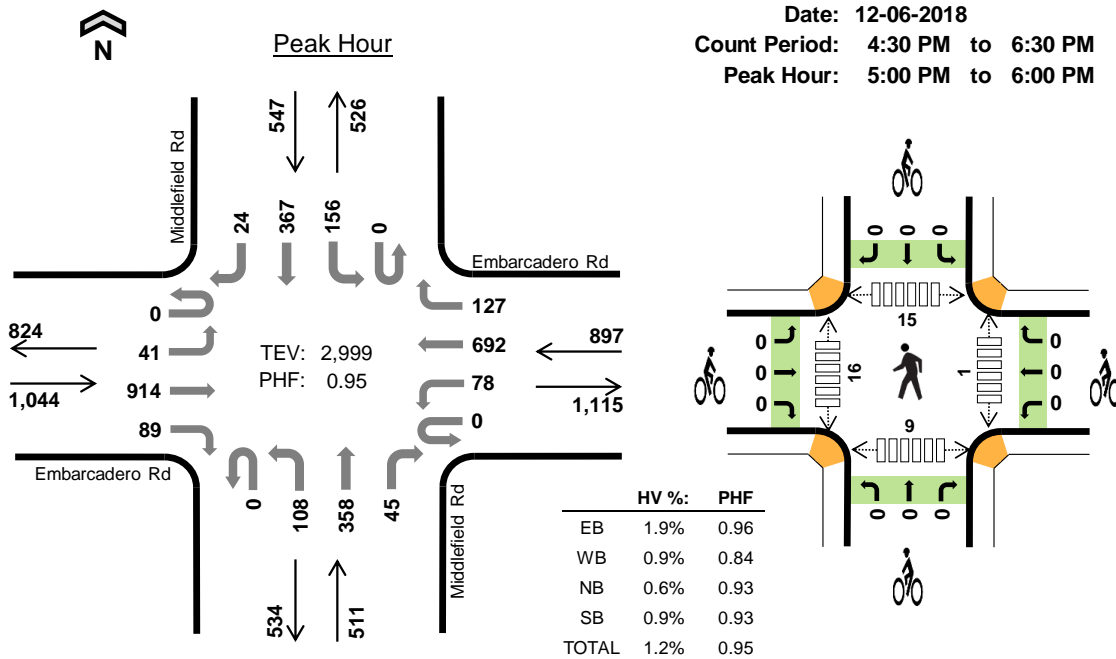
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	3	8	1	0	12	0	1	0	0	1	1	2	4	2	9
7:45 AM	6	6	1	1	14	0	0	1	1	2	1	7	6	11	25
8:00 AM	3	10	6	1	20	0	0	0	1	1	6	5	19	10	40
8:15 AM	4	8	3	2	17	0	0	0	0	0	0	0	15	1	16
8:30 AM	7	6	2	1	16	0	0	0	0	0	0	7	10	6	23
8:45 AM	6	11	6	1	24	0	0	0	0	0	0	1	1	0	2
9:00 AM	8	9	1	2	20	0	1	1	0	2	0	0	1	1	2
9:15 AM	6	8	0	3	17	0	0	1	0	1	0	1	2	0	3
Count Total	43	66	20	11	140	0	2	3	2	7	8	23	58	31	120
Peak Hour	16	32	11	4	63	0	1	1	2	4	8	14	44	24	90

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Middlefield Rd				Middlefield Rd				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	3	0	0	1	7	0	0	0	1	0	0	0	0	0	12	0
7:45 AM	0	0	6	0	0	0	5	1	0	0	1	0	0	0	1	0	14	0
8:00 AM	0	0	3	0	0	0	7	3	0	1	5	0	0	0	1	0	20	0
8:15 AM	0	0	4	0	0	0	7	1	0	0	3	0	0	0	2	0	17	63
8:30 AM	0	0	7	0	0	0	6	0	0	0	2	0	0	0	1	0	16	67
8:45 AM	0	0	6	0	0	1	9	1	0	0	6	0	0	0	0	1	24	77
9:00 AM	0	0	6	2	0	0	9	0	0	0	1	0	0	1	1	0	20	77
9:15 AM	0	0	6	0	0	1	7	0	0	0	0	0	0	1	2	0	17	77
Count Total	0	0	41	2	0	3	57	6	0	1	19	0	0	2	8	1	140	0
Peak Hour	0	0	16	0	0	1	26	5	0	1	10	0	0	0	4	0	63	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Embarcadero Rd			Embarcadero Rd			Middlefield Rd			Middlefield Rd			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
7:45 AM	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	0	
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
9:00 AM	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	2	2	
9:15 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	3	
Count Total	0	0	0	1	1	0	0	3	0	0	2	0	0	2	0	7	0	
Peak Hour	0	0	0	0	1	0	0	1	0	0	2	0	0	2	0	4	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### Middlefield Rd Embarcadero Rd



Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:00 PM to 6:00 PM



#### Two-Hour Count Summaries

Interval Start	Embarcadero Rd Eastbound				Embarcadero Rd Westbound				Middlefield Rd Northbound				Middlefield Rd Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	13	256	17	0	17	130	34	0	21	73	11	0	35	108	2	717	0	
4:45 PM	0	9	221	24	0	19	150	18	0	13	68	4	0	40	113	9	688	0	
<b>5:00 PM</b>	<b>0</b>	<b>8</b>	<b>224</b>	<b>17</b>	<b>0</b>	<b>27</b>	<b>136</b>	<b>21</b>	<b>0</b>	<b>27</b>	<b>95</b>	<b>15</b>	<b>0</b>	<b>38</b>	<b>96</b>	<b>5</b>	<b>709</b>	<b>0</b>	
5:15 PM	0	12	227	19	0	15	157	26	0	18	91	11	0	47	91	9	723	2,837	
5:30 PM	0	12	236	17	0	22	203	42	0	29	76	11	0	41	88	2	779	2,899	
<b>5:45 PM</b>	<b>0</b>	<b>9</b>	<b>227</b>	<b>36</b>	<b>0</b>	<b>14</b>	<b>196</b>	<b>38</b>	<b>0</b>	<b>34</b>	<b>96</b>	<b>8</b>	<b>0</b>	<b>30</b>	<b>92</b>	<b>8</b>	<b>788</b>	<b>2,999</b>	
6:00 PM	0	9	181	25	0	12	180	32	0	30	85	12	0	32	73	9	680	2,970	
6:15 PM	0	13	194	29	0	10	165	25	0	32	97	18	0	36	89	14	722	2,969	
Count Total	0	85	1,766	184	0	136	1,317	236	0	204	681	90	0	299	750	58	5,806	0	
Peak Hour	All	0	41	914	89	0	78	692	127	0	108	358	45	0	156	367	24	2,999	0
	HV	0	0	20	0	0	0	8	0	0	0	3	0	0	0	4	1	36	0
	HV%	-	0%	2%	0%	-	0%	1%	0%	-	0%	1%	0%	-	0%	1%	4%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	5	2	2	2	11	0	0	0	1	1	7	6	2	10	25
4:45 PM	8	2	0	1	11	0	0	0	0	0	3	1	3	1	8
<b>5:00 PM</b>	<b>2</b>	<b>5</b>	<b>1</b>	<b>1</b>	<b>9</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>9</b>	<b>2</b>	<b>19</b>
5:15 PM	6	0	1	2	9	0	0	0	0	0	1	2	3	4	10
5:30 PM	4	3	1	1	9	0	0	0	0	0	0	4	3	1	8
<b>5:45 PM</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>9</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>4</b>
6:00 PM	3	4	1	0	8	0	0	0	0	0	0	0	3	2	5
6:15 PM	6	4	0	2	12	0	0	1	1	2	0	0	0	2	2
Count Total	42	20	6	10	78	0	0	1	2	3	11	23	23	24	81
Peak Hour	20	8	3	5	36	0	0	0	0	0	1	16	15	9	41

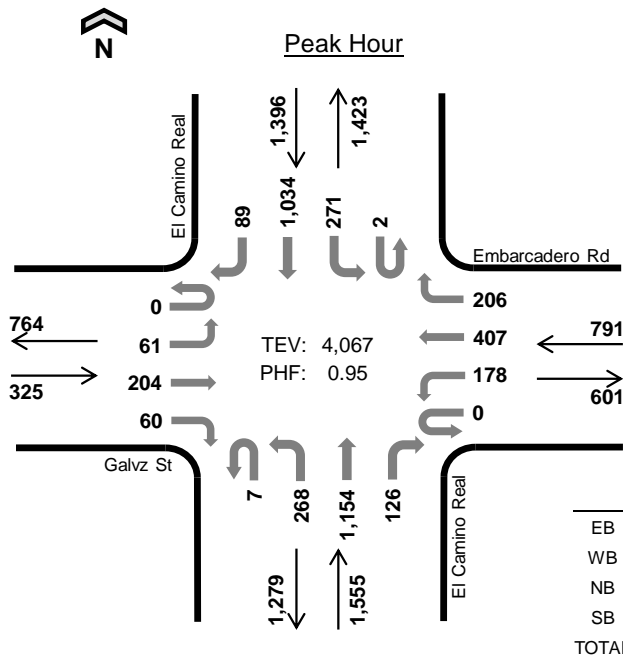
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Embarcadero Rd				Embarcadero Rd				Middlefield Rd				Middlefield Rd				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	1	4	0	0	0	2	0	0	0	2	0	0	0	2	0	11	0
4:45 PM	0	0	7	1	0	0	2	0	0	0	0	0	0	1	0	0	11	0
<b>5:00 PM</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>9</b>	<b>0</b>
5:15 PM	0	0	6	0	0	0	0	0	0	0	1	0	0	0	1	1	9	40
5:30 PM	0	0	4	0	0	0	3	0	0	0	1	0	0	0	1	0	9	38
<b>5:45 PM</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>9</b>	<b>36</b>
6:00 PM	0	0	3	0	0	0	4	0	0	0	1	0	0	0	0	0	8	35
6:15 PM	0	0	6	0	0	0	4	0	0	0	0	0	0	0	1	1	12	38
Count Total	0	1	40	1	0	0	20	0	0	0	6	0	0	1	7	2	78	0
<b>Peak Hour</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>36</b>	<b>0</b>

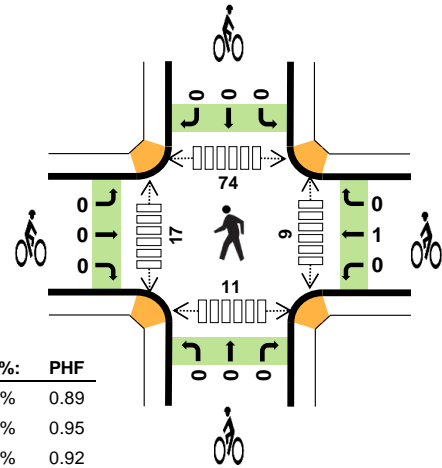
<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Embarcadero Rd			Embarcadero Rd			Middlefield Rd			Middlefield Rd			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
4:30 PM	0	0	0	0	0	0	0	0	0	0	1	0	1	0			
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
<b>5:00 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>			
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
<b>5:45 PM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>			
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
6:15 PM	0	0	0	0	0	0	0	1	0	0	1	0	2	2			
Count Total	0	0	0	0	0	0	0	1	0	0	2	0	3	0			
<b>Peak Hour</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

### El Camino Real Embarcadero Rd



Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 8:30 AM to 9:30 AM



	HV %:	PHF
EB	5.5%	0.89
WB	3.8%	0.95
NB	2.7%	0.92
SB	5.4%	0.99
TOTAL	4.1%	0.95

#### Two-Hour Count Summaries

Interval Start	Galvz St				Embarcadero Rd				El Camino Real				El Camino Real				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	12	86	25	0	46	140	52	5	71	215	12	0	75	181	20	940	0	
7:45 AM	0	14	75	26	0	52	108	52	2	64	246	27	0	71	243	24	1,004	0	
8:00 AM	0	13	45	32	0	37	66	38	0	52	262	38	1	64	192	21	861	0	
8:15 AM	0	8	31	12	0	68	100	49	9	68	295	43	0	57	209	16	965	3,770	
8:30 AM	0	18	45	14	0	42	108	43	3	87	299	32	1	66	253	21	1,032	3,862	
8:45 AM	0	17	49	21	0	54	110	45	1	68	319	34	0	61	268	24	1,071	3,929	
9:00 AM	0	17	61	13	0	38	107	59	3	56	265	28	0	74	252	25	998	4,066	
9:15 AM	0	9	49	12	0	44	82	59	0	57	271	32	1	70	261	19	966	4,067	
Count Total	0	108	441	155	0	381	821	397	23	523	2,172	246	3	538	1,859	170	7,837	0	
Peak Hour	All	0	61	204	60	0	178	407	206	7	268	1,154	126	2	271	1,034	89	4,067	0
	HV	0	8	8	2	0	6	14	10	0	8	33	1	0	12	57	6	165	0
	HV%	-	13%	4%	3%	-	3%	3%	5%	0%	3%	3%	1%	0%	4%	6%	7%	4%	0

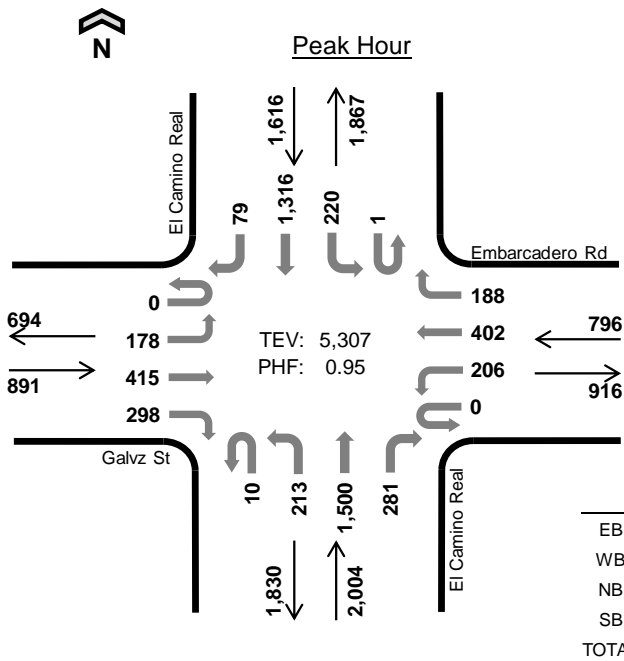
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	4	7	12	13	36	0	0	0	0	0	1	1	6	1	9
7:45 AM	6	4	7	11	28	0	0	0	0	0	1	9	6	4	20
8:00 AM	3	6	11	17	37	0	1	0	0	1	2	8	19	3	32
8:15 AM	2	10	12	9	33	0	0	0	0	0	3	6	24	6	39
8:30 AM	6	7	5	17	35	0	0	0	0	0	3	5	24	4	36
8:45 AM	4	5	12	22	43	0	0	0	0	0	1	1	20	4	26
9:00 AM	3	11	14	17	45	0	0	0	0	0	5	3	16	2	26
9:15 AM	5	7	11	19	42	0	1	0	0	1	0	8	14	1	23
Count Total	33	57	84	125	299	0	2	0	0	2	16	41	129	25	211
Peak Hour	18	30	42	75	165	0	1	0	0	1	9	17	74	11	111

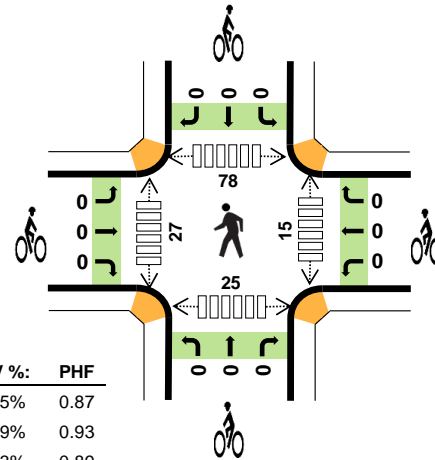


<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Galvz St				Embarcadero Rd				El Camino Real				El Camino Real				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	1	1	2	0	2	2	3	0	1	11	0	0	3	9	1	36	0
7:45 AM	0	3	1	2	0	0	2	2	0	0	7	0	0	5	6	0	28	0
8:00 AM	0	2	0	1	0	0	2	4	0	3	8	0	0	2	13	2	37	0
8:15 AM	0	1	1	0	0	3	4	3	0	1	11	0	0	0	8	1	33	134
8:30 AM	0	3	2	1	0	2	2	3	0	0	5	0	0	3	12	2	35	133
8:45 AM	0	1	3	0	0	0	3	2	0	4	8	0	0	3	18	1	43	148
9:00 AM	0	2	1	0	0	1	5	5	0	2	12	0	0	3	13	1	45	156
9:15 AM	0	2	2	1	0	3	4	0	0	2	8	1	0	3	14	2	42	165
Count Total	0	15	11	7	0	11	24	22	0	13	70	1	0	22	93	10	299	0
Peak Hour	0	8	8	2	0	6	14	10	0	8	33	1	0	12	57	6	165	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Galvz St			Embarcadero Rd			El Camino Real			El Camino Real			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:15 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
Count Total	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0
Peak Hour	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

## El Camino Real Embarcadero Rd



Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:15 PM to 6:15 PM



	HV %:	PHF
EB	1.5%	0.87
WB	0.9%	0.93
NB	1.3%	0.89
SB	1.7%	0.88
TOTAL	1.4%	0.95

### Two-Hour Count Summaries

Interval Start	Galz St				Embarcadero Rd				El Camino Real				El Camino Real				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	38	130	79	0	50	67	48	6	35	326	69	1	55	319	13	1,236	0	
4:45 PM	0	37	134	90	0	45	79	45	2	46	314	70	0	54	318	20	1,254	0	
5:00 PM	1	55	120	84	0	33	70	42	6	54	335	48	1	39	319	21	1,228	0	
5:15 PM	0	38	70	53	0	53	78	49	1	40	389	60	1	56	366	16	1,270	4,988	
5:30 PM	0	31	124	89	0	48	101	47	6	60	421	75	0	57	312	20	1,391	5,143	
5:45 PM	0	59	102	70	0	54	119	41	2	60	340	73	0	58	381	22	1,381	5,270	
6:00 PM	0	50	119	86	0	51	104	51	1	53	350	73	0	49	257	21	1,265	5,307	
6:15 PM	0	45	107	71	0	57	74	41	3	58	350	55	1	54	305	17	1,238	5,275	
Count Total	1	353	906	622	0	391	692	364	27	406	2,825	523	4	422	2,577	150	10,263	0	
Peak Hour	All	0	178	415	298	0	206	402	188	10	213	1,500	281	1	220	1,316	79	5,307	0
	HV	0	7	6	0	0	0	2	5	0	2	21	3	0	7	17	3	73	0
	HV%	-	4%	1%	0%	-	0%	0%	3%	0%	1%	1%	1%	0%	3%	1%	4%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	5	2	9	11	27	0	1	0	0	1	12	9	22	16	59
4:45 PM	5	0	7	8	20	0	0	0	0	0	15	15	36	11	77
5:00 PM	4	2	6	7	19	0	0	0	0	0	9	9	15	7	40
5:15 PM	3	3	5	5	16	0	0	0	0	0	3	7	23	7	40
5:30 PM	3	1	6	5	15	0	0	0	0	0	1	7	16	2	26
5:45 PM	5	0	6	8	19	0	0	0	0	0	4	7	21	5	37
6:00 PM	2	3	9	9	23	0	0	0	0	0	7	6	18	11	42
6:15 PM	3	2	6	6	17	0	0	0	0	0	1	5	14	3	23
Count Total	30	13	54	59	156	0	1	0	0	1	52	65	165	62	344
Peak Hour	13	7	26	27	73	0	0	0	0	0	15	27	78	25	145

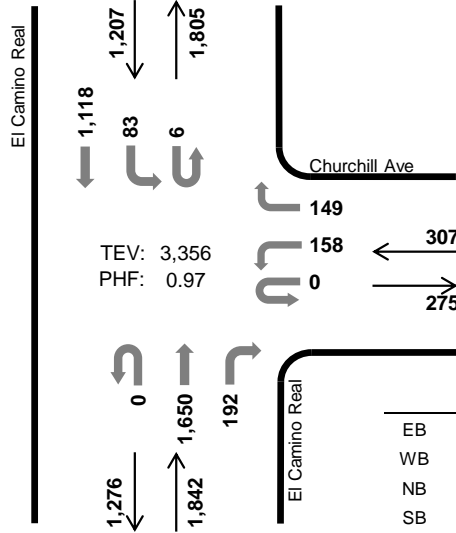
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Galvz St				Embarcadero Rd				El Camino Real				El Camino Real				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	3	2	0	0	0	0	2	0	0	9	0	0	2	8	1	27	0
4:45 PM	0	1	3	1	0	0	0	0	0	0	6	1	0	2	6	0	20	0
5:00 PM	0	2	2	0	0	0	1	1	0	0	5	1	0	1	5	1	19	0
5:15 PM	0	1	2	0	0	0	1	2	0	0	4	1	0	1	3	1	16	82
5:30 PM	0	2	1	0	0	0	0	1	0	0	6	0	0	2	3	0	15	70
5:45 PM	0	2	3	0	0	0	0	0	0	0	5	1	0	3	4	1	19	69
6:00 PM	0	2	0	0	0	0	1	2	0	2	6	1	0	1	7	1	23	73
6:15 PM	0	1	2	0	0	0	0	2	0	0	5	1	0	1	4	1	17	74
Count Total	0	14	15	1	0	0	3	10	0	2	46	6	0	13	40	6	156	0
Peak Hour	0	7	6	0	0	0	2	5	0	2	21	3	0	7	17	3	73	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Galvz St			Embarcadero Rd			El Camino Real			El Camino Real			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Count Total	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
Peak Hour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

# El Camino Real Churchill Ave

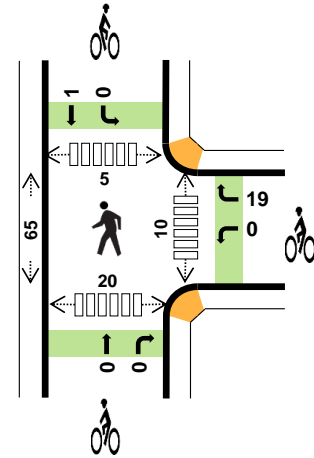


Peak Hour

Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 8:00 AM to 9:00 AM



	HV %:	PHF
EB	-	-
WB	1.3%	0.92
NB	2.7%	0.88
SB	5.0%	0.92
TOTAL	3.4%	0.97



## Two-Hour Count Summaries

Interval Start	0				Churchill Ave				El Camino Real				El Camino Real				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	0	0	0	0	36	0	46	0	0	282	10	2	23	224	0	623	0	
7:45 AM	0	0	0	0	0	42	0	40	0	0	348	48	2	31	290	0	801	0	
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>31</b>	<b>0</b>	<b>46</b>	<b>0</b>	<b>0</b>	<b>454</b>	<b>69</b>	<b>3</b>	<b>22</b>	<b>241</b>	<b>0</b>	<b>866</b>	<b>0</b>	
8:15 AM	0	0	0	0	0	48	0	34	0	0	425	42	0	17	291	0	857	3,147	
8:30 AM	0	0	0	0	0	37	0	28	0	0	407	41	2	16	286	0	817	3,341	
8:45 AM	0	0	0	0	0	42	0	41	0	0	364	40	1	28	300	0	816	3,356	
9:00 AM	0	0	0	0	0	36	0	51	0	0	312	34	0	19	304	0	756	3,246	
9:15 AM	0	0	0	0	0	29	0	39	0	0	321	34	3	22	292	0	740	3,129	
Count Total	0	0	0	0	0	301	0	325	0	0	2,913	318	13	178	2,228	0	6,276	0	
Peak Hour	All	0	0	0	0	0	158	0	149	0	0	1,650	192	6	83	1,118	0	3,356	0
	HV	0	0	0	0	0	2	0	2	0	0	39	11	0	2	58	0	114	0
	HV%	-	-	-	-	-	1%	-	1%	-	-	2%	6%	0%	2%	5%	-	3%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	0	10	15	25	0	4	0	0	4	1	9	0	0	10
7:45 AM	0	0	11	8	19	0	5	0	0	5	3	14	0	6	23
<b>8:00 AM</b>	<b>0</b>	<b>1</b>	<b>13</b>	<b>14</b>	<b>28</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>4</b>	<b>16</b>	<b>2</b>	<b>8</b>	<b>30</b>
8:15 AM	0	1	13	11	25	0	4	0	0	4	3	11	1	1	16
8:30 AM	0	0	12	14	26	0	7	0	0	7	3	16	0	6	25
8:45 AM	0	2	12	21	35	0	1	0	1	2	0	22	2	5	29
9:00 AM	0	3	15	14	32	0	5	0	0	5	2	10	0	7	19
9:15 AM	0	2	12	21	35	0	8	0	0	8	2	16	1	2	21
Count Total	0	9	98	118	225	0	41	0	1	42	18	114	6	35	173
Peak Hr	0	4	50	60	114	0	19	0	1	20	10	65	5	20	100

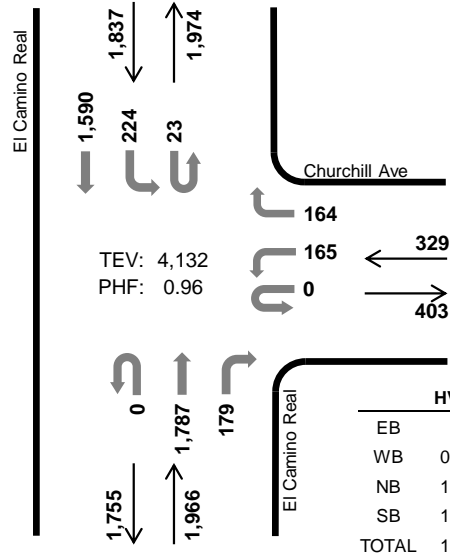
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Churchill Ave				EI Camino Real				EI Camino Real				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	0	0	0	0	0	0	0	10	0	0	0	15	0	25	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	8	3	0	0	8	0	19	0
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>11</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>13</b>	<b>0</b>	<b>28</b>	<b>0</b>
8:15 AM	0	0	0	0	0	0	0	1	0	0	10	3	0	1	10	0	25	97
8:30 AM	0	0	0	0	0	0	0	0	0	0	7	5	0	0	14	0	26	98
8:45 AM	0	0	0	0	0	2	0	0	0	0	11	1	0	0	21	0	35	114
9:00 AM	0	0	0	0	0	3	0	0	0	0	14	1	0	1	13	0	32	118
9:15 AM	0	0	0	0	0	2	0	0	0	0	10	2	0	0	21	0	35	128
Count Total	0	0	0	0	0	7	0	2	0	0	81	17	0	3	115	0	225	0
Peak Hour	0	0	0	0	0	2	0	2	0	0	39	11	0	2	58	0	114	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Churchill Ave			EI Camino Real			EI Camino Real			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0	
7:45 AM	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	5	0	
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>7</b>	<b>0</b>	
8:15 AM	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	20	
8:30 AM	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	7	23	
8:45 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2	20	
9:00 AM	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	5	18	
9:15 AM	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	8	22	
Count Total	0	0	0	0	1	40	0	0	0	0	1	0	0	1	0	42	0	
Peak Hour	0	0	0	0	0	19	0	0	0	0	1	0	0	1	0	20	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### El Camino Real Churchill Ave



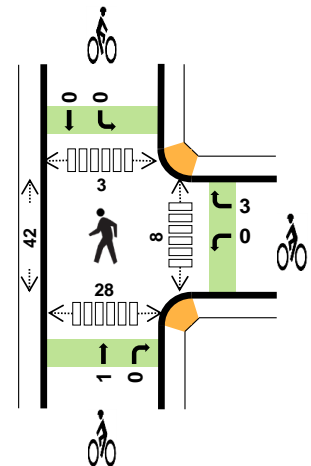
Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:15 PM to 6:15 PM



TEV: 4,132  
PHF: 0.96

	HV %:	PHF
EB	-	-
WB	0.3%	0.85
NB	1.5%	0.94
SB	1.1%	0.96
TOTAL	1.3%	0.96



#### Two-Hour Count Summaries

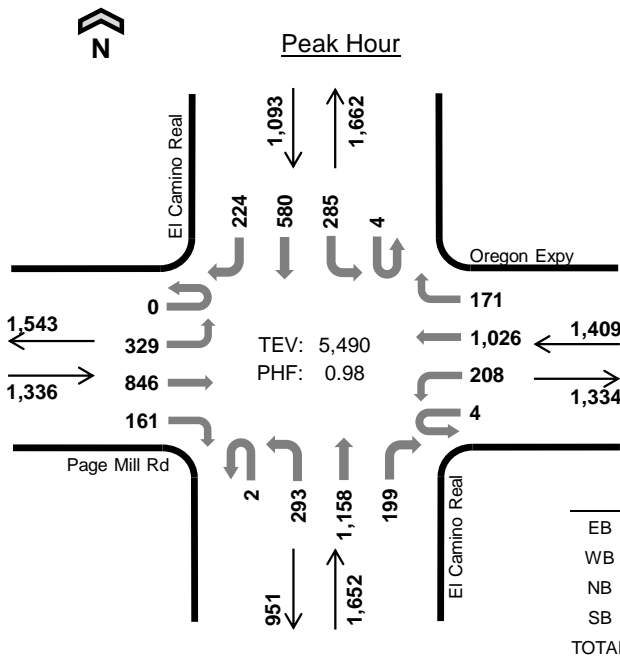
Interval Start	0				Churchill Ave				El Camino Real				El Camino Real				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	0	0	0	38	0	51	0	0	363	38	5	55	399	0	949	0	
4:45 PM	0	0	0	0	0	43	0	64	0	0	373	44	9	50	400	0	983	0	
5:00 PM	0	0	0	0	0	40	0	52	1	0	359	48	5	63	382	0	950	0	
5:15 PM	0	0	0	0	0	41	0	43	0	0	441	42	3	53	415	0	1,038	3,920	
5:30 PM	0	0	0	0	0	33	0	41	0	0	474	48	4	59	417	0	1,076	4,047	
5:45 PM	0	0	0	0	0	47	0	27	0	0	452	40	11	54	409	0	1,040	4,104	
6:00 PM	0	0	0	0	0	44	0	53	0	0	420	49	5	58	349	0	978	4,132	
6:15 PM	0	0	0	0	0	54	0	31	0	0	349	32	6	46	394	0	912	4,006	
Count Total	0	0	0	0	0	340	0	362	1	0	3,231	341	48	438	3,165	0	7,926	0	
Peak Hour	All	0	0	0	0	0	165	0	164	0	0	1,787	179	23	224	1,590	0	4,132	0
	HV	0	0	0	0	0	0	0	1	0	0	28	2	0	0	21	0	52	0
	HV%	-	-	-	-	-	0%	-	1%	-	-	2%	1%	0%	0%	1%	-	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

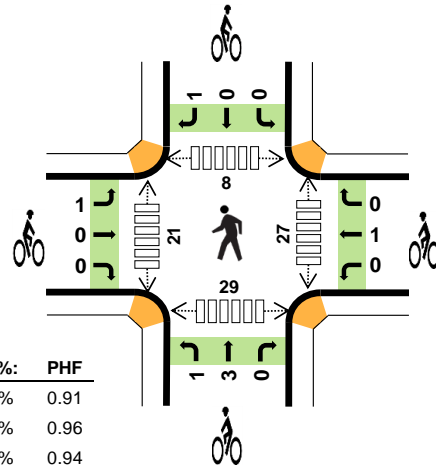
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	0	1	10	12	23	0	1	0	0	1	1	11	3	3	18
4:45 PM	0	1	6	7	14	0	1	1	0	2	0	24	7	11	42
5:00 PM	0	1	8	5	14	0	3	0	0	3	3	15	0	8	26
5:15 PM	0	0	6	4	10	0	0	0	0	0	0	13	0	8	21
5:30 PM	0	0	10	5	15	0	0	0	0	0	2	11	1	5	19
5:45 PM	0	0	6	5	11	0	1	1	0	2	4	11	2	9	26
6:00 PM	0	1	8	7	16	0	2	0	0	2	2	7	0	6	15
6:15 PM	0	0	5	5	10	0	2	1	0	3	0	17	2	11	30
Count Total	0	4	59	50	113	0	10	3	0	13	12	109	15	61	197
Peak Hr	0	1	30	21	52	0	3	1	0	4	8	42	3	28	81

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	0				Churchill Ave				EI Camino Real				EI Camino Real				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	0	0	0	0	0	1	0	0	10	0	0	0	12	0	23	0
4:45 PM	0	0	0	0	0	1	0	0	0	0	6	0	0	0	7	0	14	0
5:00 PM	0	0	0	0	0	1	0	0	0	0	8	0	0	0	5	0	14	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	6	0	0	0	4	0	10	61
5:30 PM	0	0	0	0	0	0	0	0	0	0	8	2	0	0	5	0	15	53
5:45 PM	0	0	0	0	0	0	0	0	0	0	6	0	0	0	5	0	11	50
6:00 PM	0	0	0	0	0	0	0	1	0	0	8	0	0	0	7	0	16	52
6:15 PM	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5	0	10	52
Count Total	0	0	0	0	0	2	0	2	0	0	57	2	0	0	50	0	113	0
Peak Hour	0	0	0	0	0	0	0	1	0	0	28	2	0	0	21	0	52	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	0			Churchill Ave			EI Camino Real			EI Camino Real			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	
4:45 PM	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	2	0	
5:00 PM	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	3	0	
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	
5:45 PM	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	5	
6:00 PM	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	4	
6:15 PM	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	3	7	
Count Total	0	0	0	2	0	8	0	2	1	0	0	0	0	0	0	13	0	
Peak Hour	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	4	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

### El Camino Real Page Mill Rd



Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 8:00 AM to 9:00 AM



	HV %:	PHF
EB	3.4%	0.91
WB	1.8%	0.96
NB	2.3%	0.94
SB	4.9%	0.96
TOTAL	3.0%	0.98

#### Two-Hour Count Summaries

Interval Start	Page Mill Rd				Oregon Expy				El Camino Real				El Camino Real				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	86	169	39	2	56	260	41	0	79	216	57	2	56	105	42	1,210	0	
7:45 AM	0	92	195	26	2	68	275	52	1	88	214	47	0	86	111	57	1,314	0	
8:00 AM	0	89	244	35	0	62	246	58	1	55	259	47	0	76	150	60	1,382	0	
8:15 AM	0	71	201	42	0	54	252	46	1	87	274	52	3	82	120	50	1,335	5,241	
8:30 AM	0	78	210	38	3	51	277	37	0	79	307	55	0	58	152	60	1,405	5,436	
8:45 AM	0	91	191	46	1	41	251	30	0	72	318	45	1	69	158	54	1,368	5,490	
9:00 AM	0	78	192	43	3	47	270	31	0	59	213	48	0	60	148	49	1,241	5,349	
9:15 AM	1	107	182	40	7	54	219	31	0	70	209	67	1	64	141	51	1,244	5,258	
Count Total	1	692	1,584	309	18	433	2,050	326	3	589	2,010	418	7	551	1,085	423	10,499	0	
Peak Hour	All	0	329	846	161	4	208	1,026	171	2	293	1,158	199	4	285	580	224	5,490	0
	HV	0	12	26	8	0	3	16	6	0	5	25	8	0	9	31	14	163	0
	HV%	-	4%	3%	5%	0%	1%	2%	4%	0%	2%	2%	4%	0%	3%	5%	6%	3%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	12	11	14	11	48	2	0	0	0	2	3	6	3	1	13
7:45 AM	9	6	7	5	27	0	0	0	0	0	5	4	4	4	17
8:00 AM	10	9	9	14	42	0	0	1	0	1	5	3	1	7	16
8:15 AM	15	7	7	7	36	1	0	1	0	2	6	6	3	3	18
8:30 AM	8	4	10	10	32	0	1	1	0	2	5	3	1	4	13
8:45 AM	13	5	12	23	53	0	0	1	1	2	11	9	3	15	38
9:00 AM	13	12	13	15	53	0	1	0	0	1	7	6	4	3	20
9:15 AM	10	9	12	17	48	0	1	1	0	2	7	5	1	5	18
Count Total	90	63	84	102	339	3	3	5	1	12	49	42	20	42	153
Peak Hour	46	25	38	54	163	1	1	4	1	7	27	21	8	29	85



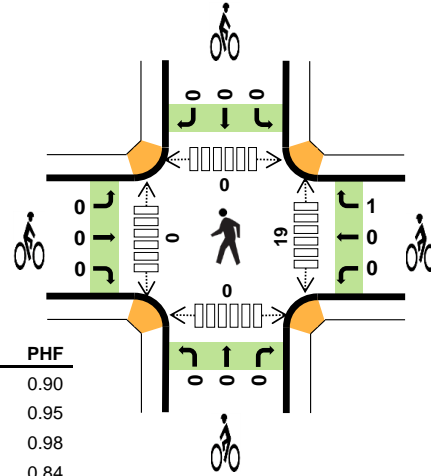
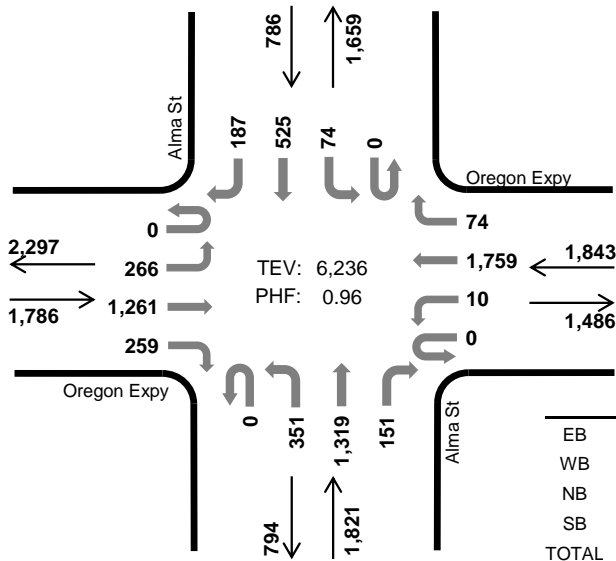
<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Page Mill Rd				Oregon Expy				El Camino Real				El Camino Real				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	1	8	3	0	2	5	4	0	2	9	3	0	2	7	2	48	0
7:45 AM	0	4	4	1	0	1	4	1	0	1	5	1	0	0	2	3	27	0
<b>8:00 AM</b>	<b>0</b>	<b>4</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>5</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>7</b>	<b>4</b>	<b>42</b>	<b>0</b>
8:15 AM	0	3	9	3	0	1	3	3	0	1	5	1	0	2	5	0	36	153
<b>8:30 AM</b>	<b>0</b>	<b>3</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>7</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>2</b>	<b>32</b>	<b>137</b>
8:45 AM	0	2	6	5	0	1	4	0	0	2	8	2	0	4	11	8	53	163
9:00 AM	0	5	5	3	0	0	8	4	0	2	8	3	0	2	10	3	53	174
9:15 AM	0	6	4	0	1	2	3	3	0	3	6	3	0	4	11	2	48	186
Count Total	0	28	47	15	1	8	36	18	0	13	53	18	0	17	61	24	339	0
<b>Peak Hour</b>	<b>0</b>	<b>12</b>	<b>26</b>	<b>8</b>	<b>0</b>	<b>3</b>	<b>16</b>	<b>6</b>	<b>0</b>	<b>5</b>	<b>25</b>	<b>8</b>	<b>0</b>	<b>9</b>	<b>31</b>	<b>14</b>	<b>163</b>	<b>0</b>
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Page Mill Rd			Oregon Expy			El Camino Real			El Camino Real			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<b>8:00 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	
8:15 AM	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	5	
<b>8:30 AM</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>5</b>	
8:45 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	7	
9:00 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	7	
9:15 AM	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	2	7	
Count Total	1	1	1	0	3	0	0	0	1	4	0	0	0	0	1	12	0	
<b>Peak Hour</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>7</b>	<b>0</b>	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

# Alma St Oregon Expy



Peak Hour

Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 7:45 AM to 8:45 AM



	HV %:	PHF
EB	2.1%	0.90
WB	1.9%	0.95
NB	1.8%	0.98
SB	1.8%	0.84
TOTAL	1.9%	0.96

## Two-Hour Count Summaries

Interval Start	Oregon Expy Eastbound				Oregon Expy Westbound				Alma St Northbound				Alma St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	55	225	52	0	5	437	17	0	57	263	32	0	8	88	34	1,273	0	
7:45 AM	0	75	267	61	0	1	421	20	0	90	326	40	0	16	129	46	1,492	0	
8:00 AM	0	77	356	64	0	3	461	21	0	77	344	45	0	19	119	42	1,628	0	
8:15 AM	0	55	339	68	0	2	422	19	0	92	306	37	0	26	157	51	1,574	5,967	
8:30 AM	0	59	299	66	0	4	455	14	0	92	343	29	0	13	120	48	1,542	6,236	
8:45 AM	2	70	272	46	0	8	340	8	0	91	298	34	0	11	160	42	1,382	6,126	
9:00 AM	0	43	303	37	0	5	339	6	0	75	285	25	0	6	135	45	1,304	5,802	
9:15 AM	0	52	273	47	0	7	409	17	0	91	310	25	0	8	98	43	1,380	5,608	
Count Total	2	486	2,334	441	0	35	3,284	122	0	665	2,475	267	0	107	1,006	351	11,575	0	
Peak Hour	All	0	266	1,261	259	0	10	1,759	74	0	351	1,319	151	0	74	525	187	6,236	0
	HV	0	2	33	2	0	0	32	3	0	0	32	1	0	1	9	4	119	0
	HV%	-	1%	3%	1%	-	0%	2%	4%	-	0%	2%	1%	-	1%	2%	2%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	17	8	6	3	34	1	0	0	0	1	9	0	0	0	9
7:45 AM	4	5	10	7	26	0	0	0	0	0	1	0	0	0	1
8:00 AM	11	12	8	1	32	0	0	0	0	0	7	0	0	0	7
8:15 AM	14	8	13	3	38	0	0	0	0	0	5	0	0	0	5
8:30 AM	8	10	2	3	23	0	1	0	0	1	6	0	0	0	6
8:45 AM	15	6	3	6	30	0	0	0	0	0	7	0	0	0	7
9:00 AM	9	9	6	3	27	0	0	2	0	2	5	0	0	0	5
9:15 AM	13	11	3	3	30	0	1	1	0	2	7	0	0	0	7
Count Total	91	69	51	29	240	1	2	3	0	6	47	0	0	0	47
Peak Hour	37	35	33	14	119	0	1	0	0	1	19	0	0	0	19

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Oregon Expy				Oregon Expy				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	9	8	0	0	8	0	0	2	3	1	0	1	2	0	34	0
7:45 AM	0	0	4	0	0	0	5	0	0	0	9	1	0	0	5	2	26	0
8:00 AM	0	0	10	1	0	0	10	2	0	0	8	0	0	0	1	0	32	0
8:15 AM	0	0	14	0	0	0	8	0	0	0	13	0	0	1	2	0	38	130
8:30 AM	0	2	5	1	0	0	9	1	0	0	2	0	0	0	1	2	23	119
8:45 AM	0	1	12	2	0	1	5	0	0	0	3	0	0	0	3	3	30	123
9:00 AM	0	0	8	1	0	0	9	0	0	1	4	1	0	0	2	1	27	118
9:15 AM	0	0	12	1	0	0	11	0	0	1	1	1	0	1	2	0	30	110
Count Total	0	3	74	14	0	1	65	3	0	4	43	4	0	3	18	8	240	0
Peak Hour	0	2	33	2	0	0	32	3	0	0	32	1	0	1	9	4	119	0

<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Oregon Expy			Oregon Expy			Alma St			Alma St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
7:30 AM	0	0	1	0	0	0	0	0	0	0	0	0	1	0			
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
8:30 AM	0	0	0	0	0	1	0	0	0	0	0	0	1	1			
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
9:00 AM	0	0	0	0	0	0	0	2	0	0	0	0	2	3			
9:15 AM	0	0	0	1	0	0	0	1	0	0	0	0	2	5			
Count Total	0	0	1	1	0	1	0	3	0	0	0	0	6	0			
Peak Hour	0	0	0	0	0	1	0	0	0	0	0	0	1	0			

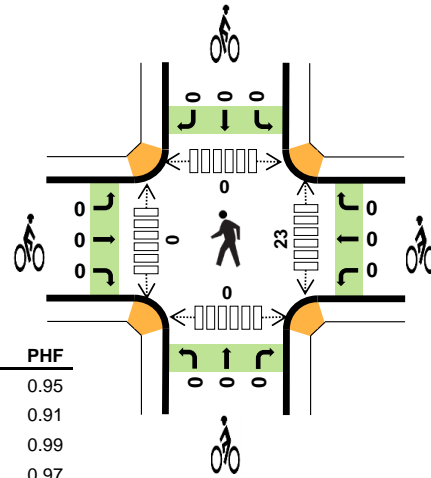
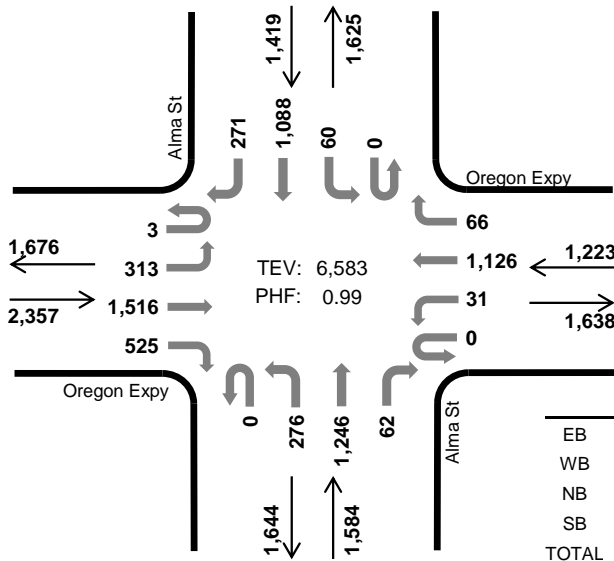
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

# Alma St Oregon Expy



Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:15 PM to 6:15 PM



	HV %:	PHF
EB	1.0%	0.95
WB	0.6%	0.91
NB	0.1%	0.99
SB	0.5%	0.97
TOTAL	0.6%	0.99

### Two-Hour Count Summaries

Interval Start	Oregon Expy Eastbound				Oregon Expy Westbound				Alma St Northbound				Alma St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	1	74	412	131	0	6	215	16	0	50	241	19	0	25	315	45	1,550	0	
4:45 PM	1	73	389	116	0	8	257	10	0	56	232	14	0	23	313	45	1,537	0	
5:00 PM	0	85	285	126	0	6	257	18	0	47	295	16	0	16	326	67	1,544	0	
5:15 PM	0	70	340	120	0	5	313	17	0	76	308	15	0	18	276	70	1,628	6,259	
5:30 PM	0	81	420	120	0	6	256	23	0	68	317	15	0	14	246	64	1,630	6,339	
5:45 PM	2	81	393	139	0	8	262	13	0	66	321	10	0	19	276	70	1,660	6,462	
6:00 PM	1	81	363	146	0	12	295	13	0	66	300	22	0	9	290	67	1,665	6,583	
6:15 PM	0	90	386	121	0	10	275	14	0	73	277	14	0	9	254	69	1,592	6,547	
Count Total	5	635	2,988	1,019	0	61	2,130	124	0	502	2,291	125	0	133	2,296	497	12,806	0	
Peak Hour	All	3	313	1,516	525	0	31	1,126	66	0	276	1,246	62	0	60	1,088	271	6,583	0
	HV	0	1	18	5	0	0	7	0	0	1	0	1	0	0	5	2	40	0
	HV%	0%	0%	1%	1%	-	0%	1%	0%	-	0%	0%	2%	-	0%	0%	1%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	8	3	3	2	16	0	0	0	0	0	1	0	0	0	1
4:45 PM	6	3	4	3	16	0	0	0	0	0	5	0	0	0	5
5:00 PM	5	5	1	2	13	0	0	0	0	0	6	0	0	0	6
5:15 PM	5	2	1	2	10	0	0	0	0	0	7	0	0	0	7
5:30 PM	6	0	1	3	10	0	0	0	0	0	6	0	0	0	6
5:45 PM	7	3	0	0	10	0	0	0	0	0	6	0	0	0	6
6:00 PM	6	2	0	2	10	0	0	0	0	0	4	0	0	0	4
6:15 PM	7	2	1	1	11	0	0	0	0	0	8	0	0	0	8
Count Total	50	20	11	15	96	0	0	0	0	0	43	0	0	0	43
Peak Hour	24	7	2	7	40	0	0	0	0	0	23	0	0	0	23

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Oregon Expy				Oregon Expy				Alma St				Alma St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	6	2	0	0	3	0	0	0	3	0	0	0	0	2	16	0
4:45 PM	0	0	5	1	0	0	3	0	0	1	3	0	0	2	1	0	16	0
5:00 PM	0	1	4	0	0	0	5	0	0	0	1	0	0	0	1	1	13	0
5:15 PM	0	1	4	0	0	0	2	0	0	0	0	1	0	0	2	0	10	55
5:30 PM	0	0	3	3	0	0	0	0	0	1	0	0	0	0	1	2	10	49
5:45 PM	0	0	6	1	0	0	3	0	0	0	0	0	0	0	0	0	10	43
6:00 PM	0	0	5	1	0	0	2	0	0	0	0	0	0	0	2	0	10	40
6:15 PM	0	1	6	0	0	0	1	1	0	1	0	0	0	0	0	1	11	41
Count Total	0	3	39	8	0	0	19	1	0	3	7	1	0	2	7	6	96	0
Peak Hour	0	1	18	5	0	0	7	0	0	1	0	1	0	0	5	2	40	0

<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Oregon Expy			Oregon Expy			Alma St			Alma St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

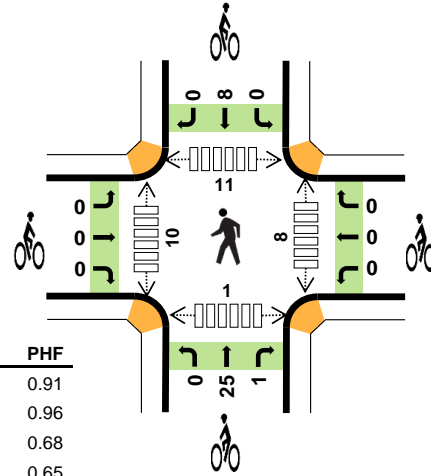
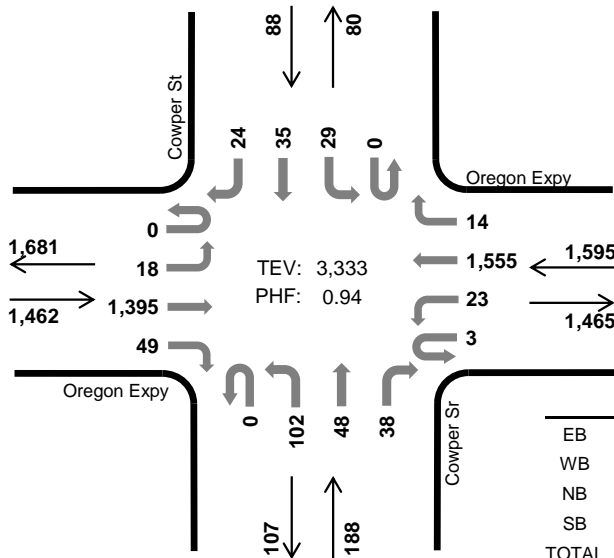
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

# Cowper Sr Oregon Expy



Peak Hour

Date: 12-06-2018  
Count Period: 7:30 AM to 9:30 AM  
Peak Hour: 7:45 AM to 8:45 AM



	HV %:	PHF
EB	1.8%	0.91
WB	2.5%	0.96
NB	1.6%	0.68
SB	1.1%	0.65
TOTAL	2.1%	0.94

## Two-Hour Count Summaries

Interval Start	Oregon Expy Eastbound				Oregon Expy Westbound				Cowper Sr Northbound				Cowper St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	1	0	256	3	0	1	405	1	0	3	2	8	0	2	2	1	685	0	
7:45 AM	0	4	318	7	1	5	408	2	0	21	10	9	0	8	8	5	806	0	
8:00 AM	0	3	385	14	1	5	371	2	0	42	21	6	0	13	12	9	884	0	
8:15 AM	0	5	342	10	0	6	385	3	0	27	11	8	0	4	11	7	819	3,194	
8:30 AM	0	6	350	18	1	7	391	7	0	12	6	15	0	4	4	3	824	3,333	
8:45 AM	0	7	316	6	0	2	294	1	0	9	8	11	0	3	5	3	665	3,192	
9:00 AM	0	4	329	6	0	2	342	3	0	6	7	8	0	4	8	3	722	3,030	
9:15 AM	0	3	302	6	2	4	359	2	0	12	4	11	0	3	5	1	714	2,925	
Count Total	1	32	2,598	70	5	32	2,955	21	0	132	69	76	0	41	55	32	6,119	0	
Peak Hour	All	0	18	1,395	49	3	23	1,555	14	0	102	48	38	0	29	35	24	3,333	0
	HV	0	0	26	0	0	4	36	0	0	2	0	1	0	0	1	0	70	0
	HV%	-	0%	2%	0%	0%	17%	2%	0%	-	2%	0%	3%	-	0%	3%	0%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	9	6	0	0	15	0	2	4	2	8	1	2	1	0	4
7:45 AM	2	10	0	0	12	0	0	3	3	6	1	2	5	0	8
8:00 AM	7	13	0	1	21	0	0	11	1	12	4	5	3	1	13
8:15 AM	13	10	1	0	24	0	0	4	2	6	3	2	3	0	8
8:30 AM	4	7	2	0	13	0	0	8	2	10	0	1	0	0	1
8:45 AM	11	11	0	0	22	0	0	3	2	5	0	0	1	0	1
9:00 AM	9	8	1	0	18	0	0	4	3	7	0	1	1	0	2
9:15 AM	16	15	1	0	32	0	0	2	0	2	1	0	0	0	1
Count Total	71	80	5	1	157	0	2	39	15	56	10	13	14	1	38
Peak Hour	26	40	3	1	70	0	0	26	8	34	8	10	11	1	30

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Oregon Expy				Oregon Expy				Cowper Sr				Cowper St				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	9	0	0	0	6	0	0	0	0	0	0	0	0	15	0	
7:45 AM	0	0	2	0	0	2	8	0	0	0	0	0	0	0	0	12	0	
8:00 AM	0	0	7	0	0	0	13	0	0	0	0	0	0	0	1	21	0	
8:15 AM	0	0	13	0	0	2	8	0	0	1	0	0	0	0	0	24	72	
8:30 AM	0	0	4	0	0	0	7	0	0	1	0	1	0	0	0	13	70	
8:45 AM	0	0	11	0	0	0	11	0	0	0	0	0	0	0	0	22	80	
9:00 AM	0	1	8	0	0	0	8	0	0	0	1	0	0	0	0	18	77	
9:15 AM	0	0	15	1	0	0	14	1	0	0	0	1	0	0	0	32	85	
Count Total	0	1	69	1	0	4	75	1	0	2	1	2	0	0	1	157	0	
Peak Hour	0	0	26	0	0	4	36	0	0	2	0	1	0	0	1	70	0	

<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Oregon Expy			Oregon Expy			Cowper Sr			Cowper St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
7:30 AM	0	0	0	0	2	0	0	4	0	0	2	0	8	0			
7:45 AM	0	0	0	0	0	0	0	3	0	0	3	0	6	0			
8:00 AM	0	0	0	0	0	0	0	10	1	0	1	0	12	0			
8:15 AM	0	0	0	0	0	0	0	4	0	0	2	0	6	32			
8:30 AM	0	0	0	0	0	0	0	8	0	0	2	0	10	34			
8:45 AM	0	0	0	0	0	0	0	3	0	0	2	0	5	33			
9:00 AM	0	0	0	0	0	0	0	4	0	0	3	0	7	28			
9:15 AM	0	0	0	0	0	0	0	2	0	0	0	0	2	24			
Count Total	0	0	0	0	2	0	0	38	1	0	15	0	56	0			
Peak Hour	0	0	0	0	0	0	0	25	1	0	8	0	34	0			

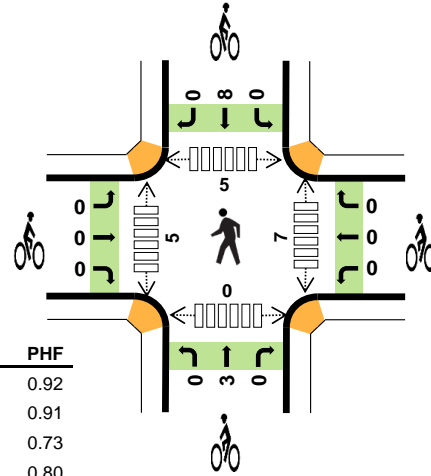
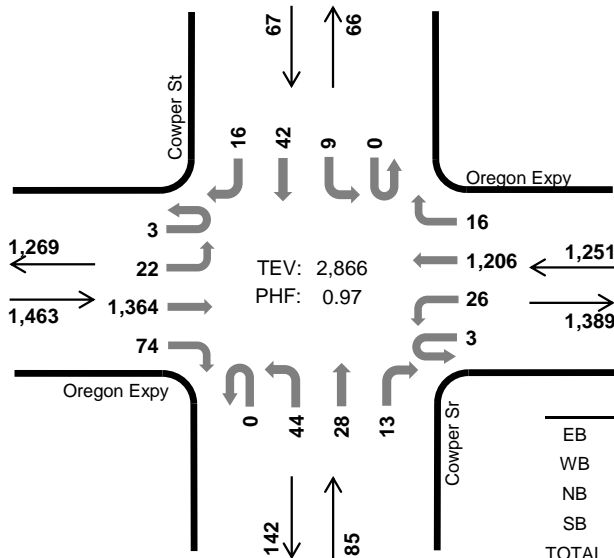
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

# Cowper Sr Oregon Expy



Peak Hour

Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:15 PM to 6:15 PM



	HV %:	PHF
EB	1.3%	0.92
WB	0.6%	0.91
NB	0.0%	0.73
SB	0.0%	0.80
TOTAL	0.9%	0.97

### Two-Hour Count Summaries

Interval Start	Oregon Expy Eastbound				Oregon Expy Westbound				Cowper Sr Northbound				Cowper St Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	11	366	20	0	5	219	1	0	3	8	5	0	2	12	4	656	0	
4:45 PM	0	7	336	10	2	3	248	2	0	5	4	11	0	6	14	5	653	0	
5:00 PM	2	3	241	3	1	6	270	3	0	12	6	11	0	5	13	3	579	0	
5:15 PM	2	4	336	11	1	9	308	4	0	18	10	1	0	5	13	3	725	2,613	
5:30 PM	1	7	375	14	0	5	259	2	0	10	9	4	0	2	9	5	702	2,659	
5:45 PM	0	4	315	32	1	4	309	5	0	10	5	5	0	1	8	0	699	2,705	
6:00 PM	0	7	338	17	1	8	330	5	0	6	4	3	0	1	12	8	740	2,866	
6:15 PM	1	4	334	23	2	3	284	5	0	4	4	4	0	2	9	3	682	2,823	
Count Total	6	47	2,641	130	8	43	2,227	27	0	68	50	44	0	24	90	31	5,436	0	
Peak Hour	All	3	22	1,364	74	3	26	1,206	16	0	44	28	13	0	9	42	16	2,866	0
	HV	0	1	18	0	0	1	6	0	0	0	0	0	0	0	0	0	26	0
	HV%	0%	5%	1%	0%	0%	4%	0%	0%	-	0%	0%	0%	-	0%	0%	0%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

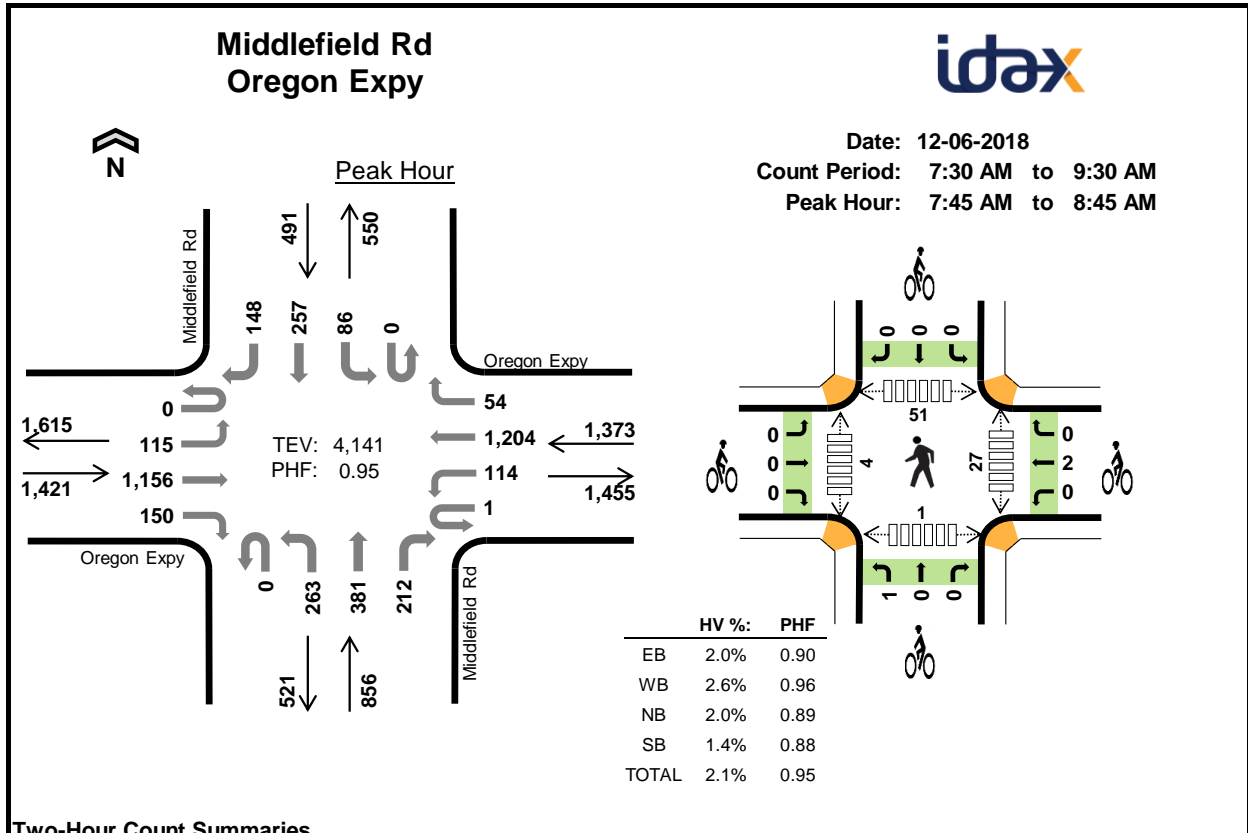
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	6	1	0	1	8	0	0	3	1	4	3	1	2	0	6
4:45 PM	5	2	0	0	7	0	0	3	3	6	2	6	3	0	11
5:00 PM	3	5	0	0	8	0	0	1	3	4	0	3	2	0	5
5:15 PM	4	2	0	0	6	0	0	0	3	3	4	2	1	0	7
5:30 PM	4	2	0	0	6	0	0	2	0	2	3	3	3	0	9
5:45 PM	5	2	0	0	7	0	0	0	3	3	0	0	1	0	1
6:00 PM	6	1	0	0	7	0	0	1	2	3	0	0	0	0	0
6:15 PM	6	1	1	0	8	1	1	1	3	6	0	3	1	2	6
Count Total	39	16	1	1	57	1	1	11	18	31	12	18	13	2	45
Peak Hour	19	7	0	0	26	0	0	3	8	11	7	5	5	0	17



<b>Two-Hour Count Summaries - Heavy Vehicles</b>																			
Interval Start	Oregon Expy				Oregon Expy				Cowper Sr				Cowper St				15-min Total	Rolling One Hour	
	Eastbound				Westbound				Northbound				Southbound						
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	0	5	1	0	0	1	0	0	0	0	0	0	0	0	0	1	8	0
4:45 PM	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	7	0
5:00 PM	0	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	8	0
5:15 PM	0	0	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	29
5:30 PM	0	1	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	6	27
5:45 PM	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	7	27
6:00 PM	0	0	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	7	26
6:15 PM	0	0	6	0	0	0	1	0	0	0	0	1	0	0	0	0	0	8	28
Count Total	0	1	37	1	0	1	15	0	0	0	0	1	0	0	0	1	0	57	0
Peak Hour	0	1	18	0	0	1	6	0	0	0	0	0	0	0	0	0	0	26	0

<b>Two-Hour Count Summaries - Bikes</b>																	
Interval Start	Oregon Expy			Oregon Expy			Cowper Sr			Cowper St			15-min Total	Rolling One Hour			
	Eastbound			Westbound			Northbound			Southbound							
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT					
4:30 PM	0	0	0	0	0	0	0	3	0	0	1	0	4	0			
4:45 PM	0	0	0	0	0	0	0	3	0	0	3	0	6	0			
5:00 PM	0	0	0	0	0	0	0	1	0	0	3	0	4	0			
5:15 PM	0	0	0	0	0	0	0	0	0	0	3	0	3	17			
5:30 PM	0	0	0	0	0	0	0	2	0	0	0	0	2	15			
5:45 PM	0	0	0	0	0	0	0	0	0	0	3	0	3	12			
6:00 PM	0	0	0	0	0	0	0	1	0	0	2	0	3	11			
6:15 PM	0	1	0	0	1	0	0	1	0	0	3	0	6	14			
Count Total	0	1	0	0	1	0	0	11	0	0	18	0	31	0			
Peak Hour	0	0	0	0	0	0	0	3	0	0	8	0	11	0			

Note: U-Turn volumes for bikes are included in Left-Turn, if any.



**Two-Hour Count Summaries**

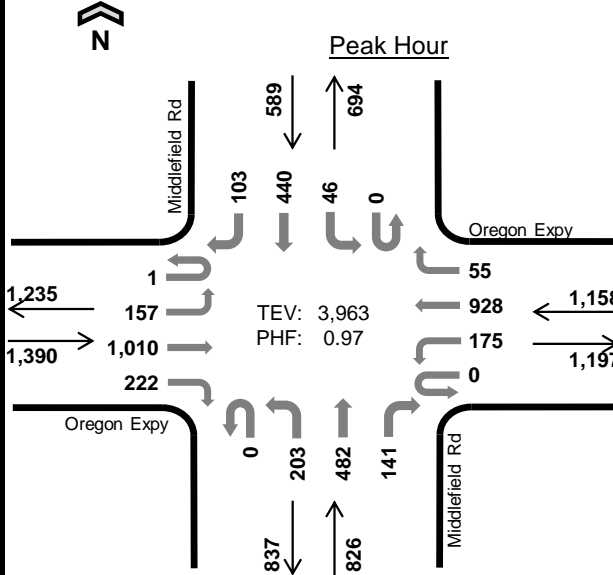
Interval Start	Oregon Expy Eastbound				Oregon Expy Westbound				Middlefield Rd Northbound				Middlefield Rd Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
7:30 AM	0	36	202	24	0	24	313	11	0	44	60	38	0	8	28	29	817	0	
7:45 AM	0	43	229	30	0	28	308	23	0	64	79	33	0	16	45	41	939	0	
8:00 AM	0	34	308	52	0	22	296	16	0	66	77	64	0	27	64	37	1,063	0	
8:15 AM	0	14	314	37	0	34	303	10	0	69	119	45	0	22	72	46	1,085	3,904	
8:30 AM	0	24	305	31	1	30	297	5	0	64	106	70	0	21	76	24	1,054	4,141	
8:45 AM	0	22	320	17	0	19	225	3	0	44	90	49	0	16	84	36	925	4,127	
9:00 AM	0	32	274	23	0	11	270	1	0	44	62	36	0	11	68	29	861	3,925	
9:15 AM	0	13	277	31	0	22	306	9	0	33	54	58	0	11	61	35	910	3,750	
Count Total	0	218	2,229	245	1	190	2,318	78	0	428	647	393	0	132	498	277	7,654	0	
Peak Hour	All	0	115	1,156	150	1	114	1,204	54	0	263	381	212	0	86	257	148	4,141	0
	HV	0	2	23	3	0	1	33	2	0	4	8	5	0	0	6	1	88	0
	HV%	-	2%	2%	2%	0%	1%	3%	4%	-	2%	2%	2%	-	0%	2%	1%	2%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

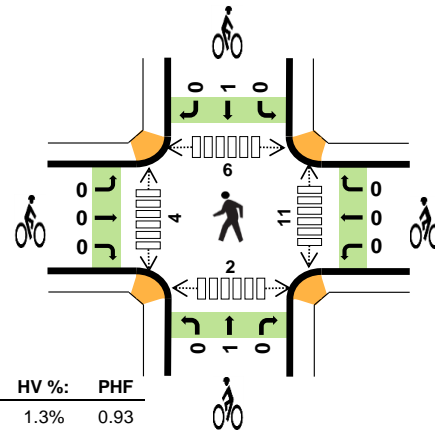
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	9	5	2	0	16	0	2	2	0	4	0	2	6	0	8
7:45 AM	2	9	2	2	15	0	0	0	0	0	16	3	10	0	29
8:00 AM	9	11	6	2	28	0	1	0	0	1	7	0	29	1	37
8:15 AM	11	8	5	2	26	0	1	1	0	2	2	1	9	0	12
8:30 AM	6	8	4	1	19	0	0	0	0	0	2	0	3	0	5
8:45 AM	12	9	7	2	30	0	1	0	0	1	5	1	6	1	13
9:00 AM	8	7	1	2	18	0	0	1	1	2	1	3	4	0	8
9:15 AM	16	14	5	2	37	0	1	0	0	1	2	0	3	0	5
Count Total	73	71	32	13	189	0	6	4	1	11	35	10	70	2	117
Peak Hour	28	36	17	7	88	0	2	1	0	3	27	4	51	1	83

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Oregon Expy				Oregon Expy				Middlefield Rd				Middlefield Rd				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	1	8	0	0	0	5	0	0	0	0	2	0	0	0	0	16	0
7:45 AM	0	1	1	0	0	0	9	0	0	0	1	1	0	0	1	1	15	0
8:00 AM	0	1	7	1	0	0	10	1	0	2	3	1	0	0	2	0	28	0
8:15 AM	0	0	11	0	0	1	7	0	0	2	1	2	0	0	2	0	26	85
8:30 AM	0	0	4	2	0	0	7	1	0	0	3	1	0	0	1	0	19	88
8:45 AM	0	0	12	0	0	0	9	0	0	0	5	2	0	0	2	0	30	103
9:00 AM	0	0	7	1	0	0	7	0	0	0	1	0	0	0	2	0	18	93
9:15 AM	0	0	15	1	0	0	14	0	0	2	1	2	0	1	1	0	37	104
Count Total	0	3	65	5	0	1	68	2	0	6	15	11	0	1	11	1	189	0
Peak Hour	0	2	23	3	0	1	33	2	0	4	8	5	0	0	6	1	88	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Oregon Expy			Oregon Expy			Middlefield Rd			Middlefield Rd			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
7:30 AM	0	0	0	0	2	0	0	2	0	0	0	0	0	0	4	0		
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
8:00 AM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0		
8:15 AM	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	7		
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3		
8:45 AM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	4		
9:00 AM	0	0	0	0	0	0	0	1	0	0	0	0	1	0	2	5		
9:15 AM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	4		
Count Total	0	0	0	0	6	0	1	3	0	0	1	0	0	1	0	11	0	
Peak Hour	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	3	0	
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

# Middlefield Rd Oregon Expy



Date: 12-06-2018  
Count Period: 4:30 PM to 6:30 PM  
Peak Hour: 5:15 PM to 6:15 PM



	HV %:	PHF
EB	1.3%	0.93
WB	0.5%	0.87
NB	0.7%	0.92
SB	0.7%	0.93
TOTAL	0.9%	0.97

## Two-Hour Count Summaries

Interval Start	Oregon Expy Eastbound				Oregon Expy Westbound				Middlefield Rd Northbound				Middlefield Rd Southbound				15-min Total	Rolling One Hour	
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT			
4:30 PM	0	33	320	51	0	20	162	10	0	35	87	32	0	21	97	25	893	0	
4:45 PM	0	25	274	43	0	37	203	11	0	35	90	40	0	11	104	22	895	0	
5:00 PM	0	21	201	37	0	38	196	10	0	55	122	43	0	20	122	26	891	0	
5:15 PM	0	21	241	59	0	42	232	6	0	58	125	41	0	10	123	25	983	3,662	
5:30 PM	0	44	276	53	0	52	179	11	0	51	126	35	0	11	102	28	968	3,737	
5:45 PM	0	43	253	56	0	47	266	21	0	44	113	37	0	9	110	18	1,017	3,859	
6:00 PM	1	49	240	54	0	34	251	17	0	50	118	28	0	16	105	32	995	3,963	
6:15 PM	0	41	214	76	0	39	211	7	0	46	97	33	0	9	107	36	916	3,896	
Count Total	1	277	2,019	429	0	309	1,700	93	0	374	878	289	0	107	870	212	7,558	0	
Peak Hour	All	1	157	1,010	222	0	175	928	55	0	203	482	141	0	46	440	103	3,963	0
	HV	0	1	16	1	0	1	5	0	0	0	3	3	0	0	3	1	34	0
	HV%	0%	1%	2%	0%	-	1%	1%	0%	-	0%	1%	2%	-	0%	1%	1%	1%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:30 PM	4	0	6	3	13	0	0	0	1	1	3	5	4	0	12
4:45 PM	5	3	1	1	10	0	0	0	0	0	2	3	2	0	7
5:00 PM	3	5	4	1	13	0	0	0	0	0	8	2	6	1	17
5:15 PM	4	1	2	1	8	0	0	0	0	0	4	0	1	0	5
5:30 PM	2	1	1	2	6	0	0	1	0	1	3	2	3	0	8
5:45 PM	6	3	2	1	12	0	0	0	0	0	3	0	2	2	7
6:00 PM	6	1	1	0	8	0	0	0	1	1	1	2	0	0	3
6:15 PM	7	1	0	1	9	0	0	0	3	3	6	0	4	1	11
Count Total	37	15	17	10	79	0	0	1	5	6	30	14	22	4	70
Peak Hour	18	6	6	4	34	0	0	1	1	2	11	4	6	2	23

<b>Two-Hour Count Summaries - Heavy Vehicles</b>																		
Interval Start	Oregon Expy				Oregon Expy				Middlefield Rd				Middlefield Rd				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:30 PM	0	0	4	0	0	0	0	0	0	2	3	1	0	0	2	1	13	0
4:45 PM	0	0	5	0	0	1	2	0	0	0	0	1	0	0	1	0	10	0
5:00 PM	0	1	2	0	0	0	5	0	0	0	2	2	0	0	1	0	13	0
5:15 PM	0	0	4	0	0	0	1	0	0	0	1	1	0	0	1	0	8	44
5:30 PM	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	1	6	37
5:45 PM	0	0	5	1	0	1	2	0	0	0	0	2	0	0	1	0	12	39
6:00 PM	0	0	6	0	0	0	1	0	0	0	1	0	0	0	0	0	8	34
6:15 PM	0	1	6	0	0	0	1	0	0	0	0	0	0	0	1	0	9	35
Count Total	0	3	33	1	0	2	13	0	0	2	8	7	0	0	8	2	79	0
Peak Hour	0	1	16	1	0	1	5	0	0	0	3	3	0	0	3	1	34	0
<b>Two-Hour Count Summaries - Bikes</b>																		
Interval Start	Oregon Expy			Oregon Expy			Middlefield Rd			Middlefield Rd			15-min Total	Rolling One Hour				
	Eastbound			Westbound			Northbound			Southbound								
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT						
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0		
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
5:30 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1		
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2		
6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	5		
Count Total	0	0	0	0	0	0	0	0	1	1	0	0	5	0	6	0		
Peak Hour	0	0	0	0	0	0	0	0	1	1	0	0	1	0	2	0		
<i>Note: U-Turn volumes for bikes are included in Left-Turn, if any.</i>																		

Location: Alma St B/W Forest Ave & Homer Ave  
 Date Range: 12/11/2018 - 12/17/2018  
 Site Code: 03

Time	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Mid-Week Average		
	12/11/2018			12/12/2018			12/13/2018			12/14/2018			12/15/2018			12/16/2018			12/17/2018					
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	42	34	76	53	28	81	83	29	112	86	51	137	138	93	231	140	84	224	42	26	68	59	30	90
1:00 AM	28	20	48	29	15	44	38	15	53	45	25	70	96	62	158	84	40	124	17	15	32	32	17	48
2:00 AM	13	14	27	20	7	27	16	13	29	20	18	38	52	32	84	38	19	57	12	8	20	16	11	28
3:00 AM	12	15	27	6	20	26	12	24	36	11	17	28	19	15	34	15	14	29	10	15	25	10	20	30
4:00 AM	26	42	68	23	43	66	24	36	60	18	34	52	16	31	47	9	16	25	22	42	64	24	40	65
5:00 AM	60	164	224	64	141	205	47	154	201	58	159	217	21	58	79	17	42	59	47	165	212	57	153	210
6:00 AM	171	385	556	125	380	505	129	365	494	134	350	484	35	137	172	40	91	131	111	341	452	142	377	518
7:00 AM	404	829	1,233	401	796	1,197	409	867	1,276	322	759	1,081	107	250	357	68	165	233	378	800	1,178	405	831	1,235
8:00 AM	513	1,101	1,614	555	1,091	1,646	491	1,034	1,525	501	1,049	1,550	213	380	593	143	284	427	440	1,087	1,527	520	1,075	1,595
9:00 AM	456	1,076	1,532	502	1,001	1,503	424	958	1,382	413	1,018	1,431	263	538	801	256	486	742	459	915	1,374	461	1,012	1,472
10:00 AM	443	883	1,326	420	890	1,310	446	937	1,383	435	936	1,371	379	683	1,062	310	516	826	409	862	1,271	436	903	1,340
11:00 AM	481	833	1,314	431	869	1,300	486	923	1,409	503	873	1,376	449	790	1,239	394	711	1,105	492	781	1,273	466	875	1,341
12:00 PM	452	742	1,194	510	768	1,278	494	862	1,356	538	863	1,401	479	805	1,284	429	703	1,132	515	787	1,302	485	791	1,276
1:00 PM	535	689	1,224	522	733	1,255	591	785	1,376	632	793	1,425	577	817	1,394	441	726	1,167	565	797	1,362	549	736	1,285
2:00 PM	602	811	1,413	690	758	1,448	652	761	1,413	700	834	1,534	550	858	1,408	506	725	1,231	642	703	1,345	648	777	1,425
3:00 PM	758	827	1,585	763	908	1,671	811	929	1,740	793	950	1,743	619	777	1,396	521	632	1,153	807	855	1,662	777	888	1,665
4:00 PM	897	947	1,844	948	881	1,829	930	972	1,902	829	951	1,780	550	710	1,260	493	643	1,136	891	861	1,752	925	933	1,858
5:00 PM	828	1,018	1,846	896	997	1,893	776	1,096	1,872	773	1,049	1,822	570	699	1,269	485	597	1,082	889	1,011	1,900	833	1,037	1,870
6:00 PM	837	1,072	1,909	776	1,034	1,810	802	1,045	1,847	734	956	1,690	504	642	1,146	434	540	974	823	818	1,641	805	1,050	1,855
7:00 PM	741	701	1,442	638	685	1,323	861	606	1,467	596	683	1,279	451	540	991	353	382	735	624	546	1,170	747	664	1,411
8:00 PM	574	380	954	544	397	941	661	444	1,105	502	442	944	364	364	728	318	257	575	442	339	781	593	407	1,000
9:00 PM	436	321	757	423	310	733	479	298	777	454	339	793	459	280	739	327	205	532	362	276	638	446	310	756
10:00 PM	351	163	514	316	149	465	281	184	465	375	226	601	355	231	586	181	107	288	257	144	401	316	165	481
11:00 PM	155	76	231	156	95	251	205	94	299	285	159	444	219	153	372	102	59	161	128	72	200	172	88	260
Total	9,815	13,143	22,958	9,811	12,996	22,807	10,148	13,431	23,579	9,757	13,534	23,291	7,485	9,945	17,430	6,104	8,044	14,148	9,384	12,266	21,650	9,925	13,190	23,115
Percent	43%	57%	-	43%	57%	-	43%	57%	-	42%	58%	-	43%	57%	-	43%	57%	-	43%	57%	-	43%	57%	-
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	11:00	08:00	08:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	08:00	08:00	08:00	08:00
Vol.	513	1,101	1,614	555	1,091	1,646	491	1,034	1,525	503	1,049	1,550	449	790	1,239	394	711	1,105	492	1,087	1,527	520	1,075	1,595
PM Peak	16:00	18:00	18:00	16:00	18:00	17:00	16:00	17:00	16:00	16:00	17:00	17:00	15:00	14:00	14:00	15:00	13:00	14:00	16:00	17:00	17:00	16:00	18:00	17:00
Vol.	897	1,072	1,909	948	1,034	1,893	930	1,096	1,902	829	1,049	1,822	619	858	1,408	521	726	1,231	891	1,011	1,900	925	1,050	1,870

1. Mid-week average includes data between Tuesday and Thursday.

Location: Emerson St, B/W Channing Ave & Addison Ave  
 Date Range: 11/28/2018 - 12/4/2018  
 Site Code: 04

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average				
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018							
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB
12:00 AM	1	0	1	3	2	5	1	3	4	2	10	12	1	1	2	0	0	0	0	2	2	1	1	3		
1:00 AM	0	3	3	2	1	3	1	3	4	0	2	2	0	0	0	0	1	1	0	0	0	1	1	2		
2:00 AM	1	0	1	1	0	1	1	0	1	0	2	2	1	0	1	0	0	0	1	1	2	1	0	1		
3:00 AM	3	0	3	0	0	0	0	0	0	3	0	3	2	1	3	0	0	0	1	0	1	1	0	1		
4:00 AM	3	1	4	3	0	3	1	2	3	2	2	4	0	4	4	2	0	2	2	1	3	3	1	3		
5:00 AM	7	5	12	4	1	5	8	2	10	1	1	2	3	0	3	10	3	13	11	1	12	7	2	10		
6:00 AM	15	7	22	19	3	22	13	4	17	8	3	11	3	1	4	14	5	19	15	3	18	16	4	21		
7:00 AM	32	11	43	31	19	50	40	13	53	7	3	10	2	8	10	36	18	54	36	11	47	33	14	47		
8:00 AM	46	33	79	60	54	114	42	42	84	18	13	31	18	13	31	61	48	109	51	43	94	52	43	96		
9:00 AM	43	33	76	54	34	88	42	37	79	30	26	56	22	19	41	50	34	84	47	37	84	48	35	83		
10:00 AM	45	44	89	44	41	85	38	34	72	35	47	82	18	24	42	44	53	97	50	47	97	46	44	90		
11:00 AM	38	52	90	54	52	106	51	42	93	47	56	103	22	19	41	49	49	98	55	58	113	49	54	103		
12:00 PM	51	64	115	51	65	116	38	64	102	52	53	105	25	36	61	45	51	96	49	54	103	50	61	111		
1:00 PM	48	59	107	40	57	97	34	49	83	41	50	91	25	45	70	41	44	85	49	51	100	46	56	101		
2:00 PM	39	50	89	41	71	112	39	62	101	53	49	102	28	48	76	31	53	84	43	65	108	41	62	103		
3:00 PM	58	62	120	46	67	113	46	72	118	39	50	89	28	51	79	42	63	105	40	62	102	48	64	112		
4:00 PM	40	63	103	49	58	107	41	49	90	31	43	74	37	41	78	31	59	90	50	54	104	46	58	105		
5:00 PM	41	40	81	43	65	108	40	48	88	41	41	82	33	34	67	33	49	82	54	57	111	46	54	100		
6:00 PM	53	57	110	50	54	104	57	47	104	37	40	77	23	19	42	34	43	77	56	54	110	53	55	108		
7:00 PM	27	22	49	23	34	57	31	31	62	15	17	32	19	16	35	24	24	48	24	31	55	25	29	54		
8:00 PM	11	24	35	7	24	31	20	33	53	15	16	31	6	24	30	19	20	39	16	17	33	11	22	33		
9:00 PM	19	15	34	10	21	31	18	23	41	12	11	23	9	10	19	8	10	18	16	21	37	15	19	34		
10:00 PM	5	15	20	6	10	16	4	20	24	4	14	18	1	10	11	6	15	21	8	16	24	6	14	20		
11:00 PM	1	4	5	2	2	4	4	11	15	6	16	22	1	3	4	2	0	2	4	6	10	2	4	6		
Total	627	664	1,291	643	735	1,378	610	691	1,301	499	565	1,064	327	427	754	582	642	1,224	678	692	1,370	649	697	1,346		
Percent	49%	51%	-	47%	53%	-	47%	53%	-	47%	53%	-	43%	57%	-	48%	52%	-	49%	51%	-	48%	52%	-		
AM Peak	08:00	11:00	11:00	08:00	08:00	08:00	11:00	08:00	11:00	11:00	11:00	11:00	09:00	10:00	10:00	08:00	10:00	08:00	11:00	11:00	11:00	08:00	11:00	11:00		
Vol.	46	52	90	60	54	114	51	42	93	47	56	103	22	24	42	61	53	109	55	58	113	52	54	103		
PM Peak	15:00	12:00	15:00	12:00	14:00	12:00	18:00	15:00	15:00	14:00	12:00	12:00	16:00	15:00	15:00	12:00	15:00	15:00	18:00	14:00	17:00	18:00	15:00	15:00		
Vol.	58	64	120	51	71	116	57	72	118	53	53	105	37	51	79	45	63	105	56	65	111	53	64	112		

1. Mid-week average includes data between Tuesday and Thursday.

**Location:** Alma St, B/W Addison Ave & Lincoln Ave  
**Date Range:** 11/28/2018 - 12/4/2018  
**Site Code:** 05

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average		
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018					
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	30	53	83	39	72	111	54	93	147	98	165	263	89	121	210	30	40	70	23	60	83	31	62	92
1:00 AM	22	30	52	16	37	53	38	58	96	54	76	130	74	88	162	16	28	44	15	40	55	18	36	53
2:00 AM	11	10	21	12	16	28	15	13	28	31	57	88	30	66	96	17	12	29	10	32	42	11	19	30
3:00 AM	15	10	25	24	14	38	26	12	38	18	24	42	11	20	31	18	8	26	18	18	36	19	14	33
4:00 AM	61	25	86	54	23	77	72	19	91	32	19	51	25	9	34	63	17	80	72	32	104	62	27	89
5:00 AM	143	68	211	152	80	232	149	61	210	67	23	90	62	31	93	188	67	255	159	60	219	151	69	221
6:00 AM	389	151	540	385	157	542	429	165	594	131	57	188	133	39	172	467	162	629	403	175	578	392	161	553
7:00 AM	960	443	1,403	974	521	1,495	1,024	457	1,481	243	124	367	234	106	340	1,067	475	1,542	1,016	530	1,546	983	498	1,481
8:00 AM	1,394	722	2,116	1,329	706	2,035	1,390	632	2,022	514	268	782	401	216	617	1,410	636	2,046	1,447	667	2,114	1,390	698	2,088
9:00 AM	1,201	599	1,800	1,231	600	1,831	1,161	610	1,771	705	419	1,124	565	379	944	1,178	621	1,799	1,255	604	1,859	1,229	601	1,830
10:00 AM	1,013	571	1,584	979	572	1,551	992	501	1,493	772	530	1,302	680	411	1,091	1,071	540	1,611	993	544	1,537	995	562	1,557
11:00 AM	792	619	1,411	843	638	1,481	894	648	1,542	850	533	1,383	791	550	1,341	827	594	1,421	830	635	1,465	822	631	1,452
12:00 PM	748	604	1,352	859	608	1,467	811	712	1,523	838	673	1,511	829	547	1,376	750	650	1,400	806	649	1,455	804	620	1,425
1:00 PM	771	640	1,411	797	633	1,430	815	733	1,548	836	697	1,533	795	622	1,417	685	648	1,333	770	670	1,440	779	648	1,427
2:00 PM	603	696	1,299	807	747	1,554	863	774	1,637	855	696	1,551	752	688	1,440	717	725	1,442	801	727	1,528	737	723	1,460
3:00 PM	844	933	1,777	976	938	1,914	1,006	950	1,956	793	761	1,554	766	690	1,456	902	878	1,780	1,013	917	1,930	944	929	1,874
4:00 PM	1,052	1,107	2,159	1,037	1,000	2,037	1,219	1,151	2,370	823	732	1,555	744	704	1,448	949	1,057	2,006	1,232	1,106	2,338	1,107	1,071	2,178
5:00 PM	1,150	1,220	2,370	1,297	1,150	2,447	1,347	1,238	2,585	708	704	1,412	708	705	1,413	1,195	1,263	2,458	1,391	1,230	2,621	1,279	1,200	2,479
6:00 PM	1,104	1,007	2,111	1,225	1,042	2,267	1,143	1,027	2,170	769	617	1,386	553	630	1,183	1,148	1,052	2,200	1,336	1,116	2,452	1,222	1,055	2,277
7:00 PM	636	723	1,359	711	789	1,500	858	796	1,654	558	525	1,083	399	515	914	653	702	1,355	794	874	1,668	714	795	1,509
8:00 PM	375	615	990	429	611	1,040	554	578	1,132	399	425	824	295	382	677	391	545	936	403	616	1,019	402	614	1,016
9:00 PM	294	492	786	287	540	827	424	532	956	295	445	740	218	342	560	254	416	670	334	529	863	305	520	825
10:00 PM	169	317	486	185	363	548	279	461	740	269	387	656	103	191	294	132	259	391	200	339	539	185	340	524
11:00 PM	84	138	222	86	192	278	151	284	435	155	238	393	60	114	174	62	150	212	79	178	257	83	169	252
Total	13,861	11,793	25,654	14,734	12,049	26,783	15,714	12,505	28,219	10,813	9,195	20,008	9,317	8,166	17,483	14,190	11,545	25,735	15,400	12,348	27,748	14,665	12,063	26,728
Percent	54%	46%		55%	45%		56%	44%		54%	46%		53%	47%		55%	45%		55%	45%		55%	45%	
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	08:00	11:00	08:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00
Vol.	1,394	722	2,116	1,329	706	2,035	1,390	648	2,022	850	533	1,383	791	550	1,341	1,410	636	2,046	1,447	667	2,114	1,390	698	2,088
PM Peak	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	14:00	15:00	16:00	12:00	17:00	15:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00
Vol.	1,150	1,220	2,370	1,297	1,150	2,447	1,347	1,238	2,585	855	761	1,555	829	705	1,456	1,195	1,263	2,458	1,391	1,230	2,621	1,279	1,200	2,479

1. Mid-week average includes data between Tuesday and Thursday.



Location: Bryant St Between Addison Ave & Lincoln Ave  
 Date Range: 12/11/2018 - 12/17/2018  
 Site Code: 06

Time	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Mid-Week Average				
	12/11/2018			12/12/2018			12/13/2018			12/14/2018			12/15/2018			12/16/2018			12/17/2018							
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB
12:00 AM	3	1	4	3	4	7	5	6	11	6	5	11	4	13	17	6	9	15	3	5	8	4	4	7		
1:00 AM	1	1	2	0	2	2	0	1	1	0	4	4	2	7	9	3	4	7	2	1	3	0	1	2		
2:00 AM	1	1	2	0	1	1	0	3	3	1	1	2	3	1	4	2	4	6	0	4	4	0	2	2		
3:00 AM	0	3	3	0	2	2	1	2	3	0	2	2	0	2	2	1	2	3	1	2	3	0	2	3		
4:00 AM	0	8	8	1	6	7	0	6	6	1	9	10	0	5	5	0	4	4	0	4	4	0	7	7		
5:00 AM	2	19	21	2	16	18	3	20	23	4	17	21	3	3	6	2	4	6	2	19	21	2	18	21		
6:00 AM	6	52	58	5	45	50	2	41	43	5	41	46	2	11	13	3	14	17	6	40	46	4	46	50		
7:00 AM	21	51	72	20	67	87	23	56	79	15	49	64	4	27	31	3	18	21	9	57	66	21	58	79		
8:00 AM	24	89	113	39	83	122	27	96	123	33	82	115	18	30	48	7	17	24	35	104	139	30	89	119		
9:00 AM	30	108	138	32	118	150	34	110	144	32	105	137	26	69	95	17	38	55	28	113	141	32	112	144		
10:00 AM	38	123	161	29	139	168	28	102	130	32	132	164	45	101	146	21	69	90	32	118	150	32	121	153		
11:00 AM	44	107	151	38	105	143	39	90	129	51	120	171	46	121	167	30	92	122	48	106	154	40	101	141		
12:00 PM	45	78	123	40	109	149	46	101	147	59	105	164	57	108	165	30	91	121	36	91	127	44	96	140		
1:00 PM	47	85	132	43	74	117	48	75	123	54	113	167	47	111	158	33	96	129	45	82	127	46	78	124		
2:00 PM	42	105	147	57	85	142	59	92	151	55	69	124	46	109	155	55	75	130	65	87	152	53	94	147		
3:00 PM	44	93	137	48	103	151	33	85	118	49	87	136	58	88	146	46	68	114	55	90	145	42	94	135		
4:00 PM	56	81	137	49	92	141	50	82	132	52	108	160	56	90	146	33	78	111	52	80	132	52	85	137		
5:00 PM	47	124	171	63	121	184	49	155	204	59	136	195	39	115	154	26	69	95	61	103	164	53	133	186		
6:00 PM	69	144	213	61	118	179	52	150	202	62	106	168	35	110	145	26	64	90	49	115	164	61	137	198		
7:00 PM	62	85	147	48	87	135	48	90	138	26	98	124	37	81	118	29	49	78	33	65	98	53	87	140		
8:00 PM	36	58	94	53	55	108	42	51	93	30	57	87	25	52	77	19	29	48	31	53	84	44	55	98		
9:00 PM	36	36	72	30	27	57	43	47	90	30	45	75	28	40	68	15	15	30	33	30	63	36	37	73		
10:00 PM	13	28	41	29	23	52	16	24	40	25	36	61	21	35	56	6	7	13	14	20	34	19	25	44		
11:00 PM	3	7	10	1	11	12	12	10	22	18	12	30	13	12	25	4	8	12	6	8	14	5	9	15		
Total	670	1,487	2,157	691	1,493	2,184	660	1,495	2,155	699	1,539	2,238	615	1,341	1,956	417	924	1,341	646	1,397	2,043	674	1,492	2,165		
Percent	31%	69%	-	32%	68%	-	31%	69%	-	31%	69%	-	31%	69%	-	31%	69%	-	32%	68%	-	31%	69%	-		
AM Peak	11:00	10:00	10:00	08:00	10:00	10:00	11:00	09:00	09:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	10:00	11:00	11:00	10:00	10:00		
Vol.	44	123	161	39	139	168	39	110	144	51	132	171	46	121	167	30	92	122	48	118	154	40	121	153		
PM Peak	18:00	18:00	18:00	17:00	17:00	17:00	14:00	17:00	17:00	18:00	17:00	17:00	15:00	17:00	12:00	14:00	13:00	14:00	18:00	18:00	17:00	18:00	18:00	18:00		
Vol.	69	144	213	63	121	184	59	155	204	62	136	195	58	115	165	55	96	130	65	115	164	61	137	198		

1. Mid-week average includes data between Tuesday and Thursday.

Location: Waverley St, B/W Kingsley Ave & Whitman Ct  
 Date Range: 11/28/2018 - 12/4/2018  
 Site Code: 07

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average				
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018							
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB
12:00 AM	5	12	17	3	11	14	1	7	8	2	12	14	8	16	24	3	10	13	1	12	13	3	12	15		
1:00 AM	3	8	11	2	6	8	2	8	10	4	11	15	4	11	15	0	3	3	0	10	10	2	8	10		
2:00 AM	2	1	3	1	1	2	1	1	2	5	6	11	2	6	8	0	1	1	0	0	0	1	1	2		
3:00 AM	1	0	1	2	3	5	1	2	3	4	8	12	0	7	7	1	0	1	1	2	3	1	2	3		
4:00 AM	5	8	13	3	4	7	5	2	7	0	4	4	1	3	4	4	8	12	3	4	7	4	5	9		
5:00 AM	10	11	21	7	11	18	11	17	28	5	4	9	4	4	8	14	9	23	6	12	18	8	11	19		
6:00 AM	24	25	49	31	33	64	24	33	57	8	14	22	7	5	12	33	26	59	24	37	61	26	32	58		
7:00 AM	60	124	184	63	165	228	74	136	210	19	33	52	26	16	42	72	139	211	73	147	220	65	145	211		
8:00 AM	141	186	327	188	161	349	134	160	294	53	69	122	36	51	87	114	137	251	155	140	295	161	162	324		
9:00 AM	108	140	248	114	143	257	128	165	293	92	89	181	41	63	104	115	150	265	122	151	273	115	145	259		
10:00 AM	86	119	205	109	145	254	125	135	260	113	152	265	69	90	159	118	130	248	119	162	281	105	142	247		
11:00 AM	129	144	273	97	141	238	100	154	254	133	169	302	91	117	208	119	126	245	116	153	269	114	146	260		
12:00 PM	104	142	246	103	160	263	102	187	289	119	178	297	87	118	205	93	142	235	87	173	260	98	158	256		
1:00 PM	87	197	284	82	147	229	99	223	322	84	152	236	88	126	214	110	183	293	124	160	284	98	168	266		
2:00 PM	175	178	353	82	195	277	107	170	277	83	135	218	68	133	201	90	176	266	106	200	306	121	191	312		
3:00 PM	123	196	319	130	178	308	114	168	282	95	168	263	91	125	216	112	158	270	117	196	313	123	190	313		
4:00 PM	128	174	302	121	201	322	110	169	279	75	166	241	80	141	221	112	187	299	112	200	312	120	192	312		
5:00 PM	130	196	326	129	211	340	134	169	303	87	97	184	81	114	195	115	202	317	135	219	354	131	209	340		
6:00 PM	114	180	294	105	164	269	117	185	302	75	102	177	55	118	173	89	175	264	123	163	286	114	169	283		
7:00 PM	77	128	205	86	135	221	76	153	229	68	85	153	38	51	89	56	166	222	74	215	289	79	159	238		
8:00 PM	48	107	155	57	140	197	54	98	152	37	63	100	30	55	85	37	109	146	50	93	143	52	113	165		
9:00 PM	21	69	90	27	95	122	39	86	125	24	86	110	20	49	69	18	54	72	25	93	118	24	86	110		
10:00 PM	17	48	65	12	53	65	19	92	111	23	58	81	9	43	52	14	42	56	11	59	70	13	53	67		
11:00 PM	2	24	26	8	25	33	15	38	53	18	49	67	7	22	29	3	23	26	8	33	41	6	27	33		
Total	1,600	2,417	4,017	1,562	2,528	4,090	1,592	2,558	4,150	1,226	1,910	3,136	943	1,484	2,427	1,442	2,356	3,798	1,592	2,634	4,226	1,585	2,526	4,111		
Percent	40%	60%	-	38%	62%	-	38%	62%	-	39%	61%	-	39%	61%	-	38%	62%	-	38%	62%	-	39%	61%	-		
AM Peak	08:00	08:00	08:00	08:00	07:00	08:00	08:00	09:00	08:00	11:00	11:00	11:00	11:00	11:00	11:00	09:00	09:00	08:00	10:00	08:00	08:00	08:00	08:00	08:00		
Vol.	141	186	327	188	165	349	134	165	294	133	169	302	91	117	208	119	150	265	155	162	295	161	162	324		
PM Peak	14:00	13:00	14:00	15:00	17:00	17:00	17:00	13:00	13:00	12:00	12:00	12:00	15:00	16:00	16:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00		
Vol.	175	197	353	130	211	340	134	223	322	119	178	297	91	141	221	115	202	317	135	219	354	131	209	340		

1. Mid-week average includes data between Tuesday and Thursday.

Location: Embarcadero Rd, B/W High St & Alma St  
 Date Range: 11/28/2018 - 12/4/2018  
 Site Code: 08

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average				
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018							
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB
12:00 AM	100	40	140	103	39	142	124	39	163	153	54	207	112	49	161	76	47	123	78	35	113	94	38	132		
1:00 AM	59	29	88	60	31	91	55	30	85	60	40	100	51	41	92	32	25	57	60	17	77	60	26	85		
2:00 AM	60	23	83	58	19	77	67	19	86	51	24	75	49	34	83	35	18	53	54	18	72	57	20	77		
3:00 AM	30	42	72	25	42	67	33	42	75	33	31	64	28	20	48	26	54	80	33	51	84	29	45	74		
4:00 AM	42	177	219	39	176	215	36	181	217	23	98	121	18	35	53	29	159	188	41	168	209	41	174	214		
5:00 AM	64	523	587	82	543	625	63	526	589	50	195	245	34	117	151	63	483	546	82	549	631	76	538	614		
6:00 AM	204	859	1,063	177	826	1,003	200	846	1,046	118	340	458	70	240	310	179	821	1,000	193	846	1,039	191	844	1,035		
7:00 AM	666	1,032	1,698	709	1,022	1,731	786	997	1,783	326	353	679	234	261	495	589	966	1,555	636	991	1,627	670	1,015	1,685		
8:00 AM	772	1,116	1,888	854	1,003	1,857	982	1,035	2,017	371	515	886	224	390	614	759	1,014	1,773	715	997	1,712	780	1,039	1,819		
9:00 AM	730	857	1,587	686	806	1,492	796	909	1,705	536	770	1,306	425	667	1,092	655	904	1,559	625	799	1,424	680	821	1,501		
10:00 AM	700	834	1,534	844	784	1,628	847	860	1,707	822	857	1,679	551	786	1,337	644	706	1,350	679	779	1,458	741	799	1,540		
11:00 AM	877	822	1,699	864	858	1,722	1,000	879	1,879	857	834	1,691	648	815	1,463	795	766	1,561	787	823	1,610	843	834	1,677		
12:00 PM	1,018	765	1,783	1,087	806	1,893	870	867	1,737	966	913	1,879	725	831	1,556	797	780	1,577	828	850	1,678	978	807	1,785		
1:00 PM	912	744	1,656	1,183	790	1,973	955	824	1,779	881	869	1,750	747	837	1,584	860	798	1,658	792	809	1,601	962	781	1,743		
2:00 PM	1,192	724	1,916	1,045	842	1,887	1,161	703	1,864	935	823	1,758	744	826	1,570	959	769	1,728	989	662	1,651	1,075	743	1,818		
3:00 PM	1,144	778	1,922	1,237	749	1,986	1,073	636	1,709	898	778	1,676	854	734	1,588	1,112	745	1,857	953	803	1,756	1,111	777	1,888		
4:00 PM	1,459	609	2,068	1,283	616	1,899	1,217	565	1,782	956	722	1,678	919	677	1,596	1,215	582	1,797	1,199	567	1,766	1,314	597	1,911		
5:00 PM	1,435	635	2,070	1,354	692	2,046	1,398	625	2,023	965	727	1,692	932	555	1,487	1,196	636	1,832	1,220	610	1,830	1,336	646	1,982		
6:00 PM	1,142	811	1,953	1,102	695	1,797	1,062	758	1,820	953	637	1,590	757	480	1,237	1,013	667	1,680	1,059	623	1,682	1,101	710	1,811		
7:00 PM	933	478	1,411	1,057	380	1,437	943	356	1,299	847	397	1,244	617	322	939	836	375	1,211	826	422	1,248	939	427	1,365		
8:00 PM	849	283	1,132	997	292	1,289	1,055	338	1,393	623	254	877	463	211	674	673	301	974	863	310	1,173	903	295	1,198		
9:00 PM	863	232	1,095	845	202	1,047	838	223	1,061	589	197	786	278	179	457	632	209	841	556	234	790	755	223	977		
10:00 PM	383	154	537	524	161	685	369	229	598	315	209	524	160	142	302	294	158	452	346	160	506	418	158	576		
11:00 PM	282	73	355	349	72	421	303	127	430	286	110	396	163	71	234	237	68	305	228	58	286	286	68	354		
Total	15,916	12,640	28,556	16,564	12,446	29,010	16,233	12,614	28,847	12,614	10,747	23,361	9,803	9,320	19,123	13,706	12,051	25,757	13,842	12,181	26,023	15,441	12,422	27,863		
Percent	56%	44%	-	57%	43%	-	56%	44%	-	54%	46%	-	51%	49%	-	53%	47%	-	53%	47%	-	55%	45%	-		
AM Peak	11:00	08:00	08:00	11:00	07:00	08:00	11:00	08:00	08:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	08:00	08:00	11:00	08:00	08:00	11:00	08:00	08:00		
Vol.	877	1,116	1,888	864	1,022	1,857	1,000	1,035	2,017	857	857	1,691	648	815	1,463	795	1,014	1,773	787	997	1,712	843	1,039	1,819		
PM Peak	16:00	18:00	17:00	17:00	14:00	17:00	17:00	12:00	17:00	12:00	12:00	12:00	17:00	13:00	16:00	16:00	13:00	15:00	17:00	12:00	17:00	17:00	12:00	17:00		
Vol.	1,459	811	2,070	1,354	842	2,046	1,398	867	2,023	966	913	1,879	932	837	1,596	1,215	798	1,857	1,220	850	1,830	1,336	807	1,982		

1. Mid-week average includes data between Tuesday and Thursday.

Location: Middlefield Rd, B/W Walter Hays Elementary School & Embarcadero Rd  
 Date Range: 11/28/2018 - 12/4/2018  
 Site Code: 09

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average				
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018							
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB
12:00 AM	12	10	22	15	21	36	19	16	35	20	27	47	24	36	60	11	8	19	16	63	79	14	31	46		
1:00 AM	5	8	13	8	15	23	9	14	23	10	23	33	16	14	30	6	3	9	5	74	79	6	32	38		
2:00 AM	9	10	19	2	3	5	4	4	8	8	4	12	12	14	26	6	4	10	4	36	40	5	16	21		
3:00 AM	1	4	5	2	8	10	6	5	11	5	8	13	8	3	11	1	1	2	6	32	38	3	15	18		
4:00 AM	8	9	17	9	11	20	10	12	22	5	5	10	4	3	7	9	16	25	11	76	87	9	32	41		
5:00 AM	25	31	56	22	26	48	28	20	48	9	9	18	8	7	15	27	29	56	30	48	78	26	35	61		
6:00 AM	91	79	170	77	81	158	83	77	160	14	40	54	13	20	33	95	87	182	105	90	195	91	83	174		
7:00 AM	226	279	505	231	310	541	184	292	476	64	64	128	48	40	88	232	271	503	242	271	513	233	287	520		
8:00 AM	340	424	764	327	420	747	299	358	657	118	139	257	112	98	210	311	385	696	290	400	690	319	415	734		
9:00 AM	311	371	682	301	389	690	306	318	624	190	207	397	220	223	443	299	371	670	331	362	693	314	374	688		
10:00 AM	269	302	571	296	353	649	244	310	554	266	269	535	220	218	438	331	296	627	291	332	623	285	329	614		
11:00 AM	281	286	567	245	359	604	271	343	614	308	296	604	244	246	490	278	288	566	259	312	571	262	319	581		
12:00 PM	261	281	542	248	292	540	299	305	604	274	363	637	231	291	522	243	278	521	250	276	526	253	283	536		
1:00 PM	296	354	650	273	281	554	271	347	618	291	325	616	346	263	609	267	279	546	286	281	567	285	305	590		
2:00 PM	298	331	629	255	399	654	274	377	651	250	304	554	244	273	517	278	348	626	239	365	604	264	365	629		
3:00 PM	311	466	777	312	476	788	339	436	775	228	304	532	244	237	481	277	450	727	310	491	801	311	478	789		
4:00 PM	320	517	837	376	528	904	356	579	935	287	296	583	224	338	562	332	536	868	343	514	857	346	520	866		
5:00 PM	398	585	983	422	514	936	391	559	950	265	258	523	267	226	493	368	548	916	445	579	1,024	422	559	981		
6:00 PM	405	469	874	395	380	775	390	449	839	198	216	414	204	361	565	449	436	885	462	522	984	421	457	878		
7:00 PM	341	287	628	318	253	571	288	284	572	209	179	388	184	164	348	237	232	469	356	325	681	338	288	627		
8:00 PM	180	154	334	156	190	346	180	193	373	117	136	253	105	101	206	141	184	325	163	198	361	166	181	347		
9:00 PM	120	136	256	94	124	218	137	104	241	124	158	282	82	157	239	101	112	213	106	167	273	107	142	249		
10:00 PM	65	124	189	60	139	199	85	188	273	73	177	250	46	43	89	39	81	120	48	107	155	58	123	181		
11:00 PM	24	52	76	36	31	67	45	66	111	56	67	123	22	26	48	17	41	58	32	38	70	31	40	71		
Total	4,597	5,569	10,166	4,480	5,603	10,083	4,518	5,656	10,174	3,389	3,874	7,263	3,128	3,402	6,530	4,355	5,284	9,639	4,630	5,959	10,589	4,569	5,710	10,279		
Percent	45%	55%	-	44%	56%	-	44%	56%	-	47%	53%	-	48%	52%	-	45%	55%	-	44%	56%	-	44%	56%	-		
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	09:00	08:00	08:00	11:00	11:00	11:00	11:00	11:00	11:00	10:00	08:00	08:00	09:00	08:00	09:00	08:00	08:00	08:00		
Vol.	340	424	764	327	420	747	306	358	657	308	296	604	244	246	490	331	385	696	331	400	693	319	415	734		
PM Peak	18:00	17:00	17:00	17:00	16:00	17:00	17:00	16:00	17:00	13:00	12:00	12:00	13:00	18:00	13:00	18:00	17:00	17:00	18:00	17:00	17:00	17:00	17:00	17:00		
Vol.	405	585	983	422	528	936	391	579	950	291	363	637	346	361	609	449	548	916	462	579	1,024	422	559	981		

1. Mid-week average includes data between Tuesday and Thursday.

Location: Embarcadero Rd, B/W Webster St & Tasso St  
Date Range: 11/28/2018 - 12/4/2018  
Site Code: 10

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average		
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018					
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
12:00 AM	54	113	167	52	124	176	58	115	173	92	175	267	91	138	229	59	88	147	41	88	129	49	108	157
1:00 AM	37	63	100	31	73	104	43	61	104	51	75	126	63	84	147	27	40	67	25	68	93	31	68	99
2:00 AM	24	62	86	22	57	79	25	60	85	37	73	110	44	58	102	23	40	63	21	55	76	22	58	80
3:00 AM	57	29	86	61	28	89	57	34	91	43	46	89	25	40	65	64	24	88	61	36	97	60	31	91
4:00 AM	215	46	261	221	41	262	212	28	240	106	28	134	48	24	72	196	44	240	206	47	253	214	45	259
5:00 AM	577	79	656	597	96	693	593	81	674	222	52	274	128	46	174	548	80	628	579	86	665	584	87	671
6:00 AM	932	198	1,130	935	200	1,135	937	213	1,150	385	97	482	271	73	344	925	203	1,128	947	218	1,165	938	205	1,143
7:00 AM	1,050	578	1,628	1,036	692	1,728	1,056	596	1,652	410	271	681	296	223	519	1,025	584	1,609	1,052	670	1,722	1,046	647	1,693
8:00 AM	896	774	1,670	797	715	1,512	865	711	1,576	639	293	932	453	221	674	854	718	1,572	804	725	1,529	832	738	1,570
9:00 AM	941	676	1,617	894	623	1,517	905	731	1,636	847	418	1,265	703	400	1,103	921	628	1,549	910	640	1,550	915	646	1,561
10:00 AM	933	597	1,530	908	695	1,603	987	659	1,646	878	612	1,490	846	453	1,299	883	649	1,532	913	688	1,601	918	660	1,578
11:00 AM	935	722	1,657	855	815	1,670	1,014	799	1,813	916	643	1,559	938	566	1,504	855	722	1,577	980	745	1,725	923	761	1,684
12:00 PM	898	813	1,711	861	786	1,647	938	836	1,774	975	745	1,720	917	695	1,612	863	800	1,663	989	813	1,802	916	804	1,720
1:00 PM	704	774	1,478	838	855	1,693	885	984	1,869	933	725	1,658	987	755	1,742	842	883	1,725	892	910	1,802	811	846	1,658
2:00 PM	794	946	1,740	774	968	1,742	762	956	1,718	918	773	1,691	956	793	1,749	767	961	1,728	744	951	1,695	771	955	1,726
3:00 PM	875	996	1,871	613	870	1,483	638	873	1,511	858	882	1,740	821	892	1,713	690	898	1,588	656	850	1,506	715	905	1,620
4:00 PM	606	979	1,585	666	992	1,658	594	985	1,579	899	943	1,842	794	941	1,735	601	1,029	1,630	618	1,008	1,626	630	993	1,623
5:00 PM	653	946	1,599	748	993	1,741	599	1,035	1,634	873	866	1,739	741	893	1,634	709	1,045	1,754	644	964	1,608	682	968	1,649
6:00 PM	869	878	1,747	756	854	1,610	783	880	1,663	747	848	1,595	539	790	1,329	724	916	1,640	712	946	1,658	779	893	1,672
7:00 PM	600	756	1,356	507	825	1,332	454	784	1,238	452	820	1,272	385	630	1,015	539	868	1,407	555	966	1,521	554	849	1,403
8:00 PM	391	769	1,160	378	819	1,197	423	828	1,251	360	563	923	265	496	761	422	694	1,116	421	846	1,267	397	811	1,208
9:00 PM	297	685	982	271	673	944	342	713	1,055	284	519	803	265	330	595	271	587	858	315	660	975	294	673	967
10:00 PM	220	413	633	212	485	697	270	486	756	299	391	690	182	227	409	188	363	551	214	415	629	215	438	653
11:00 PM	95	299	394	102	327	429	193	339	532	186	319	505	102	192	294	85	269	354	99	331	430	99	319	418
Total	13,653	13,191	26,844	13,135	13,606	26,741	13,633	13,787	27,420	12,410	11,177	23,587	10,860	9,960	20,820	13,081	13,133	26,214	13,398	13,726	27,124	13,395	13,508	26,903
Percent	51%	49%	-	49%	51%	-	50%	50%	-	53%	47%	-	52%	48%	-	50%	50%	-	49%	51%	-	50%	50%	-
AM Peak	07:00	08:00	08:00	07:00	11:00	07:00	07:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	07:00	11:00	07:00	07:00	11:00	11:00	07:00	11:00	07:00
Vol.	1,050	774	1,670	1,036	815	1,728	1,056	799	1,813	916	643	1,559	938	566	1,504	1,025	722	1,609	1,052	745	1,725	1,046	761	1,693
PM Peak	12:00	15:00	15:00	12:00	17:00	14:00	12:00	17:00	13:00	12:00	16:00	16:00	13:00	16:00	14:00	12:00	17:00	12:00	16:00	12:00	12:00	16:00	14:00	14:00
Vol.	898	996	1,871	861	993	1,742	938	1,035	1,869	975	943	1,842	987	941	1,749	863	1,045	1,754	989	1,008	1,802	916	993	1,726

1. Mid-week average includes data between Tuesday and Thursday.

Location: Churchill Ave B/W Tasso St & Cowper St  
 Date Range: 12/11/2018 - 12/17/2018  
 Site Code: 11

Time	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Mid-Week Average				
	12/11/2018			12/12/2018			12/13/2018			12/14/2018			12/15/2018			12/16/2018			12/17/2018							
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB
12:00 AM	1	1	2	6	2	8	4	1	5	2	5	7	11	3	14	9	7	16	7	2	9	4	1	5		
1:00 AM	2	1	3	4	3	7	2	0	2	4	1	5	2	2	4	3	3	6	2	2	4	3	1	4		
2:00 AM	0	0	0	0	0	0	0	0	0	1	0	1	4	3	7	6	1	7	1	0	1	0	0	0		
3:00 AM	0	1	1	0	1	1	0	0	0	0	1	1	1	0	1	1	0	1	0	3	3	0	1	1		
4:00 AM	1	3	4	2	5	7	2	3	5	3	4	7	4	1	5	0	0	0	2	3	5	2	4	5		
5:00 AM	9	12	21	5	11	16	3	11	14	7	12	19	8	7	15	1	2	3	8	14	22	6	11	17		
6:00 AM	25	28	53	16	27	43	30	22	52	19	25	44	11	5	16	4	2	6	13	21	34	24	26	49		
7:00 AM	42	37	79	37	34	71	49	39	88	39	34	73	19	15	34	15	14	29	37	35	72	43	37	79		
8:00 AM	70	34	104	66	29	95	70	39	109	65	41	106	41	30	71	26	23	49	65	31	96	69	34	103		
9:00 AM	51	25	76	57	33	90	58	36	94	55	37	92	59	25	84	45	20	65	71	32	103	55	31	87		
10:00 AM	57	23	80	56	27	83	58	27	85	58	23	81	68	28	96	63	36	99	67	26	93	57	26	83		
11:00 AM	42	33	75	58	45	103	63	36	99	58	38	96	73	53	126	57	42	99	45	38	83	54	38	92		
12:00 PM	56	36	92	67	29	96	74	29	103	74	32	106	97	36	133	69	41	110	73	35	108	66	31	97		
1:00 PM	58	25	83	73	24	97	80	39	119	73	39	112	64	33	97	94	38	132	59	33	92	70	29	100		
2:00 PM	83	30	113	83	30	113	88	41	129	100	31	131	105	40	145	82	29	111	105	29	134	85	34	118		
3:00 PM	100	23	123	106	34	140	72	19	91	80	32	112	79	26	105	61	24	85	91	28	119	93	25	118		
4:00 PM	78	26	104	99	21	120	75	24	99	65	28	93	87	33	120	51	29	80	82	28	110	84	24	108		
5:00 PM	55	45	100	66	43	109	81	29	110	76	25	101	66	23	89	49	27	76	77	36	113	67	39	106		
6:00 PM	61	29	90	58	35	93	81	30	111	63	32	95	66	28	94	51	20	71	48	34	82	67	31	98		
7:00 PM	58	21	79	64	27	91	72	31	103	49	13	62	53	16	69	37	8	45	45	18	63	65	26	91		
8:00 PM	38	14	52	49	12	61	51	27	78	31	11	42	40	6	46	28	16	44	40	19	59	46	18	64		
9:00 PM	37	16	53	27	16	43	38	14	52	50	18	68	40	19	59	24	10	34	26	13	39	34	15	49		
10:00 PM	21	3	24	18	4	22	24	14	38	24	20	44	28	18	46	8	5	13	17	15	32	21	7	28		
11:00 PM	13	2	15	6	5	11	9	8	17	27	8	35	20	12	32	11	5	16	7	3	10	9	5	14		
Total	958	468	1,426	1,023	497	1,520	1,084	519	1,603	1,023	510	1,533	1,046	462	1,508	795	402	1,197	988	498	1,486	1,022	495	1,516		
Percent	67%	33%	-	67%	33%	-	68%	32%	-	67%	33%	-	69%	31%	-	66%	34%	-	66%	34%	-	67%	33%	-		
AM Peak	08:00	07:00	08:00	08:00	11:00	11:00	08:00	07:00	08:00	08:00	08:00	08:00	11:00	11:00	11:00	10:00	11:00	10:00	09:00	11:00	09:00	08:00	11:00	08:00		
Vol.	70	37	104	66	45	103	70	39	109	65	41	106	73	53	126	63	42	99	71	38	103	69	38	103		
PM Peak	15:00	17:00	15:00	15:00	17:00	15:00	14:00	14:00	14:00	14:00	13:00	14:00	14:00	14:00	14:00	13:00	12:00	13:00	14:00	17:00	14:00	15:00	17:00	14:00		
Vol.	100	45	123	106	43	140	88	41	129	100	39	131	105	40	145	94	41	132	105	36	134	93	39	118		

1. Mid-week average includes data between Tuesday and Thursday.

Location: Waverley St, B/W Churchill Ave & Coleridge Ave  
 Date Range: 11/28/2018 - 12/4/2018  
 Site Code: 12

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average				
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018							
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB
12:00 AM	1	0	1	1	1	2	1	1	2	3	3	6	3	2	5	0	2	2	1	2	3	1	1	2		
1:00 AM	2	2	4	0	2	2	0	1	1	4	2	6	3	0	3	0	0	0	1	1	2	1	2	3		
2:00 AM	0	1	1	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0		
3:00 AM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0		
4:00 AM	1	2	3	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2		
5:00 AM	4	2	6	4	1	5	3	1	4	3	2	5	2	0	2	6	1	7	4	2	6	4	2	6		
6:00 AM	21	7	28	16	5	21	17	4	21	4	1	5	1	1	2	16	5	21	16	8	24	18	7	24		
7:00 AM	52	30	82	75	53	128	73	43	116	14	11	25	12	4	16	59	28	87	64	43	107	64	42	106		
8:00 AM	165	85	250	207	115	322	132	92	224	40	19	59	31	18	49	116	85	201	151	78	229	174	93	267		
9:00 AM	65	54	119	77	50	127	91	46	137	54	41	95	29	30	59	87	54	141	71	53	124	71	52	123		
10:00 AM	55	45	100	49	60	109	72	59	131	74	49	123	50	33	83	61	48	109	70	52	122	58	52	110		
11:00 AM	74	52	126	57	61	118	76	66	142	70	56	126	44	47	91	68	49	117	84	66	150	72	60	131		
12:00 PM	63	58	121	62	52	114	62	71	133	65	75	140	49	46	95	57	54	111	48	67	115	58	59	117		
1:00 PM	64	95	159	50	70	120	58	81	139	38	64	102	50	57	107	49	74	123	66	59	125	60	75	135		
2:00 PM	146	76	222	58	85	143	76	94	170	46	50	96	55	62	117	73	75	148	77	91	168	94	84	178		
3:00 PM	113	114	227	105	146	251	83	108	191	35	57	92	51	42	93	86	113	199	109	111	220	109	124	233		
4:00 PM	73	107	180	88	82	170	82	93	175	37	57	94	36	69	105	79	108	187	77	98	175	79	96	175		
5:00 PM	81	102	183	64	103	167	68	101	169	48	52	100	59	59	118	77	106	183	88	130	218	78	112	189		
6:00 PM	68	76	144	70	63	133	68	74	142	30	30	60	35	37	72	53	76	129	76	69	145	71	69	141		
7:00 PM	34	46	80	36	51	87	39	47	86	31	30	61	43	25	68	25	49	74	35	46	81	35	48	83		
8:00 PM	16	33	49	30	39	69	30	28	58	9	23	32	20	21	41	16	20	36	19	28	47	22	33	55		
9:00 PM	8	12	20	13	25	38	18	24	42	13	19	32	14	13	27	7	11	18	13	22	35	11	20	31		
10:00 PM	5	8	13	4	4	8	7	13	20	7	18	25	4	3	7	6	6	12	4	11	15	4	8	12		
11:00 PM	2	2	4	1	0	1	6	6	12	8	10	18	2	2	4	4	2	6	6	3	9	3	2	5		
Total	1,113	1,009	2,122	1,068	1,068	2,136	1,063	1,053	2,116	634	671	1,305	593	571	1,164	945	966	1,911	1,080	1,041	2,121	1,087	1,039	2,126		
Percent	52%	48%	-	50%	50%	-	50%	50%	-	49%	51%	-	51%	49%	-	49%	51%	-	51%	49%	-	51%	49%	-		
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	10:00	11:00	11:00	10:00	11:00	11:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00		
Vol.	165	85	250	207	115	322	132	92	224	74	56	126	50	47	91	116	85	201	151	78	229	174	93	267		
PM Peak	14:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	12:00	12:00	12:00	17:00	16:00	17:00	15:00	15:00	15:00	15:00	17:00	15:00	15:00	15:00	15:00		
Vol.	146	114	227	105	146	251	83	108	191	65	75	140	59	69	118	86	113	199	109	130	220	109	124	233		

1. Mid-week average includes data between Tuesday and Thursday.

Location: Bryant St B/W Churchill Ave & Coleridge Ave  
 Date Range: 12/11/2018 - 12/17/2018  
 Site Code: 13

Time	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Mid-Week Average				
	12/11/2018			12/12/2018			12/13/2018			12/14/2018			12/15/2018			12/16/2018			12/17/2018							
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB
12:00 AM	0	0	0	1	0	1	1	1	2	1	1	2	6	1	7	3	0	3	0	0	0	1	0	1		
1:00 AM	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0		
2:00 AM	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0		
3:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0		
4:00 AM	0	0	0	1	0	1	1	0	1	2	0	2	0	0	0	0	0	0	0	0	0	1	0	1		
5:00 AM	1	1	2	5	7	12	4	5	9	3	3	6	1	1	2	0	1	1	3	3	6	3	4	8		
6:00 AM	6	5	11	3	9	12	8	7	15	5	11	16	4	4	8	3	4	7	2	10	12	6	7	13		
7:00 AM	27	31	58	36	35	71	34	46	80	35	43	78	6	9	15	1	5	6	24	29	53	32	37	70		
8:00 AM	35	63	98	54	141	195	41	115	156	56	99	155	7	11	18	11	4	15	48	132	180	43	106	150		
9:00 AM	27	26	53	21	52	73	20	53	73	22	44	66	25	25	50	18	13	31	28	39	67	23	44	66		
10:00 AM	31	16	47	28	32	60	28	46	74	26	28	54	25	25	50	22	10	32	21	31	52	29	31	60		
11:00 AM	25	19	44	29	27	56	40	29	69	36	29	65	41	29	70	34	9	43	46	22	68	31	25	56		
12:00 PM	36	16	52	30	24	54	30	29	59	28	15	43	44	22	66	22	13	35	37	28	65	32	23	55		
1:00 PM	28	22	50	44	23	67	50	19	69	36	21	57	40	23	63	35	10	45	34	27	61	41	21	62		
2:00 PM	65	32	97	47	32	79	57	37	94	53	18	71	33	14	47	20	16	36	54	22	76	56	34	90		
3:00 PM	99	33	132	101	35	136	102	52	154	108	46	154	34	23	57	19	10	29	124	50	174	101	40	141		
4:00 PM	47	25	72	75	37	112	65	20	85	66	31	97	32	17	49	24	10	34	52	34	86	62	27	90		
5:00 PM	61	21	82	55	28	83	73	32	105	53	36	89	19	12	31	20	14	34	72	24	96	63	27	90		
6:00 PM	53	33	86	51	16	67	64	38	102	39	20	59	19	10	29	11	10	21	50	24	74	56	29	85		
7:00 PM	26	14	40	27	16	43	27	13	40	24	9	33	18	3	21	15	5	20	34	13	47	27	14	41		
8:00 PM	22	4	26	20	6	26	40	12	52	19	7	26	16	5	21	8	5	13	18	9	27	27	7	35		
9:00 PM	9	7	16	9	10	19	20	12	32	6	6	12	25	9	34	5	0	5	9	5	14	13	10	22		
10:00 PM	4	4	8	5	2	7	12	1	13	11	4	15	2	4	6	2	2	4	9	2	11	7	2	9		
11:00 PM	1	0	1	1	0	1	6	0	6	4	3	7	4	2	6	3	0	3	4	2	6	3	0	3		
Total	603	372	975	643	533	1,176	723	567	1,290	634	474	1,108	402	249	651	279	141	420	669	506	1,175	656	491	1,147		
Percent	62%	38%	-	55%	45%	-	56%	44%	-	57%	43%	-	62%	38%	-	66%	34%	-	57%	43%	-	57%	43%	-		
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	11:00	11:00	11:00	11:00	09:00	11:00	08:00	08:00	08:00	08:00	08:00	08:00		
Vol.	35	63	98	54	141	195	41	115	156	56	99	155	41	29	70	34	13	43	48	132	180	43	106	150		
PM Peak	15:00	15:00	15:00	15:00	16:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	12:00	13:00	12:00	13:00	14:00	13:00	15:00	15:00	15:00	15:00	15:00	15:00		
Vol.	99	33	132	101	37	136	102	52	154	108	46	154	44	23	66	35	16	45	124	50	174	101	40	141		

1. Mid-week average includes data between Tuesday and Thursday.



Location: Emerson St, B/W Churchill Ave & Coleridge Ave  
 Date Range: 11/28/2018 - 12/4/2018  
 Site Code: 14

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average				
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018							
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB
12:00 AM	0	0	0	0	1	1	0	0	0	2	1	3	2	6	8	0	0	0	0	0	0	0	0	0	0	
1:00 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
2:00 AM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
3:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	
4:00 AM	2	0	2	0	0	0	0	0	0	0	0	0	1	1	2	1	0	1	1	0	1	1	0	1	1	
5:00 AM	0	0	0	1	0	1	4	1	5	0	2	2	0	0	0	0	0	0	2	1	3	1	0	1	1	
6:00 AM	3	5	8	7	6	13	3	4	7	2	1	3	1	2	3	7	7	14	5	4	9	5	5	10	10	
7:00 AM	29	16	45	68	36	104	47	26	73	8	5	13	3	1	4	38	25	63	46	25	71	48	26	73	73	
8:00 AM	108	40	148	168	62	230	64	26	90	15	11	26	6	5	11	61	24	85	79	25	104	118	42	161	161	
9:00 AM	23	26	49	24	17	41	33	27	60	20	13	33	9	13	22	29	21	50	21	19	40	23	21	43	43	
10:00 AM	21	16	37	15	18	33	22	20	42	37	25	62	11	13	24	17	24	41	18	20	38	18	18	36	36	
11:00 AM	27	33	60	28	16	44	24	25	49	10	13	23	14	23	37	13	22	35	22	13	35	26	21	46	46	
12:00 PM	22	29	51	27	22	49	21	18	39	22	29	51	30	30	60	16	21	37	19	20	39	23	24	46	46	
1:00 PM	17	22	39	15	24	39	12	21	33	17	31	48	11	25	36	15	23	38	19	25	44	17	24	41	41	
2:00 PM	123	24	147	32	30	62	24	40	64	15	18	33	16	20	36	15	38	53	21	37	58	59	30	89	89	
3:00 PM	59	79	138	32	63	95	37	75	112	13	28	41	8	19	27	32	63	95	24	59	83	38	67	105	105	
4:00 PM	23	47	70	30	35	65	29	55	84	12	39	51	15	34	49	23	46	69	33	44	77	29	42	71	71	
5:00 PM	19	41	60	46	36	82	18	36	54	11	17	28	11	25	36	31	47	78	31	47	78	32	41	73	73	
6:00 PM	28	45	73	30	29	59	29	33	62	7	21	28	8	20	28	12	30	42	36	39	75	31	38	69	69	
7:00 PM	12	20	32	7	17	24	13	18	31	7	16	23	11	10	21	10	13	23	10	18	28	10	18	28	28	
8:00 PM	12	12	24	10	17	27	4	8	12	4	14	18	7	12	19	5	16	21	6	15	21	9	15	24	24	
9:00 PM	5	12	17	2	11	13	11	9	20	6	3	9	1	4	5	3	7	10	6	12	18	4	12	16	16	
10:00 PM	0	3	3	1	4	5	7	6	13	2	8	10	1	1	2	3	7	10	1	7	8	1	5	5	5	
11:00 PM	0	1	1	0	0	0	2	2	4	0	3	3	1	0	1	0	1	1	0	0	0	0	0	0	0	
Total	533	471	1,004	543	444	987	404	450	854	211	299	510	168	264	432	331	435	766	400	430	830	492	448	940	940	
Percent	53%	47%	-	55%	45%	-	47%	53%	-	41%	59%	-	39%	61%	-	43%	57%	-	48%	52%	-	52%	48%	-	-	
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	08:00	09:00	08:00	10:00	10:00	10:00	11:00	11:00	11:00	08:00	07:00	08:00	08:00	07:00	08:00	08:00	08:00	08:00	08:00	
Vol.	108	40	148	168	62	230	64	27	90	37	25	62	14	23	37	61	25	85	79	25	104	118	42	161	161	
PM Peak	14:00	15:00	14:00	17:00	15:00	15:00	15:00	15:00	15:00	12:00	16:00	12:00	12:00	16:00	12:00	15:00	15:00	15:00	18:00	15:00	15:00	14:00	15:00	15:00	15:00	
Vol.	123	79	147	46	63	95	37	75	112	22	39	51	30	34	60	32	63	95	36	59	83	59	67	105	105	

1. Mid-week average includes data between Tuesday and Thursday.

Location: Churchill Ave B/W Alma St & Emerson St  
 Date Range: 12/11/2018 - 12/17/2018  
 Site Code: 15

Time	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Mid-Week Average				
	12/11/2018			12/12/2018			12/13/2018			12/14/2018			12/15/2018			12/16/2018			12/17/2018							
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB
12:00 AM	2	2	4	6	4	10	5	3	8	4	6	10	12	6	18	16	9	25	8	2	10	4	3	7		
1:00 AM	3	1	4	3	3	6	3	0	3	5	2	7	6	7	13	5	2	7	2	2	4	3	1	4		
2:00 AM	2	0	2	0	0	0	0	2	2	3	0	3	5	6	11	5	3	8	2	2	4	1	1	1		
3:00 AM	0	1	1	0	1	1	0	0	0	0	0	0	1	0	1	1	1	2	1	2	3	0	1	1		
4:00 AM	1	3	4	1	5	6	2	3	5	2	4	6	5	1	6	0	0	0	2	3	5	1	4	5		
5:00 AM	8	21	29	3	10	13	3	18	21	7	16	23	7	14	21	0	2	2	8	17	25	5	16	21		
6:00 AM	24	29	53	21	28	49	32	34	66	22	32	54	13	11	24	7	8	15	21	25	46	26	30	56		
7:00 AM	60	88	148	58	92	150	75	88	163	64	88	152	15	34	49	13	16	29	49	65	114	64	89	154		
8:00 AM	85	150	235	99	142	241	91	160	251	86	154	240	49	49	98	34	47	81	92	132	224	92	151	242		
9:00 AM	71	84	155	68	102	170	72	73	145	62	89	151	63	62	125	49	50	99	71	82	153	70	86	157		
10:00 AM	79	94	173	85	69	154	71	57	128	76	91	167	79	77	156	74	75	149	89	83	172	78	73	152		
11:00 AM	69	96	165	80	108	188	94	86	180	89	94	183	97	97	194	85	88	173	77	90	167	81	97	178		
12:00 PM	85	71	156	113	73	186	100	80	180	96	88	184	120	93	213	91	88	179	97	85	182	99	75	174		
1:00 PM	72	83	155	104	77	181	110	83	193	116	85	201	87	86	173	103	102	205	76	93	169	95	81	176		
2:00 PM	156	115	271	142	105	247	160	128	288	171	100	271	137	95	232	112	77	189	187	113	300	153	116	269		
3:00 PM	192	161	353	230	182	412	161	181	342	158	186	344	122	82	204	94	56	150	184	174	358	194	175	369		
4:00 PM	139	103	242	169	127	296	140	115	255	124	118	242	137	74	211	69	74	143	123	124	247	149	115	264		
5:00 PM	112	167	279	146	140	286	142	143	285	119	122	241	105	74	179	74	65	139	140	126	266	133	150	283		
6:00 PM	114	152	266	123	121	244	136	109	245	104	92	196	102	51	153	68	55	123	97	79	176	124	127	252		
7:00 PM	94	55	149	82	71	153	91	88	179	76	43	119	75	24	99	41	27	68	65	50	115	89	71	160		
8:00 PM	61	41	102	69	35	104	67	73	140	50	33	83	59	19	78	39	24	63	50	34	84	66	50	115		
9:00 PM	45	45	90	39	34	73	39	40	79	59	27	86	50	44	94	31	22	53	33	31	64	41	40	81		
10:00 PM	25	10	35	23	13	36	26	18	44	29	23	52	35	23	58	18	15	33	15	18	33	25	14	38		
11:00 PM	14	5	19	7	5	12	12	4	16	31	10	41	22	10	32	13	3	16	14	4	18	11	5	16		
Total	1,513	1,577	3,090	1,671	1,547	3,218	1,632	1,586	3,218	1,553	1,503	3,056	1,403	1,039	2,442	1,042	909	1,951	1,503	1,436	2,939	1,605	1,570	3,175		
Percent	49%	51%	-	52%	48%	-	51%	49%	-	51%	49%	-	57%	43%	-	53%	47%	-	51%	49%	-	51%	49%	-		
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	11:00	08:00	08:00	11:00	08:00	08:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	08:00	08:00	08:00	08:00	08:00		
Vol.	85	150	235	99	142	241	94	160	251	89	154	240	97	97	194	85	88	173	92	132	224	92	151	242		
PM Peak	15:00	17:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	14:00	15:00	15:00	14:00	14:00	14:00	14:00	13:00	13:00	14:00	15:00	15:00	15:00	15:00	15:00		
Vol.	192	167	353	230	182	412	161	181	342	171	186	344	137	95	232	112	102	205	187	174	358	194	175	369		

1. Mid-week average includes data between Tuesday and Thursday.

Location: Alma St, B/W Coleridge Ave & Lowell Ave  
 Date Range: 11/28/2018 - 12/4/2018  
 Site Code: 16

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average		
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018					
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	33	50	83	28	55	83	44	80	124	65	134	199	66	102	168	28	34	62	20	68	88	27	58	85
1:00 AM	21	27	48	16	30	46	28	48	76	43	67	110	41	64	105	11	26	37	12	30	42	16	29	45
2:00 AM	11	14	25	8	16	24	12	18	30	21	40	61	21	55	76	12	9	21	10	36	46	10	22	32
3:00 AM	20	9	29	18	10	28	21	6	27	18	16	34	11	18	29	14	11	25	18	16	34	19	12	30
4:00 AM	47	21	68	47	22	69	57	23	80	34	13	47	14	9	23	59	15	74	56	37	93	50	27	77
5:00 AM	167	67	234	176	70	246	154	48	202	73	22	95	47	18	65	163	60	223	152	58	210	165	65	230
6:00 AM	438	140	578	467	139	606	475	154	629	144	51	195	120	27	147	466	153	619	487	149	636	464	143	607
7:00 AM	1,124	398	1,522	1,160	424	1,584	1,036	440	1,476	244	129	373	197	109	306	1,053	459	1,512	1,120	425	1,545	1,135	416	1,550
8:00 AM	1,480	719	2,199	1,307	804	2,111	1,384	659	2,043	494	257	751	367	225	592	1,477	669	2,146	1,473	686	2,159	1,420	736	2,156
9:00 AM	1,231	566	1,797	1,186	611	1,797	1,139	584	1,723	665	443	1,108	561	347	908	1,224	583	1,807	1,196	570	1,766	1,204	582	1,787
10:00 AM	919	600	1,519	972	517	1,489	994	513	1,507	778	510	1,288	716	392	1,108	1,000	572	1,572	1,049	526	1,575	980	548	1,528
11:00 AM	801	597	1,398	836	594	1,430	891	628	1,519	863	533	1,396	754	571	1,325	853	603	1,456	971	632	1,603	869	608	1,477
12:00 PM	755	575	1,330	789	645	1,434	746	667	1,413	865	669	1,534	774	617	1,391	712	620	1,332	897	631	1,528	814	617	1,431
1:00 PM	777	669	1,446	764	638	1,402	791	741	1,532	784	666	1,450	772	597	1,369	699	627	1,326	852	715	1,567	798	674	1,472
2:00 PM	443	678	1,121	872	767	1,639	819	894	1,713	740	712	1,452	714	675	1,389	768	727	1,495	889	910	1,799	735	785	1,520
3:00 PM	911	1,018	1,929	947	1,170	2,117	1,056	1,146	2,202	745	732	1,477	759	702	1,461	891	1,157	2,048	1,102	1,270	2,372	987	1,153	2,139
4:00 PM	1,061	1,323	2,384	1,093	1,231	2,324	1,125	1,324	2,449	748	674	1,422	674	743	1,417	945	1,274	2,219	1,314	1,367	2,681	1,156	1,307	2,463
5:00 PM	1,255	1,345	2,600	1,342	1,285	2,627	1,301	1,347	2,648	668	698	1,366	625	704	1,329	1,225	1,386	2,611	1,572	1,404	2,976	1,390	1,345	2,734
6:00 PM	1,138	1,110	2,248	1,117	1,140	2,257	1,151	1,153	2,304	669	604	1,273	493	656	1,149	1,179	1,096	2,275	1,434	1,300	2,734	1,230	1,183	2,413
7:00 PM	608	773	1,381	654	862	1,516	851	761	1,612	488	516	1,004	373	495	868	599	686	1,285	843	819	1,662	702	818	1,520
8:00 PM	364	612	976	398	601	999	469	558	1,027	335	411	746	255	327	582	362	550	912	408	614	1,022	390	609	999
9:00 PM	265	484	749	272	482	754	398	481	879	227	430	657	172	303	475	235	410	645	328	515	843	288	494	782
10:00 PM	117	290	407	152	342	494	235	385	620	224	338	562	95	166	261	126	232	358	208	342	550	159	325	484
11:00 PM	73	117	190	72	169	241	126	244	370	120	191	311	40	105	145	55	140	195	86	209	295	77	165	242
Total	14,059	12,202	26,261	14,693	12,624	27,317	15,303	12,902	28,205	10,055	8,856	18,911	8,661	8,027	16,688	14,156	12,099	26,255	16,497	13,329	29,826	15,083	12,718	27,801
Percent	54%	46%	-	54%	46%	-	54%	46%	-	53%	47%	-	52%	48%	-	54%	46%	-	55%	45%	-	54%	46%	-
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00
Vol.	1,480	719	2,199	1,307	804	2,111	1,384	659	2,043	863	533	1,396	754	571	1,325	1,477	669	2,146	1,473	686	2,159	1,420	736	2,156
PM Peak	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	12:00	15:00	12:00	12:00	16:00	15:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00
Vol.	1,255	1,345	2,600	1,342	1,285	2,627	1,301	1,347	2,648	865	732	1,534	774	743	1,461	1,225	1,386	2,611	1,572	1,404	2,976	1,390	1,345	2,734

1. Mid-week average includes data between Tuesday and Thursday.

Location: Churchill Ave, B/W Mariposa Ave & Train Tracks  
 Date Range: 11/28/2018 - 12/4/2018  
 Site Code: 17

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average				
	11/28/2018			11/29/2018			11/30/2018			12/1/2018			12/2/2018			12/3/2018			12/4/2018							
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB
12:00 AM	20	15	35	14	9	23	22	24	46	34	31	65	22	30	52	20	8	28	19	7	26	18	10	28		
1:00 AM	9	12	21	12	10	22	8	10	18	22	16	38	23	23	46	3	4	7	11	13	24	11	12	22		
2:00 AM	8	3	11	8	1	9	6	4	10	9	7	16	8	13	21	3	5	8	6	4	10	7	3	10		
3:00 AM	4	9	13	1	9	10	2	7	9	6	9	15	2	7	9	3	6	9	2	11	13	2	10	12		
4:00 AM	9	20	29	8	18	26	7	20	27	6	16	22	7	3	10	9	29	38	13	23	36	10	20	30		
5:00 AM	18	80	98	18	88	106	21	76	97	20	32	52	6	25	31	21	72	93	21	84	105	19	84	103		
6:00 AM	68	193	261	59	196	255	64	219	283	27	58	85	11	35	46	64	188	252	56	199	255	61	196	257		
7:00 AM	160	346	506	194	342	536	166	333	499	59	94	153	51	72	123	162	306	468	142	337	479	165	342	507		
8:00 AM	255	451	706	308	491	799	214	435	649	128	169	297	96	138	234	253	462	715	264	490	754	276	477	753		
9:00 AM	207	431	638	252	392	644	238	385	623	179	227	406	169	240	409	233	408	641	212	363	575	224	395	619		
10:00 AM	231	325	556	203	329	532	219	323	542	209	287	496	196	292	488	187	315	502	219	347	566	218	334	551		
11:00 AM	237	327	564	221	361	582	288	352	640	263	324	587	238	336	574	239	336	575	240	306	546	233	331	564		
12:00 PM	249	313	562	279	327	606	298	357	655	249	340	589	277	320	597	266	335	601	252	310	562	260	317	577		
1:00 PM	325	349	674	293	312	605	298	341	639	230	292	522	281	353	634	237	326	563	278	319	597	299	327	625		
2:00 PM	316	339	655	343	375	718	408	312	720	241	324	565	237	408	645	317	334	651	326	316	642	328	343	672		
3:00 PM	334	354	688	424	381	805	326	401	727	266	298	564	281	317	598	417	356	773	354	379	733	371	371	742		
4:00 PM	404	298	702	387	328	715	389	368	757	300	328	628	344	337	681	431	312	743	388	336	724	393	321	714		
5:00 PM	365	340	705	354	363	717	338	331	669	285	309	594	317	260	577	226	341	567	315	346	661	345	350	694		
6:00 PM	314	356	670	315	313	628	310	317	627	273	258	531	281	200	481	281	345	626	364	372	736	331	347	678		
7:00 PM	259	264	523	226	259	485	235	237	472	218	165	383	186	198	384	230	231	461	281	318	599	255	280	536		
8:00 PM	216	157	373	222	158	380	231	193	424	152	123	275	100	117	217	186	148	334	248	186	434	229	167	396		
9:00 PM	154	115	269	133	118	251	149	134	283	114	103	217	85	87	172	136	90	226	150	119	269	146	117	263		
10:00 PM	78	63	141	91	77	168	91	89	180	94	89	183	47	62	109	72	67	139	88	75	163	86	72	157		
11:00 PM	44	25	69	57	40	97	69	65	134	54	52	106	38	25	63	39	24	63	48	37	85	50	34	84		
Total	4,284	5,185	9,469	4,422	5,297	9,719	4,397	5,333	9,730	3,438	3,951	7,389	3,303	3,898	7,201	4,035	5,048	9,083	4,297	5,297	9,594	4,334	5,260	9,594		
Percent	45%	55%	-	45%	55%	-	45%	55%	-	47%	53%	-	46%	54%	-	44%	56%	-	45%	55%	-	45%	55%	-		
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	11:00	08:00	08:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00		
Vol.	255	451	706	308	491	799	288	435	649	263	324	587	238	336	574	253	462	715	264	490	754	276	477	753		
PM Peak	16:00	18:00	17:00	15:00	15:00	15:00	14:00	15:00	16:00	16:00	12:00	16:00	16:00	14:00	16:00	16:00	15:00	16:00	15:00	16:00	15:00	18:00	16:00	15:00		
Vol.	404	356	705	424	381	805	408	401	757	300	340	628	344	408	681	431	356	773	388	379	736	393	371	742		

1. Mid-week average includes data between Tuesday and Thursday.

Location: Lincoln St B/W High St & Emerson St  
 Date Range: 12/5/2018 - 12/11/2018  
 Site Code: 18

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average				
	12/5/2018			12/6/2018			12/7/2018			12/8/2018			12/9/2018			12/10/2018			12/11/2018							
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB
12:00 AM	2	0	2	0	4	4	6	3	9	4	5	9	-	-	-	-	-	-	-	-	-	-	-	1	2	3
1:00 AM	1	2	3	0	1	1	3	0	3	4	6	10	-	-	-	-	-	-	-	-	-	-	-	1	2	2
2:00 AM	1	0	1	1	1	2	0	0	0	2	6	8	-	-	-	-	-	-	-	-	-	-	-	1	1	2
3:00 AM	1	1	2	1	0	1	1	0	1	2	1	3	-	-	-	-	-	-	-	-	-	-	-	1	1	2
4:00 AM	1	2	3	2	3	5	3	2	5	1	2	3	-	-	-	-	-	-	-	-	-	-	-	2	3	4
5:00 AM	6	9	15	2	4	6	5	6	11	3	0	3	-	-	-	-	-	-	-	-	-	-	-	4	7	11
6:00 AM	19	22	41	24	17	41	20	15	35	7	5	12	-	-	-	-	-	-	-	-	-	-	-	22	20	41
7:00 AM	65	35	100	64	45	109	64	28	92	17	15	32	-	-	-	-	-	-	-	-	-	-	-	65	40	105
8:00 AM	90	87	177	99	83	182	110	73	183	25	22	47	-	-	-	-	-	-	-	-	-	-	-	95	85	180
9:00 AM	80	43	123	36	12	48	72	22	94	36	20	56	-	-	-	-	-	-	-	-	-	-	-	58	28	86
10:00 AM	53	56	109	58	14	72	45	36	81	43	47	90	-	-	-	-	-	-	-	-	-	-	-	56	35	91
11:00 AM	52	46	98	58	23	81	57	55	112	60	52	112	-	-	-	-	-	-	-	-	-	-	-	55	35	90
12:00 PM	59	58	117	56	13	69	56	56	112	59	61	120	-	-	-	-	-	-	-	-	-	-	-	58	36	93
1:00 PM	64	42	106	61	26	87	54	51	105	60	40	100	-	-	-	-	-	-	-	-	-	-	-	63	34	97
2:00 PM	66	54	120	67	29	96	59	74	133	51	54	105	-	-	-	-	-	-	-	-	-	-	-	67	42	108
3:00 PM	74	56	130	77	58	135	76	62	138	53	36	89	-	-	-	-	-	-	-	-	-	-	-	76	57	133
4:00 PM	105	60	165	104	46	150	91	60	151	57	52	109	-	-	-	-	-	-	-	-	-	-	-	105	53	158
5:00 PM	100	43	143	109	42	151	86	56	142	61	51	112	-	-	-	-	-	-	-	-	-	-	-	105	43	147
6:00 PM	95	48	143	146	41	187	102	59	161	55	47	102	-	-	-	-	-	-	-	-	-	-	-	121	45	165
7:00 PM	68	34	102	84	32	116	66	49	115	42	25	67	-	-	-	-	-	-	-	-	-	-	-	76	33	109
8:00 PM	53	28	81	55	30	85	43	32	75	22	17	39	-	-	-	-	-	-	-	-	-	-	-	54	29	83
9:00 PM	18	22	40	25	19	44	35	27	62	33	17	50	-	-	-	-	-	-	-	-	-	-	-	22	21	42
10:00 PM	10	9	19	17	14	31	19	18	37	22	15	37	-	-	-	-	-	-	-	-	-	-	-	14	12	25
11:00 PM	6	2	8	5	5	10	8	16	24	8	2	10	-	-	-	-	-	-	-	-	-	-	-	6	4	9
Total	1,089	759	1,848	1,151	562	1,713	1,081	800	1,881	727	598	1,325	-	-	-	-	-	-	-	-	-	-	-	1,120	661	1,781
Percent	59%	41%	-	67%	33%	-	57%	43%	-	55%	45%	-	-	-	-	-	-	-	-	-	-	-	-	63%	37%	-
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	11:00	11:00	11:00	-	-	-	-	-	-	-	-	-	-	-	08:00	08:00	08:00
Vol.	90	87	177	99	83	182	110	73	183	60	52	112	-	-	-	-	-	-	-	-	-	-	-	95	85	180
PM Peak	16:00	16:00	16:00	18:00	15:00	18:00	18:00	14:00	18:00	17:00	12:00	12:00	-	-	-	-	-	-	-	-	-	-	-	18:00	15:00	18:00
Vol.	105	60	165	146	58	187	102	74	161	61	61	120	-	-	-	-	-	-	-	-	-	-	-	121	57	165

1. Mid-week average includes data between Tuesday and Thursday.

Location: Emerson St B/W Lincoln Ave & Kingly Ave  
 Date Range: 12/5/2018 - 12/11/2018  
 Site Code: 19

Time	Wednesday			Thursday			Friday			Saturday			Sunday			Monday			Tuesday			Mid-Week Average				
	12/5/2018			12/6/2018			12/7/2018			12/8/2018			12/9/2018			12/10/2018			12/11/2018							
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB
12:00 AM	1	3	4	3	3	6	3	1	4	6	0	6	-	-	-	-	-	-	-	-	-	-	2	3	5	
1:00 AM	0	1	1	1	0	1	1	0	1	2	3	5	-	-	-	-	-	-	-	-	-	-	1	1	1	
2:00 AM	1	1	2	1	0	1	1	3	4	1	0	1	-	-	-	-	-	-	-	-	-	-	1	1	2	
3:00 AM	1	2	3	0	0	0	0	1	1	1	1	2	-	-	-	-	-	-	-	-	-	-	1	1	2	
4:00 AM	2	1	3	2	5	7	4	4	8	4	3	7	-	-	-	-	-	-	-	-	-	-	2	3	5	
5:00 AM	13	10	23	15	6	21	14	5	19	4	2	6	-	-	-	-	-	-	-	-	-	-	14	8	22	
6:00 AM	38	6	44	39	8	47	43	7	50	8	6	14	-	-	-	-	-	-	-	-	-	-	39	7	46	
7:00 AM	104	26	130	106	16	122	85	15	100	22	4	26	-	-	-	-	-	-	-	-	-	-	105	21	126	
8:00 AM	120	30	150	124	21	145	128	24	152	34	19	53	-	-	-	-	-	-	-	-	-	-	122	26	148	
9:00 AM	119	22	141	48	25	73	88	24	112	60	25	85	-	-	-	-	-	-	-	-	-	-	84	24	107	
10:00 AM	82	29	111	45	26	71	72	15	87	53	26	79	-	-	-	-	-	-	-	-	-	-	64	28	91	
11:00 AM	68	33	101	31	41	72	71	48	119	70	28	98	-	-	-	-	-	-	-	-	-	-	50	37	87	
12:00 PM	72	29	101	31	35	66	75	33	108	72	20	92	-	-	-	-	-	-	-	-	-	-	52	32	84	
1:00 PM	79	20	99	50	30	80	56	26	82	72	14	86	-	-	-	-	-	-	-	-	-	-	65	25	90	
2:00 PM	70	21	91	42	19	61	57	33	90	74	20	94	-	-	-	-	-	-	-	-	-	-	56	20	76	
3:00 PM	54	25	79	63	21	84	90	25	115	47	17	64	-	-	-	-	-	-	-	-	-	-	59	23	82	
4:00 PM	66	23	89	75	23	98	86	19	105	59	27	86	-	-	-	-	-	-	-	-	-	-	71	23	94	
5:00 PM	81	23	104	91	26	117	77	30	107	39	30	69	-	-	-	-	-	-	-	-	-	-	86	25	111	
6:00 PM	87	45	132	91	36	127	84	38	122	57	32	89	-	-	-	-	-	-	-	-	-	-	89	41	130	
7:00 PM	42	27	69	49	30	79	50	32	82	40	25	65	-	-	-	-	-	-	-	-	-	-	46	29	74	
8:00 PM	31	13	44	45	23	68	36	18	54	15	22	37	-	-	-	-	-	-	-	-	-	-	38	18	56	
9:00 PM	16	13	29	21	8	29	23	13	36	16	10	26	-	-	-	-	-	-	-	-	-	-	19	11	29	
10:00 PM	10	4	14	8	6	14	4	8	12	11	7	18	-	-	-	-	-	-	-	-	-	-	9	5	14	
11:00 PM	1	1	2	6	1	7	4	8	12	10	1	11	-	-	-	-	-	-	-	-	-	-	4	1	5	
Total	1,158	408	1,566	987	409	1,396	1,152	430	1,582	777	342	1,119	-	-	-	-	-	-	-	-	-	-	1,073	409	1,481	
Percent	74%	26%	-	71%	29%	-	73%	27%	-	69%	31%	-	-	-	-	-	-	-	-	-	-	-	72%	28%	-	
AM Peak	08:00	11:00	08:00	08:00	11:00	08:00	08:00	11:00	08:00	11:00	11:00	11:00	-	-	-	-	-	-	-	-	-	-	08:00	11:00	08:00	
Vol.	120	33	150	124	41	145	128	48	152	70	28	98	-	-	-	-	-	-	-	-	-	-	122	37	148	
PM Peak	18:00	18:00	18:00	17:00	18:00	18:00	15:00	18:00	18:00	14:00	18:00	14:00	-	-	-	-	-	-	-	-	-	-	18:00	18:00	18:00	
Vol.	87	45	132	91	36	127	90	38	122	74	32	94	-	-	-	-	-	-	-	-	-	-	89	41	130	

1. Mid-week average includes data between Tuesday and Thursday.

## Appendix C – Origin-Destination Data

AM Peak

Zone ID	Row Labels	Origin	Destination	Embarcadero n/o Middlefield	Pagemill WB	Alma S of Oregon	Stanford@ El Camino	Copwer N/S @ Embarcadero	SB El Camino S of Churchill	Waverly N/S @ Embarcadero	Middlefield S of Embarcadero	NB El Camino N of Embarcadero	Middlefield N of Embarcadero	Emerson @ Embarcadero	Alma N of Churchill	Copwer N/S @ Oregon Expy	WB Embarcadero	Sierra @ El Camino	Waverly N/S @ El Camino	Bryant @ Embarcadero	Grand Total
16	Stanford@ El Camino	9%	0%	0%	0%	3%	0%	2%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	15%
9	Embarcadero n/o Middlefield	0%	2%	6%	5%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	15%
17	Waverly N/S @ Embarcadero	1%	4%	3%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	11%
5	Copwer N/S @ Embarcadero	0%	0%	4%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%
7	SB El Camino N of Embarcadero	6%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%
8	NB El Camino S of Churchill	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%
10	EB Embarcadero s/o El Camino	1%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%
2	Alma S of Oregon	4%	0%	0%	0%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%
14	Pagemill EB	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	5%
11	Emerson @ Embarcadero	1%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%
1	Alma N of Churchill	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	3%
15	Sierra @ El Camino	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%
13	Middlefield S of Embarcadero	0%	0%	0%	0%	0%	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%
12	Middlefield N of Embarcadero	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%
6	Copwer N/S @ Oregon Expy	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
18	Waverly N/S @ Oregon Expy	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
3	Bryant N/S @ Oregon Expy	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
19	Webster @ Embarcadero	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	<b>Grand Total</b>	<b>36%</b>	<b>15%</b>	<b>14%</b>	<b>7%</b>	<b>6%</b>	<b>6%</b>	<b>4%</b>	<b>3%</b>	<b>2%</b>	<b>2%</b>	<b>1%</b>	<b>1%</b>	<b>1%</b>	<b>1%</b>	<b>1%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>100%</b>



PM Peak

Sum of O-M-D Traffic (StL Index)

Column Labels

Zone ID	Origin	Destination																			Grand Total
		Embarcadero n/o Middlefield	Alma S of Oregon	Copwer N/S @ Embarcadero	Waverly N/S @ Embarcadero	Middlefield S of Embarcadero	SB El Camino S of Embarcadero	Copwer N/S @ Oregon Expy	Stanford@ El Camino	NB El Camino S of Churchill	Middlefield N of Embarcadero	Pagemill WB	Webster @ Embarcadero	Almba N of Churchill	Sierra @ El Camino	Emerson @ Embarcadero	Waverly N/S @ Oregon Expy	Bryant N/S @ Oregon Expy	WB Embarcadero s/o El Camino		
2	Alma S of Oregon	5%	0%	4%	1%	0%	0%	0%	0%	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	13%	
9	Embarcadero n/o Middlefield	0%	5%	0%	0%	1%	1%	1%	1%	1%	0%	1%	0%	0%	1%	0%	0%	0%	0%	12%	
7	SB El Camino N of Embarcadero	8%	0%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	12%	
5	Copwer N/S @ Embarcadero	0%	8%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	11%	
17	Waverly N/S @ Embarcadero	1%	4%	0%	0%	0%	1%	1%	1%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	10%	
16	Stanford@ El Camino	4%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%	
1	Alma N of Churchill	4%	0%	0%	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	6%	
15	Sierra @ El Camino	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	6%	
14	Pagemill EB	2%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	
8	NB El Camino S of Churchill	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	
13	Middlefield S of Embarcadero	2%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	
10	EB Embarcadero s/o El Camino	2%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	
11	Emerson @ Embarcadero	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	
12	Middlefield N of Embarcadero	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	
18	Waverly N/S @ Oregon Expy	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	
6	Copwer N/S @ Oregon Expy	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	
19	Webster @ Embarcadero	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
4	Bryant @ Embarcadero	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
3	Bryant N/S @ Oregon Expy	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
<b>Grand Total</b>		<b>36%</b>	<b>20%</b>	<b>7%</b>	<b>6%</b>	<b>6%</b>	<b>5%</b>	<b>4%</b>	<b>3%</b>	<b>3%</b>	<b>2%</b>	<b>2%</b>	<b>2%</b>	<b>2%</b>	<b>1%</b>	<b>1%</b>	<b>1%</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>100%</b>

## Appendix D – Existing Conditions Synchro Reports

- HCM Delay and LOS Reports
- 95<sup>th</sup> Percentile Queue Length Reports

Queues  
1: Alma Street & Homer Ave













Existing Conditions  
Timing Plan: A.M. Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	343	1131	665
v/c Ratio	0.65	0.71	0.42
Control Delay	29.9	20.2	15.5
Queue Delay	0.0	0.0	0.0
Total Delay	29.9	20.2	15.5
Queue Length 50th (ft)	64	221	108
Queue Length 95th (ft)	100	327	154
Internal Link Dist (ft)	443	390	481
Turn Bay Length (ft)			
Base Capacity (vph)	830	1841	1841
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.41	0.61	0.36
Intersection Summary			

HCM Signalized Intersection Capacity Analysis  
 1: Alma Street & Homer Ave

Existing Conditions  
 Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	 		 			 
Traffic Volume (vph)	199	93	1063	0	0	559
Future Volume (vph)	199	93	1063	0	0	559
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		5.0			5.0
Lane Util. Factor	0.97		0.95			0.95
Frbp, ped/bikes	0.90		1.00			1.00
Flpb, ped/bikes	0.84		1.00			1.00
Frt	0.95		1.00			1.00
Flt Protected	0.97		1.00			1.00
Satd. Flow (prot)	2506		3539			3539
Flt Permitted	0.97		1.00			1.00
Satd. Flow (perm)	2506		3539			3539
Peak-hour factor, PHF	0.85	0.85	0.94	0.25	0.25	0.84
Adj. Flow (vph)	234	109	1131	0	0	665
RTOR Reduction (vph)	65	0	0	0	0	0
Lane Group Flow (vph)	278	0	1131	0	0	665
Confl. Peds. (#/hr)	82	102		13		
Confl. Bikes (#/hr)		1				
Turn Type	Perm		NA			NA
Protected Phases			2			6
Permitted Phases	8					
Actuated Green, G (s)	13.3		35.3			35.3
Effective Green, g (s)	13.3		35.3			35.3
Actuated g/C Ratio	0.17		0.45			0.45
Clearance Time (s)	4.0		5.0			5.0
Vehicle Extension (s)	3.0		4.0			4.0
Lane Grp Cap (vph)	428		1605			1605
v/s Ratio Prot			c0.32			0.19
v/s Ratio Perm	c0.11					
v/c Ratio	0.65		0.70			0.41
Uniform Delay, d1	30.1		17.1			14.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	3.4		1.5			0.2
Delay (s)	33.4		18.6			14.5
Level of Service	C		B			B
Approach Delay (s)	33.4		18.6			14.5
Approach LOS	C		B			B
<b>Intersection Summary</b>						
HCM 2000 Control Delay			19.7		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.52			
Actuated Cycle Length (s)			77.8		Sum of lost time (s)	13.0
Intersection Capacity Utilization			47.4%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

Intersection Sign configuration not allowed in HCM analysis.

# HCM Unsignalized Intersection Capacity Analysis

## 3: Alma Street & Lincoln Ave

Existing Conditions  
Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	40	23	1405	85	7	723
Future Volume (Veh/h)	40	23	1405	85	7	723
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.93	0.93	0.97	0.97	0.92	0.92
Hourly flow rate (vph)	43	25	1448	88	8	786
Pedestrians	11					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1912	779			1547	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1912	779			1547	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	26	93			98	
cM capacity (veh/h)	58	335			420	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	68	965	571	270	524	
Volume Left	43	0	0	8	0	
Volume Right	25	0	88	0	0	
cSH	83	1700	1700	420	1700	
Volume to Capacity	0.82	0.57	0.34	0.02	0.31	
Queue Length 95th (ft)	105	0	0	1	0	
Control Delay (s)	139.3	0.0	0.0	0.7	0.0	
Lane LOS	F		A			
Approach Delay (s)	139.3	0.0	0.2			
Approach LOS	F					
Intersection Summary						
Average Delay			4.0			
Intersection Capacity Utilization			51.9%		ICU Level of Service	A
Analysis Period (min)	15					

# HCM Unsignalized Intersection Capacity Analysis

## 4: Alma Street & Embarcadero Rd

















Existing Conditions  
Timing Plan: A.M. Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑			↗
Traffic Volume (veh/h)	0	753	1375	0	0	120
Future Volume (Veh/h)	0	753	1375	0	0	120
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.25	0.90	0.95	0.25	0.25	0.83
Hourly flow rate (vph)	0	837	1447	0	0	145
Pedestrians						33
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					3	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1480				1898	1480
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1480				1898	1480
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	0
cM capacity (veh/h)	437				59	111
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>SB 1</b>		
Volume Total	418	418	1447	145		
Volume Left	0	0	0	0		
Volume Right	0	0	0	145		
cSH	1700	1700	1700	111		
Volume to Capacity	0.25	0.25	0.85	1.31		
Queue Length 95th (ft)	0	0	0	245		
Control Delay (s)	0.0	0.0	0.0	260.6		
Lane LOS				F		
Approach Delay (s)	0.0		0.0	260.6		
Approach LOS				F		
<b>Intersection Summary</b>						
Average Delay			15.6			
Intersection Capacity Utilization			86.5%		ICU Level of Service	E
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
 5: Emerson St & Lincoln Ave

Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	58	34	69	73	11	4	7	9	7	28	1
Future Volume (vph)	8	58	34	69	73	11	4	7	9	7	28	1
Peak Hour Factor	0.76	0.76	0.76	0.77	0.77	0.77	0.71	0.71	0.71	0.56	0.56	0.56
Hourly flow rate (vph)	11	76	45	90	95	14	6	10	13	13	50	2
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	132	199	29	65								
Volume Left (vph)	11	90	6	13								
Volume Right (vph)	45	14	13	2								
Hadj (s)	-0.15	0.08	-0.19	0.06								
Departure Headway (s)	4.2	4.4	4.5	4.7								
Degree Utilization, x	0.15	0.24	0.04	0.09								
Capacity (veh/h)	830	797	730	702								
Control Delay (s)	7.9	8.7	7.7	8.2								
Approach Delay (s)	7.9	8.7	7.7	8.2								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.3									
Level of Service			A									
Intersection Capacity Utilization			27.6%		ICU Level of Service				A			
Analysis Period (min)			15									



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Intersection Sign configuration not allowed in HCM analysis.

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Intersection Sign configuration not allowed in HCM analysis.

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# HCM Unsignalized Intersection Capacity Analysis

## 8: Alma Street & Kingsley Ave

Existing Conditions  
Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	10	13	1371	21	62	690
Future Volume (Veh/h)	10	13	1371	21	62	690
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.82	0.82	0.96	0.96	0.90	0.90
Hourly flow rate (vph)	12	16	1428	22	69	767
Pedestrians	7					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1968	1446			1457	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1968	1446			1457	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	74	87			85	
cM capacity (veh/h)	46	120			457	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	28	1450	325	511		
Volume Left	12	0	69	0		
Volume Right	16	22	0	0		
cSH	71	1700	457	1700		
Volume to Capacity	0.39	0.85	0.15	0.30		
Queue Length 95th (ft)	38	0	13	0		
Control Delay (s)	85.0	0.0	5.0	0.0		
Lane LOS	F		A			
Approach Delay (s)	85.0	0.0	2.0			
Approach LOS	F					
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization			83.4%		ICU Level of Service	E
Analysis Period (min)	15					

Queues  
9: Alma St & Churchill Ave

Existing Conditions  
Timing Plan: A.M. Peak



Lane Group	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	189	195	179	224	1388	6	632	174
v/c Ratio	0.86	0.56	0.95	2.36	0.59	0.08	0.29	0.17
Control Delay	111.7	14.7	132.7	674.9	18.6	88.4	17.8	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	111.7	14.7	132.7	674.9	18.6	88.4	17.8	4.8
Queue Length 50th (ft)	229	0	221	~473	459	7	188	22
Queue Length 95th (ft)	274	37	#269	#654	620	27	225	57
Internal Link Dist (ft)	340		479		698		387	
Turn Bay Length (ft)				300		60		100
Base Capacity (vph)	241	364	189	95	2372	302	2157	1015
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.54	0.95	2.36	0.59	0.02	0.29	0.17

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 9: Alma St & Churchill Ave

Existing Conditions  
Timing Plan: A.M. Peak



















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔		↖	↕		↖	↕	↗
Traffic Volume (vph)	89	56	150	71	55	5	199	1216	20	5	569	157
Future Volume (vph)	89	56	150	71	55	5	199	1216	20	5	569	157
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Frbp, ped/bikes		1.00	0.92		0.98		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.99		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1807	1463		1767		1770	3529		1770	3539	1583
Flt Permitted		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1807	1463		1767		1770	3529		1770	3539	1583
Peak-hour factor, PHF	0.77	0.77	0.77	0.73	0.73	0.73	0.89	0.89	0.89	0.90	0.90	0.90
Adj. Flow (vph)	116	73	195	97	75	7	224	1366	22	6	632	174
RTOR Reduction (vph)	0	0	171	0	1	0	0	0	0	0	0	50
Lane Group Flow (vph)	0	189	24	0	178	0	224	1388	0	6	632	124
Confl. Peds. (#/hr)			23			101			24			
Confl. Bikes (#/hr)			4			258						
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases			8									2
Actuated Green, G (s)		22.9	22.9		20.0		10.1	122.5		1.6	114.0	114.0
Effective Green, g (s)		22.9	22.9		20.0		10.1	122.5		1.6	114.0	114.0
Actuated g/C Ratio		0.12	0.12		0.11		0.05	0.66		0.01	0.61	0.61
Clearance Time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0		3.0	6.0		3.0	6.0	6.0
Lane Grp Cap (vph)		221	179		188		95	2311		15	2157	965
v/s Ratio Prot		c0.10		c0.10			c0.13	c0.39		0.00	0.18	
v/s Ratio Perm			0.02									0.08
v/c Ratio		0.86	0.13		0.95		2.36	0.60		0.40	0.29	0.13
Uniform Delay, d1		80.4	73.2		83.0		88.5	18.3		92.2	17.3	15.5
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		26.1	0.3		50.0		642.4	0.8		16.6	0.3	0.3
Delay (s)		106.5	73.5		133.0		730.8	19.1		108.8	17.7	15.7
Level of Service		F	E		F		F	B		F	B	B
Approach Delay (s)		89.8			133.0			118.0			17.9	
Approach LOS		F			F			F			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			88.1				HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			187.0				Sum of lost time (s)			20.0		
Intersection Capacity Utilization			74.1%				ICU Level of Service			D		
Analysis Period (min)			15									

c Critical Lane Group

















HCM Unsignalized Intersection Capacity Analysis  
 10: Emerson St & Churchill Ave

Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	10	76	10	5	84	7	34	75	8	10	15	14
Future Volume (vph)	10	76	10	5	84	7	34	75	8	10	15	14
Peak Hour Factor	0.75	0.75	0.75	0.86	0.86	0.86	0.70	0.70	0.70	0.54	0.54	0.54
Hourly flow rate (vph)	13	101	13	6	98	8	49	107	11	19	28	26
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	127	112	167	73								
Volume Left (vph)	13	6	49	19								
Volume Right (vph)	13	8	11	26								
Hadj (s)	-0.01	0.00	0.05	-0.13								
Departure Headway (s)	4.6	4.6	4.6	4.6								
Degree Utilization, x	0.16	0.14	0.21	0.09								
Capacity (veh/h)	728	725	738	733								
Control Delay (s)	8.5	8.4	8.9	8.0								
Approach Delay (s)	8.5	8.4	8.9	8.0								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.5									
Level of Service			A									
Intersection Capacity Utilization			26.2%	ICU Level of Service	A							
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 11: Bryant St & Churchill Ave

Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	75	8	2	72	37	9	20	3	12	8	16
Future Volume (Veh/h)	11	75	8	2	72	37	9	20	3	12	8	16
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.71	0.71	0.71	0.87	0.87	0.87	0.57	0.57	0.57	0.47	0.47	0.47
Hourly flow rate (vph)	15	106	11	2	83	43	16	35	5	26	17	34
Pedestrians		17			14			4			11	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		2			1			0			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											936	
pX, platoon unblocked												
vC, conflicting volume	268	189	55	238	204	62	68			54		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	268	189	55	238	204	62	68			54		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	84	99	100	87	96	99			98		
cM capacity (veh/h)	551	666	992	586	654	979	1508			1531		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	132	128	56	77								
Volume Left	15	2	16	26								
Volume Right	11	43	5	34								
cSH	669	735	1508	1531								
Volume to Capacity	0.20	0.17	0.01	0.02								
Queue Length 95th (ft)	18	16	1	1								
Control Delay (s)	11.7	10.9	2.2	2.6								
Lane LOS	B	B	A	A								
Approach Delay (s)	11.7	10.9	2.2	2.6								
Approach LOS	B	B										
<b>Intersection Summary</b>												
Average Delay			8.3									
Intersection Capacity Utilization			25.6%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 12: Waverly St & Churchill Ave

















Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	12	60	9	2	31	16	17	98	11	4	74	23
Future Volume (vph)	12	60	9	2	31	16	17	98	11	4	74	23
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.72	0.72	0.72	0.62	0.62	0.62
Hourly flow rate (vph)	14	68	10	2	35	18	24	136	15	6	119	37
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	92	55	175	162								
Volume Left (vph)	14	2	24	6								
Volume Right (vph)	10	18	15	37								
Hadj (s)	0.00	-0.16	0.01	-0.10								
Departure Headway (s)	4.7	4.6	4.5	4.4								
Degree Utilization, x	0.12	0.07	0.22	0.20								
Capacity (veh/h)	700	709	774	783								
Control Delay (s)	8.4	8.0	8.7	8.4								
Approach Delay (s)	8.4	8.0	8.7	8.4								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.5									
Level of Service			A									
Intersection Capacity Utilization			29.0%	ICU Level of Service	A							
Analysis Period (min)			15									



HCM Unsignalized Intersection Capacity Analysis  
 13: Cowper St & Churchill Ave

Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	5	62	7	5	24	1	23	23	6	2	21	12
Future Volume (vph)	5	62	7	5	24	1	23	23	6	2	21	12
Peak Hour Factor	0.88	0.88	0.88	0.75	0.75	0.75	0.72	0.72	0.72	0.58	0.58	0.58
Hourly flow rate (vph)	6	70	8	7	32	1	32	32	8	3	36	21
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	84	40	72	60								
Volume Left (vph)	6	7	32	3								
Volume Right (vph)	8	1	8	21								
Hadj (s)	-0.01	0.05	0.06	-0.17								
Departure Headway (s)	4.2	4.3	4.3	4.1								
Degree Utilization, x	0.10	0.05	0.09	0.07								
Capacity (veh/h)	822	789	805	848								
Control Delay (s)	7.7	7.5	7.7	7.4								
Approach Delay (s)	7.7	7.5	7.7	7.4								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.6									
Level of Service			A									
Intersection Capacity Utilization			21.3%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 14: Churchill Ave & Embarcadero Rd

















Existing Conditions  
 Timing Plan: A.M. Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	843	2	37	949	0	80
Future Volume (Veh/h)	843	2	37	949	0	80
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.87	0.87	0.81	0.81	0.25	0.83
Hourly flow rate (vph)	969	2	46	1172	0	96
Pedestrians					11	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					1	
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)	1093			898		
pX, platoon unblocked			0.81	0.81	0.81	
vC, conflicting volume			980	1659	496	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			500	1340	0	
tC, single (s)			4.1	6.8	6.9	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			95	100	89	
cM capacity (veh/h)			848	109	867	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	646	325	437	781	96	
Volume Left	0	0	46	0	0	
Volume Right	0	2	0	0	96	
cSH	1700	1700	848	1700	867	
Volume to Capacity	0.38	0.19	0.05	0.46	0.11	
Queue Length 95th (ft)	0	0	4	0	9	
Control Delay (s)	0.0	0.0	1.6	0.0	9.7	
Lane LOS			A	A		
Approach Delay (s)	0.0	0.6		9.7		
Approach LOS			A			
Intersection Summary						
Average Delay			0.7			
Intersection Capacity Utilization			56.6%	ICU Level of Service		B
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis  
 15: Cowper St & Embarcadero Rd

Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	843	20	11	926	13	5	3	6	4	8	46
Future Volume (Veh/h)	14	843	20	11	926	13	5	3	6	4	8	46
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.82	0.82	0.82	0.58	0.58	0.58	0.69	0.69	0.69
Hourly flow rate (vph)	16	947	22	13	1129	16	9	5	10	6	12	67
Pedestrians					1			8			28	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			1			3	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.79			0.79	0.79	0.79	0.79	0.79	
vC, conflicting volume	1173			977			1662	2197	494	1710	2200	600
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1173			440			1306	1984	0	1367	1988	600
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			85	89	99	91	73	84
cM capacity (veh/h)	575			876			58	44	849	69	44	432
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>WB 2</b>	<b>NB 1</b>	<b>SB 1</b>						
Volume Total	490	496	578	580	24	85						
Volume Left	16	0	13	0	9	6						
Volume Right	0	22	0	16	10	67						
cSH	575	1700	876	1700	86	165						
Volume to Capacity	0.03	0.29	0.01	0.34	0.28	0.51						
Queue Length 95th (ft)	2	0	1	0	26	63						
Control Delay (s)	0.8	0.0	0.4	0.0	62.4	47.8						
Lane LOS	A		A		F	E						
Approach Delay (s)	0.4		0.2		62.4	47.8						
Approach LOS					F	E						
<b>Intersection Summary</b>												
Average Delay			2.7									
Intersection Capacity Utilization			44.2%		ICU Level of Service				A			
Analysis Period (min)			15									

Queues  
16: Waverly St & Embarcadero Rd

Existing Conditions  
Timing Plan: A.M. Peak






















Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	44	889	30	1128	240	362
v/c Ratio	0.66	0.69	0.27	0.88	0.32	0.44
Control Delay	66.0	26.2	32.9	42.1	14.6	16.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.0	26.2	32.9	42.1	14.6	16.3
Queue Length 50th (ft)	26	282	15	387	85	139
Queue Length 95th (ft)	#92	356	39	424	119	172
Internal Link Dist (ft)		572		576	78	709
Turn Bay Length (ft)	95		75			
Base Capacity (vph)	67	1280	110	1281	754	830
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.69	0.27	0.88	0.32	0.44

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 16: Waverly St & Embarcadero Rd

Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	41	794	33	25	911	25	77	93	24	65	101	117
Future Volume (vph)	41	794	33	25	911	25	77	93	24	65	101	117
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	1.00			0.98			0.94	
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.99	
Satd. Flow (prot)	1770	3513		1763	3518			1787			1716	
Flt Permitted	0.10	1.00		0.16	1.00			0.75			0.87	
Satd. Flow (perm)	186	3513		303	3518			1374			1509	
Peak-hour factor, PHF	0.93	0.93	0.93	0.83	0.83	0.83	0.81	0.81	0.81	0.78	0.78	0.78
Adj. Flow (vph)	44	854	35	30	1098	30	95	115	30	83	129	150
RTOR Reduction (vph)	0	3	0	0	2	0	0	5	0	0	6	0
Lane Group Flow (vph)	44	886	0	30	1126	0	0	235	0	0	356	0
Confl. Peds. (#/hr)	27		9	9		27	22		9	9		22
Confl. Bikes (#/hr)									2			13
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2				2
Permitted Phases	4			4			2			2		
Actuated Green, G (s)	40.0	40.0		40.0	40.0			60.0			60.0	
Effective Green, g (s)	40.0	40.0		40.0	40.0			60.0			60.0	
Actuated g/C Ratio	0.36	0.36		0.36	0.36			0.55			0.55	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			4.0			4.0	
Lane Grp Cap (vph)	67	1277		110	1279			749			823	
v/s Ratio Prot		0.25			c0.32							
v/s Ratio Perm	0.24			0.10				0.17			c0.24	
v/c Ratio	0.66	0.69		0.27	0.88			0.31			0.43	
Uniform Delay, d1	29.3	29.8		24.7	32.8			13.7			14.9	
Progression Factor	0.75	0.78		1.00	1.00			1.00			1.00	
Incremental Delay, d2	19.1	1.5		1.3	7.4			1.1			1.7	
Delay (s)	41.2	24.7		26.1	40.1			14.8			16.5	
Level of Service	D	C		C	D			B			B	
Approach Delay (s)		25.5			39.8			14.8			16.5	
Approach LOS		C			D			B			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			29.5									C
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			110.0							10.0		
Intersection Capacity Utilization			61.3%									B
Analysis Period (min)			15									

c Critical Lane Group

Queues  
17: Bryant St & Embarcadero Rd

Existing Conditions  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBR	SBR
Lane Group Flow (vph)	53	1164	57	1161	22	52
v/c Ratio	0.19	0.46	0.20	0.45	0.05	0.14
Control Delay	9.4	8.6	23.3	24.2	0.2	2.7
Queue Delay	0.0	0.0	0.0	0.3	0.0	0.0
Total Delay	9.4	8.6	23.3	24.5	0.2	2.7
Queue Length 50th (ft)	13	193	33	400	0	0
Queue Length 95th (ft)	29	203	m44	m464	0	0
Internal Link Dist (ft)		579		572		
Turn Bay Length (ft)	80		60			
Base Capacity (vph)	278	2529	281	2560	475	422
Starvation Cap Reductn	0	0	0	667	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.46	0.20	0.61	0.05	0.12

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 17: Bryant St & Embarcadero Rd

Existing Conditions  
 Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↗	↕		↖	↕				↗			↖
Traffic Volume (vph)	43	829	114	52	1032	36	0	0	13	0	0	37
Future Volume (vph)	43	829	114	52	1032	36	0	0	13	0	0	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Lane Util. Factor	1.00	0.95		1.00	0.95				1.00			1.00
Frbp, ped/bikes	1.00	0.99		1.00	0.99				0.94			0.89
Flpb, ped/bikes	0.98	1.00		0.99	1.00				1.00			1.00
Frt	1.00	0.98		1.00	0.99				0.86			0.86
Flt Protected	0.95	1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)	1729	3451		1759	3501				1515			1426
Flt Permitted	0.21	1.00		0.21	1.00				1.00			1.00
Satd. Flow (perm)	380	3451		386	3501				1515			1426
Peak-hour factor, PHF	0.81	0.81	0.81	0.92	0.92	0.92	0.25	0.25	0.58	0.25	0.25	0.71
Adj. Flow (vph)	53	1023	141	57	1122	39	0	0	22	0	0	52
RTOR Reduction (vph)	0	8	0	0	2	0	0	0	18	0	0	42
Lane Group Flow (vph)	53	1156	0	57	1159	0	0	0	4	0	0	10
Confl. Peds. (#/hr)	64		16	16		64			16			32
Confl. Bikes (#/hr)									26			61
Turn Type	Perm	NA		Perm	NA				Perm			Perm
Protected Phases		2			2							
Permitted Phases	2			2					4			4
Actuated Green, G (s)	78.4	78.4		78.4	78.4				21.6			21.6
Effective Green, g (s)	78.4	78.4		78.4	78.4				21.6			21.6
Actuated g/C Ratio	0.71	0.71		0.71	0.71				0.20			0.20
Clearance Time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0				3.0			3.0
Lane Grp Cap (vph)	270	2459		275	2495				297			280
v/s Ratio Prot		c0.33			0.33							
v/s Ratio Perm	0.14			0.15					0.00			c0.01
v/c Ratio	0.20	0.47		0.21	0.46				0.01			0.04
Uniform Delay, d1	5.3	6.8		5.3	6.8				35.6			35.8
Progression Factor	1.00	1.00		2.82	2.96				1.00			1.00
Incremental Delay, d2	1.6	0.6		1.0	0.4				0.0			0.1
Delay (s)	6.9	7.5		16.0	20.5				35.6			35.8
Level of Service	A	A		B	C				D			D
Approach Delay (s)		7.4			20.2			35.6			35.8	
Approach LOS		A			C			D			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			14.5									B
HCM 2000 Volume to Capacity ratio			0.38									
Actuated Cycle Length (s)			110.0						10.0			
Intersection Capacity Utilization			55.8%									B
Analysis Period (min)			15									

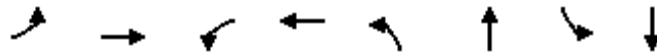
c Critical Lane Group

## Queues

## 18: Middlefield Rd &amp; Embarcadero Rd

## Existing Conditions

Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	44	1023	57	1215	161	364	120	275
v/c Ratio	0.44	1.06	0.55	1.26	0.90	0.55	0.75	0.85
Control Delay	84.0	97.4	89.9	171.0	112.3	59.7	94.9	84.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.0	97.4	89.9	171.0	112.3	59.7	94.9	84.3
Queue Length 50th (ft)	44	~646	56	~850	162	175	118	268
Queue Length 95th (ft)	78	#687	90	#817	#245	198	174	334
Internal Link Dist (ft)		577		509		183		494
Turn Bay Length (ft)	115		100		115		100	
Base Capacity (vph)	115	966	115	961	184	718	184	375
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	1.06	0.50	1.26	0.88	0.51	0.65	0.73

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.
























# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis  
18: Middlefield Rd & Embarcadero Rd

Existing Conditions  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 				
Traffic Volume (vph)	35	772	46	43	809	115	129	273	18	100	205	23
Future Volume (vph)	35	772	46	43	809	115	129	273	18	100	205	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3497		1770	3447		1770	3500		1770	1827	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3497		1770	3447		1770	3500		1770	1827	
Peak-hour factor, PHF	0.80	0.80	0.80	0.76	0.76	0.76	0.80	0.80	0.80	0.83	0.83	0.83
Adj. Flow (vph)	44	965	58	57	1064	151	161	341	22	120	247	28
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	44	1023	0	57	1215	0	161	364	0	120	275	0
Confl. Peds. (#/hr)			24			44			8			14
Confl. Bikes (#/hr)						1			1			2
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	7.2	41.6		7.6	42.0		15.6	28.9		13.9	27.2	
Effective Green, g (s)	7.2	41.6		7.6	42.0		15.6	28.9		13.9	27.2	
Actuated g/C Ratio	0.05	0.27		0.05	0.27		0.10	0.19		0.09	0.18	
Clearance Time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	2.5	3.5		2.5	3.5		2.5	3.0		2.5	3.0	
Lane Grp Cap (vph)	83	947		87	943		179	658		160	323	
v/s Ratio Prot	0.02	0.29		c0.03	c0.35		c0.09	0.10		0.07	c0.15	
v/s Ratio Perm												
v/c Ratio	0.53	1.08		0.66	1.29		0.90	0.55		0.75	0.85	
Uniform Delay, d1	71.5	55.9		71.7	55.8		68.2	56.4		68.1	61.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.0	53.4		14.7	137.8		39.5	1.0		17.0	18.9	
Delay (s)	76.5	109.4		86.4	193.6		107.7	57.5		85.1	80.1	
Level of Service	E	F		F	F		F	E		F	F	
Approach Delay (s)		108.0			188.8			72.9			81.6	
Approach LOS		F			F			E			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			130.7				HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			153.5				Sum of lost time (s)			22.5		
Intersection Capacity Utilization			66.8%				ICU Level of Service			C		
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
19: Galvez St/Embarcadero Rd & El Camino Real

Existing Conditions  
Timing Plan: A.M. Peak























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	276	1134	299	1391	69	296	187	645
v/c Ratio	1.17	0.67	0.86	0.70	0.42	0.36	0.85	0.70
Control Delay	166.5	44.7	101.1	44.2	70.7	45.1	94.8	49.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	166.5	44.7	101.1	44.2	70.7	45.1	94.8	49.3
Queue Length 50th (ft)	~321	347	311	292	66	123	179	274
Queue Length 95th (ft)	#509	401	m#424	348	113	157	#290	345
Internal Link Dist (ft)		1237		1007		755		481
Turn Bay Length (ft)	300		382				200	
Base Capacity (vph)	236	1692	346	2000	166	879	247	1106
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	0.67	0.86	0.70	0.42	0.34	0.76	0.58

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	273	1034	89	275	1154	126	61	204	60	178	407	206
Future Volume (vph)	273	1034	89	275	1154	126	61	204	60	178	407	206
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95		1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5009		1770	4998		1770	3401		1770	3254	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5009		1770	4998		1770	3401		1770	3254	
Peak-hour factor, PHF	0.99	0.99	0.99	0.92	0.92	0.92	0.89	0.89	0.89	0.95	0.95	0.95
Adj. Flow (vph)	276	1044	90	299	1254	137	69	229	67	187	428	217
RTOR Reduction (vph)	0	7	0	0	8	0	0	18	0	0	46	0
Lane Group Flow (vph)	276	1127	0	299	1383	0	69	278	0	187	599	0
Confl. Peds. (#/hr)			17			9			11			74
Confl. Bikes (#/hr)												1
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	20.0	50.5		29.3	59.8		14.1	35.4		18.8	40.1	
Effective Green, g (s)	20.0	50.5		29.3	59.8		14.1	35.4		18.8	40.1	
Actuated g/C Ratio	0.13	0.34		0.20	0.40		0.09	0.24		0.13	0.27	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	4.0		2.0	4.0		2.5	2.0		2.0	2.0	
Lane Grp Cap (vph)	236	1686		345	1992		166	802		221	869	
v/s Ratio Prot	c0.16	0.23		c0.17	c0.28		c0.04	0.08		c0.11	c0.18	
v/s Ratio Perm												
v/c Ratio	1.17	0.67		0.87	0.69		0.42	0.35		0.85	0.69	
Uniform Delay, d1	65.0	42.6		58.5	37.5		64.1	47.7		64.2	49.4	
Progression Factor	1.00	1.00		1.57	1.14		1.00	1.00		1.00	1.00	
Incremental Delay, d2	112.1	2.1		10.7	1.0		1.2	0.1		23.7	1.8	
Delay (s)	177.1	44.7		102.7	43.7		65.3	47.8		87.9	51.2	
Level of Service	F	D		F	D		E	D		F	D	
Approach Delay (s)		70.6			54.2			51.1			59.4	
Approach LOS		E			D			D			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			60.3				HCM 2000 Level of Service			E		
HCM 2000 Volume to Capacity ratio			0.78									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			95.6%			ICU Level of Service			F			
Analysis Period (min)			15									

c Critical Lane Group

Queues  
20: El Camino Real & Churchill Ave

Existing Conditions  
Timing Plan: A.M. Peak



Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	334	1875	218	90	1215
v/c Ratio	0.92	0.85	0.32	0.62	0.44
Control Delay	84.2	45.7	26.4	61.6	32.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	84.2	45.7	26.4	61.6	32.5
Queue Length 50th (ft)	292	-678	116	87	439
Queue Length 95th (ft)	#457	#824	194	m128	489
Internal Link Dist (ft)	958	687			1175
Turn Bay Length (ft)			100	170	
Base Capacity (vph)	392	2200	691	259	2749
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.85	0.85	0.32	0.35	0.44












Intersection Summary

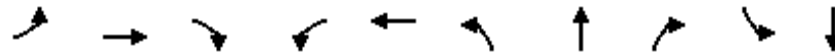
- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 20: El Camino Real & Churchill Ave

Existing Conditions  
Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	158	149	1650	192	83	1118
Future Volume (vph)	158	149	1650	192	83	1118
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	1.00		0.91	1.00	1.00	0.91
Frbp, ped/bikes	0.99		1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.93		1.00	0.85	1.00	1.00
Flt Protected	0.97		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1681		5085	1534	1770	5085
Flt Permitted	0.97		1.00	1.00	0.95	1.00
Satd. Flow (perm)	1681		5085	1534	1770	5085
Peak-hour factor, PHF	0.92	0.92	0.88	0.88	0.92	0.92
Adj. Flow (vph)	172	162	1875	218	90	1215
RTOR Reduction (vph)	23	0	0	31	0	0
Lane Group Flow (vph)	311	0	1875	187	90	1215
Confl. Peds. (#/hr)		5		10		
Turn Type	Prot		NA	Perm	Prot	NA
Protected Phases	4		6		5	2
Permitted Phases				6		
Actuated Green, G (s)	30.3		64.3	64.3	12.2	80.5
Effective Green, g (s)	30.3		64.3	64.3	12.2	80.5
Actuated g/C Ratio	0.20		0.43	0.43	0.08	0.54
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.2		4.0	4.0	2.0	4.0
Lane Grp Cap (vph)	339		2179	657	143	2728
v/s Ratio Prot	c0.18		c0.37		c0.05	0.24
v/s Ratio Perm				0.12		
v/c Ratio	0.92		0.86	0.28	0.63	0.45
Uniform Delay, d1	58.6		38.8	27.9	66.7	21.2
Progression Factor	1.00		1.00	1.00	0.71	1.36
Incremental Delay, d2	28.2		4.7	1.1	4.6	0.4
Delay (s)	86.9		43.5	29.0	52.2	29.2
Level of Service	F		D	C	D	C
Approach Delay (s)	86.9		42.0			30.8
Approach LOS	F		D			C
<b>Intersection Summary</b>						
HCM 2000 Control Delay			42.1		HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.67			
Actuated Cycle Length (s)			150.0		Sum of lost time (s)	15.0
Intersection Capacity Utilization			66.7%		ICU Level of Service	C
Analysis Period (min)			15			
c	Critical Lane Group					



































Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	301	604	233	314	1444	362	930	177	221	1247
v/c Ratio	0.85	0.43	0.41	0.84	1.03	0.82	0.59	0.19	0.78	0.90
Control Delay	104.8	59.8	10.3	102.0	94.2	95.0	40.7	18.9	103.8	61.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	104.8	59.8	10.3	102.0	94.2	95.0	40.7	18.9	103.8	61.7
Queue Length 50th (ft)	193	233	10	202	-734	228	445	100	142	755
Queue Length 95th (ft)	247	300	98	253	#945	#307	508	132	188	794
Internal Link Dist (ft)		611			978		1346			917
Turn Bay Length (ft)	350		350	300		350			100	
Base Capacity (vph)	424	1403	574	496	1399	451	1583	966	749	1578
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.43	0.41	0.63	1.03	0.80	0.59	0.18	0.30	0.79

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real



















Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  		 	  		 	 		 	 	
Traffic Volume (vph)	289	580	224	295	1158	199	329	846	161	212	1026	171
Future Volume (vph)	289	580	224	295	1158	199	329	846	161	212	1026	171
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.95	
Frbp, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1500	3433	4925		3433	3539	1583	3433	3449	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1500	3433	4925		3433	3539	1583	3433	3449	
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.91	0.91	0.91	0.96	0.96	0.96
Adj. Flow (vph)	301	604	233	314	1232	212	362	930	177	221	1069	178
RTOR Reduction (vph)	0	0	161	0	11	0	0	0	0	0	8	0
Lane Group Flow (vph)	301	604	72	314	1433	0	362	930	177	221	1239	0
Confl. Peds. (#/hr)			21			27			29			8
Confl. Bikes (#/hr)						3						1
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									
Actuated Green, G (s)	19.7	52.4	52.4	20.8	53.5		24.6	85.1	110.4	15.7	76.2	
Effective Green, g (s)	19.7	52.4	52.4	20.8	53.5		24.6	85.1	110.4	15.7	76.2	
Actuated g/C Ratio	0.10	0.28	0.28	0.11	0.28		0.13	0.45	0.58	0.08	0.40	
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	
Lane Grp Cap (vph)	355	1402	413	375	1386		444	1585	919	283	1383	
v/s Ratio Prot	0.09	0.12		c0.09	c0.29		c0.11	0.26	0.11	0.06	c0.36	
v/s Ratio Perm			0.05									
v/c Ratio	0.85	0.43	0.17	0.84	1.03		0.82	0.59	0.19	0.78	0.90	
Uniform Delay, d1	83.7	56.5	52.4	82.9	68.2		80.5	39.3	18.8	85.5	53.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	16.3	1.0	0.9	14.3	33.3		11.0	0.4	0.0	12.1	7.7	
Delay (s)	99.9	57.5	53.3	97.3	101.5		91.5	39.6	18.8	97.6	60.9	
Level of Service	F	E	D	F	F		F	D	B	F	E	
Approach Delay (s)		67.9			100.8			49.9			66.4	
Approach LOS		E			F			D			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			72.9			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.92									
Actuated Cycle Length (s)			190.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			92.9%			ICU Level of Service			F			
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis  
 22a: Oregon Ave & Alma St












Existing Conditions  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	10	0	74	0	1585	351	0	599	187
Future Volume (Veh/h)	0	0	0	10	0	74	0	1585	351	0	599	187
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.95	0.25	0.95	0.92	0.98	0.98	0.25	0.84	0.84
Hourly flow rate (vph)	0	0	0	11	0	78	0	1617	358	0	713	223
Pedestrians	19											
Lane Width (ft)	12.0											
Walking Speed (ft/s)	3.5											
Percent Blockage	2											
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1711	2818	468	1992	2572	828	936				1994	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1711	2818	468	1992	2572	828	936				1994	
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	100	100	100	68	100	75	100				100	
cM capacity (veh/h)	43	17	542	35	25	309	727				279	
Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2					
Volume Total	11	78	808	808	358	475	461					
Volume Left	11	0	0	0	0	0	0					
Volume Right	0	78	0	0	358	0	223					
cSH	35	309	1700	1700	1700	1700	1700					
Volume to Capacity	0.32	0.25	0.48	0.48	0.21	0.28	0.27					
Queue Length 95th (ft)	26	25	0	0	0	0	0					
Control Delay (s)	151.3	20.6	0.0	0.0	0.0	0.0	0.0					
Lane LOS	F	C										
Approach Delay (s)	36.7	0.0		0.0								
Approach LOS	E											
Intersection Summary												
Average Delay	1.1											
Intersection Capacity Utilization	55.1%		ICU Level of Service				B					
Analysis Period (min)	15											



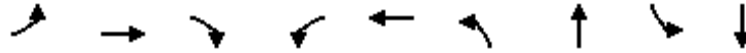
HCM Unsignalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

Existing Conditions  
 Timing Plan: A.M. Peak

							
Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	0	266	1670	151	74	535	
Future Volume (Veh/h)	0	266	1670	151	74	535	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.25	0.90	0.98	0.98	0.84	0.84	
Hourly flow rate (vph)	0	296	1704	154	88	637	
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type			None			None	
Median storage veh							
Upstream signal (ft)							
pX, platoon unblocked							
vC, conflicting volume	2198	852			1704		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	2198	852			1704		
tC, single (s)	6.8	6.9			4.1		
tC, 2 stage (s)							
tF (s)	3.5	3.3			2.2		
p0 queue free %	100	2			76		
cM capacity (veh/h)	29	303			369		
Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	296	852	852	154	88	318	318
Volume Left	0	0	0	0	88	0	0
Volume Right	296	0	0	154	0	0	0
cSH	303	1700	1700	1700	369	1700	1700
Volume to Capacity	0.98	0.50	0.50	0.09	0.24	0.19	0.19
Queue Length 95th (ft)	253	0	0	0	23	0	0
Control Delay (s)	84.2	0.0	0.0	0.0	17.8	0.0	0.0
Lane LOS	F				C		
Approach Delay (s)	84.2	0.0			2.2		
Approach LOS	F						
Intersection Summary							
Average Delay			9.2				
Intersection Capacity Utilization			69.3%		ICU Level of Service		C
Analysis Period (min)			15				

Queues  
23: Cowper St & Oregon Expy

Existing Conditions  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	20	1533	54	27	1635	150	127	45	91
v/c Ratio	0.21	0.70	0.05	0.27	0.75	0.80	0.40	0.36	0.40
Control Delay	72.7	24.6	1.1	85.3	20.9	93.7	48.4	73.9	48.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	72.7	24.6	1.1	85.3	20.9	93.7	48.4	73.9	48.5
Queue Length 50th (ft)	19	463	0	28	771	149	99	43	67
Queue Length 95th (ft)	48	785	8	m27	m825	#185	106	60	73
Internal Link Dist (ft)		1547			1028		66		60
Turn Bay Length (ft)	115		50	115					
Base Capacity (vph)	156	2177	984	154	2186	188	370	165	372
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.70	0.05	0.18	0.75	0.80	0.34	0.27	0.24

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 23: Cowper St & Oregon Expy

Existing Conditions  
Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	1395	49	26	1555	14	102	48	38	29	35	24
Future Volume (vph)	18	1395	49	26	1555	14	102	48	38	29	35	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.98		1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1546	1770	3533		1770	1700		1770	1722	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1546	1770	3533		1770	1700		1770	1722	
Peak-hour factor, PHF	0.91	0.91	0.91	0.96	0.96	0.96	0.68	0.68	0.68	0.65	0.65	0.65
Adj. Flow (vph)	20	1533	54	27	1620	15	150	71	56	45	54	37
RTOR Reduction (vph)	0	0	22	0	0	0	0	20	0	0	18	0
Lane Group Flow (vph)	20	1533	32	27	1635	0	150	107	0	45	73	0
Confl. Peds. (#/hr)			1			11			8			10
Confl. Bikes (#/hr)									25			8
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases			6									
Actuated Green, G (s)	5.1	89.4	89.4	5.4	89.9		16.0	26.2		8.9	19.3	
Effective Green, g (s)	5.1	89.4	89.4	5.4	89.9		16.0	26.2		8.9	19.3	
Actuated g/C Ratio	0.03	0.60	0.60	0.04	0.60		0.11	0.17		0.06	0.13	
Clearance Time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0		5.0	3.0		4.0	3.0	
Lane Grp Cap (vph)	60	2109	921	63	2117		188	296		105	221	
v/s Ratio Prot	0.01	0.43		c0.02	c0.46		c0.08	c0.06		0.03	0.04	
v/s Ratio Perm			0.02									
v/c Ratio	0.33	0.73	0.03	0.43	0.77		0.80	0.36		0.43	0.33	
Uniform Delay, d1	70.8	21.6	12.5	70.8	22.4		65.4	54.5		68.1	59.5	
Progression Factor	1.00	1.00	1.00	1.22	0.85		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.3	2.2	0.1	2.0	1.2		23.2	0.8		3.8	0.9	
Delay (s)	74.1	23.8	12.6	88.3	20.2		88.6	55.3		71.9	60.3	
Level of Service	E	C	B	F	C		F	E		E	E	
Approach Delay (s)		24.1			21.3			73.3			64.2	
Approach LOS		C			C			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			28.0			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.71									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			20.1			
Intersection Capacity Utilization			69.2%			ICU Level of Service				C		
Analysis Period (min)			15									

c Critical Lane Group

Queues  
24: Middlefield Rd & Oregon Expy

Existing Conditions  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	128	1284	167	120	1254	56	296	428	238	98	460
v/c Ratio	0.67	0.90	0.24	0.68	0.90	0.09	1.02	0.86	0.43	0.64	0.66
Control Delay	89.1	57.0	23.2	83.7	53.5	0.3	117.7	69.0	10.8	84.3	51.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	89.1	57.0	23.2	83.7	53.5	0.3	117.7	69.0	10.8	84.3	51.5
Queue Length 50th (ft)	111	402	25	115	625	0	~305	385	24	94	182
Queue Length 95th (ft)	m#191	#844	m147	182	#774	0	#489	#534	95	154	235
Internal Link Dist (ft)		1028			896			676			311
Turn Bay Length (ft)	360		100	390		100	230			145	
Base Capacity (vph)	191	1420	707	224	1386	601	291	527	578	184	788
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.90	0.24	0.54	0.90	0.09	1.02	0.81	0.41	0.53	0.58




























Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 24: Middlefield Rd & Oregon Expy

Existing Conditions  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Traffic Volume (vph)	115	1156	150	115	1204	54	263	381	212	86	257	148
Future Volume (vph)	115	1156	150	115	1204	54	263	381	212	86	257	148
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.83	1.00	1.00	0.96	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1561	1770	3539	1321	1770	1863	1524	1770	3326	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1561	1770	3539	1321	1770	1863	1524	1770	3326	
Peak-hour factor, PHF	0.90	0.90	0.90	0.96	0.96	0.96	0.89	0.89	0.89	0.88	0.88	0.88
Adj. Flow (vph)	128	1284	167	120	1254	56	296	428	238	98	292	168
RTOR Reduction (vph)	0	0	81	0	0	34	0	0	149	0	57	0
Lane Group Flow (vph)	128	1284	86	120	1254	22	296	428	89	98	403	0
Confl. Peds. (#/hr)			1			51			27			4
Confl. Bikes (#/hr)						2						
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			
Actuated Green, G (s)	16.2	60.2	60.2	15.0	58.8	58.8	24.7	40.3	40.3	13.1	28.8	
Effective Green, g (s)	16.2	60.2	60.2	15.0	58.8	58.8	24.7	40.3	40.3	13.1	28.8	
Actuated g/C Ratio	0.11	0.40	0.40	0.10	0.39	0.39	0.16	0.27	0.27	0.09	0.19	
Clearance Time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0	4.0	5.0	5.0	5.0	3.0	3.0	
Lane Grp Cap (vph)	191	1420	626	177	1387	517	291	500	409	154	638	
v/s Ratio Prot	0.07	c0.36		0.07	c0.35		c0.17	c0.23		0.06	0.12	
v/s Ratio Perm			0.06			0.02			0.06			
v/c Ratio	0.67	0.90	0.14	0.68	0.90	0.04	1.02	0.86	0.22	0.64	0.63	
Uniform Delay, d1	64.3	42.2	28.5	65.2	42.9	28.2	62.6	52.1	42.6	66.1	55.7	
Progression Factor	1.18	1.17	2.69	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.5	7.4	0.3	9.9	9.9	0.2	57.2	14.7	0.6	8.3	2.1	
Delay (s)	82.2	56.6	76.8	75.0	52.9	28.3	119.9	66.8	43.2	74.5	57.8	
Level of Service	F	E	E	E	D	C	F	E	D	E	E	
Approach Delay (s)		60.8			53.8			77.3			60.7	
Approach LOS		E			D			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			62.1				HCM 2000 Level of Service				E	
HCM 2000 Volume to Capacity ratio			0.95									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)				21.6		
Intersection Capacity Utilization			97.7%			ICU Level of Service				F		
Analysis Period (min)			15									

c Critical Lane Group

Queues  
1: Alma Street & Homer Ave













Existing Conditions  
Timing Plan: P.M.Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	529	1114	951
v/c Ratio	0.74	0.68	0.58
Control Delay	34.6	21.5	19.5
Queue Delay	0.0	0.0	0.0
Total Delay	34.6	21.5	19.5
Queue Length 50th (ft)	131	258	207
Queue Length 95th (ft)	189	343	277
Internal Link Dist (ft)	443	390	481
Turn Bay Length (ft)			
Base Capacity (vph)	852	1864	1864
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.62	0.60	0.51
Intersection Summary			

HCM Signalized Intersection Capacity Analysis  
 1: Alma Street & Homer Ave

Existing Conditions  
 Timing Plan: P.M.Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	 		 			 
Traffic Volume (vph)	356	126	1081	0	0	894
Future Volume (vph)	356	126	1081	0	0	894
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		5.0			5.0
Lane Util. Factor	0.97		0.95			0.95
Frbp, ped/bikes	0.96		1.00			1.00
Flpb, ped/bikes	0.88		1.00			1.00
Frt	0.96		1.00			1.00
Flt Protected	0.96		1.00			1.00
Satd. Flow (prot)	2832		3539			3539
Flt Permitted	0.96		1.00			1.00
Satd. Flow (perm)	2832		3539			3539
Peak-hour factor, PHF	0.91	0.91	0.97	0.25	0.25	0.94
Adj. Flow (vph)	391	138	1114	0	0	951
RTOR Reduction (vph)	38	0	0	0	0	0
Lane Group Flow (vph)	491	0	1114	0	0	951
Confl. Peds. (#/hr)	77	61		28		
Confl. Bikes (#/hr)		3				
Turn Type	Perm		NA			NA
Protected Phases			2			6
Permitted Phases	8					
Actuated Green, G (s)	19.2		37.0			37.0
Effective Green, g (s)	19.2		37.0			37.0
Actuated g/C Ratio	0.24		0.46			0.46
Clearance Time (s)	4.0		5.0			5.0
Vehicle Extension (s)	3.0		4.0			4.0
Lane Grp Cap (vph)	672		1618			1618
v/s Ratio Prot			c0.31			0.27
v/s Ratio Perm	c0.17					
v/c Ratio	0.73		0.69			0.59
Uniform Delay, d1	28.5		17.4			16.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	4.1		1.3			0.7
Delay (s)	32.5		18.7			16.9
Level of Service	C		B			B
Approach Delay (s)	32.5		18.7			16.9
Approach LOS	C		B			B
<b>Intersection Summary</b>						
HCM 2000 Control Delay			20.9		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.58			
Actuated Cycle Length (s)			80.9		Sum of lost time (s)	13.0
Intersection Capacity Utilization			52.7%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

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Intersection Sign configuration not allowed in HCM analysis.

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# HCM Unsignalized Intersection Capacity Analysis

## 3: Alma Street & Lincoln Ave

Existing Conditions  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	30	18	1479	84	18	1205
Future Volume (Veh/h)	30	18	1479	84	18	1205
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.75	0.75	0.94	0.94	0.95	0.95
Hourly flow rate (vph)	40	24	1573	89	19	1268
Pedestrians	12					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2302	843			1674	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2302	843			1674	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	92			95	
cM capacity (veh/h)	30	304			375	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	64	1049	613	442	845	
Volume Left	40	0	0	19	0	
Volume Right	24	0	89	0	0	
cSH	46	1700	1700	375	1700	
Volume to Capacity	1.39	0.62	0.36	0.05	0.50	
Queue Length 95th (ft)	154	0	0	4	0	
Control Delay (s)	410.1	0.0	0.0	1.6	0.0	
Lane LOS	F			A		
Approach Delay (s)	410.1	0.0		0.6		
Approach LOS	F					
Intersection Summary						
Average Delay			8.9			
Intersection Capacity Utilization			56.0%		ICU Level of Service	B
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 4: Alma Street & Embarcadero Rd

















Existing Conditions  
Timing Plan: P.M.Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑			↗
Traffic Volume (veh/h)	0	1234	1455	0	0	106
Future Volume (Veh/h)	0	1234	1455	0	0	106
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.25	0.98	0.98	0.25	0.25	0.66
Hourly flow rate (vph)	0	1259	1485	0	0	161
Pedestrians						18
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					2	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1503				2132	1503
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1503				2132	1503
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	0
cM capacity (veh/h)	434				42	109
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>SB 1</b>		
Volume Total	630	630	1485	161		
Volume Left	0	0	0	0		
Volume Right	0	0	0	161		
cSH	1700	1700	1700	109		
Volume to Capacity	0.37	0.37	0.87	1.48		
Queue Length 95th (ft)	0	0	0	293		
Control Delay (s)	0.0	0.0	0.0	330.5		
Lane LOS				F		
Approach Delay (s)	0.0		0.0	330.5		
Approach LOS				F		
<b>Intersection Summary</b>						
Average Delay			18.3			
Intersection Capacity Utilization			89.8%		ICU Level of Service	E
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
5: Emerson St & Lincoln Ave

Existing Conditions  
Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	7	70	47	29	50	8	2	31	2	8	19	0
Future Volume (vph)	7	70	47	29	50	8	2	31	2	8	19	0
Peak Hour Factor	0.78	0.78	0.78	0.73	0.73	0.73	0.88	0.88	0.88	0.84	0.84	0.84
Hourly flow rate (vph)	9	90	60	40	68	11	2	35	2	10	23	0
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	159	119	39	33								
Volume Left (vph)	9	40	2	10								
Volume Right (vph)	60	11	2	0								
Hadj (s)	-0.18	0.05	0.01	0.09								
Departure Headway (s)	4.0	4.3	4.6	4.6								
Degree Utilization, x	0.18	0.14	0.05	0.04								
Capacity (veh/h)	874	821	737	718								
Control Delay (s)	7.9	8.0	7.8	7.8								
Approach Delay (s)	7.9	8.0	7.8	7.8								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.9									
Level of Service			A									
Intersection Capacity Utilization			22.7%	ICU Level of Service	A							
Analysis Period (min)			15									

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Intersection Sign configuration not allowed in HCM analysis.

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Intersection Sign configuration not allowed in HCM analysis.

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# HCM Unsignalized Intersection Capacity Analysis

## 8: Alma Street & Kingsley Ave

Existing Conditions  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	23	27	1435	30	68	1157
Future Volume (Veh/h)	23	27	1435	30	68	1157
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.83	0.83	0.97	0.97	0.96	0.96
Hourly flow rate (vph)	28	33	1479	31	71	1205
Pedestrians	17					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	2					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2256	1512			1527	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2256	1512			1527	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	2	69			83	
cM capacity (veh/h)	29	107			425	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	61	1510	473	803		
Volume Left	28	0	71	0		
Volume Right	33	31	0	0		
cSH	47	1700	425	1700		
Volume to Capacity	1.29	0.89	0.17	0.47		
Queue Length 95th (ft)	143	0	15	0		
Control Delay (s)	365.1	0.0	5.1	0.0		
Lane LOS	F		A			
Approach Delay (s)	365.1	0.0	1.9			
Approach LOS	F					
Intersection Summary						
Average Delay			8.7			
Intersection Capacity Utilization			92.8%	ICU Level of Service	F	
Analysis Period (min)	15					

Queues  
9: Alma St & Churchill Ave

Existing Conditions  
Timing Plan: P.M.Peak



Lane Group	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	231	264	168	213	1518	8	1195	104
v/c Ratio	0.78	0.57	0.65	0.92	0.75	0.09	0.78	0.14
Control Delay	81.8	11.3	76.2	109.3	29.6	77.0	43.1	11.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	81.8	11.3	76.2	109.3	29.6	77.0	43.1	11.6
Queue Length 50th (ft)	237	0	168	230	608	8	570	22
Queue Length 95th (ft)	335	82	191	#407	840	29	681	62
Internal Link Dist (ft)	340		479		698		387	
Turn Bay Length (ft)				300		60		
Base Capacity (vph)	354	502	293	231	2020	520	2197	1008
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.53	0.57	0.92	0.75	0.02	0.54	0.10

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 9: Alma St & Churchill Ave

Existing Conditions

Timing Plan: P.M.Peak



















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕		↕	↕		↕	↕	↕
Traffic Volume (vph)	127	78	235	60	49	7	190	1325	26	7	1111	97
Future Volume (vph)	127	78	235	60	49	7	190	1325	26	7	1111	97
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Frbp, ped/bikes		1.00	0.94		0.99		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.99		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1807	1486		1790		1770	3527		1770	3539	1583
Flt Permitted		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1807	1486		1790		1770	3527		1770	3539	1583
Peak-hour factor, PHF	0.89	0.89	0.89	0.69	0.69	0.69	0.89	0.89	0.89	0.93	0.93	0.93
Adj. Flow (vph)	143	88	264	87	71	10	213	1489	29	8	1195	104
RTOR Reduction (vph)	0	0	222	0	1	0	0	0	0	0	0	38
Lane Group Flow (vph)	0	231	42	0	167	0	213	1518	0	8	1195	66
Confl. Peds. (#/hr)			11				42		6			
Confl. Bikes (#/hr)			20				8					
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases			8									2
Actuated Green, G (s)		25.4	25.4		22.3		20.2	88.7		1.5	70.0	70.0
Effective Green, g (s)		25.4	25.4		22.3		20.2	88.7		1.5	70.0	70.0
Actuated g/C Ratio		0.16	0.16		0.14		0.13	0.56		0.01	0.44	0.44
Clearance Time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0		3.0	6.0		3.0	6.0	6.0
Lane Grp Cap (vph)		290	239		252		226	1981		16	1568	701
v/s Ratio Prot		c0.13			c0.09		c0.12	c0.43		0.00	0.34	
v/s Ratio Perm			0.03									0.04
v/c Ratio		0.80	0.18		0.66		0.94	0.77		0.50	0.76	0.09
Uniform Delay, d1		63.8	57.2		64.2		68.3	26.6		77.8	37.0	25.5
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		14.0	0.4		6.4		43.8	2.4		22.5	2.9	0.2
Delay (s)		77.8	57.6		70.7		112.1	29.0		100.3	39.9	25.7
Level of Service		E	E		E		F	C		F	D	C
Approach Delay (s)		67.0			70.7			39.2			39.1	
Approach LOS		E			E			D			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			44.3									D
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			157.9							20.0		
Intersection Capacity Utilization			77.8%									D
Analysis Period (min)			15									

c Critical Lane Group



















HCM Unsignalized Intersection Capacity Analysis  
 10: Emerson St & Churchill Ave

Existing Conditions  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	5	114	12	3	83	0	13	9	3	7	22	20
Future Volume (vph)	5	114	12	3	83	0	13	9	3	7	22	20
Peak Hour Factor	0.91	0.91	0.91	0.77	0.77	0.77	0.63	0.63	0.63	0.77	0.77	0.77
Hourly flow rate (vph)	5	125	13	4	108	0	21	14	5	9	29	26
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	143	112	40	64								
Volume Left (vph)	5	4	21	9								
Volume Right (vph)	13	0	5	26								
Hadj (s)	-0.01	0.04	0.06	-0.18								
Departure Headway (s)	4.3	4.3	4.6	4.3								
Degree Utilization, x	0.17	0.13	0.05	0.08								
Capacity (veh/h)	822	794	730	771								
Control Delay (s)	8.1	8.0	7.9	7.7								
Approach Delay (s)	8.1	8.0	7.9	7.7								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.0									
Level of Service			A									
Intersection Capacity Utilization			22.1%	ICU Level of Service	A							
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 11: Bryant St & Churchill Ave

Existing Conditions  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	112	5	2	77	3	3	5	3	3	28	6
Future Volume (Veh/h)	6	112	5	2	77	3	3	5	3	3	28	6
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.82	0.82	0.82	0.39	0.39	0.39	0.84	0.84	0.84
Hourly flow rate (vph)	6	120	5	2	94	4	8	13	8	4	33	7
Pedestrians		9			12			1			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											936	
pX, platoon unblocked												
vC, conflicting volume	142	102	46	156	102	34	49			33		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	142	102	46	156	102	34	49			33		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	84	100	100	88	100	99			100		
cM capacity (veh/h)	721	766	1013	687	766	1022	1544			1561		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	131	100	29	44								
Volume Left	6	2	8	4								
Volume Right	5	4	8	7								
cSH	771	772	1544	1561								
Volume to Capacity	0.17	0.13	0.01	0.00								
Queue Length 95th (ft)	15	11	0	0								
Control Delay (s)	10.6	10.4	2.1	0.7								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.6	10.4	2.1	0.7								
Approach LOS	B	B										
<b>Intersection Summary</b>												
Average Delay			8.3									
Intersection Capacity Utilization			22.5%		ICU Level of Service					A		
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 12: Waverly St & Churchill Ave

Existing Conditions  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	25	81	9	3	43	11	8	77	2	9	102	32
Future Volume (vph)	25	81	9	3	43	11	8	77	2	9	102	32
Peak Hour Factor	0.87	0.87	0.87	0.84	0.84	0.84	0.81	0.81	0.81	0.97	0.97	0.97
Hourly flow rate (vph)	29	93	10	4	51	13	10	95	2	9	105	33
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	132	68	107	147								
Volume Left (vph)	29	4	10	9								
Volume Right (vph)	10	13	2	33								
Hadj (s)	0.03	-0.07	0.04	-0.09								
Departure Headway (s)	4.6	4.6	4.6	4.4								
Degree Utilization, x	0.17	0.09	0.14	0.18								
Capacity (veh/h)	730	726	740	767								
Control Delay (s)	8.5	8.0	8.3	8.4								
Approach Delay (s)	8.5	8.0	8.3	8.4								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.4									
Level of Service			A									
Intersection Capacity Utilization			30.2%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 13: Cowper St & Churchill Ave

Existing Conditions  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	2	84	10	3	31	0	12	25	3	0	32	6
Future Volume (vph)	2	84	10	3	31	0	12	25	3	0	32	6
Peak Hour Factor	0.86	0.86	0.86	0.61	0.61	0.61	0.91	0.91	0.91	0.73	0.73	0.73
Hourly flow rate (vph)	2	98	12	5	51	0	13	27	3	0	44	8
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	112	56	43	52								
Volume Left (vph)	2	5	13	0								
Volume Right (vph)	12	0	3	8								
Hadj (s)	-0.03	0.05	0.05	-0.06								
Departure Headway (s)	4.1	4.3	4.4	4.3								
Degree Utilization, x	0.13	0.07	0.05	0.06								
Capacity (veh/h)	844	815	781	808								
Control Delay (s)	7.8	7.6	7.6	7.5								
Approach Delay (s)	7.8	7.6	7.6	7.5								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.7									
Level of Service			A									
Intersection Capacity Utilization			22.8%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 14: Churchill Ave & Embarcadero Rd

















Existing Conditions  
 Timing Plan: P.M.Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	985	2	42	869	0	51
Future Volume (Veh/h)	985	2	42	869	0	51
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.25	0.80
Hourly flow rate (vph)	1071	2	45	924	0	64
Pedestrians						8
Lane Width (ft)						12.0
Walking Speed (ft/s)						3.5
Percent Blockage						1
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)	1093			898		
pX, platoon unblocked				0.75	0.75	0.75
vC, conflicting volume				1079	1632	544
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				437	1175	0
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				95	100	92
cM capacity (veh/h)				833	130	806
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	714	359	353	616	64	
Volume Left	0	0	45	0	0	
Volume Right	0	2	0	0	64	
cSH	1700	1700	833	1700	806	
Volume to Capacity	0.42	0.21	0.05	0.36	0.08	
Queue Length 95th (ft)	0	0	4	0	6	
Control Delay (s)	0.0	0.0	1.8	0.0	9.8	
Lane LOS				A	A	
Approach Delay (s)	0.0	0.6		9.8		
Approach LOS						A
Intersection Summary						
Average Delay				0.6		
Intersection Capacity Utilization				58.4%	ICU Level of Service	B
Analysis Period (min)				15		

HCM Unsignalized Intersection Capacity Analysis  
 15: Cowper St & Embarcadero Rd

Existing Conditions  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	18	971	15	7	821	36	2	9	6	11	6	17
Future Volume (Veh/h)	18	971	15	7	821	36	2	9	6	11	6	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.96	0.96	0.96	0.53	0.53	0.53	0.53	0.53	0.53
Hourly flow rate (vph)	20	1055	16	7	855	38	4	17	11	21	11	32
Pedestrians								8			1	
Lane Width (ft)								12.0			12.0	
Walking Speed (ft/s)								3.5			3.5	
Percent Blockage								1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.73			0.73	0.73	0.73	0.73	0.73	0.73
vC, conflicting volume	894			1079			1590	2019	544	1476	2008	448
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	894			358			1061	1651	0	904	1636	448
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			96	75	99	84	84	94
cM capacity (veh/h)	754			864			103	68	782	130	70	558
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	548	544	434	466	32	64						
Volume Left	20	0	7	0	4	21						
Volume Right	0	16	0	38	11	32						
cSH	754	1700	864	1700	106	170						
Volume to Capacity	0.03	0.32	0.01	0.27	0.30	0.38						
Queue Length 95th (ft)	2	0	1	0	29	40						
Control Delay (s)	0.7	0.0	0.2	0.0	53.2	38.5						
Lane LOS	A		A		F	E						
Approach Delay (s)	0.4		0.1		53.2	38.5						
Approach LOS					F	E						
<b>Intersection Summary</b>												
Average Delay			2.2									
Intersection Capacity Utilization			51.0%		ICU Level of Service				A			
Analysis Period (min)			15									

Queues  
16: Waverly St & Embarcadero Rd

Existing Conditions  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	88	1021	21	870	177	298
v/c Ratio	1.22	0.94	0.31	0.80	0.18	0.33
Control Delay	213.8	58.8	43.8	41.3	9.8	11.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	213.8	58.8	43.8	41.3	9.8	11.3
Queue Length 50th (ft)	~80	410	11	293	49	90
Queue Length 95th (ft)	#187	#518	38	372	73	124
Internal Link Dist (ft)		572		576	43	709
Turn Bay Length (ft)	95		75			
Base Capacity (vph)	72	1090	68	1086	984	901
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	1.22	0.94	0.31	0.80	0.18	0.33

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 16: Waverly St & Embarcadero Rd

Existing Conditions  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↗	↕		↖	↕			↕			↕	
Traffic Volume (vph)	80	906	23	20	762	55	31	97	15	88	105	52
Future Volume (vph)	80	906	23	20	762	55	31	97	15	88	105	52
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	1.00		1.00	0.99			0.99			0.97	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.98	
Satd. Flow (prot)	1768	3523		1770	3497			1813			1771	
Flt Permitted	0.13	1.00		0.12	1.00			0.89			0.83	
Satd. Flow (perm)	233	3523		219	3497			1633			1488	
Peak-hour factor, PHF	0.91	0.91	0.91	0.94	0.94	0.94	0.81	0.81	0.81	0.82	0.82	0.82
Adj. Flow (vph)	88	996	25	21	811	59	38	120	19	107	128	63
RTOR Reduction (vph)	0	1	0	0	5	0	0	4	0	0	9	0
Lane Group Flow (vph)	88	1020	0	21	865	0	0	173	0	0	289	0
Confl. Peds. (#/hr)	2		10	10		2	2		6	6		2
Confl. Bikes (#/hr)												4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2				2
Permitted Phases	4			4			2			2		
Actuated Green, G (s)	34.0	34.0		34.0	34.0			66.0			66.0	
Effective Green, g (s)	34.0	34.0		34.0	34.0			66.0			66.0	
Actuated g/C Ratio	0.31	0.31		0.31	0.31			0.60			0.60	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			4.0			4.0	
Lane Grp Cap (vph)	72	1088		67	1080			979			892	
v/s Ratio Prot		0.29			0.25							
v/s Ratio Perm	c0.38			0.10				0.11			c0.19	
v/c Ratio	1.22	0.94		0.31	0.80			0.18			0.32	
Uniform Delay, d1	38.0	37.0		29.1	34.9			9.8			10.9	
Progression Factor	1.22	1.19		1.00	1.00			1.00			1.00	
Incremental Delay, d2	173.0	13.6		2.7	4.4			0.4			1.0	
Delay (s)	219.2	57.4		31.7	39.2			10.2			11.9	
Level of Service	F	E		C	D			B			B	
Approach Delay (s)		70.3			39.1			10.2			11.9	
Approach LOS		E			D			B			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			47.7									D
HCM 2000 Volume to Capacity ratio			0.63									
Actuated Cycle Length (s)			110.0							10.0		
Intersection Capacity Utilization			65.2%									C
Analysis Period (min)			15									

c Critical Lane Group



Queues  
17: Bryant St & Embarcadero Rd

Existing Conditions  
Timing Plan: P.M.Peak























Lane Group	EBL	EBT	WBL	WBT	NBR	SBR
Lane Group Flow (vph)	164	1169	13	922	14	40
v/c Ratio	0.40	0.44	0.04	0.35	0.04	0.09
Control Delay	11.3	7.5	4.7	8.7	0.2	0.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.3	7.5	4.7	8.7	0.2	0.4
Queue Length 50th (ft)	51	196	3	330	0	0
Queue Length 95th (ft)	106	244	m4	390	0	0
Internal Link Dist (ft)		579		572		
Turn Bay Length (ft)	80		60			
Base Capacity (vph)	409	2681	303	2663	463	521
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.44	0.04	0.35	0.03	0.08

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 17: Bryant St & Embarcadero Rd

Existing Conditions  
 Timing Plan: P.M.Peak

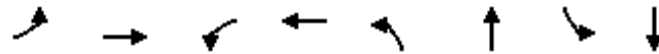
												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	149	1026	38	12	767	63	0	0	11	0	0	33
Future Volume (vph)	149	1026	38	12	767	63	0	0	11	0	0	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Lane Util. Factor	1.00	0.95		1.00	0.95				1.00			1.00
Frbp, ped/bikes	1.00	1.00		1.00	1.00				0.95			0.93
Flpb, ped/bikes	1.00	1.00		1.00	1.00				1.00			1.00
Frt	1.00	0.99		1.00	0.99				0.86			0.86
Flt Protected	0.95	1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)	1763	3515		1764	3490				1529			1495
Flt Permitted	0.29	1.00		0.21	1.00				1.00			1.00
Satd. Flow (perm)	537	3515		397	3490				1529			1495
Peak-hour factor, PHF	0.91	0.91	0.91	0.90	0.90	0.90	0.25	0.25	0.81	0.25	0.25	0.83
Adj. Flow (vph)	164	1127	42	13	852	70	0	0	14	0	0	40
RTOR Reduction (vph)	0	2	0	0	4	0	0	0	12	0	0	33
Lane Group Flow (vph)	164	1167	0	13	918	0	0	0	2	0	0	7
Confl. Peds. (#/hr)	6		8	8		6			6			20
Confl. Bikes (#/hr)									24			28
Turn Type	Perm	NA		Perm	NA				Perm			Perm
Protected Phases		2			2							
Permitted Phases	2			2					4			4
Actuated Green, G (s)	81.8	81.8		81.8	81.8				18.2			18.2
Effective Green, g (s)	81.8	81.8		81.8	81.8				18.2			18.2
Actuated g/C Ratio	0.74	0.74		0.74	0.74				0.17			0.17
Clearance Time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0				3.0			3.0
Lane Grp Cap (vph)	399	2613		295	2595				252			247
v/s Ratio Prot		c0.33			0.26							
v/s Ratio Perm	0.31			0.03					0.00			c0.00
v/c Ratio	0.41	0.45		0.04	0.35				0.01			0.03
Uniform Delay, d1	5.2	5.4		3.7	4.9				38.4			38.5
Progression Factor	1.00	1.00		0.67	1.36				1.00			1.00
Incremental Delay, d2	3.1	0.6		0.2	0.3				0.0			0.0
Delay (s)	8.3	6.0		2.7	6.9				38.4			38.5
Level of Service	A	A		A	A				D			D
Approach Delay (s)		6.3			6.8			38.4			38.5	
Approach LOS		A			A			D			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			7.2									A
HCM 2000 Volume to Capacity ratio			0.37									
Actuated Cycle Length (s)			110.0									10.0
Intersection Capacity Utilization			48.8%									A
Analysis Period (min)			15									
c Critical Lane Group												

Queues

18: Middlefield Rd & Embarcadero Rd

Existing Conditions

Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	1045	93	975	116	433	168	421
v/c Ratio	0.33	0.75	0.62	0.66	0.61	0.51	0.75	0.87
Control Delay	55.0	35.3	66.9	30.6	59.9	37.5	66.7	57.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.0	35.3	66.9	30.6	59.9	37.5	66.7	57.3
Queue Length 50th (ft)	30	356	64	309	79	138	114	278
Queue Length 95th (ft)	66	#517	111	392	134	179	#190	#426
Internal Link Dist (ft)		577		509		183		494
Turn Bay Length (ft)	115		100		115		100	
Base Capacity (vph)	160	1393	162	1485	257	994	257	534
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.75	0.57	0.66	0.45	0.44	0.65	0.79

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 18: Middlefield Rd & Embarcadero Rd

Existing Conditions  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗		
Traffic Volume (vph)	41	914	89	78	692	127	108	358	45	156	367	24	
Future Volume (vph)	41	914	89	78	692	127	108	358	45	156	367	24	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5		
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	1.00		
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Frt	1.00	0.99		1.00	0.98		1.00	0.98		1.00	0.99		
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (prot)	1770	3480		1770	3441		1770	3475		1770	1842		
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (perm)	1770	3480		1770	3441		1770	3475		1770	1842		
Peak-hour factor, PHF	0.96	0.96	0.96	0.84	0.84	0.84	0.93	0.93	0.93	0.93	0.93	0.93	
Adj. Flow (vph)	43	952	93	93	824	151	116	385	48	168	395	26	
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0	
Lane Group Flow (vph)	43	1045	0	93	975	0	116	433	0	168	421	0	
Confl. Peds. (#/hr)			9			15			1			16	
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA		
Protected Phases	5	2		1	6		3	8		7	4		
Permitted Phases													
Actuated Green, G (s)	5.3	43.2		7.9	45.8		11.9	27.0		13.9	29.0		
Effective Green, g (s)	5.3	43.2		7.9	45.8		11.9	27.0		13.9	29.0		
Actuated g/C Ratio	0.05	0.39		0.07	0.42		0.11	0.25		0.13	0.26		
Clearance Time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5		
Vehicle Extension (s)	2.5	3.5		2.5	3.5		2.5	3.0		2.5	3.0		
Lane Grp Cap (vph)	85	1366		127	1432		191	852		223	485		
v/s Ratio Prot	0.02	c0.30		c0.05	c0.28		0.07	0.12		c0.09	c0.23		
v/s Ratio Perm													
v/c Ratio	0.51	0.77		0.73	0.68		0.61	0.51		0.75	0.87		
Uniform Delay, d1	51.1	29.0		50.0	26.1		46.8	35.8		46.4	38.7		
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Incremental Delay, d2	3.4	4.1		18.4	2.6		4.5	0.5		12.8	15.1		
Delay (s)	54.5	33.1		68.4	28.8		51.4	36.3		59.2	53.8		
Level of Service	D	C		E	C		D	D		E	D		
Approach Delay (s)		34.0			32.2			39.4			55.3		
Approach LOS		C			C			D			E		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			38.1									HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.80										
Actuated Cycle Length (s)			110.0									Sum of lost time (s)	18.0
Intersection Capacity Utilization			76.9%									ICU Level of Service	D
Analysis Period (min)			15										
c Critical Lane Group													

Queues  
19: Galvez St/Embarcadero Rd & El Camino Real

Existing Conditions  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	251	1585	251	2001	205	820	222	634
v/c Ratio	1.18	0.75	1.42	1.00	0.97	0.90	1.05	0.73
Control Delay	174.8	39.4	258.4	37.3	118.3	59.8	136.4	53.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	174.8	39.4	258.4	37.3	118.3	59.8	136.4	53.1
Queue Length 50th (ft)	~294	475	~338	~189	203	361	~235	280
Queue Length 95th (ft)	#462	515	m#326	m198	#349	#426	#409	353
Internal Link Dist (ft)		1237		1007		755		481
Turn Bay Length (ft)	300		382				200	
Base Capacity (vph)	212	2114	177	1992	212	913	212	863
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.18	0.75	1.42	1.00	0.97	0.90	1.05	0.73

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Existing Conditions  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↗	↑↑↑		↗	↑↑↑		↗	↑↑		↗	↑↑	
Traffic Volume (vph)	221	1316	79	223	1500	281	178	415	298	206	402	188
Future Volume (vph)	221	1316	79	223	1500	281	178	415	298	206	402	188
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95		1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.98		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	0.94		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5026		1770	4939		1770	3264		1770	3265	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5026		1770	4939		1770	3264		1770	3265	
Peak-hour factor, PHF	0.88	0.88	0.88	0.89	0.89	0.89	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	251	1495	90	251	1685	316	205	477	343	222	432	202
RTOR Reduction (vph)	0	5	0	0	18	0	0	87	0	0	37	0
Lane Group Flow (vph)	251	1580	0	251	1983	0	205	733	0	222	597	0
Confl. Peds. (#/hr)			27			15			25			78
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	18.0	63.0		15.0	60.0		18.0	38.0		18.0	38.0	
Effective Green, g (s)	18.0	63.0		15.0	60.0		18.0	38.0		18.0	38.0	
Actuated g/C Ratio	0.12	0.42		0.10	0.40		0.12	0.25		0.12	0.25	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	4.0		2.0	4.0		2.5	2.0		2.0	2.0	
Lane Grp Cap (vph)	212	2110		177	1975		212	826		212	827	
v/s Ratio Prot	c0.14	0.31		c0.14	c0.40		0.12	c0.22		c0.13	0.18	
v/s Ratio Perm												
v/c Ratio	1.18	0.75		1.42	1.00		0.97	0.89		1.05	0.72	
Uniform Delay, d1	66.0	36.8		67.5	45.0		65.7	53.9		66.0	51.2	
Progression Factor	1.00	1.00		1.49	0.57		1.00	1.00		1.00	1.00	
Incremental Delay, d2	120.4	2.5		196.7	11.3		51.8	11.1		74.8	2.7	
Delay (s)	186.4	39.3		297.0	36.8		117.5	65.0		140.8	53.8	
Level of Service	F	D		F	D		F	E		F	D	
Approach Delay (s)		59.4			65.8			75.5			76.4	
Approach LOS		E			E			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			67.0				HCM 2000 Level of Service			E		
HCM 2000 Volume to Capacity ratio			1.04									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			103.2%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
20: El Camino Real & Churchill Ave

Existing Conditions  
Timing Plan: P.M.Peak


















Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	387	1901	190	257	1656
v/c Ratio	1.04	1.06	0.33	0.87	0.59
Control Delay	110.3	84.3	32.8	64.0	22.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	110.3	84.3	32.8	64.0	22.4
Queue Length 50th (ft)	~384	~846	112	252	515
Queue Length 95th (ft)	#542	#989	194	m320	m556
Internal Link Dist (ft)	958	687			1175
Turn Bay Length (ft)			100	170	
Base Capacity (vph)	371	1796	568	354	2786
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.04	1.06	0.33	0.73	0.59

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

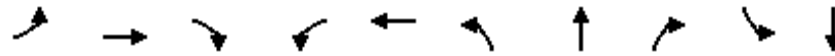
HCM Signalized Intersection Capacity Analysis  
20: El Camino Real & Churchill Ave

Existing Conditions  
Timing Plan: P.M.Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			  			  
Traffic Volume (vph)	165	164	1787	179	247	1590
Future Volume (vph)	165	164	1787	179	247	1590
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	1.00		0.91	1.00	1.00	0.91
Frbp, ped/bikes	0.99		1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.93		1.00	0.85	1.00	1.00
Flt Protected	0.98		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1681		5085	1532	1770	5085
Flt Permitted	0.98		1.00	1.00	0.95	1.00
Satd. Flow (perm)	1681		5085	1532	1770	5085
Peak-hour factor, PHF	0.85	0.85	0.94	0.94	0.96	0.96
Adj. Flow (vph)	194	193	1901	190	257	1656
RTOR Reduction (vph)	24	0	0	29	0	0
Lane Group Flow (vph)	363	0	1901	161	257	1656
Confl. Peds. (#/hr)		3		8		
Confl. Bikes (#/hr)				1		
Turn Type	Prot		NA	Perm	Prot	NA
Protected Phases	4		6		5	2
Permitted Phases				6		
Actuated Green, G (s)	31.0		52.4	52.4	25.2	81.6
Effective Green, g (s)	31.0		52.4	52.4	25.2	81.6
Actuated g/C Ratio	0.21		0.35	0.35	0.17	0.54
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.2		4.0	4.0	2.0	4.0
Lane Grp Cap (vph)	347		1776	535	297	2766
v/s Ratio Prot	c0.22		c0.37		c0.15	0.33
v/s Ratio Perm				0.10		
v/c Ratio	1.05		1.07	0.30	0.87	0.60
Uniform Delay, d1	59.5		48.8	35.5	60.7	23.1
Progression Factor	1.00		1.00	1.00	0.78	0.88
Incremental Delay, d2	61.0		43.0	1.4	13.4	0.5
Delay (s)	120.5		91.8	36.9	60.6	21.0
Level of Service	F		F	D	E	C
Approach Delay (s)	120.5		86.8			26.3
Approach LOS	F		F			C
<b>Intersection Summary</b>						
HCM 2000 Control Delay			63.4		HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio			0.82			
Actuated Cycle Length (s)			150.0		Sum of lost time (s)	15.0
Intersection Capacity Utilization			77.6%		ICU Level of Service	D
Analysis Period (min)			15			

c Critical Lane Group





Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	555	1401	198	174	1180	320	1033	215	364	969
v/c Ratio	0.92	0.69	0.29	0.73	0.82	0.66	0.91	0.33	0.87	0.93
Control Delay	93.1	49.0	10.2	99.4	62.8	79.7	70.4	36.5	98.6	74.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	93.1	49.0	10.2	99.4	62.8	79.7	70.4	36.5	98.6	74.9
Queue Length 50th (ft)	334	509	24	106	476	187	615	172	220	575
Queue Length 95th (ft)	#413	631	95	147	#655	237	668	219	278	642
Internal Link Dist (ft)		611			978		1346			917
Turn Bay Length (ft)	350		350	300		350			100	
Base Capacity (vph)	647	2025	690	371	1439	581	1287	709	486	1158
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.86	0.69	0.29	0.47	0.82	0.55	0.80	0.30	0.75	0.84

**Intersection Summary**

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real

Existing Conditions  
 Timing Plan: P.M.Peak





















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↑↑↑	↔	↔↔	↑↑↑		↔↔	↑↑	↔	↔↔	↑↑	↔
Traffic Volume (vph)	494	1247	176	172	916	252	310	1002	209	328	703	169
Future Volume (vph)	494	1247	176	172	916	252	310	1002	209	328	703	169
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.95	
Frbp, ped/bikes	1.00	1.00	0.94	1.00	0.99		1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3412	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3412	
Peak-hour factor, PHF	0.89	0.89	0.89	0.99	0.99	0.99	0.97	0.97	0.97	0.90	0.90	0.90
Adj. Flow (vph)	555	1401	198	174	925	255	320	1033	215	364	781	188
RTOR Reduction (vph)	0	0	99	0	25	0	0	0	0	0	13	0
Lane Group Flow (vph)	555	1401	99	174	1155	0	320	1033	215	364	956	0
Confl. Peds. (#/hr)			27			28			18			13
Confl. Bikes (#/hr)									3			
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									
Actuated Green, G (s)	31.8	71.7	71.7	12.5	52.4		25.4	57.9	74.9	21.9	54.4	
Effective Green, g (s)	31.8	71.7	71.7	12.5	52.4		25.4	57.9	74.9	21.9	54.4	
Actuated g/C Ratio	0.18	0.40	0.40	0.07	0.29		0.14	0.32	0.42	0.12	0.30	
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	
Lane Grp Cap (vph)	606	2025	591	238	1412		484	1138	658	417	1031	
v/s Ratio Prot	c0.16	0.28		0.05	c0.24		0.09	c0.29	0.14	0.11	c0.28	
v/s Ratio Perm			0.07									
v/c Ratio	0.92	0.69	0.17	0.73	0.82		0.66	0.91	0.33	0.87	0.93	
Uniform Delay, d1	72.8	45.0	34.9	82.1	59.4		73.2	58.5	35.5	77.7	60.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	18.3	2.0	0.6	9.5	5.4		3.4	10.2	0.1	17.4	13.5	
Delay (s)	91.1	46.9	35.5	91.6	64.7		76.6	68.7	35.6	95.1	74.4	
Level of Service	F	D	D	F	E		E	E	D	F	E	
Approach Delay (s)		57.3			68.2			65.8			80.1	
Approach LOS		E			E			E			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			66.4			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.90									
Actuated Cycle Length (s)			180.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			89.5%			ICU Level of Service			E			
Analysis Period (min)			15									

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis














## 22a: Oregon Ave & Alma St

Existing Conditions  
Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	31	0	66	0	1562	276	0	1148	271
Future Volume (Veh/h)	0	0	0	31	0	66	0	1562	276	0	1148	271
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.91	0.25	0.91	0.25	0.99	0.99	0.25	0.97	0.97
Hourly flow rate (vph)	0	0	0	34	0	73	0	1578	279	0	1184	279
Pedestrians	23											
Lane Width (ft)	12.0											
Walking Speed (ft/s)	3.5											
Percent Blockage	2											
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2186	3204	732	2193	3064	812	1463				1880	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2186	3204	732	2193	3064	812	1463				1880	
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	100	100	100	0	100	77	100				100	
cM capacity (veh/h)	19	10	364	24	12	315	458				308	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>WB 2</b>	<b>NB 1</b>	<b>NB 2</b>	<b>NB 3</b>	<b>SB 1</b>	<b>SB 2</b>					
Volume Total	34	73	789	789	279	789	674					
Volume Left	34	0	0	0	0	0	0					
Volume Right	0	73	0	0	279	0	279					
cSH	24	315	1700	1700	1700	1700	1700					
Volume to Capacity	1.41	0.23	0.46	0.46	0.16	0.46	0.40					
Queue Length 95th (ft)	106	22	0	0	0	0	0					
Control Delay (s)	565.5	19.8	0.0	0.0	0.0	0.0	0.0					
Lane LOS	F	C										
Approach Delay (s)	193.2	0.0		0.0								
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay	6.0											
Intersection Capacity Utilization	53.9%		ICU Level of Service				A					
Analysis Period (min)	15											

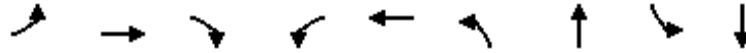
HCM Unsignalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

Existing Conditions  
 Timing Plan: P.M.Peak

							
Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations			 			 	
Traffic Volume (veh/h)	0	316	1522	62	60	1119	
Future Volume (Veh/h)	0	316	1522	62	60	1119	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.25	0.95	0.99	0.99	0.97	0.97	
Hourly flow rate (vph)	0	333	1537	63	62	1154	
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type			None			None	
Median storage veh							
Upstream signal (ft)							
pX, platoon unblocked							
vC, conflicting volume	2238	768			1537		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	2238	768			1537		
tC, single (s)	6.8	6.9			4.1		
tC, 2 stage (s)							
tF (s)	3.5	3.3			2.2		
p0 queue free %	100	3			86		
cM capacity (veh/h)	31	344			429		
Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	333	768	768	63	62	577	577
Volume Left	0	0	0	0	62	0	0
Volume Right	333	0	0	63	0	0	0
cSH	344	1700	1700	1700	429	1700	1700
Volume to Capacity	0.97	0.45	0.45	0.04	0.14	0.34	0.34
Queue Length 95th (ft)	263	0	0	0	13	0	0
Control Delay (s)	76.1	0.0	0.0	0.0	14.8	0.0	0.0
Lane LOS	F				B		
Approach Delay (s)	76.1	0.0			0.8		
Approach LOS	F						
Intersection Summary							
Average Delay			8.3				
Intersection Capacity Utilization			68.3%		ICU Level of Service		C
Analysis Period (min)			15				

Queues  
23: Cowper St & Oregon Expy

Existing Conditions  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	27	1483	80	32	1343	60	56	11	73
v/c Ratio	0.27	0.61	0.07	0.30	0.55	0.42	0.20	0.10	0.41
Control Delay	74.0	18.7	3.1	89.8	9.6	73.8	41.1	69.0	58.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	74.0	18.7	3.1	89.8	9.6	73.8	41.1	69.0	58.3
Queue Length 50th (ft)	26	421	0	33	157	57	35	10	60
Queue Length 95th (ft)	60	771	26	m40	807	84	55	29	86
Internal Link Dist (ft)		1547			1028		48		36
Turn Bay Length (ft)	115		50	115					
Base Capacity (vph)	180	2416	1108	178	2420	179	387	177	373
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.61	0.07	0.18	0.55	0.34	0.14	0.06	0.20

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 23: Cowper St & Oregon Expy

Existing Conditions  
Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	1364	74	29	1206	16	44	28	13	9	42	16
Future Volume (vph)	25	1364	74	29	1206	16	44	28	13	9	42	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3531		1770	1759		1770	1768	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3531		1770	1759		1770	1768	
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.73	0.73	0.73	0.80	0.80	0.80
Adj. Flow (vph)	27	1483	80	32	1325	18	60	38	18	11	52	20
RTOR Reduction (vph)	0	0	27	0	0	0	0	12	0	0	10	0
Lane Group Flow (vph)	27	1483	53	32	1343	0	60	44	0	11	63	0
Confl. Peds. (#/hr)							5		7			5
Confl. Bikes (#/hr)									3			8
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases			6									
Actuated Green, G (s)	5.4	99.3	99.3	5.7	99.8		10.5	21.3		3.6	14.6	
Effective Green, g (s)	5.4	99.3	99.3	5.7	99.8		10.5	21.3		3.6	14.6	
Actuated g/C Ratio	0.04	0.66	0.66	0.04	0.67		0.07	0.14		0.02	0.10	
Clearance Time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0		5.0	3.0		4.0	3.0	
Lane Grp Cap (vph)	63	2342	1047	67	2349		123	249		42	172	
v/s Ratio Prot	0.02	c0.42		c0.02	0.38		c0.03	0.03		0.01	c0.04	
v/s Ratio Perm			0.03									
v/c Ratio	0.43	0.63	0.05	0.48	0.57		0.49	0.18		0.26	0.37	
Uniform Delay, d1	70.8	14.8	8.9	70.7	13.6		67.2	56.6		71.9	63.4	
Progression Factor	1.00	1.00	1.00	1.27	0.57		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.6	1.3	0.1	2.8	0.5		6.2	0.3		4.5	1.3	
Delay (s)	75.4	16.1	9.0	92.8	8.3		73.4	57.0		76.4	64.7	
Level of Service	E	B	A	F	A		E	E		E	E	
Approach Delay (s)		16.7			10.2			65.5			66.2	
Approach LOS		B			B			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			17.0				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			20.1			
Intersection Capacity Utilization			60.4%			ICU Level of Service			B			
Analysis Period (min)			15									

c Critical Lane Group

Queues  
24: Middlefield Rd & Oregon Expy

Existing Conditions  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	170	1086	239	201	1067	63	221	524	153	49	584
v/c Ratio	0.70	0.84	0.37	0.86	0.84	0.10	0.91	0.90	0.27	0.40	0.75
Control Delay	67.6	42.4	14.9	95.6	51.6	0.3	100.9	70.2	11.0	76.3	59.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	67.6	42.4	14.9	95.6	51.6	0.3	100.9	70.2	11.0	76.3	59.6
Queue Length 50th (ft)	163	517	22	194	497	0	216	506	17	47	276
Queue Length 95th (ft)	#260	421	146	#305	559	0	#375	#782	77	91	348
Internal Link Dist (ft)		1028			896			676			311
Turn Bay Length (ft)	360		100	390		100	230			145	
Base Capacity (vph)	243	1289	653	247	1295	645	244	580	570	172	780
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.70	0.84	0.37	0.81	0.82	0.10	0.91	0.90	0.27	0.28	0.75




























Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 24: Middlefield Rd & Oregon Expy

Existing Conditions  
Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Traffic Volume (vph)	158	1010	222	175	928	55	203	482	141	46	440	103
Future Volume (vph)	158	1010	222	175	928	55	203	482	141	46	440	103
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frbp, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.96	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1558	1770	3539	1525	1770	1863	1547	1770	3427	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1558	1770	3539	1525	1770	1863	1547	1770	3427	
Peak-hour factor, PHF	0.93	0.93	0.93	0.87	0.87	0.87	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	170	1086	239	201	1067	63	221	524	153	49	473	111
RTOR Reduction (vph)	0	0	87	0	0	41	0	0	89	0	13	0
Lane Group Flow (vph)	170	1086	152	201	1067	22	221	524	64	49	571	0
Confl. Peds. (#/hr)			2			6			11			4
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			
Actuated Green, G (s)	20.7	53.6	53.6	19.8	52.5	52.5	20.7	46.7	46.7	8.5	34.6	
Effective Green, g (s)	20.7	53.6	53.6	19.8	52.5	52.5	20.7	46.7	46.7	8.5	34.6	
Actuated g/C Ratio	0.14	0.36	0.36	0.13	0.35	0.35	0.14	0.31	0.31	0.06	0.23	
Clearance Time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0	4.0	5.0	5.0	5.0	3.0	3.0	
Lane Grp Cap (vph)	244	1264	556	233	1238	533	244	580	481	100	790	
v/s Ratio Prot	0.10	c0.31		0.11	c0.30		c0.12	c0.28		0.03	0.17	
v/s Ratio Perm			0.10			0.01			0.04			
v/c Ratio	0.70	0.86	0.27	0.86	0.86	0.04	0.91	0.90	0.13	0.49	0.72	
Uniform Delay, d1	61.7	44.7	34.3	63.8	45.4	32.2	63.7	49.5	37.1	68.6	53.3	
Progression Factor	0.88	0.83	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.8	6.3	1.0	26.4	8.0	0.1	35.0	18.4	0.3	3.7	3.3	
Delay (s)	60.9	43.5	32.3	90.2	53.4	32.3	98.7	67.9	37.4	72.4	56.6	
Level of Service	E	D	C	F	D	C	F	E	D	E	E	
Approach Delay (s)		43.7			58.0			70.2			57.8	
Approach LOS		D			E			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			55.6				HCM 2000 Level of Service				E	
HCM 2000 Volume to Capacity ratio			0.92									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)				21.6		
Intersection Capacity Utilization			92.6%			ICU Level of Service				F		
Analysis Period (min)			15									

c Critical Lane Group



## Appendix E – Existing Plus Project Synchro Reports

- HCM Delay and LOS Reports
- 95<sup>th</sup> Percentile Queue Length Reports

Queues  
1: Alma Street & Homer Ave













Existing + Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	343	1131	665
v/c Ratio	0.65	0.71	0.42
Control Delay	29.9	20.2	15.5
Queue Delay	0.0	0.0	0.0
Total Delay	29.9	20.2	15.5
Queue Length 50th (ft)	64	221	108
Queue Length 95th (ft)	100	327	154
Internal Link Dist (ft)	443	390	481
Turn Bay Length (ft)			
Base Capacity (vph)	830	1841	1841
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.41	0.61	0.36
Intersection Summary			

HCM Signalized Intersection Capacity Analysis  
 1: Alma Street & Homer Ave











Existing + Churchill Closure  
 Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	 		 			 
Traffic Volume (vph)	199	93	1063	0	0	559
Future Volume (vph)	199	93	1063	0	0	559
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		5.0			5.0
Lane Util. Factor	0.97		0.95			0.95
Frbp, ped/bikes	0.90		1.00			1.00
Flpb, ped/bikes	0.84		1.00			1.00
Frt	0.95		1.00			1.00
Flt Protected	0.97		1.00			1.00
Satd. Flow (prot)	2506		3539			3539
Flt Permitted	0.97		1.00			1.00
Satd. Flow (perm)	2506		3539			3539
Peak-hour factor, PHF	0.85	0.85	0.94	0.25	0.25	0.84
Adj. Flow (vph)	234	109	1131	0	0	665
RTOR Reduction (vph)	65	0	0	0	0	0
Lane Group Flow (vph)	278	0	1131	0	0	665
Confl. Peds. (#/hr)	82	102		13		
Confl. Bikes (#/hr)		1				
Turn Type	Perm		NA			NA
Protected Phases			2			6
Permitted Phases	8					
Actuated Green, G (s)	13.3		35.3			35.3
Effective Green, g (s)	13.3		35.3			35.3
Actuated g/C Ratio	0.17		0.45			0.45
Clearance Time (s)	4.0		5.0			5.0
Vehicle Extension (s)	3.0		4.0			4.0
Lane Grp Cap (vph)	428		1605			1605
v/s Ratio Prot			c0.32			0.19
v/s Ratio Perm	c0.11					
v/c Ratio	0.65		0.70			0.41
Uniform Delay, d1	30.1		17.1			14.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	3.4		1.5			0.2
Delay (s)	33.4		18.6			14.5
Level of Service	C		B			B
Approach Delay (s)	33.4		18.6			14.5
Approach LOS	C		B			B
<b>Intersection Summary</b>						
HCM 2000 Control Delay			19.7		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.52			
Actuated Cycle Length (s)			77.8		Sum of lost time (s)	13.0
Intersection Capacity Utilization			47.4%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

Intersection Sign configuration not allowed in HCM analysis.

HCM Unsignalized Intersection Capacity Analysis  
3: Alma Street & Lincoln Ave

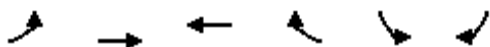
Existing + Churchill Closure  
Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	40	23	1494	85	7	566
Future Volume (Veh/h)	40	23	1494	85	7	566
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.93	0.93	0.97	0.97	0.92	0.92
Hourly flow rate (vph)	43	25	1540	88	8	615
Pedestrians	11					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1918	825			1639	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1918	825			1639	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	25	92			98	
cM capacity (veh/h)	57	312			387	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	68	1027	601	213	410	
Volume Left	43	0	0	8	0	
Volume Right	25	0	88	0	0	
cSH	82	1700	1700	387	1700	
Volume to Capacity	0.83	0.60	0.35	0.02	0.24	
Queue Length 95th (ft)	106	0	0	2	0	
Control Delay (s)	144.4	0.0	0.0	0.9	0.0	
Lane LOS	F			A		
Approach Delay (s)	144.4	0.0	0.3			
Approach LOS	F					
Intersection Summary						
Average Delay			4.3			
Intersection Capacity Utilization			54.4%		ICU Level of Service	A
Analysis Period (min)	15					

# HCM Unsignalized Intersection Capacity Analysis

## 4: Alma Street & Embarcadero Rd

















Existing + Churchill Closure  
Timing Plan: A.M. Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑			↑
Traffic Volume (veh/h)	0	596	1464	0	0	120
Future Volume (Veh/h)	0	596	1464	0	0	120
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.25	0.90	0.95	0.25	0.25	0.83
Hourly flow rate (vph)	0	662	1541	0	0	145
Pedestrians					33	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					3	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1574				1905	1574
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1574				1905	1574
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	0
cM capacity (veh/h)	402				59	96
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>SB 1</b>		
Volume Total	331	331	1541	145		
Volume Left	0	0	0	0		
Volume Right	0	0	0	145		
cSH	1700	1700	1700	96		
Volume to Capacity	0.19	0.19	0.91	1.51		
Queue Length 95th (ft)	0	0	0	277		
Control Delay (s)	0.0	0.0	0.0	355.7		
Lane LOS				F		
Approach Delay (s)	0.0		0.0	355.7		
Approach LOS				F		
<b>Intersection Summary</b>						
Average Delay			22.0			
Intersection Capacity Utilization			91.1%		ICU Level of Service	F
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
5: Emerson St & Lincoln Ave

Existing + Churchill Closure  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	58	34	69	73	11	4	7	9	7	185	1
Future Volume (vph)	8	58	34	69	73	11	4	7	9	7	185	1
Peak Hour Factor	0.76	0.76	0.76	0.77	0.77	0.77	0.71	0.71	0.71	0.56	0.56	0.56
Hourly flow rate (vph)	11	76	45	90	95	14	6	10	13	13	330	2
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	132	199	29	345								
Volume Left (vph)	11	90	6	13								
Volume Right (vph)	45	14	13	2								
Hadj (s)	-0.15	0.08	-0.19	0.04								
Departure Headway (s)	5.0	5.1	5.1	4.8								
Degree Utilization, x	0.18	0.28	0.04	0.46								
Capacity (veh/h)	658	651	635	706								
Control Delay (s)	9.1	10.1	8.3	12.0								
Approach Delay (s)	9.1	10.1	8.3	12.0								
Approach LOS	A	B	A	B								
Intersection Summary												
Delay			10.8									
Level of Service			B									
Intersection Capacity Utilization			33.0%		ICU Level of Service	A						
Analysis Period (min)			15									

Intersection Sign configuration not allowed in HCM analysis.



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Intersection Sign configuration not allowed in HCM analysis.

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HCM Unsignalized Intersection Capacity Analysis  
8: Alma Street & Kingsley Ave

Existing + Churchill Closure  
Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	10	102	1371	21	62	533
Future Volume (Veh/h)	10	102	1371	21	62	533
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.82	0.82	0.96	0.96	0.90	0.90
Hourly flow rate (vph)	12	124	1428	22	69	592
Pedestrians	7					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1880	1446			1457	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1880	1446			1457	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	77	0			85	
cM capacity (veh/h)	53	120			457	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	136	1450	266	395		
Volume Left	12	0	69	0		
Volume Right	124	22	0	0		
cSH	108	1700	457	1700		
Volume to Capacity	1.26	0.85	0.15	0.23		
Queue Length 95th (ft)	228	0	13	0		
Control Delay (s)	245.9	0.0	5.5	0.0		
Lane LOS	F		A			
Approach Delay (s)	245.9	0.0	2.2			
Approach LOS	F					
Intersection Summary						
Average Delay			15.5			
Intersection Capacity Utilization			87.0%	ICU Level of Service	E	
Analysis Period (min)	15					

Queues  
9: Alma St & Churchill Ave

Existing + Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	104	1388	638
v/c Ratio	0.38	0.51	0.25
Control Delay	62.5	7.6	5.4
Queue Delay	0.0	0.0	0.0
Total Delay	62.5	7.6	5.4
Queue Length 50th (ft)	95	250	86
Queue Length 95th (ft)	125	284	106
Internal Link Dist (ft)	479	698	387
Turn Bay Length (ft)			
Base Capacity (vph)	351	2721	2561
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.30	0.51	0.25
Intersection Summary			

HCM Signalized Intersection Capacity Analysis  
9: Alma St & Churchill Ave

Existing + Churchill Closure  
Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↙		↕	↘		↕
Traffic Volume (vph)	71	5	1216	20	5	569
Future Volume (vph)	71	5	1216	20	5	569
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		6.0			6.0
Lane Util. Factor	1.00		0.95			0.95
Frbp, ped/bikes	0.97		1.00			1.00
Flpb, ped/bikes	1.00		1.00			1.00
Frt	0.99		1.00			1.00
Flt Protected	0.96		1.00			1.00
Satd. Flow (prot)	1711		3529			3538
Flt Permitted	0.96		1.00			0.94
Satd. Flow (perm)	1711		3529			3324
Peak-hour factor, PHF	0.73	0.73	0.89	0.89	0.90	0.90
Adj. Flow (vph)	97	7	1366	22	6	632
RTOR Reduction (vph)	2	0	1	0	0	0
Lane Group Flow (vph)	102	0	1387	0	0	638
Confl. Peds. (#/hr)		101		24		
Confl. Bikes (#/hr)		258				
Turn Type	Perm		NA		Perm	NA
Protected Phases			6			2
Permitted Phases	7				2	
Actuated Green, G (s)	25.0		121.0			121.0
Effective Green, g (s)	25.0		121.0			121.0
Actuated g/C Ratio	0.16		0.77			0.77
Clearance Time (s)	5.0		6.0			6.0
Vehicle Extension (s)	3.0		6.0			6.0
Lane Grp Cap (vph)	272		2719			2561
v/s Ratio Prot			c0.39			
v/s Ratio Perm	c0.06					0.19
v/c Ratio	0.38		0.51			0.25
Uniform Delay, d1	59.0		6.8			5.1
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	0.9		0.4			0.2
Delay (s)	59.9		7.2			5.3
Level of Service	E		A			A
Approach Delay (s)	59.9		7.2			5.3
Approach LOS	E		A			A

















Intersection Summary

HCM 2000 Control Delay	9.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	157.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	63.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

















HCM Unsignalized Intersection Capacity Analysis  
 10: Emerson St & Churchill Ave

Existing + Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	10	76	10	5	29	7	34	75	8	10	15	14
Future Volume (vph)	10	76	10	5	29	7	34	75	8	10	15	14
Peak Hour Factor	0.75	0.75	0.75	0.86	0.86	0.86	0.70	0.70	0.70	0.54	0.54	0.54
Hourly flow rate (vph)	13	101	13	6	34	8	49	107	11	19	28	26
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	127	48	167	73								
Volume Left (vph)	13	6	49	19								
Volume Right (vph)	13	8	11	26								
Hadj (s)	-0.01	-0.04	0.05	-0.13								
Departure Headway (s)	4.5	4.6	4.5	4.4								
Degree Utilization, x	0.16	0.06	0.21	0.09								
Capacity (veh/h)	748	731	773	771								
Control Delay (s)	8.4	7.9	8.6	7.8								
Approach Delay (s)	8.4	7.9	8.6	7.8								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.3									
Level of Service			A									
Intersection Capacity Utilization			25.1%	ICU Level of Service	A							
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 11: Bryant St & Churchill Ave

Existing + Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	75	8	13	28	37	9	20	3	12	8	16
Future Volume (Veh/h)	11	75	8	13	28	37	9	20	3	12	8	16
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.71	0.71	0.71	0.87	0.87	0.87	0.57	0.57	0.57	0.47	0.47	0.47
Hourly flow rate (vph)	15	106	11	15	32	43	16	35	5	26	17	34
Pedestrians		17			14			4			11	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		2			1			0			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											936	
pX, platoon unblocked												
vC, conflicting volume	242	189	55	238	204	62	68			54		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	242	189	55	238	204	62	68			54		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	84	99	97	95	96	99			98		
cM capacity (veh/h)	610	666	992	586	654	979	1508			1531		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	132	90	56	77								
Volume Left	15	15	16	26								
Volume Right	11	43	5	34								
cSH	678	760	1508	1531								
Volume to Capacity	0.19	0.12	0.01	0.02								
Queue Length 95th (ft)	18	10	1	1								
Control Delay (s)	11.6	10.4	2.2	2.6								
Lane LOS	B	B	A	A								
Approach Delay (s)	11.6	10.4	2.2	2.6								
Approach LOS	B	B										
Intersection Summary												
Average Delay			7.8									
Intersection Capacity Utilization			23.6%		ICU Level of Service					A		
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 12: Waverly St & Churchill Ave

Existing + Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	12	60	9	13	42	49	17	98	11	4	74	23
Future Volume (vph)	12	60	9	13	42	49	17	98	11	4	74	23
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.72	0.72	0.72	0.62	0.62	0.62
Hourly flow rate (vph)	14	68	10	15	48	56	24	136	15	6	119	37
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	92	119	175	162								
Volume Left (vph)	14	15	24	6								
Volume Right (vph)	10	56	15	37								
Hadj (s)	0.00	-0.22	0.01	-0.10								
Departure Headway (s)	4.9	4.6	4.6	4.5								
Degree Utilization, x	0.12	0.15	0.22	0.20								
Capacity (veh/h)	680	719	738	745								
Control Delay (s)	8.5	8.4	9.0	8.7								
Approach Delay (s)	8.5	8.4	9.0	8.7								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.7									
Level of Service			A									
Intersection Capacity Utilization			28.1%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 13: Cowper St & Churchill Ave

Existing + Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	5	62	7	5	24	1	23	23	6	2	21	12
Future Volume (vph)	5	62	7	5	24	1	23	23	6	2	21	12
Peak Hour Factor	0.88	0.88	0.88	0.75	0.75	0.75	0.72	0.72	0.72	0.58	0.58	0.58
Hourly flow rate (vph)	6	70	8	7	32	1	32	32	8	3	36	21
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	84	40	72	60								
Volume Left (vph)	6	7	32	3								
Volume Right (vph)	8	1	8	21								
Hadj (s)	-0.01	0.05	0.06	-0.17								
Departure Headway (s)	4.2	4.3	4.3	4.1								
Degree Utilization, x	0.10	0.05	0.09	0.07								
Capacity (veh/h)	822	789	805	848								
Control Delay (s)	7.7	7.5	7.7	7.4								
Approach Delay (s)	7.7	7.5	7.7	7.4								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.6									
Level of Service			A									
Intersection Capacity Utilization			21.3%	ICU Level of Service	A							
Analysis Period (min)			15									



HCM Unsignalized Intersection Capacity Analysis  
 14: Churchill Ave & Embarcadero Rd

















Existing + Churchill Closure  
 Timing Plan: A.M. Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	843	2	37	949	0	80
Future Volume (Veh/h)	843	2	37	949	0	80
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.87	0.87	0.81	0.81	0.25	0.83
Hourly flow rate (vph)	969	2	46	1172	0	96
Pedestrians						11
Lane Width (ft)						12.0
Walking Speed (ft/s)						3.5
Percent Blockage						1
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)	1093			898		
pX, platoon unblocked				0.81	0.81	0.81
vC, conflicting volume				980	1659	496
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				505	1343	0
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				95	100	89
cM capacity (veh/h)				846	108	869
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	646	325	437	781	96	
Volume Left	0	0	46	0	0	
Volume Right	0	2	0	0	96	
cSH	1700	1700	846	1700	869	
Volume to Capacity	0.38	0.19	0.05	0.46	0.11	
Queue Length 95th (ft)	0	0	4	0	9	
Control Delay (s)	0.0	0.0	1.6	0.0	9.7	
Lane LOS				A	A	
Approach Delay (s)	0.0	0.6		9.7		
Approach LOS						A
Intersection Summary						
Average Delay				0.7		
Intersection Capacity Utilization				56.6%	ICU Level of Service	B
Analysis Period (min)				15		

HCM Unsignalized Intersection Capacity Analysis  
 15: Cowper St & Embarcadero Rd

Existing + Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	843	34	11	926	13	5	3	6	4	8	46
Future Volume (Veh/h)	14	843	34	11	926	13	5	3	6	4	8	46
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.82	0.82	0.82	0.58	0.58	0.58	0.69	0.69	0.69
Hourly flow rate (vph)	16	947	38	13	1129	16	9	5	10	6	12	67
Pedestrians					1			8			28	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			1			3	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.79			0.79	0.79	0.79	0.79	0.79	
vC, conflicting volume	1173			993			1670	2205	502	1710	2216	600
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1173			445			1306	1988	0	1358	2002	600
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			84	89	99	91	72	84
cM capacity (veh/h)	575			867			57	44	844	70	43	432
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	490	512	578	580	24	85						
Volume Left	16	0	13	0	9	6						
Volume Right	0	38	0	16	10	67						
cSH	575	1700	867	1700	85	163						
Volume to Capacity	0.03	0.30	0.02	0.34	0.28	0.52						
Queue Length 95th (ft)	2	0	1	0	26	64						
Control Delay (s)	0.8	0.0	0.4	0.0	63.4	48.8						
Lane LOS	A		A		F	E						
Approach Delay (s)	0.4		0.2		63.4	48.8						
Approach LOS					F	E						
Intersection Summary												
Average Delay			2.8									
Intersection Capacity Utilization			44.7%		ICU Level of Service				A			
Analysis Period (min)			15									

Queues  
16: Waverly St & Embarcadero Rd

Existing + Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	44	911	30	1128	281	362
v/c Ratio	0.66	0.71	0.29	0.88	0.41	0.44
Control Delay	65.2	26.1	34.3	42.1	16.5	16.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.2	26.1	34.3	42.1	16.5	16.4
Queue Length 50th (ft)	26	291	15	387	107	140
Queue Length 95th (ft)	m#87	367	40	424	148	173
Internal Link Dist (ft)		572		576	78	709
Turn Bay Length (ft)	95		75			
Base Capacity (vph)	67	1276	103	1281	679	819
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.71	0.29	0.88	0.41	0.44

Intersection Summary




















# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 16: Waverly St & Embarcadero Rd

Existing + Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	41	794	53	25	911	25	110	93	24	65	101	117
Future Volume (vph)	41	794	53	25	911	25	110	93	24	65	101	117
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	1.00			0.99			0.94	
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.99	
Satd. Flow (prot)	1770	3498		1764	3518			1783			1716	
Flt Permitted	0.10	1.00		0.15	1.00			0.68			0.86	
Satd. Flow (perm)	186	3498		285	3518			1239			1491	
Peak-hour factor, PHF	0.93	0.93	0.93	0.83	0.83	0.83	0.81	0.81	0.81	0.78	0.78	0.78
Adj. Flow (vph)	44	854	57	30	1098	30	136	115	30	83	129	150
RTOR Reduction (vph)	0	4	0	0	2	0	0	4	0	0	6	0
Lane Group Flow (vph)	44	907	0	30	1126	0	0	277	0	0	356	0
Confl. Peds. (#/hr)	27		9	9		27	22		9	9		22
Confl. Bikes (#/hr)									2			13
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2				2
Permitted Phases	4			4			2			2		
Actuated Green, G (s)	40.0	40.0		40.0	40.0			60.0			60.0	
Effective Green, g (s)	40.0	40.0		40.0	40.0			60.0			60.0	
Actuated g/C Ratio	0.36	0.36		0.36	0.36			0.55			0.55	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			4.0			4.0	
Lane Grp Cap (vph)	67	1272		103	1279			675			813	
v/s Ratio Prot		0.26			c0.32							
v/s Ratio Perm	0.24			0.11				0.22			c0.24	
v/c Ratio	0.66	0.71		0.29	0.88			0.41			0.44	
Uniform Delay, d1	29.3	30.1		24.9	32.8			14.6			14.9	
Progression Factor	0.74	0.76		1.00	1.00			1.00			1.00	
Incremental Delay, d2	18.9	1.7		1.6	7.4			1.8			1.7	
Delay (s)	40.6	24.7		26.5	40.1			16.5			16.6	
Level of Service	D	C		C	D			B			B	
Approach Delay (s)		25.4			39.8			16.5			16.6	
Approach LOS		C			D			B			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			29.4									C
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			110.0							10.0		
Intersection Capacity Utilization			66.6%									C
ICU Level of Service												
Analysis Period (min)			15									

c Critical Lane Group

Queues  
17: Bryant St & Embarcadero Rd

Existing + Churchill Closure  
Timing Plan: A.M. Peak





















Lane Group	EBL	EBT	WBL	WBT	NBR	SBR
Lane Group Flow (vph)	53	1206	57	1197	22	52
v/c Ratio	0.20	0.48	0.21	0.47	0.05	0.14
Control Delay	9.7	8.8	22.9	23.5	0.2	3.5
Queue Delay	0.0	0.0	0.0	0.3	0.0	0.0
Total Delay	9.7	8.8	22.9	23.7	0.2	3.5
Queue Length 50th (ft)	13	204	32	410	0	0
Queue Length 95th (ft)	29	213	m43	m477	0	1
Internal Link Dist (ft)		579		572		
Turn Bay Length (ft)	80		60			
Base Capacity (vph)	265	2530	267	2561	466	417
Starvation Cap Reductn	0	0	0	645	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.48	0.21	0.62	0.05	0.12

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 17: Bryant St & Embarcadero Rd

Existing + Churchill Closure  
 Timing Plan: A.M. Peak

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	43	863	114	52	1065	36	0	0	13	0	0	37	
Future Volume (vph)	43	863	114	52	1065	36	0	0	13	0	0	37	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	5.0	5.0		5.0	5.0				5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95				1.00			1.00	
Frbp, ped/bikes	1.00	0.99		1.00	0.99				0.94			0.89	
Flpb, ped/bikes	0.98	1.00		0.99	1.00				1.00			1.00	
Frt	1.00	0.98		1.00	1.00				0.86			0.86	
Flt Protected	0.95	1.00		0.95	1.00				1.00			1.00	
Satd. Flow (prot)	1732	3454		1760	3502				1515			1426	
Flt Permitted	0.20	1.00		0.20	1.00				1.00			1.00	
Satd. Flow (perm)	363	3454		365	3502				1515			1426	
Peak-hour factor, PHF	0.81	0.81	0.81	0.92	0.92	0.92	0.25	0.25	0.58	0.25	0.25	0.71	
Adj. Flow (vph)	53	1065	141	57	1158	39	0	0	22	0	0	52	
RTOR Reduction (vph)	0	8	0	0	2	0	0	0	18	0	0	42	
Lane Group Flow (vph)	53	1198	0	57	1195	0	0	0	4	0	0	10	
Confl. Peds. (#/hr)	64		16	16		64			16			32	
Confl. Bikes (#/hr)									26			61	
Turn Type	Perm	NA		Perm	NA				Perm			Perm	
Protected Phases		2			2								
Permitted Phases	2			2					4			4	
Actuated Green, G (s)	78.4	78.4		78.4	78.4				21.6			21.6	
Effective Green, g (s)	78.4	78.4		78.4	78.4				21.6			21.6	
Actuated g/C Ratio	0.71	0.71		0.71	0.71				0.20			0.20	
Clearance Time (s)	5.0	5.0		5.0	5.0				5.0			5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0				3.0			3.0	
Lane Grp Cap (vph)	258	2461		260	2495				297			280	
v/s Ratio Prot		c0.35			0.34								
v/s Ratio Perm	0.15			0.16					0.00			c0.01	
v/c Ratio	0.21	0.49		0.22	0.48				0.01			0.04	
Uniform Delay, d1	5.3	7.0		5.4	6.9				35.6			35.8	
Progression Factor	1.00	1.00		2.71	2.81				1.00			1.00	
Incremental Delay, d2	1.8	0.7		1.1	0.4				0.0			0.1	
Delay (s)	7.1	7.6		15.7	19.8				35.6			35.8	
Level of Service	A	A		B	B				D			D	
Approach Delay (s)		7.6			19.6			35.6			35.8		
Approach LOS		A			B			D			D		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			14.2									HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.39										
Actuated Cycle Length (s)			110.0									Sum of lost time (s)	10.0
Intersection Capacity Utilization			56.7%									ICU Level of Service	B
Analysis Period (min)			15										

c Critical Lane Group

Queues  
18: Middlefield Rd & Embarcadero Rd

Existing + Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	44	1023	57	1215	161	364	120	275
v/c Ratio	0.44	1.06	0.55	1.26	0.90	0.55	0.75	0.85
Control Delay	84.0	97.4	89.9	171.0	112.3	59.7	94.9	84.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.0	97.4	89.9	171.0	112.3	59.7	94.9	84.3
Queue Length 50th (ft)	44	~646	56	~850	162	175	118	268
Queue Length 95th (ft)	78	#687	90	#817	#245	198	174	334
Internal Link Dist (ft)		577		509		183		494
Turn Bay Length (ft)	115		100		115		100	
Base Capacity (vph)	115	966	115	961	184	718	184	375
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	1.06	0.50	1.26	0.88	0.51	0.65	0.73






















**Intersection Summary**

~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
18: Middlefield Rd & Embarcadero Rd

Existing + Churchill Closure  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	772	46	43	809	115	129	273	18	100	205	23
Future Volume (vph)	35	772	46	43	809	115	129	273	18	100	205	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3497		1770	3447		1770	3500		1770	1827	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3497		1770	3447		1770	3500		1770	1827	
Peak-hour factor, PHF	0.80	0.80	0.80	0.76	0.76	0.76	0.80	0.80	0.80	0.83	0.83	0.83
Adj. Flow (vph)	44	965	58	57	1064	151	161	341	22	120	247	28
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	44	1023	0	57	1215	0	161	364	0	120	275	0
Confl. Peds. (#/hr)			24			44			8			14
Confl. Bikes (#/hr)						1			1			2
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	7.2	41.6		7.6	42.0		15.6	28.9		13.9	27.2	
Effective Green, g (s)	7.2	41.6		7.6	42.0		15.6	28.9		13.9	27.2	
Actuated g/C Ratio	0.05	0.27		0.05	0.27		0.10	0.19		0.09	0.18	
Clearance Time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	2.5	3.5		2.5	3.5		2.5	3.0		2.5	3.0	
Lane Grp Cap (vph)	83	947		87	943		179	658		160	323	
v/s Ratio Prot	0.02	0.29		c0.03	c0.35		c0.09	0.10		0.07	c0.15	
v/s Ratio Perm												
v/c Ratio	0.53	1.08		0.66	1.29		0.90	0.55		0.75	0.85	
Uniform Delay, d1	71.5	55.9		71.7	55.8		68.2	56.4		68.1	61.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.0	53.4		14.7	137.8		39.5	1.0		17.0	18.9	
Delay (s)	76.5	109.4		86.4	193.6		107.7	57.5		85.1	80.1	
Level of Service	E	F		F	F		F	E		F	F	
Approach Delay (s)		108.0			188.8			72.9			81.6	
Approach LOS		F			F			E			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			130.7				HCM 2000 Level of Service			F		
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			153.5				Sum of lost time (s)			22.5		
Intersection Capacity Utilization			66.8%				ICU Level of Service			C		
Analysis Period (min)			15									
c Critical Lane Group												



Queues  
 19: Galvez St/Embarcadero Rd & El Camino Real

Existing + Churchill Closure  
 Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	276	1134	299	1525	69	296	388	645
v/c Ratio	1.17	0.67	0.86	0.77	0.42	0.38	1.57	0.70
Control Delay	166.5	44.7	101.1	44.8	70.7	46.5	315.6	49.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	166.5	44.7	101.1	44.8	70.7	46.5	315.6	49.3
Queue Length 50th (ft)	~321	347	311	317	66	123	~536	274
Queue Length 95th (ft)	#509	401	m#424	375	113	157	#747	345
Internal Link Dist (ft)		1237		1007		755		481
Turn Bay Length (ft)	300		382				200	
Base Capacity (vph)	236	1692	346	1985	166	879	247	1106
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	0.67	0.86	0.77	0.42	0.34	1.57	0.58

**Intersection Summary**

- ~ Volume exceeds capacity, queue is theoretically infinite.  
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Existing + Churchill Closure  
 Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↑↑↑		↖	↑↑↑		↖	↑↑		↖	↑↑	
Traffic Volume (vph)	273	1034	89	275	1154	249	61	204	60	369	407	206
Future Volume (vph)	273	1034	89	275	1154	249	61	204	60	369	407	206
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95		1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5009		1770	4928		1770	3401		1770	3254	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5009		1770	4928		1770	3401		1770	3254	
Peak-hour factor, PHF	0.99	0.99	0.99	0.92	0.92	0.92	0.89	0.89	0.89	0.95	0.95	0.95
Adj. Flow (vph)	276	1044	90	299	1254	271	69	229	67	388	428	217
RTOR Reduction (vph)	0	7	0	0	22	0	0	19	0	0	46	0
Lane Group Flow (vph)	276	1127	0	299	1503	0	69	277	0	388	599	0
Confl. Peds. (#/hr)			17			9			11			74
Confl. Bikes (#/hr)												1
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	20.0	50.5		29.3	59.8		14.1	33.2		21.0	40.1	
Effective Green, g (s)	20.0	50.5		29.3	59.8		14.1	33.2		21.0	40.1	
Actuated g/C Ratio	0.13	0.34		0.20	0.40		0.09	0.22		0.14	0.27	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	4.0		2.0	4.0		2.5	2.0		2.0	2.0	
Lane Grp Cap (vph)	236	1686		345	1964		166	752		247	869	
v/s Ratio Prot	c0.16	0.23		c0.17	c0.31		0.04	c0.08		c0.22	c0.18	
v/s Ratio Perm												
v/c Ratio	1.17	0.67		0.87	0.77		0.42	0.37		1.57	0.69	
Uniform Delay, d1	65.0	42.6		58.5	39.0		64.1	49.5		64.5	49.4	
Progression Factor	1.00	1.00		1.57	1.11		1.00	1.00		1.00	1.00	
Incremental Delay, d2	112.1	2.1		10.7	1.5		1.2	0.1		275.6	1.8	
Delay (s)	177.1	44.7		102.7	44.9		65.3	49.6		340.1	51.2	
Level of Service	F	D		F	D		E	D		F	D	
Approach Delay (s)		70.6			54.4			52.6			159.7	
Approach LOS		E			D			D			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			82.7									F
HCM 2000 Volume to Capacity ratio			0.91									
Actuated Cycle Length (s)			150.0							16.0		
Intersection Capacity Utilization			97.8%									F
ICU Level of Service												
Analysis Period (min)			15									

c Critical Lane Group

Queues  
20: El Camino Real & Churchill Ave

Existing + Churchill Closure  
Timing Plan: A.M. Peak


















Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	334	1875	218	90	1215
v/c Ratio	0.92	0.85	0.32	0.62	0.44
Control Delay	84.2	45.7	26.4	61.1	28.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	84.2	45.7	26.4	61.1	28.1
Queue Length 50th (ft)	292	-678	116	86	443
Queue Length 95th (ft)	#457	#824	194	m104	m437
Internal Link Dist (ft)	958	687			1175
Turn Bay Length (ft)			100	170	
Base Capacity (vph)	392	2200	691	259	2749
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.85	0.85	0.32	0.35	0.44

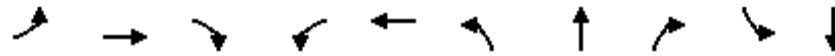
Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 20: El Camino Real & Churchill Ave

Existing + Churchill Closure  
 Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			  			  
Traffic Volume (vph)	158	149	1650	192	83	1118
Future Volume (vph)	158	149	1650	192	83	1118
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	1.00		0.91	1.00	1.00	0.91
Frbp, ped/bikes	0.99		1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.93		1.00	0.85	1.00	1.00
Flt Protected	0.97		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1681		5085	1534	1770	5085
Flt Permitted	0.97		1.00	1.00	0.95	1.00
Satd. Flow (perm)	1681		5085	1534	1770	5085
Peak-hour factor, PHF	0.92	0.92	0.88	0.88	0.92	0.92
Adj. Flow (vph)	172	162	1875	218	90	1215
RTOR Reduction (vph)	23	0	0	31	0	0
Lane Group Flow (vph)	311	0	1875	187	90	1215
Confl. Peds. (#/hr)		5		10		
Turn Type	Prot		NA	Perm	Prot	NA
Protected Phases	4		6		5	2
Permitted Phases				6		
Actuated Green, G (s)	30.3		64.3	64.3	12.2	80.5
Effective Green, g (s)	30.3		64.3	64.3	12.2	80.5
Actuated g/C Ratio	0.20		0.43	0.43	0.08	0.54
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.2		4.0	4.0	2.0	4.0
Lane Grp Cap (vph)	339		2179	657	143	2728
v/s Ratio Prot	c0.18		c0.37		c0.05	0.24
v/s Ratio Perm				0.12		
v/c Ratio	0.92		0.86	0.28	0.63	0.45
Uniform Delay, d1	58.6		38.8	27.9	66.7	21.2
Progression Factor	1.00		1.00	1.00	0.79	1.18
Incremental Delay, d2	28.2		4.7	1.1	2.7	0.2
Delay (s)	86.9		43.5	29.0	55.6	25.2
Level of Service	F		D	C	E	C
Approach Delay (s)	86.9		42.0			27.3
Approach LOS	F		D			C
<b>Intersection Summary</b>						
HCM 2000 Control Delay			40.9		HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.67			
Actuated Cycle Length (s)			150.0		Sum of lost time (s)	15.0
Intersection Capacity Utilization			66.7%		ICU Level of Service	C
Analysis Period (min)			15			
c	Critical Lane Group					



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	480	604	233	314	1444	362	930	177	221	1459
v/c Ratio	1.04	0.49	0.44	0.84	1.33	0.90	0.55	0.18	0.78	0.96
Control Delay	127.9	64.4	10.8	102.0	206.3	106.8	36.4	16.6	103.8	64.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	127.9	64.4	10.8	102.0	206.3	106.8	36.4	16.6	103.8	64.7
Queue Length 50th (ft)	~356	243	11	202	-849	234	418	92	142	892
Queue Length 95th (ft)	#480	300	98	253	#945	#325	508	132	188	#1016
Internal Link Dist (ft)		611			978		1346			917
Turn Bay Length (ft)	350		350	300		350			100	
Base Capacity (vph)	461	1238	533	496	1088	411	1699	1018	749	1554
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.04	0.49	0.44	0.63	1.33	0.88	0.55	0.17	0.30	0.94

**Intersection Summary**

- ~ Volume exceeds capacity, queue is theoretically infinite.  
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real

Existing + Churchill Closure  
 Timing Plan: A.M. Peak





















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↑↑↑	↗	↔↔	↑↑↑		↔↔	↑↑	↗	↔↔	↑↑	↔↔
Traffic Volume (vph)	461	580	224	295	1158	199	329	846	161	212	1026	374
Future Volume (vph)	461	580	224	295	1158	199	329	846	161	212	1026	374
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.95	
Frbp, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1500	3433	4925		3433	3539	1583	3433	3371	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1500	3433	4925		3433	3539	1583	3433	3371	
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.91	0.91	0.91	0.96	0.96	0.96
Adj. Flow (vph)	480	604	233	314	1232	212	362	930	177	221	1069	390
RTOR Reduction (vph)	0	0	168	0	13	0	0	0	0	0	20	0
Lane Group Flow (vph)	480	604	65	314	1431	0	362	930	177	221	1439	0
Confl. Peds. (#/hr)			21			27			29			8
Confl. Bikes (#/hr)						3						1
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									
Actuated Green, G (s)	25.6	46.2	46.2	20.8	41.4		22.4	91.3	116.6	15.7	84.6	
Effective Green, g (s)	25.6	46.2	46.2	20.8	41.4		22.4	91.3	116.6	15.7	84.6	
Actuated g/C Ratio	0.13	0.24	0.24	0.11	0.22		0.12	0.48	0.61	0.08	0.45	
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	
Lane Grp Cap (vph)	462	1236	364	375	1073		404	1700	971	283	1500	
v/s Ratio Prot	c0.14	0.12		0.09	c0.29		c0.11	0.26	0.11	0.06	c0.43	
v/s Ratio Perm			0.04									
v/c Ratio	1.04	0.49	0.18	0.84	1.33		0.90	0.55	0.18	0.78	0.96	
Uniform Delay, d1	82.2	61.8	56.9	82.9	74.3		82.7	34.8	16.0	85.5	51.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	52.3	1.4	1.1	14.3	156.8		21.6	0.2	0.0	12.1	14.4	
Delay (s)	134.5	63.1	58.0	97.3	231.1		104.3	35.0	16.0	97.6	65.4	
Level of Service	F	E	E	F	F		F	C	B	F	E	
Approach Delay (s)		88.2			207.2			49.8			69.7	
Approach LOS		F			F			D			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			107.7			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.05									
Actuated Cycle Length (s)			190.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			104.4%			ICU Level of Service			G			
Analysis Period (min)			15									

c Critical Lane Group














HCM Unsignalized Intersection Capacity Analysis  
22a: Oregon Ave & Alma St

Existing + Churchill Closure  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	10	0	74	0	1605	472	0	599	207
Future Volume (Veh/h)	0	0	0	10	0	74	0	1605	472	0	599	207
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.95	0.25	0.95	0.92	0.98	0.98	0.25	0.84	0.84
Hourly flow rate (vph)	0	0	0	11	0	78	0	1638	482	0	713	246
Pedestrians	19											
Lane Width (ft)	12.0											
Walking Speed (ft/s)	3.5											
Percent Blockage	2											
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1733	2975	480	2014	2616	838	959				2139	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1733	2975	480	2014	2616	838	959				2139	
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	100	100	100	67	100	74	100				100	
cM capacity (veh/h)	41	14	532	33	23	304	713				245	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>WB 2</b>	<b>NB 1</b>	<b>NB 2</b>	<b>NB 3</b>	<b>SB 1</b>	<b>SB 2</b>					
Volume Total	11	78	819	819	482	475	484					
Volume Left	11	0	0	0	0	0	0					
Volume Right	0	78	0	0	482	0	246					
cSH	33	304	1700	1700	1700	1700	1700					
Volume to Capacity	0.33	0.26	0.48	0.48	0.28	0.28	0.28					
Queue Length 95th (ft)	27	25	0	0	0	0	0					
Control Delay (s)	158.7	20.9	0.0	0.0	0.0	0.0	0.0					
Lane LOS	F	C										
Approach Delay (s)	37.9	0.0		0.0			0.0					
Approach LOS	E											
<b>Intersection Summary</b>												
Average Delay	1.1											
Intersection Capacity Utilization	55.6%		ICU Level of Service				B					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

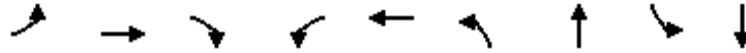
Existing + Churchill Closure  
 Timing Plan: A.M. Peak

							
Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations			 			 	
Traffic Volume (veh/h)	0	286	1791	151	74	535	
Future Volume (Veh/h)	0	286	1791	151	74	535	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.25	0.90	0.98	0.98	0.84	0.84	
Hourly flow rate (vph)	0	318	1828	154	88	637	
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type			None			None	
Median storage (veh)							
Upstream signal (ft)							
pX, platoon unblocked							
vC, conflicting volume	2322	914			1828		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	2322	914			1828		
tC, single (s)	6.8	6.9			4.1		
tC, 2 stage (s)							
tF (s)	3.5	3.3			2.2		
p0 queue free %	100	0			73		
cM capacity (veh/h)	23	276			330		
Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	318	914	914	154	88	318	318
Volume Left	0	0	0	0	88	0	0
Volume Right	318	0	0	154	0	0	0
cSH	276	1700	1700	1700	330	1700	1700
Volume to Capacity	1.15	0.54	0.54	0.09	0.27	0.19	0.19
Queue Length 95th (ft)	347	0	0	0	26	0	0
Control Delay (s)	142.1	0.0	0.0	0.0	19.8	0.0	0.0
Lane LOS	F				C		
Approach Delay (s)	142.1	0.0			2.4		
Approach LOS	F						
Intersection Summary							
Average Delay			15.5				
Intersection Capacity Utilization			73.9%		ICU Level of Service		D
Analysis Period (min)			15				



Queues  
23: Cowper St & Oregon Expy

Existing + Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	20	1567	54	27	1635	150	127	45	139
v/c Ratio	0.21	0.73	0.06	0.27	0.75	0.80	0.39	0.36	0.55
Control Delay	72.7	25.6	1.1	85.8	21.6	93.7	47.6	73.9	45.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	72.7	25.6	1.1	85.8	21.6	93.7	47.6	73.9	45.8
Queue Length 50th (ft)	19	503	0	28	771	149	97	43	88
Queue Length 95th (ft)	48	815	8	m27	m825	#185	106	60	88
Internal Link Dist (ft)		1547			1028		66		60
Turn Bay Length (ft)	115		50	115					
Base Capacity (vph)	156	2159	976	154	2168	188	370	165	379
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.73	0.06	0.18	0.75	0.80	0.34	0.27	0.37

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 23: Cowper St & Oregon Expy

Existing + Churchill Closure  
Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	1426	49	26	1555	14	102	48	38	29	35	55
Future Volume (vph)	18	1426	49	26	1555	14	102	48	38	29	35	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.98		1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.93		1.00	0.91	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1546	1770	3533		1770	1700		1770	1653	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1546	1770	3533		1770	1700		1770	1653	
Peak-hour factor, PHF	0.91	0.91	0.91	0.96	0.96	0.96	0.68	0.68	0.68	0.65	0.65	0.65
Adj. Flow (vph)	20	1567	54	27	1620	15	150	71	56	45	54	85
RTOR Reduction (vph)	0	0	22	0	0	0	0	20	0	0	42	0
Lane Group Flow (vph)	20	1567	32	27	1635	0	150	107	0	45	97	0
Confl. Peds. (#/hr)			1			11			8			10
Confl. Bikes (#/hr)									25			8
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases			6									
Actuated Green, G (s)	5.1	88.6	88.6	5.4	89.1		16.0	27.0		8.9	20.1	
Effective Green, g (s)	5.1	88.6	88.6	5.4	89.1		16.0	27.0		8.9	20.1	
Actuated g/C Ratio	0.03	0.59	0.59	0.04	0.59		0.11	0.18		0.06	0.13	
Clearance Time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0		5.0	3.0		4.0	3.0	
Lane Grp Cap (vph)	60	2090	913	63	2098		188	306		105	221	
v/s Ratio Prot	0.01	0.44		c0.02	c0.46		c0.08	0.06		0.03	c0.06	
v/s Ratio Perm			0.02									
v/c Ratio	0.33	0.75	0.03	0.43	0.78		0.80	0.35		0.43	0.44	
Uniform Delay, d1	70.8	22.6	12.8	70.8	23.0		65.4	53.8		68.1	59.8	
Progression Factor	1.00	1.00	1.00	1.23	0.86		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.3	2.5	0.1	2.0	1.3		23.2	0.7		3.8	1.4	
Delay (s)	74.1	25.1	12.9	88.9	21.1		88.6	54.5		71.9	61.2	
Level of Service	E	C	B	F	C		F	D		E	E	
Approach Delay (s)		25.3			22.2			73.0			63.8	
Approach LOS		C			C			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			29.3			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.72									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)				20.1		
Intersection Capacity Utilization			69.2%			ICU Level of Service				C		
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
24: Middlefield Rd & Oregon Expy

Existing + Churchill Closure  
Timing Plan: A.M. Peak






























Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	128	1319	167	120	1254	56	296	428	238	98	460
v/c Ratio	0.67	0.93	0.24	0.68	0.90	0.09	1.02	0.86	0.43	0.64	0.66
Control Delay	89.4	59.3	23.8	83.7	53.5	0.3	117.7	69.0	10.8	84.3	51.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	89.4	59.3	23.8	83.7	53.5	0.3	117.7	69.0	10.8	84.3	51.5
Queue Length 50th (ft)	111	-479	32	115	625	0	-305	385	24	94	182
Queue Length 95th (ft)	m#175	#881	m141	182	#774	0	#489	#534	95	154	235
Internal Link Dist (ft)		1028			896			676			311
Turn Bay Length (ft)	360		100	390		100	230			145	
Base Capacity (vph)	191	1420	707	224	1386	601	291	527	578	184	788
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.93	0.24	0.54	0.90	0.09	1.02	0.81	0.41	0.53	0.58

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 24: Middlefield Rd & Oregon Expy

Existing + Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Traffic Volume (vph)	115	1187	150	115	1204	54	263	381	212	86	257	148
Future Volume (vph)	115	1187	150	115	1204	54	263	381	212	86	257	148
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.83	1.00	1.00	0.96	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1561	1770	3539	1321	1770	1863	1524	1770	3326	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1561	1770	3539	1321	1770	1863	1524	1770	3326	
Peak-hour factor, PHF	0.90	0.90	0.90	0.96	0.96	0.96	0.89	0.89	0.89	0.88	0.88	0.88
Adj. Flow (vph)	128	1319	167	120	1254	56	296	428	238	98	292	168
RTOR Reduction (vph)	0	0	81	0	0	34	0	0	149	0	57	0
Lane Group Flow (vph)	128	1319	86	120	1254	22	296	428	89	98	403	0
Confl. Peds. (#/hr)			1			51			27			4
Confl. Bikes (#/hr)						2						
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			
Actuated Green, G (s)	16.2	60.2	60.2	15.0	58.8	58.8	24.7	40.3	40.3	13.1	28.8	
Effective Green, g (s)	16.2	60.2	60.2	15.0	58.8	58.8	24.7	40.3	40.3	13.1	28.8	
Actuated g/C Ratio	0.11	0.40	0.40	0.10	0.39	0.39	0.16	0.27	0.27	0.09	0.19	
Clearance Time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0	4.0	5.0	5.0	5.0	3.0	3.0	
Lane Grp Cap (vph)	191	1420	626	177	1387	517	291	500	409	154	638	
v/s Ratio Prot	0.07	c0.37		0.07	c0.35		c0.17	c0.23		0.06	0.12	
v/s Ratio Perm			0.06			0.02			0.06			
v/c Ratio	0.67	0.93	0.14	0.68	0.90	0.04	1.02	0.86	0.22	0.64	0.63	
Uniform Delay, d1	64.3	42.9	28.5	65.2	42.9	28.2	62.6	52.1	42.6	66.1	55.7	
Progression Factor	1.19	1.18	2.76	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.3	9.0	0.3	9.9	9.9	0.2	57.2	14.7	0.6	8.3	2.1	
Delay (s)	82.7	59.4	78.9	75.0	52.9	28.3	119.9	66.8	43.2	74.5	57.8	
Level of Service	F	E	E	E	D	C	F	E	D	E	E	
Approach Delay (s)		63.3			53.8			77.3			60.7	
Approach LOS		E			D			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			62.9				HCM 2000 Level of Service				E	
HCM 2000 Volume to Capacity ratio			0.96									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)				21.6		
Intersection Capacity Utilization			97.7%			ICU Level of Service				F		
Analysis Period (min)			15									

c Critical Lane Group

Queues  
1: Alma Street & Homer Ave













Existing + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	529	1114	951
v/c Ratio	0.74	0.68	0.58
Control Delay	34.6	21.5	19.5
Queue Delay	0.0	0.0	0.0
Total Delay	34.6	21.5	19.5
Queue Length 50th (ft)	131	258	207
Queue Length 95th (ft)	189	343	277
Internal Link Dist (ft)	443	390	481
Turn Bay Length (ft)			
Base Capacity (vph)	852	1864	1864
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.62	0.60	0.51
Intersection Summary			

HCM Signalized Intersection Capacity Analysis  
 1: Alma Street & Homer Ave

Existing + Churchill Closure  
 Timing Plan: P.M.Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	 		 			 
Traffic Volume (vph)	356	126	1081	0	0	894
Future Volume (vph)	356	126	1081	0	0	894
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		5.0			5.0
Lane Util. Factor	0.97		0.95			0.95
Frbp, ped/bikes	0.96		1.00			1.00
Flpb, ped/bikes	0.88		1.00			1.00
Frt	0.96		1.00			1.00
Flt Protected	0.96		1.00			1.00
Satd. Flow (prot)	2832		3539			3539
Flt Permitted	0.96		1.00			1.00
Satd. Flow (perm)	2832		3539			3539
Peak-hour factor, PHF	0.91	0.91	0.97	0.25	0.25	0.94
Adj. Flow (vph)	391	138	1114	0	0	951
RTOR Reduction (vph)	38	0	0	0	0	0
Lane Group Flow (vph)	491	0	1114	0	0	951
Confl. Peds. (#/hr)	77	61		28		
Confl. Bikes (#/hr)		3				
Turn Type	Perm		NA			NA
Protected Phases			2			6
Permitted Phases	8					
Actuated Green, G (s)	19.2		37.0			37.0
Effective Green, g (s)	19.2		37.0			37.0
Actuated g/C Ratio	0.24		0.46			0.46
Clearance Time (s)	4.0		5.0			5.0
Vehicle Extension (s)	3.0		4.0			4.0
Lane Grp Cap (vph)	672		1618			1618
v/s Ratio Prot			c0.31			0.27
v/s Ratio Perm	c0.17					
v/c Ratio	0.73		0.69			0.59
Uniform Delay, d1	28.5		17.4			16.3
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	4.1		1.3			0.7
Delay (s)	32.5		18.7			16.9
Level of Service	C		B			B
Approach Delay (s)	32.5		18.7			16.9
Approach LOS	C		B			B
<b>Intersection Summary</b>						
HCM 2000 Control Delay			20.9		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.58			
Actuated Cycle Length (s)			80.9		Sum of lost time (s)	13.0
Intersection Capacity Utilization			52.7%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

Intersection Sign configuration not allowed in HCM analysis.

# HCM Unsignalized Intersection Capacity Analysis

## 3: Alma Street & Lincoln Ave

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	30	18	1606	84	18	1108
Future Volume (Veh/h)	30	18	1606	84	18	1108
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.75	0.75	0.94	0.94	0.95	0.95
Hourly flow rate (vph)	40	24	1709	89	19	1166
Pedestrians	12					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2386	911			1810	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2386	911			1810	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	91			94	
cM capacity (veh/h)	26	274			332	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	64	1139	659	408	777	
Volume Left	40	0	0	19	0	
Volume Right	24	0	89	0	0	
cSH	40	1700	1700	332	1700	
Volume to Capacity	1.60	0.67	0.39	0.06	0.46	
Queue Length 95th (ft)	166	0	0	5	0	
Control Delay (s)	518.5	0.0	0.0	1.9	0.0	
Lane LOS	F			A		
Approach Delay (s)	518.5	0.0	0.7			
Approach LOS	F					
Intersection Summary						
Average Delay			11.2			
Intersection Capacity Utilization			57.1%		ICU Level of Service	B
Analysis Period (min)	15					



HCM Unsignalized Intersection Capacity Analysis  
 4: Alma Street & Embarcadero Rd

















Existing + Churchill Closure  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑			↗
Traffic Volume (veh/h)	0	1137	1582	0	0	106
Future Volume (Veh/h)	0	1137	1582	0	0	106
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.25	0.98	0.98	0.25	0.25	0.66
Hourly flow rate (vph)	0	1160	1614	0	0	161
Pedestrians						18
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					2	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1632				2212	1632
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1632				2212	1632
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	0
cM capacity (veh/h)	387				37	89
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>SB 1</b>		
Volume Total	580	580	1614	161		
Volume Left	0	0	0	0		
Volume Right	0	0	0	161		
cSH	1700	1700	1700	89		
Volume to Capacity	0.34	0.34	0.95	1.82		
Queue Length 95th (ft)	0	0	0	338		
Control Delay (s)	0.0	0.0	0.0	487.5		
Lane LOS				F		
Approach Delay (s)	0.0		0.0	487.5		
Approach LOS				F		
<b>Intersection Summary</b>						
Average Delay			26.7			
Intersection Capacity Utilization			96.5%		ICU Level of Service	F
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
 5: Emerson St & Lincoln Ave

Existing + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	7	70	47	29	50	8	2	31	2	8	116	0
Future Volume (vph)	7	70	47	29	50	8	2	31	2	8	116	0
Peak Hour Factor	0.78	0.78	0.78	0.73	0.73	0.73	0.88	0.88	0.88	0.84	0.84	0.84
Hourly flow rate (vph)	9	90	60	40	68	11	2	35	2	10	138	0
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	159	119	39	148								
Volume Left (vph)	9	40	2	10								
Volume Right (vph)	60	11	2	0								
Hadj (s)	-0.18	0.05	0.01	0.05								
Departure Headway (s)	4.3	4.6	4.7	4.6								
Degree Utilization, x	0.19	0.15	0.05	0.19								
Capacity (veh/h)	795	740	702	726								
Control Delay (s)	8.3	8.4	8.0	8.7								
Approach Delay (s)	8.3	8.4	8.0	8.7								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.5									
Level of Service			A									
Intersection Capacity Utilization			27.0%	ICU Level of Service	A							
Analysis Period (min)			15									

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Intersection Sign configuration not allowed in HCM analysis.

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Intersection Sign configuration not allowed in HCM analysis.

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HCM Unsignalized Intersection Capacity Analysis  
8: Alma Street & Kingsley Ave

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	23	154	1435	30	68	1060
Future Volume (Veh/h)	23	154	1435	30	68	1060
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.83	0.83	0.97	0.97	0.96	0.96
Hourly flow rate (vph)	28	186	1479	31	71	1104
Pedestrians	17					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	2					
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2206	1512			1527	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2206	1512			1527	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	10	0			83	
cM capacity (veh/h)	31	107			425	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>	<b>SB 2</b>		
Volume Total	214	1510	439	736		
Volume Left	28	0	71	0		
Volume Right	186	31	0	0		
cSH	81	1700	425	1700		
Volume to Capacity	2.64	0.89	0.17	0.43		
Queue Length 95th (ft)	513	0	15	0		
Control Delay (s)	852.0	0.0	5.2	0.0		
Lane LOS	F		A			
Approach Delay (s)	852.0	0.0	1.9			
Approach LOS	F					
<b>Intersection Summary</b>						
Average Delay			63.7			
Intersection Capacity Utilization			97.9%	ICU Level of Service	F	
Analysis Period (min)			15			

Queues  
9: Alma St & Churchill Ave

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	97	1518	1203
v/c Ratio	0.32	0.59	0.49
Control Delay	48.9	9.1	7.9
Queue Delay	0.0	0.0	0.0
Total Delay	48.9	9.1	7.9
Queue Length 50th (ft)	61	291	206
Queue Length 95th (ft)	105	331	244
Internal Link Dist (ft)	479	698	387
Turn Bay Length (ft)			
Base Capacity (vph)	457	3257	3075
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.21	0.47	0.39
<b>Intersection Summary</b>			

HCM Signalized Intersection Capacity Analysis  
9: Alma St & Churchill Ave

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	60	7	1325	26	7	1111
Future Volume (vph)	60	7	1325	26	7	1111
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		6.0			6.0
Lane Util. Factor	1.00		0.95			0.95
Frbp, ped/bikes	0.99		1.00			1.00
Flpb, ped/bikes	1.00		1.00			1.00
Frt	0.99		1.00			1.00
Flt Protected	0.96		1.00			1.00
Satd. Flow (prot)	1743		3527			3538
Flt Permitted	0.96		1.00			0.94
Satd. Flow (perm)	1743		3527			3329
Peak-hour factor, PHF	0.69	0.69	0.89	0.89	0.93	0.93
Adj. Flow (vph)	87	10	1489	29	8	1195
RTOR Reduction (vph)	2	0	1	0	0	0
Lane Group Flow (vph)	95	0	1517	0	0	1203
Confl. Peds. (#/hr)		42		6		
Confl. Bikes (#/hr)		8				
Turn Type	Perm		NA		Perm	NA
Protected Phases			6			2
Permitted Phases	7				2	
Actuated Green, G (s)	20.7		88.1			88.1
Effective Green, g (s)	20.7		88.1			88.1
Actuated g/C Ratio	0.17		0.74			0.74
Clearance Time (s)	5.0		6.0			6.0
Vehicle Extension (s)	3.0		6.0			6.0
Lane Grp Cap (vph)	301		2593			2448
v/s Ratio Prot			c0.43			
v/s Ratio Perm	c0.05					0.36
v/c Ratio	0.31		0.59			0.49
Uniform Delay, d1	43.3		7.4			6.6
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	0.6		0.7			0.4
Delay (s)	43.9		8.0			7.0
Level of Service	D		A			A
Approach Delay (s)	43.9		8.0			7.0
Approach LOS	D		A			A

















Intersection Summary

HCM 2000 Control Delay	8.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	119.8	Sum of lost time (s)	11.0
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis  
 10: Emerson St & Churchill Ave

















Existing + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	5	114	12	3	34	0	13	9	3	7	22	20
Future Volume (vph)	5	114	12	3	34	0	13	9	3	7	22	20
Peak Hour Factor	0.91	0.91	0.91	0.77	0.77	0.77	0.63	0.63	0.63	0.77	0.77	0.77
Hourly flow rate (vph)	5	125	13	4	44	0	21	14	5	9	29	26
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	143	48	40	64								
Volume Left (vph)	5	4	21	9								
Volume Right (vph)	13	0	5	26								
Hadj (s)	-0.01	0.05	0.06	-0.18								
Departure Headway (s)	4.2	4.3	4.5	4.2								
Degree Utilization, x	0.17	0.06	0.05	0.07								
Capacity (veh/h)	839	802	764	818								
Control Delay (s)	8.0	7.6	7.7	7.5								
Approach Delay (s)	8.0	7.6	7.7	7.5								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.8									
Level of Service			A									
Intersection Capacity Utilization			21.3%		ICU Level of Service				A			
Analysis Period (min)			15									



















HCM Unsignalized Intersection Capacity Analysis  
 11: Bryant St & Churchill Ave

Existing + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	112	5	12	38	3	3	5	3	3	28	6
Future Volume (Veh/h)	6	112	5	12	38	3	3	5	3	3	28	6
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.82	0.82	0.82	0.39	0.39	0.39	0.84	0.84	0.84
Hourly flow rate (vph)	6	120	5	15	46	4	8	13	8	4	33	7
Pedestrians		9			12			1			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											936	
pX, platoon unblocked												
vC, conflicting volume	118	102	46	156	102	34	49			33		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	118	102	46	156	102	34	49			33		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	84	100	98	94	100	99			100		
cM capacity (veh/h)	787	766	1013	687	766	1022	1544			1561		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	131	65	29	44								
Volume Left	6	15	8	4								
Volume Right	5	4	8	7								
cSH	774	758	1544	1561								
Volume to Capacity	0.17	0.09	0.01	0.00								
Queue Length 95th (ft)	15	7	0	0								
Control Delay (s)	10.6	10.2	2.1	0.7								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.6	10.2	2.1	0.7								
Approach LOS	B	B										
<b>Intersection Summary</b>												
Average Delay			8.0									
Intersection Capacity Utilization			21.3%		ICU Level of Service				A			
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 12: Waverly St & Churchill Ave

Existing + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	25	81	9	13	53	40	8	77	2	9	102	32
Future Volume (vph)	25	81	9	13	53	40	8	77	2	9	102	32
Peak Hour Factor	0.87	0.87	0.87	0.84	0.84	0.84	0.81	0.81	0.81	0.97	0.97	0.97
Hourly flow rate (vph)	29	93	10	15	63	48	10	95	2	9	105	33
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	132	126	107	147								
Volume Left (vph)	29	15	10	9								
Volume Right (vph)	10	48	2	33								
Hadj (s)	0.03	-0.17	0.04	-0.09								
Departure Headway (s)	4.7	4.5	4.7	4.6								
Degree Utilization, x	0.17	0.16	0.14	0.19								
Capacity (veh/h)	713	743	710	736								
Control Delay (s)	8.7	8.4	8.5	8.6								
Approach Delay (s)	8.7	8.4	8.5	8.6								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.5									
Level of Service			A									
Intersection Capacity Utilization			28.2%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 13: Cowper St & Churchill Ave

Existing + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	2	84	10	3	31	0	12	25	3	0	32	6
Future Volume (vph)	2	84	10	3	31	0	12	25	3	0	32	6
Peak Hour Factor	0.86	0.86	0.86	0.61	0.61	0.61	0.91	0.91	0.91	0.73	0.73	0.73
Hourly flow rate (vph)	2	98	12	5	51	0	13	27	3	0	44	8
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	112	56	43	52								
Volume Left (vph)	2	5	13	0								
Volume Right (vph)	12	0	3	8								
Hadj (s)	-0.03	0.05	0.05	-0.06								
Departure Headway (s)	4.1	4.3	4.4	4.3								
Degree Utilization, x	0.13	0.07	0.05	0.06								
Capacity (veh/h)	844	815	781	808								
Control Delay (s)	7.8	7.6	7.6	7.5								
Approach Delay (s)	7.8	7.6	7.6	7.5								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.7									
Level of Service			A									
Intersection Capacity Utilization			22.8%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 14: Churchill Ave & Embarcadero Rd

















Existing + Churchill Closure  
 Timing Plan: P.M.Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	985	2	42	869	0	51
Future Volume (Veh/h)	985	2	42	869	0	51
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.25	0.80
Hourly flow rate (vph)	1071	2	45	924	0	64
Pedestrians						8
Lane Width (ft)						12.0
Walking Speed (ft/s)						3.5
Percent Blockage						1
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)	1093			898		
pX, platoon unblocked				0.75	0.75	0.75
vC, conflicting volume				1079	1632	544
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				428	1169	0
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				95	100	92
cM capacity (veh/h)				836	131	804
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	714	359	353	616	64	
Volume Left	0	0	45	0	0	
Volume Right	0	2	0	0	64	
cSH	1700	1700	836	1700	804	
Volume to Capacity	0.42	0.21	0.05	0.36	0.08	
Queue Length 95th (ft)	0	0	4	0	6	
Control Delay (s)	0.0	0.0	1.8	0.0	9.9	
Lane LOS				A	A	
Approach Delay (s)	0.0	0.6		9.9		
Approach LOS						A
Intersection Summary						
Average Delay				0.6		
Intersection Capacity Utilization				58.4%	ICU Level of Service	B
Analysis Period (min)				15		

HCM Unsignalized Intersection Capacity Analysis  
 15: Cowper St & Embarcadero Rd

Existing + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	18	971	34	7	821	36	2	9	6	11	6	17
Future Volume (Veh/h)	18	971	34	7	821	36	2	9	6	11	6	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.96	0.96	0.96	0.53	0.53	0.53	0.53	0.53	0.53
Hourly flow rate (vph)	20	1055	37	7	855	38	4	17	11	21	11	32
Pedestrians								8			1	
Lane Width (ft)								12.0			12.0	
Walking Speed (ft/s)								3.5			3.5	
Percent Blockage								1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.72			0.72	0.72	0.72	0.72	0.72	0.72
vC, conflicting volume	894			1100			1600	2030	554	1476	2029	448
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	894			361			1056	1652	0	883	1651	448
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			96	75	99	84	84	94
cM capacity (veh/h)	754			853			102	67	775	133	67	558
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	548	564	434	466	32	64						
Volume Left	20	0	7	0	4	21						
Volume Right	0	37	0	38	11	32						
cSH	754	1700	853	1700	105	169						
Volume to Capacity	0.03	0.33	0.01	0.27	0.31	0.38						
Queue Length 95th (ft)	2	0	1	0	29	41						
Control Delay (s)	0.7	0.0	0.2	0.0	53.9	38.8						
Lane LOS	A		A		F	E						
Approach Delay (s)	0.4		0.1		53.9	38.8						
Approach LOS					F	E						
Intersection Summary												
Average Delay			2.2									
Intersection Capacity Utilization			51.7%	ICU Level of Service	A							
Analysis Period (min)			15									

Queues  
16: Waverly St & Embarcadero Rd

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	88	1052	21	870	213	298
v/c Ratio	1.22	0.97	0.31	0.80	0.24	0.34
Control Delay	213.1	63.7	43.8	41.3	10.7	11.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	213.1	63.7	43.8	41.3	10.7	11.4
Queue Length 50th (ft)	~79	421	11	293	63	91
Queue Length 95th (ft)	#186	#543	38	372	90	125
Internal Link Dist (ft)		572		576	43	709
Turn Bay Length (ft)	95		75			
Base Capacity (vph)	72	1086	68	1086	889	886
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	1.22	0.97	0.31	0.80	0.24	0.34

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 16: Waverly St & Embarcadero Rd

Existing + Churchill Closure  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	80	906	51	20	762	55	60	97	15	88	105	52	
Future Volume (vph)	80	906	51	20	762	55	60	97	15	88	105	52	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0		
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00		
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00		
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00		
Frt	1.00	0.99		1.00	0.99			0.99			0.97		
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.98		
Satd. Flow (prot)	1768	3503		1770	3497			1806			1771		
Flt Permitted	0.13	1.00		0.12	1.00			0.80			0.81		
Satd. Flow (perm)	233	3503		219	3497			1478			1464		
Peak-hour factor, PHF	0.91	0.91	0.91	0.94	0.94	0.94	0.81	0.81	0.81	0.82	0.82	0.82	
Adj. Flow (vph)	88	996	56	21	811	59	74	120	19	107	128	63	
RTOR Reduction (vph)	0	3	0	0	5	0	0	3	0	0	9	0	
Lane Group Flow (vph)	88	1049	0	21	865	0	0	210	0	0	289	0	
Confl. Peds. (#/hr)	2		10	10		2	2		6	6		2	
Confl. Bikes (#/hr)												4	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA		
Protected Phases		4			4			2				2	
Permitted Phases	4			4			2			2			
Actuated Green, G (s)	34.0	34.0		34.0	34.0			66.0			66.0		
Effective Green, g (s)	34.0	34.0		34.0	34.0			66.0			66.0		
Actuated g/C Ratio	0.31	0.31		0.31	0.31			0.60			0.60		
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0		
Vehicle Extension (s)	3.0	3.0		3.0	3.0			4.0			4.0		
Lane Grp Cap (vph)	72	1082		67	1080			886			878		
v/s Ratio Prot		0.30			0.25								
v/s Ratio Perm	c0.38			0.10				0.14			c0.20		
v/c Ratio	1.22	0.97		0.31	0.80			0.24			0.33		
Uniform Delay, d1	38.0	37.5		29.1	34.9			10.3			11.0		
Progression Factor	1.21	1.18		1.00	1.00			1.00			1.00		
Incremental Delay, d2	172.4	18.8		2.7	4.4			0.6			1.0		
Delay (s)	218.6	63.1		31.7	39.2			10.9			12.0		
Level of Service	F	E		C	D			B			B		
Approach Delay (s)		75.1			39.1			10.9			12.0		
Approach LOS		E			D			B			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			49.7									HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.63										
Actuated Cycle Length (s)			110.0									Sum of lost time (s)	10.0
Intersection Capacity Utilization			63.9%									ICU Level of Service	B
Analysis Period (min)			15										
c Critical Lane Group													

Queues  
17: Bryant St & Embarcadero Rd

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	NBR	SBR
Lane Group Flow (vph)	164	1221	13	954	14	40
v/c Ratio	0.42	0.46	0.05	0.36	0.04	0.09
Control Delay	11.9	7.7	4.7	8.6	0.2	0.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.9	7.7	4.7	8.6	0.2	0.4
Queue Length 50th (ft)	52	211	3	332	0	0
Queue Length 95th (ft)	110	261	m4	391	0	0
Internal Link Dist (ft)		579		572		
Turn Bay Length (ft)	80		60			
Base Capacity (vph)	393	2681	283	2664	454	511
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.46	0.05	0.36	0.03	0.08

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



HCM Signalized Intersection Capacity Analysis  
 17: Bryant St & Embarcadero Rd

Existing + Churchill Closure  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	149	1073	38	12	796	63	0	0	11	0	0	33
Future Volume (vph)	149	1073	38	12	796	63	0	0	11	0	0	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Lane Util. Factor	1.00	0.95		1.00	0.95				1.00			1.00
Frbp, ped/bikes	1.00	1.00		1.00	1.00				0.95			0.93
Flpb, ped/bikes	1.00	1.00		1.00	1.00				1.00			1.00
Frt	1.00	0.99		1.00	0.99				0.86			0.86
Flt Protected	0.95	1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)	1764	3516		1765	3492				1529			1495
Flt Permitted	0.28	1.00		0.20	1.00				1.00			1.00
Satd. Flow (perm)	517	3516		371	3492				1529			1495
Peak-hour factor, PHF	0.91	0.91	0.91	0.90	0.90	0.90	0.25	0.25	0.81	0.25	0.25	0.83
Adj. Flow (vph)	164	1179	42	13	884	70	0	0	14	0	0	40
RTOR Reduction (vph)	0	2	0	0	4	0	0	0	12	0	0	33
Lane Group Flow (vph)	164	1219	0	13	950	0	0	0	2	0	0	7
Confl. Peds. (#/hr)	6		8	8		6			6			20
Confl. Bikes (#/hr)									24			28
Turn Type	Perm	NA		Perm	NA				Perm			Perm
Protected Phases		2			2							
Permitted Phases	2			2					4			4
Actuated Green, G (s)	81.8	81.8		81.8	81.8				18.2			18.2
Effective Green, g (s)	81.8	81.8		81.8	81.8				18.2			18.2
Actuated g/C Ratio	0.74	0.74		0.74	0.74				0.17			0.17
Clearance Time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0				3.0			3.0
Lane Grp Cap (vph)	384	2614		275	2596				252			247
v/s Ratio Prot		c0.35			0.27							
v/s Ratio Perm	0.32			0.04					0.00			c0.00
v/c Ratio	0.43	0.47		0.05	0.37				0.01			0.03
Uniform Delay, d1	5.3	5.5		3.7	5.0				38.4			38.5
Progression Factor	1.00	1.00		0.68	1.32				1.00			1.00
Incremental Delay, d2	3.4	0.6		0.2	0.3				0.0			0.0
Delay (s)	8.7	6.1		2.8	6.8				38.4			38.5
Level of Service	A	A		A	A				D			D
Approach Delay (s)		6.4			6.8			38.4			38.5	
Approach LOS		A			A			D			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			7.3									A
HCM 2000 Volume to Capacity ratio			0.39									
Actuated Cycle Length (s)			110.0									10.0
Intersection Capacity Utilization			50.1%									A
Analysis Period (min)			15									

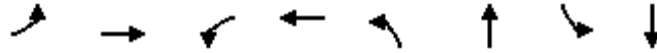
c Critical Lane Group

Queues

Existing + Churchill Closure

18: Middlefield Rd & Embarcadero Rd

Timing Plan: P.M.Peak


























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	1045	93	975	116	433	168	421
v/c Ratio	0.33	0.75	0.62	0.66	0.61	0.51	0.75	0.87
Control Delay	55.0	35.3	66.9	30.6	59.9	37.5	66.7	57.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.0	35.3	66.9	30.6	59.9	37.5	66.7	57.3
Queue Length 50th (ft)	30	356	64	309	79	138	114	278
Queue Length 95th (ft)	66	#517	111	392	134	179	#190	#426
Internal Link Dist (ft)		577		509		183		494
Turn Bay Length (ft)	115		100		115		100	
Base Capacity (vph)	160	1393	162	1485	257	994	257	534
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.75	0.57	0.66	0.45	0.44	0.65	0.79

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 18: Middlefield Rd & Embarcadero Rd

Existing + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 				
Traffic Volume (vph)	41	914	89	78	692	127	108	358	45	156	367	24
Future Volume (vph)	41	914	89	78	692	127	108	358	45	156	367	24
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3480		1770	3441		1770	3475		1770	1842	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3480		1770	3441		1770	3475		1770	1842	
Peak-hour factor, PHF	0.96	0.96	0.96	0.84	0.84	0.84	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	43	952	93	93	824	151	116	385	48	168	395	26
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	43	1045	0	93	975	0	116	433	0	168	421	0
Confl. Peds. (#/hr)			9			15			1			16
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	5.3	43.2		7.9	45.8		11.9	27.0		13.9	29.0	
Effective Green, g (s)	5.3	43.2		7.9	45.8		11.9	27.0		13.9	29.0	
Actuated g/C Ratio	0.05	0.39		0.07	0.42		0.11	0.25		0.13	0.26	
Clearance Time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	2.5	3.5		2.5	3.5		2.5	3.0		2.5	3.0	
Lane Grp Cap (vph)	85	1366		127	1432		191	852		223	485	
v/s Ratio Prot	0.02	c0.30		c0.05	c0.28		0.07	0.12		c0.09	c0.23	
v/s Ratio Perm												
v/c Ratio	0.51	0.77		0.73	0.68		0.61	0.51		0.75	0.87	
Uniform Delay, d1	51.1	29.0		50.0	26.1		46.8	35.8		46.4	38.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.4	4.1		18.4	2.6		4.5	0.5		12.8	15.1	
Delay (s)	54.5	33.1		68.4	28.8		51.4	36.3		59.2	53.8	
Level of Service	D	C		E	C		D	D		E	D	
Approach Delay (s)		34.0			32.2			39.4			55.3	
Approach LOS		C			C			D			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			38.1				HCM 2000 Level of Service				D	
HCM 2000 Volume to Capacity ratio			0.80									
Actuated Cycle Length (s)			110.0				Sum of lost time (s)			18.0		
Intersection Capacity Utilization			76.9%				ICU Level of Service			D		
Analysis Period (min)			15									
c	Critical Lane Group											

Queues  
19: Galvez St/Embarcadero Rd & El Camino Real

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	251	1585	251	2196	205	820	357	634
v/c Ratio	1.18	0.75	1.42	1.11	0.97	0.90	1.68	0.73
Control Delay	174.8	39.4	261.7	76.3	118.3	59.8	365.2	53.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	174.8	39.4	261.7	76.3	118.3	59.8	365.2	53.1
Queue Length 50th (ft)	~294	475	~337	~852	203	361	~509	280
Queue Length 95th (ft)	#462	515	m#340	m#323	#349	#426	#714	353
Internal Link Dist (ft)		1237		1007		755		481
Turn Bay Length (ft)	300		382				200	
Base Capacity (vph)	212	2114	177	1984	212	913	212	863
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.18	0.75	1.42	1.11	0.97	0.90	1.68	0.73

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Existing + Churchill Closure  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↑↑↑		↖	↑↑↑		↖	↑↑		↖	↑↑	
Traffic Volume (vph)	221	1316	79	223	1500	455	178	415	298	332	402	188
Future Volume (vph)	221	1316	79	223	1500	455	178	415	298	332	402	188
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95		1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.98		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.94		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5026		1770	4870		1770	3264		1770	3265	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5026		1770	4870		1770	3264		1770	3265	
Peak-hour factor, PHF	0.88	0.88	0.88	0.89	0.89	0.89	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	251	1495	90	251	1685	511	205	477	343	357	432	202
RTOR Reduction (vph)	0	5	0	0	37	0	0	87	0	0	37	0
Lane Group Flow (vph)	251	1580	0	251	2159	0	205	733	0	357	597	0
Confl. Peds. (#/hr)			27			15			25			78
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	18.0	63.0		15.0	60.0		18.0	38.0		18.0	38.0	
Effective Green, g (s)	18.0	63.0		15.0	60.0		18.0	38.0		18.0	38.0	
Actuated g/C Ratio	0.12	0.42		0.10	0.40		0.12	0.25		0.12	0.25	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	4.0		2.0	4.0		2.5	2.0		2.0	2.0	
Lane Grp Cap (vph)	212	2110		177	1948		212	826		212	827	
v/s Ratio Prot	c0.14	0.31		c0.14	c0.44		0.12	c0.22		c0.20	0.18	
v/s Ratio Perm												
v/c Ratio	1.18	0.75		1.42	1.11		0.97	0.89		1.68	0.72	
Uniform Delay, d1	66.0	36.8		67.5	45.0		65.7	53.9		66.0	51.2	
Progression Factor	1.00	1.00		1.45	0.54		1.00	1.00		1.00	1.00	
Incremental Delay, d2	120.4	2.5		201.3	52.4		51.8	11.1		327.4	2.7	
Delay (s)	186.4	39.3		299.0	76.8		117.5	65.0		393.4	53.8	
Level of Service	F	D		F	E		F	E		F	D	
Approach Delay (s)		59.4			99.6			75.5			176.2	
Approach LOS		E			F			E			F	

Intersection Summary		
HCM 2000 Control Delay	96.0	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	1.15	F
Actuated Cycle Length (s)	150.0	Sum of lost time (s)
Intersection Capacity Utilization	112.8%	16.0
Analysis Period (min)	15	ICU Level of Service
c Critical Lane Group		H

Queues  
20: El Camino Real & Churchill Ave

Existing + Churchill Closure  
Timing Plan: P.M.Peak


















Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	387	1901	190	257	1656
v/c Ratio	1.04	1.06	0.33	0.87	0.59
Control Delay	110.3	84.3	32.8	62.9	20.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	110.3	84.3	32.8	62.9	20.1
Queue Length 50th (ft)	~384	~846	112	254	478
Queue Length 95th (ft)	#542	#989	194	m295	m484
Internal Link Dist (ft)	958	687			1175
Turn Bay Length (ft)			100	170	
Base Capacity (vph)	371	1796	568	354	2786
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.04	1.06	0.33	0.73	0.59

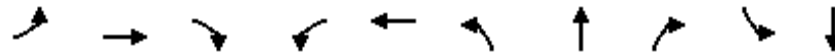
Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
20: El Camino Real & Churchill Ave

Existing + Churchill Closure  
Timing Plan: P.M.Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			  			  
Traffic Volume (vph)	165	164	1787	179	247	1590
Future Volume (vph)	165	164	1787	179	247	1590
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	1.00		0.91	1.00	1.00	0.91
Frbp, ped/bikes	0.99		1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.93		1.00	0.85	1.00	1.00
Flt Protected	0.98		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1681		5085	1532	1770	5085
Flt Permitted	0.98		1.00	1.00	0.95	1.00
Satd. Flow (perm)	1681		5085	1532	1770	5085
Peak-hour factor, PHF	0.85	0.85	0.94	0.94	0.96	0.96
Adj. Flow (vph)	194	193	1901	190	257	1656
RTOR Reduction (vph)	24	0	0	29	0	0
Lane Group Flow (vph)	363	0	1901	161	257	1656
Confl. Peds. (#/hr)		3		8		
Confl. Bikes (#/hr)				1		
Turn Type	Prot		NA	Perm	Prot	NA
Protected Phases	4		6		5	2
Permitted Phases				6		
Actuated Green, G (s)	31.0		52.4	52.4	25.2	81.6
Effective Green, g (s)	31.0		52.4	52.4	25.2	81.6
Actuated g/C Ratio	0.21		0.35	0.35	0.17	0.54
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.2		4.0	4.0	2.0	4.0
Lane Grp Cap (vph)	347		1776	535	297	2766
v/s Ratio Prot	c0.22		c0.37		c0.15	0.33
v/s Ratio Perm				0.10		
v/c Ratio	1.05		1.07	0.30	0.87	0.60
Uniform Delay, d1	59.5		48.8	35.5	60.7	23.1
Progression Factor	1.00		1.00	1.00	0.84	0.80
Incremental Delay, d2	61.0		43.0	1.4	9.3	0.4
Delay (s)	120.5		91.8	36.9	60.5	18.8
Level of Service	F		F	D	E	B
Approach Delay (s)	120.5		86.8			24.4
Approach LOS	F		F			C
<b>Intersection Summary</b>						
HCM 2000 Control Delay			62.6		HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio			0.82			
Actuated Cycle Length (s)			150.0		Sum of lost time (s)	15.0
Intersection Capacity Utilization			77.6%		ICU Level of Service	D
Analysis Period (min)			15			
c Critical Lane Group						



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	855	1401	198	174	1180	320	1033	215	364	1189
v/c Ratio	1.09	0.73	0.30	0.73	1.08	0.73	0.85	0.32	0.87	1.03
Control Delay	122.0	51.9	10.3	99.4	113.6	85.1	63.0	34.5	98.6	89.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	122.0	51.9	10.3	99.4	113.6	85.1	63.0	34.5	98.6	89.4
Queue Length 50th (ft)	~572	516	25	106	-556	192	607	169	220	-764
Queue Length 95th (ft)	#797	631	95	147	#655	237	668	219	278	#907
Internal Link Dist (ft)		611			978		1346			917
Turn Bay Length (ft)	350		350	300		350			100	
Base Capacity (vph)	782	1920	663	371	1092	581	1287	742	486	1152
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.09	0.73	0.30	0.47	1.08	0.55	0.80	0.29	0.75	1.03

**Intersection Summary**

- ~ Volume exceeds capacity, queue is theoretically infinite.  
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real

Existing + Churchill Closure  
 Timing Plan: P.M.Peak





















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↑↑↑	↗	↔↔	↑↑↑		↔↔	↑↑	↗	↔↔	↑↑	↔
Traffic Volume (vph)	761	1247	176	172	916	252	310	1002	209	328	703	367
Future Volume (vph)	761	1247	176	172	916	252	310	1002	209	328	703	367
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.95	
Frpb, ped/bikes	1.00	1.00	0.94	1.00	0.99		1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3315	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3315	
Peak-hour factor, PHF	0.89	0.89	0.89	0.99	0.99	0.99	0.97	0.97	0.97	0.90	0.90	0.90
Adj. Flow (vph)	855	1401	198	174	925	255	320	1033	215	364	781	408
RTOR Reduction (vph)	0	0	103	0	27	0	0	0	0	0	37	0
Lane Group Flow (vph)	855	1401	95	174	1153	0	320	1033	215	364	1152	0
Confl. Peds. (#/hr)			27			28			18			13
Confl. Bikes (#/hr)									3			
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									
Actuated Green, G (s)	41.0	68.0	68.0	12.5	39.5		23.0	61.6	78.6	21.9	60.5	
Effective Green, g (s)	41.0	68.0	68.0	12.5	39.5		23.0	61.6	78.6	21.9	60.5	
Actuated g/C Ratio	0.23	0.38	0.38	0.07	0.22		0.13	0.34	0.44	0.12	0.34	
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	
Lane Grp Cap (vph)	781	1921	561	238	1064		438	1211	691	417	1114	
v/s Ratio Prot	c0.25	0.28		0.05	c0.24		0.09	c0.29	0.14	0.11	c0.35	
v/s Ratio Perm			0.06									
v/c Ratio	1.09	0.73	0.17	0.73	1.08		0.73	0.85	0.31	0.87	1.03	
Uniform Delay, d1	69.5	48.1	37.2	82.1	70.2		75.5	55.0	33.1	77.7	59.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	61.2	2.5	0.7	9.5	53.1		6.2	5.8	0.1	17.4	36.1	
Delay (s)	130.7	50.6	37.9	91.6	123.3		81.7	60.8	33.1	95.1	95.9	
Level of Service	F	D	D	F	F		F	E	C	F	F	
Approach Delay (s)		77.5			119.2			61.3			95.7	
Approach LOS		E			F			E			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			86.0			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.04									
Actuated Cycle Length (s)			180.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			100.5%			ICU Level of Service			G			
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis  
22a: Oregon Ave & Alma St

Existing + Churchill Closure  
Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	31	0	66	0	1593	391	0	1148	290
Future Volume (Veh/h)	0	0	0	31	0	66	0	1593	391	0	1148	290
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.91	0.25	0.91	0.25	0.99	0.99	0.25	0.97	0.97
Hourly flow rate (vph)	0	0	0	34	0	73	0	1609	395	0	1184	299
Pedestrians	23											
Lane Width (ft)	12.0											
Walking Speed (ft/s)	3.5											
Percent Blockage	2											
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2211	3360	742	2224	3115	828	1483				2027	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2211	3360	742	2224	3115	828	1483				2027	
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	100	100	100	0	100	76	100				100	
cM capacity (veh/h)	18	8	358	23	11	308	450				270	
Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2					
Volume Total	34	73	804	804	395	789	694					
Volume Left	34	0	0	0	0	0	0					
Volume Right	0	73	0	0	395	0	299					
cSH	23	308	1700	1700	1700	1700	1700					
Volume to Capacity	1.49	0.24	0.47	0.47	0.23	0.46	0.41					
Queue Length 95th (ft)	108	23	0	0	0	0	0					
Control Delay (s)	613.6	20.3	0.0	0.0	0.0	0.0	0.0					
Lane LOS	F	C										
Approach Delay (s)	208.8	0.0		0.0			0.0					
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay	6.2											
Intersection Capacity Utilization	54.8%		ICU Level of Service				A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

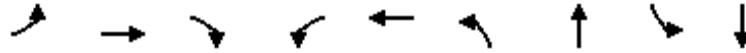
Existing + Churchill Closure  
 Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations		↗	↕	↗	↖	↕	
Traffic Volume (veh/h)	0	347	1637	62	60	1119	
Future Volume (Veh/h)	0	347	1637	62	60	1119	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.25	0.95	0.99	0.99	0.97	0.97	
Hourly flow rate (vph)	0	365	1654	63	62	1154	
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type							
Median storage veh							
Upstream signal (ft)							
pX, platoon unblocked							
vC, conflicting volume	2355	827			1654		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	2355	827			1654		
tC, single (s)	6.8	6.9			4.1		
tC, 2 stage (s)							
tF (s)	3.5	3.3			2.2		
p0 queue free %	100	0			84		
cM capacity (veh/h)	25	315			386		
Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	365	827	827	63	62	577	577
Volume Left	0	0	0	0	62	0	0
Volume Right	365	0	0	63	0	0	0
cSH	315	1700	1700	1700	386	1700	1700
Volume to Capacity	1.16	0.49	0.49	0.04	0.16	0.34	0.34
Queue Length 95th (ft)	381	0	0	0	14	0	0
Control Delay (s)	137.6	0.0	0.0	0.0	16.1	0.0	0.0
Lane LOS	F				C		
Approach Delay (s)	137.6	0.0			0.8		
Approach LOS	F						
Intersection Summary							
Average Delay			15.5				
Intersection Capacity Utilization			73.4%		ICU Level of Service		D
Analysis Period (min)			15				

Queues  
23: Cowper St & Oregon Expy

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	27	1534	80	32	1343	60	56	11	109
v/c Ratio	0.27	0.64	0.07	0.30	0.56	0.42	0.19	0.10	0.54
Control Delay	74.0	19.8	3.1	90.9	10.1	73.8	40.3	69.0	52.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	74.0	19.8	3.1	90.9	10.1	73.8	40.3	69.0	52.9
Queue Length 50th (ft)	26	462	0	32	170	57	34	10	74
Queue Length 95th (ft)	60	817	26	m40	807	84	55	29	104
Internal Link Dist (ft)		1547			1028		48		36
Turn Bay Length (ft)	115		50	115					
Base Capacity (vph)	180	2394	1099	178	2398	179	387	177	374
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.64	0.07	0.18	0.56	0.34	0.14	0.06	0.29

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 23: Cowper St & Oregon Expy

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	1411	74	29	1206	16	44	28	13	9	42	45
Future Volume (vph)	25	1411	74	29	1206	16	44	28	13	9	42	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.95		1.00	0.92	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3531		1770	1759		1770	1688	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3531		1770	1759		1770	1688	
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.73	0.73	0.73	0.80	0.80	0.80
Adj. Flow (vph)	27	1534	80	32	1325	18	60	38	18	11	52	56
RTOR Reduction (vph)	0	0	28	0	0	0	0	12	0	0	29	0
Lane Group Flow (vph)	27	1534	52	32	1343	0	60	44	0	11	80	0
Confl. Peds. (#/hr)						5			7			5
Confl. Bikes (#/hr)									3			8
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases			6									
Actuated Green, G (s)	5.4	98.4	98.4	5.7	98.9		10.5	22.2		3.6	15.5	
Effective Green, g (s)	5.4	98.4	98.4	5.7	98.9		10.5	22.2		3.6	15.5	
Actuated g/C Ratio	0.04	0.66	0.66	0.04	0.66		0.07	0.15		0.02	0.10	
Clearance Time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0		5.0	3.0		4.0	3.0	
Lane Grp Cap (vph)	63	2321	1038	67	2328		123	260		42	174	
v/s Ratio Prot	0.02	c0.43		c0.02	0.38		c0.03	0.03		0.01	c0.05	
v/s Ratio Perm			0.03									
v/c Ratio	0.43	0.66	0.05	0.48	0.58		0.49	0.17		0.26	0.46	
Uniform Delay, d1	70.8	15.7	9.2	70.7	14.0		67.2	55.8		71.9	63.3	
Progression Factor	1.00	1.00	1.00	1.29	0.58		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.6	1.5	0.1	2.8	0.6		6.2	0.3		4.5	1.9	
Delay (s)	75.4	17.2	9.3	93.9	8.7		73.4	56.2		76.4	65.3	
Level of Service	E	B	A	F	A		E	E		E	E	
Approach Delay (s)		17.7			10.7			65.1			66.3	
Approach LOS		B			B			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			18.2			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.62									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			20.1			
Intersection Capacity Utilization			61.7%			ICU Level of Service				B		
Analysis Period (min)			15									

c Critical Lane Group

Queues  
24: Middlefield Rd & Oregon Expy

Existing + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	170	1137	239	201	1067	63	221	524	153	49	584
v/c Ratio	0.68	0.89	0.37	0.86	0.86	0.10	0.91	0.90	0.27	0.40	0.74
Control Delay	65.0	44.3	14.5	95.6	52.8	0.3	100.9	69.5	11.0	76.3	59.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.0	44.3	14.5	95.6	52.8	0.3	100.9	69.5	11.0	76.3	59.3
Queue Length 50th (ft)	162	552	26	194	497	0	216	506	17	47	276
Queue Length 95th (ft)	#260	486	146	#305	559	0	#375	#782	77	91	348
Internal Link Dist (ft)		1028			896			676			311
Turn Bay Length (ft)	360		100	390		100	230			145	
Base Capacity (vph)	249	1284	651	247	1295	645	244	583	572	172	785
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.89	0.37	0.81	0.82	0.10	0.91	0.90	0.27	0.28	0.74




























Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 24: Middlefield Rd & Oregon Expy

Existing + Churchill Closure  
Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Traffic Volume (vph)	158	1057	222	175	928	55	203	482	141	46	440	103
Future Volume (vph)	158	1057	222	175	928	55	203	482	141	46	440	103
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frbp, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.96	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1558	1770	3539	1525	1770	1863	1547	1770	3427	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1558	1770	3539	1525	1770	1863	1547	1770	3427	
Peak-hour factor, PHF	0.93	0.93	0.93	0.87	0.87	0.87	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	170	1137	239	201	1067	63	221	524	153	49	473	111
RTOR Reduction (vph)	0	0	87	0	0	41	0	0	89	0	13	0
Lane Group Flow (vph)	170	1137	152	201	1067	22	221	524	64	49	571	0
Confl. Peds. (#/hr)			2			6			11			4
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			
Actuated Green, G (s)	21.2	53.4	53.4	19.8	51.8	51.8	20.7	46.9	46.9	8.5	34.8	
Effective Green, g (s)	21.2	53.4	53.4	19.8	51.8	51.8	20.7	46.9	46.9	8.5	34.8	
Actuated g/C Ratio	0.14	0.36	0.36	0.13	0.35	0.35	0.14	0.31	0.31	0.06	0.23	
Clearance Time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0	4.0	5.0	5.0	5.0	3.0	3.0	
Lane Grp Cap (vph)	250	1259	554	233	1222	526	244	582	483	100	795	
v/s Ratio Prot	0.10	c0.32		0.11	c0.30		c0.12	c0.28		0.03	0.17	
v/s Ratio Perm			0.10			0.01			0.04			
v/c Ratio	0.68	0.90	0.27	0.86	0.87	0.04	0.91	0.90	0.13	0.49	0.72	
Uniform Delay, d1	61.2	45.8	34.5	63.8	46.0	32.6	63.7	49.3	37.0	68.6	53.1	
Progression Factor	0.87	0.81	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	5.8	8.6	0.9	26.4	8.8	0.1	35.0	18.0	0.3	3.7	3.1	
Delay (s)	58.7	45.9	31.6	90.2	54.8	32.8	98.7	67.3	37.2	72.4	56.2	
Level of Service	E	D	C	F	D	C	F	E	D	E	E	
Approach Delay (s)		45.1			59.1			69.9			57.5	
Approach LOS		D			E			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			56.1									E
HCM 2000 Volume to Capacity ratio			0.94									
Actuated Cycle Length (s)			150.0								21.6	
Intersection Capacity Utilization			93.9%									F
Analysis Period (min)			15									

c Critical Lane Group

## Appendix F – Peak Hour Signal Warrants



Signal Warrant Analysis  
Existing Plus Project Conditions  
Alma Street and Embarcadero Road  
City of Palo Alto

**WARRANT 3 - Peak Hours**

PART A or PART B SATISFIED

YES  NO

**PART A**

**SATISFIED**

YES  NO

(All parts, 1, 2 and 3 below must be satisfied)

1. The total delay experienced for traffic on one minor street approach controlled by a STOP sign equals or exceeds four vehicle-hours for a one-lane approach and five vehicle-hours for a two-lane approach; AND
2. The volume on the same minor street approach equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes; AND
3. The total entering volume services during the hour equals or exceeds 800 vph for intersections with four or more approaches or 650 vph for intersections with three approaches.

YES  NO

YES  NO

YES  NO

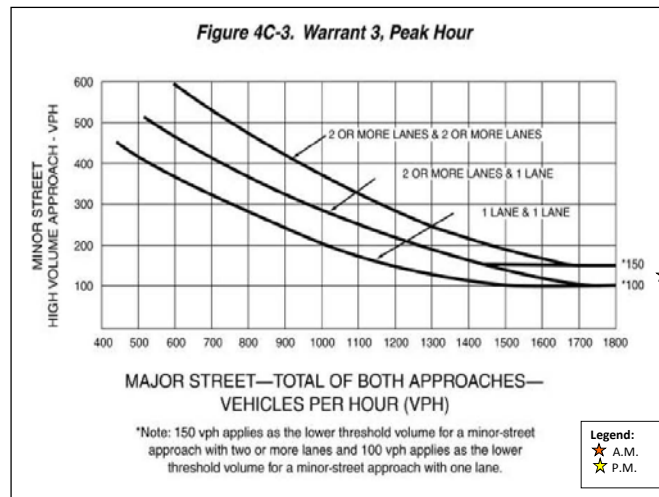
Part A is not met for the A.M. and P.M. Peak Hours

**PART B**

YES  NO

APPROACH LANES	Hour		SATISFIED	
	One	2 or More	8:00-8:30	7:30-8:30
Both Approaches - Major Street		2	2060	2719
Highest Approaches - Minor Street	1		120	106

The plotted points for vehicles per hour on major streets (both approaches) and the corresponding per hour higher volume vehicle minor street approach (one direction only) for one hour (any 4 consecutive 15 minute intervals)



Part B is met for the A.M. and P.M. Peak Hours

Signal Warrant Analysis  
Existing Plus Project Conditions  
Alma Street and Kingsley Avenue  
City of Palo Alto

**WARRANT 3 - Peak Hours**

PART A or PART B SATISFIED

YES  NO

**PART A**

**SATISFIED**

YES  NO

(All parts, 1, 2 and 3 below must be satisfied)

1. The total delay experienced for traffic on one minor street approach controlled by a STOP sign equals or exceeds four vehicle-hours for a one-lane approach and five vehicle-hours for a two-lane approach; AND
2. The volume on the same minor street approach equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes; AND
3. The total entering volume services during the hour equals or exceeds 800 vph for intersections with four or more approaches or 650 vph for intersections with three approaches.

YES  NO

YES  NO

YES  NO

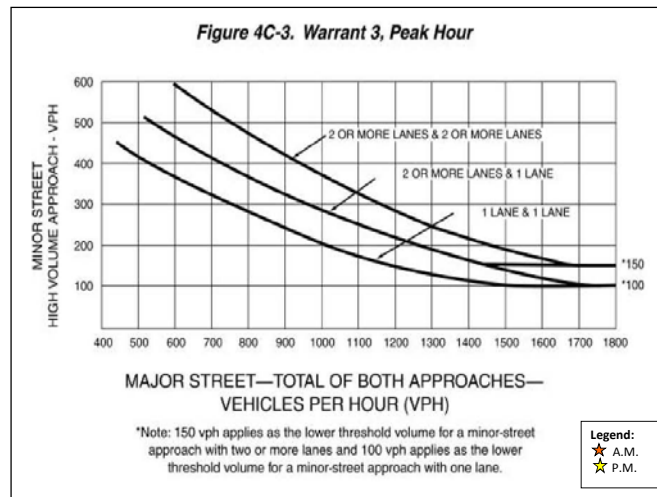
Part A is not met for the A.M. and P.M. Peak Hours

**PART B**

YES  NO

APPROACH LANES	One		2 or More		SATISFIED	
	One	2 or More	650-800 vph	7-99 vph	Hour	Hour
Both Approaches - Major Street		2	1987	2593		
Highest Approaches - Minor Street	1		112	117		

The plotted points for vehicles per hour on major streets (both approaches) and the corresponding per hour higher volume vehicle minor street approach (one direction only) for one hour (any 4 consecutive 15 minute intervals)



Part B is met for the A.M. and P.M. Peak Hours

Signal Warrant Analysis  
Existing Plus Project Conditions  
Alma Street and Oregon Expressway EB Ramps  
City of Palo Alto

**WARRANT 3 - Peak Hours**

PART A or PART B SATISFIED

YES  NO

**PART A**

SATISFIED

YES  NO

(All parts, 1, 2 and 3 below must be satisfied)

1. The total delay experienced for traffic on one minor street approach controlled by a STOP sign equals or exceeds four vehicle-hours for a one-lane approach and five vehicle-hours for a two-lane approach; AND
2. The volume on the same minor street approach equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes; AND
3. The total entering volume services during the hour equals or exceeds 800 vph for intersections with four or more approaches or 650 vph for intersections with three approaches.

YES  NO

YES  NO

YES  NO

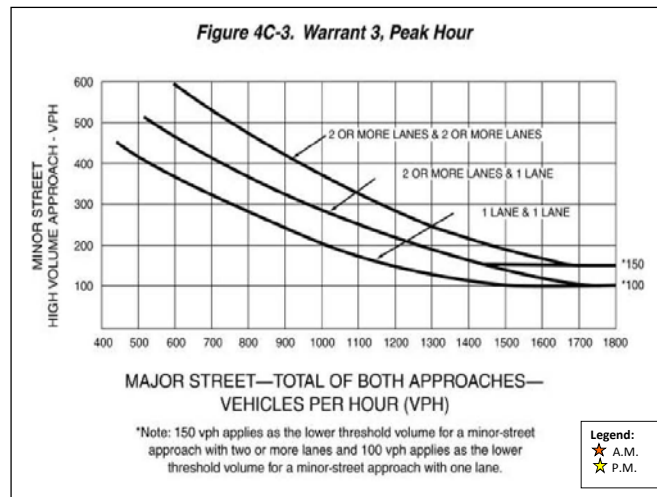
Part A is not met for the A.M. and P.M. Peak Hours

YES  NO

**PART B**

APPROACH LANES	One	2 or More	SATISFIED		Hour
			07:15-08:45	17:15-18:45	
Both Approaches - Major Street		2	2551	2878	
Highest Approaches - Minor Street	1		286	347	

The plotted points for vehicles per hour on major streets (both approaches) and the corresponding per hour higher volume vehicle minor street approach (one direction only) for one hour (any 4 consecutive 15 minute intervals)



Part B is met for the A.M. and P.M. Peak Hours

## Appendix G – Existing Plus Project Conditions with Mitigations Synchro Reports

- HCM Delay and LOS Reports

HCM Unsignalized Intersection Capacity Analysis Existing + Churchill Closure with Mitigation  
 3: Alma Street & Lincoln Ave

Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	23	1494	85	7	566
Future Volume (Veh/h)	0	23	1494	85	7	566
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.93	0.93	0.97	0.97	0.92	0.92
Hourly flow rate (vph)	0	25	1540	88	8	615
Pedestrians	11					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)			175			
pX, platoon unblocked						
vC, conflicting volume	1918	825			1639	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1918	825			1639	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	92			98	
cM capacity (veh/h)	57	312			387	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>NB 2</b>	<b>SB 1</b>	<b>SB 2</b>	
Volume Total	25	1027	601	213	410	
Volume Left	0	0	0	8	0	
Volume Right	25	0	88	0	0	
cSH	312	1700	1700	387	1700	
Volume to Capacity	0.08	0.60	0.35	0.02	0.24	
Queue Length 95th (ft)	6	0	0	2	0	
Control Delay (s)	17.5	0.0	0.0	0.9	0.0	
Lane LOS	C			A		
Approach Delay (s)	17.5	0.0		0.3		
Approach LOS	C					
<b>Intersection Summary</b>						
Average Delay			0.3			
Intersection Capacity Utilization			54.1%		ICU Level of Service	A
Analysis Period (min)			15			

Queues  
4: Alma Street & Embarcadero Rd

Existing + Churchill Closure with Mitigation  
Timing Plan: A.M. Peak



Lane Group	WBL	WBR	NBT	SBT
Lane Group Flow (vph)	160	145	1541	662
v/c Ratio	0.71	0.55	1.04	0.24
Control Delay	66.7	33.0	33.1	3.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	66.7	33.0	33.1	3.4
Queue Length 50th (ft)	117	52	-1269	55
Queue Length 95th (ft)	48	104	m#1382	80
Internal Link Dist (ft)	166		189	95
Turn Bay Length (ft)				
Base Capacity (vph)	270	302	1483	2817
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	81
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.59	0.48	1.04	0.24

Intersection Summary












- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 4: Alma Street & Embarcadero Rd

Existing + Churchill Closure with Mitigation

Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						 
Traffic Volume (vph)	40	120	1464	0	0	596
Future Volume (vph)	40	120	1464	0	0	596
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5			4.5
Lane Util. Factor	1.00	1.00	1.00			0.95
Frbp, ped/bikes	1.00	1.00	1.00			1.00
Flpb, ped/bikes	1.00	1.00	1.00			1.00
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	1770	1583	1863			3539
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	1770	1583	1863			3539
Peak-hour factor, PHF	0.25	0.83	0.95	0.25	0.25	0.90
Adj. Flow (vph)	160	145	1541	0	0	662
RTOR Reduction (vph)	0	62	0	0	0	0
Lane Group Flow (vph)	160	83	1541	0	0	662
Confl. Peds. (#/hr)				22	33	
Turn Type	Prot	Perm	NA			NA
Protected Phases	4		2			6
Permitted Phases		4				
Actuated Green, G (s)	15.0	15.0	93.7			93.7
Effective Green, g (s)	15.0	15.0	93.7			93.7
Actuated g/C Ratio	0.13	0.13	0.80			0.80
Clearance Time (s)	4.5	4.5	4.5			4.5
Vehicle Extension (s)	3.0	3.0	3.0			3.0
Lane Grp Cap (vph)	225	201	1483			2817
v/s Ratio Prot	c0.09		c0.83			0.19
v/s Ratio Perm		0.05				
v/c Ratio	0.71	0.41	1.04			0.24
Uniform Delay, d1	49.3	47.3	12.0			3.0
Progression Factor	1.00	1.00	0.28			1.00
Incremental Delay, d2	10.1	1.4	25.4			0.0
Delay (s)	59.4	48.7	28.8			3.1
Level of Service	E	D	C			A
Approach Delay (s)	54.3		28.8			3.1
Approach LOS	D		C			A
<b>Intersection Summary</b>						
HCM 2000 Control Delay			25.1		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.99			
Actuated Cycle Length (s)			117.7		Sum of lost time (s)	9.0
Intersection Capacity Utilization			92.0%		ICU Level of Service	F
Analysis Period (min)			15			
c Critical Lane Group						

Queues  
8: Alma Street & Kingsley Ave

Existing + Churchill Closure with Mitigation  
Timing Plan: A.M. Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	136	1450	661
v/c Ratio	0.47	0.98	1.10dl
Control Delay	23.2	32.2	6.3
Queue Delay	0.0	11.5	0.3
Total Delay	23.2	43.7	6.6
Queue Length 50th (ft)	30	863	128
Queue Length 95th (ft)	76	#1445	180
Internal Link Dist (ft)	142	24	189
Turn Bay Length (ft)			
Base Capacity (vph)	326	1480	1504
Starvation Cap Reductn	0	0	297
Spillback Cap Reductn	3	67	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.42	1.03	0.55

Intersection Summary

- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- dl Defacto Left Lane. Recode with 1 though lane as a left lane.



HCM Signalized Intersection Capacity Analysis  
8: Alma Street & Kingsley Ave

Existing + Churchill Closure with Mitigation  
Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			L
Traffic Volume (vph)	10	102	1371	21	62	533
Future Volume (vph)	10	102	1371	21	62	533
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			0.95
Frbp, ped/bikes	1.00		1.00			1.00
Flpb, ped/bikes	1.00		1.00			1.00
Frt	0.88		1.00			1.00
Flt Protected	1.00		1.00			0.99
Satd. Flow (prot)	1626		1858			3521
Flt Permitted	1.00		1.00			0.53
Satd. Flow (perm)	1626		1858			1890
Peak-hour factor, PHF	0.82	0.82	0.96	0.96	0.90	0.90
Adj. Flow (vph)	12	124	1428	22	69	592
RTOR Reduction (vph)	80	0	0	0	0	0
Lane Group Flow (vph)	56	0	1450	0	0	661
Confl. Peds. (#/hr)				7	7	
Turn Type	Prot		NA		Perm	NA
Protected Phases	4		2			6
Permitted Phases					6	
Actuated Green, G (s)	15.0		93.7			93.7
Effective Green, g (s)	15.0		93.7			93.7
Actuated g/C Ratio	0.13		0.80			0.80
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	207		1479			1504
v/s Ratio Prot	c0.03		c0.78			
v/s Ratio Perm						0.35
v/c Ratio	0.27		0.98			1.10dl
Uniform Delay, d1	46.4		11.1			3.8
Progression Factor	1.00		1.00			1.30
Incremental Delay, d2	0.7		18.8			0.2
Delay (s)	47.1		29.9			5.1
Level of Service	D		C			A
Approach Delay (s)	47.1		29.9			5.1
Approach LOS	D		C			A

Intersection Summary

HCM 2000 Control Delay	23.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	117.7	Sum of lost time (s)	9.0
Intersection Capacity Utilization	87.8%	ICU Level of Service	E
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis Existing + Churchill Closure with Mitigation  
 15: Cowper St & Embarcadero Rd Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔			↔↔				↗			↗
Traffic Volume (veh/h)	14	843	34	11	926	13	0	0	6	0	0	46
Future Volume (Veh/h)	14	843	34	11	926	13	0	0	6	0	0	46
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.82	0.82	0.82	0.58	0.58	0.58	0.69	0.69	0.69
Hourly flow rate (vph)	16	947	38	13	1129	16	0	0	10	0	0	67
Pedestrians					1			8				28
Lane Width (ft)					12.0			12.0				12.0
Walking Speed (ft/s)					3.5			3.5				3.5
Percent Blockage					0			1				3
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.79			0.79	0.79	0.79	0.79	0.79	
vC, conflicting volume	1173			993			1664	2205	502	1708	2216	600
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1173			445			1298	1988	0	1354	2002	600
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			100	100	99	100	100	84
cM capacity (veh/h)	575			867			74	44	844	77	43	432
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	490	512	578	580	10	67						
Volume Left	16	0	13	0	0	0						
Volume Right	0	38	0	16	10	67						
cSH	575	1700	867	1700	844	432						
Volume to Capacity	0.03	0.30	0.02	0.34	0.01	0.16						
Queue Length 95th (ft)	2	0	1	0	1	14						
Control Delay (s)	0.8	0.0	0.4	0.0	9.3	14.9						
Lane LOS	A		A		A	B						
Approach Delay (s)	0.4		0.2		9.3	14.9						
Approach LOS					A	B						
Intersection Summary												
Average Delay			0.8									
Intersection Capacity Utilization			37.7%		ICU Level of Service				A			
Analysis Period (min)			15									

Queues  
19: Galvez St/Embarcadero Rd & El Camino Real

Existing + Churchill Closure with Mitigation  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	276	1134	299	1254	271	69	296	388	645
v/c Ratio	1.12	0.69	0.84	0.63	0.37	0.34	0.38	0.80	0.70
Control Delay	149.0	47.8	97.0	62.3	34.2	63.0	45.5	74.6	48.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	149.0	47.8	97.0	62.3	34.2	63.0	45.5	74.6	48.7
Queue Length 50th (ft)	~309	347	311	378	141	66	123	192	270
Queue Length 95th (ft)	#497	#476	m#382	456	m203	104	151	241	342
Internal Link Dist (ft)		1237		1007			755		481
Turn Bay Length (ft)	300		382		250			200	
Base Capacity (vph)	247	1652	357	1985	734	212	970	663	1323
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.12	0.69	0.84	0.63	0.37	0.33	0.31	0.59	0.49

**Intersection Summary**























~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Existing + Churchill Closure with Mitigation  
 Timing Plan: A.M. Peak

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	273	1034	89	275	1154	249	61	204	60	369	407	206	
Future Volume (vph)	273	1034	89	275	1154	249	61	204	60	369	407	206	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0		
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.97	0.95		
Frbp, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	0.99		1.00	0.97		
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00		
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	0.95		
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00		
Satd. Flow (prot)	1770	5009		1770	5085	1544	1770	3401		3433	3254		
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00		
Satd. Flow (perm)	1770	5009		1770	5085	1544	1770	3401		3433	3254		
Peak-hour factor, PHF	0.99	0.99	0.99	0.92	0.92	0.92	0.89	0.89	0.89	0.95	0.95	0.95	
Adj. Flow (vph)	276	1044	90	299	1254	271	69	229	67	388	428	217	
RTOR Reduction (vph)	0	6	0	0	0	133	0	19	0	0	51	0	
Lane Group Flow (vph)	276	1128	0	299	1254	138	69	277	0	388	594	0	
Confl. Peds. (#/hr)			17			9			11			74	
Confl. Bikes (#/hr)												1	
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA		
Protected Phases	5	2		1	6		3	8		7	4		
Permitted Phases						6							
Actuated Green, G (s)	21.0	48.5		30.3	57.8	57.8	15.2	33.9		21.3	40.0		
Effective Green, g (s)	21.0	48.5		30.3	57.8	57.8	15.2	33.9		21.3	40.0		
Actuated g/C Ratio	0.14	0.32		0.20	0.39	0.39	0.10	0.23		0.14	0.27		
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0		
Vehicle Extension (s)	2.0	4.0		2.0	4.0	4.0	2.5	2.0		2.0	2.0		
Lane Grp Cap (vph)	247	1619		357	1959	594	179	768		487	867		
v/s Ratio Prot	c0.16	c0.23		c0.17	0.25		0.04	c0.08		c0.11	c0.18		
v/s Ratio Perm						0.09							
v/c Ratio	1.12	0.70		0.84	0.64	0.23	0.39	0.36		0.80	0.68		
Uniform Delay, d1	64.5	44.3		57.5	37.6	31.1	63.0	48.9		62.3	49.3		
Progression Factor	1.00	1.00		1.52	1.57	3.74	1.00	1.00		1.00	1.00		
Incremental Delay, d2	92.5	2.5		8.0	0.8	0.5	1.0	0.1		8.2	1.8		
Delay (s)	157.0	46.8		95.6	59.8	116.7	64.0	49.0		70.5	51.1		
Level of Service	F	D		F	E	F	E	D		E	D		
Approach Delay (s)		68.4			74.1			51.9			58.4		
Approach LOS		E			E			D			E		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			67.1									HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio			0.76										
Actuated Cycle Length (s)			150.0									Sum of lost time (s)	16.0
Intersection Capacity Utilization			95.6%									ICU Level of Service	F
Analysis Period (min)			15										

c Critical Lane Group

Queues

Existing + Churchill Closure with Mitigation

21: Page Mill Rd/Oregon Expy & El Camino Real

Timing Plan: A.M. Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	480	604	233	314	1444	362	930	177	221	1108	351
v/c Ratio	0.96	0.33	0.34	0.84	0.91	0.93	0.71	0.23	0.79	0.98	0.66
Control Delay	109.8	45.6	6.1	102.9	70.3	112.9	55.7	28.1	105.6	83.4	46.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	109.8	45.6	6.1	102.9	70.3	112.9	55.7	28.1	105.6	83.4	46.7
Queue Length 50th (ft)	310	202	2	202	633	235	527	125	142	757	317
Queue Length 95th (ft)	#420	249	69	254	698	#335	630	179	189	#919	460
Internal Link Dist (ft)		611			978		1346			917	
Turn Bay Length (ft)	350		350	300		350			100		100
Base Capacity (vph)	514	1821	685	460	1604	392	1301	823	348	1136	530
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.33	0.34	0.68	0.90	0.92	0.71	0.22	0.64	0.98	0.66

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real

Existing + Churchill Closure with Mitigation  
 Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↑↑↑	↗	↔↔	↑↑↑		↔↔	↑↑	↗	↔↔	↑↑	↗
Traffic Volume (vph)	461	580	224	295	1158	199	329	846	161	212	1026	374
Future Volume (vph)	461	580	224	295	1158	199	329	846	161	212	1026	374
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	4.5
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.91	0.91
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	1.00	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.99	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1500	3433	4925		3433	3539	1583	3433	3369	1400
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1500	3433	4925		3433	3539	1583	3433	3369	1400
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.91	0.91	0.91	0.96	0.96	0.96
Adj. Flow (vph)	480	604	233	314	1232	212	362	930	177	221	1069	390
RTOR Reduction (vph)	0	0	148	0	13	0	0	0	0	0	1	58
Lane Group Flow (vph)	480	604	85	314	1431	0	362	930	177	221	1107	293
Confl. Peds. (#/hr)			21			27			29			8
Confl. Bikes (#/hr)						3						1
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	Perm
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									4
Actuated Green, G (s)	27.8	68.0	68.0	20.6	60.8		21.6	69.9	95.0	15.5	63.8	63.8
Effective Green, g (s)	27.8	68.0	68.0	20.6	60.8		21.6	69.9	95.0	15.5	63.8	63.8
Actuated g/C Ratio	0.15	0.36	0.36	0.11	0.32		0.11	0.37	0.50	0.08	0.34	0.34
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	4.5
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	1.0
Lane Grp Cap (vph)	502	1819	536	372	1576		390	1301	791	280	1131	470
v/s Ratio Prot	c0.14	0.12		0.09	c0.29		c0.11	0.26	0.11	0.06	c0.33	
v/s Ratio Perm			0.06									0.21
v/c Ratio	0.96	0.33	0.16	0.84	0.91		0.93	0.71	0.22	0.79	0.98	0.62
Uniform Delay, d1	80.5	44.5	41.5	83.1	61.9		83.4	51.5	26.7	85.6	62.4	53.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	28.9	0.5	0.6	15.3	9.2		27.9	1.6	0.1	12.7	21.4	1.8
Delay (s)	109.4	44.9	42.1	98.4	71.1		111.3	53.1	26.8	98.4	83.8	54.8
Level of Service	F	D	D	F	E		F	D	C	F	F	D
Approach Delay (s)		67.9			76.0			64.3			79.7	
Approach LOS		E			E			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			72.5			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.94									
Actuated Cycle Length (s)			190.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			96.3%			ICU Level of Service			F			
Analysis Period (min)			15									

c Critical Lane Group

Queues  
22a: Oregon Ave & Alma St

Existing + Churchill Closure with Mitigation  
Timing Plan: A.M. Peak



Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	11	78	1638	482	959
v/c Ratio	0.04	0.25	0.72	0.45	0.37
Control Delay	33.8	10.6	7.7	1.9	4.3
Queue Delay	0.0	0.0	0.3	0.2	0.0
Total Delay	33.8	10.6	7.9	2.1	4.3
Queue Length 50th (ft)	6	0	118	3	80
Queue Length 95th (ft)	21	39	184	m29	103
Internal Link Dist (ft)			473		363
Turn Bay Length (ft)				150	
Base Capacity (vph)	352	377	2268	1067	2666
Starvation Cap Reductn	0	0	164	128	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.21	0.78	0.51	0.36

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
22a: Oregon Ave & Alma St

Existing + Churchill Closure with Mitigation  
Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				↶		↷		↕	↷		↕	↶
Traffic Volume (vph)	0	0	0	10	0	74	0	1605	472	0	599	207
Future Volume (vph)	0	0	0	10	0	74	0	1605	472	0	599	207
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5		4.5		4.5	4.5		4.5	
Lane Util. Factor				1.00		1.00		0.95	1.00		0.95	
Frbp, ped/bikes				1.00		1.00		1.00	0.93		1.00	
Flpb, ped/bikes				1.00		1.00		1.00	1.00		1.00	
Frt				1.00		0.85		1.00	0.85		0.96	
Flt Protected				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (prot)				1770		1583		3539	1474		3403	
Flt Permitted				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (perm)				1770		1583		3539	1474		3403	
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.25	0.95	0.92	0.98	0.98	0.25	0.84	0.84
Adj. Flow (vph)	0	0	0	11	0	78	0	1638	482	0	713	246
RTOR Reduction (vph)	0	0	0	0	0	66	0	0	127	0	31	0
Lane Group Flow (vph)	0	0	0	11	0	12	0	1638	355	0	928	0
Confl. Peds. (#/hr)									19			
Turn Type				Prot		Perm		NA	Perm		NA	
Protected Phases				8				2			6	
Permitted Phases						8			2			
Actuated Green, G (s)				14.6		14.6		60.1	60.1		71.1	
Effective Green, g (s)				14.6		14.6		60.1	60.1		71.1	
Actuated g/C Ratio				0.15		0.15		0.63	0.63		0.75	
Clearance Time (s)				4.5		4.5		4.5	4.5		4.5	
Vehicle Extension (s)				3.0		3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)				272		244		2245	935		2554	
v/s Ratio Prot				0.01				c0.46			c0.27	
v/s Ratio Perm						c0.01			0.24			
v/c Ratio				0.04		0.05		0.73	0.38		0.36	
Uniform Delay, d1				34.1		34.1		11.8	8.3		4.0	
Progression Factor				1.00		1.00		0.49	0.36		1.00	
Incremental Delay, d2				0.1		0.1		0.7	0.1		0.1	
Delay (s)				34.1		34.2		6.4	3.2		4.1	
Level of Service				C		C		A	A		A	
Approach Delay (s)		0.0			34.2			5.7			4.1	
Approach LOS		A			C			A			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			6.0									A
HCM 2000 Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			94.7							13.5		
Intersection Capacity Utilization			56.4%									B
Analysis Period (min)			15									
c Critical Lane Group												



Queues  
22b: Alma St & Oregon Expy EB Ramps



Lane Group	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	318	1828	154	88	637
v/c Ratio	0.84	0.81	0.15	0.58	0.24
Control Delay	40.2	18.2	5.2	74.8	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	40.2	18.2	5.2	74.8	2.8
Queue Length 50th (ft)	100	454	20	59	31
Queue Length 95th (ft)	#225	597	48	104	36
Internal Link Dist (ft)		386			473
Turn Bay Length (ft)			100	50	
Base Capacity (vph)	442	2268	1040	162	2742
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.72	0.81	0.15	0.54	0.23

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

Existing + Churchill Closure with Mitigation  
 Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↗	↕	↗	↘	↕
Traffic Volume (vph)	0	286	1791	151	74	535
Future Volume (vph)	0	286	1791	151	74	535
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	0.95	1.00	1.00	0.95
Frt		0.86	1.00	0.85	1.00	1.00
Flt Protected		1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)		1611	3539	1583	1770	3539
Flt Permitted		1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)		1611	3539	1583	1770	3539
Peak-hour factor, PHF	0.25	0.90	0.98	0.98	0.84	0.84
Adj. Flow (vph)	0	318	1828	154	88	637
RTOR Reduction (vph)	0	129	0	26	0	0
Lane Group Flow (vph)	0	189	1828	128	88	637
Turn Type		Perm	NA	Perm	Prot	NA
Protected Phases			2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)		14.6	60.1	60.1	6.5	71.1
Effective Green, g (s)		14.6	60.1	60.1	6.5	71.1
Actuated g/C Ratio		0.15	0.63	0.63	0.07	0.75
Clearance Time (s)		4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		248	2245	1004	121	2657
v/s Ratio Prot			c0.52		c0.05	0.18
v/s Ratio Perm		c0.12		0.08		
v/c Ratio		0.76	0.81	0.13	0.73	0.24
Uniform Delay, d1		38.4	13.1	6.9	43.2	3.6
Progression Factor		1.00	1.00	1.00	1.38	0.64
Incremental Delay, d2		13.0	2.4	0.1	18.6	0.0
Delay (s)		51.4	15.5	6.9	78.2	2.3
Level of Service		D	B	A	E	A
Approach Delay (s)	51.4		14.8			11.5
Approach LOS	D		B			B

Intersection Summary

HCM 2000 Control Delay	17.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	94.7	Sum of lost time (s)	13.5
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis Existing + Churchill Closure with Mitigation  
 3: Alma Street & Lincoln Ave

Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↗	↕↗			↖↕
Traffic Volume (veh/h)	0	18	1606	84	18	1108
Future Volume (Veh/h)	0	18	1606	84	18	1108
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.75	0.75	0.94	0.94	0.95	0.95
Hourly flow rate (vph)	0	24	1709	89	19	1166
Pedestrians	12					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (ft)			175			
pX, platoon unblocked						
vC, conflicting volume	2386	911			1810	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2386	911			1810	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	91			94	
cM capacity (veh/h)	26	274			332	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>NB 2</b>	<b>SB 1</b>	<b>SB 2</b>	
Volume Total	24	1139	659	408	777	
Volume Left	0	0	0	19	0	
Volume Right	24	0	89	0	0	
cSH	274	1700	1700	332	1700	
Volume to Capacity	0.09	0.67	0.39	0.06	0.46	
Queue Length 95th (ft)	7	0	0	5	0	
Control Delay (s)	19.4	0.0	0.0	1.9	0.0	
Lane LOS	C			A		
Approach Delay (s)	19.4	0.0		0.7		
Approach LOS	C					
<b>Intersection Summary</b>						
Average Delay			0.4			
Intersection Capacity Utilization			57.1%		ICU Level of Service	B
Analysis Period (min)			15			

Queues  
4: Alma Street & Embarcadero Rd














Lane Group	WBL	WBR	NBT	SBT
Lane Group Flow (vph)	120	161	1614	1160
v/c Ratio	0.56	0.66	1.08	0.41
Control Delay	58.1	42.3	51.1	4.2
Queue Delay	0.0	0.0	7.4	0.1
Total Delay	58.1	42.3	58.5	4.3
Queue Length 50th (ft)	86	70	~1377	115
Queue Length 95th (ft)	38	87	m#1427	161
Internal Link Dist (ft)	166		189	95
Turn Bay Length (ft)				
Base Capacity (vph)	273	294	1491	2834
Starvation Cap Reductn	0	0	29	0
Spillback Cap Reductn	0	0	0	362
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.44	0.55	1.10	0.47

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
4: Alma Street & Embarcadero Rd

Existing + Churchill Closure with Mitigation  
Timing Plan: P.M.Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						 
Traffic Volume (vph)	30	106	1582	0	0	1137
Future Volume (vph)	30	106	1582	0	0	1137
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5			4.5
Lane Util. Factor	1.00	1.00	1.00			0.95
Frpb, ped/bikes	1.00	0.99	1.00			1.00
Flpb, ped/bikes	1.00	1.00	1.00			1.00
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	1770	1561	1863			3539
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	1770	1561	1863			3539
Peak-hour factor, PHF	0.25	0.66	0.98	0.25	0.25	0.98
Adj. Flow (vph)	120	161	1614	0	0	1160
RTOR Reduction (vph)	0	55	0	0	0	0
Lane Group Flow (vph)	120	106	1614	0	0	1160
Confl. Peds. (#/hr)				18		
Confl. Bikes (#/hr)		1				
Turn Type	Prot	Perm	NA			NA
Protected Phases	4		2			6
Permitted Phases		4				
Actuated Green, G (s)	14.2	14.2	93.3			93.3
Effective Green, g (s)	14.2	14.2	93.3			93.3
Actuated g/C Ratio	0.12	0.12	0.80			0.80
Clearance Time (s)	4.5	4.5	4.5			4.5
Vehicle Extension (s)	3.0	3.0	3.0			3.0
Lane Grp Cap (vph)	215	190	1491			2834
v/s Ratio Prot	c0.07		c0.87			0.33
v/s Ratio Perm		0.07				
v/c Ratio	0.56	0.56	1.08			0.41
Uniform Delay, d1	48.2	48.2	11.6			3.4
Progression Factor	1.00	1.00	0.48			1.00
Incremental Delay, d2	3.1	3.5	41.0			0.1
Delay (s)	51.3	51.7	46.5			3.5
Level of Service	D	D	D			A
Approach Delay (s)	51.5		46.5			3.5
Approach LOS	D		D			A
<b>Intersection Summary</b>						
HCM 2000 Control Delay			30.7		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			1.01			
Actuated Cycle Length (s)			116.5		Sum of lost time (s)	9.0
Intersection Capacity Utilization			97.3%		ICU Level of Service	F
Analysis Period (min)			15			
c Critical Lane Group						

Queues  
8: Alma Street & Kingsley Ave



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	214	1510	1175
v/c Ratio	0.79	1.02	1.11dl
Control Delay	51.6	41.5	11.2
Queue Delay	1.9	31.8	0.0
Total Delay	53.5	73.3	11.2
Queue Length 50th (ft)	98	~1220	273
Queue Length 95th (ft)	162	#1546	414
Internal Link Dist (ft)	142	24	189
Turn Bay Length (ft)			
Base Capacity (vph)	321	1485	1508
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	33	126	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.74	1.11	0.78

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- dl Defacto Left Lane. Recode with 1 though lane as a left lane.

HCM Signalized Intersection Capacity Analysis  
8: Alma Street & Kingsley Ave

Existing + Churchill Closure with Mitigation  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	23	154	1435	30	68	1060
Future Volume (vph)	23	154	1435	30	68	1060
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			0.95
Frbp, ped/bikes	1.00		1.00			1.00
Flpb, ped/bikes	1.00		1.00			1.00
Frt	0.88		1.00			1.00
Flt Protected	0.99		1.00			1.00
Satd. Flow (prot)	1633		1855			3529
Flt Permitted	0.99		1.00			0.53
Satd. Flow (perm)	1633		1855			1882
Peak-hour factor, PHF	0.83	0.83	0.97	0.97	0.96	0.96
Adj. Flow (vph)	28	186	1479	31	71	1104
RTOR Reduction (vph)	71	0	1	0	0	0
Lane Group Flow (vph)	143	0	1509	0	0	1175
Confl. Peds. (#/hr)				17	17	
Confl. Bikes (#/hr)				1		
Turn Type	Prot		NA		Perm	NA
Protected Phases	4		2			6
Permitted Phases					6	
Actuated Green, G (s)	14.2		93.3			93.3
Effective Green, g (s)	14.2		93.3			93.3
Actuated g/C Ratio	0.12		0.80			0.80
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	199		1485			1507
v/s Ratio Prot	c0.09		c0.81			
v/s Ratio Perm						0.62
v/c Ratio	0.72		1.02			1.11dl
Uniform Delay, d1	49.2		11.6			6.2
Progression Factor	1.00		1.00			0.98
Incremental Delay, d2	11.7		27.5			2.4
Delay (s)	60.9		39.1			8.4
Level of Service	E		D			A
Approach Delay (s)	60.9		39.1			8.4
Approach LOS	E		D			A

Intersection Summary

HCM 2000 Control Delay	28.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	116.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	98.7%	ICU Level of Service	F
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis Existing + Churchill Closure with Mitigation  
 15: Cowper St & Embarcadero Rd Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔			↔↔				↗			↗
Traffic Volume (veh/h)	18	971	34	7	821	36	0	0	6	0	0	17
Future Volume (Veh/h)	18	971	34	7	821	36	0	0	6	0	0	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.96	0.96	0.96	0.53	0.53	0.53	0.53	0.53	0.53
Hourly flow rate (vph)	20	1055	37	7	855	38	0	0	11	0	0	32
Pedestrians								8			1	
Lane Width (ft)								12.0			12.0	
Walking Speed (ft/s)								3.5			3.5	
Percent Blockage								1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.72			0.72	0.72	0.72	0.72	0.72	0.72
vC, conflicting volume	894			1100			1595	2030	554	1468	2029	448
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	894			361			1048	1652	0	871	1651	448
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			100	100	99	100	100	94
cM capacity (veh/h)	754			853			119	67	775	168	67	558
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	548	564	434	466	11	32						
Volume Left	20	0	7	0	0	0						
Volume Right	0	37	0	38	11	32						
cSH	754	1700	853	1700	775	558						
Volume to Capacity	0.03	0.33	0.01	0.27	0.01	0.06						
Queue Length 95th (ft)	2	0	1	0	1	5						
Control Delay (s)	0.7	0.0	0.2	0.0	9.7	11.8						
Lane LOS	A		A		A	B						
Approach Delay (s)	0.4		0.1		9.7	11.8						
Approach LOS					A	B						
Intersection Summary												
Average Delay			0.5									
Intersection Capacity Utilization			44.1%		ICU Level of Service				A			
Analysis Period (min)			15									



Queues  
19: Galvez St/Embarcadero Rd & El Camino Real

Existing + Churchill Closure with Mitigation  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	251	1585	251	1685	511	205	820	357	634
v/c Ratio	0.93	0.91	0.91	0.95	0.69	0.93	0.82	0.92	0.70
Control Delay	100.6	55.6	111.8	49.0	24.0	108.9	50.9	95.7	50.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	100.6	55.6	111.8	49.0	24.0	108.9	50.9	95.7	50.3
Queue Length 50th (ft)	246	551	258	317	141	201	345	180	274
Queue Length 95th (ft)	#402	599	m260	m324	m156	#337	407	#275	345
Internal Link Dist (ft)		1237		1007			755		481
Turn Bay Length (ft)	300		382		250			200	
Base Capacity (vph)	271	1742	295	1772	737	224	1000	389	907
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.91	0.85	0.95	0.69	0.92	0.82	0.92	0.70

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.























Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Existing + Churchill Closure with Mitigation

Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	221	1316	79	223	1500	455	178	415	298	332	402	188
Future Volume (vph)	221	1316	79	223	1500	455	178	415	298	332	402	188
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.97	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	0.98		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.94		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5026		1770	5085	1531	1770	3264		3433	3265	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5026		1770	5085	1531	1770	3264		3433	3265	
Peak-hour factor, PHF	0.88	0.88	0.88	0.89	0.89	0.89	0.87	0.87	0.87	0.93	0.93	0.93
Adj. Flow (vph)	251	1495	90	251	1685	511	205	477	343	357	432	202
RTOR Reduction (vph)	0	5	0	0	0	204	0	87	0	0	37	0
Lane Group Flow (vph)	251	1580	0	251	1685	307	205	733	0	357	597	0
Confl. Peds. (#/hr)			27			15			25			78
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases						6						
Actuated Green, G (s)	23.0	51.9		23.4	52.3	52.3	18.7	41.8		16.9	40.0	
Effective Green, g (s)	23.0	51.9		23.4	52.3	52.3	18.7	41.8		16.9	40.0	
Actuated g/C Ratio	0.15	0.35		0.16	0.35	0.35	0.12	0.28		0.11	0.27	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	4.0		2.0	4.0	4.0	2.5	2.0		2.0	2.0	
Lane Grp Cap (vph)	271	1738		276	1772	533	220	909		386	870	
v/s Ratio Prot	0.14	c0.31		0.14	c0.33		c0.12	c0.22		0.10	0.18	
v/s Ratio Perm						0.20						
v/c Ratio	0.93	0.91		0.91	0.95	0.58	0.93	0.81		0.92	0.69	
Uniform Delay, d1	62.7	46.8		62.3	47.6	39.8	65.0	50.3		65.9	49.4	
Progression Factor	1.00	1.00		1.54	0.90	1.39	1.00	1.00		1.00	1.00	
Incremental Delay, d2	34.8	8.6		15.8	6.2	1.9	41.9	5.0		27.2	1.8	
Delay (s)	97.5	55.4		111.6	48.9	57.3	107.0	55.3		93.1	51.2	
Level of Service	F	E		F	D	E	F	E		F	D	
Approach Delay (s)		61.1			57.1			65.7			66.3	
Approach LOS		E			E			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			61.1				HCM 2000 Level of Service			E		
HCM 2000 Volume to Capacity ratio			0.92									
Actuated Cycle Length (s)			150.0				Sum of lost time (s)			16.0		
Intersection Capacity Utilization			96.7%				ICU Level of Service			F		
Analysis Period (min)			15									
c Critical Lane Group												

Queues

Existing + Churchill Closure with Mitigation

21: Page Mill Rd/Oregon Expy & El Camino Real

Timing Plan: P.M.Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	855	1401	198	174	1180	320	1033	215	364	830	359
v/c Ratio	0.98	0.63	0.26	0.75	0.96	0.67	0.98	0.35	0.95	0.92	0.77
Control Delay	92.2	41.8	4.6	101.4	80.8	81.2	85.6	40.9	113.5	79.4	50.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	92.2	41.8	4.6	101.4	80.8	81.2	85.6	40.9	113.5	79.4	50.2
Queue Length 50th (ft)	521	475	0	106	500	188	640	180	224	524	292
Queue Length 95th (ft)	#645	533	52	149	#603	#266	#787	251	#328	596	428
Internal Link Dist (ft)		611			978		1346			917	
Turn Bay Length (ft)	350		350	300		350			100		100
Base Capacity (vph)	879	2208	757	289	1235	480	1059	630	387	1002	502
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.97	0.63	0.26	0.60	0.96	0.67	0.98	0.34	0.94	0.83	0.72

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real

Existing + Churchill Closure with Mitigation  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↑↑↑	↖	↖↗	↑↑↑		↖↗	↑↑	↖	↖↗	↑↔	↖
Traffic Volume (vph)	761	1247	176	172	916	252	310	1002	209	328	703	367
Future Volume (vph)	761	1247	176	172	916	252	310	1002	209	328	703	367
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	4.5
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.91	0.91
Frpb, ped/bikes	1.00	1.00	0.94	1.00	0.99		1.00	1.00	1.00	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.99	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3353	1388
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3353	1388
Peak-hour factor, PHF	0.89	0.89	0.89	0.99	0.99	0.99	0.97	0.97	0.97	0.90	0.90	0.90
Adj. Flow (vph)	855	1401	198	174	925	255	320	1033	215	364	781	408
RTOR Reduction (vph)	0	0	112	0	27	0	0	0	0	0	2	92
Lane Group Flow (vph)	855	1401	86	174	1153	0	320	1033	215	364	828	267
Confl. Peds. (#/hr)			27			28			18			13
Confl. Bikes (#/hr)									3			
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	Perm
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									4
Actuated Green, G (s)	45.6	78.2	78.2	12.3	44.9		25.2	53.5	70.3	20.0	48.3	48.3
Effective Green, g (s)	45.6	78.2	78.2	12.3	44.9		25.2	53.5	70.3	20.0	48.3	48.3
Actuated g/C Ratio	0.25	0.43	0.43	0.07	0.25		0.14	0.30	0.39	0.11	0.27	0.27
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	4.5
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	1.0
Lane Grp Cap (vph)	869	2209	645	234	1210		480	1051	618	381	899	372
v/s Ratio Prot	c0.25	0.28		0.05	c0.24		0.09	c0.29	0.14	0.11	c0.25	
v/s Ratio Perm			0.06									0.19
v/c Ratio	0.98	0.63	0.13	0.74	0.95		0.67	0.98	0.35	0.96	0.92	0.72
Uniform Delay, d1	66.8	39.7	30.6	82.3	66.5		73.4	62.8	38.7	79.6	64.0	59.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	26.3	1.4	0.4	10.6	16.8		3.5	23.4	0.1	34.1	14.2	5.4
Delay (s)	93.2	41.1	31.0	92.9	83.3		76.9	86.2	38.8	113.7	78.2	65.1
Level of Service	F	D	C	F	F		E	F	D	F	E	E
Approach Delay (s)		58.4			84.5			77.8			83.5	
Approach LOS		E			F			E			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			73.5			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.97									
Actuated Cycle Length (s)			180.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			97.1%			ICU Level of Service			F			
Analysis Period (min)			15									

c Critical Lane Group

Queues  
22a: Oregon Ave & Alma St

Existing + Churchill Closure with Mitigation  
Timing Plan: P.M.Peak



Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	34	73	1609	395	1483
v/c Ratio	0.11	0.22	0.72	0.39	0.59
Control Delay	34.8	10.4	7.6	1.3	6.9
Queue Delay	0.0	0.0	0.2	0.0	0.0
Total Delay	34.8	10.4	7.9	1.3	6.9
Queue Length 50th (ft)	18	0	132	2	191
Queue Length 95th (ft)	45	38	164	m14	243
Internal Link Dist (ft)			473		363
Turn Bay Length (ft)				150	
Base Capacity (vph)	347	369	2226	1021	2643
Starvation Cap Reductn	0	0	134	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.10	0.20	0.77	0.39	0.56

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
22a: Oregon Ave & Alma St

Existing + Churchill Closure with Mitigation  
Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				↖		↗		↑↑	↗		↑↑	
Traffic Volume (vph)	0	0	0	31	0	66	0	1593	391	0	1148	290
Future Volume (vph)	0	0	0	31	0	66	0	1593	391	0	1148	290
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5		4.5		4.5	4.5		4.5	
Lane Util. Factor				1.00		1.00		0.95	1.00		0.95	
Frbp, ped/bikes				1.00		1.00		1.00	0.92		1.00	
Flpb, ped/bikes				1.00		1.00		1.00	1.00		1.00	
Frt				1.00		0.85		1.00	0.85		0.97	
Flt Protected				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (prot)				1770		1583		3539	1457		3432	
Flt Permitted				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (perm)				1770		1583		3539	1457		3432	
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.25	0.91	0.25	0.99	0.99	0.25	0.97	0.97
Adj. Flow (vph)	0	0	0	34	0	73	0	1609	395	0	1184	299
RTOR Reduction (vph)	0	0	0	0	0	61	0	0	109	0	21	0
Lane Group Flow (vph)	0	0	0	34	0	12	0	1609	286	0	1462	0
Confl. Peds. (#/hr)									23			
Turn Type				Prot		Perm		NA	Perm		NA	
Protected Phases				8				2			6	
Permitted Phases						8			2			
Actuated Green, G (s)				16.4		16.4		59.7	59.7		70.5	
Effective Green, g (s)				16.4		16.4		59.7	59.7		70.5	
Actuated g/C Ratio				0.17		0.17		0.62	0.62		0.74	
Clearance Time (s)				4.5		4.5		4.5	4.5		4.5	
Vehicle Extension (s)				3.0		3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)				302		270		2203	907		2523	
v/s Ratio Prot				c0.02				c0.45			c0.43	
v/s Ratio Perm						0.01			0.20			
v/c Ratio				0.11		0.05		0.73	0.31		0.58	
Uniform Delay, d1				33.6		33.2		12.5	8.5		5.9	
Progression Factor				1.00		1.00		0.46	0.22		1.00	
Incremental Delay, d2				0.2		0.1		0.8	0.1		0.3	
Delay (s)				33.8		33.3		6.6	2.0		6.2	
Level of Service				C		C		A	A		A	
Approach Delay (s)		0.0			33.4			5.7			6.2	
Approach LOS		A			C			A			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			6.7									A
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			95.9							13.5		
Intersection Capacity Utilization			55.7%									B
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
22b: Alma St & Oregon Expy EB Ramps



Lane Group	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	365	1654	63	62	1154
v/c Ratio	0.89	0.74	0.06	0.44	0.45
Control Delay	47.2	16.4	5.2	67.8	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.1
Total Delay	47.2	16.4	5.2	67.8	3.4
Queue Length 50th (ft)	130	391	8	42	58
Queue Length 95th (ft)	#290	488	25	m76	67
Internal Link Dist (ft)		386			473
Turn Bay Length (ft)			100	50	
Base Capacity (vph)	444	2226	1007	159	2705
Starvation Cap Reductn	0	0	0	0	329
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.82	0.74	0.06	0.39	0.49

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

Existing + Churchill Closure with Mitigation  
 Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↗	↕	↗	↘	↕
Traffic Volume (vph)	0	347	1637	62	60	1119
Future Volume (vph)	0	347	1637	62	60	1119
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	0.95	1.00	1.00	0.95
Frt		0.86	1.00	0.85	1.00	1.00
Flt Protected		1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)		1611	3539	1583	1770	3539
Flt Permitted		1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)		1611	3539	1583	1770	3539
Peak-hour factor, PHF	0.25	0.95	0.99	0.99	0.97	0.97
Adj. Flow (vph)	0	365	1654	63	62	1154
RTOR Reduction (vph)	0	132	0	12	0	0
Lane Group Flow (vph)	0	233	1654	51	62	1154
Turn Type		Perm	NA	Perm	Prot	NA
Protected Phases			2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)		16.4	59.7	59.7	6.3	70.5
Effective Green, g (s)		16.4	59.7	59.7	6.3	70.5
Actuated g/C Ratio		0.17	0.62	0.62	0.07	0.74
Clearance Time (s)		4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		275	2203	985	116	2601
v/s Ratio Prot			c0.47		0.04	c0.33
v/s Ratio Perm		c0.14		0.03		
v/c Ratio		0.85	0.75	0.05	0.53	0.44
Uniform Delay, d1		38.5	12.8	7.1	43.4	5.0
Progression Factor		1.00	1.00	1.00	1.36	0.54
Incremental Delay, d2		20.8	1.5	0.0	3.9	0.1
Delay (s)		59.4	14.3	7.1	63.1	2.8
Level of Service		E	B	A	E	A
Approach Delay (s)	59.4		14.0			5.9
Approach LOS	E		B			A

Intersection Summary			
HCM 2000 Control Delay	16.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	95.9	Sum of lost time (s)	13.5
Intersection Capacity Utilization	74.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



## Appendix H – Cumulative Conditions (2030) Synchro Reports

- HCM Delay and LOS Reports
- 95<sup>th</sup> Percentile Queue Length Reports

Queues  
1: Alma Street & Homer Ave













Cumulative + No Project  
Timing Plan: A.M. Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	359	1278	687
v/c Ratio	0.72	0.74	0.40
Control Delay	35.8	21.1	15.0
Queue Delay	0.0	0.0	0.0
Total Delay	35.8	21.1	15.0
Queue Length 50th (ft)	79	281	119
Queue Length 95th (ft)	127	382	170
Internal Link Dist (ft)	443	390	481
Turn Bay Length (ft)			
Base Capacity (vph)	606	1911	1911
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.59	0.67	0.36
Intersection Summary			

HCM Signalized Intersection Capacity Analysis  
 1: Alma Street & Homer Ave

Cumulative + No Project  
 Timing Plan: A.M. Peak












						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	 		 			 
Traffic Volume (vph)	225	105	1201	0	0	632
Future Volume (vph)	225	105	1201	0	0	632
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		5.0			5.0
Lane Util. Factor	0.97		0.95			0.95
Frbp, ped/bikes	0.90		1.00			1.00
Flpb, ped/bikes	0.84		1.00			1.00
Frt	0.95		1.00			1.00
Flt Protected	0.97		1.00			1.00
Satd. Flow (prot)	2503		3539			3539
Flt Permitted	0.97		1.00			1.00
Satd. Flow (perm)	2503		3539			3539
Peak-hour factor, PHF	0.92	0.92	0.94	0.25	0.25	0.92
Adj. Flow (vph)	245	114	1278	0	0	687
RTOR Reduction (vph)	61	0	0	0	0	0
Lane Group Flow (vph)	298	0	1278	0	0	687
Confl. Peds. (#/hr)	82	102		13		
Confl. Bikes (#/hr)		1				
Turn Type	Perm		NA			NA
Protected Phases			2			6
Permitted Phases	8					
Actuated Green, G (s)	14.5		41.4			41.4
Effective Green, g (s)	14.5		41.4			41.4
Actuated g/C Ratio	0.17		0.49			0.49
Clearance Time (s)	4.0		5.0			5.0
Vehicle Extension (s)	3.0		4.0			4.0
Lane Grp Cap (vph)	426		1721			1721
v/s Ratio Prot			c0.36			0.19
v/s Ratio Perm	c0.12					
v/c Ratio	0.70		0.74			0.40
Uniform Delay, d1	33.2		17.6			13.9
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	5.0		1.9			0.2
Delay (s)	38.2		19.5			14.1
Level of Service	D		B			B
Approach Delay (s)	38.2		19.5			14.1
Approach LOS	D		B			B
<b>Intersection Summary</b>						
HCM 2000 Control Delay			20.8		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.57			
Actuated Cycle Length (s)			85.1		Sum of lost time (s)	13.0
Intersection Capacity Utilization			52.3%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

Intersection Sign configuration not allowed in HCM analysis.

# HCM Unsignalized Intersection Capacity Analysis

## 3: Alma Street & Lincoln Ave

Cumulative + No Project  
Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			 			 
Traffic Volume (veh/h)	45	26	1588	96	8	817
Future Volume (Veh/h)	45	26	1588	96	8	817
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.93	0.93	0.97	0.97	0.92	0.92
Hourly flow rate (vph)	48	28	1637	99	9	888
Pedestrians	11					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type			None		None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2160	879			1747	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2160	879			1747	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	90			97	
cM capacity (veh/h)	39	288			352	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	76	1091	645	305	592	
Volume Left	48	0	0	9	0	
Volume Right	28	0	99	0	0	
cSH	57	1700	1700	352	1700	
Volume to Capacity	1.32	0.64	0.38	0.03	0.35	
Queue Length 95th (ft)	166	0	0	2	0	
Control Delay (s)	347.1	0.0	0.0	0.9	0.0	
Lane LOS	F		A			
Approach Delay (s)	347.1	0.0	0.3			
Approach LOS	F					
Intersection Summary						
Average Delay			9.8			
Intersection Capacity Utilization			57.8%		ICU Level of Service	B
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis  
 4: Alma Street & Embarcadero Rd

















Cumulative + No Project  
 Timing Plan: A.M. Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑			↗
Traffic Volume (veh/h)	0	851	1554	0	0	136
Future Volume (Veh/h)	0	851	1554	0	0	136
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.25	0.92	0.95	0.25	0.25	0.92
Hourly flow rate (vph)	0	925	1636	0	0	148
Pedestrians						33
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					3	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1669				2132	1669
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1669				2132	1669
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	0
cM capacity (veh/h)	369				41	82
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>SB 1</b>		
Volume Total	462	462	1636	148		
Volume Left	0	0	0	0		
Volume Right	0	0	0	148		
cSH	1700	1700	1700	82		
Volume to Capacity	0.27	0.27	0.96	1.80		
Queue Length 95th (ft)	0	0	0	315		
Control Delay (s)	0.0	0.0	0.0	487.0		
Lane LOS				F		
Approach Delay (s)	0.0		0.0	487.0		
Approach LOS				F		
<b>Intersection Summary</b>						
Average Delay			26.6			
Intersection Capacity Utilization			96.9%		ICU Level of Service	F
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
 5: Emerson St & Lincoln Ave

Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	9	66	38	78	82	12	5	8	10	8	32	1
Future Volume (vph)	9	66	38	78	82	12	5	8	10	8	32	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	72	41	85	89	13	5	9	11	9	35	1
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	123	187	25	45								
Volume Left (vph)	10	85	5	9								
Volume Right (vph)	41	13	11	1								
Hadj (s)	-0.15	0.08	-0.19	0.06								
Departure Headway (s)	4.1	4.3	4.4	4.7								
Degree Utilization, x	0.14	0.22	0.03	0.06								
Capacity (veh/h)	851	824	747	711								
Control Delay (s)	7.8	8.5	7.6	8.0								
Approach Delay (s)	7.8	8.5	7.6	8.0								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.1									
Level of Service			A									
Intersection Capacity Utilization			28.6%	ICU Level of Service	A							
Analysis Period (min)			15									

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Intersection Sign configuration not allowed in HCM analysis.

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Intersection Sign configuration not allowed in HCM analysis.

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# HCM Unsignalized Intersection Capacity Analysis

## 8: Alma Street & Kingsley Ave

Cumulative + No Project  
Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	11	15	1549	24	70	780
Future Volume (Veh/h)	11	15	1549	24	70	780
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.96	0.96	0.92	0.92
Hourly flow rate (vph)	12	16	1614	25	76	848
Pedestrians	7					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2210	1634			1646	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2210	1634			1646	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	60	82			80	
cM capacity (veh/h)	30	89			386	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>	<b>SB 2</b>		
Volume Total	28	1639	359	565		
Volume Left	12	0	76	0		
Volume Right	16	25	0	0		
cSH	48	1700	386	1700		
Volume to Capacity	0.58	0.96	0.20	0.33		
Queue Length 95th (ft)	55	0	18	0		
Control Delay (s)	153.5	0.0	6.6	0.0		
Lane LOS	F		A			
Approach Delay (s)	153.5	0.0	2.6			
Approach LOS	F					
<b>Intersection Summary</b>						
Average Delay			2.6			
Intersection Capacity Utilization			93.0%	ICU Level of Service	F	
Analysis Period (min)			15			

Queues  
9: Alma St & Churchill Ave

Cumulative + No Project  
Timing Plan: A.M. Peak



Lane Group	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	178	185	161	245	1518	7	699	192
v/c Ratio	0.79	0.54	0.67	0.84	0.67	0.09	0.42	0.24
Control Delay	102.6	14.1	90.8	99.2	24.6	89.0	35.9	18.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	102.6	14.1	90.8	99.2	24.6	89.0	35.9	18.7
Queue Length 50th (ft)	216	0	191	296	571	8	298	73
Queue Length 95th (ft)	300	80	279	388	863	28	416	156
Internal Link Dist (ft)	340		479		698		387	
Turn Bay Length (ft)				300		60		100
Base Capacity (vph)	289	390	255	369	2261	75	1652	786
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	0.47	0.63	0.66	0.67	0.09	0.42	0.24
Intersection Summary								

# HCM Signalized Intersection Capacity Analysis

## 9: Alma St & Churchill Ave

















Cumulative + No Project  
Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗		↕		↗	↕↗		↗	↕↗	↗
Traffic Volume (vph)	101	63	170	80	62	6	225	1374	23	6	643	177
Future Volume (vph)	101	63	170	80	62	6	225	1374	23	6	643	177
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Frbp, ped/bikes		1.00	0.92		0.98		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.99		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1807	1463		1764		1770	3528		1770	3539	1583
Flt Permitted		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1807	1463		1764		1770	3528		1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	110	68	185	87	67	7	245	1493	25	7	699	192
RTOR Reduction (vph)	0	0	162	0	1	0	0	0	0	0	0	47
Lane Group Flow (vph)	0	178	23	0	160	0	245	1518	0	7	699	145
Confl. Peds. (#/hr)			23			101			24			
Confl. Bikes (#/hr)			4			258						
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases			8									2
Actuated Green, G (s)		23.4	23.4		25.4		30.8	116.6		1.6	87.4	87.4
Effective Green, g (s)		23.4	23.4		25.4		30.8	116.6		1.6	87.4	87.4
Actuated g/C Ratio		0.13	0.13		0.14		0.16	0.62		0.01	0.47	0.47
Clearance Time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0		3.0	6.0		3.0	6.0	6.0
Lane Grp Cap (vph)		226	183		239		291	2199		15	1654	739
v/s Ratio Prot		c0.10			c0.09		c0.14	c0.43		0.00	0.20	
v/s Ratio Perm			0.02									0.09
v/c Ratio		0.79	0.13		0.67		0.84	0.69		0.47	0.42	0.20
Uniform Delay, d1		79.4	72.7		76.8		75.7	23.3		92.3	33.1	29.2
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		16.4	0.3		7.2		19.3	1.4		21.2	0.8	0.6
Delay (s)		95.8	73.0		84.0		95.0	24.7		113.5	33.8	29.8
Level of Service		F	E		F		F	C		F	C	C
Approach Delay (s)		84.2			84.0		34.5			33.6		
Approach LOS		F			F		C			C		
<b>Intersection Summary</b>												
HCM 2000 Control Delay			42.4				HCM 2000 Level of Service			D		
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			187.0			Sum of lost time (s)			20.0			
Intersection Capacity Utilization			78.5%			ICU Level of Service			D			
Analysis Period (min)			15									
c Critical Lane Group												

















HCM Unsignalized Intersection Capacity Analysis  
 10: Emerson St & Churchill Ave

Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	11	86	11	6	95	8	38	85	9	11	17	16
Future Volume (vph)	11	86	11	6	95	8	38	85	9	11	17	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	93	12	7	103	9	41	92	10	12	18	17
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	117	119	143	47								
Volume Left (vph)	12	7	41	12								
Volume Right (vph)	12	9	10	17								
Hadj (s)	-0.01	0.00	0.05	-0.13								
Departure Headway (s)	4.5	4.5	4.6	4.5								
Degree Utilization, x	0.15	0.15	0.18	0.06								
Capacity (veh/h)	764	755	748	742								
Control Delay (s)	8.3	8.3	8.6	7.8								
Approach Delay (s)	8.3	8.3	8.6	7.8								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.3									
Level of Service			A									
Intersection Capacity Utilization			27.7%	ICU Level of Service	A							
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 11: Bryant St & Churchill Ave

Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	12	85	9	2	81	42	10	23	3	14	9	18
Future Volume (Veh/h)	12	85	9	2	81	42	10	23	3	14	9	18
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	92	10	2	88	46	11	25	3	15	10	20
Pedestrians		17			14			4			11	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		2			1			0			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											936	
pX, platoon unblocked												
vC, conflicting volume	216	131	41	172	140	52	47			42		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	216	131	41	172	140	52	47			42		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	87	99	100	88	95	99			99		
cM capacity (veh/h)	601	725	1009	671	717	992	1535			1546		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	115	136	39	45								
Volume Left	13	2	11	15								
Volume Right	10	46	3	20								
cSH	726	791	1535	1546								
Volume to Capacity	0.16	0.17	0.01	0.01								
Queue Length 95th (ft)	14	15	1	1								
Control Delay (s)	10.9	10.5	2.1	2.5								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.9	10.5	2.1	2.5								
Approach LOS	B	B										
<b>Intersection Summary</b>												
Average Delay			8.6									
Intersection Capacity Utilization			27.1%		ICU Level of Service					A		
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 12: Waverly St & Churchill Ave

Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	14	68	10	2	35	18	19	111	12	5	84	26
Future Volume (vph)	14	68	10	2	35	18	19	111	12	5	84	26
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	74	11	2	38	20	21	121	13	5	91	28
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	100	60	155	124								
Volume Left (vph)	15	2	21	5								
Volume Right (vph)	11	20	13	28								
Hadj (s)	0.00	-0.16	0.01	-0.09								
Departure Headway (s)	4.6	4.5	4.4	4.4								
Degree Utilization, x	0.13	0.08	0.19	0.15								
Capacity (veh/h)	725	737	776	779								
Control Delay (s)	8.3	7.9	8.5	8.1								
Approach Delay (s)	8.3	7.9	8.5	8.1								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.3									
Level of Service			A									
Intersection Capacity Utilization			31.6%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 13: Cowper St & Churchill Ave

Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	6	70	8	6	27	1	26	26	7	2	24	14
Future Volume (vph)	6	70	8	6	27	1	26	26	7	2	24	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	76	9	7	29	1	28	28	8	2	26	15
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	92	37	64	43								
Volume Left (vph)	7	7	28	2								
Volume Right (vph)	9	1	8	15								
Hadj (s)	-0.01	0.06	0.05	-0.17								
Departure Headway (s)	4.2	4.3	4.3	4.1								
Degree Utilization, x	0.11	0.04	0.08	0.05								
Capacity (veh/h)	838	812	808	847								
Control Delay (s)	7.7	7.5	7.6	7.3								
Approach Delay (s)	7.7	7.5	7.6	7.3								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.6									
Level of Service			A									
Intersection Capacity Utilization			22.3%	ICU Level of Service	A							
Analysis Period (min)			15									



HCM Unsignalized Intersection Capacity Analysis  
 14: Churchill Ave & Embarcadero Rd

















Cumulative + No Project  
 Timing Plan: A.M. Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	953	2	42	1072	0	90
Future Volume (Veh/h)	953	2	42	1072	0	90
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1036	2	46	1165	0	98
Pedestrians						11
Lane Width (ft)						12.0
Walking Speed (ft/s)						3.5
Percent Blockage						1
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)	1093			898		
pX, platoon unblocked				0.83	0.83	0.83
vC, conflicting volume				1047	1722	530
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				635	1453	9
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				94	100	89
cM capacity (veh/h)				772	93	875
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	691	347	434	777	98	
Volume Left	0	0	46	0	0	
Volume Right	0	2	0	0	98	
cSH	1700	1700	772	1700	875	
Volume to Capacity	0.41	0.20	0.06	0.46	0.11	
Queue Length 95th (ft)	0	0	5	0	9	
Control Delay (s)	0.0	0.0	1.7	0.0	9.6	
Lane LOS				A	A	
Approach Delay (s)	0.0	0.6		9.6		
Approach LOS						A
Intersection Summary						
Average Delay				0.7		
Intersection Capacity Utilization				63.7%	ICU Level of Service	B
Analysis Period (min)				15		

HCM Unsignalized Intersection Capacity Analysis  
 15: Cowper St & Embarcadero Rd

Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	953	23	12	1046	15	6	3	7	5	9	52
Future Volume (Veh/h)	16	953	23	12	1046	15	6	3	7	5	9	52
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	1036	25	13	1137	16	7	3	8	5	10	57
Pedestrians					1			8			28	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			1			3	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.80			0.80	0.80	0.80	0.80	0.80	
vC, conflicting volume	1181			1069			1747	2298	540	1762	2302	604
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1181			600			1443	2127	0	1461	2132	604
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			85	92	99	92	72	87
cM capacity (veh/h)	571			777			48	36	865	62	36	429
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	535	543	582	584	18	72						
Volume Left	17	0	13	0	7	5						
Volume Right	0	25	0	16	8	57						
cSH	571	1700	777	1700	76	147						
Volume to Capacity	0.03	0.32	0.02	0.34	0.24	0.49						
Queue Length 95th (ft)	2	0	1	0	21	58						
Control Delay (s)	0.8	0.0	0.5	0.0	66.9	51.1						
Lane LOS	A		A		F	F						
Approach Delay (s)	0.4		0.2		66.9	51.1						
Approach LOS					F	F						
<b>Intersection Summary</b>												
Average Delay			2.4									
Intersection Capacity Utilization			49.2%		ICU Level of Service				A			
Analysis Period (min)			15									

Queues  
16: Waverly St & Embarcadero Rd



















Cumulative + No Project  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	49	1005	30	1148	238	346
v/c Ratio	0.36	0.57	0.17	0.65	0.45	0.54
Control Delay	37.7	31.9	16.9	21.9	27.1	26.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.7	31.9	16.9	21.9	27.1	26.5
Queue Length 50th (ft)	31	376	11	291	120	167
Queue Length 95th (ft)	79	464	30	361	195	263
Internal Link Dist (ft)		572		576	78	709
Turn Bay Length (ft)	95		75			
Base Capacity (vph)	139	1823	186	1824	528	635
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.55	0.16	0.63	0.45	0.54
<b>Intersection Summary</b>						

HCM Signalized Intersection Capacity Analysis  
 16: Waverly St & Embarcadero Rd

Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	46	897	37	28	1029	28	87	105	27	73	114	132
Future Volume (vph)	46	897	37	28	1029	28	87	105	27	73	114	132
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	
Flpb, ped/bikes	0.99	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	1.00			0.98			0.94	
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.99	
Satd. Flow (prot)	1758	3513		1764	3518			1786			1712	
Flt Permitted	0.15	1.00		0.19	1.00			0.71			0.87	
Satd. Flow (perm)	271	3513		360	3518			1291			1512	
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	49	965	40	30	1118	30	95	114	29	79	124	143
RTOR Reduction (vph)	0	3	0	0	2	0	0	4	0	0	23	0
Lane Group Flow (vph)	49	1002	0	30	1146	0	0	234	0	0	323	0
Confl. Peds. (#/hr)	27		9	9		27	22		9	9		22
Confl. Bikes (#/hr)									2			13
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)	55.4	55.4		55.4	55.4			44.6			44.6	
Effective Green, g (s)	55.4	55.4		55.4	55.4			44.6			44.6	
Actuated g/C Ratio	0.50	0.50		0.50	0.50			0.41			0.41	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			4.0			4.0	
Lane Grp Cap (vph)	136	1769		181	1771			523			613	
v/s Ratio Prot		0.29			c0.33							
v/s Ratio Perm	0.18			0.08				0.18			c0.21	
v/c Ratio	0.36	0.57		0.17	0.65			0.45			0.53	
Uniform Delay, d1	16.6	19.0		14.8	20.1			23.7			24.7	
Progression Factor	1.74	1.63		1.00	1.00			1.00			1.00	
Incremental Delay, d2	1.5	0.4		0.4	0.8			2.8			3.2	
Delay (s)	30.3	31.3		15.2	20.9			26.5			28.0	
Level of Service	C	C		B	C			C			C	
Approach Delay (s)		31.3			20.8			26.5			28.0	
Approach LOS		C			C			C			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			26.1									C
HCM 2000 Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			110.0						10.0			
Intersection Capacity Utilization			67.7%									C
Analysis Period (min)			15									

c Critical Lane Group

Queues  
17: Bryant St & Embarcadero Rd

Cumulative + No Project  
Timing Plan: A.M. Peak





















Lane Group	EBL	EBT	WBL	WBT	NBR	SBR
Lane Group Flow (vph)	53	1158	64	1312	16	46
v/c Ratio	0.23	0.46	0.23	0.51	0.04	0.13
Control Delay	10.8	8.5	17.4	19.3	0.1	5.6
Queue Delay	0.0	0.0	0.0	0.4	0.0	0.0
Total Delay	10.8	8.5	17.4	19.7	0.1	5.6
Queue Length 50th (ft)	14	192	33	437	0	0
Queue Length 95th (ft)	37	239	m61	500	0	20
Internal Link Dist (ft)		579		572		
Turn Bay Length (ft)	80		60			
Base Capacity (vph)	228	2529	284	2560	486	416
Starvation Cap Reductn	0	0	0	626	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.46	0.23	0.68	0.03	0.11

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 17: Bryant St & Embarcadero Rd

Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	49	937	129	59	1166	41	0	0	15	0	0	42
Future Volume (vph)	49	937	129	59	1166	41	0	0	15	0	0	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Lane Util. Factor	1.00	0.95		1.00	0.95				1.00			1.00
Frbp, ped/bikes	1.00	0.99		1.00	0.99				0.94			0.89
Flpb, ped/bikes	0.98	1.00		0.99	1.00				1.00			1.00
Frt	1.00	0.98		1.00	0.99				0.86			0.86
Flt Protected	0.95	1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)	1740	3451		1759	3500				1515			1426
Flt Permitted	0.17	1.00		0.21	1.00				1.00			1.00
Satd. Flow (perm)	312	3451		389	3500				1515			1426
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.25	0.25	0.92	0.25	0.25	0.92
Adj. Flow (vph)	53	1018	140	64	1267	45	0	0	16	0	0	46
RTOR Reduction (vph)	0	8	0	0	2	0	0	0	13	0	0	37
Lane Group Flow (vph)	53	1150	0	64	1310	0	0	0	3	0	0	9
Confl. Peds. (#/hr)	64		16	16		64			16			32
Confl. Bikes (#/hr)									26			61
Turn Type	Perm	NA		Perm	NA				Perm			Perm
Protected Phases		2			2							
Permitted Phases	2			2					4			4
Actuated Green, G (s)	78.4	78.4		78.4	78.4				21.6			21.6
Effective Green, g (s)	78.4	78.4		78.4	78.4				21.6			21.6
Actuated g/C Ratio	0.71	0.71		0.71	0.71				0.20			0.20
Clearance Time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0				3.0			3.0
Lane Grp Cap (vph)	222	2459		277	2494				297			280
v/s Ratio Prot		0.33			c0.37							
v/s Ratio Perm	0.17			0.16					0.00			c0.01
v/c Ratio	0.24	0.47		0.23	0.53				0.01			0.03
Uniform Delay, d1	5.5	6.8		5.4	7.3				35.6			35.7
Progression Factor	1.00	1.00		1.98	2.16				1.00			1.00
Incremental Delay, d2	2.5	0.6		1.6	0.6				0.0			0.0
Delay (s)	8.0	7.4		12.3	16.3				35.6			35.8
Level of Service	A	A		B	B				D			D
Approach Delay (s)		7.5			16.1			35.6			35.8	
Approach LOS		A			B			D			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			12.6			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.42									
Actuated Cycle Length (s)			110.0			Sum of lost time (s)			10.0			
Intersection Capacity Utilization			59.7%			ICU Level of Service			B			
Analysis Period (min)			15									

c Critical Lane Group

Queues  
18: Middlefield Rd & Embarcadero Rd

Cumulative + No Project  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	1005	53	1134	159	357	123	280
v/c Ratio	0.53	0.89	0.64	1.01	1.26	0.57	1.07	0.89
Control Delay	94.9	60.5	103.7	80.7	220.5	61.5	168.4	91.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	94.9	60.5	103.7	80.7	220.5	61.5	168.4	91.9
Queue Length 50th (ft)	43	523	53	~674	~199	172	~136	274
Queue Length 95th (ft)	#95	#664	#124	#814	#352	227	#275	#426
Internal Link Dist (ft)		577		509		183		494
Turn Bay Length (ft)	115		100		115		100	
Base Capacity (vph)	81	1131	83	1120	126	661	115	333
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.89	0.64	1.01	1.26	0.54	1.07	0.84
























**Intersection Summary**

~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
18: Middlefield Rd & Embarcadero Rd

Cumulative + No Project  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 				
Traffic Volume (vph)	40	872	52	49	914	130	146	308	20	113	232	26
Future Volume (vph)	40	872	52	49	914	130	146	308	20	113	232	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3498		1770	3450		1770	3501		1770	1828	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3498		1770	3450		1770	3501		1770	1828	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	948	57	53	993	141	159	335	22	123	252	28
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	43	1005	0	53	1134	0	159	357	0	123	280	0
Confl. Peds. (#/hr)			24			44			8			14
Confl. Bikes (#/hr)						1			1			2
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	5.7	48.9		5.8	49.0		11.0	27.3		10.0	26.3	
Effective Green, g (s)	5.7	48.9		5.8	49.0		11.0	27.3		10.0	26.3	
Actuated g/C Ratio	0.04	0.32		0.04	0.32		0.07	0.18		0.07	0.17	
Clearance Time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	2.5	3.5		2.5	3.5		2.5	3.0		2.5	3.0	
Lane Grp Cap (vph)	65	1114		66	1101		126	622		115	313	
v/s Ratio Prot	0.02	0.29		c0.03	c0.33		c0.09	0.10		0.07	c0.15	
v/s Ratio Perm												
v/c Ratio	0.66	0.90		0.80	1.03		1.26	0.57		1.07	0.89	
Uniform Delay, d1	72.9	50.0		73.3	52.2		71.2	57.8		71.8	62.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	20.4	11.8		47.7	35.1		166.6	1.3		103.8	26.0	
Delay (s)	93.4	61.8		121.0	87.3		237.8	59.1		175.6	88.2	
Level of Service	F	E		F	F		F	E		F	F	
Approach Delay (s)		63.1			88.8			114.1			114.9	
Approach LOS		E			F			F			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			87.7			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			0.70									
Actuated Cycle Length (s)			153.5			Sum of lost time (s)		22.5				
Intersection Capacity Utilization			72.7%			ICU Level of Service			C			
Analysis Period (min)			15									
c	Critical Lane Group											



Queues  
 19: Galvez St/Embarcadero Rd & El Camino Real

Cumulative + No Project  
 Timing Plan: A.M. Peak























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	311	1282	338	1571	75	325	212	729
v/c Ratio	0.98	0.80	0.92	0.90	0.47	0.38	1.00	0.78
Control Delay	105.5	51.2	95.9	77.5	74.4	44.3	126.4	52.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	105.5	51.2	95.9	77.5	74.4	44.3	126.4	52.1
Queue Length 50th (ft)	307	420	352	574	72	133	211	325
Queue Length 95th (ft)	#505	502	m#401	m#657	127	168	#385	382
Internal Link Dist (ft)		1237		1007		755		481
Turn Bay Length (ft)	300		382				200	
Base Capacity (vph)	318	1612	378	1752	172	970	212	1062
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	0.80	0.89	0.90	0.44	0.34	1.00	0.69

Intersection Summary

- # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	308	1168	101	311	1304	142	69	231	68	201	460	233
Future Volume (vph)	308	1168	101	311	1304	142	69	231	68	201	460	233
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95		1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5009		1770	4998		1770	3400		1770	3254	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5009		1770	4998		1770	3400		1770	3254	
Peak-hour factor, PHF	0.99	0.99	0.99	0.92	0.92	0.92	0.92	0.92	0.92	0.95	0.95	0.95
Adj. Flow (vph)	311	1180	102	338	1417	154	75	251	74	212	484	245
RTOR Reduction (vph)	0	6	0	0	8	0	0	19	0	0	45	0
Lane Group Flow (vph)	311	1276	0	338	1563	0	75	306	0	212	684	0
Confl. Peds. (#/hr)			17			9			11			74
Confl. Bikes (#/hr)												1
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	27.0	48.0		31.3	52.3		13.5	36.7		18.0	41.2	
Effective Green, g (s)	27.0	48.0		31.3	52.3		13.5	36.7		18.0	41.2	
Actuated g/C Ratio	0.18	0.32		0.21	0.35		0.09	0.24		0.12	0.27	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	4.0		2.0	4.0		2.5	2.0		2.0	2.0	
Lane Grp Cap (vph)	318	1602		369	1742		159	831		212	893	
v/s Ratio Prot	c0.18	0.25		0.19	c0.31		c0.04	0.09		c0.12	c0.21	
v/s Ratio Perm												
v/c Ratio	0.98	0.80		0.92	0.90		0.47	0.37		1.00	0.77	
Uniform Delay, d1	61.2	46.5		58.1	46.3		64.9	47.0		66.0	50.0	
Progression Factor	1.00	1.00		1.42	1.65		1.00	1.00		1.00	1.00	
Incremental Delay, d2	43.8	4.2		13.5	3.4		1.6	0.1		61.8	3.6	
Delay (s)	105.0	50.7		96.0	79.8		66.5	47.1		127.8	53.5	
Level of Service	F	D		F	E		E	D		F	D	
Approach Delay (s)		61.3			82.7			50.8			70.3	
Approach LOS		E			F			D			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			70.6									E
HCM 2000 Volume to Capacity ratio			0.85									
Actuated Cycle Length (s)			150.0								16.0	
Intersection Capacity Utilization			100.4%									G
Analysis Period (min)			15									

c Critical Lane Group

Queues  
20: El Camino Real & Churchill Ave

Cumulative + No Project  
Timing Plan: A.M. Peak














Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	378	2027	236	102	1373
v/c Ratio	1.06	0.89	0.33	0.91	0.50
Control Delay	114.9	45.7	22.8	92.7	51.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	114.9	45.7	22.8	92.7	51.5
Queue Length 50th (ft)	~380	720	115	105	520
Queue Length 95th (ft)	#594	#842	189	m#154	m563
Internal Link Dist (ft)	958	687			1175
Turn Bay Length (ft)			100	170	
Base Capacity (vph)	358	2280	722	112	2738
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.06	0.89	0.33	0.91	0.50

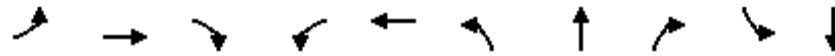
Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 20: El Camino Real & Churchill Ave

Cumulative + No Project  
 Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	179	168	1865	217	94	1263
Future Volume (vph)	179	168	1865	217	94	1263
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	1.00		0.91	1.00	1.00	0.91
Frbp, ped/bikes	0.99		1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.93		1.00	0.85	1.00	1.00
Flt Protected	0.97		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1681		5085	1534	1770	5085
Flt Permitted	0.97		1.00	1.00	0.95	1.00
Satd. Flow (perm)	1681		5085	1534	1770	5085
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	195	183	2027	236	102	1373
RTOR Reduction (vph)	22	0	0	36	0	0
Lane Group Flow (vph)	356	0	2027	200	102	1373
Confl. Peds. (#/hr)		5		10		
Turn Type	Prot		NA	Perm	Prot	NA
Protected Phases	4		6		5	2
Permitted Phases				6		
Actuated Green, G (s)	30.0		66.7	66.7	9.5	80.2
Effective Green, g (s)	30.0		66.7	66.7	9.5	80.2
Actuated g/C Ratio	0.20		0.44	0.44	0.06	0.53
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.2		4.0	4.0	2.0	4.0
Lane Grp Cap (vph)	336		2261	682	112	2718
v/s Ratio Prot	c0.21		c0.40		c0.06	0.27
v/s Ratio Perm				0.13		
v/c Ratio	1.06		0.90	0.29	0.91	0.51
Uniform Delay, d1	60.0		38.5	26.6	69.8	22.2
Progression Factor	1.00		1.00	1.00	0.67	2.13
Incremental Delay, d2	65.3		6.1	1.1	39.8	0.4
Delay (s)	125.3		44.6	27.7	86.4	47.7
Level of Service	F		D	C	F	D
Approach Delay (s)	125.3		42.8			50.4
Approach LOS	F		D			D
<b>Intersection Summary</b>						
HCM 2000 Control Delay			53.1		HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.74			
Actuated Cycle Length (s)			150.0		Sum of lost time (s)	15.0
Intersection Capacity Utilization			73.2%		ICU Level of Service	D
Analysis Period (min)			15			
c	Critical Lane Group					



































Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	341	682	264	354	1632	404	1039	198	250	1408
v/c Ratio	1.01	0.45	0.44	0.86	1.03	1.02	0.72	0.23	0.81	1.06
Control Delay	133.8	55.7	13.6	101.6	90.6	130.6	51.2	23.1	105.2	98.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	133.8	55.7	13.6	101.6	90.6	130.6	51.2	23.1	105.2	98.1
Queue Length 50th (ft)	~226	255	43	227	~785	~274	574	126	160	~1011
Queue Length 95th (ft)	#342	311	137	281	#878	#393	682	178	210	#1150
Internal Link Dist (ft)		611			978		1346			917
Turn Bay Length (ft)	350		350	300		350			250	
Base Capacity (vph)	337	1518	599	507	1591	395	1441	907	379	1323
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.01	0.45	0.44	0.70	1.03	1.02	0.72	0.22	0.66	1.06

**Intersection Summary**

- ~ Volume exceeds capacity, queue is theoretically infinite.  
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real



















Cumulative + No Project  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  		 	  		 	 		 	 	
Traffic Volume (vph)	327	655	253	333	1309	225	372	956	182	240	1159	193
Future Volume (vph)	327	655	253	333	1309	225	372	956	182	240	1159	193
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.95	
Frbp, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1500	3433	4926		3433	3539	1583	3433	3449	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1500	3433	4926		3433	3539	1583	3433	3449	
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.92	0.92	0.92	0.96	0.96	0.96
Adj. Flow (vph)	341	682	264	354	1393	239	404	1039	198	250	1207	201
RTOR Reduction (vph)	0	0	152	0	13	0	0	0	0	0	7	0
Lane Group Flow (vph)	341	682	112	354	1619	0	404	1039	198	250	1401	0
Confl. Peds. (#/hr)			21			27			29			8
Confl. Bikes (#/hr)						3						1
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									
Actuated Green, G (s)	18.7	56.7	56.7	22.9	60.9		21.9	77.4	104.8	17.0	72.5	
Effective Green, g (s)	18.7	56.7	56.7	22.9	60.9		21.9	77.4	104.8	17.0	72.5	
Actuated g/C Ratio	0.10	0.30	0.30	0.12	0.32		0.12	0.41	0.55	0.09	0.38	
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	
Lane Grp Cap (vph)	337	1517	447	413	1578		395	1441	873	307	1316	
v/s Ratio Prot	c0.10	0.13		c0.10	c0.33		c0.12	0.29	0.13	0.07	c0.41	
v/s Ratio Perm			0.07									
v/c Ratio	1.01	0.45	0.25	0.86	1.03		1.02	0.72	0.23	0.81	1.06	
Uniform Delay, d1	85.7	54.0	50.5	81.9	64.5		84.0	47.2	21.8	85.0	58.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	52.1	1.0	1.3	15.4	29.5		51.2	1.5	0.0	14.4	44.0	
Delay (s)	137.7	55.0	51.9	97.3	94.1		135.3	48.8	21.9	99.4	102.8	
Level of Service	F	D	D	F	F		F	D	C	F	F	
Approach Delay (s)		76.3			94.7			66.8			102.3	
Approach LOS		E			F			E			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			86.0			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.05									
Actuated Cycle Length (s)			190.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			103.1%			ICU Level of Service			G			
Analysis Period (min)			15									

c Critical Lane Group
















HCM Unsignalized Intersection Capacity Analysis  
22a: Oregon Ave & Alma St

Cumulative + No Project  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	11	0	84	0	1791	397	0	677	211
Future Volume (Veh/h)	0	0	0	11	0	84	0	1791	397	0	677	211
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.95	0.25	0.95	0.92	0.98	0.98	0.25	0.92	0.92
Hourly flow rate (vph)	0	0	0	12	0	88	0	1828	405	0	736	229
Pedestrians	19											
Lane Width (ft)	12.0											
Walking Speed (ft/s)	3.5											
Percent Blockage	2											
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1852	3102	482	2215	2812	933	965				2252	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1852	3102	482	2215	2812	933	965				2252	
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	100	100	100	49	100	67	100				100	
cM capacity (veh/h)	30	11	530	23	17	263	709				221	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>WB 2</b>	<b>NB 1</b>	<b>NB 2</b>	<b>NB 3</b>	<b>SB 1</b>	<b>SB 2</b>					
Volume Total	12	88	914	914	405	491	474					
Volume Left	12	0	0	0	0	0	0					
Volume Right	0	88	0	0	405	0	229					
cSH	23	263	1700	1700	1700	1700	1700					
Volume to Capacity	0.51	0.33	0.54	0.54	0.24	0.29	0.28					
Queue Length 95th (ft)	38	35	0	0	0	0	0					
Control Delay (s)	267.0	25.4	0.0	0.0	0.0	0.0	0.0					
Lane LOS	F	D										
Approach Delay (s)	54.4	0.0		0.0			0.0					
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay	1.7											
Intersection Capacity Utilization	61.4%		ICU Level of Service				B					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

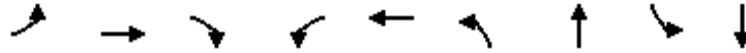
Cumulative + No Project  
 Timing Plan: A.M. Peak

							
Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations			 		 	  	
Traffic Volume (veh/h)	0	301	1887	171	84	605	
Future Volume (Veh/h)	0	301	1887	171	84	605	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.25	0.92	0.98	0.98	0.92	0.92	
Hourly flow rate (vph)	0	327	1926	174	91	658	
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type			None			None	
Median storage (veh)							
Upstream signal (ft)							
pX, platoon unblocked							
vC, conflicting volume	2437	963			1926		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	2437	963			1926		
tC, single (s)	6.8	6.9			4.1		
tC, 2 stage (s)							
tF (s)	3.5	3.3			2.2		
p0 queue free %	100	0			70		
cM capacity (veh/h)	18	256			302		
Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	327	963	963	174	91	329	329
Volume Left	0	0	0	0	91	0	0
Volume Right	327	0	0	174	0	0	0
cSH	256	1700	1700	1700	302	1700	1700
Volume to Capacity	1.28	0.57	0.57	0.10	0.30	0.19	0.19
Queue Length 95th (ft)	410	0	0	0	31	0	0
Control Delay (s)	191.7	0.0	0.0	0.0	21.9	0.0	0.0
Lane LOS	F				C		
Approach Delay (s)	191.7	0.0			2.7		
Approach LOS	F						
Intersection Summary							
Average Delay			20.4				
Intersection Capacity Utilization			77.5%		ICU Level of Service		D
Analysis Period (min)			15				



Queues  
23: Cowper St & Oregon Expy

Cumulative + No Project  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	22	1713	60	30	1847	125	106	36	72
v/c Ratio	0.23	0.77	0.06	0.31	0.82	0.89	0.34	0.34	0.29
Control Delay	74.2	26.4	1.7	89.0	16.7	117.5	41.9	76.8	39.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	74.2	26.4	1.7	89.0	16.7	117.5	41.9	76.8	39.4
Queue Length 50th (ft)	21	530	0	31	88	123	77	35	48
Queue Length 95th (ft)	53	#1048	12	m26	m#872	#250	114	74	82
Internal Link Dist (ft)		1547			1028		66		60
Turn Bay Length (ft)	115		50	115					
Base Capacity (vph)	95	2237	1009	97	2241	141	474	106	445
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.77	0.06	0.31	0.82	0.89	0.22	0.34	0.16

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.























Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 23: Cowper St & Oregon Expy

Cumulative + No Project  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	1576	55	29	1757	16	115	54	43	33	40	27
Future Volume (vph)	20	1576	55	29	1757	16	115	54	43	33	40	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.98		1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.93		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1546	1770	3533		1770	1698		1770	1724	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1546	1770	3533		1770	1698		1770	1724	
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	22	1713	60	30	1830	17	125	59	47	36	43	29
RTOR Reduction (vph)	0	0	23	0	0	0	0	22	0	0	19	0
Lane Group Flow (vph)	22	1713	37	30	1847	0	125	84	0	36	53	0
Confl. Peds. (#/hr)			1			11			8			10
Confl. Bikes (#/hr)									25			8
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases			6									
Actuated Green, G (s)	4.9	91.9	91.9	5.0	92.2		12.0	25.8		7.2	21.2	
Effective Green, g (s)	4.9	91.9	91.9	5.0	92.2		12.0	25.8		7.2	21.2	
Actuated g/C Ratio	0.03	0.61	0.61	0.03	0.61		0.08	0.17		0.05	0.14	
Clearance Time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0		5.0	3.0		4.0	3.0	
Lane Grp Cap (vph)	57	2168	947	59	2171		141	292		84	243	
v/s Ratio Prot	0.01	0.48		c0.02	c0.52		c0.07	c0.05		0.02	0.03	
v/s Ratio Perm			0.02									
v/c Ratio	0.39	0.79	0.04	0.51	0.85		0.89	0.29		0.43	0.22	
Uniform Delay, d1	71.1	21.8	11.5	71.3	23.3		68.3	54.1		69.4	57.1	
Progression Factor	1.00	1.00	1.00	1.28	0.60		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.3	3.0	0.1	0.6	0.4		46.0	0.6		4.7	0.5	
Delay (s)	75.4	24.8	11.6	92.1	14.4		114.3	54.7		74.1	57.5	
Level of Service	E	C	B	F	B		F	D		E	E	
Approach Delay (s)		25.0			15.6			86.9			63.1	
Approach LOS		C			B			F			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			25.2			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.75									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			20.1			
Intersection Capacity Utilization			75.4%			ICU Level of Service				D		
Analysis Period (min)			15									

c Critical Lane Group

Queues  
24: Middlefield Rd & Oregon Expy

Cumulative + No Project  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	141	1420	185	135	1418	64	323	468	261	105	497
v/c Ratio	1.11	1.15	0.29	0.68	1.03	0.11	1.32	0.80	0.43	0.73	0.54
Control Delay	166.3	126.3	27.6	80.2	77.6	0.4	219.1	57.1	12.5	95.6	40.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	166.3	126.3	27.6	80.2	77.6	0.4	219.1	57.1	12.5	95.6	40.9
Queue Length 50th (ft)	~154	-857	39	129	-798	0	-407	417	50	102	184
Queue Length 95th (ft)	m#245	#998	m167	#310	#1036	0	#606	514	119	#187	225
Internal Link Dist (ft)		1028			896			676			311
Turn Bay Length (ft)	360		100	390		100	230			145	
Base Capacity (vph)	127	1231	630	200	1372	595	244	690	684	153	1118
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.11	1.15	0.29	0.68	1.03	0.11	1.32	0.68	0.38	0.69	0.44

























Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 24: Middlefield Rd & Oregon Expy

Cumulative + No Project  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	1306	170	130	1361	61	297	431	240	97	290	167
Future Volume (vph)	130	1306	170	130	1361	61	297	431	240	97	290	167
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.83	1.00	1.00	0.96	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1561	1770	3539	1321	1770	1863	1524	1770	3326	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1561	1770	3539	1321	1770	1863	1524	1770	3326	
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	1420	185	135	1418	64	323	468	261	105	315	182
RTOR Reduction (vph)	0	0	88	0	0	39	0	0	130	0	59	0
Lane Group Flow (vph)	141	1420	97	135	1418	25	323	468	131	105	438	0
Confl. Peds. (#/hr)			1			51			27			4
Confl. Bikes (#/hr)						2						
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			
Actuated Green, G (s)	10.8	52.2	52.2	17.0	58.2	58.2	20.7	47.3	47.3	12.1	38.8	
Effective Green, g (s)	10.8	52.2	52.2	17.0	58.2	58.2	20.7	47.3	47.3	12.1	38.8	
Actuated g/C Ratio	0.07	0.35	0.35	0.11	0.39	0.39	0.14	0.32	0.32	0.08	0.26	
Clearance Time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0	4.0	5.0	5.0	5.0	3.0	3.0	
Lane Grp Cap (vph)	127	1231	543	200	1373	512	244	587	480	142	860	
v/s Ratio Prot	0.08	c0.40		0.08	c0.40		c0.18	c0.25		0.06	0.13	
v/s Ratio Perm			0.06			0.02			0.09			
v/c Ratio	1.11	1.15	0.18	0.68	1.03	0.05	1.32	0.80	0.27	0.74	0.51	
Uniform Delay, d1	69.6	48.9	34.0	63.8	45.9	28.6	64.7	47.0	38.5	67.4	47.5	
Progression Factor	1.18	1.20	2.48	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	97.0	75.6	0.5	8.7	33.1	0.2	171.3	8.5	0.6	18.1	0.5	
Delay (s)	179.1	134.4	84.7	72.5	79.0	28.8	236.0	55.5	39.1	85.5	47.9	
Level of Service	F	F	F	E	E	C	F	E	D	F	D	
Approach Delay (s)		132.8			76.5			106.8			54.5	
Approach LOS		F			E			F			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			99.8				HCM 2000 Level of Service				F	
HCM 2000 Volume to Capacity ratio			1.09									
Actuated Cycle Length (s)			150.0				Sum of lost time (s)				21.6	
Intersection Capacity Utilization			103.1%				ICU Level of Service				G	
Analysis Period (min)			15									

c Critical Lane Group

Queues  
1: Alma Street & Homer Ave

Cumulative + No Project  
Timing Plan: P.M.Peak















Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	591	1260	1074
v/c Ratio	0.85	0.81	0.69
Control Delay	43.1	27.0	23.0
Queue Delay	0.0	0.0	0.0
Total Delay	43.1	27.0	23.0
Queue Length 50th (ft)	153	321	253
Queue Length 95th (ft)	#237	410	326
Internal Link Dist (ft)	443	390	481
Turn Bay Length (ft)			
Base Capacity (vph)	742	1608	1608
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.80	0.78	0.67

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 1: Alma Street & Homer Ave

Cumulative + No Project  
 Timing Plan: P.M.Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	 		 			 
Traffic Volume (vph)	402	142	1222	0	0	1010
Future Volume (vph)	402	142	1222	0	0	1010
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		5.0			5.0
Lane Util. Factor	0.97		0.95			0.95
Frbp, ped/bikes	0.96		1.00			1.00
Flpb, ped/bikes	0.88		1.00			1.00
Frt	0.96		1.00			1.00
Flt Protected	0.96		1.00			1.00
Satd. Flow (prot)	2821		3539			3539
Flt Permitted	0.96		1.00			1.00
Satd. Flow (perm)	2821		3539			3539
Peak-hour factor, PHF	0.92	0.92	0.97	0.25	0.25	0.94
Adj. Flow (vph)	437	154	1260	0	0	1074
RTOR Reduction (vph)	38	0	0	0	0	0
Lane Group Flow (vph)	553	0	1260	0	0	1074
Confl. Peds. (#/hr)	77	61		28		
Confl. Bikes (#/hr)		3				
Turn Type	Perm		NA			NA
Protected Phases			2			6
Permitted Phases	8					
Actuated Green, G (s)	20.5		38.7			38.7
Effective Green, g (s)	20.5		38.7			38.7
Actuated g/C Ratio	0.23		0.44			0.44
Clearance Time (s)	4.0		5.0			5.0
Vehicle Extension (s)	3.0		4.0			4.0
Lane Grp Cap (vph)	654		1551			1551
v/s Ratio Prot			c0.36			0.30
v/s Ratio Perm	c0.20					
v/c Ratio	0.84		0.81			0.69
Uniform Delay, d1	32.4		21.6			20.0
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	9.8		3.5			1.5
Delay (s)	42.2		25.2			21.5
Level of Service	D		C			C
Approach Delay (s)	42.2		25.2			21.5
Approach LOS	D		C			C
<b>Intersection Summary</b>						
HCM 2000 Control Delay			27.2		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.65			
Actuated Cycle Length (s)			88.3		Sum of lost time (s)	13.0
Intersection Capacity Utilization			58.4%		ICU Level of Service	B
Analysis Period (min)			15			

c Critical Lane Group

Intersection Sign configuration not allowed in HCM analysis.

# HCM Unsignalized Intersection Capacity Analysis

## 3: Alma Street & Lincoln Ave

Cumulative + No Project  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	34	20	1671	95	20	1362
Future Volume (Veh/h)	34	20	1671	95	20	1362
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.95	0.95
Hourly flow rate (vph)	37	22	1778	101	21	1434
Pedestrians	12					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type			None		None	
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2600	952			1891	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2600	952			1891	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	91			93	
cM capacity (veh/h)	19	257			309	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	59	1185	694	499	956	
Volume Left	37	0	0	21	0	
Volume Right	22	0	101	0	0	
cSH	28	1700	1700	309	1700	
Volume to Capacity	2.07	0.70	0.41	0.07	0.56	
Queue Length 95th (ft)	175	0	0	5	0	
Control Delay (s)	792.8	0.0	0.0	2.3	0.0	
Lane LOS	F		A			
Approach Delay (s)	792.8	0.0	0.8			
Approach LOS	F					
Intersection Summary						
Average Delay			14.1			
Intersection Capacity Utilization			61.8%		ICU Level of Service	B
Analysis Period (min)			15			



HCM Unsignalized Intersection Capacity Analysis  
 4: Alma Street & Embarcadero Rd

















Cumulative + No Project  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑			↗
Traffic Volume (veh/h)	0	1394	1644	0	0	120
Future Volume (Veh/h)	0	1394	1644	0	0	120
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.25	0.98	0.98	0.25	0.25	0.92
Hourly flow rate (vph)	0	1422	1678	0	0	130
Pedestrians						18
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					2	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1696				2407	1696
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1696				2407	1696
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	0
cM capacity (veh/h)	365				27	80
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>SB 1</b>		
Volume Total	711	711	1678	130		
Volume Left	0	0	0	0		
Volume Right	0	0	0	130		
cSH	1700	1700	1700	80		
Volume to Capacity	0.42	0.42	0.99	1.62		
Queue Length 95th (ft)	0	0	0	269		
Control Delay (s)	0.0	0.0	0.0	418.6		
Lane LOS				F		
Approach Delay (s)	0.0		0.0	418.6		
Approach LOS				F		
<b>Intersection Summary</b>						
Average Delay			16.8			
Intersection Capacity Utilization			100.6%		ICU Level of Service	G
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
 5: Emerson St & Lincoln Ave

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	79	53	33	57	9	2	35	2	9	21	0
Future Volume (vph)	8	79	53	33	57	9	2	35	2	9	21	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	86	58	36	62	10	2	38	2	10	23	0
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	153	108	42	33								
Volume Left (vph)	9	36	2	10								
Volume Right (vph)	58	10	2	0								
Hadj (s)	-0.18	0.05	0.01	0.09								
Departure Headway (s)	4.0	4.3	4.5	4.6								
Degree Utilization, x	0.17	0.13	0.05	0.04								
Capacity (veh/h)	875	820	746	726								
Control Delay (s)	7.8	7.9	7.8	7.8								
Approach Delay (s)	7.8	7.9	7.8	7.8								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.8									
Level of Service			A									
Intersection Capacity Utilization			28.5%	ICU Level of Service	A							
Analysis Period (min)			15									

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Intersection Sign configuration not allowed in HCM analysis.

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Intersection Sign configuration not allowed in HCM analysis.

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# HCM Unsignalized Intersection Capacity Analysis

## 8: Alma Street & Kingsley Ave

Cumulative + No Project  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	26	31	1622	34	77	1307
Future Volume (Veh/h)	26	31	1622	34	77	1307
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.97	0.97	0.96	0.96
Hourly flow rate (vph)	28	34	1672	35	80	1361
Pedestrians	17					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	2					
Right turn flare (veh)						
Median type			None		None	
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2547	1706			1724	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2547	1706			1724	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	57			78	
cM capacity (veh/h)	17	79			357	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>	<b>SB 2</b>		
Volume Total	62	1707	534	907		
Volume Left	28	0	80	0		
Volume Right	34	35	0	0		
cSH	30	1700	357	1700		
Volume to Capacity	2.10	1.00	0.22	0.53		
Queue Length 95th (ft)	182	0	21	0		
Control Delay (s)	794.7	0.0	7.4	0.0		
Lane LOS	F		A			
Approach Delay (s)	794.7	0.0	2.7			
Approach LOS	F					
<b>Intersection Summary</b>						
Average Delay			16.6			
Intersection Capacity Utilization			103.7%		ICU Level of Service	G
Analysis Period (min)			15			

Queues  
9: Alma St & Churchill Ave

Cumulative + No Project  
Timing Plan: P.M.Peak
























Lane Group	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	253	289	143	234	1659	9	1349	118
v/c Ratio	0.87	0.60	0.65	0.87	0.79	0.11	0.85	0.16
Control Delay	101.4	12.6	90.0	105.1	32.5	90.9	51.4	10.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	101.4	12.6	90.0	105.1	32.5	90.9	51.4	10.7
Queue Length 50th (ft)	311	3	170	288	766	11	804	23
Queue Length 95th (ft)	#460	102	256	#440	1008	34	908	67
Internal Link Dist (ft)	340		479		698		387	
Turn Bay Length (ft)				300		60		
Base Capacity (vph)	328	503	254	301	2182	80	1667	791
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.77	0.57	0.56	0.78	0.76	0.11	0.81	0.15

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

















HCM Signalized Intersection Capacity Analysis  
 9: Alma St & Churchill Ave

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	144	88	266	68	55	8	215	1497	29	8	1255	110
Future Volume (vph)	144	88	266	68	55	8	215	1497	29	8	1255	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Frbp, ped/bikes		1.00	0.93		0.99		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt		1.00	0.85		0.99		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1807	1480		1787		1770	3527		1770	3539	1583
Flt Permitted		0.97	1.00		0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1807	1480		1787		1770	3527		1770	3539	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	157	96	289	74	60	9	234	1627	32	9	1349	118
RTOR Reduction (vph)	0	0	240	0	1	0	0	1	0	0	0	47
Lane Group Flow (vph)	0	253	49	0	142	0	234	1658	0	9	1349	71
Confl. Peds. (#/hr)			11				42		6			
Confl. Bikes (#/hr)			20				8					
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	8	8		7	7		1	6		5	2	
Permitted Phases			8									2
Actuated Green, G (s)		28.9	28.9		22.0		27.2	107.0		3.0	82.8	82.8
Effective Green, g (s)		28.9	28.9		22.0		27.2	107.0		3.0	82.8	82.8
Actuated g/C Ratio		0.16	0.16		0.12		0.15	0.59		0.02	0.46	0.46
Clearance Time (s)		5.0	5.0		5.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)		3.0	3.0		3.0		3.0	6.0		3.0	6.0	6.0
Lane Grp Cap (vph)		288	236		217		266	2086		29	1619	724
v/s Ratio Prot		c0.14			c0.08		c0.13	0.47		0.01	c0.38	
v/s Ratio Perm			0.03									0.05
v/c Ratio		0.88	0.21		0.65		0.88	0.79		0.31	0.83	0.10
Uniform Delay, d1		74.3	66.0		75.8		75.2	28.5		87.9	43.0	27.9
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		24.7	0.4		6.9		26.4	2.7		6.0	4.5	0.2
Delay (s)		98.9	66.5		82.8		101.6	31.1		94.0	47.5	28.0
Level of Service		F	E		F		F	C		F	D	C
Approach Delay (s)		81.6			82.8		39.9			46.2		
Approach LOS		F			F		D			D		
<b>Intersection Summary</b>												
HCM 2000 Control Delay			49.3				HCM 2000 Level of Service			D		
HCM 2000 Volume to Capacity ratio			0.82									
Actuated Cycle Length (s)			180.9				Sum of lost time (s)			20.0		
Intersection Capacity Utilization			83.4%				ICU Level of Service			E		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis  
 10: Emerson St & Churchill Ave

















Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	6	129	14	3	94	0	15	10	3	8	25	23
Future Volume (vph)	6	129	14	3	94	0	15	10	3	8	25	23
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	140	15	3	102	0	16	11	3	9	27	25
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	162	105	30	61								
Volume Left (vph)	7	3	16	9								
Volume Right (vph)	15	0	3	25								
Hadj (s)	-0.01	0.04	0.08	-0.18								
Departure Headway (s)	4.2	4.3	4.6	4.3								
Degree Utilization, x	0.19	0.13	0.04	0.07								
Capacity (veh/h)	832	799	723	768								
Control Delay (s)	8.2	7.9	7.8	7.7								
Approach Delay (s)	8.2	7.9	7.8	7.7								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.0									
Level of Service			A									
Intersection Capacity Utilization			23.6%		ICU Level of Service				A			
Analysis Period (min)			15									



















HCM Unsignalized Intersection Capacity Analysis  
 11: Bryant St & Churchill Ave

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	7	127	6	2	87	3	3	6	3	3	32	7
Future Volume (Veh/h)	7	127	6	2	87	3	3	6	3	3	32	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	137	6	2	95	3	3	7	3	3	35	8
Pedestrians		9			12			1			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											936	
pX, platoon unblocked												
vC, conflicting volume	124	82	49	147	84	26	52			22		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	124	82	49	147	84	26	52			22		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	83	99	100	88	100	100			100		
cM capacity (veh/h)	746	789	1010	687	787	1034	1541			1575		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	151	100	13	46								
Volume Left	8	2	3	3								
Volume Right	6	3	3	8								
cSH	794	790	1541	1575								
Volume to Capacity	0.19	0.13	0.00	0.00								
Queue Length 95th (ft)	17	11	0	0								
Control Delay (s)	10.6	10.2	1.7	0.5								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.6	10.2	1.7	0.5								
Approach LOS	B	B										
<b>Intersection Summary</b>												
Average Delay			8.6									
Intersection Capacity Utilization			24.0%		ICU Level of Service				A			
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 12: Waverly St & Churchill Ave

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	28	92	10	3	49	12	9	87	2	10	115	36
Future Volume (vph)	28	92	10	3	49	12	9	87	2	10	115	36
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.97	0.97	0.97
Hourly flow rate (vph)	30	100	11	3	53	13	10	95	2	10	119	37
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	141	69	107	166								
Volume Left (vph)	30	3	10	10								
Volume Right (vph)	11	13	2	37								
Hadj (s)	0.03	-0.07	0.04	-0.09								
Departure Headway (s)	4.7	4.7	4.7	4.5								
Degree Utilization, x	0.18	0.09	0.14	0.21								
Capacity (veh/h)	721	714	730	761								
Control Delay (s)	8.7	8.1	8.4	8.6								
Approach Delay (s)	8.7	8.1	8.4	8.6								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.5									
Level of Service			A									
Intersection Capacity Utilization			31.8%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 13: Cowper St & Churchill Ave

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	2	95	11	3	35	0	14	28	3	0	36	7
Future Volume (vph)	2	95	11	3	35	0	14	28	3	0	36	7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	103	12	3	38	0	15	30	3	0	39	8
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	117	41	48	47								
Volume Left (vph)	2	3	15	0								
Volume Right (vph)	12	0	3	8								
Hadj (s)	-0.02	0.05	0.06	-0.07								
Departure Headway (s)	4.1	4.3	4.4	4.2								
Degree Utilization, x	0.13	0.05	0.06	0.06								
Capacity (veh/h)	847	815	787	814								
Control Delay (s)	7.8	7.5	7.6	7.5								
Approach Delay (s)	7.8	7.5	7.6	7.5								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.6									
Level of Service			A									
Intersection Capacity Utilization			23.6%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 14: Churchill Ave & Embarcadero Rd

















Cumulative + No Project  
 Timing Plan: P.M.Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	1113	2	47	982	0	58
Future Volume (Veh/h)	1113	2	47	982	0	58
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.25	0.92
Hourly flow rate (vph)	1210	2	50	1045	0	63
Pedestrians						8
Lane Width (ft)						12.0
Walking Speed (ft/s)						3.5
Percent Blockage						1
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)	1093			898		
pX, platoon unblocked				0.78	0.78	0.78
vC, conflicting volume				1218	1842	614
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				722	1519	0
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				93	100	93
cM capacity (veh/h)				680	79	842
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	807	405	398	697	63	
Volume Left	0	0	50	0	0	
Volume Right	0	2	0	0	63	
cSH	1700	1700	680	1700	842	
Volume to Capacity	0.47	0.24	0.07	0.41	0.07	
Queue Length 95th (ft)	0	0	6	0	6	
Control Delay (s)	0.0	0.0	2.2	0.0	9.6	
Lane LOS				A	A	
Approach Delay (s)	0.0		0.8		9.6	
Approach LOS						A
Intersection Summary						
Average Delay				0.6		
Intersection Capacity Utilization				65.2%	ICU Level of Service	C
Analysis Period (min)				15		

HCM Unsignalized Intersection Capacity Analysis  
 15: Cowper St & Embarcadero Rd

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	1097	17	8	928	41	2	10	7	12	7	19
Future Volume (Veh/h)	20	1097	17	8	928	41	2	10	7	12	7	19
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.96	0.96	0.96	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	1192	18	8	967	43	2	11	8	13	8	21
Pedestrians								8			1	
Lane Width (ft)								12.0			12.0	
Walking Speed (ft/s)								3.5			3.5	
Percent Blockage								1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.77			0.77	0.77	0.77	0.77	0.77	
vC, conflicting volume	1011			1218			1778	2280	613	1659	2268	506
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1011			685			1412	2065	0	1258	2049	506
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			97	72	99	82	80	96
cM capacity (veh/h)	681			691			58	39	828	73	40	511
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	618	614	492	526	21	42						
Volume Left	22	0	8	0	2	13						
Volume Right	0	18	0	43	8	21						
cSH	681	1700	691	1700	65	101						
Volume to Capacity	0.03	0.36	0.01	0.31	0.32	0.42						
Queue Length 95th (ft)	3	0	1	0	30	43						
Control Delay (s)	0.9	0.0	0.3	0.0	85.0	64.3						
Lane LOS	A		A		F	F						
Approach Delay (s)	0.4		0.2		85.0	64.3						
Approach LOS					F	F						
Intersection Summary												
Average Delay			2.2									
Intersection Capacity Utilization			56.7%	ICU Level of Service	B							
Analysis Period (min)			15									

Queues  
16: Waverly St & Embarcadero Rd




















Cumulative + No Project  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	98	1141	24	982	176	301
v/c Ratio	0.48	0.62	0.16	0.53	0.28	0.53
Control Delay	34.6	28.0	15.6	18.0	25.1	29.8
Queue Delay	0.0	0.2	0.0	0.0	0.0	0.0
Total Delay	34.6	28.2	15.6	18.0	25.1	29.8
Queue Length 50th (ft)	56	342	8	216	85	160
Queue Length 95th (ft)	104	416	25	272	141	251
Internal Link Dist (ft)		572		576	43	709
Turn Bay Length (ft)	95		75			
Base Capacity (vph)	214	1922	160	1913	625	572
Starvation Cap Reductn	0	197	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.66	0.15	0.51	0.28	0.53
<b>Intersection Summary</b>						

HCM Signalized Intersection Capacity Analysis  
 16: Waverly St & Embarcadero Rd

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	90	1024	26	23	861	62	35	110	17	99	119	59
Future Volume (vph)	90	1024	26	23	861	62	35	110	17	99	119	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	1.00		1.00	0.99			0.99			0.97	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.98	
Satd. Flow (prot)	1768	3523		1765	3498			1814			1769	
Flt Permitted	0.21	1.00		0.16	1.00			0.88			0.82	
Satd. Flow (perm)	393	3523		293	3498			1619			1470	
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	1113	28	24	916	66	38	120	18	108	129	64
RTOR Reduction (vph)	0	2	0	0	5	0	0	4	0	0	9	0
Lane Group Flow (vph)	98	1139	0	24	977	0	0	172	0	0	292	0
Confl. Peds. (#/hr)	2		10	10		2	2		6	6		2
Confl. Bikes (#/hr)												4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)	57.8	57.8		57.8	57.8			42.2			42.2	
Effective Green, g (s)	57.8	57.8		57.8	57.8			42.2			42.2	
Actuated g/C Ratio	0.53	0.53		0.53	0.53			0.38			0.38	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			4.0			4.0	
Lane Grp Cap (vph)	206	1851		153	1838			621			563	
v/s Ratio Prot		c0.32			0.28							
v/s Ratio Perm	0.25			0.08				0.11			c0.20	
v/c Ratio	0.48	0.62		0.16	0.53			0.28			0.52	
Uniform Delay, d1	16.5	18.3		13.5	17.2			23.4			26.1	
Progression Factor	1.61	1.47		1.00	1.00			1.00			1.00	
Incremental Delay, d2	1.5	0.5		0.5	0.3			1.1			3.4	
Delay (s)	28.1	27.4		14.0	17.5			24.5			29.5	
Level of Service	C	C		B	B			C			C	
Approach Delay (s)		27.5			17.4			24.5			29.5	
Approach LOS		C			B			C			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			23.8									C
HCM 2000 Volume to Capacity ratio			0.57									
Actuated Cycle Length (s)			110.0							10.0		
Intersection Capacity Utilization			73.9%									D
Analysis Period (min)			15									

c Critical Lane Group

Queues  
17: Bryant St & Embarcadero Rd

Cumulative + No Project  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	NBR	SBR
Lane Group Flow (vph)	183	1307	15	1019	13	40
v/c Ratio	0.50	0.49	0.06	0.38	0.04	0.10
Control Delay	14.9	8.0	4.7	6.9	0.2	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.9	8.0	4.7	6.9	0.2	0.5
Queue Length 50th (ft)	64	234	3	268	0	0
Queue Length 95th (ft)	145	288	m7	338	0	0
Internal Link Dist (ft)		579		572		
Turn Bay Length (ft)	80		60			
Base Capacity (vph)	363	2681	253	2663	443	496
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.49	0.06	0.38	0.03	0.08



















Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



HCM Signalized Intersection Capacity Analysis  
 17: Bryant St & Embarcadero Rd

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	1159	43	14	867	71	0	0	12	0	0	37
Future Volume (vph)	168	1159	43	14	867	71	0	0	12	0	0	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Lane Util. Factor	1.00	0.95		1.00	0.95				1.00			1.00
Frbp, ped/bikes	1.00	1.00		1.00	1.00				0.95			0.93
Flpb, ped/bikes	1.00	1.00		1.00	1.00				1.00			1.00
Frt	1.00	0.99		1.00	0.99				0.86			0.86
Flt Protected	0.95	1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)	1764	3515		1766	3490				1529			1495
Flt Permitted	0.26	1.00		0.18	1.00				1.00			1.00
Satd. Flow (perm)	478	3515		332	3490				1529			1495
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.25	0.25	0.92	0.25	0.25	0.92
Adj. Flow (vph)	183	1260	47	15	942	77	0	0	13	0	0	40
RTOR Reduction (vph)	0	2	0	0	4	0	0	0	11	0	0	33
Lane Group Flow (vph)	183	1305	0	15	1015	0	0	0	2	0	0	7
Confl. Peds. (#/hr)	6		8	8		6			6			20
Confl. Bikes (#/hr)									24			28
Turn Type	Perm	NA		Perm	NA				Perm			Perm
Protected Phases		2			2							
Permitted Phases	2			2					4			4
Actuated Green, G (s)	81.8	81.8		81.8	81.8				18.2			18.2
Effective Green, g (s)	81.8	81.8		81.8	81.8				18.2			18.2
Actuated g/C Ratio	0.74	0.74		0.74	0.74				0.17			0.17
Clearance Time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0				3.0			3.0
Lane Grp Cap (vph)	355	2613		246	2595				252			247
v/s Ratio Prot		0.37			0.29							
v/s Ratio Perm	c0.38			0.05					0.00			c0.00
v/c Ratio	0.52	0.50		0.06	0.39				0.01			0.03
Uniform Delay, d1	5.9	5.8		3.8	5.1				38.4			38.5
Progression Factor	1.00	1.00		0.64	1.02				1.00			1.00
Incremental Delay, d2	5.3	0.7		0.4	0.4				0.0			0.0
Delay (s)	11.1	6.4		2.9	5.6				38.4			38.5
Level of Service	B	A		A	A				D			D
Approach Delay (s)		7.0			5.5			38.4			38.5	
Approach LOS		A			A			D			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			7.1									A
HCM 2000 Volume to Capacity ratio			0.43									
Actuated Cycle Length (s)			110.0						10.0			
Intersection Capacity Utilization			52.7%									A
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
18: Middlefield Rd & Embarcadero Rd

Cumulative + No Project  
Timing Plan: P.M.Peak
























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	48	1181	96	1007	131	490	189	475
v/c Ratio	0.43	0.83	0.81	0.68	0.91	0.58	0.91	0.92
Control Delay	61.8	35.8	96.1	29.1	105.3	39.5	91.2	63.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.8	35.8	96.1	29.1	105.3	39.5	91.2	63.5
Queue Length 50th (ft)	33	393	68	312	93	158	134	319
Queue Length 95th (ft)	73	486	#166	392	#210	212	#267	#505
Internal Link Dist (ft)		577		509		183		494
Turn Bay Length (ft)	115		100		115		100	
Base Capacity (vph)	112	1421	118	1484	144	887	209	537
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.43	0.83	0.81	0.68	0.91	0.55	0.90	0.88

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 18: Middlefield Rd & Embarcadero Rd

Cumulative + No Project  
 Timing Plan: P.M.Peak

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	46	1033	101	88	782	144	122	405	51	176	415	27	
Future Volume (vph)	46	1033	101	88	782	144	122	405	51	176	415	27	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5		
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	1.00		
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Frt	1.00	0.99		1.00	0.98		1.00	0.98		1.00	0.99		
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (prot)	1770	3480		1770	3440		1770	3474		1770	1842		
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (perm)	1770	3480		1770	3440		1770	3474		1770	1842		
Peak-hour factor, PHF	0.96	0.96	0.96	0.92	0.92	0.92	0.93	0.93	0.93	0.93	0.93	0.93	
Adj. Flow (vph)	48	1076	105	96	850	157	131	435	55	189	446	29	
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0	
Lane Group Flow (vph)	48	1181	0	96	1007	0	131	490	0	189	475	0	
Confl. Peds. (#/hr)			9			15			1			16	
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA		
Protected Phases	5	2		1	6		3	8		7	4		
Permitted Phases													
Actuated Green, G (s)	5.6	44.8		7.4	46.6		9.0	26.8		13.0	30.8		
Effective Green, g (s)	5.6	44.8		7.4	46.6		9.0	26.8		13.0	30.8		
Actuated g/C Ratio	0.05	0.41		0.07	0.42		0.08	0.24		0.12	0.28		
Clearance Time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5		
Vehicle Extension (s)	2.5	3.5		2.5	3.5		2.5	3.0		2.5	3.0		
Lane Grp Cap (vph)	90	1417		119	1457		144	846		209	515		
v/s Ratio Prot	0.03	c0.34		c0.05	0.29		0.07	0.14		c0.11	c0.26		
v/s Ratio Perm													
v/c Ratio	0.53	0.83		0.81	0.69		0.91	0.58		0.90	0.92		
Uniform Delay, d1	50.9	29.3		50.6	25.8		50.1	36.6		47.9	38.4		
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Incremental Delay, d2	4.7	5.9		30.8	2.7		48.3	1.0		36.8	22.2		
Delay (s)	55.6	35.1		81.4	28.5		98.4	37.6		84.7	60.6		
Level of Service	E	D		F	C		F	D		F	E		
Approach Delay (s)		35.9			33.1			50.4			67.5		
Approach LOS		D			C			D			E		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			43.4									HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.88										
Actuated Cycle Length (s)			110.0									Sum of lost time (s)	18.0
Intersection Capacity Utilization			83.0%									ICU Level of Service	E
Analysis Period (min)			15										
c	Critical Lane Group												

Queues  
19: Galvez St/Embarcadero Rd & El Camino Real

Cumulative + No Project  
Timing Plan: P.M.Peak























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	272	1713	274	2188	218	876	251	716
v/c Ratio	1.28	0.96	1.06	1.16	0.97	0.88	1.25	0.79
Control Delay	208.4	61.2	125.2	104.9	117.7	55.1	200.4	54.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	208.4	61.2	125.2	104.9	117.7	55.1	200.4	54.7
Queue Length 50th (ft)	~336	598	~301	~884	216	382	~306	322
Queue Length 95th (ft)	#525	#705	m250	m324	#387	#475	#488	402
Internal Link Dist (ft)		1237		1007		755		481
Turn Bay Length (ft)	300		382				200	
Base Capacity (vph)	212	1781	259	1894	224	1000	200	907
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.28	0.96	1.06	1.16	0.97	0.88	1.25	0.79

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Cumulative + No Project  
 Timing Plan: P.M.Peak

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	250	1487	89	252	1695	318	201	469	337	233	454	212	
Future Volume (vph)	250	1487	89	252	1695	318	201	469	337	233	454	212	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0		
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95		1.00	0.95		
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.98		1.00	0.97		
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Frt	1.00	0.99		1.00	0.98		1.00	0.94		1.00	0.95		
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (prot)	1770	5026		1770	4938		1770	3264		1770	3265		
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (perm)	1770	5026		1770	4938		1770	3264		1770	3265		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.93	0.93	
Adj. Flow (vph)	272	1616	97	274	1842	346	218	510	366	251	488	228	
RTOR Reduction (vph)	0	5	0	0	18	0	0	86	0	0	37	0	
Lane Group Flow (vph)	272	1708	0	274	2170	0	218	790	0	251	679	0	
Confl. Peds. (#/hr)			27			15			25			78	
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA		
Protected Phases	5	2		1	6		3	8		7	4		
Permitted Phases													
Actuated Green, G (s)	18.0	53.0		22.0	57.0		19.0	42.0		17.0	40.0		
Effective Green, g (s)	18.0	53.0		22.0	57.0		19.0	42.0		17.0	40.0		
Actuated g/C Ratio	0.12	0.35		0.15	0.38		0.13	0.28		0.11	0.27		
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0		
Vehicle Extension (s)	2.0	4.0		2.0	4.0		2.5	2.0		2.0	2.0		
Lane Grp Cap (vph)	212	1775		259	1876		224	913		200	870		
v/s Ratio Prot	c0.15	0.34		0.15	c0.44		0.12	c0.24		c0.14	0.21		
v/s Ratio Perm													
v/c Ratio	1.28	0.96		1.06	1.16		0.97	0.86		1.25	0.78		
Uniform Delay, d1	66.0	47.5		64.0	46.5		65.2	51.3		66.5	50.9		
Progression Factor	1.00	1.00		1.61	0.80		1.00	1.00		1.00	1.00		
Incremental Delay, d2	158.3	14.2		34.7	71.2		52.2	8.3		148.9	4.2		
Delay (s)	224.3	61.7		137.5	108.3		117.4	59.6		215.4	55.2		
Level of Service	F	E		F	F		F	E		F	E		
Approach Delay (s)		84.0			111.6			71.1			96.8		
Approach LOS		F			F			E			F		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			94.2									HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio			1.09										
Actuated Cycle Length (s)			150.0									Sum of lost time (s)	16.0
Intersection Capacity Utilization			110.8%									ICU Level of Service	H
Analysis Period (min)			15										
c Critical Lane Group													

Queues  
20: El Camino Real & Churchill Ave

Cumulative + No Project  
Timing Plan: P.M.Peak



Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	403	2148	215	291	1872
v/c Ratio	1.24	1.17	0.37	0.97	0.66
Control Delay	175.6	123.2	29.4	66.6	25.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	175.6	123.2	29.4	66.6	25.3
Queue Length 50th (ft)	~464	~941	120	~355	626
Queue Length 95th (ft)	#682	#1031	196	m#371	m643
Internal Link Dist (ft)	958	687			1175
Turn Bay Length (ft)			100	170	
Base Capacity (vph)	326	1842	586	300	2840
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.24	1.17	0.37	0.97	0.66
















Intersection Summary

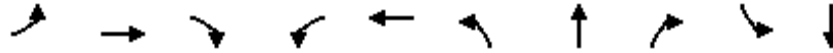
- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 20: El Camino Real & Churchill Ave

Cumulative + No Project  
Timing Plan: P.M.Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			  			  
Traffic Volume (vph)	186	185	2019	202	279	1797
Future Volume (vph)	186	185	2019	202	279	1797
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	1.00		0.91	1.00	1.00	0.91
Frpb, ped/bikes	0.99		1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.93		1.00	0.85	1.00	1.00
Flt Protected	0.98		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1681		5085	1533	1770	5085
Flt Permitted	0.98		1.00	1.00	0.95	1.00
Satd. Flow (perm)	1681		5085	1533	1770	5085
Peak-hour factor, PHF	0.92	0.92	0.94	0.94	0.96	0.96
Adj. Flow (vph)	202	201	2148	215	291	1872
RTOR Reduction (vph)	24	0	0	32	0	0
Lane Group Flow (vph)	379	0	2148	183	291	1872
Confl. Peds. (#/hr)		3		8		
Confl. Bikes (#/hr)				1		
Turn Type	Prot		NA	Perm	Prot	NA
Protected Phases	4		6		5	2
Permitted Phases				6		
Actuated Green, G (s)	27.0		53.8	53.8	25.4	83.2
Effective Green, g (s)	27.0		53.8	53.8	25.4	83.2
Actuated g/C Ratio	0.18		0.36	0.36	0.17	0.55
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.2		4.0	4.0	2.0	4.0
Lane Grp Cap (vph)	302		1823	549	299	2820
v/s Ratio Prot	c0.23		c0.42		c0.16	0.37
v/s Ratio Perm				0.12		
v/c Ratio	1.26		1.18	0.33	0.97	0.66
Uniform Delay, d1	61.5		48.1	35.0	62.0	23.5
Progression Factor	1.00		1.00	1.00	0.69	0.98
Incremental Delay, d2	139.2		86.3	1.6	20.3	0.3
Delay (s)	200.7		134.4	36.7	63.3	23.3
Level of Service	F		F	D	E	C
Approach Delay (s)	200.7		125.5			28.7
Approach LOS	F		F			C
<b>Intersection Summary</b>						
HCM 2000 Control Delay			89.2		HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio			0.90			
Actuated Cycle Length (s)			150.0		Sum of lost time (s)	15.0
Intersection Capacity Utilization			86.3%		ICU Level of Service	E
Analysis Period (min)			15			
c Critical Lane Group						



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	607	1532	216	196	1333	361	1167	243	403	1071
v/c Ratio	0.98	0.78	0.31	0.83	0.97	0.82	0.99	0.36	0.97	0.96
Control Delay	103.7	51.5	8.0	109.7	80.2	91.0	83.3	37.6	114.1	76.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	103.7	51.5	8.0	109.7	80.2	91.0	83.3	37.6	114.1	76.3
Queue Length 50th (ft)	373	581	21	119	560	222	728	195	248	635
Queue Length 95th (ft)	#503	641	84	#179	#657	#324	#889	274	#367	#764
Internal Link Dist (ft)		611			978		1346			917
Turn Bay Length (ft)	350		350	300		350			250	
Base Capacity (vph)	619	1976	692	253	1389	442	1176	674	416	1162
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	0.78	0.31	0.77	0.96	0.82	0.99	0.36	0.97	0.92

































**Intersection Summary**

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real



















Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  		 	  		 	 		 	 	
Traffic Volume (vph)	558	1409	199	194	1035	285	350	1132	236	371	794	191
Future Volume (vph)	558	1409	199	194	1035	285	350	1132	236	371	794	191
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.95	
Frbp, ped/bikes	1.00	1.00	0.94	1.00	0.99		1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3412	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3412	
Peak-hour factor, PHF	0.92	0.92	0.92	0.99	0.99	0.99	0.97	0.97	0.97	0.92	0.92	0.92
Adj. Flow (vph)	607	1532	216	196	1045	288	361	1167	243	403	863	208
RTOR Reduction (vph)	0	0	115	0	27	0	0	0	0	0	12	0
Lane Group Flow (vph)	607	1532	101	196	1306	0	361	1167	243	403	1059	0
Confl. Peds. (#/hr)			27			28			18			13
Confl. Bikes (#/hr)									3			
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									
Actuated Green, G (s)	32.5	70.0	70.0	12.4	49.9		23.2	59.8	76.7	21.8	58.4	
Effective Green, g (s)	32.5	70.0	70.0	12.4	49.9		23.2	59.8	76.7	21.8	58.4	
Actuated g/C Ratio	0.18	0.39	0.39	0.07	0.28		0.13	0.33	0.43	0.12	0.32	
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	
Lane Grp Cap (vph)	619	1977	577	236	1345		442	1175	674	415	1107	
v/s Ratio Prot	c0.18	0.30		0.06	c0.27		0.11	c0.33	0.15	0.12	c0.31	
v/s Ratio Perm			0.07									
v/c Ratio	0.98	0.77	0.18	0.83	0.97		0.82	0.99	0.36	0.97	0.96	
Uniform Delay, d1	73.4	48.1	36.1	82.8	64.3		76.3	59.9	35.0	78.8	59.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	31.1	3.0	0.7	20.5	18.5		11.1	24.4	0.1	36.3	17.3	
Delay (s)	104.5	51.2	36.7	103.2	82.8		87.5	84.3	35.1	115.1	76.8	
Level of Service	F	D	D	F	F		F	F	D	F	E	
Approach Delay (s)		63.6			85.4			78.2			87.3	
Approach LOS		E			F			E			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			76.8			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			0.98									
Actuated Cycle Length (s)			180.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			98.9%			ICU Level of Service			F			
Analysis Period (min)			15									

c Critical Lane Group












HCM Unsignalized Intersection Capacity Analysis  
 22a: Oregon Ave & Alma St

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	35	0	75	0	1765	312	0	1297	306
Future Volume (Veh/h)	0	0	0	35	0	75	0	1765	312	0	1297	306
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.25	0.92	0.25	0.99	0.99	0.25	0.97	0.97
Hourly flow rate (vph)	0	0	0	38	0	82	0	1783	315	0	1337	315
Pedestrians												23
Lane Width (ft)												12.0
Walking Speed (ft/s)												3.5
Percent Blockage												2
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2468	3616	826	2474	3458	914	1652			2121		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2468	3616	826	2474	3458	914	1652			2121		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	0	100	70	100			100		
cM capacity (veh/h)	11	5	315	15	6	269	387			248		
Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2					
Volume Total	38	82	892	892	315	891	761					
Volume Left	38	0	0	0	0	0	0					
Volume Right	0	82	0	0	315	0	315					
cSH	15	269	1700	1700	1700	1700	1700					
Volume to Capacity	2.59	0.30	0.52	0.52	0.19	0.52	0.45					
Queue Length 95th (ft)	138	31	0	0	0	0	0					
Control Delay (s)	1252.6	24.1	0.0	0.0	0.0	0.0	0.0					
Lane LOS	F	C										
Approach Delay (s)	413.1		0.0			0.0						
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay			12.8									
Intersection Capacity Utilization			60.1%		ICU Level of Service				B			
Analysis Period (min)			15									

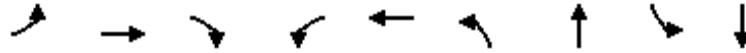
HCM Unsignalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

Cumulative + No Project  
 Timing Plan: P.M.Peak

							
Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	0	357	1720	70	68	1264	
Future Volume (Veh/h)	0	357	1720	70	68	1264	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.25	0.95	0.99	0.99	0.97	0.97	
Hourly flow rate (vph)	0	376	1737	71	70	1303	
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type			None			None	
Median storage veh							
Upstream signal (ft)							
pX, platoon unblocked							
vC, conflicting volume	2528	868			1737		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	2528	868			1737		
tC, single (s)	6.8	6.9			4.1		
tC, 2 stage (s)							
tF (s)	3.5	3.3			2.2		
p0 queue free %	100	0			80		
cM capacity (veh/h)	18	295			358		
Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	376	868	868	71	70	652	652
Volume Left	0	0	0	0	70	0	0
Volume Right	376	0	0	71	0	0	0
cSH	295	1700	1700	1700	358	1700	1700
Volume to Capacity	1.27	0.51	0.51	0.04	0.20	0.38	0.38
Queue Length 95th (ft)	448	0	0	0	18	0	0
Control Delay (s)	182.3	0.0	0.0	0.0	17.5	0.0	0.0
Lane LOS	F				C		
Approach Delay (s)	182.3	0.0			0.9		
Approach LOS	F						
Intersection Summary							
Average Delay			19.6				
Intersection Capacity Utilization			76.3%		ICU Level of Service		D
Analysis Period (min)			15				

Queues  
23: Cowper St & Oregon Expy

Cumulative + No Project  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	30	1675	91	36	1502	54	51	11	71
v/c Ratio	0.31	0.70	0.08	0.36	0.61	0.47	0.19	0.10	0.36
Control Delay	76.9	21.0	3.8	91.1	12.7	80.5	39.7	69.1	52.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.9	21.0	3.8	91.1	12.7	80.5	39.7	69.1	52.4
Queue Length 50th (ft)	29	500	2	37	175	52	30	10	56
Queue Length 95th (ft)	66	#1008	34	m42	m837	100	63	33	88
Internal Link Dist (ft)		1547			1028		48		36
Turn Bay Length (ft)	115		50	115					
Base Capacity (vph)	97	2384	1094	99	2447	122	481	106	467
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.70	0.08	0.36	0.61	0.44	0.11	0.10	0.15

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 23: Cowper St & Oregon Expy

Cumulative + No Project  
Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	28	1541	84	33	1363	18	50	32	15	10	47	18
Future Volume (vph)	28	1541	84	33	1363	18	50	32	15	10	47	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.95		1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3531		1770	1761		1770	1767	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3531		1770	1761		1770	1767	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	30	1675	91	36	1482	20	54	35	16	11	51	20
RTOR Reduction (vph)	0	0	29	0	0	0	0	13	0	0	12	0
Lane Group Flow (vph)	30	1675	62	36	1502	0	54	38	0	11	59	0
Confl. Peds. (#/hr)						5			7			5
Confl. Bikes (#/hr)									3			8
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases			6									
Actuated Green, G (s)	5.0	98.9	98.9	6.8	100.9		8.3	20.6		3.6	16.1	
Effective Green, g (s)	5.0	98.9	98.9	6.8	100.9		8.3	20.6		3.6	16.1	
Actuated g/C Ratio	0.03	0.66	0.66	0.05	0.67		0.06	0.14		0.02	0.11	
Clearance Time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0		5.0	3.0		4.0	3.0	
Lane Grp Cap (vph)	59	2333	1043	80	2375		97	241		42	189	
v/s Ratio Prot	0.02	c0.47		c0.02	0.43		c0.03	c0.02		0.01	c0.03	
v/s Ratio Perm			0.04									
v/c Ratio	0.51	0.72	0.06	0.45	0.63		0.56	0.16		0.26	0.31	
Uniform Delay, d1	71.3	16.5	9.1	69.8	14.0		69.1	57.1		71.9	61.9	
Progression Factor	1.00	1.00	1.00	1.27	0.73		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.7	1.9	0.1	1.5	0.5		11.3	0.3		4.5	1.0	
Delay (s)	78.0	18.5	9.2	90.0	10.7		80.3	57.4		76.4	62.8	
Level of Service	E	B	A	F	B		F	E		E	E	
Approach Delay (s)		19.0			12.6			69.2			64.6	
Approach LOS		B			B			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			18.8			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.64									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			20.1			
Intersection Capacity Utilization			65.5%			ICU Level of Service				C		
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
24: Middlefield Rd & Oregon Expy

Cumulative + No Project  
Timing Plan: P.M.Peak



























Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	192	1227	270	215	1140	67	249	592	173	56	659
v/c Ratio	1.10	1.11	0.47	0.90	0.93	0.11	1.13	0.86	0.26	0.53	0.66
Control Delay	143.9	102.7	22.5	100.6	61.2	0.4	157.4	57.2	10.2	86.8	48.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	143.9	102.7	22.5	100.6	61.2	0.4	157.4	57.2	10.2	86.8	48.4
Queue Length 50th (ft)	~213	~733	47	~245	~625	0	~281	521	27	54	277
Queue Length 95th (ft)	m#371	#855	217	#417	#765	0	#462	687	81	104	344
Internal Link Dist (ft)		1028			896			676			311
Turn Bay Length (ft)	360		100	390		100	230			145	
Base Capacity (vph)	174	1104	579	238	1227	618	220	715	673	106	1110
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.10	1.11	0.47	0.90	0.93	0.11	1.13	0.83	0.26	0.53	0.59

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 24: Middlefield Rd & Oregon Expy

Cumulative + No Project  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	179	1141	251	198	1049	62	229	545	159	52	497	116
Future Volume (vph)	179	1141	251	198	1049	62	229	545	159	52	497	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.96	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1558	1770	3539	1525	1770	1863	1547	1770	3428	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1558	1770	3539	1525	1770	1863	1547	1770	3428	
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	192	1227	270	215	1140	67	249	592	173	56	534	125
RTOR Reduction (vph)	0	0	94	0	0	44	0	0	81	0	14	0
Lane Group Flow (vph)	192	1227	176	215	1140	23	249	592	92	56	645	0
Confl. Peds. (#/hr)			2			6			11			4
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			
Actuated Green, G (s)	14.8	45.7	45.7	20.2	50.9	50.9	18.7	55.5	55.5	7.2	44.1	
Effective Green, g (s)	14.8	45.7	45.7	20.2	50.9	50.9	18.7	55.5	55.5	7.2	44.1	
Actuated g/C Ratio	0.10	0.30	0.30	0.13	0.34	0.34	0.12	0.37	0.37	0.05	0.29	
Clearance Time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0	4.0	5.0	5.0	5.0	3.0	3.0	
Lane Grp Cap (vph)	174	1078	474	238	1200	517	220	689	572	84	1007	
v/s Ratio Prot	0.11	c0.35		0.12	c0.32		c0.14	c0.32		0.03	0.19	
v/s Ratio Perm			0.11			0.01			0.06			
v/c Ratio	1.10	1.14	0.37	0.90	0.95	0.04	1.13	0.86	0.16	0.67	0.64	
Uniform Delay, d1	67.6	52.1	40.9	63.9	48.3	33.2	65.7	43.6	31.6	70.2	46.1	
Progression Factor	0.93	0.90	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	88.0	70.8	1.6	33.5	16.5	0.2	100.7	11.4	0.3	18.2	1.4	
Delay (s)	150.6	117.6	42.7	97.5	64.8	33.4	166.3	55.0	31.9	88.4	47.5	
Level of Service	F	F	D	F	E	C	F	D	C	F	D	
Approach Delay (s)		109.4			68.2			78.4			50.7	
Approach LOS		F			E			E			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			82.1									F
HCM 2000 Volume to Capacity ratio			1.05									
Actuated Cycle Length (s)			150.0								21.6	
Intersection Capacity Utilization			99.7%									F
ICU Level of Service												
Analysis Period (min)			15									

c Critical Lane Group

## Appendix I – Cumulative (2030) Plus Project Conditions Synchro Reports

- HCM Delay and LOS Reports
- 95<sup>th</sup> Percentile Queue Length Reports



Queues  
1: Alma Street & Homer Ave













Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	359	1278	687
v/c Ratio	0.72	0.74	0.40
Control Delay	35.8	21.1	15.0
Queue Delay	0.0	0.0	0.0
Total Delay	35.8	21.1	15.0
Queue Length 50th (ft)	79	281	119
Queue Length 95th (ft)	127	382	170
Internal Link Dist (ft)	443	390	481
Turn Bay Length (ft)			
Base Capacity (vph)	606	1911	1911
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.59	0.67	0.36
Intersection Summary			

HCM Signalized Intersection Capacity Analysis  
 1: Alma Street & Homer Ave

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak










						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	 		 			 
Traffic Volume (vph)	225	105	1201	0	0	632
Future Volume (vph)	225	105	1201	0	0	632
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		5.0			5.0
Lane Util. Factor	0.97		0.95			0.95
Frbp, ped/bikes	0.90		1.00			1.00
Flpb, ped/bikes	0.84		1.00			1.00
Frt	0.95		1.00			1.00
Flt Protected	0.97		1.00			1.00
Satd. Flow (prot)	2503		3539			3539
Flt Permitted	0.97		1.00			1.00
Satd. Flow (perm)	2503		3539			3539
Peak-hour factor, PHF	0.92	0.92	0.94	0.25	0.25	0.92
Adj. Flow (vph)	245	114	1278	0	0	687
RTOR Reduction (vph)	61	0	0	0	0	0
Lane Group Flow (vph)	298	0	1278	0	0	687
Confl. Peds. (#/hr)	82	102		13		
Confl. Bikes (#/hr)		1				
Turn Type	Perm		NA			NA
Protected Phases			2			6
Permitted Phases	8					
Actuated Green, G (s)	14.5		41.4			41.4
Effective Green, g (s)	14.5		41.4			41.4
Actuated g/C Ratio	0.17		0.49			0.49
Clearance Time (s)	4.0		5.0			5.0
Vehicle Extension (s)	3.0		4.0			4.0
Lane Grp Cap (vph)	426		1721			1721
v/s Ratio Prot			c0.36			0.19
v/s Ratio Perm	c0.12					
v/c Ratio	0.70		0.74			0.40
Uniform Delay, d1	33.2		17.6			13.9
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	5.0		1.9			0.2
Delay (s)	38.2		19.5			14.1
Level of Service	D		B			B
Approach Delay (s)	38.2		19.5			14.1
Approach LOS	D		B			B
<b>Intersection Summary</b>						
HCM 2000 Control Delay			20.8		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.57			
Actuated Cycle Length (s)			85.1		Sum of lost time (s)	13.0
Intersection Capacity Utilization			52.3%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

Intersection Sign configuration not allowed in HCM analysis.

# HCM Unsignalized Intersection Capacity Analysis

## 3: Alma Street & Lincoln Ave

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	45	26	1688	96	8	640
Future Volume (Veh/h)	45	26	1688	96	8	640
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.93	0.93	0.97	0.97	0.92	0.92
Hourly flow rate (vph)	48	28	1740	99	9	696
Pedestrians	11					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type			None		None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2166	930			1850	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2166	930			1850	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	89			97	
cM capacity (veh/h)	39	266			321	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	76	1160	679	241	464	
Volume Left	48	0	0	9	0	
Volume Right	28	0	99	0	0	
cSH	56	1700	1700	321	1700	
Volume to Capacity	1.35	0.68	0.40	0.03	0.27	
Queue Length 95th (ft)	168	0	0	2	0	
Control Delay (s)	359.2	0.0	0.0	1.1	0.0	
Lane LOS	F		A			
Approach Delay (s)	359.2	0.0	0.4			
Approach LOS	F					
Intersection Summary						
Average Delay			10.5			
Intersection Capacity Utilization			60.5%		ICU Level of Service	B
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis  
 4: Alma Street & Embarcadero Rd

















Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑			↗
Traffic Volume (veh/h)	0	673	1654	0	0	136
Future Volume (Veh/h)	0	673	1654	0	0	136
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.25	0.92	0.95	0.25	0.25	0.92
Hourly flow rate (vph)	0	732	1741	0	0	148
Pedestrians						33
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					3	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1774				2140	1774
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1774				2140	1774
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	0
cM capacity (veh/h)	336				41	70
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>SB 1</b>		
Volume Total	366	366	1741	148		
Volume Left	0	0	0	0		
Volume Right	0	0	0	148		
cSH	1700	1700	1700	70		
Volume to Capacity	0.22	0.22	1.02	2.12		
Queue Length 95th (ft)	0	0	0	345		
Control Delay (s)	0.0	0.0	0.0	644.3		
Lane LOS				F		
Approach Delay (s)	0.0		0.0	644.3		
Approach LOS				F		
<b>Intersection Summary</b>						
Average Delay			36.4			
Intersection Capacity Utilization			102.1%		ICU Level of Service	G
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis  
5: Emerson St & Lincoln Ave

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	9	66	38	78	82	12	5	8	10	8	209	1
Future Volume (vph)	9	66	38	78	82	12	5	8	10	8	209	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	72	41	85	89	13	5	9	11	9	227	1
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	123	187	25	237								
Volume Left (vph)	10	85	5	9								
Volume Right (vph)	41	13	11	1								
Hadj (s)	-0.15	0.08	-0.19	0.04								
Departure Headway (s)	4.6	4.8	4.8	4.7								
Degree Utilization, x	0.16	0.25	0.03	0.31								
Capacity (veh/h)	718	706	681	716								
Control Delay (s)	8.5	9.4	8.0	9.9								
Approach Delay (s)	8.5	9.4	8.0	9.9								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			9.3									
Level of Service			A									
Intersection Capacity Utilization			35.0%	ICU Level of Service	A							
Analysis Period (min)			15									

Intersection Sign configuration not allowed in HCM analysis.

Intersection Sign configuration not allowed in HCM analysis.



# HCM Unsignalized Intersection Capacity Analysis

## 8: Alma Street & Kingsley Ave

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	11	115	1549	24	70	602
Future Volume (Veh/h)	11	115	1549	24	70	602
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.96	0.96	0.92	0.92
Hourly flow rate (vph)	12	125	1614	25	76	654
Pedestrians	7					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2112	1634			1646	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2112	1634			1646	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	66	0			80	
cM capacity (veh/h)	35	89			386	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>	<b>SB 2</b>		
Volume Total	137	1639	294	436		
Volume Left	12	0	76	0		
Volume Right	125	25	0	0		
cSH	79	1700	386	1700		
Volume to Capacity	1.74	0.96	0.20	0.26		
Queue Length 95th (ft)	292	0	18	0		
Control Delay (s)	470.2	0.0	7.1	0.0		
Lane LOS	F		A			
Approach Delay (s)	470.2	0.0	2.8			
Approach LOS	F					
<b>Intersection Summary</b>						
Average Delay			26.5			
Intersection Capacity Utilization			97.4%	ICU Level of Service	F	
Analysis Period (min)			15			

Queues  
9: Alma St & Churchill Ave

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	94	1518	706
v/c Ratio	0.33	0.56	0.28
Control Delay	58.7	8.4	5.7
Queue Delay	0.0	0.0	0.0
Total Delay	58.7	8.4	5.7
Queue Length 50th (ft)	82	291	98
Queue Length 95th (ft)	141	338	121
Internal Link Dist (ft)	479	698	387
Turn Bay Length (ft)			
Base Capacity (vph)	339	2694	2523
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.28	0.56	0.28
Intersection Summary			

# HCM Signalized Intersection Capacity Analysis

## 9: Alma St & Churchill Ave

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T	R		T
Traffic Volume (vph)	80	6	1374	23	6	643
Future Volume (vph)	80	6	1374	23	6	643
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		6.0			6.0
Lane Util. Factor	1.00		0.95			0.95
Frbp, ped/bikes	0.97		1.00			1.00
Flpb, ped/bikes	1.00		1.00			1.00
Frt	0.99		1.00			1.00
Flt Protected	0.96		1.00			1.00
Satd. Flow (prot)	1705		3528			3537
Flt Permitted	0.96		1.00			0.93
Satd. Flow (perm)	1705		3528			3306
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	7	1493	25	7	699
RTOR Reduction (vph)	2	0	1	0	0	0
Lane Group Flow (vph)	92	0	1517	0	0	706
Confl. Peds. (#/hr)		101		24		
Confl. Bikes (#/hr)		258				
Turn Type	Perm		NA		Perm	NA
Protected Phases			6			2
Permitted Phases	7				2	
Actuated Green, G (s)	25.0		116.0			116.0
Effective Green, g (s)	25.0		116.0			116.0
Actuated g/C Ratio	0.16		0.76			0.76
Clearance Time (s)	5.0		6.0			6.0
Vehicle Extension (s)	3.0		6.0			6.0
Lane Grp Cap (vph)	280		2692			2523
v/s Ratio Prot			c0.43			
v/s Ratio Perm	c0.05					0.21
v/c Ratio	0.33		0.56			0.28
Uniform Delay, d1	56.1		7.5			5.4
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	0.7		0.6			0.3
Delay (s)	56.8		8.0			5.7
Level of Service	E		A			A
Approach Delay (s)	56.8		8.0			5.7
Approach LOS	E		A			A

















### Intersection Summary

HCM 2000 Control Delay	9.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	152.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

















HCM Unsignalized Intersection Capacity Analysis  
 10: Emerson St & Churchill Ave

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	11	86	11	6	33	8	38	85	9	11	17	16
Future Volume (vph)	11	86	11	6	33	8	38	85	9	11	17	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	93	12	7	36	9	41	92	10	12	18	17
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	117	52	143	47								
Volume Left (vph)	12	7	41	12								
Volume Right (vph)	12	9	10	17								
Hadj (s)	-0.01	-0.04	0.05	-0.13								
Departure Headway (s)	4.4	4.4	4.4	4.3								
Degree Utilization, x	0.14	0.06	0.17	0.06								
Capacity (veh/h)	783	762	784	782								
Control Delay (s)	8.1	7.7	8.3	7.6								
Approach Delay (s)	8.1	7.7	8.3	7.6								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.1									
Level of Service			A									
Intersection Capacity Utilization			26.5%	ICU Level of Service	A							
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 11: Bryant St & Churchill Ave

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	12	85	9	15	32	42	10	23	3	14	9	18
Future Volume (Veh/h)	12	85	9	15	32	42	10	23	3	14	9	18
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	92	10	16	35	46	11	25	3	15	10	20
Pedestrians		17			14			4			11	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		2			1			0			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											936	
pX, platoon unblocked												
vC, conflicting volume	190	131	41	172	140	52	47			42		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	190	131	41	172	140	52	47			42		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	87	99	98	95	95	99			99		
cM capacity (veh/h)	664	725	1009	671	717	992	1535			1546		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	115	97	39	45								
Volume Left	13	16	11	15								
Volume Right	10	46	3	20								
cSH	735	815	1535	1546								
Volume to Capacity	0.16	0.12	0.01	0.01								
Queue Length 95th (ft)	14	10	1	1								
Control Delay (s)	10.8	10.0	2.1	2.5								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.8	10.0	2.1	2.5								
Approach LOS	B	B										
Intersection Summary												
Average Delay			8.1									
Intersection Capacity Utilization			24.6%		ICU Level of Service					A		
Analysis Period (min)			15									

















HCM Unsignalized Intersection Capacity Analysis  
 12: Waverly St & Churchill Ave

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	14	68	10	15	47	55	19	111	12	5	84	26
Future Volume (vph)	14	68	10	15	47	55	19	111	12	5	84	26
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	74	11	16	51	60	21	121	13	5	91	28
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	100	127	155	124								
Volume Left (vph)	15	16	21	5								
Volume Right (vph)	11	60	13	28								
Hadj (s)	0.00	-0.22	0.01	-0.09								
Departure Headway (s)	4.7	4.5	4.6	4.5								
Degree Utilization, x	0.13	0.16	0.20	0.16								
Capacity (veh/h)	706	747	739	741								
Control Delay (s)	8.4	8.3	8.7	8.4								
Approach Delay (s)	8.4	8.3	8.7	8.4								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.5									
Level of Service			A									
Intersection Capacity Utilization			30.0%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 13: Cowper St & Churchill Ave

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	6	70	8	6	27	1	26	26	7	2	24	14
Future Volume (vph)	6	70	8	6	27	1	26	26	7	2	24	14
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	76	9	7	29	1	28	28	8	2	26	15
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	92	37	64	43								
Volume Left (vph)	7	7	28	2								
Volume Right (vph)	9	1	8	15								
Hadj (s)	-0.01	0.06	0.05	-0.17								
Departure Headway (s)	4.2	4.3	4.3	4.1								
Degree Utilization, x	0.11	0.04	0.08	0.05								
Capacity (veh/h)	838	812	808	847								
Control Delay (s)	7.7	7.5	7.6	7.3								
Approach Delay (s)	7.7	7.5	7.6	7.3								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.6									
Level of Service			A									
Intersection Capacity Utilization			22.3%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 14: Churchill Ave & Embarcadero Rd

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak



















Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	953	2	42	1072	0	90
Future Volume (Veh/h)	953	2	42	1072	0	90
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.25	0.92
Hourly flow rate (vph)	1036	2	46	1165	0	98
Pedestrians						11
Lane Width (ft)						12.0
Walking Speed (ft/s)						3.5
Percent Blockage						1
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)	1093			898		
pX, platoon unblocked				0.81	0.81	0.81
vC, conflicting volume				1047	1722	530
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				602	1431	0
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				94	100	89
cM capacity (veh/h)				783	95	874
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	691	347	434	777	98	
Volume Left	0	0	46	0	0	
Volume Right	0	2	0	0	98	
cSH	1700	1700	783	1700	874	
Volume to Capacity	0.41	0.20	0.06	0.46	0.11	
Queue Length 95th (ft)	0	0	5	0	9	
Control Delay (s)	0.0	0.0	1.7	0.0	9.6	
Lane LOS				A	A	
Approach Delay (s)	0.0	0.6		9.6		
Approach LOS						A
Intersection Summary						
Average Delay				0.7		
Intersection Capacity Utilization				63.7%	ICU Level of Service	B
Analysis Period (min)	15					



HCM Unsignalized Intersection Capacity Analysis  
 15: Cowper St & Embarcadero Rd

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	953	38	12	1046	15	6	3	7	5	9	52
Future Volume (Veh/h)	16	953	38	12	1046	15	6	3	7	5	9	52
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	1036	41	13	1137	16	7	3	8	5	10	57
Pedestrians					1			8			28	
Lane Width (ft)					12.0			12.0			12.0	
Walking Speed (ft/s)					3.5			3.5			3.5	
Percent Blockage					0			1			3	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.79			0.79	0.79	0.79	0.79	0.79	
vC, conflicting volume	1181			1085			1755	2306	548	1762	2318	604
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1181			569			1420	2118	0	1428	2134	604
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			86	92	99	92	72	87
cM capacity (veh/h)	571			781			48	36	847	64	35	429
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	535	559	582	584	18	72						
Volume Left	17	0	13	0	7	5						
Volume Right	0	41	0	16	8	57						
cSH	571	1700	781	1700	76	146						
Volume to Capacity	0.03	0.33	0.02	0.34	0.24	0.49						
Queue Length 95th (ft)	2	0	1	0	21	58						
Control Delay (s)	0.8	0.0	0.5	0.0	66.6	51.7						
Lane LOS	A		A		F	F						
Approach Delay (s)	0.4		0.2		66.6	51.7						
Approach LOS					F	F						
Intersection Summary												
Average Delay			2.4									
Intersection Capacity Utilization			49.7%		ICU Level of Service				A			
Analysis Period (min)			15									

Queues  
16: Waverly St & Embarcadero Rd

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	49	1030	30	1148	278	346
v/c Ratio	0.42	0.62	0.20	0.69	0.54	0.51
Control Delay	33.1	24.8	20.6	25.0	27.6	23.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.1	24.8	20.6	25.0	27.6	23.4
Queue Length 50th (ft)	28	342	12	316	140	155
Queue Length 95th (ft)	m78	428	34	392	229	245
Internal Link Dist (ft)		572		576	78	709
Turn Bay Length (ft)	95		75			
Base Capacity (vph)	118	1690	153	1696	513	673
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	4	5
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.61	0.20	0.68	0.55	0.52

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 16: Waverly St & Embarcadero Rd

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗			↕			↕	
Traffic Volume (vph)	46	897	60	28	1029	28	124	105	27	73	114	132
Future Volume (vph)	46	897	60	28	1029	28	124	105	27	73	114	132
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	
Flpb, ped/bikes	0.99	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	1.00			0.99			0.94	
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.99	
Satd. Flow (prot)	1759	3497		1765	3518			1782			1713	
Flt Permitted	0.13	1.00		0.17	1.00			0.64			0.86	
Satd. Flow (perm)	245	3497		320	3518			1171			1498	
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	49	965	65	30	1118	30	135	114	29	79	124	143
RTOR Reduction (vph)	0	5	0	0	2	0	0	4	0	0	23	0
Lane Group Flow (vph)	49	1025	0	30	1146	0	0	274	0	0	323	0
Confl. Peds. (#/hr)	27		9	9		27	22		9	9		22
Confl. Bikes (#/hr)									2			13
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)	52.2	52.2		52.2	52.2			47.8			47.8	
Effective Green, g (s)	52.2	52.2		52.2	52.2			47.8			47.8	
Actuated g/C Ratio	0.47	0.47		0.47	0.47			0.43			0.43	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			4.0			4.0	
Lane Grp Cap (vph)	116	1659		151	1669			508			650	
v/s Ratio Prot		0.29			c0.33							
v/s Ratio Perm	0.20			0.09				c0.23			0.22	
v/c Ratio	0.42	0.62		0.20	0.69			0.54			0.50	
Uniform Delay, d1	19.0	21.5		16.8	22.5			23.0			22.4	
Progression Factor	1.09	1.09		1.00	1.00			1.00			1.00	
Incremental Delay, d2	2.2	0.6		0.6	1.2			4.1			2.7	
Delay (s)	22.9	23.9		17.4	23.7			27.0			25.1	
Level of Service	C	C		B	C			C			C	
Approach Delay (s)		23.9			23.6			27.0			25.1	
Approach LOS		C			C			C			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			24.2									C
HCM 2000 Volume to Capacity ratio			0.62									
Actuated Cycle Length (s)			110.0								10.0	
Intersection Capacity Utilization			73.8%									D
Analysis Period (min)			15									

c Critical Lane Group

Queues  
17: Bryant St & Embarcadero Rd

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBR	SBR
Lane Group Flow (vph)	53	1200	64	1353	16	46
v/c Ratio	0.25	0.47	0.24	0.53	0.04	0.13
Control Delay	11.2	8.7	21.7	22.6	0.2	7.0
Queue Delay	0.0	0.0	0.0	0.4	0.0	0.0
Total Delay	11.2	8.7	21.7	23.0	0.2	7.0
Queue Length 50th (ft)	14	203	34	443	0	0
Queue Length 95th (ft)	38	252	m57	511	0	23
Internal Link Dist (ft)		579		572		
Turn Bay Length (ft)	80		60			
Base Capacity (vph)	216	2530	269	2561	477	412
Starvation Cap Reductn	0	0	0	591	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.47	0.24	0.69	0.03	0.11

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 17: Bryant St & Embarcadero Rd

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak

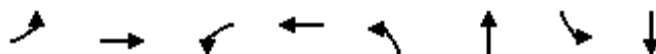


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↗	↗↘		↗	↗↘				↗			↗	
Traffic Volume (vph)	49	975	129	59	1203	41	0	0	15	0	0	42	
Future Volume (vph)	49	975	129	59	1203	41	0	0	15	0	0	42	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	5.0	5.0		5.0	5.0				5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95				1.00			1.00	
Frbp, ped/bikes	1.00	0.99		1.00	0.99				0.94			0.89	
Flpb, ped/bikes	0.98	1.00		0.99	1.00				1.00			1.00	
Frt	1.00	0.98		1.00	1.00				0.86			0.86	
Flt Protected	0.95	1.00		0.95	1.00				1.00			1.00	
Satd. Flow (prot)	1742	3454		1760	3502				1515			1426	
Flt Permitted	0.16	1.00		0.20	1.00				1.00			1.00	
Satd. Flow (perm)	295	3454		368	3502				1515			1426	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.25	0.25	0.92	0.25	0.25	0.92	
Adj. Flow (vph)	53	1060	140	64	1308	45	0	0	16	0	0	46	
RTOR Reduction (vph)	0	8	0	0	2	0	0	0	13	0	0	37	
Lane Group Flow (vph)	53	1192	0	64	1351	0	0	0	3	0	0	9	
Confl. Peds. (#/hr)	64		16	16		64			16			32	
Confl. Bikes (#/hr)									26			61	
Turn Type	Perm	NA		Perm	NA				Perm			Perm	
Protected Phases		2			2								
Permitted Phases	2			2					4			4	
Actuated Green, G (s)	78.4	78.4		78.4	78.4				21.6			21.6	
Effective Green, g (s)	78.4	78.4		78.4	78.4				21.6			21.6	
Actuated g/C Ratio	0.71	0.71		0.71	0.71				0.20			0.20	
Clearance Time (s)	5.0	5.0		5.0	5.0				5.0			5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0				3.0			3.0	
Lane Grp Cap (vph)	210	2461		262	2495				297			280	
v/s Ratio Prot		0.35			c0.39								
v/s Ratio Perm	0.18			0.17					0.00			c0.01	
v/c Ratio	0.25	0.48		0.24	0.54				0.01			0.03	
Uniform Delay, d1	5.5	6.9		5.5	7.4				35.6			35.7	
Progression Factor	1.00	1.00		2.44	2.49				1.00			1.00	
Incremental Delay, d2	2.9	0.7		1.7	0.7				0.0			0.0	
Delay (s)	8.4	7.6		15.1	19.1				35.6			35.8	
Level of Service	A	A		B	B				D			D	
Approach Delay (s)		7.7			18.9			35.6			35.8		
Approach LOS		A			B			D			D		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			14.1									HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.43										
Actuated Cycle Length (s)			110.0									Sum of lost time (s)	10.0
Intersection Capacity Utilization			60.7%									ICU Level of Service	B
Analysis Period (min)			15										

c Critical Lane Group

Queues  
18: Middlefield Rd & Embarcadero Rd

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak


























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	1005	53	1134	159	357	123	280
v/c Ratio	0.53	0.89	0.64	1.01	1.26	0.57	1.07	0.89
Control Delay	94.9	60.5	103.7	80.7	220.5	61.5	168.4	91.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	94.9	60.5	103.7	80.7	220.5	61.5	168.4	91.9
Queue Length 50th (ft)	43	523	53	~674	~199	172	~136	274
Queue Length 95th (ft)	#95	#664	#124	#814	#352	227	#275	#426
Internal Link Dist (ft)		577		509		183		494
Turn Bay Length (ft)	115		100		115		100	
Base Capacity (vph)	81	1131	83	1120	126	661	115	333
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.89	0.64	1.01	1.26	0.54	1.07	0.84

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 18: Middlefield Rd & Embarcadero Rd

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 				
Traffic Volume (vph)	40	872	52	49	914	130	146	308	20	113	232	26
Future Volume (vph)	40	872	52	49	914	130	146	308	20	113	232	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	0.99		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3498		1770	3450		1770	3501		1770	1828	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3498		1770	3450		1770	3501		1770	1828	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	948	57	53	993	141	159	335	22	123	252	28
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	43	1005	0	53	1134	0	159	357	0	123	280	0
Confl. Peds. (#/hr)			24			44			8			14
Confl. Bikes (#/hr)						1			1			2
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	5.7	48.9		5.8	49.0		11.0	27.3		10.0	26.3	
Effective Green, g (s)	5.7	48.9		5.8	49.0		11.0	27.3		10.0	26.3	
Actuated g/C Ratio	0.04	0.32		0.04	0.32		0.07	0.18		0.07	0.17	
Clearance Time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5	
Vehicle Extension (s)	2.5	3.5		2.5	3.5		2.5	3.0		2.5	3.0	
Lane Grp Cap (vph)	65	1114		66	1101		126	622		115	313	
v/s Ratio Prot	0.02	0.29		c0.03	c0.33		c0.09	0.10		0.07	c0.15	
v/s Ratio Perm												
v/c Ratio	0.66	0.90		0.80	1.03		1.26	0.57		1.07	0.89	
Uniform Delay, d1	72.9	50.0		73.3	52.2		71.2	57.8		71.8	62.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	20.4	11.8		47.7	35.1		166.6	1.3		103.8	26.0	
Delay (s)	93.4	61.8		121.0	87.3		237.8	59.1		175.6	88.2	
Level of Service	F	E		F	F		F	E		F	F	
Approach Delay (s)		63.1			88.8			114.1			114.9	
Approach LOS		E			F			F			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			87.7									F
HCM 2000 Volume to Capacity ratio			0.70									
Actuated Cycle Length (s)			153.5								22.5	
Intersection Capacity Utilization			72.7%									C
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
 19: Galvez St/Embarcadero Rd & El Camino Real

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	311	1282	338	1722	75	325	439	729
v/c Ratio	1.32	0.94	0.83	0.94	0.37	0.46	1.33	0.77
Control Delay	217.8	65.9	81.2	73.4	64.5	49.1	213.6	51.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	217.8	65.9	81.2	73.4	64.5	49.1	213.6	51.0
Queue Length 50th (ft)	~392	433	352	606	72	145	~555	321
Queue Length 95th (ft)	#588	#575	m#463	m#785	119	168	#775	374
Internal Link Dist (ft)		1237		1007		755		481
Turn Bay Length (ft)	300		382				200	
Base Capacity (vph)	236	1368	407	1838	210	970	330	1301
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.32	0.94	0.83	0.94	0.36	0.34	1.33	0.56

**Intersection Summary**

~ Volume exceeds capacity, queue is theoretically infinite.  
 Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↑↑↑		↖	↑↑↑		↖	↑↑		↖	↑↑	
Traffic Volume (vph)	308	1168	101	311	1304	281	69	231	68	417	460	233
Future Volume (vph)	308	1168	101	311	1304	281	69	231	68	417	460	233
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.97		1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5009		1770	4928		1770	3400		1770	3254	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5009		1770	4928		1770	3400		1770	3254	
Peak-hour factor, PHF	0.99	0.99	0.99	0.92	0.92	0.92	0.92	0.92	0.92	0.95	0.95	0.95
Adj. Flow (vph)	311	1180	102	338	1417	305	75	251	74	439	484	245
RTOR Reduction (vph)	0	7	0	0	20	0	0	20	0	0	50	0
Lane Group Flow (vph)	311	1275	0	338	1702	0	75	305	0	439	679	0
Confl. Peds. (#/hr)			17			9			11			74
Confl. Bikes (#/hr)												1
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	20.0	40.7		34.6	55.3		17.3	30.7		28.0	41.4	
Effective Green, g (s)	20.0	40.7		34.6	55.3		17.3	30.7		28.0	41.4	
Actuated g/C Ratio	0.13	0.27		0.23	0.37		0.12	0.20		0.19	0.28	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	4.0		2.0	4.0		2.5	2.0		2.0	2.0	
Lane Grp Cap (vph)	236	1359		408	1816		204	695		330	898	
v/s Ratio Prot	c0.18	0.25		0.19	c0.35		0.04	c0.09		c0.25	c0.21	
v/s Ratio Perm												
v/c Ratio	1.32	0.94		0.83	0.94		0.37	0.44		1.33	0.76	
Uniform Delay, d1	65.0	53.4		54.9	45.7		61.3	52.1		61.0	49.7	
Progression Factor	1.00	1.00		1.39	1.64		1.00	1.00		1.00	1.00	
Incremental Delay, d2	169.7	13.6		5.5	5.1		0.8	0.2		168.1	3.3	
Delay (s)	234.7	67.0		81.9	79.9		62.1	52.3		229.1	52.9	
Level of Service	F	E		F	E		E	D		F	D	
Approach Delay (s)		99.7			80.2			54.1			119.1	
Approach LOS		F			F			D			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			92.9									F
HCM 2000 Volume to Capacity ratio			0.99									
Actuated Cycle Length (s)			150.0								16.0	
Intersection Capacity Utilization			103.6%									G
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
20: El Camino Real & Churchill Ave

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak


















Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	378	2027	236	102	1373
v/c Ratio	1.06	0.89	0.33	0.91	0.50
Control Delay	114.9	45.7	22.8	56.9	46.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	114.9	45.7	22.8	56.9	46.8
Queue Length 50th (ft)	~380	720	115	99	523
Queue Length 95th (ft)	#594	#842	189	m102	m513
Internal Link Dist (ft)	958	687			1175
Turn Bay Length (ft)			100	170	
Base Capacity (vph)	358	2280	722	112	2738
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.06	0.89	0.33	0.91	0.50

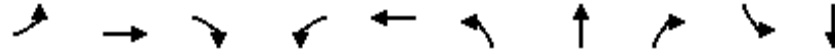
Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
20: El Camino Real & Churchill Ave

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			  			  
Traffic Volume (vph)	179	168	1865	217	94	1263
Future Volume (vph)	179	168	1865	217	94	1263
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	1.00		0.91	1.00	1.00	0.91
Frbp, ped/bikes	0.99		1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.93		1.00	0.85	1.00	1.00
Flt Protected	0.97		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1681		5085	1534	1770	5085
Flt Permitted	0.97		1.00	1.00	0.95	1.00
Satd. Flow (perm)	1681		5085	1534	1770	5085
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	195	183	2027	236	102	1373
RTOR Reduction (vph)	22	0	0	36	0	0
Lane Group Flow (vph)	356	0	2027	200	102	1373
Confl. Peds. (#/hr)		5		10		
Turn Type	Prot		NA	Perm	Prot	NA
Protected Phases	4		6		5	2
Permitted Phases				6		
Actuated Green, G (s)	30.0		66.7	66.7	9.5	80.2
Effective Green, g (s)	30.0		66.7	66.7	9.5	80.2
Actuated g/C Ratio	0.20		0.44	0.44	0.06	0.53
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.2		4.0	4.0	2.0	4.0
Lane Grp Cap (vph)	336		2261	682	112	2718
v/s Ratio Prot	c0.21		c0.40		c0.06	0.27
v/s Ratio Perm				0.13		
v/c Ratio	1.06		0.90	0.29	0.91	0.51
Uniform Delay, d1	60.0		38.5	26.6	69.8	22.2
Progression Factor	1.00		1.00	1.00	0.62	1.94
Incremental Delay, d2	65.3		6.1	1.1	9.9	0.1
Delay (s)	125.3		44.6	27.7	53.1	43.3
Level of Service	F		D	C	D	D
Approach Delay (s)	125.3		42.8			44.0
Approach LOS	F		D			D
<b>Intersection Summary</b>						
HCM 2000 Control Delay			50.8		HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.74			
Actuated Cycle Length (s)			150.0		Sum of lost time (s)	15.0
Intersection Capacity Utilization			73.2%		ICU Level of Service	D
Analysis Period (min)			15			
c Critical Lane Group						



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	543	682	264	354	1632	404	1039	198	250	1648
v/c Ratio	1.23	0.44	0.45	0.86	1.10	1.21	0.73	0.23	0.81	1.23
Control Delay	185.0	54.5	18.2	101.6	116.6	185.6	52.7	23.9	105.4	156.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	185.0	54.5	18.2	101.6	116.6	185.6	52.7	23.9	105.4	156.2
Queue Length 50th (ft)	~428	252	71	227	-841	~315	581	128	160	~1320
Queue Length 95th (ft)	#556	308	171	281	#934	#434	690	181	211	#1453
Internal Link Dist (ft)		611			978		1346			917
Turn Bay Length (ft)	350		350	300		350			250	
Base Capacity (vph)	442	1555	589	507	1477	334	1415	896	377	1341
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.23	0.44	0.45	0.70	1.10	1.21	0.73	0.22	0.66	1.23

**Intersection Summary**

- ~ Volume exceeds capacity, queue is theoretically infinite.  
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak





















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	521	655	253	333	1309	225	372	956	182	240	1159	423
Future Volume (vph)	521	655	253	333	1309	225	372	956	182	240	1159	423
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.95	
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1500	3433	4925		3433	3539	1583	3433	3371	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1500	3433	4925		3433	3539	1583	3433	3371	
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.92	0.92	0.92	0.96	0.96	0.96
Adj. Flow (vph)	543	682	264	354	1393	239	404	1039	198	250	1207	441
RTOR Reduction (vph)	0	0	131	0	13	0	0	0	0	0	19	0
Lane Group Flow (vph)	543	682	133	354	1619	0	404	1039	198	250	1629	0
Confl. Peds. (#/hr)			21			27			29			8
Confl. Bikes (#/hr)						3						1
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									
Actuated Green, G (s)	24.5	58.1	58.1	22.9	56.5		18.5	76.0	103.4	17.0	74.5	
Effective Green, g (s)	24.5	58.1	58.1	22.9	56.5		18.5	76.0	103.4	17.0	74.5	
Actuated g/C Ratio	0.13	0.31	0.31	0.12	0.30		0.10	0.40	0.54	0.09	0.39	
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	
Lane Grp Cap (vph)	442	1554	458	413	1464		334	1415	861	307	1321	
v/s Ratio Prot	c0.16	0.13		0.10	c0.33		c0.12	0.29	0.13	0.07	c0.48	
v/s Ratio Perm			0.09									
v/c Ratio	1.23	0.44	0.29	0.86	1.11		1.21	0.73	0.23	0.81	1.23	
Uniform Delay, d1	82.8	52.9	50.3	81.9	66.8		85.8	48.4	22.6	85.0	57.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	121.4	0.9	1.6	15.4	58.3		119.0	1.7	0.0	14.4	111.5	
Delay (s)	204.1	53.8	51.9	97.3	125.0		204.7	50.2	22.6	99.4	169.3	
Level of Service	F	D	D	F	F		F	D	C	F	F	
Approach Delay (s)		108.3			120.1			84.9			160.1	
Approach LOS		F			F			F			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			120.2			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.18									
Actuated Cycle Length (s)			190.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			116.1%			ICU Level of Service			H			
Analysis Period (min)			15									

c Critical Lane Group

















HCM Unsignalized Intersection Capacity Analysis  
22a: Oregon Ave & Alma St

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	11	0	84	0	1814	533	0	677	234
Future Volume (Veh/h)	0	0	0	11	0	84	0	1814	533	0	677	234
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.95	0.25	0.95	0.92	0.98	0.98	0.25	0.92	0.92
Hourly flow rate (vph)	0	0	0	12	0	88	0	1851	544	0	736	254
Pedestrians	19											
Lane Width (ft)	12.0											
Walking Speed (ft/s)	3.5											
Percent Blockage	2											
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1876	3277	495	2238	2860	944	990				2414	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1876	3277	495	2238	2860	944	990				2414	
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	100	100	100	47	100	66	100				100	
cM capacity (veh/h)	29	9	520	22	16	258	694				191	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>WB 2</b>	<b>NB 1</b>	<b>NB 2</b>	<b>NB 3</b>	<b>SB 1</b>	<b>SB 2</b>					
Volume Total	12	88	926	926	544	491	499					
Volume Left	12	0	0	0	0	0	0					
Volume Right	0	88	0	0	544	0	254					
cSH	22	258	1700	1700	1700	1700	1700					
Volume to Capacity	0.53	0.34	0.54	0.54	0.32	0.29	0.29					
Queue Length 95th (ft)	39	36	0	0	0	0	0					
Control Delay (s)	282.6	26.0	0.0	0.0	0.0	0.0	0.0					
Lane LOS	F	D										
Approach Delay (s)	56.8	0.0		0.0			0.0					
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay	1.6											
Intersection Capacity Utilization	62.0%		ICU Level of Service				B					
Analysis Period (min)	15											

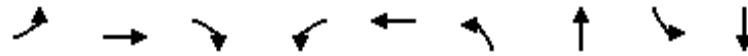
HCM Unsignalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

Cumulative+ Churchill Closure  
 Timing Plan: A.M. Peak

							
Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations			 			 	 
Traffic Volume (veh/h)	0	323	2024	171	84	605	
Future Volume (Veh/h)	0	323	2024	171	84	605	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.25	0.92	0.98	0.98	0.92	0.92	
Hourly flow rate (vph)	0	351	2065	174	91	658	
<b>Pedestrians</b>							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type	None			None			
Median storage (veh)							
Upstream signal (ft)							
pX, platoon unblocked							
vC, conflicting volume	2576	1032			2065		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	2576	1032			2065		
tC, single (s)	6.8	6.9			4.1		
tC, 2 stage (s)							
tF (s)	3.5	3.3			2.2		
p0 queue free %	100	0			66		
cM capacity (veh/h)	14	230			267		
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>NB 2</b>	<b>NB 3</b>	<b>SB 1</b>	<b>SB 2</b>	<b>SB 3</b>
Volume Total	351	1032	1032	174	91	329	329
Volume Left	0	0	0	0	91	0	0
Volume Right	351	0	0	174	0	0	0
cSH	230	1700	1700	1700	267	1700	1700
Volume to Capacity	1.53	0.61	0.61	0.10	0.34	0.19	0.19
Queue Length 95th (ft)	533	0	0	0	36	0	0
Control Delay (s)	297.2	0.0	0.0	0.0	25.3	0.0	0.0
Lane LOS	F				D		
Approach Delay (s)	297.2	0.0			3.1		
Approach LOS	F						
<b>Intersection Summary</b>							
Average Delay			31.9				
Intersection Capacity Utilization			82.6%		ICU Level of Service		E
Analysis Period (min)			15				

Queues  
23: Cowper St & Oregon Expy

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	22	1751	60	30	1847	125	106	36	110
v/c Ratio	0.23	0.78	0.06	0.31	0.82	0.92	0.34	0.34	0.41
Control Delay	74.2	26.9	1.7	89.0	16.7	125.4	41.9	76.8	33.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	74.2	26.9	1.7	89.0	16.7	125.4	41.9	76.8	33.6
Queue Length 50th (ft)	21	564	0	31	842	124	76	35	58
Queue Length 95th (ft)	53	#1087	12	m26	m#886	#255	114	74	102
Internal Link Dist (ft)		1547			1028		66		60
Turn Bay Length (ft)	115		50	115					
Base Capacity (vph)	95	2239	1009	97	2243	136	474	106	453
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.78	0.06	0.31	0.82	0.92	0.22	0.34	0.24

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 23: Cowper St & Oregon Expy

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	1611	55	29	1757	16	115	54	43	33	40	62
Future Volume (vph)	20	1611	55	29	1757	16	115	54	43	33	40	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.98		1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.93		1.00	0.91	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1546	1770	3533		1770	1698		1770	1655	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1546	1770	3533		1770	1698		1770	1655	
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	22	1751	60	30	1830	17	125	59	47	36	43	67
RTOR Reduction (vph)	0	0	23	0	0	0	0	22	0	0	43	0
Lane Group Flow (vph)	22	1751	37	30	1847	0	125	84	0	36	67	0
Confl. Peds. (#/hr)			1			11			8			10
Confl. Bikes (#/hr)									25			8
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases			6									
Actuated Green, G (s)	4.9	92.0	92.0	5.0	92.3		11.6	25.7		7.2	21.5	
Effective Green, g (s)	4.9	92.0	92.0	5.0	92.3		11.6	25.7		7.2	21.5	
Actuated g/C Ratio	0.03	0.61	0.61	0.03	0.62		0.08	0.17		0.05	0.14	
Clearance Time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0		5.0	3.0		4.0	3.0	
Lane Grp Cap (vph)	57	2170	948	59	2173		136	290		84	237	
v/s Ratio Prot	0.01	0.49		c0.02	c0.52		c0.07	c0.05		0.02	0.04	
v/s Ratio Perm			0.02									
v/c Ratio	0.39	0.81	0.04	0.51	0.85		0.92	0.29		0.43	0.28	
Uniform Delay, d1	71.1	22.2	11.5	71.3	23.3		68.7	54.2		69.4	57.4	
Progression Factor	1.00	1.00	1.00	1.28	0.60		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.3	3.3	0.1	0.6	0.4		54.7	0.6		4.7	0.7	
Delay (s)	75.4	25.5	11.6	92.1	14.5		123.4	54.8		74.1	58.0	
Level of Service	E	C	B	F	B		F	D		E	E	
Approach Delay (s)		25.7			15.7			91.9			62.0	
Approach LOS		C			B			F			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			26.1			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.75									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)				20.1		
Intersection Capacity Utilization			75.4%			ICU Level of Service				D		
Analysis Period (min)			15									

c Critical Lane Group

Queues  
24: Middlefield Rd & Oregon Expy

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak






























Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	141	1458	185	135	1418	64	323	468	261	105	497
v/c Ratio	1.11	1.19	0.29	0.67	1.03	0.11	1.32	0.79	0.43	0.76	0.54
Control Delay	165.5	138.3	27.8	79.3	76.5	0.4	219.1	56.7	12.9	98.9	41.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	165.5	138.3	27.8	79.3	76.5	0.4	219.1	56.7	12.9	98.9	41.1
Queue Length 50th (ft)	~154	-898	43	128	-791	0	-407	417	53	102	185
Queue Length 95th (ft)	m#236	#1038	m162	#310	#1036	0	#606	511	122	#194	225
Internal Link Dist (ft)		1028			896			676			311
Turn Bay Length (ft)	360		100	390		100	230			145	
Base Capacity (vph)	127	1230	630	202	1377	597	244	698	687	146	1118
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.11	1.19	0.29	0.67	1.03	0.11	1.32	0.67	0.38	0.72	0.44

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
24: Middlefield Rd & Oregon Expy

Cumulative+ Churchill Closure  
Timing Plan: A.M. Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Traffic Volume (vph)	130	1341	170	130	1361	61	297	431	240	97	290	167
Future Volume (vph)	130	1341	170	130	1361	61	297	431	240	97	290	167
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.83	1.00	1.00	0.96	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1561	1770	3539	1321	1770	1863	1524	1770	3326	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1561	1770	3539	1321	1770	1863	1524	1770	3326	
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	1458	185	135	1418	64	323	468	261	105	315	182
RTOR Reduction (vph)	0	0	88	0	0	39	0	0	127	0	59	0
Lane Group Flow (vph)	141	1458	97	135	1418	25	323	468	134	105	438	0
Confl. Peds. (#/hr)			1			51			27			4
Confl. Bikes (#/hr)						2						
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			
Actuated Green, G (s)	10.8	52.1	52.1	17.2	58.3	58.3	20.7	47.5	47.5	11.8	38.7	
Effective Green, g (s)	10.8	52.1	52.1	17.2	58.3	58.3	20.7	47.5	47.5	11.8	38.7	
Actuated g/C Ratio	0.07	0.35	0.35	0.11	0.39	0.39	0.14	0.32	0.32	0.08	0.26	
Clearance Time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0	4.0	5.0	5.0	5.0	3.0	3.0	
Lane Grp Cap (vph)	127	1229	542	202	1375	513	244	589	482	139	858	
v/s Ratio Prot	0.08	c0.41		0.08	c0.40		c0.18	c0.25		0.06	0.13	
v/s Ratio Perm			0.06			0.02			0.09			
v/c Ratio	1.11	1.19	0.18	0.67	1.03	0.05	1.32	0.79	0.28	0.76	0.51	
Uniform Delay, d1	69.6	49.0	34.1	63.7	45.9	28.6	64.7	46.8	38.4	67.7	47.5	
Progression Factor	1.18	1.21	2.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	96.0	89.4	0.5	8.1	32.7	0.2	171.3	8.3	0.7	20.6	0.5	
Delay (s)	178.4	148.4	85.7	71.8	78.5	28.7	236.0	55.1	39.1	88.2	48.1	
Level of Service	F	F	F	E	E	C	F	E	D	F	D	
Approach Delay (s)		144.3			76.0			106.7			55.1	
Approach LOS		F			E			F			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			104.0				HCM 2000 Level of Service				F	
HCM 2000 Volume to Capacity ratio			1.11									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)				21.6		
Intersection Capacity Utilization			103.1%			ICU Level of Service				G		
Analysis Period (min)			15									

c Critical Lane Group

Queues  
1: Alma Street & Homer Ave

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak












Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	591	1260	1074
v/c Ratio	0.85	0.81	0.69
Control Delay	43.1	27.0	23.0
Queue Delay	0.0	0.0	0.0
Total Delay	43.1	27.0	23.0
Queue Length 50th (ft)	153	321	253
Queue Length 95th (ft)	#237	410	326
Internal Link Dist (ft)	443	390	481
Turn Bay Length (ft)			
Base Capacity (vph)	742	1608	1608
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.80	0.78	0.67

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 1: Alma Street & Homer Ave

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	402	142	1222	0	0	1010
Future Volume (vph)	402	142	1222	0	0	1010
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		5.0			5.0
Lane Util. Factor	0.97		0.95			0.95
Frbp, ped/bikes	0.96		1.00			1.00
Flpb, ped/bikes	0.88		1.00			1.00
Frt	0.96		1.00			1.00
Flt Protected	0.96		1.00			1.00
Satd. Flow (prot)	2821		3539			3539
Flt Permitted	0.96		1.00			1.00
Satd. Flow (perm)	2821		3539			3539
Peak-hour factor, PHF	0.92	0.92	0.97	0.25	0.25	0.94
Adj. Flow (vph)	437	154	1260	0	0	1074
RTOR Reduction (vph)	38	0	0	0	0	0
Lane Group Flow (vph)	553	0	1260	0	0	1074
Confl. Peds. (#/hr)	77	61		28		
Confl. Bikes (#/hr)		3				
Turn Type	Perm		NA			NA
Protected Phases			2			6
Permitted Phases	8					
Actuated Green, G (s)	20.5		38.7			38.7
Effective Green, g (s)	20.5		38.7			38.7
Actuated g/C Ratio	0.23		0.44			0.44
Clearance Time (s)	4.0		5.0			5.0
Vehicle Extension (s)	3.0		4.0			4.0
Lane Grp Cap (vph)	654		1551			1551
v/s Ratio Prot			c0.36			0.30
v/s Ratio Perm	c0.20					
v/c Ratio	0.84		0.81			0.69
Uniform Delay, d1	32.4		21.6			20.0
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	9.8		3.5			1.5
Delay (s)	42.2		25.2			21.5
Level of Service	D		C			C
Approach Delay (s)	42.2		25.2			21.5
Approach LOS	D		C			C
<b>Intersection Summary</b>						
HCM 2000 Control Delay			27.2		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.65			
Actuated Cycle Length (s)			88.3		Sum of lost time (s)	13.0
Intersection Capacity Utilization			58.4%		ICU Level of Service	B
Analysis Period (min)			15			
c Critical Lane Group						

Intersection Sign configuration not allowed in HCM analysis.

# HCM Unsignalized Intersection Capacity Analysis

## 3: Alma Street & Lincoln Ave

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	34	20	1815	95	20	1252
Future Volume (Veh/h)	34	20	1815	95	20	1252
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.95	0.95
Hourly flow rate (vph)	37	22	1931	101	21	1318
Pedestrians	12					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2694	1028			2044	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2694	1028			2044	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	90			92	
cM capacity (veh/h)	16	229			269	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>NB 2</b>	<b>SB 1</b>	<b>SB 2</b>	
Volume Total	59	1287	745	460	879	
Volume Left	37	0	0	21	0	
Volume Right	22	0	101	0	0	
cSH	24	1700	1700	269	1700	
Volume to Capacity	2.44	0.76	0.44	0.08	0.52	
Queue Length 95th (ft)	184	0	0	6	0	
Control Delay (s)	993.5	0.0	0.0	2.9	0.0	
Lane LOS	F			A		
Approach Delay (s)	993.5	0.0		1.0		
Approach LOS	F					
<b>Intersection Summary</b>						
Average Delay			17.5			
Intersection Capacity Utilization			63.3%	ICU Level of Service	B	
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 4: Alma Street & Embarcadero Rd

Cumulative + Churchill Closure

Timing Plan: P.M.Peak



















Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑			↑
Traffic Volume (veh/h)	0	1285	1788	0	0	120
Future Volume (Veh/h)	0	1285	1788	0	0	120
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.25	0.98	0.98	0.25	0.25	0.92
Hourly flow rate (vph)	0	1311	1824	0	0	130
Pedestrians					18	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					3.5	
Percent Blockage					2	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1842			2498	1842	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1842			2498	1842	
tC, single (s)	4.1			6.8	6.9	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	100			100	0	
cM capacity (veh/h)	321			23	64	
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>SB 1</b>		
Volume Total	656	656	1824	130		
Volume Left	0	0	0	0		
Volume Right	0	0	0	130		
cSH	1700	1700	1700	64		
Volume to Capacity	0.39	0.39	1.07	2.04		
Queue Length 95th (ft)	0	0	0	307		
Control Delay (s)	0.0	0.0	0.0	624.2		
Lane LOS				F		
Approach Delay (s)	0.0		0.0	624.2		
Approach LOS				F		
<b>Intersection Summary</b>						
Average Delay			24.9			
Intersection Capacity Utilization			108.2%	ICU Level of Service		G
Analysis Period (min)			15			



HCM Unsignalized Intersection Capacity Analysis  
5: Emerson St & Lincoln Ave

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	8	79	53	33	57	9	2	35	2	9	131	0
Future Volume (vph)	8	79	53	33	57	9	2	35	2	9	131	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	86	58	36	62	10	2	38	2	10	142	0
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	153	108	42	152								
Volume Left (vph)	9	36	2	10								
Volume Right (vph)	58	10	2	0								
Hadj (s)	-0.18	0.05	0.01	0.05								
Departure Headway (s)	4.3	4.6	4.7	4.6								
Degree Utilization, x	0.18	0.14	0.05	0.19								
Capacity (veh/h)	794	737	710	734								
Control Delay (s)	8.3	8.3	8.0	8.7								
Approach Delay (s)	8.3	8.3	8.0	8.7								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.4									
Level of Service			A									
Intersection Capacity Utilization			33.3%	ICU Level of Service	A							
Analysis Period (min)			15									

Intersection Sign configuration not allowed in HCM analysis.

Intersection Sign configuration not allowed in HCM analysis.

HCM Unsignalized Intersection Capacity Analysis  
8: Alma Street & Kingsley Ave

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	26	174	1622	34	77	1198
Future Volume (Veh/h)	26	174	1622	34	77	1198
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.97	0.97	0.96	0.96
Hourly flow rate (vph)	28	189	1672	35	80	1248
Pedestrians	17					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	2					
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2490	1706			1724	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2490	1706			1724	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	0			78	
cM capacity (veh/h)	18	79			357	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	217	1707	496	832		
Volume Left	28	0	80	0		
Volume Right	189	35	0	0		
cSH	55	1700	357	1700		
Volume to Capacity	3.92	1.00	0.22	0.49		
Queue Length 95th (ft)	Err	0	21	0		
Control Delay (s)	Err	0.0	7.4	0.0		
Lane LOS	F		A			
Approach Delay (s)	Err	0.0	2.8			
Approach LOS	F					
Intersection Summary						
Average Delay			668.3			
Intersection Capacity Utilization			109.9%	ICU Level of Service	H	
Analysis Period (min)			15			

Queues  
9: Alma St & Churchill Ave

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	83	1659	1358
v/c Ratio	0.31	0.62	0.54
Control Delay	54.9	8.9	7.9
Queue Delay	0.0	0.0	0.0
Total Delay	54.9	8.9	7.9
Queue Length 50th (ft)	71	342	253
Queue Length 95th (ft)	125	396	296
Internal Link Dist (ft)	479	698	387
Turn Bay Length (ft)			
Base Capacity (vph)	382	2987	2805
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.22	0.56	0.48
Intersection Summary			

HCM Signalized Intersection Capacity Analysis  
9: Alma St & Churchill Ave

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	68	8	1497	29	8	1255
Future Volume (vph)	68	8	1497	29	8	1255
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		6.0			6.0
Lane Util. Factor	1.00		0.95			0.95
Frbp, ped/bikes	0.99		1.00			1.00
Flpb, ped/bikes	1.00		1.00			1.00
Frt	0.99		1.00			1.00
Flt Protected	0.96		1.00			1.00
Satd. Flow (prot)	1740		3527			3538
Flt Permitted	0.96		1.00			0.94
Satd. Flow (perm)	1740		3527			3314
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.93	0.93
Adj. Flow (vph)	74	9	1627	32	9	1349
RTOR Reduction (vph)	3	0	1	0	0	0
Lane Group Flow (vph)	80	0	1658	0	0	1358
Confl. Peds. (#/hr)		42		6		
Confl. Bikes (#/hr)		8				
Turn Type	Perm		NA		Perm	NA
Protected Phases			6			2
Permitted Phases	7				2	
Actuated Green, G (s)	20.7		101.4			101.4
Effective Green, g (s)	20.7		101.4			101.4
Actuated g/C Ratio	0.16		0.76			0.76
Clearance Time (s)	5.0		6.0			6.0
Vehicle Extension (s)	3.0		6.0			6.0
Lane Grp Cap (vph)	270		2686			2524
v/s Ratio Prot			c0.47			
v/s Ratio Perm	c0.05					0.41
v/c Ratio	0.30		0.62			0.54
Uniform Delay, d1	49.8		7.1			6.4
Progression Factor	1.00		1.00			1.00
Incremental Delay, d2	0.6		0.7			0.5
Delay (s)	50.4		7.9			6.9
Level of Service	D		A			A
Approach Delay (s)	50.4		7.9			6.9
Approach LOS	D		A			A

















Intersection Summary

HCM 2000 Control Delay	8.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	133.1	Sum of lost time (s)	11.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis  
 10: Emerson St & Churchill Ave

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	6	129	14	3	38	0	15	10	3	8	25	23
Future Volume (vph)	6	129	14	3	38	0	15	10	3	8	25	23
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	140	15	3	41	0	16	11	3	9	27	25
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	162	44	30	61								
Volume Left (vph)	7	3	16	9								
Volume Right (vph)	15	0	3	25								
Hadj (s)	-0.01	0.05	0.08	-0.18								
Departure Headway (s)	4.1	4.3	4.5	4.2								
Degree Utilization, x	0.19	0.05	0.04	0.07								
Capacity (veh/h)	848	797	754	812								
Control Delay (s)	8.1	7.6	7.7	7.5								
Approach Delay (s)	8.1	7.6	7.7	7.5								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.9									
Level of Service			A									
Intersection Capacity Utilization			22.7%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 11: Bryant St & Churchill Ave

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak



















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (veh/h)	7	127	6	14	43	3	3	6	3	3	32	7
Future Volume (Veh/h)	7	127	6	14	43	3	3	6	3	3	32	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	137	6	15	47	3	3	7	3	3	35	8
Pedestrians		9			12			1			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		1			1			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											936	
pX, platoon unblocked												
vC, conflicting volume	100	82	49	147	84	26	52			22		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	100	82	49	147	84	26	52			22		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	83	99	98	94	100	100			100		
cM capacity (veh/h)	813	789	1010	687	787	1034	1541			1575		
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>								
Volume Total	151	65	13	46								
Volume Left	8	15	3	3								
Volume Right	6	3	3	8								
cSH	797	769	1541	1575								
Volume to Capacity	0.19	0.08	0.00	0.00								
Queue Length 95th (ft)	17	7	0	0								
Control Delay (s)	10.6	10.1	1.7	0.5								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.6	10.1	1.7	0.5								
Approach LOS	B	B										
<b>Intersection Summary</b>												
Average Delay			8.4									
Intersection Capacity Utilization			22.1%	ICU Level of Service		A						
Analysis Period (min)			15									



















HCM Unsignalized Intersection Capacity Analysis  
12: Waverly St & Churchill Ave

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	28	92	10	15	60	45	9	87	2	10	115	36
Future Volume (vph)	28	92	10	15	60	45	9	87	2	10	115	36
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.97	0.97	0.97
Hourly flow rate (vph)	30	100	11	16	65	49	10	95	2	10	119	37
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	141	130	107	166								
Volume Left (vph)	30	16	10	10								
Volume Right (vph)	11	49	2	37								
Hadj (s)	0.03	-0.17	0.04	-0.09								
Departure Headway (s)	4.8	4.6	4.8	4.6								
Degree Utilization, x	0.19	0.17	0.14	0.21								
Capacity (veh/h)	704	729	698	729								
Control Delay (s)	8.8	8.5	8.6	8.9								
Approach Delay (s)	8.8	8.5	8.6	8.9								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.7									
Level of Service			A									
Intersection Capacity Utilization			30.0%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 13: Cowper St & Churchill Ave

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	2	95	11	3	35	0	14	28	3	0	36	7
Future Volume (vph)	2	95	11	3	35	0	14	28	3	0	36	7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	103	12	3	38	0	15	30	3	0	39	8
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	117	41	48	47								
Volume Left (vph)	2	3	15	0								
Volume Right (vph)	12	0	3	8								
Hadj (s)	-0.02	0.05	0.06	-0.07								
Departure Headway (s)	4.1	4.3	4.4	4.2								
Degree Utilization, x	0.13	0.05	0.06	0.06								
Capacity (veh/h)	847	815	787	814								
Control Delay (s)	7.8	7.5	7.6	7.5								
Approach Delay (s)	7.8	7.5	7.6	7.5								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.6									
Level of Service			A									
Intersection Capacity Utilization			23.6%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis  
 14: Churchill Ave & Embarcadero Rd

















Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	1113	2	47	982	0	58
Future Volume (Veh/h)	1113	2	47	982	0	58
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.25	0.92
Hourly flow rate (vph)	1210	2	50	1045	0	63
Pedestrians						8
Lane Width (ft)						12.0
Walking Speed (ft/s)						3.5
Percent Blockage						1
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)	1093			898		
pX, platoon unblocked				0.78	0.78	0.78
vC, conflicting volume				1218	1842	614
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				709	1511	0
tC, single (s)				4.1	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.2	3.5	3.3
p0 queue free %				93	100	92
cM capacity (veh/h)				684	79	837
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	
Volume Total	807	405	398	697	63	
Volume Left	0	0	50	0	0	
Volume Right	0	2	0	0	63	
cSH	1700	1700	684	1700	837	
Volume to Capacity	0.47	0.24	0.07	0.41	0.08	
Queue Length 95th (ft)	0	0	6	0	6	
Control Delay (s)	0.0	0.0	2.2	0.0	9.7	
Lane LOS				A	A	
Approach Delay (s)	0.0	0.8		9.7		
Approach LOS						A
Intersection Summary						
Average Delay				0.6		
Intersection Capacity Utilization				65.2%	ICU Level of Service	C
Analysis Period (min)				15		

HCM Unsignalized Intersection Capacity Analysis  
 15: Cowper St & Embarcadero Rd

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	1097	38	8	928	41	2	10	7	12	7	19
Future Volume (Veh/h)	20	1097	38	8	928	41	2	10	7	12	7	19
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.96	0.96	0.96	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	1192	41	8	967	43	2	11	8	13	8	21
Pedestrians								8			1	
Lane Width (ft)								12.0			12.0	
Walking Speed (ft/s)								3.5			3.5	
Percent Blockage								1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.76			0.76	0.76	0.76	0.76	0.76	
vC, conflicting volume	1011			1241			1789	2292	624	1659	2290	506
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1011			681			1403	2066	0	1232	2065	506
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			97	72	99	83	79	96
cM capacity (veh/h)	681			683			58	39	816	75	39	511
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>WB 2</b>	<b>NB 1</b>	<b>SB 1</b>						
Volume Total	618	637	492	526	21	42						
Volume Left	22	0	8	0	2	13						
Volume Right	0	41	0	43	8	21						
cSH	681	1700	683	1700	64	100						
Volume to Capacity	0.03	0.37	0.01	0.31	0.33	0.42						
Queue Length 95th (ft)	3	0	1	0	30	44						
Control Delay (s)	0.9	0.0	0.3	0.0	86.8	65.0						
Lane LOS	A		A		F	F						
Approach Delay (s)	0.4		0.2		86.8	65.0						
Approach LOS					F	F						
<b>Intersection Summary</b>												
Average Delay			2.3									
Intersection Capacity Utilization			57.4%		ICU Level of Service				B			
Analysis Period (min)			15									

Queues  
16: Waverly St & Embarcadero Rd

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	98	1176	24	982	212	301
v/c Ratio	0.49	0.64	0.17	0.54	0.37	0.53
Control Delay	36.8	29.9	16.8	18.4	26.6	29.5
Queue Delay	0.0	0.2	0.0	0.0	0.0	0.0
Total Delay	36.8	30.1	16.8	18.4	26.6	29.5
Queue Length 50th (ft)	58	368	8	222	106	158
Queue Length 95th (ft)	108	442	26	278	172	249
Internal Link Dist (ft)		572		576	43	709
Turn Bay Length (ft)	95		75			
Base Capacity (vph)	208	1882	144	1880	567	567
Starvation Cap Reductn	0	185	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.69	0.17	0.52	0.37	0.53
Intersection Summary						

HCM Signalized Intersection Capacity Analysis  
 16: Waverly St & Embarcadero Rd

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↗	↑↗		↗	↑↗			↕			↕	
Traffic Volume (vph)	90	1024	58	23	861	62	68	110	17	99	119	59
Future Volume (vph)	90	1024	58	23	861	62	68	110	17	99	119	59
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.99			0.99			0.97	
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.98	
Satd. Flow (prot)	1768	3503		1765	3498			1807			1769	
Flt Permitted	0.21	1.00		0.15	1.00			0.79			0.80	
Satd. Flow (perm)	389	3503		270	3498			1451			1438	
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	1113	63	24	916	66	74	120	18	108	129	64
RTOR Reduction (vph)	0	4	0	0	5	0	0	3	0	0	9	0
Lane Group Flow (vph)	98	1172	0	24	977	0	0	209	0	0	292	0
Confl. Peds. (#/hr)	2		10	10		2	2		6	6		2
Confl. Bikes (#/hr)												4
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)	57.2	57.2		57.2	57.2			42.8			42.8	
Effective Green, g (s)	57.2	57.2		57.2	57.2			42.8			42.8	
Actuated g/C Ratio	0.52	0.52		0.52	0.52			0.39			0.39	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			4.0			4.0	
Lane Grp Cap (vph)	202	1821		140	1818			564			559	
v/s Ratio Prot		c0.33			0.28							
v/s Ratio Perm	0.25			0.09				0.14			c0.20	
v/c Ratio	0.49	0.64		0.17	0.54			0.37			0.52	
Uniform Delay, d1	16.9	19.0		13.9	17.6			24.0			25.8	
Progression Factor	1.65	1.50		1.00	1.00			1.00			1.00	
Incremental Delay, d2	1.6	0.7		0.6	0.3			1.9			3.5	
Delay (s)	29.5	29.3		14.5	17.9			25.8			29.2	
Level of Service	C	C		B	B			C			C	
Approach Delay (s)		29.4			17.8			25.8			29.2	
Approach LOS		C			B			C			C	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			24.9									C
HCM 2000 Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			110.0							10.0		
Intersection Capacity Utilization			69.7%									C
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
17: Bryant St & Embarcadero Rd

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak























Lane Group	EBL	EBT	WBL	WBT	NBR	SBR
Lane Group Flow (vph)	183	1364	15	1054	13	40
v/c Ratio	0.53	0.51	0.06	0.40	0.04	0.10
Control Delay	16.1	8.3	4.9	7.0	0.2	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.1	8.3	4.9	7.0	0.2	0.5
Queue Length 50th (ft)	66	251	3	276	0	0
Queue Length 95th (ft)	154	308	m7	345	0	0
Internal Link Dist (ft)		579		572		
Turn Bay Length (ft)	80		60			
Base Capacity (vph)	348	2681	235	2664	436	487
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.51	0.06	0.40	0.03	0.08

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 17: Bryant St & Embarcadero Rd

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	168	1212	43	14	899	71	0	0	12	0	0	37
Future Volume (vph)	168	1212	43	14	899	71	0	0	12	0	0	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Lane Util. Factor	1.00	0.95		1.00	0.95				1.00			1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00				0.95			0.93
Flpb, ped/bikes	1.00	1.00		1.00	1.00				1.00			1.00
Frt	1.00	0.99		1.00	0.99				0.86			0.86
Flt Protected	0.95	1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)	1765	3516		1766	3492				1529			1495
Flt Permitted	0.25	1.00		0.17	1.00				1.00			1.00
Satd. Flow (perm)	458	3516		308	3492				1529			1495
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.25	0.25	0.92	0.25	0.25	0.92
Adj. Flow (vph)	183	1317	47	15	977	77	0	0	13	0	0	40
RTOR Reduction (vph)	0	2	0	0	4	0	0	0	11	0	0	33
Lane Group Flow (vph)	183	1362	0	15	1050	0	0	0	2	0	0	7
Confl. Peds. (#/hr)	6		8	8		6			6			20
Confl. Bikes (#/hr)									24			28
Turn Type	Perm	NA		Perm	NA				Perm			Perm
Protected Phases		2			2							
Permitted Phases	2			2					4			4
Actuated Green, G (s)	81.8	81.8		81.8	81.8				18.2			18.2
Effective Green, g (s)	81.8	81.8		81.8	81.8				18.2			18.2
Actuated g/C Ratio	0.74	0.74		0.74	0.74				0.17			0.17
Clearance Time (s)	5.0	5.0		5.0	5.0				5.0			5.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0				3.0			3.0
Lane Grp Cap (vph)	340	2614		229	2596				252			247
v/s Ratio Prot		0.39			0.30							
v/s Ratio Perm	c0.40			0.05					0.00			c0.00
v/c Ratio	0.54	0.52		0.07	0.40				0.01			0.03
Uniform Delay, d1	6.0	5.9		3.8	5.2				38.4			38.5
Progression Factor	1.00	1.00		0.65	1.01				1.00			1.00
Incremental Delay, d2	6.0	0.7		0.5	0.4				0.0			0.0
Delay (s)	12.0	6.6		3.0	5.6				38.4			38.5
Level of Service	B	A		A	A				D			D
Approach Delay (s)		7.3			5.6			38.4			38.5	
Approach LOS		A			A			D			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			7.2									A
HCM 2000 Volume to Capacity ratio			0.44									
Actuated Cycle Length (s)			110.0						10.0			
Intersection Capacity Utilization			54.1%									A
Analysis Period (min)			15									

c Critical Lane Group

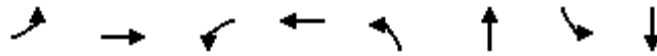


Queues

Cumulative + Churchill Closure

18: Middlefield Rd & Embarcadero Rd

Timing Plan: P.M.Peak
























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	48	1181	96	1007	131	490	189	475
v/c Ratio	0.43	0.83	0.81	0.68	0.91	0.58	0.91	0.92
Control Delay	61.8	35.8	96.1	29.1	105.3	39.5	91.2	63.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.8	35.8	96.1	29.1	105.3	39.5	91.2	63.5
Queue Length 50th (ft)	33	393	68	312	93	158	134	319
Queue Length 95th (ft)	73	486	#166	392	#210	212	#267	#505
Internal Link Dist (ft)		577		509		183		494
Turn Bay Length (ft)	115		100		115		100	
Base Capacity (vph)	112	1421	118	1484	144	887	209	537
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.43	0.83	0.81	0.68	0.91	0.55	0.90	0.88

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
18: Middlefield Rd & Embarcadero Rd

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	46	1033	101	88	782	144	122	405	51	176	415	27	
Future Volume (vph)	46	1033	101	88	782	144	122	405	51	176	415	27	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5		
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	0.95		1.00	1.00		
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Frt	1.00	0.99		1.00	0.98		1.00	0.98		1.00	0.99		
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (prot)	1770	3480		1770	3440		1770	3474		1770	1842		
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (perm)	1770	3480		1770	3440		1770	3474		1770	1842		
Peak-hour factor, PHF	0.96	0.96	0.96	0.92	0.92	0.92	0.93	0.93	0.93	0.93	0.93	0.93	
Adj. Flow (vph)	48	1076	105	96	850	157	131	435	55	189	446	29	
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0	
Lane Group Flow (vph)	48	1181	0	96	1007	0	131	490	0	189	475	0	
Confl. Peds. (#/hr)			9			15			1			16	
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA		
Protected Phases	5	2		1	6		3	8		7	4		
Permitted Phases													
Actuated Green, G (s)	5.6	44.8		7.4	46.6		9.0	26.8		13.0	30.8		
Effective Green, g (s)	5.6	44.8		7.4	46.6		9.0	26.8		13.0	30.8		
Actuated g/C Ratio	0.05	0.41		0.07	0.42		0.08	0.24		0.12	0.28		
Clearance Time (s)	4.0	5.5		4.0	5.5		4.0	4.5		4.0	4.5		
Vehicle Extension (s)	2.5	3.5		2.5	3.5		2.5	3.0		2.5	3.0		
Lane Grp Cap (vph)	90	1417		119	1457		144	846		209	515		
v/s Ratio Prot	0.03	c0.34		c0.05	0.29		0.07	0.14		c0.11	c0.26		
v/s Ratio Perm													
v/c Ratio	0.53	0.83		0.81	0.69		0.91	0.58		0.90	0.92		
Uniform Delay, d1	50.9	29.3		50.6	25.8		50.1	36.6		47.9	38.4		
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Incremental Delay, d2	4.7	5.9		30.8	2.7		48.3	1.0		36.8	22.2		
Delay (s)	55.6	35.1		81.4	28.5		98.4	37.6		84.7	60.6		
Level of Service	E	D		F	C		F	D		F	E		
Approach Delay (s)		35.9			33.1			50.4			67.5		
Approach LOS		D			C			D			E		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			43.4									HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			0.88										
Actuated Cycle Length (s)			110.0									Sum of lost time (s)	18.0
Intersection Capacity Utilization			83.0%									ICU Level of Service	E
Analysis Period (min)			15										
c	Critical Lane Group												

Queues  
 19: Galvez St/Embarcadero Rd & El Camino Real

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak



























Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	272	1713	274	2401	218	876	403	716
v/c Ratio	1.36	1.06	0.96	1.31	0.87	0.92	1.56	0.78
Control Delay	238.2	89.0	100.4	178.4	94.2	60.9	308.5	53.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	238.2	89.0	100.4	178.4	94.2	60.9	308.5	53.5
Queue Length 50th (ft)	~348	~672	~299	~1091	209	382	~554	319
Queue Length 95th (ft)	#537	#769	m266	m#911	#339	#475	#769	397
Internal Link Dist (ft)		1237		1007		755		481
Turn Bay Length (ft)	300		382				200	
Base Capacity (vph)	200	1613	285	1826	271	1000	259	929
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.36	1.06	0.96	1.31	0.80	0.88	1.56	0.77

**Intersection Summary**

- ~ Volume exceeds capacity, queue is theoretically infinite.  
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 19: Galvez St/Embarcadero Rd & El Camino Real

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			 			 			 		
Traffic Volume (vph)	250	1487	89	252	1695	514	201	469	337	375	454	212	
Future Volume (vph)	250	1487	89	252	1695	514	201	469	337	375	454	212	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0		
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95		1.00	0.95		
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	0.98		1.00	0.97		
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Frt	1.00	0.99		1.00	0.97		1.00	0.94		1.00	0.95		
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (prot)	1770	5026		1770	4870		1770	3264		1770	3265		
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (perm)	1770	5026		1770	4870		1770	3264		1770	3265		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.93	0.93	
Adj. Flow (vph)	272	1616	97	274	1842	559	218	510	366	403	488	228	
RTOR Reduction (vph)	0	4	0	0	35	0	0	88	0	0	37	0	
Lane Group Flow (vph)	272	1709	0	274	2366	0	218	788	0	403	679	0	
Confl. Peds. (#/hr)			27			15			25			78	
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA		
Protected Phases	5	2		1	6		3	8		7	4		
Permitted Phases													
Actuated Green, G (s)	17.0	48.0		24.2	55.2		21.2	39.8		22.0	40.6		
Effective Green, g (s)	17.0	48.0		24.2	55.2		21.2	39.8		22.0	40.6		
Actuated g/C Ratio	0.11	0.32		0.16	0.37		0.14	0.27		0.15	0.27		
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0		
Vehicle Extension (s)	2.0	4.0		2.0	4.0		2.5	2.0		2.0	2.0		
Lane Grp Cap (vph)	200	1608		285	1792		250	866		259	883		
v/s Ratio Prot	c0.15	0.34		0.15	c0.49		0.12	c0.24		c0.23	0.21		
v/s Ratio Perm													
v/c Ratio	1.36	1.06		0.96	1.32		0.87	0.91		1.56	0.77		
Uniform Delay, d1	66.5	51.0		62.4	47.4		63.1	53.4		64.0	50.4		
Progression Factor	1.00	1.00		1.56	0.96		1.00	1.00		1.00	1.00		
Incremental Delay, d2	190.9	41.2		8.7	144.4		26.4	13.0		268.3	3.7		
Delay (s)	257.4	92.2		106.2	189.8		89.5	66.4		332.3	54.0		
Level of Service	F	F		F	F		F	E		F	D		
Approach Delay (s)		114.9			181.2			71.0			154.3		
Approach LOS		F			F			E			F		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			140.1									HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio			1.24										
Actuated Cycle Length (s)			150.0									Sum of lost time (s)	16.0
Intersection Capacity Utilization			123.1%									ICU Level of Service	H
Analysis Period (min)			15										
c	Critical Lane Group												

Queues

20: El Camino Real & Churchill Ave

Cumulative + Churchill Closure

Timing Plan: P.M.Peak














Lane Group	WBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	403	2148	215	291	1872
v/c Ratio	1.33	1.12	0.35	0.97	0.64
Control Delay	210.7	106.1	28.0	57.0	24.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	210.7	106.1	28.0	57.0	24.6
Queue Length 50th (ft)	~486	~916	117	~352	630
Queue Length 95th (ft)	#704	#1005	191	m#307	m562
Internal Link Dist (ft)	958	687			1175
Turn Bay Length (ft)			100	170	
Base Capacity (vph)	304	1910	607	300	2908
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.33	1.12	0.35	0.97	0.64

Intersection Summary

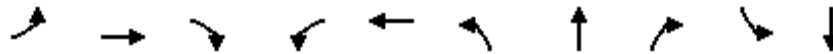
- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 20: El Camino Real & Churchill Ave

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	186	185	2019	202	279	1797
Future Volume (vph)	186	185	2019	202	279	1797
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	1.00		0.91	1.00	1.00	0.91
Frpb, ped/bikes	0.99		1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.93		1.00	0.85	1.00	1.00
Flt Protected	0.98		1.00	1.00	0.95	1.00
Satd. Flow (prot)	1680		5085	1533	1770	5085
Flt Permitted	0.98		1.00	1.00	0.95	1.00
Satd. Flow (perm)	1680		5085	1533	1770	5085
Peak-hour factor, PHF	0.92	0.92	0.94	0.94	0.96	0.96
Adj. Flow (vph)	202	201	2148	215	291	1872
RTOR Reduction (vph)	24	0	0	32	0	0
Lane Group Flow (vph)	379	0	2148	183	291	1872
Confl. Peds. (#/hr)		3		8		
Confl. Bikes (#/hr)				1		
Turn Type	Prot		NA	Perm	Prot	NA
Protected Phases	4		6		5	2
Permitted Phases				6		
Actuated Green, G (s)	25.0		55.8	55.8	25.4	85.2
Effective Green, g (s)	25.0		55.8	55.8	25.4	85.2
Actuated g/C Ratio	0.17		0.37	0.37	0.17	0.57
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.2		4.0	4.0	2.0	4.0
Lane Grp Cap (vph)	280		1891	570	299	2888
v/s Ratio Prot	c0.23		c0.42		c0.16	0.37
v/s Ratio Perm				0.12		
v/c Ratio	1.35		1.14	0.32	0.97	0.65
Uniform Delay, d1	62.5		47.1	33.6	62.0	22.2
Progression Factor	1.00		1.00	1.00	0.71	1.01
Incremental Delay, d2	180.5		68.3	1.5	10.1	0.1
Delay (s)	243.0		115.4	35.1	54.2	22.5
Level of Service	F		F	D	D	C
Approach Delay (s)	243.0		108.1			26.8
Approach LOS	F		F			C
<b>Intersection Summary</b>						
HCM 2000 Control Delay			83.4		HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio			0.90			
Actuated Cycle Length (s)			150.0		Sum of lost time (s)	15.0
Intersection Capacity Utilization			86.3%		ICU Level of Service	E
Analysis Period (min)			15			

c Critical Lane Group



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	935	1532	216	196	1333	361	1167	243	403	1314
v/c Ratio	1.15	0.73	0.30	0.77	1.06	1.15	1.06	0.38	1.05	1.16
Control Delay	141.6	46.9	7.1	101.3	104.5	165.5	102.9	39.5	133.8	131.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	141.6	46.9	7.1	101.3	104.5	165.5	102.9	39.5	133.8	131.6
Queue Length 50th (ft)	~667	556	17	119	-620	~256	~794	201	~266	-939
Queue Length 95th (ft)	#805	628	79	164	#718	#370	#934	276	#383	#1081
Internal Link Dist (ft)		611			978		1346			917
Turn Bay Length (ft)	350		350	300		350			250	
Base Capacity (vph)	810	2107	728	310	1254	314	1099	665	383	1133
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.15	0.73	0.30	0.63	1.06	1.15	1.06	0.37	1.05	1.16

**Intersection Summary**

- ~ Volume exceeds capacity, queue is theoretically infinite.  
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis  
 21: Page Mill Rd/Oregon Expy & El Camino Real

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak





















Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↑↑↑	↗	↔↔	↑↑↑		↔↔	↑↑	↗	↔↔	↑↑	↗
Traffic Volume (vph)	860	1409	199	194	1035	285	350	1132	236	371	794	415
Future Volume (vph)	860	1409	199	194	1035	285	350	1132	236	371	794	415
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.95	
Frpb, ped/bikes	1.00	1.00	0.94	1.00	0.99		1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3315	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3315	
Peak-hour factor, PHF	0.92	0.92	0.92	0.99	0.99	0.99	0.97	0.97	0.97	0.92	0.92	0.92
Adj. Flow (vph)	935	1532	216	196	1045	288	361	1167	243	403	863	451
RTOR Reduction (vph)	0	0	112	0	28	0	0	0	0	0	37	0
Lane Group Flow (vph)	935	1532	104	196	1305	0	361	1167	243	403	1277	0
Confl. Peds. (#/hr)			27			28			18			13
Confl. Bikes (#/hr)									3			
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									
Actuated Green, G (s)	42.5	74.6	74.6	13.4	45.5		16.5	55.9	73.8	20.1	59.5	
Effective Green, g (s)	42.5	74.6	74.6	13.4	45.5		16.5	55.9	73.8	20.1	59.5	
Actuated g/C Ratio	0.24	0.41	0.41	0.07	0.25		0.09	0.31	0.41	0.11	0.33	
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	
Lane Grp Cap (vph)	810	2107	615	255	1226		314	1099	649	383	1095	
v/s Ratio Prot	c0.27	0.30		0.06	c0.27		0.11	c0.33	0.15	0.12	c0.39	
v/s Ratio Perm			0.07									
v/c Ratio	1.15	0.73	0.17	0.77	1.06		1.15	1.06	0.37	1.05	1.17	
Uniform Delay, d1	68.8	44.2	33.2	81.8	67.2		81.8	62.0	37.0	80.0	60.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	83.3	2.2	0.6	11.8	44.8		97.7	45.2	0.1	60.4	84.8	
Delay (s)	152.1	46.4	33.8	93.6	112.1		179.5	107.2	37.1	140.3	145.0	
Level of Service	F	D	C	F	F		F	F	D	F	F	
Approach Delay (s)		82.2			109.7			112.3			143.9	
Approach LOS		F			F			F			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			108.4			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.13									
Actuated Cycle Length (s)			180.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			111.3%			ICU Level of Service			H			
Analysis Period (min)			15									

c Critical Lane Group



















HCM Unsignalized Intersection Capacity Analysis  
 22a: Oregon Ave & Alma St

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	35	0	75	0	1800	442	0	1297	328
Future Volume (Veh/h)	0	0	0	35	0	75	0	1800	442	0	1297	328
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.25	0.92	0.25	0.99	0.99	0.25	0.97	0.97
Hourly flow rate (vph)	0	0	0	38	0	82	0	1818	446	0	1337	338
Pedestrians												23
Lane Width (ft)												12.0
Walking Speed (ft/s)												3.5
Percent Blockage												2
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2497	3793	838	2510	3516	932	1675			2287		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2497	3793	838	2510	3516	932	1675			2287		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	0	100	69	100			100		
cM capacity (veh/h)	10	4	310	14	6	262	379			213		
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>WB 2</b>	<b>NB 1</b>	<b>NB 2</b>	<b>NB 3</b>	<b>SB 1</b>	<b>SB 2</b>					
Volume Total	38	82	909	909	446	891	784					
Volume Left	38	0	0	0	0	0	0					
Volume Right	0	82	0	0	446	0	338					
cSH	14	262	1700	1700	1700	1700	1700					
Volume to Capacity	2.76	0.31	0.53	0.53	0.26	0.52	0.46					
Queue Length 95th (ft)	140	32	0	0	0	0	0					
Control Delay (s)	1355.8	24.9	0.0	0.0	0.0	0.0	0.0					
Lane LOS	F	C										
Approach Delay (s)	446.3		0.0			0.0						
Approach LOS	F											
<b>Intersection Summary</b>												
Average Delay			13.2									
Intersection Capacity Utilization			61.1%		ICU Level of Service				B			
Analysis Period (min)			15									

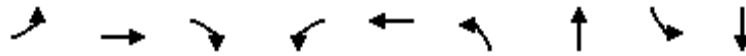
HCM Unsignalized Intersection Capacity Analysis  
 22b: Alma St & Oregon Expy EB Ramps

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

							
Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations			 			 	 
Traffic Volume (veh/h)	0	392	1850	70	68	1264	
Future Volume (Veh/h)	0	392	1850	70	68	1264	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.25	0.95	0.99	0.99	0.97	0.97	
Hourly flow rate (vph)	0	413	1869	71	70	1303	
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type	None			None			
Median storage (veh)							
Upstream signal (ft)							
pX, platoon unblocked							
vC, conflicting volume	2660	934			1869		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	2660	934			1869		
tC, single (s)	6.8	6.9			4.1		
tC, 2 stage (s)							
tF (s)	3.5	3.3			2.2		
p0 queue free %	100	0			78		
cM capacity (veh/h)	14	267			318		
Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	413	934	934	71	70	652	652
Volume Left	0	0	0	0	70	0	0
Volume Right	413	0	0	71	0	0	0
cSH	267	1700	1700	1700	318	1700	1700
Volume to Capacity	1.55	0.55	0.55	0.04	0.22	0.38	0.38
Queue Length 95th (ft)	614	0	0	0	21	0	0
Control Delay (s)	298.0	0.0	0.0	0.0	19.5	0.0	0.0
Lane LOS	F				C		
Approach Delay (s)	298.0	0.0			1.0		
Approach LOS	F						
Intersection Summary							
Average Delay			33.4				
Intersection Capacity Utilization			82.1%		ICU Level of Service		E
Analysis Period (min)			15				

Queues  
23: Cowper St & Oregon Expy

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	30	1733	91	36	1502	54	51	11	106
v/c Ratio	0.31	0.73	0.08	0.36	0.62	0.47	0.18	0.10	0.48
Control Delay	76.9	22.1	3.8	90.3	13.4	81.1	39.1	69.1	46.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.9	22.1	3.8	90.3	13.4	81.1	39.1	69.1	46.3
Queue Length 50th (ft)	29	550	2	37	190	52	30	10	68
Queue Length 95th (ft)	66	#1068	34	m43	m852	101	63	33	108
Internal Link Dist (ft)		1547			1028		48		36
Turn Bay Length (ft)	115		50	115					
Base Capacity (vph)	97	2368	1088	99	2432	120	481	106	466
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.73	0.08	0.36	0.62	0.45	0.11	0.10	0.23

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 23: Cowper St & Oregon Expy

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	28	1594	84	33	1363	18	50	32	15	10	47	51
Future Volume (vph)	28	1594	84	33	1363	18	50	32	15	10	47	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	0.98	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.95		1.00	0.92	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3531		1770	1762		1770	1688	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3531		1770	1762		1770	1688	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	30	1733	91	36	1482	20	54	35	16	11	51	55
RTOR Reduction (vph)	0	0	30	0	0	0	0	13	0	0	31	0
Lane Group Flow (vph)	30	1733	61	36	1502	0	54	38	0	11	75	0
Confl. Peds. (#/hr)						5			7			5
Confl. Bikes (#/hr)									3			8
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases			6									
Actuated Green, G (s)	5.0	98.2	98.2	6.8	100.2		8.2	21.3		3.6	16.9	
Effective Green, g (s)	5.0	98.2	98.2	6.8	100.2		8.2	21.3		3.6	16.9	
Actuated g/C Ratio	0.03	0.65	0.65	0.05	0.67		0.05	0.14		0.02	0.11	
Clearance Time (s)	4.7	5.1	5.1	4.9	5.1		4.8	5.1		5.0	5.1	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0		5.0	3.0		4.0	3.0	
Lane Grp Cap (vph)	59	2316	1036	80	2358		96	250		42	190	
v/s Ratio Prot	0.02	c0.49		c0.02	0.43		c0.03	c0.02		0.01	c0.04	
v/s Ratio Perm			0.04									
v/c Ratio	0.51	0.75	0.06	0.45	0.64		0.56	0.15		0.26	0.39	
Uniform Delay, d1	71.3	17.5	9.3	69.8	14.4		69.2	56.4		71.9	61.8	
Progression Factor	1.00	1.00	1.00	1.25	0.75		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.7	2.3	0.1	1.6	0.5		11.8	0.3		4.5	1.4	
Delay (s)	78.0	19.8	9.4	89.1	11.3		81.0	56.7		76.4	63.1	
Level of Service	E	B	A	F	B		F	E		E	E	
Approach Delay (s)		20.2			13.2			69.2			64.4	
Approach LOS		C			B			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			20.1			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.67									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			20.1			
Intersection Capacity Utilization			67.0%			ICU Level of Service				C		
Analysis Period (min)			15									

c Critical Lane Group

Queues  
24: Middlefield Rd & Oregon Expy

Cumulative + Churchill Closure  
Timing Plan: P.M.Peak






























Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	192	1284	270	215	1140	67	249	592	173	56	659
v/c Ratio	1.17	1.13	0.46	0.92	0.90	0.11	1.20	0.87	0.27	0.53	0.66
Control Delay	163.6	110.0	21.4	104.2	57.0	0.3	179.7	59.1	10.4	86.8	48.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	163.6	110.0	21.4	104.2	57.0	0.3	179.7	59.1	10.4	86.8	48.2
Queue Length 50th (ft)	~222	~759	45	~257	584	0	~293	527	28	54	277
Queue Length 95th (ft)	m#362	#891	209	#429	#740	0	#474	#705	82	104	344
Internal Link Dist (ft)		1028			896			676			311
Turn Bay Length (ft)	360		100	390		100	230			145	
Base Capacity (vph)	164	1132	590	234	1265	633	208	702	664	106	1110
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	1.13	0.46	0.92	0.90	0.11	1.20	0.84	0.26	0.53	0.59

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis  
 24: Middlefield Rd & Oregon Expy

Cumulative + Churchill Closure  
 Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Traffic Volume (vph)	179	1194	251	198	1049	62	229	545	159	52	497	116
Future Volume (vph)	179	1194	251	198	1049	62	229	545	159	52	497	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frbp, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.96	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1558	1770	3539	1525	1770	1863	1547	1770	3428	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1558	1770	3539	1525	1770	1863	1547	1770	3428	
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	192	1284	270	215	1140	67	249	592	173	56	534	125
RTOR Reduction (vph)	0	0	93	0	0	44	0	0	82	0	14	0
Lane Group Flow (vph)	192	1284	177	215	1140	23	249	592	91	56	645	0
Confl. Peds. (#/hr)			2			6			11			4
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			
Actuated Green, G (s)	14.0	46.9	46.9	19.8	52.5	52.5	17.7	54.7	54.7	7.2	44.3	
Effective Green, g (s)	14.0	46.9	46.9	19.8	52.5	52.5	17.7	54.7	54.7	7.2	44.3	
Actuated g/C Ratio	0.09	0.31	0.31	0.13	0.35	0.35	0.12	0.36	0.36	0.05	0.30	
Clearance Time (s)	5.2	5.1	5.1	5.0	5.1	5.1	5.3	5.9	5.9	5.4	5.9	
Vehicle Extension (s)	3.0	4.0	4.0	3.0	4.0	4.0	5.0	5.0	5.0	3.0	3.0	
Lane Grp Cap (vph)	165	1106	487	233	1238	533	208	679	564	84	1012	
v/s Ratio Prot	0.11	c0.36		0.12	c0.32		c0.14	c0.32		0.03	0.19	
v/s Ratio Perm			0.11			0.02			0.06			
v/c Ratio	1.16	1.16	0.36	0.92	0.92	0.04	1.20	0.87	0.16	0.67	0.64	
Uniform Delay, d1	68.0	51.5	40.0	64.3	46.8	32.2	66.2	44.4	32.2	70.2	45.9	
Progression Factor	0.92	0.89	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	109.1	79.7	1.4	38.3	12.5	0.2	125.8	12.8	0.3	18.2	1.3	
Delay (s)	171.7	125.6	41.1	102.6	59.3	32.3	191.9	57.1	32.4	88.4	47.2	
Level of Service	F	F	D	F	E	C	F	E	C	F	D	
Approach Delay (s)		117.6			64.6			86.0			50.4	
Approach LOS		F			E			F			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			85.9									F
HCM 2000 Volume to Capacity ratio			1.07									
Actuated Cycle Length (s)			150.0								21.6	
Intersection Capacity Utilization			101.2%									G
Analysis Period (min)			15									

c Critical Lane Group

## Appendix J – Cumulative (2030) Plus Project Conditions with Mitigations Synchro Reports

- HCM Delay and LOS Reports

# HCM Unsignalized Intersection Capacity Analysis Cumulative+ Churchill Closure with Mitigation 3: Alma Street & Lincoln Ave

Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	26	1688	96	8	640
Future Volume (Veh/h)	0	26	1688	96	8	640
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.93	0.93	0.97	0.97	0.92	0.92
Hourly flow rate (vph)	0	28	1740	99	9	696
Pedestrians	11					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)			175			
pX, platoon unblocked						
vC, conflicting volume	2166	930			1850	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2166	930			1850	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	89			97	
cM capacity (veh/h)	39	266			321	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>NB 2</b>	<b>SB 1</b>	<b>SB 2</b>	
Volume Total	28	1160	679	241	464	
Volume Left	0	0	0	9	0	
Volume Right	28	0	99	0	0	
cSH	266	1700	1700	321	1700	
Volume to Capacity	0.11	0.68	0.40	0.03	0.27	
Queue Length 95th (ft)	9	0	0	2	0	
Control Delay (s)	20.1	0.0	0.0	1.1	0.0	
Lane LOS	C			A		
Approach Delay (s)	20.1	0.0		0.4		
Approach LOS	C					
<b>Intersection Summary</b>						
Average Delay			0.3			
Intersection Capacity Utilization			59.8%		ICU Level of Service	B
Analysis Period (min)			15			



Queues  
4: Alma Street & Embarcadero Rd



Lane Group	WBL	WBR	NBT	SBT
Lane Group Flow (vph)	180	148	1741	732
v/c Ratio	0.88	0.63	1.13	0.25
Control Delay	101.9	50.0	71.4	3.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	101.9	50.0	71.4	3.2
Queue Length 50th (ft)	175	83	~1984	71
Queue Length 95th (ft)	66	162	m#1779	86
Internal Link Dist (ft)	166		189	95
Turn Bay Length (ft)				
Base Capacity (vph)	213	242	1534	2914
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	221
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.85	0.61	1.13	0.27

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis Cumulative+ Churchill Closure with Mitigation

## 4: Alma Street & Embarcadero Rd

Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	45	136	1654	0	0	673
Future Volume (vph)	45	136	1654	0	0	673
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5			4.5
Lane Util. Factor	1.00	1.00	1.00			0.95
Frbp, ped/bikes	1.00	1.00	1.00			1.00
Flpb, ped/bikes	1.00	1.00	1.00			1.00
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	1770	1583	1863			3539
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	1770	1583	1863			3539
Peak-hour factor, PHF	0.25	0.92	0.95	0.25	0.25	0.92
Adj. Flow (vph)	180	148	1741	0	0	732
RTOR Reduction (vph)	0	52	0	0	0	0
Lane Group Flow (vph)	180	96	1741	0	0	732
Confl. Peds. (#/hr)				22	33	
Turn Type	Prot	Perm	NA			NA
Protected Phases	4		2			6
Permitted Phases		4				
Actuated Green, G (s)	17.4	17.4	123.0			123.0
Effective Green, g (s)	17.4	17.4	123.0			123.0
Actuated g/C Ratio	0.12	0.12	0.82			0.82
Clearance Time (s)	4.5	4.5	4.5			4.5
Vehicle Extension (s)	3.0	3.0	3.0			3.0
Lane Grp Cap (vph)	206	184	1533			2913
v/s Ratio Prot	c0.10		c0.93			0.21
v/s Ratio Perm		0.06				
v/c Ratio	0.87	0.52	1.14			0.25
Uniform Delay, d1	64.9	62.1	13.2			2.9
Progression Factor	1.00	1.00	0.30			1.00
Incremental Delay, d2	31.0	2.6	61.9			0.0
Delay (s)	95.9	64.7	65.9			3.0
Level of Service	F	E	E			A
Approach Delay (s)	81.8		65.9			3.0
Approach LOS	F		E			A

Intersection Summary				
HCM 2000 Control Delay		51.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio		1.10		
Actuated Cycle Length (s)		149.4	Sum of lost time (s)	9.0
Intersection Capacity Utilization		103.0%	ICU Level of Service	G
Analysis Period (min)		15		
c Critical Lane Group				

Queues  
8: Alma Street & Kingsley Ave



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	137	1639	730
v/c Ratio	0.53	1.07	1.52dl
Control Delay	36.1	60.2	8.1
Queue Delay	0.9	12.1	0.3
Total Delay	37.0	72.3	8.3
Queue Length 50th (ft)	55	~1782	184
Queue Length 95th (ft)	128	#2049	235
Internal Link Dist (ft)	142	24	189
Turn Bay Length (ft)			
Base Capacity (vph)	264	1530	1468
Starvation Cap Reductn	0	22	224
Spillback Cap Reductn	27	84	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.58	1.13	0.59

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- dl Defacto Left Lane. Recode with 1 though lane as a left lane.

# HCM Signalized Intersection Capacity Analysis Cumulative+ Churchill Closure with Mitigation 8: Alma Street & Kingsley Ave

Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Volume (vph)	11	115	1549	24	70	602
Future Volume (vph)	11	115	1549	24	70	602
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			0.95
Frbp, ped/bikes	1.00		1.00			1.00
Flpb, ped/bikes	1.00		1.00			1.00
Frt	0.88		1.00			1.00
Flt Protected	1.00		1.00			0.99
Satd. Flow (prot)	1626		1858			3521
Flt Permitted	1.00		1.00			0.50
Satd. Flow (perm)	1626		1858			1783
Peak-hour factor, PHF	0.92	0.92	0.96	0.96	0.92	0.92
Adj. Flow (vph)	12	125	1614	25	76	654
RTOR Reduction (vph)	68	0	0	0	0	0
Lane Group Flow (vph)	69	0	1639	0	0	730
Confl. Peds. (#/hr)				7	7	
Turn Type	Prot		NA		Perm	NA
Protected Phases	4		2			6
Permitted Phases					6	
Actuated Green, G (s)	17.4		123.0			123.0
Effective Green, g (s)	17.4		123.0			123.0
Actuated g/C Ratio	0.12		0.82			0.82
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	189		1529			1467
v/s Ratio Prot	c0.04		c0.88			
v/s Ratio Perm						0.41
v/c Ratio	0.36		1.07			1.52dl
Uniform Delay, d1	60.9		13.2			4.0
Progression Factor	1.00		1.00			1.68
Incremental Delay, d2	1.2		44.9			0.3
Delay (s)	62.1		58.1			6.9
Level of Service	E		E			A
Approach Delay (s)	62.1		58.1			6.9
Approach LOS	E		E			A

## Intersection Summary

HCM 2000 Control Delay	43.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	149.4	Sum of lost time (s)	9.0
Intersection Capacity Utilization	98.2%	ICU Level of Service	F
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis Cumulative+ Churchill Closure with Mitigation  
 15: Cowper St & Embarcadero Rd

Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕				↗			↗
Traffic Volume (veh/h)	16	953	38	12	1046	15	0	0	7	0	0	52
Future Volume (Veh/h)	16	953	38	12	1046	15	0	0	7	0	0	52
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	1036	41	13	1137	16	0	0	8	0	0	57
Pedestrians					1			8				28
Lane Width (ft)					12.0			12.0				12.0
Walking Speed (ft/s)					3.5			3.5				3.5
Percent Blockage					0			1				3
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.79			0.79	0.79	0.79	0.79	0.79	
vC, conflicting volume	1181			1085			1750	2306	548	1760	2318	604
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1181			569			1413	2118	0	1426	2134	604
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			100	100	99	100	100	87
cM capacity (veh/h)	571			781			62	36	847	68	35	429
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>WB 2</b>	<b>NB 1</b>	<b>SB 1</b>						
Volume Total	535	559	582	584	8	57						
Volume Left	17	0	13	0	0	0						
Volume Right	0	41	0	16	8	57						
cSH	571	1700	781	1700	847	429						
Volume to Capacity	0.03	0.33	0.02	0.34	0.01	0.13						
Queue Length 95th (ft)	2	0	1	0	1	11						
Control Delay (s)	0.8	0.0	0.5	0.0	9.3	14.7						
Lane LOS	A		A		A	B						
Approach Delay (s)	0.4		0.2		9.3	14.7						
Approach LOS					A	B						
<b>Intersection Summary</b>												
Average Delay			0.7									
Intersection Capacity Utilization			42.3%		ICU Level of Service				A			
Analysis Period (min)			15									

Queues

Cumulative+ Churchill Closure with Mitigation

19: Galvez St/Embarcadero Rd & El Camino Real

Timing Plan: A.M. Peak



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	311	1282	338	1417	305	75	325	439	729
v/c Ratio	0.98	0.81	0.91	0.81	0.45	0.45	0.40	0.96	0.78
Control Delay	105.5	52.6	94.1	77.6	43.5	72.1	45.1	97.2	51.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	105.5	52.6	94.1	77.6	43.5	72.1	45.1	97.2	51.9
Queue Length 50th (ft)	307	423	352	528	202	72	136	223	324
Queue Length 95th (ft)	#505	#510	m#414	m#573	m238	126	168	#332	381
Internal Link Dist (ft)		1237		1007			755		481
Turn Bay Length (ft)	300		382		250			200	
Base Capacity (vph)	318	1577	376	1747	676	174	970	457	1127
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	0.81	0.90	0.81	0.45	0.43	0.34	0.96	0.65

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis Cumulative+ Churchill Closure with Mitigation  
 19: Galvez St/Embarcadero Rd & El Camino Real

Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗↖↗		↖	↗↖↗	↗	↖	↗↖		↖↗	↗↖	
Traffic Volume (vph)	308	1168	101	311	1304	281	69	231	68	417	460	233
Future Volume (vph)	308	1168	101	311	1304	281	69	231	68	417	460	233
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.97	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	0.99		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5009		1770	5085	1544	1770	3400		3433	3254	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5009		1770	5085	1544	1770	3400		3433	3254	
Peak-hour factor, PHF	0.99	0.99	0.99	0.92	0.92	0.92	0.92	0.92	0.92	0.95	0.95	0.95
Adj. Flow (vph)	311	1180	102	338	1417	305	75	251	74	439	484	245
RTOR Reduction (vph)	0	6	0	0	0	146	0	19	0	0	46	0
Lane Group Flow (vph)	311	1276	0	338	1417	159	75	306	0	439	683	0
Confl. Peds. (#/hr)			17			9			11			74
Confl. Bikes (#/hr)												1
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases						6						
Actuated Green, G (s)	27.0	47.1		31.5	51.6	51.6	14.2	35.4		20.0	41.2	
Effective Green, g (s)	27.0	47.1		31.5	51.6	51.6	14.2	35.4		20.0	41.2	
Actuated g/C Ratio	0.18	0.31		0.21	0.34	0.34	0.09	0.24		0.13	0.27	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	4.0		2.0	4.0	4.0	2.5	2.0		2.0	2.0	
Lane Grp Cap (vph)	318	1572		371	1749	531	167	802		457	893	
v/s Ratio Prot	c0.18	0.25		c0.19	c0.28		0.04	c0.09		c0.13	c0.21	
v/s Ratio Perm						0.10						
v/c Ratio	0.98	0.81		0.91	0.81	0.30	0.45	0.38		0.96	0.77	
Uniform Delay, d1	61.2	47.4		57.9	44.7	36.0	64.2	48.1		64.6	50.0	
Progression Factor	1.00	1.00		1.42	1.68	3.76	1.00	1.00		1.00	1.00	
Incremental Delay, d2	43.8	4.7		12.9	1.8	0.6	1.4	0.1		31.9	3.6	
Delay (s)	105.0	52.0		95.1	77.0	135.8	65.6	48.2		96.5	53.5	
Level of Service	F	D		F	E	F	E	D		F	D	
Approach Delay (s)		62.4			88.7			51.5			69.7	
Approach LOS		E			F			D			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			73.6									HCM 2000 Level of Service E
HCM 2000 Volume to Capacity ratio			0.83									
Actuated Cycle Length (s)			150.0									Sum of lost time (s) 16.0
Intersection Capacity Utilization			97.8%									ICU Level of Service F
Analysis Period (min)			15									

c Critical Lane Group

Queues

Cumulative+ Churchill Closure with Mitigation

21: Page Mill Rd/Oregon Expy & El Camino Real

Timing Plan: A.M. Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	543	682	264	354	1632	404	1039	198	250	1251	397
v/c Ratio	1.04	0.39	0.40	0.86	1.06	1.03	0.79	0.25	0.87	1.09	0.74
Control Delay	125.3	49.0	11.1	101.6	101.9	131.8	59.1	26.9	112.5	112.3	52.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	125.3	49.0	11.1	101.6	101.9	131.8	59.1	26.9	112.5	112.3	52.1
Queue Length 50th (ft)	~375	239	36	227	-812	~275	617	139	160	-963	386
Queue Length 95th (ft)	#503	292	122	281	#905	#394	710	188	#227	#1111	548
Internal Link Dist (ft)		611			978		1346			917	
Turn Bay Length (ft)	350		350	300		350			250		100
Base Capacity (vph)	522	1734	658	507	1536	393	1308	848	312	1145	534
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.04	0.39	0.40	0.70	1.06	1.03	0.79	0.23	0.80	1.09	0.74

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis Cumulative+ Churchill Closure with Mitigation  
 21: Page Mill Rd/Oregon Expy & El Camino Real

Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↑↑↑	↖	↖↗	↑↑↑		↖↗	↑↑	↖	↖↗	↑↘	↖
Traffic Volume (vph)	521	655	253	333	1309	225	372	956	182	240	1159	423
Future Volume (vph)	521	655	253	333	1309	225	372	956	182	240	1159	423
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	4.5
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.91	0.91
Frpb, ped/bikes	1.00	1.00	0.95	1.00	0.99		1.00	1.00	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.99	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1500	3433	4926		3433	3539	1583	3433	3369	1400
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1500	3433	4926		3433	3539	1583	3433	3369	1400
Peak-hour factor, PHF	0.96	0.96	0.96	0.94	0.94	0.94	0.92	0.92	0.92	0.96	0.96	0.96
Adj. Flow (vph)	543	682	264	354	1393	239	404	1039	198	250	1207	441
RTOR Reduction (vph)	0	0	146	0	12	0	0	0	0	0	1	59
Lane Group Flow (vph)	543	682	118	354	1620	0	404	1039	198	250	1250	338
Confl. Peds. (#/hr)			21			27			29			8
Confl. Bikes (#/hr)						3						1
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	Perm
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									4
Actuated Green, G (s)	28.9	64.8	64.8	22.9	58.8		21.8	70.3	97.7	16.0	64.5	64.5
Effective Green, g (s)	28.9	64.8	64.8	22.9	58.8		21.8	70.3	97.7	16.0	64.5	64.5
Actuated g/C Ratio	0.15	0.34	0.34	0.12	0.31		0.11	0.37	0.51	0.08	0.34	0.34
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	4.5
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	1.0
Lane Grp Cap (vph)	522	1734	511	413	1524		393	1309	813	289	1143	475
v/s Ratio Prot	c0.16	0.13		0.10	c0.33		c0.12	0.29	0.13	0.07	c0.37	
v/s Ratio Perm			0.08									0.24
v/c Ratio	1.04	0.39	0.23	0.86	1.06		1.03	0.79	0.24	0.87	1.09	0.71
Uniform Delay, d1	80.5	47.6	44.8	81.9	65.6		84.1	53.4	25.6	85.9	62.8	54.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	50.2	0.7	1.1	15.4	41.7		52.8	3.2	0.1	21.9	55.9	4.2
Delay (s)	130.8	48.3	45.8	97.3	107.3		136.9	56.6	25.7	107.9	118.6	58.8
Level of Service	F	D	D	F	F		F	E	C	F	F	E
Approach Delay (s)		77.9			105.6			72.6			104.7	
Approach LOS		E			F			E			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			91.8			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.07									
Actuated Cycle Length (s)			190.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			106.9%			ICU Level of Service			G			
Analysis Period (min)			15									

c Critical Lane Group

Queues  
22a: Oregon Ave & Alma St

Cumulative+ Churchill Closure with Mitigation  
Timing Plan: A.M. Peak



Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	12	88	1851	544	990
v/c Ratio	0.04	0.26	0.83	0.52	0.39
Control Delay	33.7	9.9	10.4	2.7	4.7
Queue Delay	0.0	0.0	1.0	0.3	0.0
Total Delay	33.7	9.9	11.4	3.0	4.7
Queue Length 50th (ft)	6	0	174	24	92
Queue Length 95th (ft)	22	41	m200	m28	121
Internal Link Dist (ft)			473		363
Turn Bay Length (ft)				150	
Base Capacity (vph)	347	381	2222	1052	2632
Starvation Cap Reductn	0	0	160	126	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.23	0.90	0.59	0.38

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis Cumulative+ Churchill Closure with Mitigation  
 22a: Oregon Ave & Alma St Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				↖		↗		↑↑	↗		↑↑	
Traffic Volume (vph)	0	0	0	11	0	84	0	1814	533	0	677	234
Future Volume (vph)	0	0	0	11	0	84	0	1814	533	0	677	234
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5		4.5		4.5	4.5		4.5	
Lane Util. Factor				1.00		1.00		0.95	1.00		0.95	
Frbp, ped/bikes				1.00		1.00		1.00	0.93		1.00	
Flpb, ped/bikes				1.00		1.00		1.00	1.00		1.00	
Frt				1.00		0.85		1.00	0.85		0.96	
Flt Protected				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (prot)				1770		1583		3539	1473		3403	
Flt Permitted				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (perm)				1770		1583		3539	1473		3403	
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.25	0.95	0.92	0.98	0.98	0.25	0.92	0.92
Adj. Flow (vph)	0	0	0	12	0	88	0	1851	544	0	736	254
RTOR Reduction (vph)	0	0	0	0	0	73	0	0	132	0	33	0
Lane Group Flow (vph)	0	0	0	12	0	15	0	1851	412	0	957	0
Confl. Peds. (#/hr)									19			
Turn Type				Prot		Perm		NA	Perm		NA	
Protected Phases				8				2			6	
Permitted Phases						8			2			
Actuated Green, G (s)				16.3		16.3		59.6	59.6		70.6	
Effective Green, g (s)				16.3		16.3		59.6	59.6		70.6	
Actuated g/C Ratio				0.17		0.17		0.62	0.62		0.74	
Clearance Time (s)				4.5		4.5		4.5	4.5		4.5	
Vehicle Extension (s)				3.0		3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)				300		269		2199	915		2505	
v/s Ratio Prot				0.01				c0.52			c0.28	
v/s Ratio Perm						c0.01			0.28			
v/c Ratio				0.04		0.06		0.84	0.45		0.38	
Uniform Delay, d1				33.3		33.4		14.4	9.5		4.6	
Progression Factor				1.00		1.00		0.53	0.52		1.00	
Incremental Delay, d2				0.1		0.1		1.2	0.1		0.1	
Delay (s)				33.3		33.4		8.9	5.1		4.7	
Level of Service				C		C		A	A		A	
Approach Delay (s)		0.0			33.4			8.0			4.7	
Approach LOS		A			C			A			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay				7.8							A	
HCM 2000 Volume to Capacity ratio				0.66								
Actuated Cycle Length (s)				95.9						13.5		
Intersection Capacity Utilization				62.8%							B	
Analysis Period (min)				15								
c Critical Lane Group												

Queues  
22b: Alma St & Oregon Expy EB Ramps

Cumulative+ Churchill Closure with Mitigation

Timing Plan: A.M. Peak



Lane Group	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	351	2065	174	91	658
v/c Ratio	0.89	0.93	0.17	0.61	0.25
Control Delay	47.7	27.0	5.8	77.1	3.0
Queue Delay	0.1	1.2	0.0	0.0	0.0
Total Delay	47.9	28.2	5.8	77.1	3.0
Queue Length 50th (ft)	130	625	26	62	33
Queue Length 95th (ft)	#283	#848	56	#126	40
Internal Link Dist (ft)		386			473
Turn Bay Length (ft)			100	50	
Base Capacity (vph)	432	2222	1020	159	2704
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	2	53	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.82	0.95	0.17	0.57	0.24

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis Cumulative+ Churchill Closure with Mitigation  
 22b: Alma St & Oregon Expy EB Ramps

Timing Plan: A.M. Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↖	↕	↗	↖	↕
Traffic Volume (vph)	0	323	2024	171	84	605
Future Volume (vph)	0	323	2024	171	84	605
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	0.95	1.00	1.00	0.95
Frt		0.86	1.00	0.85	1.00	1.00
Flt Protected		1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)		1611	3539	1583	1770	3539
Flt Permitted		1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)		1611	3539	1583	1770	3539
Peak-hour factor, PHF	0.25	0.92	0.98	0.98	0.92	0.92
Adj. Flow (vph)	0	351	2065	174	91	658
RTOR Reduction (vph)	0	120	0	27	0	0
Lane Group Flow (vph)	0	231	2065	147	91	658
Turn Type		Perm	NA	Perm	Prot	NA
Protected Phases			2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)		16.3	59.6	59.6	6.5	70.6
Effective Green, g (s)		16.3	59.6	59.6	6.5	70.6
Actuated g/C Ratio		0.17	0.62	0.62	0.07	0.74
Clearance Time (s)		4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		273	2199	983	119	2605
v/s Ratio Prot			c0.58		c0.05	0.19
v/s Ratio Perm		c0.14		0.09		
v/c Ratio		0.84	0.94	0.15	0.76	0.25
Uniform Delay, d1		38.6	16.5	7.6	43.9	4.1
Progression Factor		1.00	1.00	1.00	1.38	0.62
Incremental Delay, d2		20.6	8.5	0.1	23.7	0.0
Delay (s)		59.2	25.0	7.6	84.5	2.6
Level of Service		E	C	A	F	A
Approach Delay (s)	59.2		23.7			12.5
Approach LOS	E		C			B

Intersection Summary			
HCM 2000 Control Delay	24.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	95.9	Sum of lost time (s)	13.5
Intersection Capacity Utilization	83.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Queues  
24: Middlefield Rd & Oregon Expy

Cumulative+ Churchill Closure with Mitigation  
Timing Plan: A.M. Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	141	1458	185	135	1418	64	323	729	105	315	182
v/c Ratio	1.11	1.15	0.23	0.65	0.99	0.10	1.32	0.72	0.66	0.70	0.32
Control Delay	165.5	123.1	19.2	78.0	66.3	2.0	219.1	46.1	84.8	58.9	11.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	165.5	123.1	19.2	78.0	66.3	2.0	219.1	46.1	84.8	58.9	11.0
Queue Length 50th (ft)	~154	-898	33	130	-803	0	-407	294	101	272	41
Queue Length 95th (ft)	m#236	#1038	m122	#310	#1036	11	#606	347	166	353	71
Internal Link Dist (ft)		1028			896			676		311	
Turn Bay Length (ft)	360		100	390		100	230		145		
Base Capacity (vph)	127	1269	805	208	1427	633	244	1200	193	596	562
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.11	1.15	0.23	0.65	0.99	0.10	1.32	0.61	0.54	0.53	0.32

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis Cumulative+ Churchill Closure with Mitigation  
 24: Middlefield Rd & Oregon Expy Timing Plan: A.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	1341	170	130	1361	61	297	431	240	97	290	167
Future Volume (vph)	130	1341	170	130	1361	61	297	431	240	97	290	167
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.3	5.0	5.1	5.1	5.3	5.9		5.4	5.9	5.2
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.90	1.00	0.99		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1567	1770	3539	1426	1770	3304		1770	1863	1564
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1567	1770	3539	1426	1770	3304		1770	1863	1564
Peak-hour factor, PHF	0.92	0.92	0.92	0.96	0.96	0.96	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	1458	185	135	1418	64	323	468	261	105	315	182
RTOR Reduction (vph)	0	0	29	0	0	38	0	55	0	0	0	62
Lane Group Flow (vph)	141	1458	156	135	1418	26	323	674	0	105	315	120
Confl. Peds. (#/hr)			1			51			27			4
Confl. Bikes (#/hr)						2						
Turn Type	Prot	NA	pm+ov	Prot	NA	Perm	Prot	NA		Prot	NA	pm+ov
Protected Phases	1	6	7	5	2		7	4		3	8	1
Permitted Phases			6			2						8
Actuated Green, G (s)	10.8	53.8	74.5	17.7	60.5	60.5	20.7	43.5		13.6	36.5	47.3
Effective Green, g (s)	10.8	53.8	74.5	17.7	60.5	60.5	20.7	43.5		13.6	36.5	47.3
Actuated g/C Ratio	0.07	0.36	0.50	0.12	0.40	0.40	0.14	0.29		0.09	0.24	0.32
Clearance Time (s)	5.2	5.1	5.3	5.0	5.1	5.1	5.3	5.9		5.4	5.9	5.2
Vehicle Extension (s)	3.0	4.0	5.0	3.0	4.0	4.0	5.0	5.0		3.0	3.0	3.0
Lane Grp Cap (vph)	127	1269	778	208	1427	575	244	958		160	453	493
v/s Ratio Prot	0.08	c0.41	0.03	0.08	c0.40		c0.18	c0.20		0.06	0.17	0.02
v/s Ratio Perm			0.07			0.02						0.06
v/c Ratio	1.11	1.15	0.20	0.65	0.99	0.04	1.32	0.70		0.66	0.70	0.24
Uniform Delay, d1	69.6	48.1	21.1	63.2	44.6	27.2	64.7	47.5		65.9	51.7	38.1
Progression Factor	1.18	1.20	1.40	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	96.0	73.3	0.2	6.8	22.4	0.1	171.3	3.0		9.3	4.6	0.3
Delay (s)	178.4	131.2	29.8	70.0	66.9	27.3	236.0	50.5		75.3	56.3	38.3
Level of Service	F	F	C	E	E	C	F	D		E	E	D
Approach Delay (s)		124.4			65.6			107.4			54.2	
Approach LOS		F			E			F			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			93.7									F
HCM 2000 Volume to Capacity ratio			1.06									
Actuated Cycle Length (s)			150.0								21.6	
Intersection Capacity Utilization			102.2%									G
Analysis Period (min)			15									

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis Cumulative + Churchill Closure with Mitigation 3: Alma Street & Lincoln Ave

Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↗	↕↗			↖↕
Traffic Volume (veh/h)	0	20	1815	95	20	1252
Future Volume (Veh/h)	0	20	1815	95	20	1252
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.94	0.94	0.95	0.95
Hourly flow rate (vph)	0	22	1931	101	21	1318
Pedestrians	12					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	1					
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)			175			
pX, platoon unblocked						
vC, conflicting volume	2694	1028			2044	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2694	1028			2044	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	90			92	
cM capacity (veh/h)	16	229			269	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>NB 2</b>	<b>SB 1</b>	<b>SB 2</b>	
Volume Total	22	1287	745	460	879	
Volume Left	0	0	0	21	0	
Volume Right	22	0	101	0	0	
cSH	229	1700	1700	269	1700	
Volume to Capacity	0.10	0.76	0.44	0.08	0.52	
Queue Length 95th (ft)	8	0	0	6	0	
Control Delay (s)	22.4	0.0	0.0	2.9	0.0	
Lane LOS	C			A		
Approach Delay (s)	22.4	0.0		1.0		
Approach LOS	C					
<b>Intersection Summary</b>						
Average Delay			0.5			
Intersection Capacity Utilization			63.3%		ICU Level of Service	B
Analysis Period (min)			15			



Queues  
4: Alma Street & Embarcadero Rd

Cumulative + Churchill Closure with Mitigation  
Timing Plan: P.M.Peak



Lane Group	WBL	WBR	NBT	SBT
Lane Group Flow (vph)	136	130	1824	1311
v/c Ratio	0.68	0.59	1.18	0.45
Control Delay	81.4	48.5	96.2	4.2
Queue Delay	0.0	0.0	0.0	0.1
Total Delay	81.4	48.5	96.3	4.3
Queue Length 50th (ft)	129	72	-2154	160
Queue Length 95th (ft)	53	146	m#1839	186
Internal Link Dist (ft)	166		189	95
Turn Bay Length (ft)				
Base Capacity (vph)	214	234	1540	2926
Starvation Cap Reductn	0	0	22	0
Spillback Cap Reductn	0	0	0	375
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.64	0.56	1.20	0.51

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis Cumulative + Churchill Closure with Mitigation

## 4: Alma Street & Embarcadero Rd

Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						 
Traffic Volume (vph)	34	120	1788	0	0	1285
Future Volume (vph)	34	120	1788	0	0	1285
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5			4.5
Lane Util. Factor	1.00	1.00	1.00			0.95
Frpb, ped/bikes	1.00	0.99	1.00			1.00
Flpb, ped/bikes	1.00	1.00	1.00			1.00
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	1770	1561	1863			3539
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	1770	1561	1863			3539
Peak-hour factor, PHF	0.25	0.92	0.98	0.25	0.25	0.98
Adj. Flow (vph)	136	130	1824	0	0	1311
RTOR Reduction (vph)	0	46	0	0	0	0
Lane Group Flow (vph)	136	84	1824	0	0	1311
Confl. Peds. (#/hr)				18		
Confl. Bikes (#/hr)		1				
Turn Type	Prot	Perm	NA			NA
Protected Phases	4		2			6
Permitted Phases		4				
Actuated Green, G (s)	16.7	16.7	123.0			123.0
Effective Green, g (s)	16.7	16.7	123.0			123.0
Actuated g/C Ratio	0.11	0.11	0.83			0.83
Clearance Time (s)	4.5	4.5	4.5			4.5
Vehicle Extension (s)	3.0	3.0	3.0			3.0
Lane Grp Cap (vph)	198	175	1541			2927
v/s Ratio Prot	c0.08		c0.98			0.37
v/s Ratio Perm		0.05				
v/c Ratio	0.69	0.48	1.18			0.45
Uniform Delay, d1	63.5	61.9	12.8			3.5
Progression Factor	1.00	1.00	0.50			1.00
Incremental Delay, d2	9.5	2.1	83.3			0.1
Delay (s)	73.0	64.0	89.8			3.6
Level of Service	E	E	F			A
Approach Delay (s)	68.6		89.8			3.6
Approach LOS	E		F			A

Intersection Summary				
HCM 2000 Control Delay		54.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio		1.12		
Actuated Cycle Length (s)		148.7	Sum of lost time (s)	9.0
Intersection Capacity Utilization		109.0%	ICU Level of Service	H
Analysis Period (min)		15		

c Critical Lane Group

Queues  
8: Alma Street & Kingsley Ave

Cumulative + Churchill Closure with Mitigation  
Timing Plan: P.M.Peak



Lane Group	WBL	NBT	SBT
Lane Group Flow (vph)	217	1707	1328
v/c Ratio	0.89	1.11	1.60dl
Control Delay	79.4	76.8	21.4
Queue Delay	58.9	0.2	0.0
Total Delay	138.2	77.0	21.4
Queue Length 50th (ft)	147	~1925	505
Queue Length 95th (ft)	#292	#2190	#734
Internal Link Dist (ft)	142	24	189
Turn Bay Length (ft)			
Base Capacity (vph)	257	1533	1460
Starvation Cap Reductn	0	14	0
Spillback Cap Reductn	94	102	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	1.33	1.19	0.91

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- dl Defacto Left Lane. Recode with 1 though lane as a left lane.

# HCM Signalized Intersection Capacity Analysis Cumulative + Churchill Closure with Mitigation

## 8: Alma Street & Kingsley Ave

Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	26	174	1622	34	77	1198
Future Volume (vph)	26	174	1622	34	77	1198
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5		4.5			4.5
Lane Util. Factor	1.00		1.00			0.95
Frbp, ped/bikes	1.00		1.00			1.00
Flpb, ped/bikes	1.00		1.00			1.00
Frt	0.88		1.00			1.00
Flt Protected	0.99		1.00			1.00
Satd. Flow (prot)	1633		1854			3529
Flt Permitted	0.99		1.00			0.50
Satd. Flow (perm)	1633		1854			1767
Peak-hour factor, PHF	0.92	0.92	0.97	0.97	0.96	0.96
Adj. Flow (vph)	28	189	1672	35	80	1248
RTOR Reduction (vph)	60	0	1	0	0	0
Lane Group Flow (vph)	157	0	1706	0	0	1328
Confl. Peds. (#/hr)				17	17	
Confl. Bikes (#/hr)				1		
Turn Type	Prot		NA		Perm	NA
Protected Phases	4		2			6
Permitted Phases					6	
Actuated Green, G (s)	16.7		123.0			123.0
Effective Green, g (s)	16.7		123.0			123.0
Actuated g/C Ratio	0.11		0.83			0.83
Clearance Time (s)	4.5		4.5			4.5
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	183		1533			1461
v/s Ratio Prot	c0.10		c0.92			
v/s Ratio Perm						0.75
v/c Ratio	0.86		1.11			1.60dl
Uniform Delay, d1	64.8		12.8			9.0
Progression Factor	1.00		1.00			1.16
Incremental Delay, d2	30.3		60.6			7.8
Delay (s)	95.1		73.5			18.2
Level of Service	F		E			B
Approach Delay (s)	95.1		73.5			18.2
Approach LOS	F		E			B

### Intersection Summary

HCM 2000 Control Delay	52.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	148.7	Sum of lost time (s)	9.0
Intersection Capacity Utilization	110.7%	ICU Level of Service	H
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis Cumulative + Churchill Closure with Mitigation  
 15: Cowper St & Embarcadero Rd

Timing Plan: P.M. Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔			↔↔				↔			↔
Traffic Volume (veh/h)	20	1097	38	8	928	41	0	0	7	0	0	19
Future Volume (Veh/h)	20	1097	38	8	928	41	0	0	7	0	0	19
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.96	0.96	0.96	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	1192	41	8	967	43	0	0	8	0	0	21
Pedestrians								8				1
Lane Width (ft)								12.0			12.0	
Walking Speed (ft/s)								3.5			3.5	
Percent Blockage								1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		656										
pX, platoon unblocked				0.76			0.76	0.76	0.76	0.76	0.76	0.76
vC, conflicting volume	1011			1241			1785	2292	624	1654	2290	506
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1011			681			1398	2066	0	1225	2065	506
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			100	100	99	100	100	96
cM capacity (veh/h)	681			683			70	39	816	97	39	511
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	618	637	492	526	8	21						
Volume Left	22	0	8	0	0	0						
Volume Right	0	41	0	43	8	21						
cSH	681	1700	683	1700	816	511						
Volume to Capacity	0.03	0.37	0.01	0.31	0.01	0.04						
Queue Length 95th (ft)	3	0	1	0	1	3						
Control Delay (s)	0.9	0.0	0.3	0.0	9.5	12.3						
Lane LOS	A		A		A	B						
Approach Delay (s)	0.4		0.2		9.5	12.3						
Approach LOS					A	B						
Intersection Summary												
Average Delay			0.5									
Intersection Capacity Utilization			49.2%		ICU Level of Service				A			
Analysis Period (min)			15									

Queues

Cumulative + Churchill Closure with Mitigation

19: Galvez St/Embarcadero Rd & El Camino Real

Timing Plan: P.M.Peak



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	272	1713	274	1842	559	218	876	403	716
v/c Ratio	1.36	1.06	0.96	0.99	0.72	0.87	0.89	0.86	0.78
Control Delay	238.2	89.0	100.4	50.0	22.9	94.2	56.7	81.3	53.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	238.2	89.0	100.4	50.0	22.9	94.2	56.7	81.3	53.5
Queue Length 50th (ft)	~348	~672	~299	~475	202	209	382	199	319
Queue Length 95th (ft)	#537	#769	m266	m358	m176	#339	#475	#264	397
Internal Link Dist (ft)		1237		1007			755		481
Turn Bay Length (ft)	300		382		250			200	
Base Capacity (vph)	200	1613	285	1870	776	271	1000	503	929
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.36	1.06	0.96	0.99	0.72	0.80	0.88	0.80	0.77

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis Cumulative + Churchill Closure with Mitigation  
 19: Galvez St/Embarcadero Rd & El Camino Real

Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↗	↑↑↑		↖	↑↑↑	↗	↖	↑↑		↖	↑↑		
Traffic Volume (vph)	250	1487	89	252	1695	514	201	469	337	375	454	212	
Future Volume (vph)	250	1487	89	252	1695	514	201	469	337	375	454	212	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0		
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00	1.00	0.95		0.97	0.95		
Frbp, ped/bikes	1.00	1.00		1.00	1.00	0.97	1.00	0.98		1.00	0.97		
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00		
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.94		1.00	0.95		
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00		
Satd. Flow (prot)	1770	5026		1770	5085	1531	1770	3264		3433	3265		
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00		
Satd. Flow (perm)	1770	5026		1770	5085	1531	1770	3264		3433	3265		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.93	0.93	
Adj. Flow (vph)	272	1616	97	274	1842	559	218	510	366	403	488	228	
RTOR Reduction (vph)	0	4	0	0	0	214	0	87	0	0	37	0	
Lane Group Flow (vph)	272	1709	0	274	1842	345	218	789	0	403	679	0	
Confl. Peds. (#/hr)			27			15			25			78	
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA		Prot	NA		
Protected Phases	5	2		1	6		3	8		7	4		
Permitted Phases						6							
Actuated Green, G (s)	17.0	48.0		24.2	55.2	55.2	21.2	41.3		20.5	40.6		
Effective Green, g (s)	17.0	48.0		24.2	55.2	55.2	21.2	41.3		20.5	40.6		
Actuated g/C Ratio	0.11	0.32		0.16	0.37	0.37	0.14	0.28		0.14	0.27		
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0		
Vehicle Extension (s)	2.0	4.0		2.0	4.0	4.0	2.5	2.0		2.0	2.0		
Lane Grp Cap (vph)	200	1608		285	1871	563	250	898		469	883		
v/s Ratio Prot	c0.15	c0.34		0.15	c0.36		c0.12	c0.24		0.12	0.21		
v/s Ratio Perm						0.23							
v/c Ratio	1.36	1.06		0.96	0.98	0.61	0.87	0.88		0.86	0.77		
Uniform Delay, d1	66.5	51.0		62.4	47.0	38.7	63.1	52.0		63.3	50.4		
Progression Factor	1.00	1.00		1.56	0.99	1.41	1.00	1.00		1.00	1.00		
Incremental Delay, d2	190.9	41.2		8.7	3.6	0.5	26.4	9.5		14.0	3.7		
Delay (s)	257.4	92.2		106.2	50.2	55.2	89.5	61.4		77.3	54.0		
Level of Service	F	F		F	D	E	F	E		E	D		
Approach Delay (s)		114.9			57.0			67.0			62.4		
Approach LOS		F			E			E			E		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			76.2									HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio			1.00										
Actuated Cycle Length (s)			150.0									Sum of lost time (s)	16.0
Intersection Capacity Utilization			103.5%									ICU Level of Service	G
Analysis Period (min)			15										
c Critical Lane Group													

Queues

Cumulative + Churchill Closure with Mitigation

21: Page Mill Rd/Oregon Expy & El Camino Real

Timing Plan: P.M.Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	935	1532	216	196	1333	361	1167	243	403	917	397
v/c Ratio	1.08	0.72	0.29	0.77	1.11	0.83	1.09	0.39	1.05	0.95	0.81
Control Delay	115.2	45.8	6.8	101.3	119.1	92.6	110.8	40.4	133.8	80.3	53.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	115.2	45.8	6.8	101.3	119.1	92.6	110.8	40.4	133.8	80.3	53.3
Queue Length 50th (ft)	~631	549	15	119	-642	222	-810	204	~266	574	336
Queue Length 95th (ft)	#769	621	76	164	#741	#324	#950	279	#383	#681	503
Internal Link Dist (ft)		611			978		1346			917	
Turn Bay Length (ft)	350		350	300		350			250		100
Base Capacity (vph)	867	2141	738	310	1205	435	1075	655	383	1017	508
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.08	0.72	0.29	0.63	1.11	0.83	1.09	0.37	1.05	0.90	0.78

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.



HCM Signalized Intersection Capacity Analysis Cumulative + Churchill Closure with Mitigation  
 21: Page Mill Rd/Oregon Expy & El Camino Real

Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↑↑↑	↗	↔↔	↑↑↑		↔↔	↑↑	↗	↔↔	↑↑	↗
Traffic Volume (vph)	860	1409	199	194	1035	285	350	1132	236	371	794	415
Future Volume (vph)	860	1409	199	194	1035	285	350	1132	236	371	794	415
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5	4.5	3.5	4.5	4.5
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91		0.97	0.95	1.00	0.97	0.91	0.91
Frbp, ped/bikes	1.00	1.00	0.94	1.00	0.99		1.00	1.00	1.00	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.99	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3353	1388
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1486	3433	4853		3433	3539	1583	3433	3353	1388
Peak-hour factor, PHF	0.92	0.92	0.92	0.99	0.99	0.99	0.97	0.97	0.97	0.92	0.92	0.92
Adj. Flow (vph)	935	1532	216	196	1045	288	361	1167	243	403	863	451
RTOR Reduction (vph)	0	0	112	0	27	0	0	0	0	0	2	90
Lane Group Flow (vph)	935	1532	104	196	1306	0	361	1167	243	403	915	307
Confl. Peds. (#/hr)			27				28		18			13
Confl. Bikes (#/hr)									3			
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	pt+ov	Prot	NA	Perm
Protected Phases	5	2		1	6		3	8	8 1	7	4	
Permitted Phases			2									4
Actuated Green, G (s)	45.5	75.8	75.8	13.4	43.7		22.8	54.7	72.6	20.1	52.0	52.0
Effective Green, g (s)	45.5	75.8	75.8	13.4	43.7		22.8	54.7	72.6	20.1	52.0	52.0
Actuated g/C Ratio	0.25	0.42	0.42	0.07	0.24		0.13	0.30	0.40	0.11	0.29	0.29
Clearance Time (s)	3.5	4.5	4.5	3.5	4.5		3.5	4.5		3.5	4.5	4.5
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0		3.0	1.0		1.0	1.0	1.0
Lane Grp Cap (vph)	867	2141	625	255	1178		434	1075	638	383	968	400
v/s Ratio Prot	c0.27	0.30		0.06	c0.27		0.11	c0.33	0.15	c0.12	0.27	
v/s Ratio Perm			0.07									0.22
v/c Ratio	1.08	0.72	0.17	0.77	1.11		0.83	1.09	0.38	1.05	0.95	0.77
Uniform Delay, d1	67.2	43.2	32.4	81.8	68.2		76.7	62.6	37.9	80.0	62.6	58.5
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	54.0	2.1	0.6	11.8	61.2		12.8	53.7	0.1	60.4	16.9	7.7
Delay (s)	121.2	45.2	33.0	93.6	129.4		89.5	116.4	38.0	140.3	79.5	66.2
Level of Service	F	D	C	F	F		F	F	D	F	E	E
Approach Delay (s)		70.7			124.8			100.1			90.7	
Approach LOS		E			F			F			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			92.7			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.09									
Actuated Cycle Length (s)			180.0			Sum of lost time (s)			16.0			
Intersection Capacity Utilization			107.5%			ICU Level of Service			G			
Analysis Period (min)			15									

c Critical Lane Group

Queues  
22a: Oregon Ave & Alma St

Cumulative + Churchill Closure with Mitigation  
Timing Plan: P.M.Peak



Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	38	82	1818	446	1675
v/c Ratio	0.11	0.22	0.84	0.44	0.67
Control Delay	34.8	9.8	10.4	2.3	8.7
Queue Delay	0.0	0.0	0.9	0.0	0.0
Total Delay	34.8	9.8	11.3	2.3	8.7
Queue Length 50th (ft)	20	0	155	4	242
Queue Length 95th (ft)	49	40	m221	m27	305
Internal Link Dist (ft)			473		363
Turn Bay Length (ft)				150	
Base Capacity (vph)	337	368	2170	1003	2567
Starvation Cap Reductn	0	0	135	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.11	0.22	0.89	0.44	0.65

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis Cumulative + Churchill Closure with Mitigation 22a: Oregon Ave & Alma St

Timing Plan: P.M.Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				↖		↗		↑↑	↗		↑↑	
Traffic Volume (vph)	0	0	0	35	0	75	0	1800	442	0	1297	328
Future Volume (vph)	0	0	0	35	0	75	0	1800	442	0	1297	328
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.5		4.5		4.5	4.5		4.5	
Lane Util. Factor				1.00		1.00		0.95	1.00		0.95	
Frbp, ped/bikes				1.00		1.00		1.00	0.92		1.00	
Flpb, ped/bikes				1.00		1.00		1.00	1.00		1.00	
Frt				1.00		0.85		1.00	0.85		0.97	
Flt Protected				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (prot)				1770		1583		3539	1454		3432	
Flt Permitted				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (perm)				1770		1583		3539	1454		3432	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.25	0.92	0.25	0.99	0.99	0.25	0.97	0.97
Adj. Flow (vph)	0	0	0	38	0	82	0	1818	446	0	1337	338
RTOR Reduction (vph)	0	0	0	0	0	67	0	0	114	0	23	0
Lane Group Flow (vph)	0	0	0	38	0	15	0	1818	332	0	1652	0
Confl. Peds. (#/hr)									23			
Turn Type				Prot		Perm		NA	Perm		NA	
Protected Phases				8				2			6	
Permitted Phases						8			2			
Actuated Green, G (s)				18.5		18.5		59.7	59.7		70.7	
Effective Green, g (s)				18.5		18.5		59.7	59.7		70.7	
Actuated g/C Ratio				0.19		0.19		0.61	0.61		0.72	
Clearance Time (s)				4.5		4.5		4.5	4.5		4.5	
Vehicle Extension (s)				3.0		3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)				333		298		2151	883		2470	
v/s Ratio Prot				c0.02				c0.51			c0.48	
v/s Ratio Perm						0.01			0.23			
v/c Ratio				0.11		0.05		0.85	0.38		0.67	
Uniform Delay, d1				33.1		32.7		15.5	9.8		7.4	
Progression Factor				1.00		1.00		0.51	0.44		1.00	
Incremental Delay, d2				0.2		0.1		1.5	0.1		0.7	
Delay (s)				33.2		32.7		9.5	4.5		8.1	
Level of Service				C		C		A	A		A	
Approach Delay (s)		0.0			32.9			8.5			8.1	
Approach LOS		A			C			A			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			9.1									A
HCM 2000 Volume to Capacity ratio			0.69									
Actuated Cycle Length (s)			98.2							13.5		
Intersection Capacity Utilization			61.9%									B
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
22b: Alma St & Oregon Expy EB Ramps

Cumulative + Churchill Closure with Mitigation

Timing Plan: P.M.Peak



Lane Group	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	413	1869	71	70	1303
v/c Ratio	0.96	0.86	0.07	0.50	0.51
Control Delay	62.5	21.7	5.6	69.0	3.6
Queue Delay	0.8	0.4	0.0	0.0	0.1
Total Delay	63.4	22.1	5.6	69.0	3.7
Queue Length 50th (ft)	176	499	10	48	65
Queue Length 95th (ft)	#373	626	28	m74	74
Internal Link Dist (ft)		386			473
Turn Bay Length (ft)			100	50	
Base Capacity (vph)	428	2170	983	155	2624
Starvation Cap Reductn	0	0	0	0	329
Spillback Cap Reductn	2	55	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.97	0.88	0.07	0.45	0.57

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis Cumulative + Churchill Closure with Mitigation  
 22b: Alma St & Oregon Expy EB Ramps

Timing Plan: P.M.Peak



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		↗	↕	↘	↗	↕
Traffic Volume (vph)	0	392	1850	70	68	1264
Future Volume (vph)	0	392	1850	70	68	1264
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5	4.5
Lane Util. Factor		1.00	0.95	1.00	1.00	0.95
Frt		0.86	1.00	0.85	1.00	1.00
Flt Protected		1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)		1611	3539	1583	1770	3539
Flt Permitted		1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)		1611	3539	1583	1770	3539
Peak-hour factor, PHF	0.25	0.95	0.99	0.99	0.97	0.97
Adj. Flow (vph)	0	413	1869	71	70	1303
RTOR Reduction (vph)	0	122	0	13	0	0
Lane Group Flow (vph)	0	291	1869	58	70	1303
Turn Type		Perm	NA	Perm	Prot	NA
Protected Phases			2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)		18.5	59.7	59.7	6.5	70.7
Effective Green, g (s)		18.5	59.7	59.7	6.5	70.7
Actuated g/C Ratio		0.19	0.61	0.61	0.07	0.72
Clearance Time (s)		4.5	4.5	4.5	4.5	4.5
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		303	2151	962	117	2547
v/s Ratio Prot			c0.53		0.04	c0.37
v/s Ratio Perm		c0.18		0.04		
v/c Ratio		0.96	0.87	0.06	0.60	0.51
Uniform Delay, d1		39.5	16.0	7.8	44.6	6.1
Progression Factor		1.00	1.00	1.00	1.35	0.49
Incremental Delay, d2		41.1	4.0	0.0	6.2	0.1
Delay (s)		80.6	20.0	7.9	66.6	3.1
Level of Service		F	C	A	E	A
Approach Delay (s)	80.6		19.6			6.4
Approach LOS	F		B			A

Intersection Summary			
HCM 2000 Control Delay	21.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	98.2	Sum of lost time (s)	13.5
Intersection Capacity Utilization	82.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Queues  
24: Middlefield Rd & Oregon Expy

Cumulative + Churchill Closure with Mitigation  
Timing Plan: P.M.Peak



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	192	1284	270	215	1140	67	249	765	56	534	125
v/c Ratio	1.19	1.13	0.37	1.06	0.94	0.11	1.20	0.59	0.49	0.94	0.18
Control Delay	169.6	110.0	11.2	140.9	63.7	0.4	179.7	38.4	82.3	75.7	2.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	169.6	110.0	11.2	140.9	63.7	0.4	179.7	38.4	82.3	75.7	2.7
Queue Length 50th (ft)	~222	~759	30	~257	584	0	~293	306	54	499	0
Queue Length 95th (ft)	m#362	#891	122	#429	#740	0	#474	376	103	#710	25
Internal Link Dist (ft)		1028			896			676		311	
Turn Bay Length (ft)	360		100	390		100	230		145		
Base Capacity (vph)	162	1132	731	203	1207	618	208	1303	121	596	705
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.19	1.13	0.37	1.06	0.94	0.11	1.20	0.59	0.46	0.90	0.18

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

























# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis Cumulative + Churchill Closure with Mitigation 24: Middlefield Rd & Oregon Expy

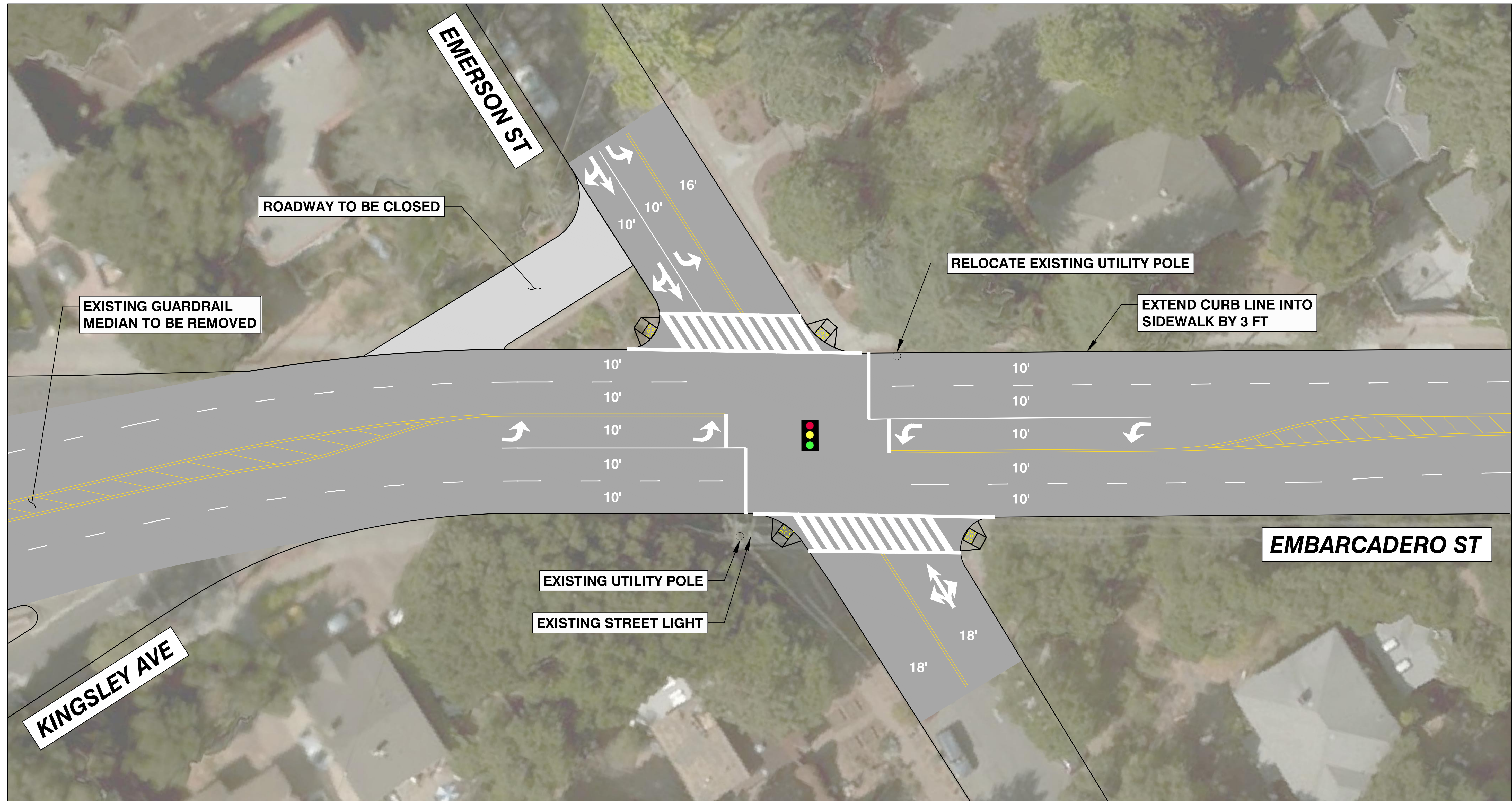
Timing Plan: P.M.Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	179	1194	251	198	1049	62	229	545	159	52	497	116
Future Volume (vph)	179	1194	251	198	1049	62	229	545	159	52	497	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.2	5.1	5.3	5.0	5.1	5.1	5.3	5.9		5.4	5.9	5.2
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95		1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.98	1.00	0.99		1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1565	1770	3539	1548	1770	3401		1770	1863	1563
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1565	1770	3539	1548	1770	3401		1770	1863	1563
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	192	1284	270	215	1140	67	249	592	173	56	534	125
RTOR Reduction (vph)	0	0	48	0	0	45	0	18	0	0	0	74
Lane Group Flow (vph)	192	1284	222	215	1140	22	249	747	0	56	534	51
Confl. Peds. (#/hr)			2			6			11			4
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	pm+ov	Prot	NA	Perm	Prot	NA		Prot	NA	pm+ov
Protected Phases	1	6	7	5	2		7	4		3	8	1
Permitted Phases			6			2						8
Actuated Green, G (s)	13.8	46.9	64.6	17.2	50.1	50.1	17.7	56.6		7.9	46.9	60.7
Effective Green, g (s)	13.8	46.9	64.6	17.2	50.1	50.1	17.7	56.6		7.9	46.9	60.7
Actuated g/C Ratio	0.09	0.31	0.43	0.11	0.33	0.33	0.12	0.38		0.05	0.31	0.40
Clearance Time (s)	5.2	5.1	5.3	5.0	5.1	5.1	5.3	5.9		5.4	5.9	5.2
Vehicle Extension (s)	3.0	4.0	5.0	3.0	4.0	4.0	5.0	5.0		3.0	3.0	3.0
Lane Grp Cap (vph)	162	1106	673	202	1182	517	208	1283		93	582	632
v/s Ratio Prot	0.11	c0.36	0.04	0.12	c0.32		c0.14	0.22		0.03	c0.29	0.01
v/s Ratio Perm			0.10			0.01						0.02
v/c Ratio	1.19	1.16	0.33	1.06	0.96	0.04	1.20	0.58		0.60	0.92	0.08
Uniform Delay, d1	68.1	51.5	28.3	66.4	49.1	33.8	66.2	37.3		69.5	49.7	27.5
Progression Factor	0.92	0.89	0.61	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	117.5	79.7	0.4	81.4	18.9	0.2	125.8	1.0		10.5	19.4	0.1
Delay (s)	180.2	125.6	17.7	147.8	68.0	33.9	191.9	38.3		80.0	69.0	27.5
Level of Service	F	F	B	F	E	C	F	D		F	E	C
Approach Delay (s)		114.9			78.5			76.0			62.6	
Approach LOS		F			E			E			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			88.6			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.07									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			21.6			
Intersection Capacity Utilization			102.3%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												




## Appendix K – Alma Street and Embarcadero Road Conceptual Improvements



# Embarcadero Street & Emerson Street Intersection Improvements

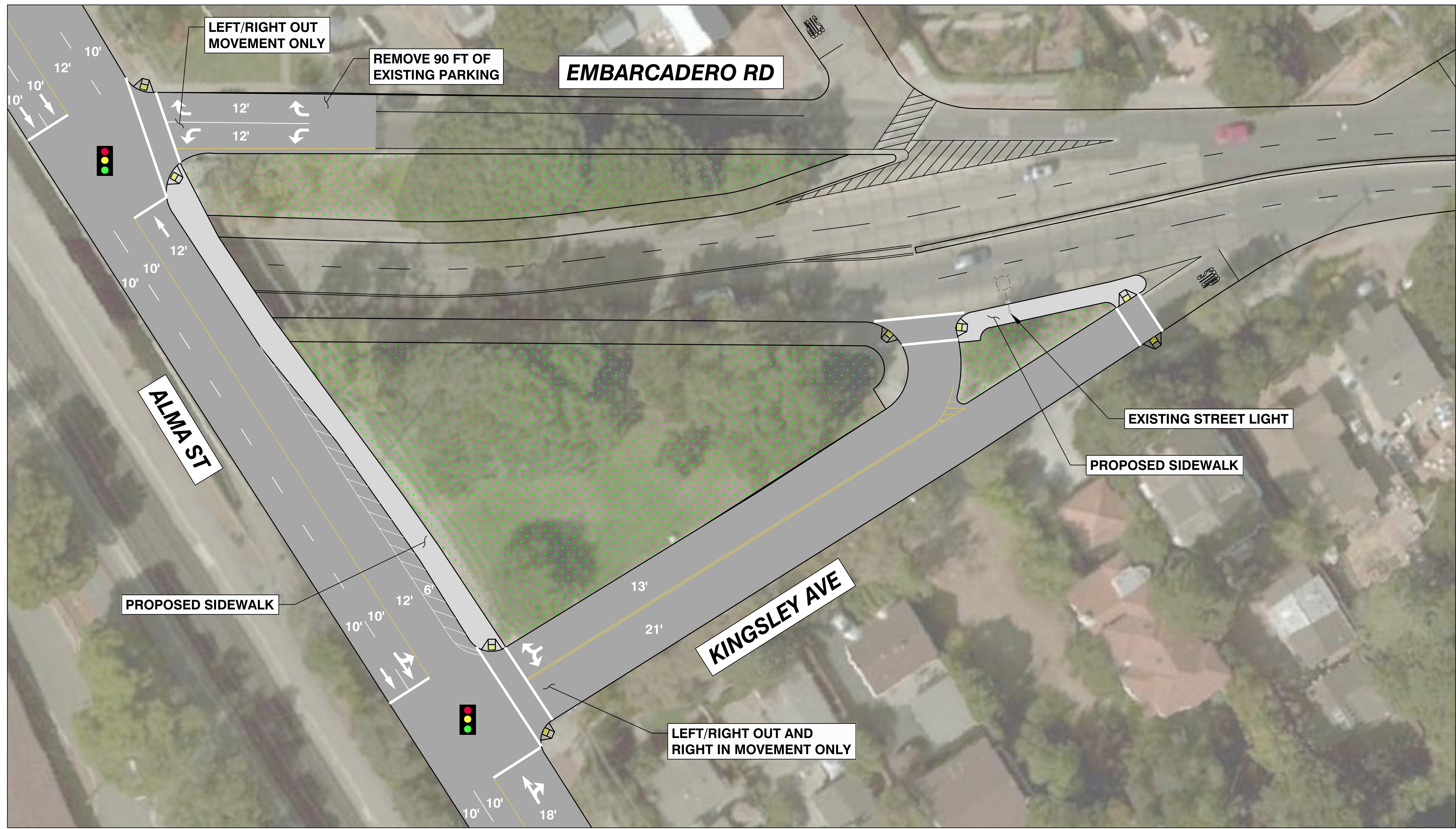


**LEGEND:**




-  SIGNALIZED INTERSECTION
-  EXISTING UTILITY POLE
-  ADA COMPLIANT CURB RAMP

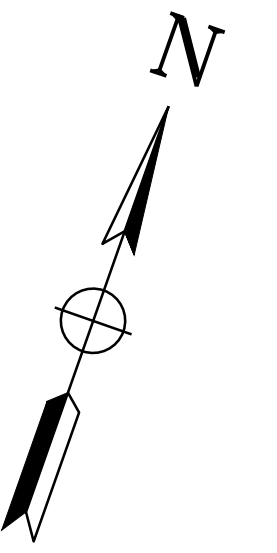
Concept 1

# Alma Street - Near Term Improvements



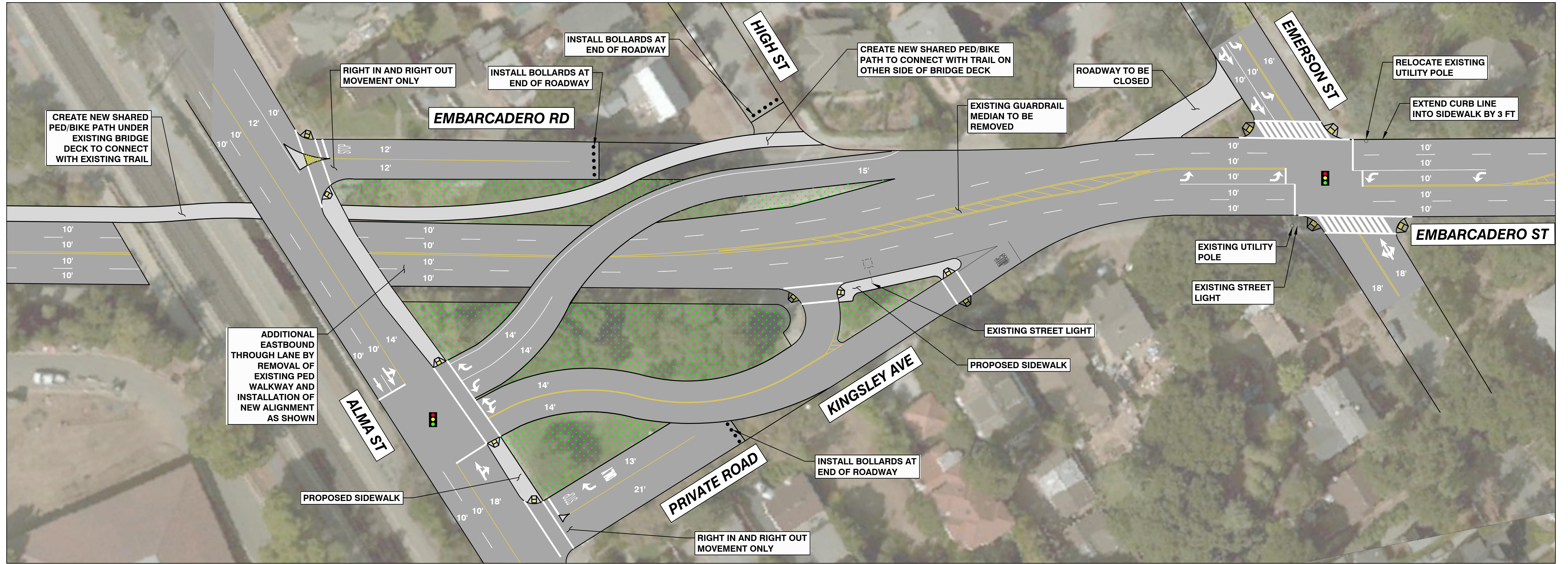
**LEGEND:**

-  SIGNALIZED INTERSECTION
-  ADA COMPLIANT CURB RAMP
-  EXISTING STREET LIGHT

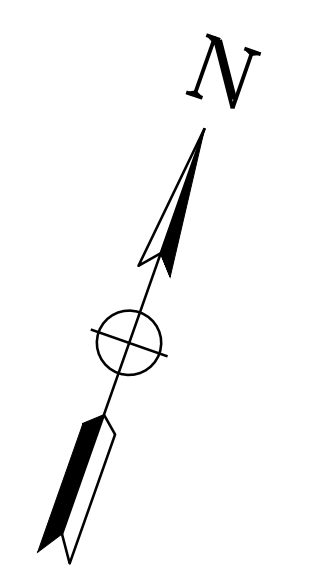


Concept 2A

# Embarcadero Street - Long Term Improvements



- LEGEND:**
- SIGNALIZED INTERSECTION
  - CONCRETE BOLLARD
  - EXISTING UTILITY POLE
  - ADA COMPLIANT CURB RAMP
  - EXISTING STREET LIGHT



Concept 1 & 2B

# Review of Recent Traffic Study and Discussion of Submitted Questions

Expanded Community Advisory Panel (XCAP)

Special Meeting – January 8, 2019

Item #3

Hexagon Consulting

# Summary

- Questions received by XCAP and members of the public
- Questions generally themed around future outreach, study methodology, definition of mitigations, clarifications on the analysis, other studies desired, clarifications on the mitigations, and general comments
- Today's discussion focuses on discussion of the methodology, definition of mitigations, clarifications on the analysis, and clarifications on the mitigations

# Methodology

- VISSIM Model Used (“Verkehr In Städten - SIMulationsmodell” (German for “Traffic in cities - simulation model”))
- Assumptions built into VISSIM: geometrics, traffic volume, signal timing, behavioral characteristics. Crashes are not included in the model.
- Simulation was Alma from Lincoln to Churchill and Embarcadero at Kingsley (see map on later slide)
- Simulation calculates intersection delays at peak hours

# Methodology, continued

- Travel Demand Model looks at traffic growth based on population and employment changes and availability and cost of transportation options
- Assumptions based on KNOWN growth and projections (e.g., the Castilleja School and Stanford General Use Permit projections were included)
- Projections done to 2030 instead of later years because 2030 is the General Plan forecast year

# Definition of 'Mitigations'

- “Mitigations” – street system changes that would allow additional capacity to accommodate diverted traffic



# Clarifications on Traffic Analysis

- The following slides have information about the analysis conducted for the traffic data included in the traffic report ([www.connectingpaloalto.com/traffic](http://www.connectingpaloalto.com/traffic))

# Traffic Counts

<b>Churchill Avenue - West of Alma Street</b>				
	<b>2016</b>	<b>Dec-18</b>	<b>Jun-19</b>	
	<b>(Standford GUP)</b>	<b>(TIA Report)</b>	<b>Highest Weekday</b>	<b>Weekday Average</b>
<b>AM Peak Hour</b>				
Eastbound	235	295	292	281
Westbound	429	411	382	367
<i>Total</i>	<i>664</i>	<i>706</i>	<i>674</i>	<i>648</i>
<b>PM Peak Hour</b>				
Eastbound	384	440	437	410
Westbound	384	335	392	342
<i>Total</i>	<i>768</i>	<i>775</i>	<i>829</i>	<i>752</i>



# Traffic Counts

- 2016, 2018, 2019 Consistent
- No need for new counts
- Churchill Crossing Daily traffic is 9,800
- Matches Caltrain Business Plan
- Traffic analysis based on peak hours

# Churchill Queuing AM



**LEGEND**

-  = AM Queues
-  = AM Queues with Electrification

# Churchill Queuing PM



# Queuing at Churchill Crossing

- Existing assumes 9 trains per hour
- Future assumes 12 trains per hour

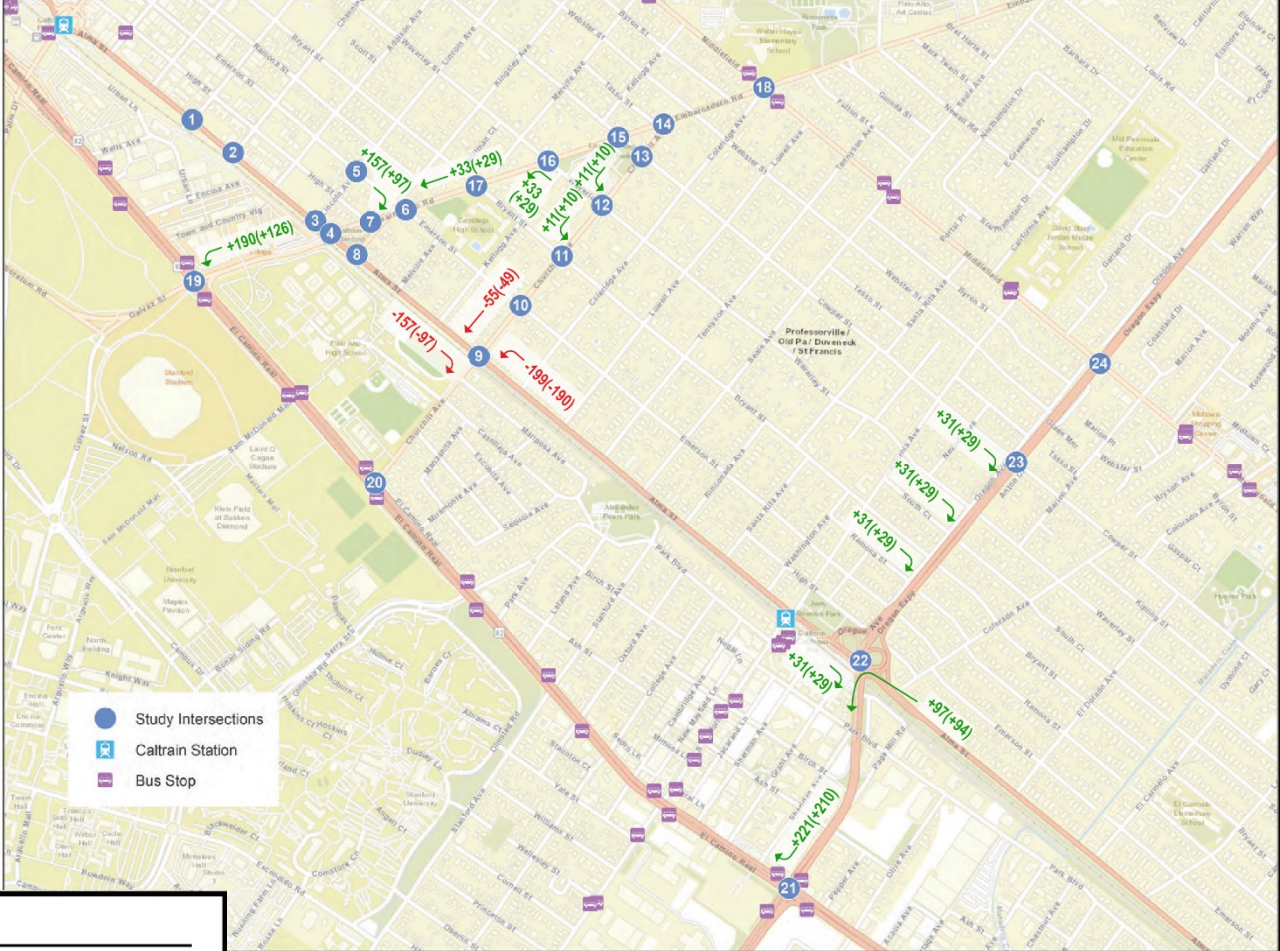
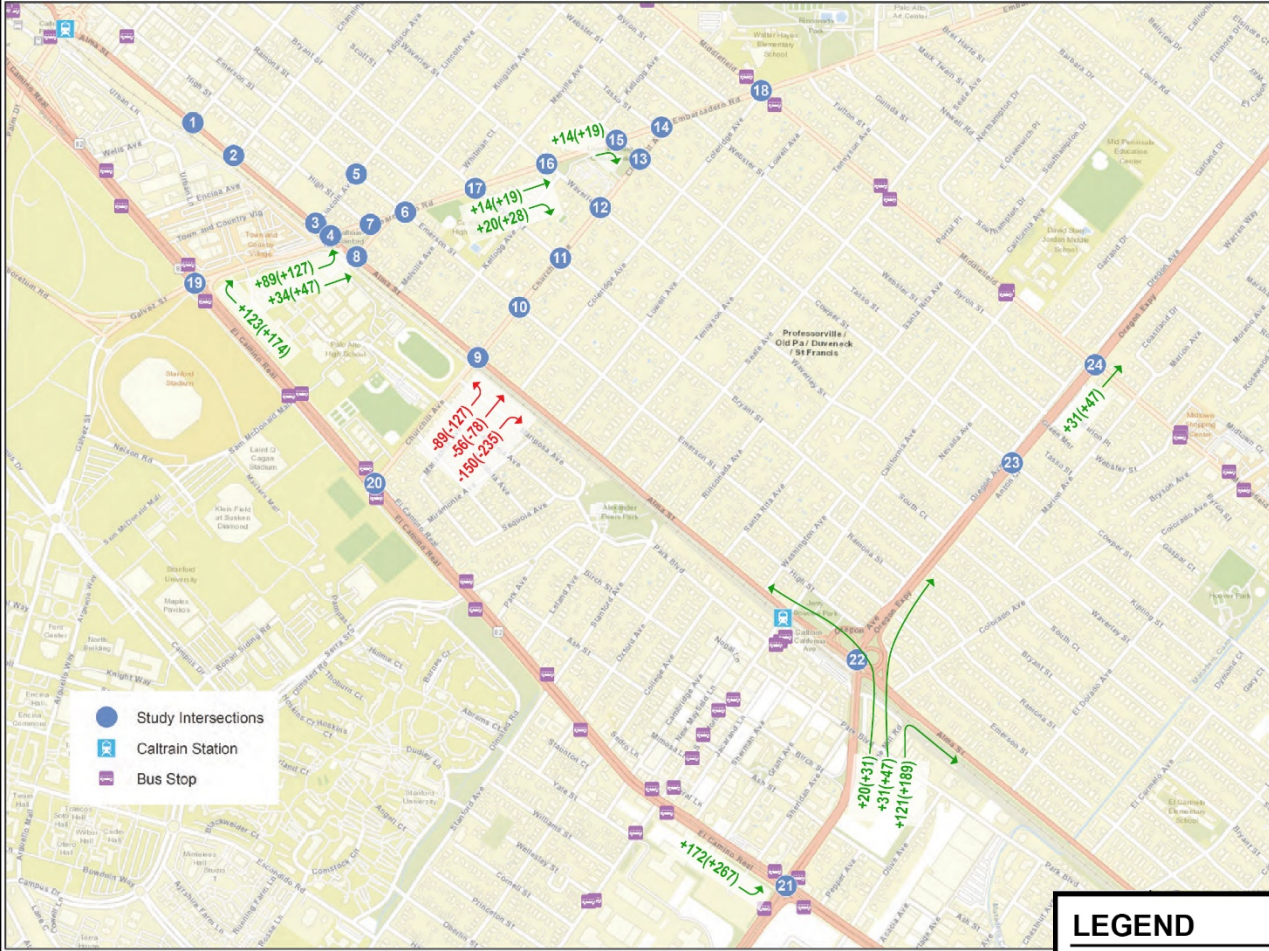
# Traffic Forecasts

- 2030 General Plan
- Includes Stanford and Castilleja School
- Includes Caltrain Service Increase

# Traffic Reassignment

## Eastbound Trips

## Westbound Trips



**LEGEND**

- +XX = Increase in Trips
- XX = Decrease in Trips
- XX(X) = AM(PM) Peak-Hour Volumes



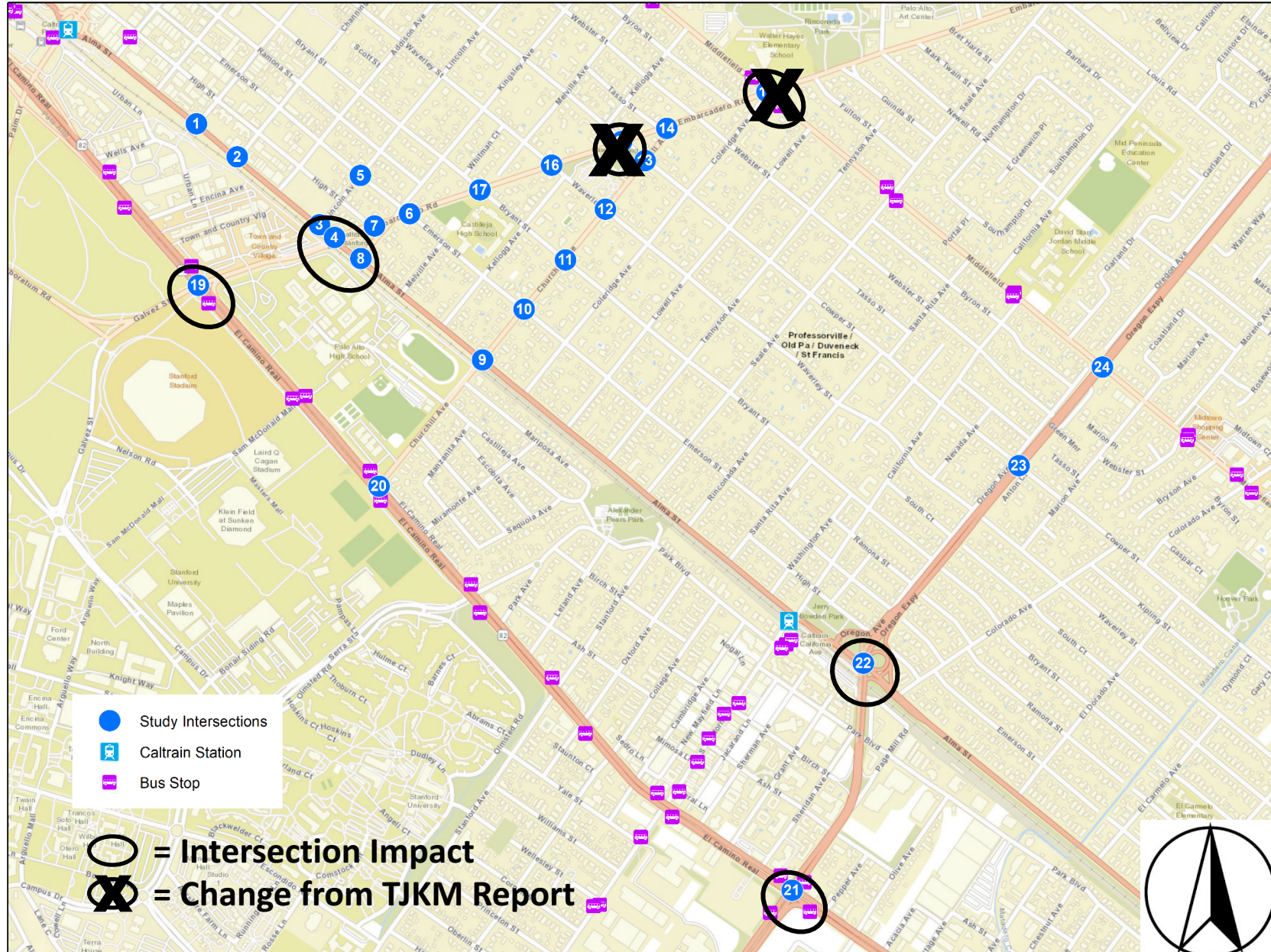
# Traffic Reassignment

- Based on streetlight data (cell phones)
- Existing Origin-Destination (O-D) reassigned by hand
- Based on shortest path
- To/From North assigned to Embarcadero
- To/From South assigned to Oregon/Page Mill
- Through split between Embarcadero and Oregon/Page Mill

# Clarifications on Traffic Mitigations

- The following slides have information about the traffic mitigations proposed as described in the traffic report ([www.connectingpaloalto.com/traffic](http://www.connectingpaloalto.com/traffic))

# Intersection Impacts

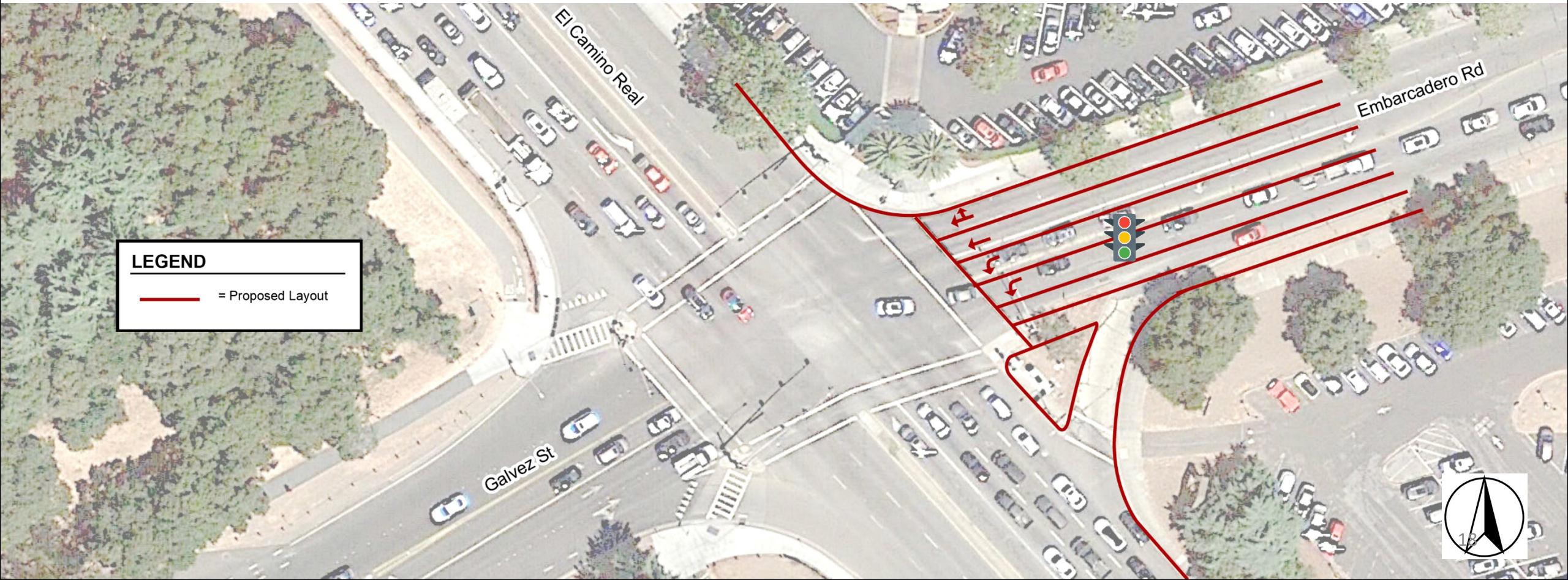


# Intersection Impacts

- Defined as an increase in delay of 4 seconds or more at deficient locations
- Improvements (mitigation) were studied for the 7 locations with impacts
- Hexagon disagrees with TJKM report at two locations (Embarcadero/Cowper and Embarcadero/Middlefield)

# Recommended Improvement for El Camino Real/Embarcadero Road

- Install additional westbound left turn lane and northbound right turn lane
- Optimize signal timings

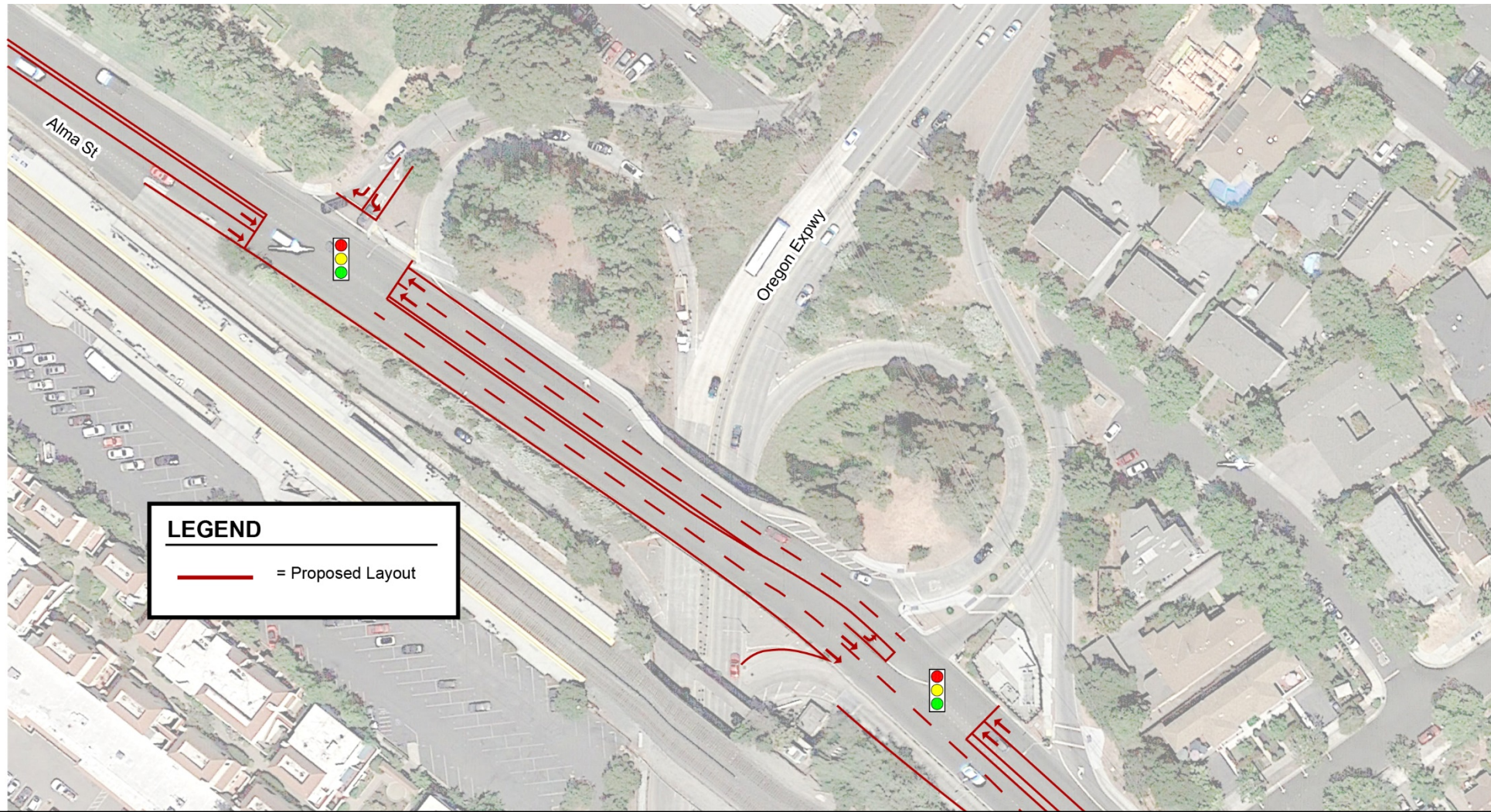


# El Camino/Embarcadero

- Can accommodate planned cycle tracks
- Other improvements also possible in conjunction (eliminate pork chop islands)
- No improvements necessary at Town and Country/Palo Alto High School (Paly) driveway
- Backups on Embarcadero are a result of signal at El Camino

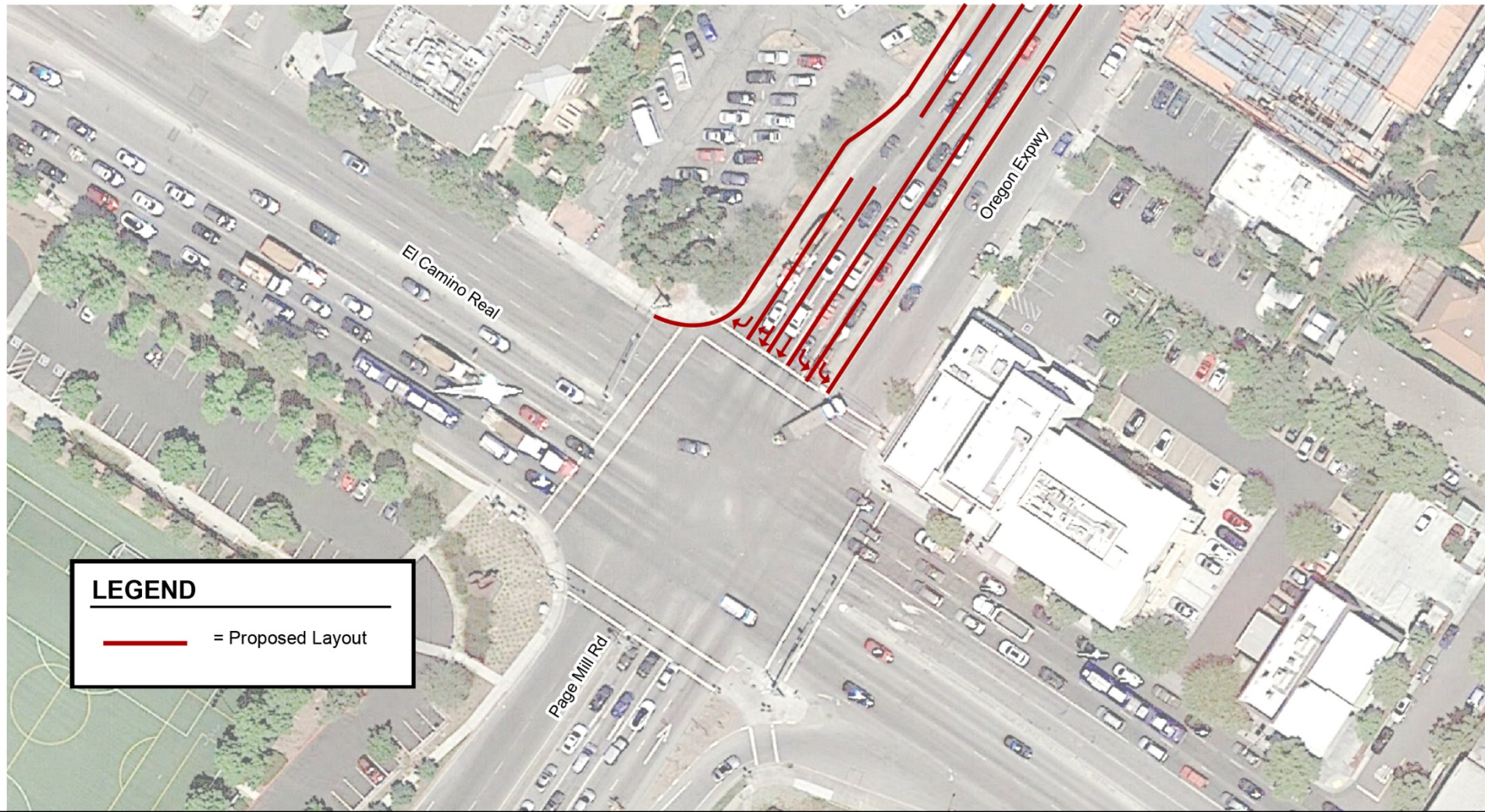
# Recommended Improvement for Alma Street/Oregon Expressway

- Signalize both on/off ramps with one controller



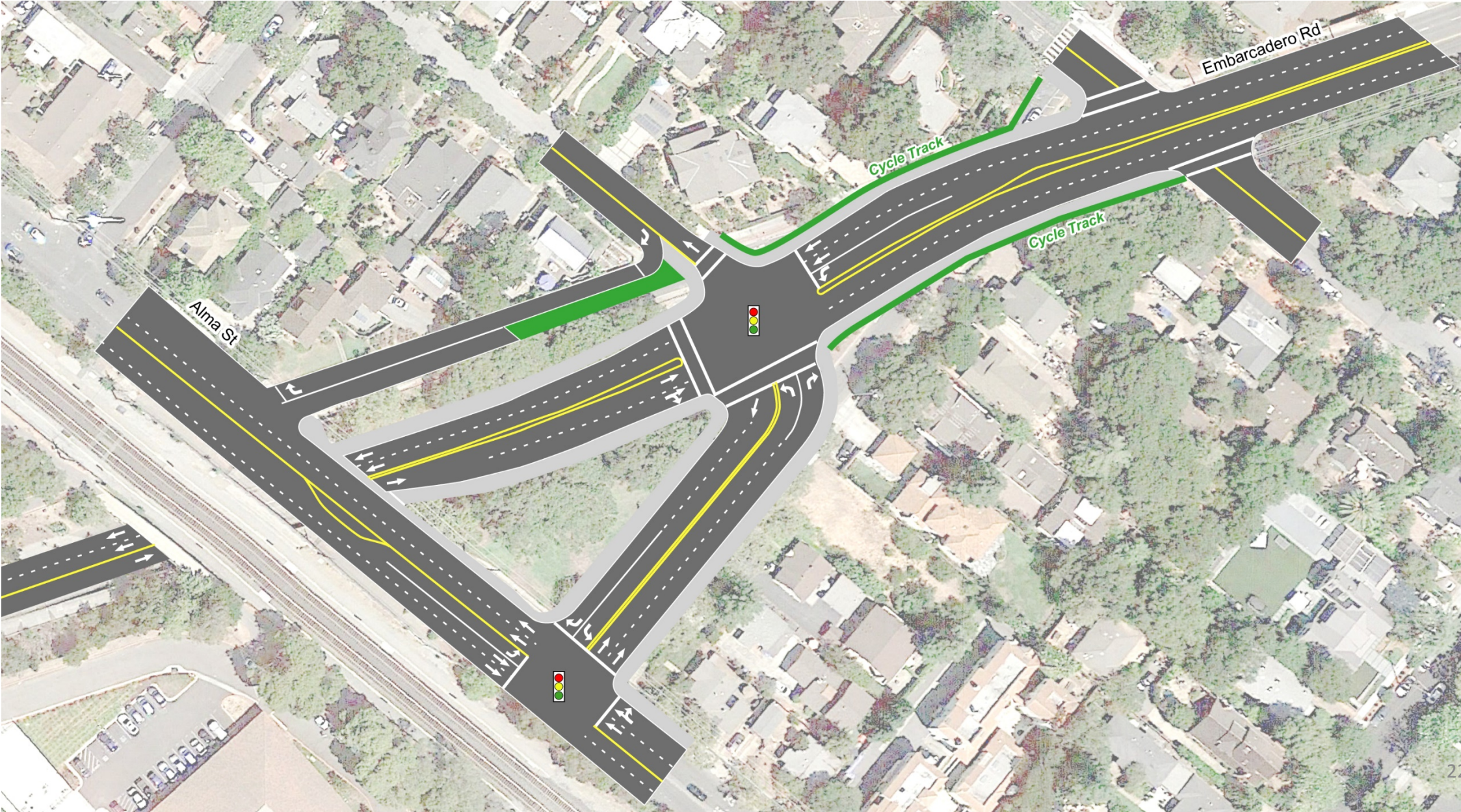
# Recommended Improvement for El Camino Real/Oregon Expressway-Page Mill Road

- Install westbound right turn lane from Oregon Expressway to El Camino Real
- Optimize signal timing





# Recommended Improvement (Alma and Embarcadero)



# Recommended Improvement (Alma and Embarcadero)

- Requires widening the Alma overcrossing to add one north bound lane
- Can accommodate planned cycle track
- Two new signals
- Can tie in High Street as an option
- Can maintain connection to Embarcadero ramp as an option

# Recommended Improvement (Alma and Embarcadero)

- Can also eliminate the Paly high school crosswalk signal as an option
- No excessive queuing (could be coordinated with signal at El Camino)
- Need to work out driveway access
- Bicycle and pedestrian safety a function of design
- Traffic could still use Emerson, like today, but it is a longer route than the proposed Kingsley route

# Design Option

Note, this does not include the cycle track designs. Those are possible and would come later in the design process.



# Design Option

- Signal on Alma not shown but would exist
- Possible new overcrossing for the school is shown
- Ties in High Street
- Cycle track would be possible, but not shown

# Intersection Level of Service (LOS)

#	Intersection	Peak Hour	Churchill Closure								
			Existing			No Improvements			With Improvements		
			Traffic Control	Avg. Delay (sec.)	LOS	Traffic Control	Avg. Delay (sec.)	LOS	Traffic Control	Avg. Delay (sec.)	LOS
1	Alma Street & Lincoln Avenue	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	One-Way	<b>&gt;=50</b>	<b>F</b>	One-Way	5.7	A
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	Stop	<b>&gt;=50</b>	<b>F</b>	Stop	21.1	C
2	Alma Street & Embarcadero Road	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	One-Way	<b>&gt;=50</b>	<b>F</b>	Signal	4.8	A
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	Stop	<b>&gt;=50</b>	<b>F</b>	Signal	3.0	A
3	Alma Street & Kingsley Avenue	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	One-Way	<b>&gt;=50</b>	<b>F</b>	Signal	13.3	B
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	Stop	<b>&gt;=50</b>	<b>F</b>	Signal	18.3	B
4	El Camino Real/Embarcadero Rd*	AM	Signal	60.3	E	Signal	<b>&gt;80</b>	<b>F</b>	Signal	67.1	E
		PM	Signal	67.0	E	Signal	<b>&gt;80</b>	<b>F</b>	Signal	61.1	E
5	El Camino Real/Oregon Expwy-Page Mill Rd*	AM	Signal	72.9	E	Signal	<b>&gt;80</b>	<b>F</b>	Signal	72.5	E
		PM	Signal	66.4	E	Signal	<b>&gt;80</b>	<b>F</b>	Signal	73.5	E
6A	Alma St & Oregon Expwy WB Off Ramp (Oregon Ave)	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	One-Way	<b>&gt;=50</b>	<b>F</b>	Signal	6	A
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	Stop	<b>&gt;=50</b>	<b>F</b>	Signal	6.7	A
6B	Alma St & Oregon Expwy EB Off Ramp	AM	One-Way	<b>&gt;=50</b>	<b>F</b>	One-Way	<b>&gt;=50</b>	<b>F</b>	Signal	17.9	B
		PM	Stop	<b>&gt;=50</b>	<b>F</b>	Stop	<b>&gt;=50</b>	<b>F</b>	Signal	16.0	B

Notes:

1. Average delay is reported for the worst approach at unsignalized intersections.
2. Bold indicates substandard intersection level of service.

# Intersection Level of Service (LOS)

#	Intersection	Year 2030			Churchill Closure - Year 2030 Conditions						
		Peak Hour	(No Churchill Closure)			No Improvements			With Improvements		
			Traffic Control	Avg. Delay (sec.)	LOS	Traffic Control	Avg. Delay (sec.)	LOS	Traffic Control	Avg. Delay (sec.)	LOS
1	Alma Street & Lincoln Avenue	AM	One-Way	>=50	F	One-Way	>=50	F	One-Way	14.4	B
		PM	Stop	>=50	F	Stop	>=50	F	Stop	15.2	C
2	Alma Street & Embarcadero Road	AM	One-Way	>=50	F	One-Way	>=50	F	Signal	4	A
		PM	Stop	>=50	F	Stop	>=50	F		3.6	A
3	Alma Street & Kingsley Avenue	AM	One-Way	>=50	F	One-Way	>=50	F	Signal	13.0	B
		PM	Stop	>=50	F	Stop	>=50	F		14.8	B
4	El Camino Real/Embarcadero Rd*	AM	Signal	70.6	E	Signal	>80	F	Signal	73.6	E
		PM		>80	F		>80	F		76.2	E
5	El Camino Real/Oregon Expwy-Page Mill Rd*	AM	Signal	>=80	F	Signal	>80 (120.3)	F	Signal	>80 (91.8)	F
		PM		76.8	E		>80 (108.4)	F		>80 (92.7)	F
6A	Alma St & Oregon Expwy WB Off Ramp (Oregon Ave)	AM	One-Way	>=50	F	One-Way	>=50	F	Signal	7.8	A
		PM	Stop	>=50	F	Stop	>=50	F		9.1	A
6B	Alma St & Oregon Expwy EB Off Ramp	AM	One-Way	>=50	F	One-Way	>=50	F	Signal	24.9	C
		PM	Stop	>=50	F	Stop	>=50	F		21.5	C

Notes:

1. Average delay is reported for the worst approach at unsignalized intersections.
2. Bold indicates substandard intersection level of service.

# Intersection Level of Service (LOS)

- Embarcadero/El Camino slightly worse with reassigned traffic and improvements, further improvement possible
- Page Mill/El Camino worse with reassigned traffic and improvement



# Future Outreach

- The City will be discussing the grade separations in different neighborhoods over the coming months. Please plan to attend one of the following:

## CONNECTING PALO ALTO



### Rail Crossing Community Conversations

**JOIN THE RAIL CONVERSATION TOWN HALLS THURSDAYS @ 6:00-8:00PM**  
*Community conversations with structured presentations, question and answer sessions and more*

#### FEBRUARY 20

*General presentation and topics, including update from the November 2019 community discussion.*

**Mitchell Park  
Community Center**

3700 Middlefield Rd, Palo Alto

#### FEBRUARY 27

*General presentation plus focus on Meadow/Charleston Rail Grade Separation Alternatives.*

**Palo Alto  
Elks Lodge**

4249 El Camino Real, Palo Alto

#### MARCH 12

*General presentation plus focus on Churchill Rail Grade Separation Alternatives.*

**Palo Alto  
High School**

50 Embarcadero Rd, Palo Alto

### WORD ON THE STREET COMMUNITY CONVERSATIONS THURSDAYS

*Informal open-house style community conversations, with City staff regarding transportation projects including rail*

#### JANUARY 30

**Ohlone Elementary (6-8 p.m.)**  
950 Amarillo Ave, Palo Alto

#### MARCH 19

**JLS Middle School (6-8 p.m.)**  
480 E Meadow Dr, Palo Alto

#### APRIL 16

**Gunn High School (3-5 p.m.)**  
780 Arastradero Rd, Palo Alto

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# XCAP Approved Traffic Questions & Proposed Work

Questions are those compiled as of the January 22, 2020 XCAP Meeting.

1. Can we add a private lane for that small strip of Kingsley between Alma and Embarcadero? If we can add 4 lanes there as on/off ramp for Alma there, there seems to be room to add an additional lane to the benefit of the residents there. (Dave)  
***A private lane is not necessary. Please see the attached conceptual design for the intersection the shows the existing driveway access can stay essentially as-is.***
2. Is there space for two-way cycle tracks on both sides of Embarcadero east of the underpass? (Megan)  
***No. The current design is for one-way cycle tracks/bike lanes. One on each side.***
3. How and when will we know if the light at Kingsley results in queues that impact driveways on Embarcadero in a manner that results in the need to take those properties? (Megan)  
***The new light at Kingsley would not require the acquisition of any right-of-way or properties.***
4. Could a right-hand-turn lane be added on Embarcadero heading west at the El Camino light if we want to maintain bike/ped improvements? (Megan)  
***There isn't room to add a right-turn lane and a second left turn lane. The current design concept is to add a second left turn lane. See the attached diagram.***
5. Can you confirm that the ramp southbound from Oregon Expressway to Alma misses the proposed light on Alma or is gated by the light? Concern is queuing backing up Oregon. (Megan)  
***The ramp from Oregon Expressway to southbound Alma would not be controlled by the signal. Please see the attached concept diagrams.***
6. The traffic simulations only modeled peak hours using Caltrain numbers. However, Caltrain intends to expand all day service. If trains now increase to peak hour-levels all day long, can we predict whether we may have multiple peak hour times throughout the day in the future? (Nadia)  
***Traffic volume also peaks during the same hours as peak Caltrain service. Expanded all-day Caltrain service would not correspond to traffic peaks, so impacts would be less than shown in the traffic simulations because the volume of cars at non-peak hours is fewer than peak hours.***

7. Why did Hexagon disagree with the previous consultant that there would be impacts to Middlefield / Embarcadero? (Nadia)

***The previous consultant assumed that there would be an increase in traffic on Middlefield accessing Embarcadero with the closure of Churchill. However, the Streetlight origin-destination data show that almost all Churchill traffic originates west of Middlefield. There are other streets that can be used to access Embarcadero from that neighborhood if Churchill were closed. These include Webster, Cowper, and Waverly, although only Waverly is signalized. Hexagon assumed most neighborhood traffic would access Embarcadero via Waverly.***

8. What would a viaduct do to traffic in the Churchill area and how could any potential inducement be mitigated?

***The effect of the viaduct would be to eliminate the gate down time. During the gate down time, Alma traffic receives a green light. Without the train interruptions, it would be possible to give more signal green time to the movements that cross the tracks. These are primarily right and left turns on and off Alma. Hexagon would expect to see slight decreases in traffic on Embarcadero, between El Camino Real and Alma, and slight increases on Churchill between El Camino Real and Alma. We would not expect to see much cut-through traffic added to Churchill through the neighborhood because we would expect the 8 -8:45 AM through traffic prohibition left intact.***

Similar question for Mike Price's idea at Churchill – how would it impact traffic and how could any inducement be mitigated?

***Mike Price's idea would serve the heaviest movements that cross the railroad tracks, so the traffic redistribution impacts would be similar to the viaduct.***

Could some mitigations proposed from the closure be coupled with Mike Price idea to help with potential inducement?

***Inducement would mean less traffic on Embarcadero and more traffic on Churchill, so the closure mitigations would not apply. The closure mitigations are intended to serve the increased traffic that would occur on Embarcadero with closure. Mike Price's idea would not serve all turning movements, so there would be some traffic redistribution, although substantially less than closure. Whether any "off-site" improvements would be necessary with Mike Price's idea is subject to further analysis.***

9. Can trucks/buses turn on Kingsley?

***Yes. See the attached diagram.***

Turn seems very tight? (Nadia) Can we make Kingsley a "no truck" road?

***That would not be necessary. Emergency vehicles also need to use the road so the design must accommodate them.***

10. What is the LOS (seconds of delay in the AM and PM) of the new Kingsley / Embarcadero light in 2030? (Megan)

***Please see the table below. Because of the LOS E in 2030, Hexagon has revised the design at Alma/Embarcadero/Kingsley (see attached figure) to maintain LOS D in 2030.***

Intersection	Peak Hour	With Existing Volume		With 2030 Volume	
		Avg. Delay (sec.)	LOS	Avg. Delay (sec.)	LOS
Embarcadero Road & Kingsley Avenue New Signal	AM	22.0	C	35.7	C
	PM	22.7	C	67.5	E

11. Do we have a way to measure pedestrian connectivity? Do any metrics exist? (Megan)

***We do not understand what this question means.***

12. When you explain percent increases for intersections, it would be helpful to understand them relative to the current totals so we know how many more cars above today? (Nadia)

***Please see the table below.***

#	Intersection	Peak Hour	Existing Volume	Churchill Closure (With Improvements)		
				Added Volume	Total Volume	% Increase
1	Alma Street & Lincoln Avenue	AM	2,283	-68	2,215	-3%
		PM	2,834	30	2,864	1%
2	Alma Street & Embarcadero Road	AM	2,248	-68	2,180	-3%
		PM	2,795	30	2,825	1%
3	Alma Street & Kingsley Avenue	AM	2,167	-68	2,099	-3%
		PM	2,740	30	2,770	1%
4	El Camino Real/Embarcadero Rd	AM	4,067	202	4,269	5%
		PM	5,307	300	5,607	6%
5	El Camino Real/Oregon Expwy-Page Mill Rd	AM	5,490	375	5,865	7%
		PM	5,978	465	6,443	8%
6A	Alma St & Oregon Expwy WB Off Ramp (Oregon Ave)	AM	2,619	141	2,760	5%
		PM	3,083	146	3,229	5%
6B	Alma St & Oregon Expwy EB Off Ramp	AM	2,696	141	2,837	5%
		PM	3,079	146	3,225	5%

## Questions About Work Feasibility

1. Can induced demand be modeled? (Keith)

***Probably, but this question needs expansion. Induced demand from what? Induced demand where?***

2. Does data exist to simulate further out than 2030? Until 2050 as in Caltrain's business plan? (Megan)

***Approved land use data for Palo Alto exist only to 2030. Therefore, transportation forecasts are for that year. ABAG data exists for year 2040, but that hasn't been vetted for Palo Alto. The VTA model can be used to make forecasts for 2040 but with the understanding that Palo Alto land use may not be correct.***

3. Traffic mitigation on residential streets during the construction phase related to lane closures on Alma. If Palo Alto residents and other drivers from surrounding communities become frustrated with slow traffic, they will most likely use other streets, such as West Bayshore and Middlefield Road for their commute. Also, residential streets that run perpendicular to Alma and parallel to Oregon Expressway and Embarcadero, such as Channing Avenue will also see increased traffic. Therefore, is it feasible for the traffic study to include how some of these residential streets will be affected during the construction phase? (Pat)

***There has been no analysis of traffic impacts during construction, but it could be done.***

4. Is it possible to show network delay estimates and what is the best way to represent how they would impact the system. (For example, even after closure and mitigations, El Camino/Page Mill and El Camino/Embarcadero will continue to fail – how will that make the system worse?) (Nadia)

***The transportation demand model can be used to study network-wide operations. It is not clear exactly what the commenter wants to see.***

## Work Requests

### How much would each cost?

1. Impact of eight (8) trains per direction per peak hour in 2027<sup>1</sup>

***The simulation can be run with any number of trains. The cost is about \$2,000 per scenario.***

2. Traffic impacts of the new alternatives (Price and Alexis plans)<sup>2,3,4</sup>

- a. Price plan without Embarcadero mitigations

***This has been studied. This plan would function well, although there would be some diversions that haven't been studied.***

- b. Price plan with Embarcadero mitigations

***This needs to be studied. The Embarcadero mitigations may or may not be needed. This study is in our scope of work.***

- c. How expensive is it to do both (a) & (b)?

***This is in our scope of work.***

3. LOS (average delays) for completed grade separation intersections<sup>5,6,7</sup> including multimodal LOS (including bike and pedestrian delays) if possible<sup>8</sup>:

- a. Churchill / Alma with viaduct

***This is in our scope of work.***

- b. Churchill / Alma with closure

***This has been done. Please see the results below.***

	Traffic Operations (Existing Traffic Volumes)															
	No Improvements (No Electrification) <sup>1</sup>				Churchill Closure <sup>2</sup>				Viaduct <sup>3</sup>				Partial Underpass <sup>4</sup>			
	AM		PM		AM		PM		AM		PM		AM		PM	
	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS
Alma Street & Churchill Avenue	88.9	F	66.67	E	23.58	C	28.23	C	45.39	D	42.73	D	-	-	-	-
Alma Street & Churchill Avenue (West)	-	-	-	-	-	-	-	-	-	-	-	-	18.30	B	26.06	C
Alma Street & Churchill Avenue (East) <sup>5</sup>	-	-	-	-	-	-	-	-	-	-	-	-	21.95	C	16.61	B

**Notes:-**  
1. Traffic analysis was conducted using PTV Vissim software.  
2. Traffic analysis was conducted using PTV Vissim software.  
3. Traffic analysis was conducted using PTV Vissim software.  
4. Traffic analysis was conducted using SimTraffic.  
5. The analysis assumes that the pedestrian phase is called every signal cycle during the AM peak hour and during 50% of the cycles during the PM peak hour. Only one northbound through lane is assumed on Alma

	Traffic Operations (Year 2030 Traffic Volumes)															
	No Improvements (No Electrification) <sup>1</sup>				Churchill Closure <sup>2</sup>				Viaduct <sup>3</sup>				Partial Underpass <sup>4</sup>			
	AM		PM		AM		PM		AM		PM		AM		PM	
	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS	Delay (secs)	LOS
Alma Street & Churchill Avenue	118.5	F	89.99	F	25.09	C	30.61	C	48.41	D	56.77	E	-	-	-	-
Alma Street & Churchill Avenue (West)	-	-	-	-	-	-	-	-	-	-	-	-	18.34	B	31.69	C
Alma Street & Churchill Avenue (East) <sup>4</sup>	-	-	-	-	-	-	-	-	-	-	-	-	41.81	D	101.72	F

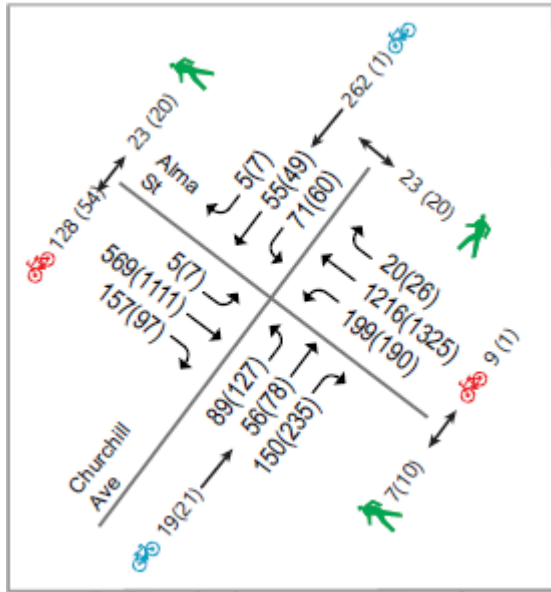
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5. The analysis assumes that the pedestrian phase is called every signal cycle during the AM peak hour and during 50% of the cycles during the PM peak hour. Long queues would occur on northbound Alma during the PM peak hour. Two northbound through lanes would be required to mitigate the queues on Alma.

- c. Meadow / Alma with trench, tunnel, hybrid, or viaduct  
***This is in our scope of work but hasn't been finished.***
  - d. Charleston / Alma with trench, tunnel, hybrid, or viaduct  
***This is in our scope of work but hasn't been finished.***
  - e. Meadow / Alma with Alexis plan  
***This has been run and it works. Details to come.***
  - f. Charleston / Alma with Alexis plan  
***This has been run and it works. Details to come.***
  - g. Churchill / Alma with Price plan  
***This has been run and it works. Details to come.***
4. Expected queue lengths and number of cars that can queue at the Kingsley light as part of the mitigated Churchill closure<sup>9,10,11</sup>  
***The simulation has been run for Kingsley/Embarcadero, as well as for Kingsley/Alma, Lincoln/Alma, Embarcadero slip ramp/Alma, and Churchill/Alma. The attached figures show snapshots of the queuing at Kingsley/Embarcadero. Queues on Kingsley would fit given four lanes on Kingsley. Embarcadero has not been simulated. Therefore, we cannot say how long queues would be on Embarcadero. Simulating Embarcadero would cost around \$20,000.***
5. Traffic impacts of Churchill closure on residential streets after mitigation<sup>12,13</sup>:
- a. If Park Blvd were reopened at Peers Park  
***This is not under consideration.***
  - b. Local streets of Professorville  
***It is unlikely that the streets in Professorville, other than Emerson, would be affected by the closure of Churchill. It is most likely that students and parents in Professorville are using Embarcadero to access the high school. Potential increased traffic on Emerson can be addressed with the new signal at Kingsley. Refer to previous questions and answers related to this.***

6. Additional traffic counts

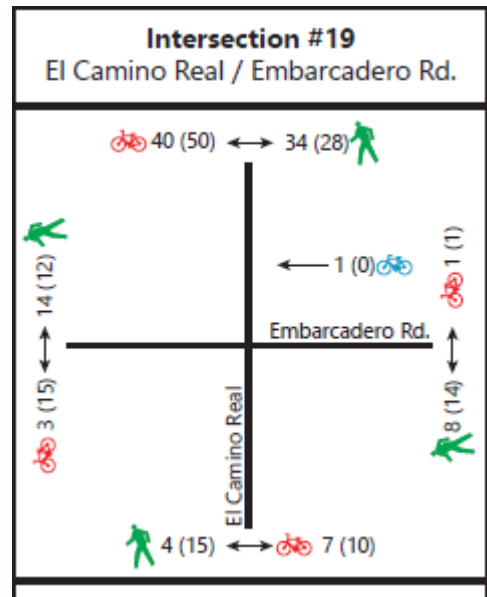
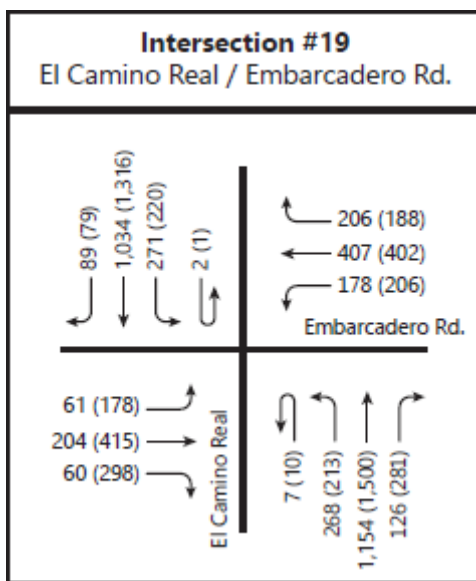
- a. Bike and pedestrian routes and traffic counts at Churchill and Embarcadero<sup>14,15</sup>

**The diagram below (from the traffic study) shows the pedestrian and bike volume on Churchill. The counts show the highest hours between 7-9 AM and 406 PM. Pedestrian and bike counts on Embarcadero would cost around \$1,000.**



- b. The intersection of Embarcadero / El Camino<sup>16</sup>

**Below are the car counts and bike/ped counts for Embarcadero/El Camino**



7. Animations of unclearable queues at Churchill (cost?)<sup>17</sup>

**This could be done. The cost would be about \$2,000.**

8. Collision history data for Churchill and Embarcadero areas<sup>18</sup>

**This would need to come from City staff.**

9. Please include in the footnotes what calibrations were done in VISSIM (Nadia)

**VISSIM was calibrated to the traffic counts and queue lengths. Traffic volume per minute can be adjusted in VISSIM to get the simulation to match the observed queue lengths.**

10. Please provide network delay diagrams for all impacted areas. (Nadia)

***Hexagon does not know what this means.***

## Answered Questions and Those Not for the Traffic Consultant

1. Are trucks currently allowed on Churchill? What restrictions, if any, are there on roads in the area impacted by any mitigations proposed for Churchill closure? (Nadia)
  - a. ***Inyoung says that they are allowed on Churchill with no restrictions***
2. During public comments, folks made reference to cars dropping off kids on the Embarcadero slip road and walking to PALY. Do we know of any other areas used as unofficial drop off/ pick up sites that need to be addressed? Can PAUSD provide us information on that? (Nadia)
3. How can the Alma Road bridge on Embarcadero be widened? Do we have more information about whether there will be a replacement or seismic retrofit needed that might impact the proposed widening? (Nadia)

<sup>1</sup> Can we re-run the Churchill closure model but with 8 trains per direction by 2027 rather than 6 per Caltrains most recent plan? (The group at the last meeting)

<sup>2</sup> Can we study traffic with Elizabeth's designs? (Dave)

<sup>3</sup> Now that we are starting to study on Mike Price's idea, can we study traffic effects? (Dave)

<sup>4</sup> I am most concerned about traffic on Churchill between El Camino and Alma if access to Alma is open. It is my guess that given the existing congestion there, that little stretch of road will completely fill up with cars and that traffic lights will not be able to empty that road fast enough. The residents on that street already have experienced negative impacts due to what congestion exists today. (Dave)

<sup>5</sup> What's the LOS and delays at the Churchill light with the Viaduct, closure, or Price plan complete? (Megan)

<sup>6</sup> It would seem worthwhile to get more details on traffic patterns in South PA at Meadow and Charleston. Haven't heard much about traffic down there in a long time. (Dave)

<sup>7</sup> Do we have LOS/delay data for Meadow / Charleston such that we can estimate 2030 No Build vs Alternative delay differences? Or does it not matter because it's the same for every alternative -- except perhaps Elizabeth's? (Megan)

<sup>8</sup> We need multi-modal LOS numbers – not just cars. Same for system wide impacts from the proposed mitigations. (Nadia)

<sup>9</sup> Can we find out more about queuing on Kingsley and if it would back up onto Alma? (Keith)

<sup>10</sup> How many cars can queue along Kingsley? When showing turn lanes that allow for queuing, please indicate number of cars that fit in the turn pockets, etc. (Nadia)

<sup>11</sup> Can we get some more information about what queues might look like at the Kingsley/Alma light? And at T&C and El Camino if that light exists? Is there enough queueing space in the single lane in the underpass heading east? (Megan)

<sup>12</sup> Can we model traffic effects if Park Blvd were to be reopened at Peers Park? (Dave)

<sup>13</sup> Can we model traffic effects in local streets of Professorville after mitigations at Embarcadero? (Dave)

<sup>14</sup> Can we include a map (similar to traffic counts map) showing bike ped data for Churchill and similar data for the area around the Embarcadero road area targeted for bike improvements and traffic mitigations? (Nadia)

<sup>15</sup> We need better diagrams showing ped/bike routes and the proposed mitigations – we need equal treatment of both bike and ped routes in terms of diagrams. (Nadia)

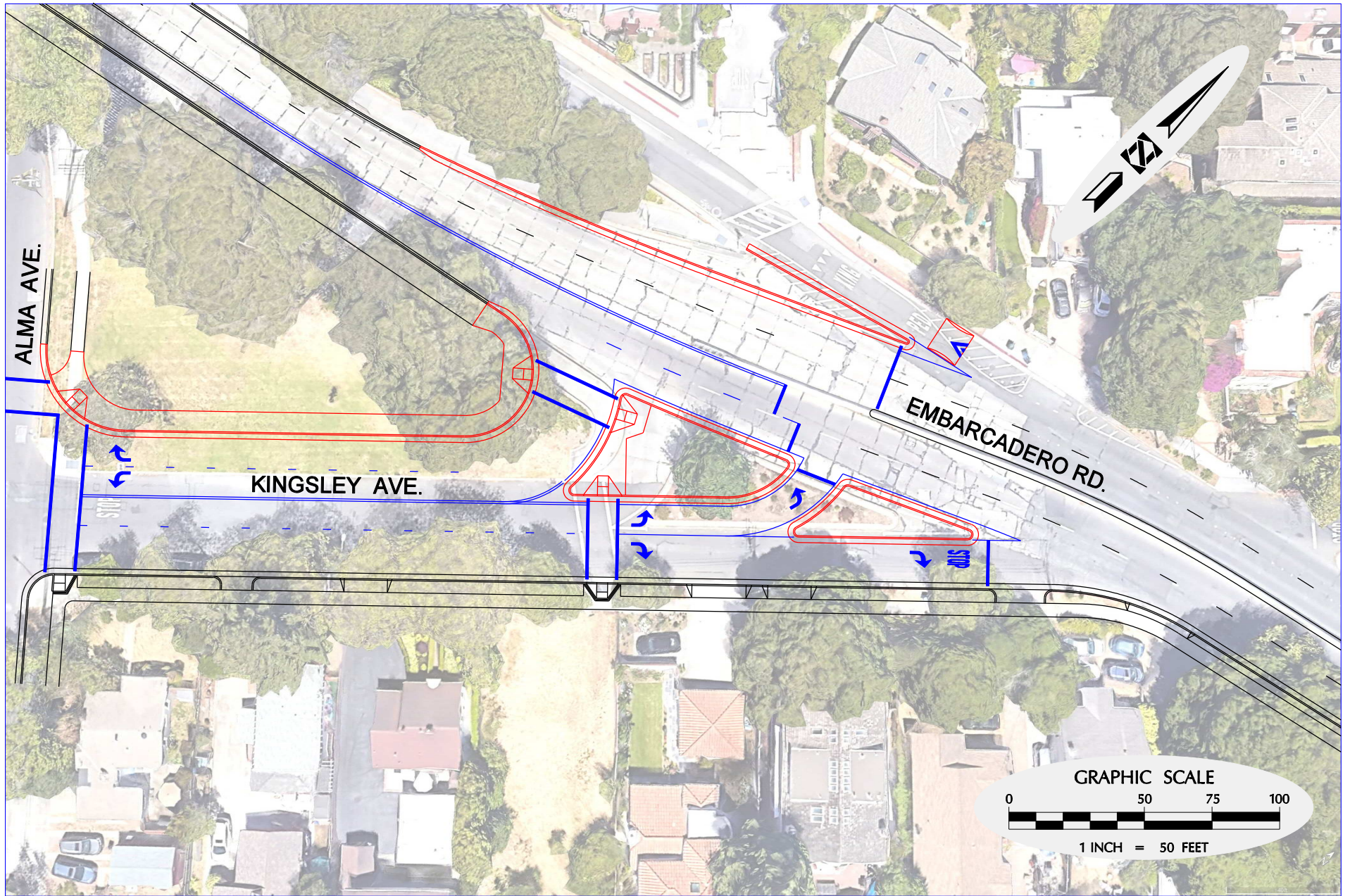
<sup>16</sup> Please provide traffic data for the intersection of Embarcadero/El Camino (how many go North, South, East, West at that intersection, turning movements, etc.). (Nadia)

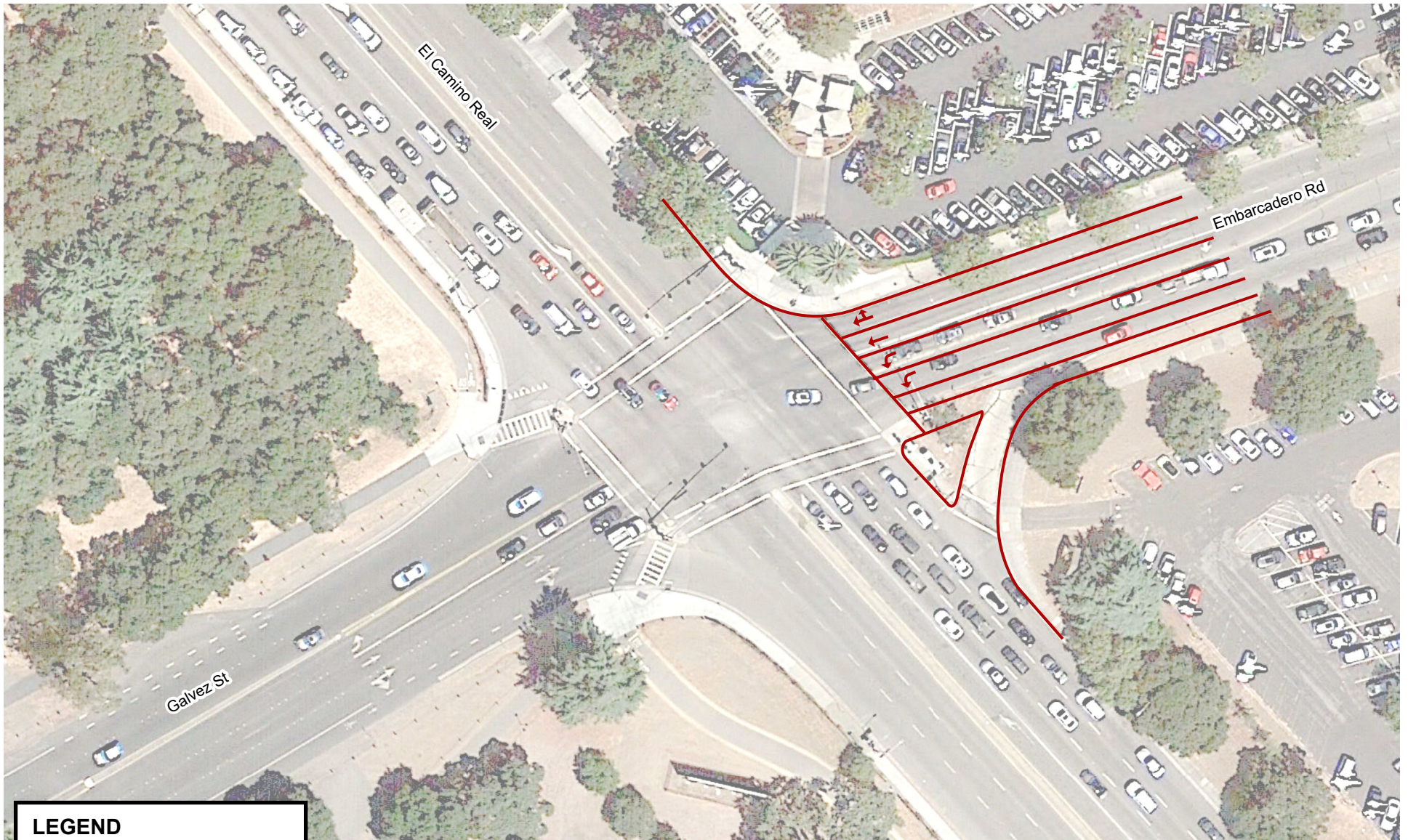
<sup>17</sup> Gary Black mentioned being able to do animations to show delays. Animations showing the unclearable queues for Churchill would be particularly useful. (Nadia)

<sup>18</sup> You mentioned crashes not included in the data - please provide a map showing collision points (all modes) within the areas around Churchill and those that are near the mitigations areas being proposed to ensure we understand where we have current "hot spots" for accidents. (Nadia)



**The following pages contain the  
Diagrams Referenced in the Answers**

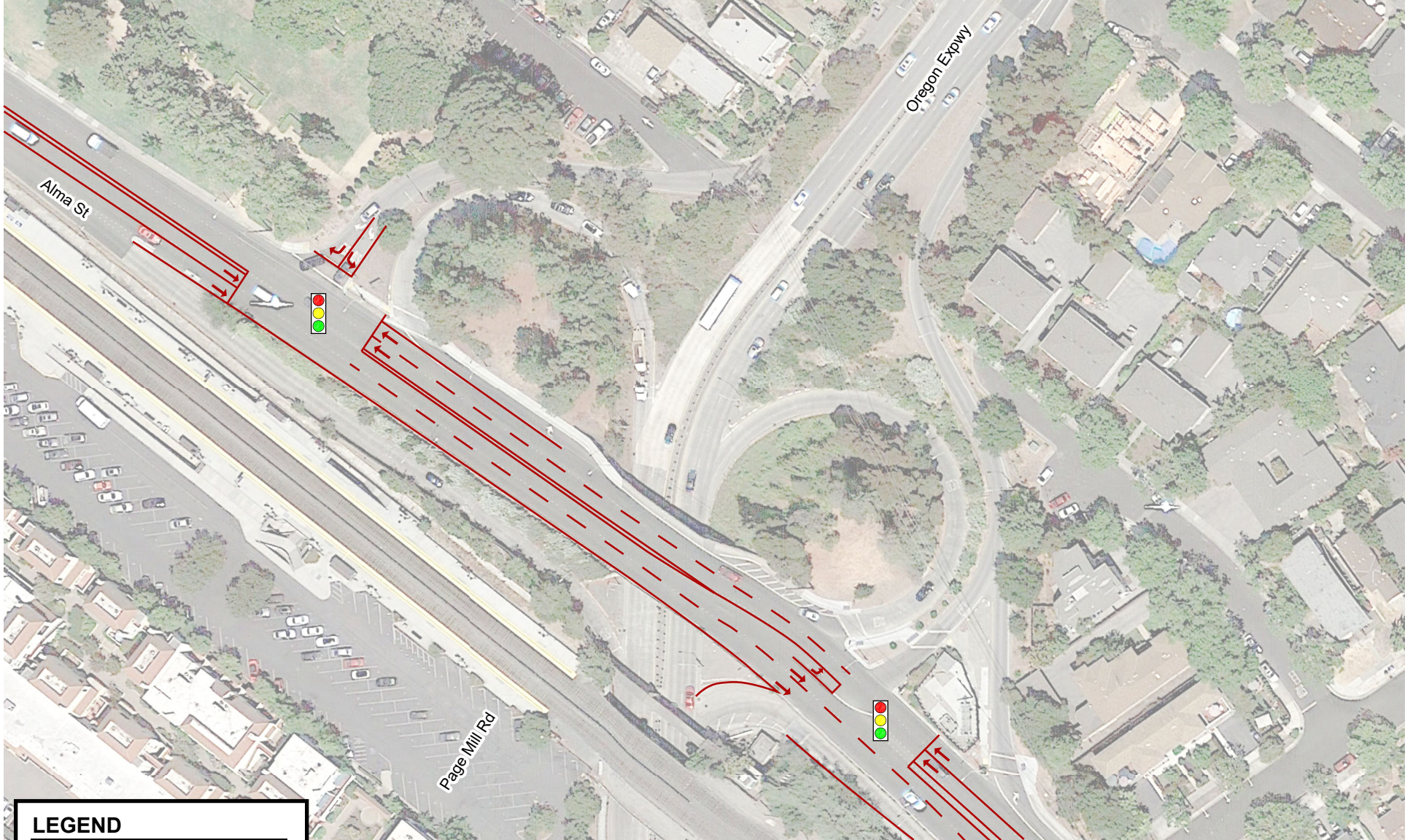




**LEGEND**

— = Proposed Layout

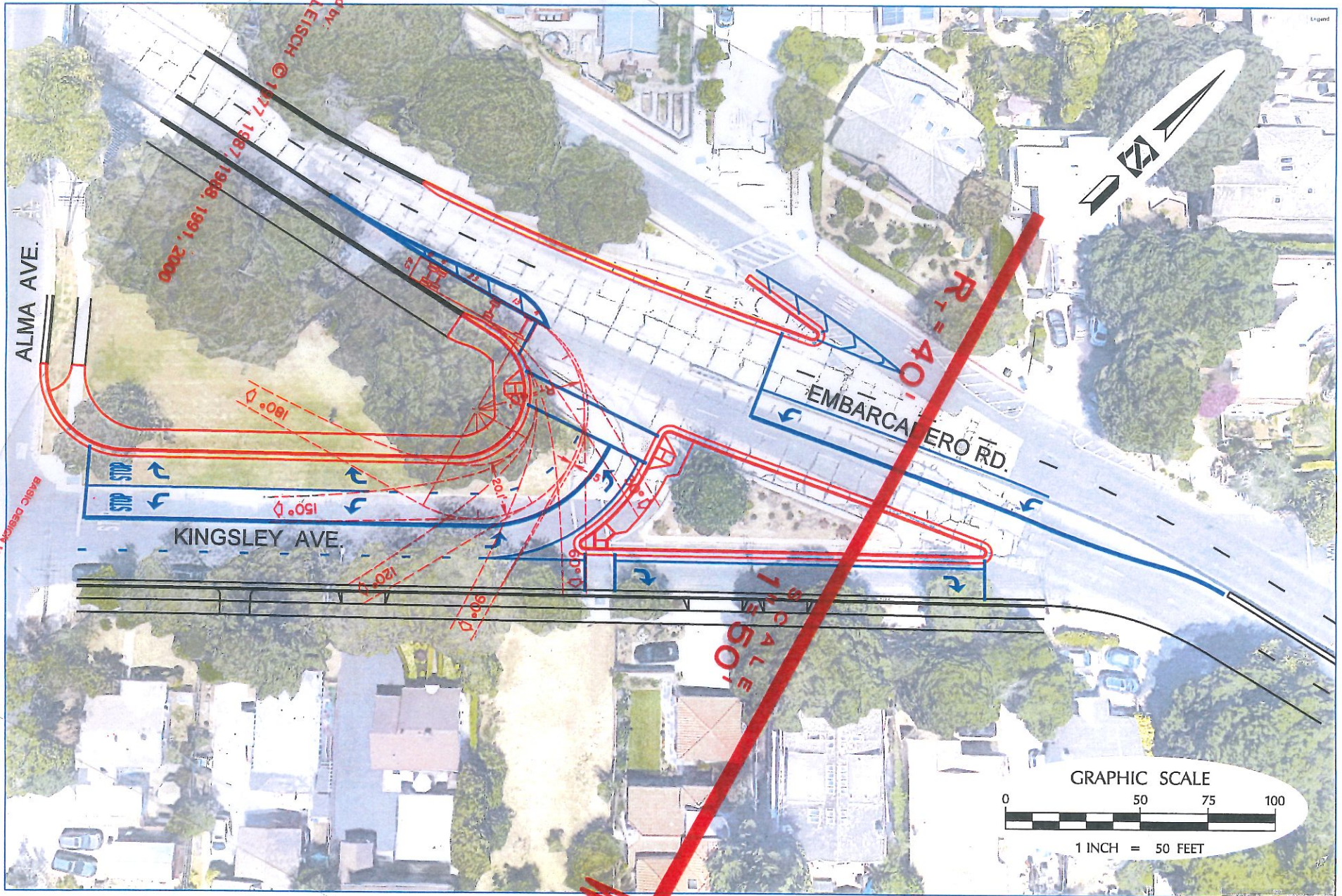
**Figure 9**  
**El Camino Real and Embarcadero Road Improvements**



**LEGEND**

— = Proposed Layout

**Figure 11**  
**Alma Street and Oregon Expressway Improvements**





Embarcadero Rd and Kingsley Ave AM Queues



Embarcadero Rd and Kingsley Ave PM Queues



Embarcadero Rd and Kingsley Ave AM Queues - Cumulative Conditions





Embarcadero Rd and Kingsley Ave PM Queues - Cumulative Conditions

# Connecting Palo Alto Rail Program Management Services

Noise and Vibration Comparative Analysis

City of Palo Alto

Project number: 60577356  
Final Draft Report

July 24, 2020

Prepared for:  
City of Palo Alto

Prepared by:  
Paul L. Burge, INCE Bd. Cert.  
E: paul.burge@aecom.com

AECOM  
401 West A Street  
Suite 120  
San Diego, CA 92101  
aecom.com

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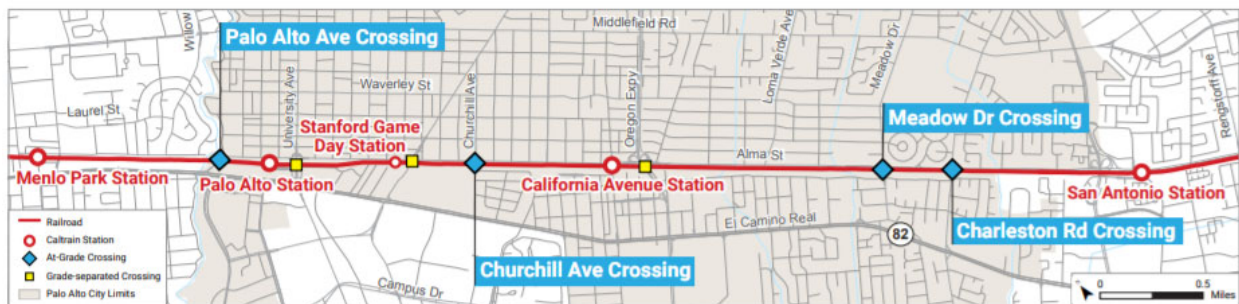
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# 1. Introduction

## 1.1 Project Description

Connecting Palo Alto is a community-based process to address various aspects of the busy rail line that traverses the City of Palo Alto, including traffic, safety, visual impacts and noise. The existing rail line carries nearly 100 trains per day, which are almost exclusive Caltrain commuter rail trains, but also include a few freight trains in the overnight hours. There are currently 7 locations within the Palo Alto city limits where roads cross the tracks. Three of these are grade-separated, with the road crossing under the rail line. The remaining four crossings (at Palo Alto Ave, Churchill Ave, Meadow Dr. and Charleston Drive) are at-grade crossings where the road and the rail line cross at the same elevation. These at-grade crossings are equipped with crossing gates and bells that activate when a train approaches, and the train is also required to sound its horn as it approaches the crossing. In order to address the traffic, safety, and noise issues associated with the at-grade crossings, the City is exploring several different grade separation strategies, which include at-grade crossing closures, trenches and tunnels (where trains would run under the roadway), viaducts (where the train would pass over the existing road), and roadway underpasses (where the road would pass under the existing rail line). An overview of the project area is included in Figure 1-1.



Source: Connecting Palo Alto fact sheet

Figure 1-1 Project Area

## 1.2 Purpose of Noise Study

As part of the Connecting Palo Alto project, a noise study was required to better understand the relative benefits or penalties of the available grade separation alternatives. This noise analysis was conducted to address that need and to be considered in addition to other evaluation criteria such as traffic, safety, visual impacts and cost.

# 2. Background on Noise

Noise is typically defined as unwanted sound. The following is a brief discussion of fundamental environmental noise concepts.

## 2.1 Sound, Noise, and Acoustics

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air) to a hearing organ, such as a human ear. Noise is defined as loud, unexpected, or annoying sound.

In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receptor, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receptor determine the sound level and characteristics of the noise perceived by the receptor. The field of acoustics deals primarily with the propagation and control of sound.

## 2.2 Frequency

Continuous sound can be described by frequency (pitch) and amplitude (loudness). A low-frequency sound is perceived as low in pitch. Frequency is expressed in terms of cycles per second, or Hertz (Hz) (e.g., a frequency of 250 cycles per second is referred to as 250 Hz). High frequencies are sometimes more conveniently expressed in kilohertz (kHz), or thousands of Hertz. The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

## 2.3 Sound Pressure Levels and Decibels

The amplitude of pressure waves generated by a sound source determines the loudness of that source. Sound pressure amplitude is measured in micro-Pascals ( $\mu\text{Pa}$ ). One  $\mu\text{Pa}$  is approximately one hundred billionth (0.0000000001) of normal atmospheric pressure. Sound pressure amplitudes for different kinds of noise environments can range from less than 100 to 100,000,000  $\mu\text{Pa}$ . Because of this huge range of values, sound is rarely expressed in terms of  $\mu\text{Pa}$ . Instead, a logarithmic scale is used to describe sound pressure level (SPL) in terms of decibels (dB). The threshold of hearing for young people is about 0 dB, which corresponds to 20  $\mu\text{Pa}$ .

## 2.4 Addition of Decibels

Because decibels are logarithmic units, SPL cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dB higher than one source under the same conditions. For example, if one automobile produces an SPL of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB—rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level 5 dB louder than one source.

## 2.5 A-Weighted Decibels

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Although the intensity (energy per unit area) of the sound is a purely physical quantity, the loudness or human response is determined by the characteristics of the human ear.

Human hearing is limited in the range of audible frequencies as well as in the way it perceives the SPL in that range. In general, people are most sensitive to the frequency range of 1,000–8,000 Hz, and perceive sounds within that range better than sounds of the same amplitude at higher or lower frequencies. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending on the human sensitivity to those frequencies. Then, an “A-weighted” sound level (expressed in units of dBA) can be computed based on this information.

The A-weighting network approximates the frequency response of the average young ear when listening to most ordinary sounds. When people make judgments of the relative loudness or annoyance of a sound, their judgments correlate well with the A-scale sound levels of those

sounds. Other weighting networks have been devised to address high noise levels or other special problems (e.g., B-, C-, and D-scales), but these scales are rarely used in conjunction with highway-traffic noise. Noise levels for traffic noise reports are typically reported in terms of A-weighted decibels or dBA. Table 2-1 describes typical A-weighted noise levels for various noise sources.

**Table 2-1 Typical A-Weighted Noise Levels**

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	— 110 —	Rock band
Jet fly-over at 1000 feet	— 100 —	
Gas lawn mower at 3 feet	— 90 —	
Diesel truck at 50 feet at 50 mph	— 80 —	Food blender at 3 feet Garbage disposal at 3 feet
Noisy urban area, daytime	— 70 —	Vacuum cleaner at 10 feet Normal speech at 3 feet
Gas lawn mower, 100 feet Commercial area	— 60 —	
Heavy traffic at 300 feet	— 50 —	Large business office Dishwasher next room
Quiet urban daytime	— 40 —	Theater, large conference room (background)
Quiet urban nighttime	— 30 —	Library
Quiet suburban nighttime	— 20 —	Bedroom at night, concert hall (background)
Quiet rural nighttime	— 10 —	Broadcast/recording studio
Lowest threshold of human hearing	— 0 —	Lowest threshold of human hearing

Source: Caltrans 2013.

## 2.6 Human Response to Changes in Noise Levels

As discussed above, doubling sound energy results in a 3-dB increase in sound level. However, given a sound level change measured with precise instrumentation, the subjective human perception of a doubling of loudness will usually be different than what is measured.

Under controlled conditions in an acoustical laboratory, the trained, healthy human ear is able to discern 1-dB changes in sound levels, when exposed to steady, single-frequency (“pure-tone”) signals in the midfrequency (1,000 Hz–8,000 Hz) range. In typical noisy environments, changes in noise levels of 1 to 2 dB are generally not perceptible. However, it is widely accepted that people are able to begin to detect sound level increases of 3 dB in typical noisy environments. Further, a 5-dB increase is generally perceived as a distinctly noticeable increase, and a 10-dB increase is generally perceived as a doubling of loudness. Therefore, a doubling of sound energy (e.g., doubling the volume of traffic on a highway) that would result in a 3-dB increase in sound level, would generally be perceived as barely detectable.

## 2.7 Noise Descriptors

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, but others are random. Some noise levels fluctuate rapidly, but others slowly. Some noise levels vary widely, but others are



relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors used in this rail noise analysis.

- **Equivalent Sound Level (Leq):** Leq represents an average of the sound energy occurring over a specified period. In effect, Leq is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same period. The 1-hour A-weighted equivalent sound level (Leq[h]) is the energy average of A-weighted sound levels occurring during a one-hour period and is the basis for noise abatement criteria for many agencies. In this report the peak hour Leq (Leq<sub>peak hr</sub>) is used to describe the equivalent noise level during the loudest hours of the day (typified by the peak amount of road traffic and train events).
- **Maximum Sound Level (Lmax):** Lmax is the highest instantaneous sound level measured during a specified period.
- **Day-Night Level (Ldn):** Ldn is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to A-weighted sound levels occurring during nighttime hours between 10 p.m. and 7 a.m. This metric is often used to assess human annoyance to community noise.

## 2.8 Sound Propagation

When sound propagates over a distance, it changes in level and frequency content. The manner in which noise reduces with distance depends on the following factors.

### 2.8.1 Geometric Spreading

Sound from a localized source (i.e., a point source) propagates uniformly outward in a spherical pattern. The sound level attenuates (or decreases) at a rate of 6 decibels for each doubling of distance from a point source. Highways consist of several localized noise sources on a defined path, and hence can be treated as a line source, which approximates the effect of several point sources. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of 3 decibels for each doubling of distance from a line source.

### 2.8.2 Ground Absorption

The propagation path of noise from a highway to a receptor is usually very close to the ground. Noise attenuation from ground absorption and reflective-wave canceling adds to the attenuation associated with geometric spreading. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is usually sufficiently accurate for distances of less than 200 feet. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receptor, such as a parking lot or body of water,), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface between the source and the receptor, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 decibels per doubling of distance is normally assumed. When added to the cylindrical spreading, the excess ground attenuation results in an overall drop-off rate of 4.5 decibels per doubling of distance.

### **2.8.3 Atmospheric Effects**

Receptors located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels. Sound levels can be increased at large distances (e.g., more than 500 feet) from the highway or rail noise due to atmospheric temperature inversion (i.e., increasing temperature with elevation). Other factors such as air temperature, humidity, and turbulence can also have significant effects.

### **2.8.4 Shielding by Natural or Human-Made Features**

A large object or barrier in the path between a noise source and a receptor can substantially attenuate noise levels at the receptor. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and solid walls) can substantially reduce noise levels. Walls are often constructed between a source and a receptor specifically to reduce noise. A barrier that breaks the line of sight between a source and a receptor will typically result in at least 5 dB of noise reduction. Taller barriers provide increased noise reduction. Vegetation between the highway and receptor is rarely effective in reducing noise because it does not create a solid barrier.

## **3. Existing Conditions**

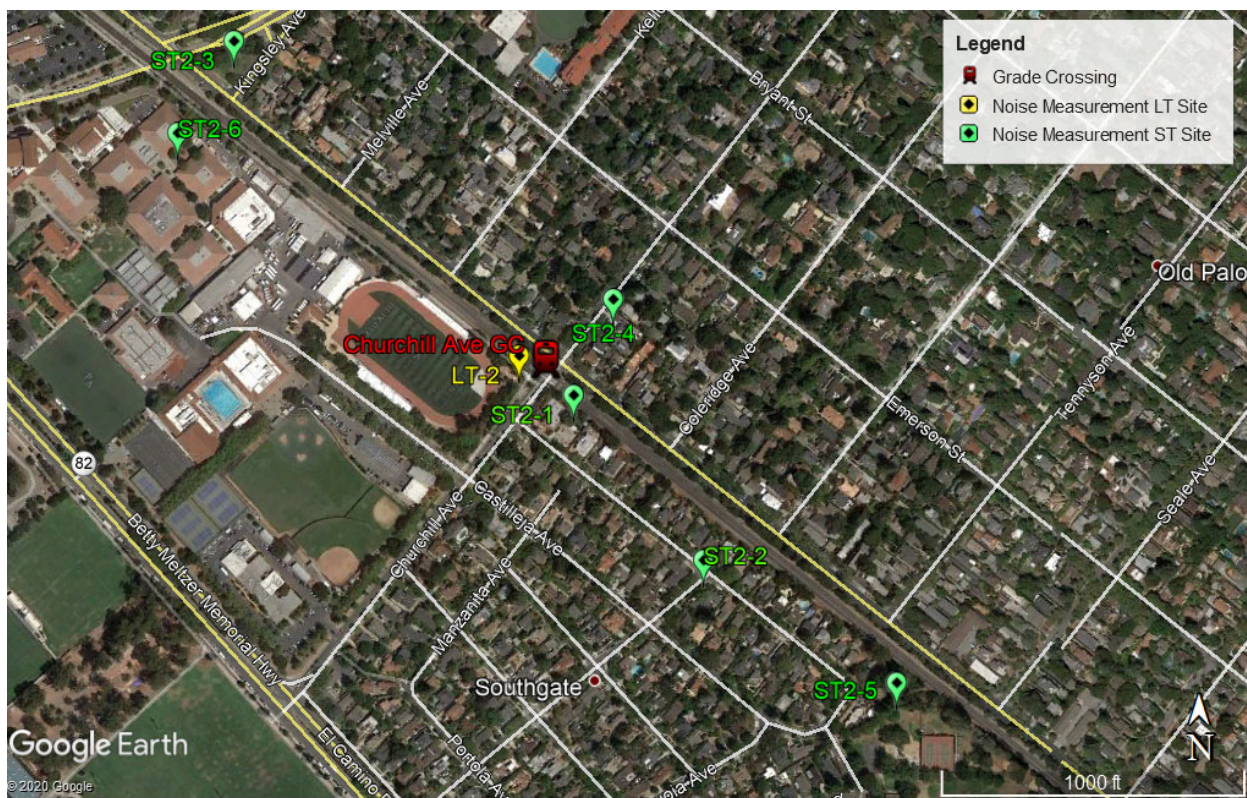
A noise survey was conducted in the study area to establish existing conditions in a variety of locations throughout project area.

### **3.1 Noise Measurement Survey**

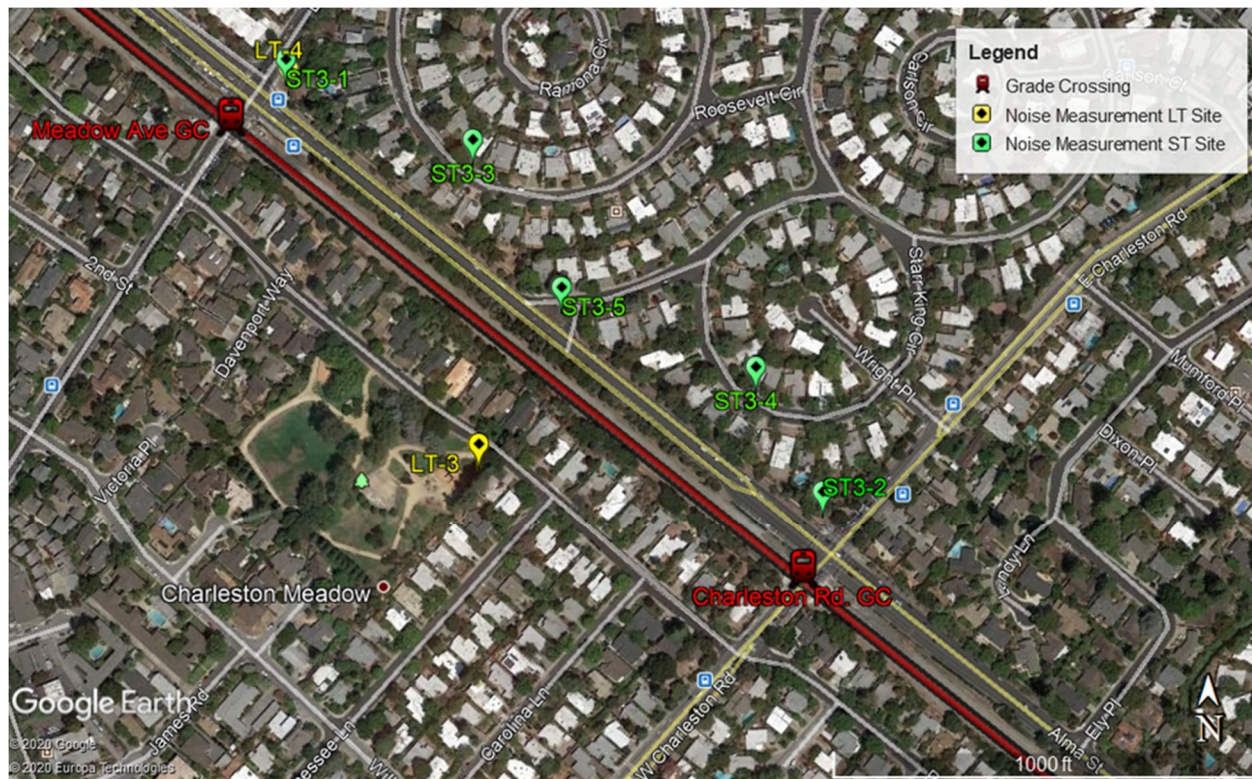
The existing condition noise survey included a combination of Short-term (15 to 60 minutes) and Long-term (24 hour) measurements at a total of 18 locations. These were conducted between March 10 through March 12, 2020. The noise measurements were conducted in three general areas within the larger project area, near existing grade crossings at Palo Alto Ave., Churchill Ave., and Meadow Dr./Charleston Rd., as shown in Figures 3-1, 3-2 and 3-3, respectively. Short-term measurement locations are denoted by ST-# in the graphic below. Similarly, long-term measurement locations are denoted by LT-#.



**Figure 3-1 Noise Measurement Locations, Palo Alto Grade-Crossing Area**



**Figure 3-2 Noise Measurement Locations, Churchill Grade-Crossing Area**



**Figure 3-3 Noise Measurement Locations, Meadow/Charleston Grade-Crossing Area**

The noise measurement locations were selected to represent a variety of noise sensitive land uses in the study area with an emphasis on residential land uses. While access to actual residential property was limited, most measurement locations were conducted at publicly accessible areas that were similar in distance and acoustical setting to nearby residential locations with an emphasis on first and second row homes (typically within about 300 feet of the rail line and about 1500 feet of a grade crossing).

The noise measurements were all conducted using ANSI Class1/Type 1 precision Sound Level Meters (SLM) all within their manufacture’s recommended 1-year laboratory calibration period and under appropriate meteorological conditions (mild temperatures, no precipitation, low winds).

For each measurement location and session, a detailed field noise measurement data sheet was recorded with SLM settings, measurement observations (including observed train events), and meteorological data were collected for each measurement. Photos were recorded for each site.

Table 3-1 provides a summary of the short-term noise measurement data, reporting for each measurement the site ID, location and type (row and direction), distance from tracks, date and time for each, number of train events observed for each measurement, the measured equivalent noise level (Leq) for measurement intervals with and without train events, and the difference (or delta, based on unrounded Leq values) between the two. It can be seen by comparing the delta number for each measurement that the measured noise level with trains was always greater than for those intervals without train events, but this number varied between about 1 dBA and 9 dBA. This suggests that there is a significant amount of variation in both ambient, non-train periods (typically dominated by traffic noise) and train event periods.

**Table 3-1 Short-Term Noise Measurement Summary (Leq in dBA)**

Site	Location	Location type	Dist. From Tracks (ft.)	Date	Start Time	Duration (min.)	Train Events	Leq with events	Leq w/o events	delta
<i>Area 1: Palo Alto Grade Crossing</i>										
ST1-1	Palo Alto Mini-Park	1st Row, E	80-95	3/10	14:45	20	2	66.1	57.1	9.1
ST1-2	Tower Well Park	1st Row, E	175-200	3/10	12:15	15	2	58.9	58.0	0.9
"	"			3/10	17:00	30	4	66.1	58.7	7.4
ST1-3	El Camino Park - south	1st Row, W	60-95	3/10	11:25	42	2	62.1	55.4	6.7
"	"			3/10	15:25	35	3	61.3	56.6	4.7
<i>Area 2: Churchill Grade Crossing</i>										
ST2-1	1551 Mariposa	1st Row, W	50-65	3/12	9:10	35	5	67.1	64.6	2.5
ST2-2	Mariposa/Miramonte	2nd Row, W	205-220	3/10	11:20	30	1	56.8	52.9	3.9
"	"			3/11	8:20	15	2	62.4	54.5	7.9
ST2-3	Alma/Kingsley	1st Row, E	150-165	3/10	14:45	60	2	61.0	59.6	1.3
"	"			3/11	9:20	30	2	67.5	63.3	4.3
ST2-4	128 Churchill	3rd Row, E	260-275	3/10	16:50	30	3	60.9	56.9	4.0
ST2-5	Peers Park	1st Row, W	130-145	3/10	12:20	45	1	54.5	53.3	1.2
"	"			3/11	8:45	20	2	56.6	53.6	3.0
ST2-6	PA High School (outdoor area)	2nd Row, W	185-200	3/11	8:40	15	3	62.5	56.3	6.2
<i>Area 3: Meadow and Charleston Grade Crossings</i>										
ST3-1	NE Alma/Meadow	1st Row, E	150-165	3/11	15:45	45	2	67.1	65.7	1.3
"	"			3/12	8:25	20	4	72.5	67.2	5.3
ST3-2	NW Alma/Charleston	1st Row, E	140-155	3/11	16:40	20	2	69.6	65.3	4.3
"	"			3/12	9:00	45	4	70.2	66.5	3.7
ST3-3	37 Roosevelt Cr.	2nd Row, E	275-290	3/12	10:20	45	2	54.4	50.6	3.8
ST3-4	3716 Stark Kirg Cr.	2nd Row, E	270-285	3/12	11:30	50	2	52.3	51.6	0.7
ST3-5	Alma/Lindero	1st Row, E	135-150	3/12	10:00	70	4	71.8	70.1	1.7

Table 3-2 presents a summary of the long-term noise measurements with similar data categories as reported for short-term data. The summarized long-term noise measurements are reported as the 24-hour day-night noise level (Ldn).

**Table 3-2 Long-Term Noise Measurement Summary (Ldn in dBA)**

Site	Location	Location type	Dist. From Tracks (ft.)	Start Date	Start Time	Duration (hr.)	Train Events	Ldn with events	Ldn w/o events	delta
LT-1	Near Palo Alto GC	1st Row, W	45-60	3/10	9:45	24	88	76.1	58.8	17.3
LT-2	Near Churchill GC	1st Row, W	60-75	3/10	10:45	24	88	80.3	64.6	15.7
LT-3	Robles Park	2nd Row, W	260-275	3/11	11:40	24	90	63.5	62.5	1.0
LT-4	Near Meadow GC	1st Row, E	135-150	3/11	13:10	24	91	73.6	67.2	6.4

## 3.2 Discussion on Various Noise Sources in Study Area

The existing noise environment in the project area is a combination of many different noise sources, as discussed below:

### 3.2.1 Train noise sources.

Noise from train operations are typically limited to short bursts of loud noise associated with individual train pass-by events; these include:

Train horn and crossing bell noise. Noise from gate bells at the grade crossing sound when the crossing gates closes for a short period before the train arrives and continues until the gates are opened. Train horns are activated upon approaching the grade crossing, usually within about 1500 feet of the crossing, and are typically the loudest part of the train pass-by event. Train horns, usually located near the top of the locomotive cab or lead car, are designed to provide a standard level of noise when activated by the train operator, but in practice the sequence and duration of horn soundings vary significantly.

Propulsion/engine noise. The locomotives that provide the power to trains, both commuter and freight train, generate engine and exhaust noise. Locomotive engine noise can be affected by the engine throttle setting (which may, in turn, be influenced by the train speed or length). The engine noise is generally generated from exhaust vents near the top of the locomotive. Both diesel and electric locomotive generate engine noise, although electric locomotives (that pull power from overhead catenary power lines) generate less noise than diesel units. Commuter trains are usually hauled by a single locomotive, either diesel or electric, while freight trains are usually hauled by multiple diesel locomotives, depending on the number of cars they are pulling. Alternatively, Electric Multiple Unit (EMU) trains do not use separate locomotives for power, but rather incorporate electrical motors into several of the passenger cars (typically about half of the cars are powered). EMU trains are typically quieter than either diesel or electric locomotives.

All trains, passenger and freight, currently operating on the rail line through Palo Alto are hauled by diesel locomotives. However, Caltrain is planning to gradually switch all passenger trains to EMU trains starting soon. The limited number of freight trains operating on the line will continue to use diesel locomotives for the foreseeable future.

Wheel/rail noise. All rail vehicles (locomotives, passenger cars, EMU units, freight cars) create wheel/rail noise, which is generated by the metal train wheels rolling along the metal tracks and is speed dependent. Wheel/rail noise is increased with the number of cars in the train and the train speed. When tracks or wheels are in poor condition the generated wheel/rail noise may increase.

Other train noises. There are a few other types of noise produced by trains, including sounds from heating and air-condition systems, public address systems, and other minor mechanical noises, but these are minor contributors to overall train noise, especially when the train is in motion and are not taken into account in this analysis.

### 3.2.2 Non-Train noise sources.

While the train event noise is usually the most noticeable noise in the study area, it is not always the most dominant contributing source, as discussed below.

Road traffic noise: In most areas of the study area, the dominant non-train noise source is from cars and trucks moving on local roadways. While the road noise in the study is typically lower than the noise level generated by a train event, it is more constant. Alma Street, which

generally runs parallel to the rail line through the study area, is a moderately busy arterial roadway, generally a 4-lane road with a 35-mph posted speed limit. During most of the time when there are no train events, Alma St. is the dominant noise source. Some other major cross streets (including University Ave., Churchill Ave., Oregon Expy., Meadow Dr., and Charleston Rd.) may also contribute some traffic noise at homes near those intersection. Local residential streets would contribute a much smaller amount of noise.

Aircraft overflight noise. Commercial and private aircraft can occasionally be heard within the project area; however, the noise measurement observations indicate that these do not make a significant contribution to overall equivalent noise levels.

Other community noise sources. A few other localized noise sources may occasionally be heard throughout the study area. These may include noise from group activities at local schools and parks, general activity in commercial areas, residential air-condition units and occasional landscaping activities. However, these noise sources would generally not be noticeable or make a significant contribution to daily equivalent noise levels in most residential areas.

## 4. Proposed Alternatives:

As part of the Connecting Palo Alto project, several new proposed alternatives have been suggested to create grade separations at three of the four at-grade crossings (Churchill Ave., Meadow Dr., Charleston Rd.). Analyzed alternatives are listed below:

- Grade crossing closure
- Viaduct with noise barriers
- Hybrid with noise barriers
- Trench
- Tunnel (passenger and freight)
- Tunnel (freight at-grade)
- Roadway underpass

In addition to these official alternatives, the current existing condition and the planned switch-over to EMU units for all passenger commuter rail trains were also evaluated as well as a transition option for trains transitioning between at-grade and trench/tunnel options.

### 4.1 Description of Alternatives.

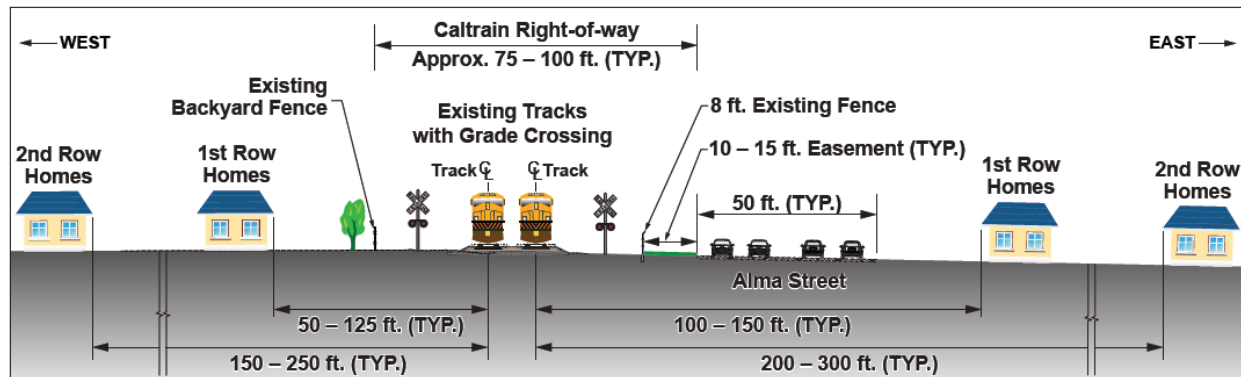
In order to compare relative acoustical benefits for these alternatives, future noise levels were calculated for representative residential locations at typical first and second row homes to the east and west of the rail line. These calculations followed the methodology and calculation methods presented in the Federal Transit Administration's Transit Noise and Vibration Impact Assessment Manual (2018), for detailed noise assessment, and took into consideration both rail and roadway noise sources.

A description of each alternative regarding noise generation or reduction is provided in the following sub-sections.

#### 4.1.1 Existing Condition and Electric Locomotives.

Figure 4-1 depicts a schematic cross-section diagram for the typical existing condition at existing grade crossings in the project area. Please note that for this cross-section diagram, and all that follow, all dimensioned distances are typical ranges and not-to-scale. The distance

from the rail lines to the first and second row homes may vary considerably from one home to the next but are usually within the ranges indicated.



**Figure 4-1 Existing Condition at Grade Crossing**

For the existing condition, both passenger and freight trains use diesel locomotives and sound horns at all grade crossing. All road traffic at all grade-crossings are controlled by cross gates with gate bells. There are no special noise control devices in place. Second row homes to both the east and west receive some acoustical shielding by the first row of homes. The option of switching over to electric locomotives for passenger trains would be functionally the same cross-section as the existing condition except for the installation of catenary over the existing tracks. The use of electric locomotives would result in reduced engine noise at nearby receptors.

#### 4.1.2 Crossing Closure Alternative.

The crossing closure alternative would look similar to the existing condition except that the grade-crossing would be physically closed to road traffic. This alternative is only under consideration for the Churchill grade crossing.

Closing the grade-crossing would eliminate the requirement for trains to sound horns when approaching the grade-crossing, which would result in a significant reduction in noise exposure for nearby homes. However, no additional acoustical shielding would be provided for this alternative to reduce other noise sources.

#### 4.1.3 Viaduct Alternative.

The proposed Viaduct alternative for the Churchill Road and Meadow-Charleston grade-crossings are shown in Figures 4-2 and 4-3, respectively. While this alternative is under consideration for the Churchill, Meadow and Charleston grade crossings, the difference between the two alternatives is that for the Churchill area the viaduct would run for about 2500 feet over the existing rail alignment, but for the Meadow-Charleston area the viaduct would run for about 4200 feet and be shifted approximately 25 feet to the east.



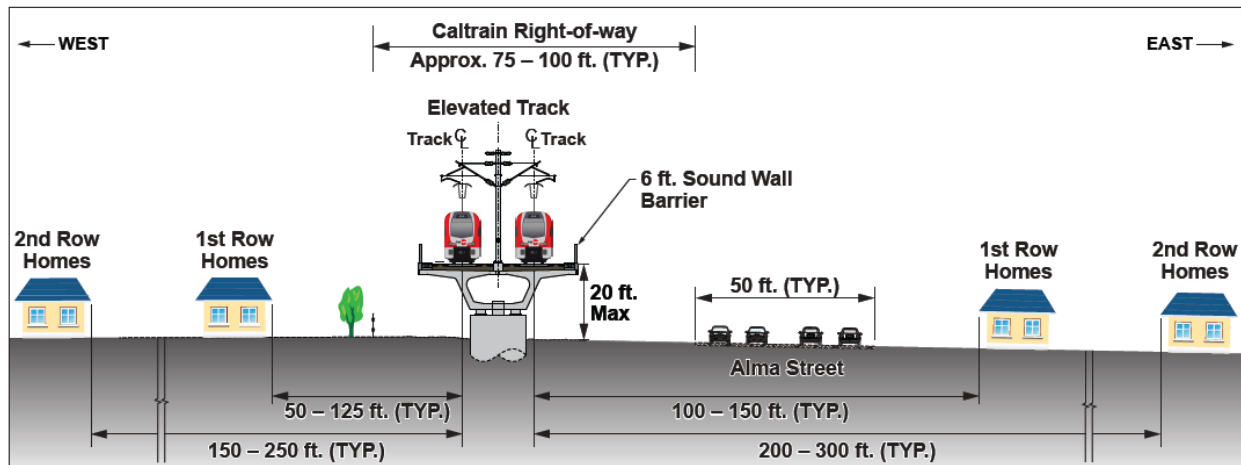


Figure 4-2 Churchill Viaduct Alternative

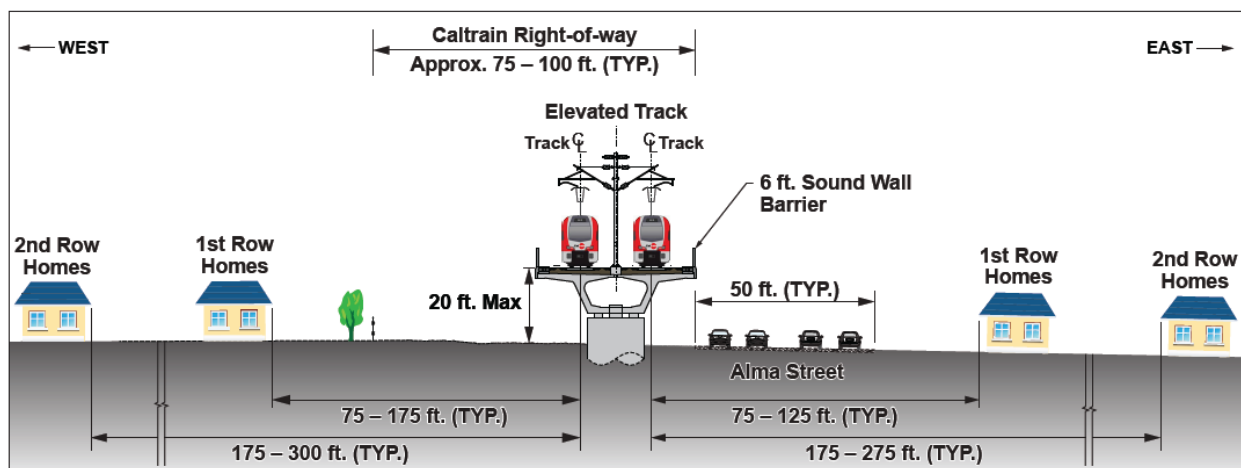


Figure 4-3 Meadow-Charleston Viaduct Alternative

For both viaduct alternatives, the train noise levels would be reduced by eliminating the need for horn sounding and the use of 6-foot-high parapet sound walls to block the wheel/rail noise from propagating into the neighborhood. The increased elevation would also reduce the effectiveness of the first row of homes to block the engine noise at second row homes. It is also noted here that, while some older metal rail viaduct and bridge structures tend to radiate significant additional noise due to structural resonance during train pass-by events, newer more modern viaduct structures built mostly from reinforce concrete have greater mass and internal damping properties that would greatly reduce noise generated by structural resonance to a less than significant levels.

#### 4.1.4 Hybrid Alternative.

The hybrid alternative cross-section is depicted in Figure 4-4. This Alternative is similar to the Viaduct alternative except that the solid embankment on which the new rail alignment would be located, runs for about 4000 feet and is not as high as the viaduct alternative (15-foot high for Hybrid compared to 20-foot for Viaduct). This option is being considered for Meadow and Charleston grade crossings, but not for Churchill.

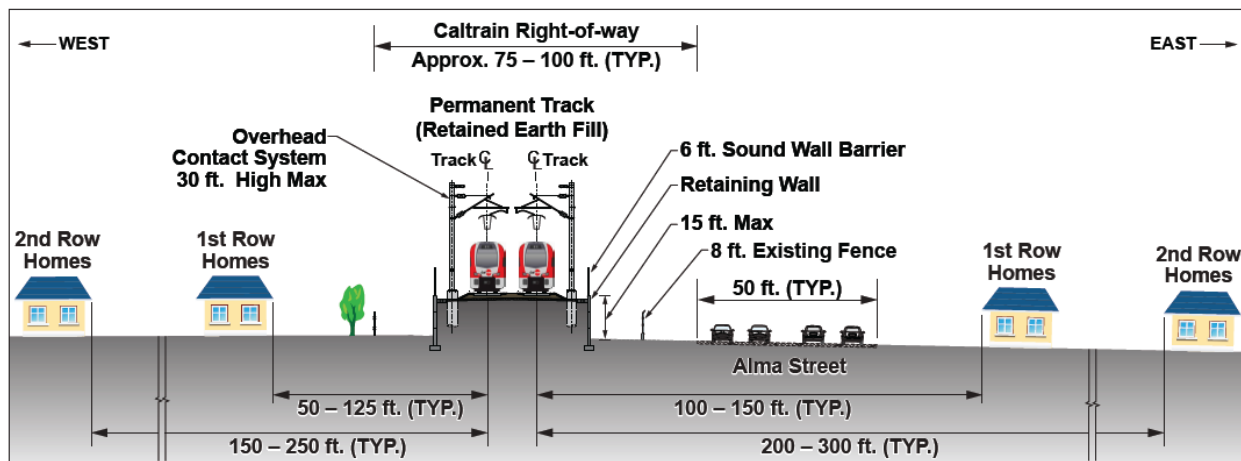


Figure 4-4 Hybrid Alternative

The added acoustical advantage to this alternative is that the solid embankment would act as a noise barrier between the traffic noise on Alma St. and the homes on the west side of the tracks. The slightly lower elevation of this alternative may result in a slightly reduced degradation of first row shielding for second row homes.

#### 4.1.5 Trench Alternative.

The Trench alternative cross-section is shown in Figure 4-5. This alternative would place both passenger and freight trains in a 37-foot-deep trench using the same horizontal alignment as the existing tracks. This option is being considered for Meadow and Charleston Grade Crossings, but not for Churchill.

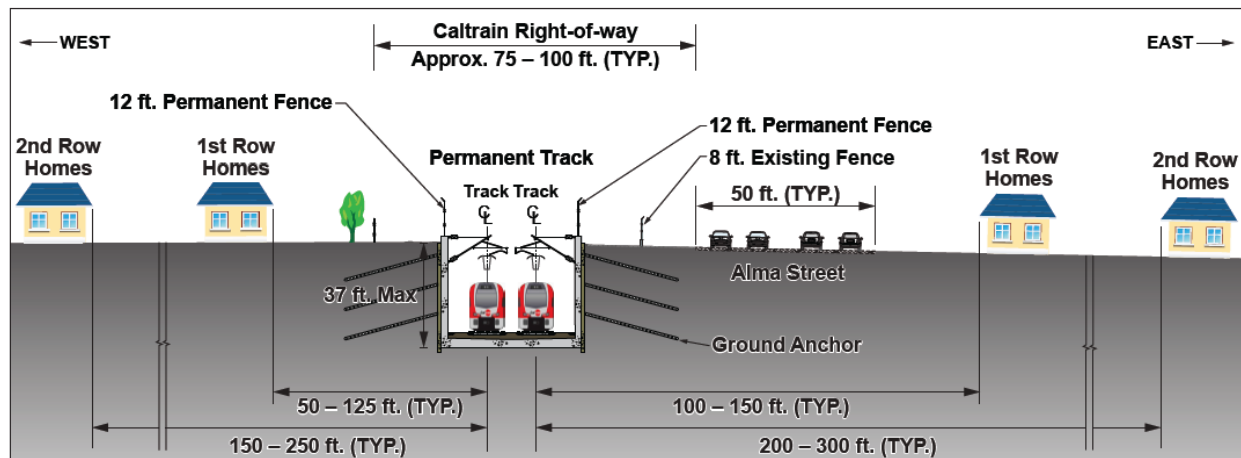
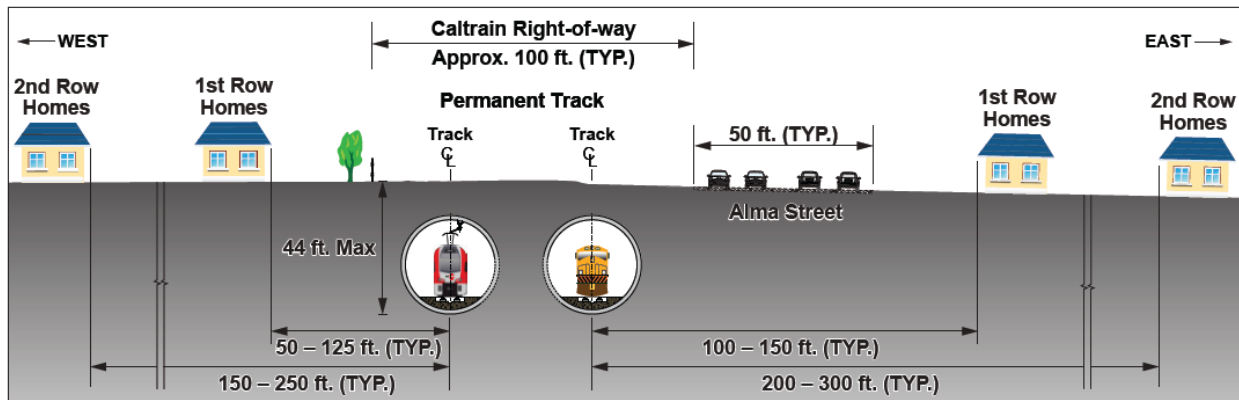


Figure 4-5 Trench Alternative

The acoustical advantage to this alternative is that, in addition to eliminating horn soundings, with the rail located inside the trench, the trench walls would provide beneficial barrier effects to reduce both engine and wheel/rail noise to homes on both sides.

#### 4.1.6 South Tunnel, Passenger and Freight Alternative.

The South Tunnel Passenger and Freight Alternative cross-section is shown in Figure 4-6. This alternative would route both passenger and freight trains through underground tunnels through the Meadow/Charleston area while leaving Alma Street as is. This option is being considered for Meadow and Charleston Grade Crossings, but not for Churchill.

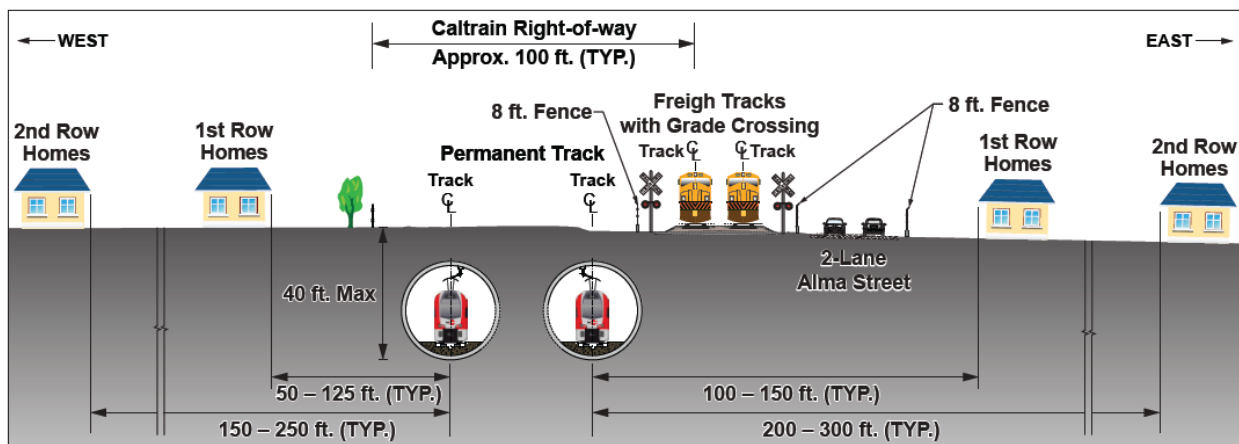


**Figure 4-6 South Tunnel Passenger and Freight Alternative**

The acoustical benefit of this alternative is that, in addition to eliminating the need for horn soundings in this area, the tunnel structure would also effectively eliminate the engine and wheel/rail noise from propagating into the adjacent neighborhoods (assuming that required ventilation systems do not allow a significant noise path to the surface).

#### 4.1.7 South Tunnel, Freight at-Grade Alternative.

The South Tunnel Alternative Freight at Grade Alternative cross-section is shown in Figure 4-7. This alternative would operate similar to the South Tunnel Passenger and Freight Alternative, except the freight trains would not use the tunnels, but would remain at grade level on a new alignment that would reduce Alma Street to two lanes. While the passenger train would no longer sound horns at grade crossings, the freight train still would. This option is being considered for Meadow and Charleston Grade Crossings, but not for Churchill.



**Figure 4-7 South Tunnel At-Grade Freight Alternative**

The acoustical benefits of this alternative is that, in addition to eliminating the need for passenger train horn soundings in this area, the tunnel structure would also effectively eliminate the passenger train engine and wheel/rail noise from propagating into the adjacent neighborhoods (assuming that required ventilation systems do not allow a significant noise path to the surface). All train noise sources for freight train events, including horn soundings, would remain. However, an added benefit is that traffic noise from Alma street would be reduced due to that road being reduced to just two lanes.

### 4.1.8 Road Underpass Alternative.

The cross-section diagrams for the Meadow and Charleston Underpass and the Churchill Underpass Alternatives are shown in Figures 4-8 and 4-9, respectively. Both alternatives would eliminate at-grade crossing by rerouting the cross street under the at-grade rail line. The Meadow and Charleston Underpass Alternatives would route the cross-street completely under both the rail line and Alma Street, as shown in Figure 4-8, while the Churchill Underpass Alternative would be a partial underpass that would pass under the at-grade rail line and form a partial below-grade intersection with Alma Street, as shown in Figure 4-9.

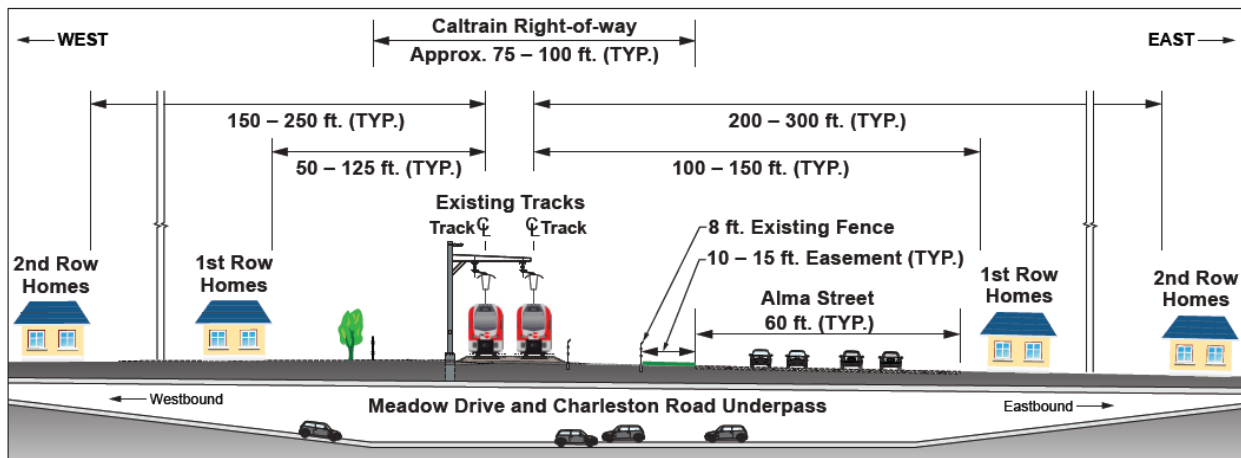


Figure 4-8 Underpass Alternative at Meadow and Charleston

The acoustical benefit of the Meadow and Charleston full under pass alternatives is that it would eliminate the at-grade crossing and associated horn sounds, but other remaining train noise sources and noise from Alma Street would remain.

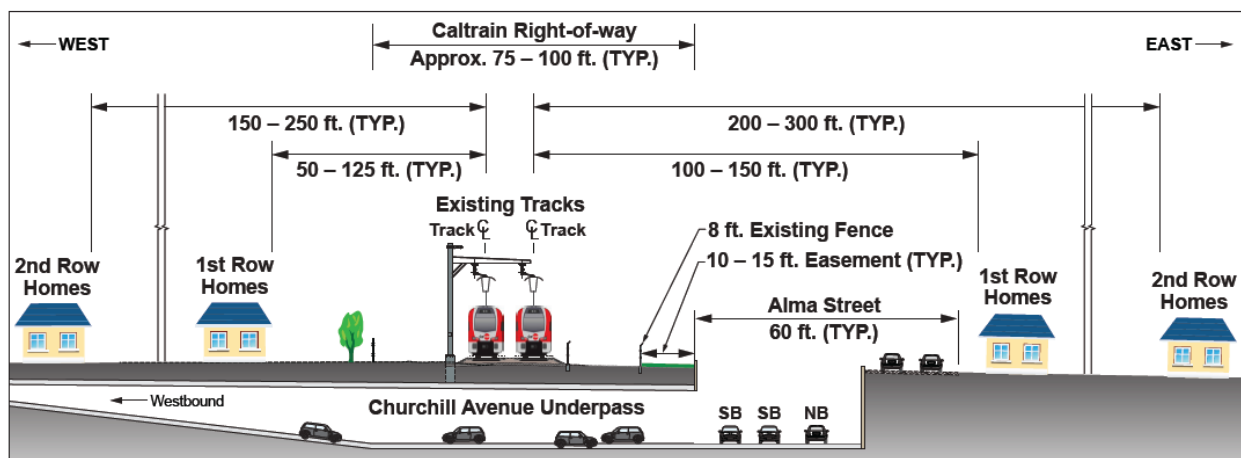


Figure 4-9 Underpass Alternative at Churchill

The Churchill underpass alternative would also eliminate the at-grade crossings and horn soundings but would also provide some acoustical shielding for the portion of Alma Street that would be lowered to create the below-grade intersection with Churchill.

### 4.1.9 Locations where Alternatives are Being Considered.

Not all the alternatives described above are being considered for all the grade crossing locations. Table 4-1 below provides a summary of which alternatives are being considered for which locations. Please note that, while there is an existing grade crossing at Palo Alto Ave. at the northern part of the study area, none of the proposed alternatives are being considered for this location.

**Table 4-1 Alternatives Considered for each Grade Crossing**

<b>Alternatives Considered</b>	<b>Grade Crossing Location</b>		
	<b>Churchill Ave</b>	<b>Meadow Drive</b>	<b>Charleston Drive</b>
EMU trains	●	●	●
Crossing Closure	●		
Trench		●	●
Viaduct	●	●	●
Hybrid		●	●
Tunnel		●	●
Underpass	●	●	●

## 5. Predicted Acoustical Benefits of Proposed Alternatives

Table 5-1 provides a summary of how the relative contributions of rail and road noise sources may be expected to change as a function of proposed alternatives. Most noise source levels will be reduced by most alternatives as they introduce more noise reducing features such as increased shielding from noise barriers or structures, however, it is noted that engine noise from hybrid and viaduct alternatives could increase slightly since the increased elevation of the rail path may reduce the effectiveness of first row shielding at second row homes.

**Table 5-1 Noise Source Changes by Alternative**

<b>Proposed Alternative</b>	<b>Potential Noise Reduction</b>			
	<b>Horns/Bells</b>	<b>Wheel/Rail</b>	<b>Engine</b>	<b>Road</b>
Existing	No change	No change	No change	No change
EMU trains	No change	No change	Reduction	No change
Closure	Reduction	No change	No change	No change
Trench	Reduction	Reduction	Reduction	No change
Viaduct	Reduction	Reduction	Reduction <sup>1</sup>	No change
Hybrid	Reduction	Reduction	Reduction <sup>1</sup>	Reduction <sup>2</sup>
Tunnel (passenger + freight)	Reduction	Reduction	Reduction	No change
Tunnel (freight at grade)	Reduction	Reduction	Reduction	Reduction
Underpass	Reduction	No change	No change	Reduction <sup>3</sup>

1) May create some increased noise level beyond first row for diesel freight events  
 2) decrease at receivers to west  
 3) depends on new roadway configuration

In order to provide a quantitative comparison of relative acoustical benefits for these alternatives, future noise levels were calculated for representative residential locations at typical first and second row homes to the east and west of the rail line. These calculations followed the methodology and calculation methods presented in the Federal Transit Administration’s Transit Noise and Vibration Impact Assessment Manual (2018), for detailed noise assessment, and took into consideration both rail and roadway noise sources. This technical analysis takes into consideration noise contributed by locomotive engines (diesel and electric), wheel/rail noise, horn noise, roadway noise, and noise reduction associated with noise barriers, building rows, trenches and other treatments, all assuming the current level of rail traffic. The noise modeling assumptions included in the analysis are detail in Table 5-2.

Special note on backyard fences: Many of the first-row residential homes adjacent to the rail line have some kind of backyard fence between the rail line and their own back yard. Most of these fences appeared to be simple wooden board or stockade type fences between 6-8 feet high, although a few may be of more significant construction. Wooden board fences generally do not offer a significant amount of noise reduction due to the relatively thin materials, intentionally porous construction (with gaps to accommodate thermal expansion and contraction without warping or breaking), and the relative short height relative to some rail noise sources. Therefore, the acoustical influence of these fences was conservatively ignored in predicting project noise levels for this analysis.

**Table 5-2 Noise Analysis Modeling Assumptions**

<b>Parameter</b>	<b>Modeling Assumption</b>
Trains speeds	Freight trains 50 mph, passenger trains 80 mph
Train consists <sup>1</sup>	Current passenger trains: 1 locomotive + 6 Cars, Future passenger trains: 6 EMU units, 3 powered, 3 unpowered Freight: 2 locomotives + 50 cars,
Daily trains <sup>2</sup>	Current: Passenger trains: 80/day + 12/night, Freight: 0/day + 3/night Future: Passenger trains: 99/day + 15/night, Freight: 0/day + 3/night
Peak hour trains <sup>1</sup>	16 Passenger trains/hour, no freight trains
Daily roads	Alma: 4 lanes, 36,000 daily total, 4% trucks/buses, 85% day/15% night, all 35 mph
Peak hour roads	Alma Street: 900 vehicles/lane/hour, 4% trucks/buses, all 35 mph
Building Row Attenuation <sup>2</sup>	First Row building row (<35% gap) provide 5 dB Noise reduction for second row homes, except for Hybrid and Viaduct Alts for locomotive engine noise.
Parapet Barrier Attenuation <sup>3</sup> (Viaduct, Hybrid)	Assumed acoustically absorptive on train facing side, 12 dBA reduction for wheel/rail and motor noise for EMU units, wheel/rail noise only for locomotive hauled trains. Assume ballasted track structure viaduct and hybrid alternatives
Trench Attenuation <sup>2</sup>	Full depth trench 5 dBA for engine noise, 10 dBA for wheel/rail noise For transition/partial depth, 0 dBA for engine, 5 dBA for wheel/rail Assume trench walls lined for acoustical absorption
Tunnel Attenuation	Assume 40 dBA reduction, any ventilation designed to limit exterior noise
Ground type	Hard ground, no additional acoustical absorption
Backyard fences	No additional noise reduction.
1) EMU prediction parameters are consistent with Caltrain 2014 Noise Report and comply with Caltrain Specification for new EMU units (Leq of no greater than 81 dBA @ 50 mph and 87 dBA at 80 mph as measured at 25 feet) 2) Passenger train operations from current published schedule, weekday service (10/7/2019), future train operations from Caltrain 2014 Electrification Report, 2014, and assume full changeover to EMU units, does not include potential future High Speed Rail 3) As estimated by FTA 2018, Tables 4-28, 4-29	

For each alternative, the noise levels were predicted for generalized locations, as depicted in the cross-section diagrams.

- First Row, West Side
- Second Row West Side
- First Row, East Side
- Second Row, East Side

It is expected that at locations beyond second row homes, train events may still be audible, but calculated equitant noise levels would be much closer to (or lower than) existing ambient noise levels.

The noise levels calculated for each alternative and receiver location are provided in the following two metrics:

- Peak Hour Leq (Leq<sub>peak</sub>). This represents the hourly Leq of the single hour day with the most rail and traffic activity (typically about 7-8 am or 5-6 pm), which would include up to 10 train events per hour for the current train schedules.
- Day-night Noise Level (Ldn). 24-hour energy average with 10 dB penalty added for nighttime noise levels

In addition to the officially proposed alternatives discussed in Section 4, and at the specific request of the City, two additional variations were also evaluated. These included employing the same acoustically beneficial 6-foot tall parapet barrier described for the viaduct and hybrid alternatives for the grade crossing closure and underpass alternatives (identified in the results tables below as Alternatives “w/barriers”). The results of the noise prediction analysis for each alternative and each generalized receiver location are summarized in Table 5-3.

**Table 5-3 Predicted Noise Levels by Alternative (dBA)**

Alternative	First Row West		Second Row West		First Row East		Second Row East		Average	
	Peak	Ldn	Peak	Ldn	Peak	Ldn	Peak	Ldn	Peak	Ldn
Existing/w Horns (Diesel)	85.5	84.1	75.5	74.2	82.7	81.4	74.7	73.4	79.6	78.3
Existing/w Horns (EMU)	85.5	84.1	75.5	74.2	82.7	81.4	74.6	73.5	79.6	78.3
GC Closure (Diesel)	72.1	71.7	62.8	62.4	72.2	72.0	63.1	62.8	67.6	67.2
GC Closure (EMU)	71.3	71.2	62.1	62.0	71.8	71.7	62.6	62.5	67.0	66.9
GC Closure (EMU) w/barrier	67.1	67.6	58.9	59.2	70.4	70.5	60.6	60.7	64.3	64.5
Viaduct (Churchill)	67.1	67.6	58.9	60.1	70.4	70.5	60.6	61.2	64.3	64.9
Viaduct (Meadow/Charleston)	67.0	67.5	58.9	60.0	70.4	70.6	60.6	61.4	64.2	64.9
Hybrid	61.9	63.3	54.9	57.0	70.5	70.5	61.1	61.5	62.1	63.1
Trench	67.5	67.5	59.2	59.2	70.5	70.4	60.7	60.7	64.5	64.5
Transition (trench or tunnel)	64.4	68.5	60.0	60.1	70.1	71.0	61.4	61.5	64.0	65.3
Tunnel Pass. & Freight	66.6	66.5	58.6	58.5	70.3	70.2	60.4	60.3	64.0	63.9
Tunnel At Grade Freight	63.6	65.8	55.6	57.9	67.3	68.9	57.4	59.4	61.0	63.0
Underpass Meadow/Charleston	71.3	71.2	62.1	62.0	71.8	71.7	62.6	62.5	67.0	66.9
Underpass M/C w/barrier	67.1	67.6	58.9	59.3	70.4	70.5	60.6	60.7	64.3	64.5
Underpass Churchill	69.9	69.8	60.2	60.1	68.3	68.2	59.8	59.7	64.6	64.5
Underpass Churchill w/barrier	62.0	63.7	53.4	54.7	64.3	64.8	54.7	55.4	58.6	59.7
Minimum Level	61.9	63.3	53.4	54.7	64.3	64.8	54.7	55.4	58.6	59.6
Exist v. Closure (Diesel)	13.4	12.4	12.7	11.8	10.5	9.4	11.6	10.6	12.1	11.1
Exist v. Closure (EMU)	14.2	12.9	13.4	12.2	10.9	9.7	12.0	11.0	12.6	11.5
EMU v. Diesel	0.8	0.5	0.7	0.4	0.4	0.3	0.4	0.4	0.6	0.4

Table 5-4 provided the same information as Table 5-3, except expressed in term of predicted noise reduction of the various alternative relative to the existing conditions (existing diesel trains with horn soundings).

**Table 5-4 Predicted Noise Reduction Relative to Existing Condition by Alternative (dBA)**

Alternative	First Row West		Second Row West		First Row East		Second Row East		Average	
	Peak	Ldn	Peak	Ldn	Peak	Ldn	Peak	Ldn	Peak	Ldn
Existing/w Horns (EMU)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0
GC Closure (Diesel)	13.4	12.4	12.7	11.8	10.5	9.4	11.6	10.6	12.1	11.1
GC Closure (EMU)	14.2	12.9	13.4	12.2	10.9	9.7	12.1	10.9	12.7	11.4
GC Closure (EMU) w/barrier	18.4	16.5	16.6	15	12.3	10.9	14.1	12.7	15.4	13.8
Viaduct (Churchill)	18.4	16.5	16.6	14.1	12.3	10.9	14.1	12.2	15.4	13.4
Viaduct (Meadow/Charleston)	18.5	16.6	16.6	14.2	12.3	10.8	14.1	12.0	15.4	13.4
Hybrid	23.6	20.8	20.6	17.2	12.2	10.9	13.6	11.9	17.5	15.2
Trench	18.0	16.6	16.3	15.0	12.2	11.0	14.0	12.7	15.1	13.8
Transition (trench or tunnel)	21.1	15.6	15.5	14.1	12.6	10.4	13.3	11.9	15.6	13.0
Tunnel Pass. & Freight	18.9	17.6	16.9	15.7	12.4	11.2	14.3	13.1	15.6	14.4
Tunnel At Grade Freight	21.9	18.3	19.9	16.3	15.4	12.5	17.3	14.0	18.6	15.3
Underpass Meadow/Charleston	14.2	12.9	13.4	12.2	10.9	9.7	12.1	10.9	12.7	11.4
Underpass M/C w/barrier	18.4	16.5	16.6	14.9	12.3	10.9	14.1	12.7	15.4	13.8
Underpass Churchill	15.6	14.3	15.3	14.1	14.4	13.2	14.9	13.7	15.1	13.8
Underpass Churchill w/barrier	23.5	20.4	22.1	19.5	18.4	16.6	20	18	21.0	18.6

Reviewing the results in above tables it is clear that the biggest noise reduction would come from eliminating horn soundings in the vicinity of grade crossings with typical reductions of 9 to 14 dBA (as demonstrated by the “Existing vs. Closure” line in Table 5-3). While all the studied alternatives will provide the acoustical benefit of ending horn soundings, some will provide smaller additional benefits. Viaduct and hybrid alternatives will provide the additional benefit of reducing wheel/rail noise at all receivers and the hybrid alternative will also help reduce Alma street road noise for homes to the west of the rail line. The trench and tunnel alternative will both provide significant reductions for engine and wheel/rail noise. The Tunnel with at-grade freight would provide additional overall reduction for homes in that area by essentially eliminating passenger train noise, and also reducing noise from Alma Street (freight at-grade alternative) by reducing it down to two lanes of traffic.

Overall, based upon the reduced noise levels averaged over all predicted receiver location, the “Underpass with Barrier” Alternative would offer the lowest noise level in the vicinity of the Churchill crossing (average Peak Hour level of 58.6 dBA, or a 21.0 dBA reduction from existing), and the “Tunnel with At-grade Freight” would offer the lowest average noise level for the Meadow/Charleston area (61.0 dBA, or a 18.6 dBA reduction from existing).

## 6. Ground-Borne Vibration

The movements of rail vehicles generate ground-borne vibration. Ground-borne vibration is typically quantified in terms of vibrational velocity in either Vibration Velocity (inch per second, peak particle velocity, (ips, PPV) or Vibration Level (VdB). The amount of vibration and whether



it is enough to cause annoyance to people or potential structural damage is influenced by many factors including the weight and speed of the rail vehicles, the type and condition of track and support structures, the distance to nearby residential structures, the geological characteristics of the ground between the track and the structure, and the type and condition of the structure's construction.

According to FTA guidelines a passenger/freight rail line would have to pass within less than 20 feet of typical residential structure to potentially cause structural damage (with a ground vibration velocity of 94 VdB, or approximately 0.2 ips, PPV), which would not be an issue with this project.

However, human perception of, and potential annoyance to ground-borne vibration could be triggered in homes within 150-200 feet from the tracks (72 VdB, or about 0.02 ips, PPV). Under the current existing conditions, many of the first-row homes to both the east and west of the track are already within 200 feet of the tracks and may already be experiencing perceptible vibrations from train pass-by events.

Table 6-1 provides a relative qualitative assessment of changes in ground-borne vibration level by proposed alternative, based on FTA guidance.

**Table 6-1 Potential Change in Ground-Borne Vibration by Alternative**

<b>Alternative</b>	<b>Qualitative Change in Ground Born Vibration</b>
Grade Crossing Closure	No Change
Churchill Viaduct	Significant reduction for homes both east and west.
Meadow/Charleston Viaduct	Significant reduction for both east and west, but slightly better for west.
Hybrid	Slight reduction for homes both east and west
Trench	Slight reduction for homes both east and west
Tunnel, passenger and freight	Probable slight reduction for homes both east and west
Tunnel, freight at grade	Slight reduction for homes to west, possible increase for homes to east for nighttime freight events (which would be moved closer to homes)
Underpass	Little or no change

Source: FTA 2018, Table 6-12

As seen in Table 6-1, most of the proposed alternatives would either create no significant change or perhaps a slight improvement in ground-borne vibration. The viaduct alternative may provide a significant improvement. Only the Tunnel with at-grade freight alternative would likely increase vibration levels slightly for homes to the east, but only for the few nighttime freight train events.

It should be noted that, if one alternative is selected for construction, a more detailed ground vibration engineering analysis should be completed to develop a more detailed vibration impact assessment and provide detailed recommendations for vibration mitigation features to be incorporated into the final design.

## 7. Construction Noise

While the primary focus of this analysis has been on comparing the operational noise associated with the various proposal alternatives, it should also be noted that the construction of the selected alternative may also generate a significant amount of noise and vibration in the

study area. For most of the alternatives, the construction process will include not only the construction of the new alternative itself but also the construction, use, and eventual removal of temporary tracks to allow train service to continue through the construction process. Depending on the selected alternative, varying levels of construction noise and vibration would be experienced. Table 7-1 provides a qualitative comparison of potential construction noise and vibration impacts from the various alternatives.

**Table 7-1 Potential Construction Noise and Vibration Issues by Alternative**

<b>Alternative</b>	<b>Estimated Activity Creating Construction Noise and Vibration Impacts</b>
Grade Crossing Closure	<b>Minor construction noise impacts.</b> Intersection modification to Alma at Churchill and construction of pedestrian underpass. No temporary track construction required. May require backhoe, jackhammers, excavator, concrete mixers, dump trucks. Two year duration.
Viaduct	<b>Moderate construction noise impacts.</b> Construction, use and demolition of temporary tracks, removal of current tracks, installation of pillars, pathway and new track system. Will require use of dozers, graders, cranes, concrete trucks, heavy trucks, pneumatic tools, tie cutters/inserters. Two year duration.
Hybrid	<b>Moderate to severe construction noise impacts.</b> Construction, use and demolition of temporary tracks, removal of current tracks, construction of raised railbed, bridges over cross streets, and new track system. Will require use of dozers, graders, cranes, concrete trucks, dump trucks, pneumatic tools, pile drivers, tie cutters/inserters and truck haul routes to import fill. Four year duration.
Tunnel, passenger and freight	<b>Moderate to severe construction noise impacts.</b> Construction, use and demolition of temporary tracks, removal of current tracks, boring and construction of tunnels and approach trenches, install new track system. Will require use of dozers, excavators, tunnel boring machine, cranes, concrete trucks, dump trucks, pneumatic tools, tie cutters/inserters, and truck haul routes to more material. Six year duration.
Tunnel, freight at-grade	<b>Moderate to severe construction noise impacts.</b> Construction of new at-grade freight tracks, removal of current tracks, excavation and construction of trench, road bridges over trench, construct new freight track pathway, install new track system. Will require use of dozers, excavators, cranes, concrete trucks, dump trucks, pneumatic tools, tie cutters/inserters and truck haul routes. Six year duration.
Trench	<b>Severe construction noise impacts.</b> Construction, use and demolition of temporary tracks, removal of current tracks, excavation and construction of trench, construct road bridges over trench, install new track system. Will require use of dozers, excavators, cranes, concrete trucks, dump trucks, pneumatic tools, pile drivers, tie cutters/inserters and truck haul routes to remove material. Six year duration.
Underpass	<b>Severe construction noise impacts.</b> Construction, use and demolition of temporary tracks, removal of current tracks, excavation and construction of underpass roadways and ramps, construction of road and rail bridges, install new track system. Will require use of dozers, excavators, cranes, concrete trucks, dump trucks, pneumatic tools, pile drivers, tie cutters/inserters and truck haul routes to remove material. Unknown duration.
Source: FTA 2018, Table 7-1	

It is recommended that once a preferred alternative is selected that a detailed construction noise and vibration analysis be conducted to accurately assess construction noise and vibration impacts and identify appropriate mitigation options.

## **8. Summary**

This study has attempted to provide a reasonable comparison of the various proposed alternatives in terms of potential noise and vibration benefits and impacts. From an operational noise perspective, all of the future alternatives would provide the major benefit of eliminating the need for horn sounding which would reduce train noise by a significant and noticeable amount at first row homes near the existing grade crossings, but the alternatives differed by smaller amounts when considering secondary noise benefits between alternatives.

In addition, the analysis provided qualitative assessments of operational vibration, with result ranging from “no improvement” to “significant reduction”, and construction noise and vibration, ranging from “minor” to “severe” construction noise and vibration impacts.

These three aspects of noise and vibration benefits and impacts related to each of the proposed alternatives should each be considered in determining which alternatives best serve the community, together with other important considerations not included in this report (including overall project costs, safety, aesthetics, traffic, access, and others).

## 9. References

Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, 2018.  
[https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123\\_0.pdf](https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf)

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<https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/tens-sep2013-a11y.pdf>

Caltrans Transportation and Vibration Guidance Manual, 2013.  
<https://www.contracosta.ca.gov/DocumentCenter/View/34120/Caltrans-2013-construction-vibration-PDF?bidId=>

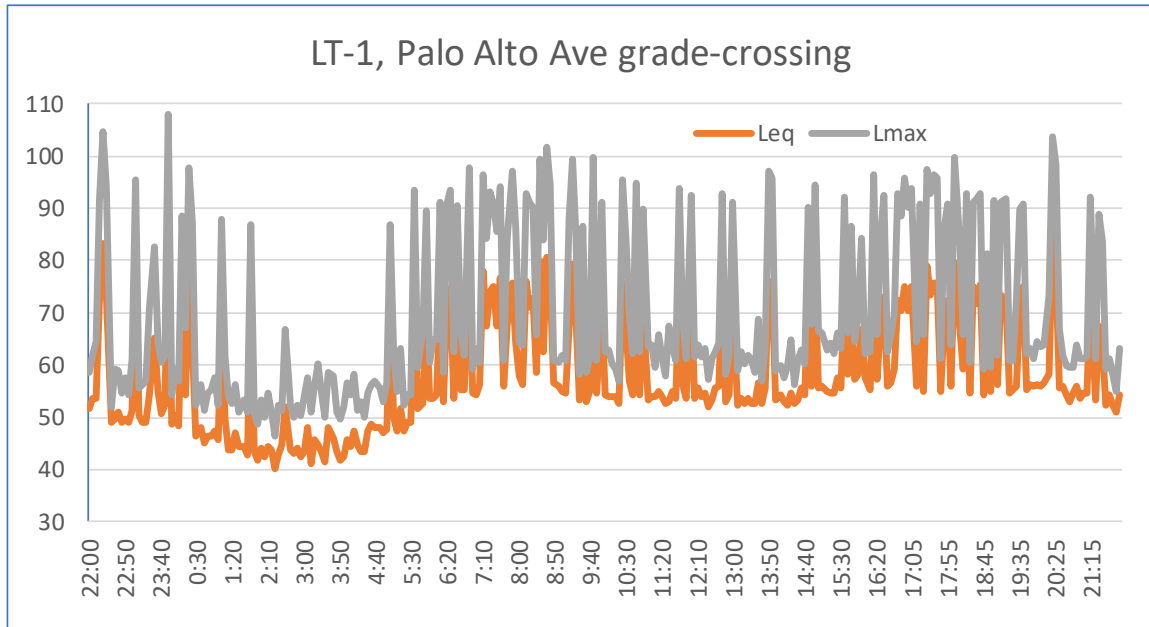
Caltrain Peninsula Corridor Electrification Project, Noise and Vibration Technical Report, February 2014.  
<https://www.caltrain.com/Assets/Caltrain+Modernization+Program/DEIR/Appendix+C+Noise+Study.pdf>

Connecting Palo Alto website and Fact Sheets  
<https://connectingpaloalto.com/fact-sheets/>

## **Appendix A Noise Measurement Data**

This appendix includes a summary of Long-term data measurements and calculated values. Field noise datasheets and photologs are on file and can be provided upon request.

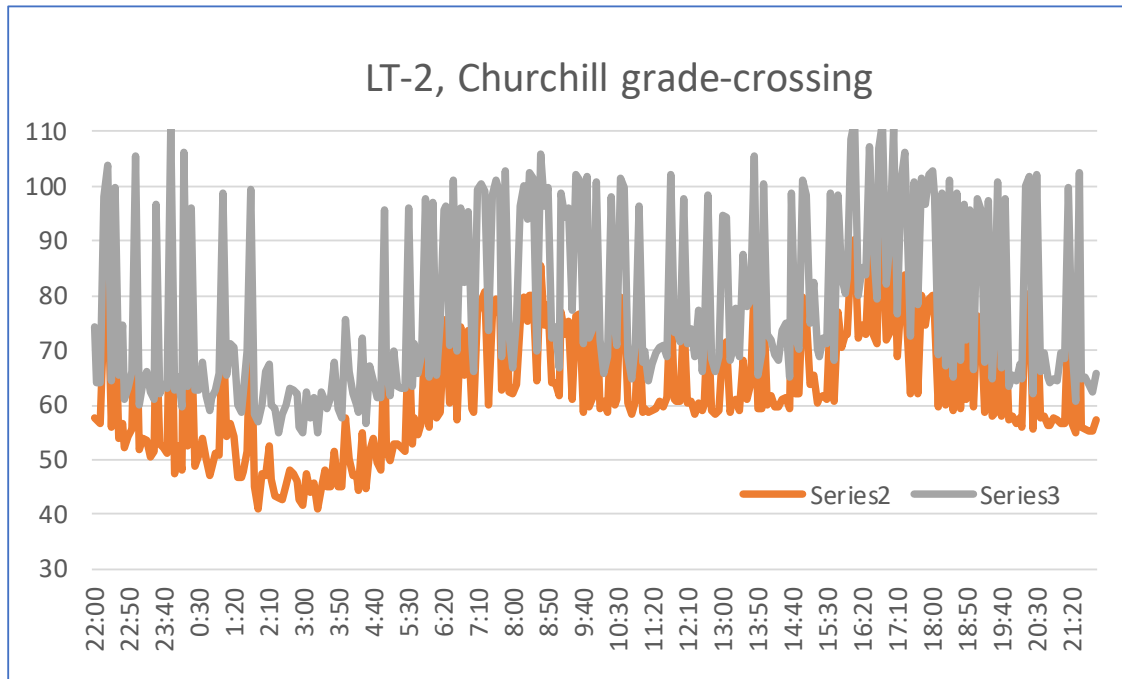
**LT-1 Data Summary**



Lmax Threshold	80
Leq-L33 Threshold	5
No. of events	88

Period	Existing	No Train	delta
Leq-day	71	57	14
Leq-night	69	51	19
Leq-24h	70	55	15
Ldn	76	59	17

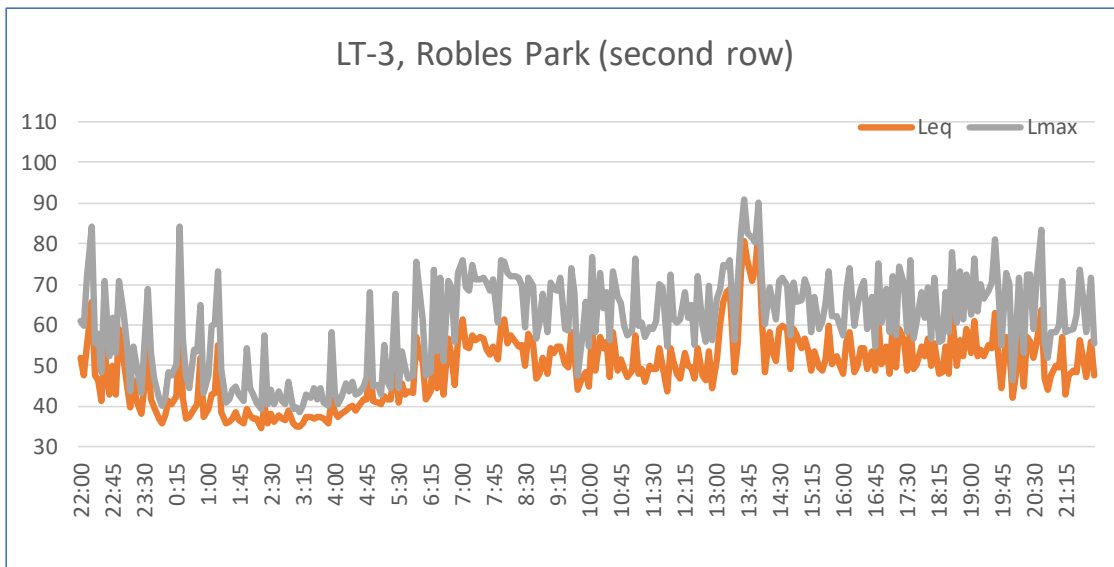
LT-2 Data Summary



Lmax Threshold	80
Leq-L33 Threshold	5
No. of events	88

Period	Existing	No Trains	Delta
Leq-day	78	65	13
Leq-night	73	54	19
Leq-24h	76	63	13
Ldn	80	65	16

**LT-3 Data Summary**

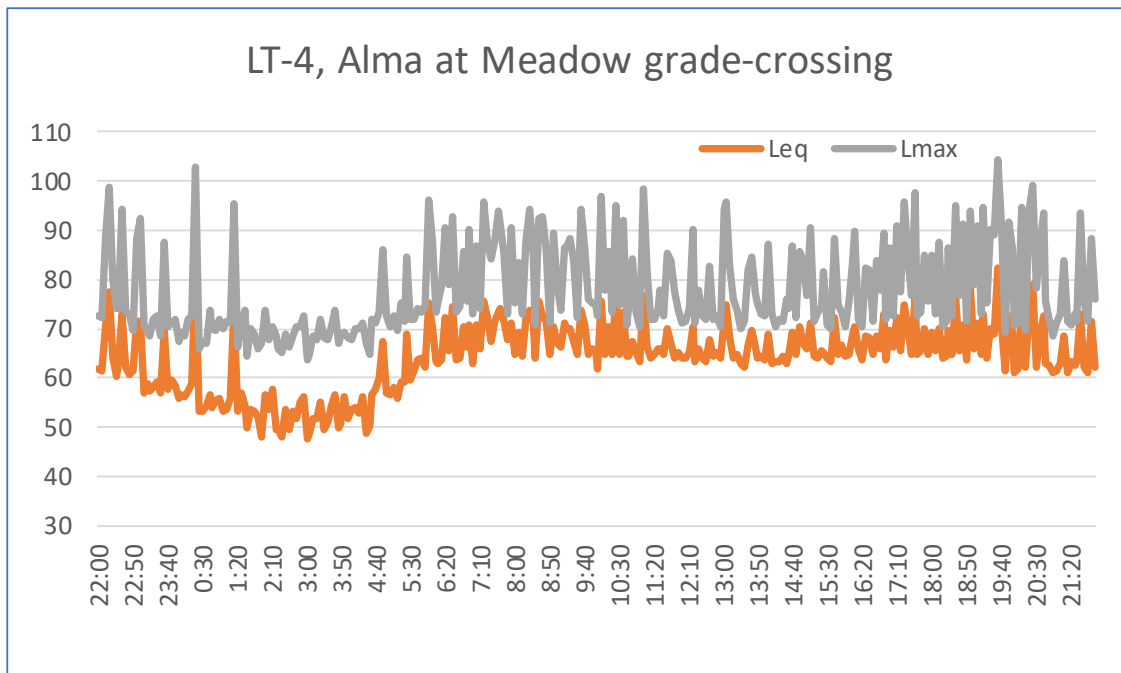


Lmax Threshold	60
Leq-L33 Threshold	3
No. of events	90

Period	Existing	No Train	Delta
Leq-day	64.5	64.3	0.3
Leq-night	51.0	43.9	7.1
Leq-24h	62.6	62.3	0.3
Ldn	63.5	62.5	1.1



LT-4 Data Summary



Lmax Threshold	70
Leq-L33 Threshold	5
No. of events	91

Period	Existing	No Train	Delta
Leq-day	70.0	66.3	3.7
Leq-night	66.5	58.4	8.0
Leq-24h	69.0	64.7	4.3
Ldn	73.6	67.2	6.4

## **Appendix B Noise Prediction Tables**

This Appendix includes copies of noise prediction spreadsheets for each analyzed alternative.

## Existing Conditions

Existing Condition with Grade Crossings: Key Assumptions																														
Train parameters	speed	locos	cars	#peak	#day	#night	k																							
Passenger (Diesel)	80	1	6	16	6.61	1.65	-10																							
Passenger (EMU)	80	3	6	16	6.61	1.65	0																							
Freight	50	2	50	0	0	0.33	-10																							
Hard Ground (G=0)																														
CR and FR run on same tracks																														
Standard Horn sounding at all GCs																														
Typical Distance to Rail or Roadway CL																														
Typical CR consist = 1 Loco + 6 cars																														
Typical FR consist = 2 Locos + 50 cars (night only)																														
No Shielding Except building rows (5 dBA)																														
Existing condition with diesel locomotives and Grade Crossings																														
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																														
Leq @ 50 feet								First Row West				Second Row West				First Row East				Second Row East										
Comm. Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Diesel Loco	92	88	66.4	62.6	56.5	64.5	65	0	65.3	61.4	55.4	63.4	205	5	55.3	51.4	45.4	53.4	130	0	62.3	58.4	52.4	60.3	255	5	54.3	50.5	44.5	52.4
Cars(wheel/rail)	82	80	70.3	66.5	60.4	68.4	65	0	69.2	65.3	59.3	67.3	205	5	59.2	55.3	49.3	57.3	130	0	66.2	62.3	56.3	64.3	255	5	58.2	54.4	48.4	56.3
Horns	110	110	86.4	82.6	76.6	84.5	65	0	85.3	81.5	75.4	83.4	205	5	75.3	71.5	65.4	73.4	130	0	82.3	78.5	72.4	80.4	255	5	74.4	70.5	64.5	72.5
Combined train event @ 50 Ft			86.6	82.7	76.7	84.7	combined		85.4	81.6	75.6	83.5	combined		75.5	71.6	65.6	73.6	combined		82.4	78.6	72.6	80.5	combined		74.5	70.7	64.6	72.6
Leq @ 50 feet								First Row West				Second Row West				First Row East				Second Row East										
Freight Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Diesel Loco	92	88	0.0	0.0	54.6	60.3	65	0	0.0	0.0	53.5	59.2	205	5	0.0	0.0	43.5	49.2	130	0	0.0	0.0	50.4	56.2	255	5	0.0	0.0	42.5	48.3
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3	65	0	0.0	0.0	57.4	63.2	205	5	0.0	0.0	47.4	53.2	130	0	0.0	0.0	54.4	60.2	255	5	0.0	0.0	46.5	52.2
Horns	110	110	0.0	0.0	69.6	75.3	65	0	0.0	0.0	68.4	74.2	205	5	0.0	0.0	58.5	64.2	130	0	0.0	0.0	65.4	71.2	255	5	0.0	0.0	57.5	63.3
Combined train event @ 50 Ft			0.0	0.0	70.0	75.8	combined		0.0	0.0	68.9	74.6	combined		0.0	0.0	58.9	64.7	combined		0.0	0.0	65.9	71.6	combined		0.0	0.0	58.0	63.7
Leq @ 50 ft.								First Row West				Second Row West				First Row East				Second Row East										
Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	61.7	59.3	54.0	61.7	140	0	57.3	54.8	49.5	57.2	280	5	49.3	46.8	41.5	49.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0
Buses/trucks	83	80	61.5	59.0	53.7	61.4	140	0	57.0	54.5	49.2	56.9	280	5	49.0	46.5	41.2	48.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5	combined		60.1	57.7	52.4	60.1	combined		52.1	49.7	44.4	52.0	combined		63.8	61.4	56.0	63.7	combined		53.9	51.5	46.2	53.8
Leq @ 50 ft.								First Row West				Second Row West				First Row East				Second Row East										
Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	69.1	66.7	61.4	69.0	140	0	64.7	62.2	56.9	64.6	280	5	56.7	54.2	48.9	56.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4
Buses/trucks	83	80	66.7	64.2	58.9	66.6	140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0	combined		66.6	64.2	58.8	66.5	combined		58.6	56.1	50.8	58.5	combined		70.3	67.8	62.5	70.2	combined		60.4	57.9	52.6	60.3
Rail + 2 lane Alma												Peak Day Night Ldn				Peak Day Night Ldn				Peak Day Night Ldn				Peak Day Night Ldn						
Rail + 4 lane Alma												85.5 81.6 76.4 84.1				75.5 71.6 66.5 74.1				82.5 78.7 73.5 81.1				74.5 70.7 65.5 73.2						
Rail + 4 lane Alma												85.5 81.7 76.5 84.1				75.5 71.7 66.6 74.2				82.7 78.9 73.8 81.4				74.7 70.9 65.7 73.4						
Existing condition with EMU trains and Grade Crossings																														
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																														
Leq @ 50 feet								First Row West				Second Row West				First Row East				Second Row East										
Comm. Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8	65	0	57.6	53.7	47.7	55.7	205	5	47.6	43.7	37.7	45.7	130	0	54.6	50.7	44.7	52.7	255	5	46.6	42.8	36.8	44.7
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4	65	0	69.2	65.3	59.3	67.3	205	5	59.2	55.3	49.3	57.3	130	0	66.2	62.3	56.3	64.3	255	5	58.2	54.4	48.4	56.3
Horns	110	110	86.4	82.6	76.6	84.5	65	0	85.3	81.5	75.4	83.4	205	5	75.3	71.5	65.4	73.4	130	0	82.3	78.5	72.4	80.4	255	5	74.4	70.5	64.5	72.5
Combined train event @ 50 Ft			86.6	82.7	76.7	84.6	combined		85.4	81.6	75.5	83.5	combined		75.4	71.6	65.6	73.5	combined		82.4	78.6	72.5	80.5	combined		74.5	70.6	64.6	72.6
Leq @ 50 feet								First Row West				Second Row West				First Row East				Second Row East										
Freight Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Diesel Loco	92	88	0.0	0.0	54.6	60.3	65	0	0.0	0.0	53.5	59.2	205	5	0.0	0.0	43.5	49.2	130	0	0.0	0.0	50.4	56.2	255	5	0.0	0.0	42.5	48.3
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3	65	0	0.0	0.0	57.4	63.2	205	5	0.0	0.0	47.4	53.2	130	0	0.0	0.0	54.4	60.2	255	5	0.0	0.0	46.5	52.2
Horns	110	110	0.0	0.0	69.6	75.3	65	0	0.0	0.0	68.4	74.2	205	5	0.0	0.0	58.5	64.2	130	0	0.0	0.0	65.4	71.2	255	5	0.0	0.0	57.5	63.3
Combined train event @ 50 Ft			0.0	0.0	70.0	75.8	combined		0.0	0.0	68.9	74.6	combined		0.0	0.0	58.9	64.7	combined		0.0	0.0	65.9	71.6	combined		0.0	0.0	58.0	63.7
Leq @ 50 ft.								First Row West				Second Row West				First Row East				Second Row East										
Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	61.7	59.3	54.0	61.7	140	0	57.3	54.8	49.5	57.2	280	5	49.3	46.8	41.5	49.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0
Buses/trucks	83	80	61.5	59.0	53.7	61.4	140	0	57.0	54.5	49.2	56.9	280	5	49.0	46.5	41.2	48.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5	combined		60.1	57.7	52.4	60.1	combined		52.1	49.7	44.4	52.0	combined		63.8	61.4	56.0	63.7	combined		53.9	51.5	46.2	53.8
Leq @ 50 ft.								First Row West				Second Row West				First Row East				Second Row East										
Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	69.1	66.7	61.4	69.0	140	0	64.7	62.2	56.9	64.6	280	5	56.7	54.2	48.9	56.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4
Buses/trucks	83	80	66.7	64.2	58.9	66.6	140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0	combined		66.6	64.2	58.8	66.5	combined		58.6	56.1	50.8	58.5	combined		70.3	67.8	62.5	70.2	combined		60.4	57.9	52.6	60.3
Rail + 2 lane Alma												Peak Day Night Ldn				Peak Day Night Ldn				Peak Day Night Ldn				Peak Day Night Ldn						
Rail + 4 lane Alma												85.4 81.6 76.4 84.1				75.4 71.6 66.4 74.1				82.5 78.6 73.5 81.1				74.5 70.7 65.5 73.2						
Rail + 4 lane Alma												85.5 81.7 76.5 84.1				75.5 71.7 66.5 74.2				82.7 78.9 73.7 81.4				74.6 70.9 65.7 73.3						

Grade Crossing Closure Alternative

Grade Crossing Closure: Key Assumptions and parameters										
Train parameters	speed	locos	cars	#peak	#day	#night	k			
Passenger (Diesel)	80	1	6	16	6.61	1.65	-10			
Passenger (EMU)	80	3	6	16	6.61	1.65	0			
Freight	50	2	50	0	0	0.33	-10			
Hard Ground (G=0)										
CR and FR run on same tracks										
No Horn Soundings										
Typical Distance to Rail or Roadway CL										
No Shielding Except building rows (5 dBA)										
Grade Crossing Closure, CR w/diesel locomotives										
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
Comm. Rail Source SEL Lmax Leq @ 50 feet										
Peak Day Night Ldn										
Diesel Loco	92	88	66.4	62.6	56.5	64.5				
Cars(wheel/rail)	82	80	70.3	66.5	60.4	68.4				
Combined train event @ 50 Ft			71.8	67.9	61.9	69.9				
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
First Row West Second Row West First Row East Second Row East										
Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn										
65 0 65.3 61.4 55.4 63.4 205 5 55.3 51.4 45.4 53.4 130 0 62.3 58.4 52.4 60.3 255 5 54.3 50.5 44.5 52.4										
65 0 69.2 65.3 59.3 67.3 205 5 59.2 55.3 49.3 57.3 130 0 66.2 62.3 56.3 64.3 255 5 58.2 54.4 48.4 56.3										
combined 70.6 66.8 60.8 68.7 combined 60.7 56.8 50.8 58.8 combined 67.6 63.8 57.8 65.7 combined 59.7 55.9 49.8 57.8										
Freight Rail Source SEL Lmax Leq @ 50 feet										
Peak Day Night Ldn										
Diesel Loco	92	88	0.0	0.0	54.6	60.3				
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3				
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8				
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
First Row West Second Row West First Row East Second Row East										
Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn										
65 0 0.0 0.0 53.5 59.2 205 5 0.0 0.0 43.5 49.2 130 0 0.0 0.0 50.4 56.2 255 5 0.0 0.0 42.5 48.3										
65 0 0.0 0.0 57.4 63.2 205 5 0.0 0.0 47.4 53.2 130 0 0.0 0.0 54.4 60.2 255 5 0.0 0.0 46.5 52.2										
combined 0.0 0.0 58.9 64.6 combined 0.0 0.0 48.9 54.7 combined 0.0 0.0 55.9 61.6 combined 0.0 0.0 48.0 53.7										
2 lane Alma (25 mph) Highway Source SEL Lmax Leq @ 50 feet										
Peak Day Night Ldn										
Cars	74	70	61.7	59.3	54.0	61.7				
Buses/trucks	83	80	61.5	59.0	53.7	61.4				
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5				
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
First Row West Second Row West First Row East Second Row East										
Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn										
140 0 57.3 54.8 49.5 57.2 280 5 49.3 46.8 41.5 49.2 60 0 61.0 58.5 53.2 60.9 185 5 51.1 48.6 43.3 51.0										
140 0 57.0 54.5 49.2 56.9 280 5 49.0 46.5 41.2 48.9 60 0 60.7 58.2 52.9 60.6 185 5 50.8 48.3 43.0 50.7										
combined 60.1 57.7 52.4 60.1 combined 52.1 49.7 44.4 52.0 combined 63.8 61.4 56.0 63.7 combined 53.9 51.5 46.2 53.8										
4 lane Alma (35 mph) Highway Source SEL Lmax Leq @ 50 feet										
Peak Day Night Ldn										
Cars	74	70	69.1	66.7	61.4	69.0				
Buses/trucks	83	80	66.7	64.2	58.9	66.6				
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0				
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
First Row West Second Row West First Row East Second Row East										
Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn										
140 0 64.7 62.2 56.9 64.6 280 5 56.7 54.2 48.9 56.6 60 0 68.3 65.9 60.6 68.3 185 5 58.5 56.0 50.7 58.4										
140 0 62.2 59.7 54.4 62.1 280 5 54.2 51.7 46.4 54.1 60 0 65.9 63.4 58.1 65.8 185 5 56.0 53.5 48.2 55.9										
combined 66.6 64.2 58.8 66.5 combined 58.6 56.1 50.8 58.5 combined 70.3 67.8 62.5 70.2 combined 60.4 57.9 52.6 60.3										
Rail + 2 lane Alma										
Peak Day Night Ldn										
71.0 67.3 63.3 70.6										
72.1 68.7 64.4 71.7										
61.2 57.6 53.5 60.8										
62.8 59.5 55.0 62.4										
69.1 65.8 61.4 68.8										
72.2 69.3 64.4 72.0										
60.7 57.2 53.0 60.3										
63.1 60.0 55.3 62.8										
Grade Crossing Closure, CR w/EMU										
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
Comm. Rail Source SEL Lmax Leq @ 50 feet										
Peak Day Night Ldn										
EMU pwr cars	77.5	88	51.9	48.1	42.0	50.0				
EMU Non-pwr cars	82	80	70.6	66.5	60.4	68.4				
Combined train event @ 50 Ft			70.7	66.5	60.5	68.5				
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
First Row West Second Row West First Row East Second Row East										
Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn										
65 0 50.8 46.9 40.9 48.9 205 5 40.8 36.9 30.9 38.9 130 0 47.8 43.9 37.9 45.8 255 5 39.8 36.0 30.0 37.9										
65 0 69.5 65.3 59.3 67.3 205 5 59.5 55.3 49.3 57.3 130 0 66.5 62.3 56.3 64.3 255 5 58.5 54.4 48.4 56.3										
combined 69.5 65.4 59.4 67.3 combined 59.6 55.4 49.4 57.3 combined 66.5 62.4 56.4 64.3 combined 58.6 54.5 48.4 56.4										
Freight Rail Source SEL Lmax Leq @ 50 feet										
Peak Day Night Ldn										
Diesel Loco	92	88	0.0	0.0	54.6	60.3				
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3				
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8				
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
First Row West Second Row West First Row East Second Row East										
Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn										
65 0 0.0 0.0 53.5 59.2 205 5 0.0 0.0 43.5 49.2 130 0 0.0 0.0 50.4 56.2 255 5 0.0 0.0 42.5 48.3										
65 0 0.0 0.0 57.4 63.2 205 5 0.0 0.0 47.4 53.2 130 0 0.0 0.0 54.4 60.2 255 5 0.0 0.0 46.5 52.2										
combined 0.0 0.0 58.9 64.6 combined 0.0 0.0 48.9 54.7 combined 0.0 0.0 55.9 61.6 combined 0.0 0.0 48.0 53.7										
2 lane Alma (25 mph) Highway Source SEL Lmax Leq @ 50 feet										
Peak Day Night Ldn										
Cars	74	70	61.7	59.3	54.0	61.7				
Buses/trucks	83	80	61.5	59.0	53.7	61.4				
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5				
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
First Row West Second Row West First Row East Second Row East										
Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn										
140 0 57.3 54.8 49.5 57.2 280 5 49.3 46.8 41.5 49.2 60 0 61.0 58.5 53.2 60.9 185 5 51.1 48.6 43.3 51.0										
140 0 57.0 54.5 49.2 56.9 280 5 49.0 46.5 41.2 48.9 60 0 60.7 58.2 52.9 60.6 185 5 50.8 48.3 43.0 50.7										
combined 60.1 57.7 52.4 60.1 combined 52.1 49.7 44.4 52.0 combined 63.8 61.4 56.0 63.7 combined 53.9 51.5 46.2 53.8										
4 lane Alma (35 mph) Highway Source SEL Lmax Leq @ 50 feet										
Peak Day Night Ldn										
Cars	74	70	69.1	66.7	61.4	69.0				
Buses/trucks	83	80	66.7	64.2	58.9	66.6				
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0				
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
First Row West Second Row West First Row East Second Row East										
Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn Dist. Shield Peak Day Night Ldn										
140 0 64.7 62.2 56.9 64.6 280 5 56.7 54.2 48.9 56.6 60 0 68.3 65.9 60.6 68.3 185 5 58.5 56.0 50.7 58.4										
140 0 62.2 59.7 54.4 62.1 280 5 54.2 51.7 46.4 54.1 60 0 65.9 63.4 58.1 65.8 185 5 56.0 53.5 48.2 55.9										
combined 66.6 64.2 58.8 66.5 combined 58.6 56.1 50.8 58.5 combined 70.3 67.8 62.5 70.2 combined 60.4 57.9 52.6 60.3										
Rail + 2 lane Alma										
Peak Day Night Ldn										
70.0 66.1 62.6 69.7										
71.3 67.8 63.8 71.1										
60.3 56.4 52.8 60.0										
62.1 58.8 54.6 61.9										
68.4 64.9 60.9 68.1										
71.8 68.9 64.2 71.7										
59.9 56.2 52.4 59.6										
62.6 59.5 55.0 62.4										

**Grade Crossing Closure Alternative with Barrier**

Grade Crossing Closure: Key Assumptions and parameters										
Train parameters	speed	locos	cars	#peak	#day	#night	k			
Passenger (Diesel)	80	1	6	16	6.61	1.65	-10			
Passenger (EMU)	80	3	6	16	6.61	1.65	0			
Freight	50	2	50	0	0	0.33	-10			
Hard Ground (G=0)										
CR and FR run on same tracks										
No Horn Soundings										
Typical Distance to Rail or Roadway CL										
12 dBA shielding for first row + 5 dBA shielding for Second row.										
Grade Crossing Closure, CR w/diesel locomotives										
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
Comm. Rail Source SEL Lmax Leq @ 50 feet										
Diesel Loco 92 88 66.4 62.6 56.5 64.5										
Cars(wheel/rail) 82 80 70.3 66.5 60.4 68.4										
Combined train event @ 50 Ft 71.8 67.9 61.9 69.9										
Freight Rail Source SEL Lmax Leq @ 50 feet										
Diesel Loco 92 88 0.0 0.0 54.6 60.3										
Cars(wheel/rail) 82 80 0.0 0.0 58.6 64.3										
Combined train event @ 50 Ft 0.0 0.0 60.0 65.8										
2 lane Alma (25 mph) Highway Source SEL Lmax Leq @ 50 ft.										
Cars 74 70 61.7 59.3 54.0 61.7										
Buses/trucks 83 80 61.5 59.0 53.7 61.4										
Combined Road noise @ 50 ft 64.6 62.2 56.8 64.5										
4 lane Alma (35 mph) Highway Source SEL Lmax Leq @ 50 ft.										
Cars 74 70 69.1 66.7 61.4 69.0										
Buses/trucks 83 80 66.7 64.2 58.9 66.6										
Combined Road noise @ 50 ft 71.1 68.6 63.3 71.0										
Rail + 2 lane Alma										
Peak Day Night Ldn										
71.0 67.3 63.3 70.6										
72.1 68.7 64.4 71.7										
Second Row West										
Peak Day Night Ldn										
61.2 57.6 53.5 60.8										
62.8 59.5 55.0 62.4										
First Row East										
Peak Day Night Ldn										
69.1 65.8 61.4 68.8										
72.2 69.3 64.4 72.0										
Second Row East										
Peak Day Night Ldn										
60.7 57.2 53.0 60.3										
63.1 60.0 55.3 62.8										
Grade Crossing Closure, CR w/EMU										
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)										
Comm. Rail Source SEL Lmax Leq @ 50 feet										
EMU pwr cars 77.5 88 51.9 48.1 42.0 50.0										
EMU Non-pwr cars 82 80 70.6 66.5 60.4 68.4										
Combined train event @ 50 Ft 70.7 66.5 60.5 68.5										
Freight Rail Source SEL Lmax Leq @ 50 feet										
Diesel Loco 92 88 0.0 0.0 54.6 60.3										
Cars(wheel/rail) 82 80 0.0 0.0 58.6 64.3										
Combined train event @ 50 Ft 0.0 0.0 60.0 65.8										
2 lane Alma (25 mph) Highway Source SEL Lmax Leq @ 50 ft.										
Cars 74 70 61.7 59.3 54.0 61.7										
Buses/trucks 83 80 61.5 59.0 53.7 61.4										
Combined Road noise @ 50 ft 64.6 62.2 56.8 64.5										
4 lane Alma (35 mph) Highway Source SEL Lmax Leq @ 50 ft.										
Cars 74 70 69.1 66.7 61.4 69.0										
Buses/trucks 83 80 66.7 64.2 58.9 66.6										
Combined Road noise @ 50 ft 71.1 68.6 63.3 71.0										
Rail + 2 lane Alma										
Peak Day Night Ldn										
62.0 59.1 56.8 63.6										
67.1 64.5 60.3 67.6										
Second Row West										
Peak Day Night Ldn										
53.4 50.6 47.7 54.6										
58.9 56.4 51.8 59.2										
First Row East										
Peak Day Night Ldn										
64.3 61.7 57.5 64.8										
70.4 67.9 62.9 70.5										
Second Row East										
Peak Day Night Ldn										
54.7 52.0 48.2 55.4										
60.6 58.1 53.2 60.7										

## Viaduct Alternatives

Viaduct Alternative: Key Assumptions																															
Train parameters		speed	locos	cars	#peak	#day	#night	k																							
Passenger (EMU)		80	3	6	16	6.61	1.65	0																							
Freight		50	2	50	0	0	0.33	-10																							
Hard Ground (G=0)																															
No Horn Soundings																															
Assume parapet barriers would be absorptive																															
Typical Distance to Rail or Roadway CL																															
Typical CR consist = 6 cars/3 powered																															
Typical FR consist = 2 locos + 50 cars (night only)																															
For EMU assume 12 dB 1st row, 17 dB 2nd row																															
For Freight assume 12 dB 1st row, 17 dB 2nd row for W/R noise, 0 dB for locos																															
Viaduct on original alignment (Churchill)																															
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																															
Comm. Rail Source		SEL	Lmax	Leq @ 50 feet				First Row West		Second Row West		First Row East		Second Row East																	
				Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn												
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8		65	12	45.6	41.7	35.7	43.7	205	17	35.6	31.7	25.7	33.7	130	12	42.6	38.7	32.7	40.7	255	17	34.6	30.8	24.8	32.7
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4		65	12	57.2	53.3	47.3	55.3	205	17	47.2	43.3	37.3	45.3	130	12	54.2	50.3	44.3	52.3	255	17	46.2	42.4	36.4	44.3
Combined train event @ 50 Ft			70.6	66.8	60.7	68.7		combined		57.5	53.6	47.6	55.6	combined		47.5	43.6	37.6	45.6	combined		54.4	50.6	44.6	52.5	combined		46.5	42.7	36.7	44.6
Freight Rail Source		SEL	Lmax	Leq @ 50 feet				First Row West		Second Row West		First Row East		Second Row East																	
				Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn												
Diesel Loco	92	88	0.0	0.0	54.6	60.3		65	0	0.0	0.0	53.5	59.2	205	0	0.0	0.0	48.5	54.2	130	0	0.0	0.0	50.4	56.2	255	0	0.0	0.0	47.5	53.3
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3		65	12	0.0	0.0	45.4	51.2	205	17	0.0	0.0	35.4	41.2	130	12	0.0	0.0	42.4	48.2	255	17	0.0	0.0	34.5	40.2
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8		combined		0.0	0.0	54.1	59.8	combined		0.0	0.0	48.7	54.4	combined		0.0	0.0	51.1	56.8	combined		0.0	0.0	47.7	53.5
2 lane Alma (25 mph)		SEL	Lmax	Leq @ 50 ft.				First Row West		Second Row West		First Row East		Second Row East																	
Highway Source				Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn												
Cars	74	70	61.7	59.3	54.0	61.7		140	0	57.3	54.8	49.5	57.2	280	5	49.3	46.8	41.5	49.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0
Buses/trucks	83	80	61.5	59.0	53.7	61.4		140	0	57.0	54.5	49.2	56.9	280	5	49.0	46.5	41.2	48.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5		combined		60.1	57.7	52.4	60.1	combined		52.1	49.7	44.4	52.0	combined		63.8	61.4	56.0	63.7	combined		53.9	51.5	46.2	53.8
4 lane Alma (35 mph)		SEL	Lmax	Leq @ 50 ft.				First Row West		Second Row West		First Row East		Second Row East																	
Highway Source				Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn												
Cars	74	70	69.1	66.7	61.4	69.0		140	0	64.7	62.2	56.9	64.6	280	5	56.7	54.2	48.9	56.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4
Buses/trucks	83	80	66.7	64.2	58.9	66.6		140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0		combined		66.6	64.2	58.8	66.5	combined		58.6	56.1	50.8	58.5	combined		70.3	67.8	62.5	70.2	combined		60.4	57.9	52.6	60.3
Rail + 2 lane Alma				First Row West				Second Row West				First Row East				Second Row East															
				Peak Day Night Ldn				Peak Day Night Ldn				Peak Day Night Ldn				Peak Day Night Ldn															
				62.0	59.1	56.9	63.7	53.4	50.6	50.3	56.7	64.3	61.7	57.5	64.8	54.7	52.0	50.2	56.9												
Rail + 4 lane Alma				67.1	64.5	60.3	67.6	58.9	56.4	53.0	60.1	70.4	67.9	62.9	70.5	60.6	58.1	53.9	61.2												
Viaduct on shifted alignment (Meadow-Charleston)																															
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																															
Comm. Rail Source		SEL	Lmax	Leq @ 50 feet				First Row West		Second Row West		First Row East		Second Row East																	
				Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn												
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8		90	12	44.2	40.3	34.3	42.3	230	17	35.1	31.2	25.2	33.2	105	12	43.5	39.7	33.6	41.6	220	17	35.3	31.4	25.4	33.4
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4		90	12	55.8	51.9	45.9	53.8	230	17	46.7	42.8	36.8	44.8	105	12	55.1	51.2	45.2	53.2	220	17	46.9	43.0	37.0	45.0
Combined train event @ 50 Ft			70.6	66.8	60.7	68.7		combined		56.0	52.2	46.2	54.1	combined		47.0	43.1	37.1	45.1	combined		55.4	51.5	45.5	53.5	combined		47.2	43.3	37.3	45.3
Freight Rail Source		SEL	Lmax	Leq @ 50 feet				First Row West		Second Row West		First Row East		Second Row East																	
				Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn												
Diesel Loco	92	88	0.0	0.0	54.6	60.3		90	0	0.0	0.0	52.0	57.8	230	0	0.0	0.0	48.0	53.7	105	0	0.0	0.0	51.4	57.1	220	0	0.0	0.0	48.2	53.9
Cars(wheel/rail)	82	80	0.0	0.0	62.0	67.7		90	12	0.0	0.0	47.4	53.2	230	17	0.0	0.0	38.4	44.1	105	12	0.0	0.0	46.8	52.5	220	17	0.0	0.0	38.5	44.3
Combined train event @ 50 Ft			0.0	0.0	62.7	68.5		combined		0.0	0.0	53.3	59.1	combined		0.0	0.0	48.4	54.2	combined		0.0	0.0	52.7	58.4	combined		0.0	0.0	48.6	54.4
2 lane Alma (25 mph)		SEL	Lmax	Leq @ 50 ft.				First Row West		Second Row West		First Row East		Second Row East																	
Highway Source				Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn												
Cars	74	70	61.7	59.3	54.0	61.7		140	0	57.3	54.8	49.5	57.2	280	5	49.3	46.8	41.5	49.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0
Buses/trucks	83	80	61.5	59.0	53.7	61.4		140	0	57.0	54.5	49.2	56.9	280	5	49.0	46.5	41.2	48.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5		combined		60.1	57.7	52.4	60.1	combined		52.1	49.7	44.4	52.0	combined		63.8	61.4	56.0	63.7	combined		53.9	51.5	46.2	53.8
4 lane Alma (35 mph)		SEL	Lmax	Leq @ 50 ft.				First Row West		Second Row West		First Row East		Second Row East																	
Highway Source				Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn												
Cars	74	70	69.1	66.7	61.4	69.0		140	0	64.7	62.2	56.9	64.6	280	5	56.7	54.2	48.9	56.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4
Buses/trucks	83	80	66.7	64.2	58.9	66.6		140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0		combined		66.6	64.2	58.8	66.5	combined		58.6	56.1	50.8	58.5	combined		70.3	67.8	62.5	70.2	combined		60.4	57.9	52.6	60.3
Rail + 2 lane Alma				First Row West				Second Row West				First Row East				Second Row East															
				Peak Day Night Ldn				Peak Day Night Ldn				Peak Day Night Ldn				Peak Day Night Ldn															
				61.6	58.8	56.3	63.2	53.3	50.5	50.1	56.6	64.4	61.8	57.9	65.2	54.8	52.1	50.8	57.4												
Rail + 4 lane Alma				67.0	64.4	60.1	67.5	58.9	56.4	52.9	60.0	70.4	67.9	63.0	70.6	60.6	58.1	54.2	61.4												

**Hybrid Alternative**

Hybrid Alternative: Key Assumptions																														
Train parameters	speed	locos	cars	#peak	#day	#night	k																							
Passenger (EMU)	80	3	6	16	6.61	1.65	0																							
Freight	50	2	50	0	0	0.33	##																							
Rail Speeds = 50 mph																														
CR = EMUs, FR = diesel locos																														
CR and FR run on same tracks																														
Hard Ground (G=0)																														
No Horn Soundings																														
Assume Parapet barriers would be absorptive																														
Typical Distance to Rail or Roadway CL																														
Typical CR consist = 1 Loco + 6 cars																														
Typical FR consist = 2 locos + 50 cars (night only)																														
For W/R noise assume 10 dB Barrier + 5 dB BR NR																														
For Engine noise, assume no barrier or BR NR																														
For road noise, assume 10 dB barr. NR for west receipt.																														
Hybrid Alternative (existing alignment)																														
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																														
Comm. Rail Source				Leq @ 50 feet				First Row West				Second Row West				First Row East				Second Row East										
SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8	65	0	57.6	53.7	47.7	55.7	205	0	52.6	48.7	42.7	50.7	130	0	54.6	50.7	44.7	52.7	255	0	51.6	47.8	41.8	49.7
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4	65	12	57.2	53.3	47.3	55.3	205	17	47.2	43.3	37.3	45.3	130	12	54.2	50.3	44.3	52.3	255	17	46.2	42.4	36.4	44.3
Combined train event @ 50 Ft			70.6	66.8	60.7	68.7	combined	60.4	56.5	50.5	58.5	combined	53.7	49.8	43.8	51.8	combined	57.4	53.5	47.5	55.5	combined	52.7	48.9	42.9	50.8				
Freight Rail Source				Leq @ 50 feet				First Row West				Second Row West				First Row East				Second Row East										
SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	
Diesel Loco	92	88	0.0	0.0	54.6	60.3	65	0	0.0	0.0	53.5	59.2	205	0	0.0	0.0	48.5	54.2	130	0	0.0	0.0	50.4	56.2	255	0	0.0	0.0	47.5	53.3
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3	65	12	0.0	0.0	45.4	51.2	205	17	0.0	0.0	35.4	41.2	130	12	0.0	0.0	42.4	48.2	255	17	0.0	0.0	34.5	40.2
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8	combined	0.0	0.0	54.1	59.8	combined	0.0	0.0	48.7	54.4	combined	0.0	0.0	51.1	56.8	combined	0.0	0.0	47.7	53.5				
2 lane Alma (25 mph)				Leq @ 50 ft.				First Row West				Second Row West				First Row East				Second Row East										
SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	
Cars	74	70	61.7	59.3	54.0	61.7	140	10	47.3	44.8	39.5	47.2	280	15	39.3	36.8	31.5	39.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0
Buses/trucks	83	80	61.5	59.0	53.7	61.4	140	10	47.0	44.5	39.2	46.9	280	15	39.0	36.5	31.2	38.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5	combined	50.1	47.7	42.4	50.1	combined	42.1	39.7	34.4	42.0	combined	63.8	61.4	56.0	63.7	combined	53.9	51.5	46.2	53.8				
4 lane Alma (35 mph)				Leq @ 50 ft.				First Row West				Second Row West				First Row East				Second Row East										
SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	
Cars	74	70	69.1	66.7	61.4	69.0	140	10	54.7	52.2	46.9	54.6	280	15	46.7	44.2	38.9	46.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4
Buses/trucks	83	80	66.7	64.2	58.9	66.6	140	10	52.2	49.7	44.4	52.1	280	15	44.2	41.7	36.4	44.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0	combined	56.6	54.2	48.8	56.5	combined	48.6	46.1	40.8	48.5	combined	70.3	67.8	62.5	70.2	combined	60.4	57.9	52.6	60.3				
Rail + 2 lane Alma				Leq @ 50 ft.				First Row West				Second Row West				First Row East				Second Row East										
SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	
Rail + 2 lane Alma			60.8	57.1	55.9	62.5	combined	60.8	57.1	55.9	62.5	combined	54.0	50.2	50.0	56.5	combined	64.7	62.0	57.7	65.0	combined	56.4	53.4	50.8	57.7				
Rail + 4 lane Alma			61.9	58.5	56.5	63.3	combined	61.9	58.5	56.5	63.3	combined	54.9	51.4	50.4	57.0	combined	70.5	68.0	62.9	70.5	combined	61.1	58.5	54.2	61.5				

**Trench Alternative and Trench Transition**

Trench Alternative: Key Assumptions									
Train parameters	speed	locos	cars	#peak	#day	#night	k		
Passenger (EMU)	80	3	6	16	6.61	1.65	0		
Freight	50	2	50	0	0	0.33	##		
CR and FR run on same tracks									
Hard Ground (G=0)									
No Horn Soundings									
Assume Trench walls would have acoustical lining									
Typical Distance to Rail or Roadway CL									
Typical CR consist = 1 Loco + 6 cars									
Typical FR consist = 2 locos + 50 cars (night only)									
For W/R noise assume 10 dB Barrier + 5 dB BR NR									
For Engine noise, assume 5 barrier + 5 BR NR									
For transition assume 0 NR for engines, 5 NR for W/R									

Trench Alternative on original alignment																														
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																														
Leq @ 50 feet					First Row West					Second Row West					First Row East					Second Row East										
Comm. Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8	65	5	52.6	48.7	42.7	50.7	205	10	42.6	38.7	32.7	40.7	130	5	49.6	45.7	39.7	47.7	255	10	41.6	37.8	31.8	39.7
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4	65	10	59.2	55.3	49.3	57.3	205	15	49.2	45.3	39.3	47.3	130	10	56.2	52.3	46.3	54.3	255	15	48.2	44.4	38.4	46.3
Combined train event @ 50 Ft			70.6	66.8	60.7	68.7	combined		60.0	56.2	50.2	58.1	combined		50.0	46.2	40.2	48.1	combined		57.0	53.2	47.1	55.1	combined		49.1	45.3	39.2	47.2
Leq @ 50 feet					First Row West					Second Row West					First Row East					Second Row East										
Freight Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Diesel Loco	92	88	0.0	0.0	54.6	60.3	65	5	0.0	0.0	48.5	54.2	205	10	0.0	0.0	38.5	44.2	130	5	0.0	0.0	45.4	51.2	255	10	0.0	0.0	37.5	43.3
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3	65	10	0.0	0.0	47.4	53.2	205	15	0.0	0.0	37.4	43.2	130	10	0.0	0.0	44.4	50.2	255	15	0.0	0.0	36.5	42.2
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8	combined		0.0	0.0	51.0	56.7	combined		0.0	0.0	41.0	46.7	combined		0.0	0.0	48.0	53.7	combined		0.0	0.0	40.0	45.8
Leq @ 50 ft.					First Row West					Second Row West					First Row East					Second Row East										
2 lane Alma (25 mph) Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	61.7	59.3	54.0	61.7	140	0	57.3	54.8	49.5	57.2	280	5	49.3	46.8	41.5	49.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0
Buses/trucks	83	80	61.5	59.0	53.7	61.4	140	0	57.0	54.5	49.2	56.9	280	5	49.0	46.5	41.2	48.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5	combined		60.1	57.7	52.4	60.1	combined		52.1	49.7	44.4	52.0	combined		63.8	61.4	56.0	63.7	combined		53.9	51.5	46.2	53.8
Leq @ 50 ft.					First Row West					Second Row West					First Row East					Second Row East										
4 lane Alma (35 mph) Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	69.1	66.7	61.4	69.0	140	0	64.7	62.2	56.9	64.6	280	5	56.7	54.2	48.9	56.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4
Buses/trucks	83	80	66.7	64.2	58.9	66.6	140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0	combined		66.6	64.2	58.8	66.5	combined		58.6	56.1	50.8	58.5	combined		70.3	67.8	62.5	70.2	combined		60.4	57.9	52.6	60.3
					First Row West					Second Row West					First Row East					Second Row East										
					Peak Day Night Ldn					Peak Day Night Ldn					Peak Day Night Ldn					Peak Day Night Ldn										
Rail + 2 lane Alma					63.1 60.0 56.0 63.3					54.2 51.3 47.0 54.4					64.6 62.0 57.1 64.7					55.2 52.4 47.8 55.2										
Rail + 4 lane Alma					67.5 64.8 60.0 67.5					59.2 56.6 51.6 59.2					70.5 68.0 62.8 70.4					60.7 58.2 53.0 60.7										

At-grade to Trench transition																														
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																														
Leq @ 50 feet					First Row West					Second Row West					First Row East					Second Row East										
Comm. Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8	90	0	56.2	52.3	46.3	54.3	230	5	47.1	43.2	37.2	45.2	105	0	55.5	51.7	45.6	53.6	220	5	47.3	43.4	37.4	45.4
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4	90	5	62.8	58.9	52.9	60.8	230	10	53.7	49.8	43.8	51.8	105	5	62.1	58.2	52.2	60.2	220	10	53.9	50.0	44.0	52.0
Combined train event @ 50 Ft			70.6	66.8	60.7	68.7	combined		63.6	59.8	53.7	61.7	combined		54.5	50.7	44.7	52.6	combined		62.9	59.1	53.1	61.0	combined		54.7	50.9	44.9	52.8
Leq @ 50 feet					First Row West					Second Row West					First Row East					Second Row East										
Freight Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Diesel Loco	92	88	0.0	0.0	54.6	60.3	90	0	0.0	0.0	52.0	57.8	230	5	0.0	0.0	43.0	48.7	105	0	0.0	0.0	51.4	57.1	220	5	0.0	0.0	43.2	48.9
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3	90	5	0.0	0.0	51.0	56.8	230	10	0.0	0.0	41.9	47.7	105	5	0.0	0.0	50.4	56.1	220	10	0.0	0.0	42.1	47.9
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8	combined		0.0	0.0	54.6	60.3	combined		0.0	0.0	45.5	51.2	combined		0.0	0.0	53.9	59.6	combined		0.0	0.0	45.7	51.4
Leq @ 50 ft.					First Row West					Second Row West					First Row East					Second Row East										
2 lane Alma (25 mph) Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	61.7	59.3	54.0	61.7	140	0	57.3	54.8	49.5	57.2	280	5	49.3	46.8	41.5	49.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0
Buses/trucks	83	80	61.5	59.0	53.7	61.4	140	0	57.0	54.5	49.2	56.9	280	5	49.0	46.5	41.2	48.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5	combined		60.1	57.7	52.4	60.1	combined		52.1	49.7	44.4	52.0	combined		63.8	61.4	56.0	63.7	combined		53.9	51.5	46.2	53.8
Leq @ 50 ft.					First Row West					Second Row West					First Row East					Second Row East										
4 lane Alma (35 mph) Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	69.1	66.7	61.4	69.0	140	0	64.7	62.2	56.9	64.6	280	5	56.7	54.2	48.9	56.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4
Buses/trucks	83	80	66.7	64.2	58.9	66.6	140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0	combined		66.6	64.2	58.8	66.5	combined		58.6	56.1	50.8	58.5	combined		70.3	67.8	62.5	70.2	combined		60.4	57.9	52.6	60.3
					First Row West					Second Row West					First Row East					Second Row East										
					Peak Day Night Ldn					Peak Day Night Ldn					Peak Day Night Ldn					Peak Day Night Ldn										
Rail + 2 lane Alma					65.2 61.9 58.4 65.5					60.0 57.2 52.7 60.1					66.4 63.4 59.3 66.6					57.4 54.2 50.4 57.6										
Rail + 4 lane Alma					68.4 65.5 61.1 68.5					60.0 57.2 52.7 60.1					71.0 68.4 63.5 71.0					61.4 58.7 54.0 61.5										



## Tunnel Alternatives

Tunnel Alternative: Key Assumptions																														
Train parameters	speed	locos	cars	#peak	#day	#night	k																							
Passenger (EMU)	80	3	6	16	6.61	1.65	0																							
Freight	50	2	50	0	0	0.33	-10																							
Option 1, CR and FR both run in tunnel																														
Option 2, CR in Tunnel, FR at grade (shifted alignment)																														
Option 2, Alma reduced to 2 lanes, 25 mph																														
Hard Ground (G=0)																														
No Horn Soundings																														
Typical Distance to Rail or Roadway CL																														
Typical CR consist = 1 Loco + 6 cars																														
Typical FR consist = 2 locos + 50 cars (night only)																														
For tunnel, assume all rail NR = 40 dBA																														
<b>Tunnel Option 1: CR and FR run in tunnel</b>																														
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																														
Leq @ 50 feet																														
Comm. Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	First Row West			Second Row West			First Row East			Second Row East														
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4	65	40	17.6	13.7	7.7	15.7	205	45	7.6	3.7	-2.3	5.7	130	40	14.6	10.7	4.7	12.7	255	45	6.6	2.8	-3.2	4.7
Combined train event @ 50 Ft			70.6	66.8	60.7	68.7	65	40	29.2	25.3	19.3	27.3	205	45	19.2	15.3	9.3	17.3	130	40	26.2	22.3	16.3	24.3	255	45	18.2	14.4	8.4	16.3
Freight Rail Source																														
Diesel Loco	92	88	0.0	0.0	54.6	60.3	First Row West			Second Row West			First Row East			Second Row East														
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8	65	40	0.0	0.0	13.5	19.2	205	45	0.0	0.0	3.5	9.2	130	40	0.0	0.0	10.4	16.2	255	45	0.0	0.0	2.5	8.3
2 lane Alma (25 mph)																														
Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	First Row West			Second Row West			First Row East			Second Row East														
Cars	74	70	61.7	59.3	54.0	61.7	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Buses/trucks	83	80	61.5	59.0	53.7	61.4	140	0	57.3	54.8	49.5	57.2	280	5	49.3	46.8	41.5	49.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5	140	0	57.0	54.5	49.2	56.9	280	5	49.0	46.5	41.2	48.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7
4 lane Alma (35 mph)																														
Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	First Row West			Second Row West			First Row East			Second Row East														
Cars	74	70	69.1	66.7	61.4	69.0	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Buses/trucks	83	80	66.7	64.2	58.9	66.6	140	0	64.7	62.2	56.9	64.6	280	5	56.7	54.2	48.9	56.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0	140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Rail + 2 lane Alma																														
Rail + 4 lane Alma																														
			First Row West			Second Row West			First Row East			Second Row East																		
			Peak	Day	Night	Ldn	Peak	Day	Night	Ldn	Peak	Day	Night	Ldn	Peak	Day	Night	Ldn												
			60.1	57.7	52.4	60.1	52.1	49.7	44.4	52.0	63.8	61.4	56.0	63.7	53.9	51.5	46.2	53.8												
			<b>66.6</b>	<b>64.2</b>	<b>58.8</b>	<b>66.5</b>	<b>58.6</b>	<b>56.1</b>	<b>50.8</b>	<b>58.5</b>	<b>70.3</b>	<b>67.8</b>	<b>62.5</b>	<b>70.2</b>	<b>60.4</b>	<b>57.9</b>	<b>52.6</b>	<b>60.3</b>												
<b>Tunnel Option 2: CR in tunnel, FR at grade</b>																														
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																														
Leq @ 50 feet																														
Comm. Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	First Row West			Second Row West			First Row East			Second Row East														
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4	65	40	17.6	13.7	7.7	15.7	205	45	7.6	3.7	-2.3	5.7	130	40	14.6	10.7	4.7	12.7	255	45	6.6	2.8	-3.2	4.7
Combined train event @ 50 Ft			70.6	66.8	60.7	68.7	65	40	29.2	25.3	19.3	27.3	205	45	19.2	15.3	9.3	17.3	130	40	26.2	22.3	16.3	24.3	255	45	18.2	14.4	8.4	16.3
Freight Rail Source																														
Diesel Loco	92	88	0.0	0.0	54.6	60.3	First Row West			Second Row West			First Row East			Second Row East														
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8	125	0	0.0	0.0	50.6	56.4	225	5	0.0	0.0	43.1	48.8	75	0	0.0	0.0	52.8	58.6	175	5	0.0	0.0	44.2	49.9
2 lane Alma (35 mph)																														
Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	First Row West			Second Row West			First Row East			Second Row East														
Cars	74	70	66.1	63.7	58.3	66.0	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Buses/trucks	83	80	63.6	61.2	55.9	63.6	140	0	59.2	56.7	51.4	59.1	280	5	51.2	48.7	43.4	51.1	60	0	62.9	60.4	55.1	62.8	185	5	53.0	50.5	45.2	52.9
Combined Road noise @ 50 ft			68.1	65.6	60.3	68.0	140	0	61.7	59.2	53.9	61.6	280	5	53.6	51.2	45.9	53.6	60	0	65.3	62.9	57.6	65.2	185	5	55.4	53.0	47.7	55.4
4 lane Alma (35 mph)																														
Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	First Row West			Second Row West			First Row East			Second Row East														
Cars	74	70	69.1	66.7	61.4	69.0	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Buses/trucks	83	80	66.7	64.2	58.9	66.6	140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0	140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Rail + 2 lane Alma																														
Rail + 4 lane Alma																														
			First Row West			Second Row West			First Row East			Second Row East																		
			Peak	Day	Night	Ldn	Peak	Day	Night	Ldn	Peak	Day	Night	Ldn	Peak	Day	Night	Ldn												
			<b>63.6</b>	<b>61.1</b>	<b>59.0</b>	<b>65.8</b>	<b>55.6</b>	<b>53.1</b>	<b>51.2</b>	<b>57.9</b>	<b>67.3</b>	<b>64.8</b>	<b>61.9</b>	<b>68.9</b>	<b>57.4</b>	<b>54.9</b>	<b>52.6</b>	<b>59.4</b>												
			<b>66.6</b>	<b>64.2</b>	<b>60.7</b>	<b>67.8</b>	<b>58.6</b>	<b>56.1</b>	<b>52.8</b>	<b>59.9</b>	<b>70.3</b>	<b>67.8</b>	<b>63.9</b>	<b>71.1</b>	<b>60.4</b>	<b>57.9</b>	<b>54.4</b>	<b>61.5</b>												

## Underpass Alternatives

Underpass Option 1: Key Assumptions																														
Train parameters	speed	locos	cars	#peak	#day	#night	k																							
Passenger (EMU)	80	3	6	16	6.61	1.65	0																							
Freight	50	2	50	0	0	0.33	-10																							
Hard Ground (G=0)																														
CR and FR run on same tracks																														
No Horn Soundings																														
Typical Distance to Rail or Roadway CL																														
Typical CR consist = 6 EMU units																														
Typical FR consist = 2 locos + 50 cars (night only)																														
Option 1 assume 4 lane Alma																														
Option 2 assume 2 lane Alma																														
No extra shielding except build. rows (5 dBA)																														
Underpass Option1: Passes under Alma																														
Underpass Option2: Split level Alma																														
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																														
		Leq @ 50 feet				First Row West				Second Row West				First Row East				Second Row East												
Comm. Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8	65	0	57.6	53.7	47.7	55.7	205	5	47.6	43.7	37.7	45.7	130	0	54.6	50.7	44.7	52.7	255	5	46.6	42.8	36.8	44.7
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4	65	0	69.2	65.3	59.3	67.3	205	5	59.2	55.3	49.3	57.3	130	0	66.2	62.3	56.3	64.3	255	5	58.2	54.4	48.4	56.3
Combined train event @ 50 Ft			70.6	66.8	60.7	68.7	combined		69.5	65.6	59.6	67.6	combined		59.5	55.6	49.6	57.6	combined		66.4	62.6	56.6	64.5	combined		58.5	54.7	48.7	56.6
		Leq @ 50 feet				First Row West				Second Row West				First Row East				Second Row East												
Freight Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Diesel Loco	92	88	0.0	0.0	54.6	60.3	65	0	0.0	0.0	53.5	59.2	205	5	0.0	0.0	43.5	49.2	130	0	0.0	0.0	50.4	56.2	255	5	0.0	0.0	42.5	48.3
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3	65	0	0.0	0.0	57.4	63.2	205	5	0.0	0.0	47.4	53.2	130	0	0.0	0.0	54.4	60.2	255	5	0.0	0.0	46.5	52.2
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8	combined		0.0	0.0	58.9	64.6	combined		0.0	0.0	48.9	54.7	combined		0.0	0.0	55.9	61.6	combined		0.0	0.0	48.0	53.7
		Leq @ 50 ft.				First Row West				Second Row West				First Row East				Second Row East												
2 lane Alma (25 mph)	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	61.7	59.3	54.0	61.7	140	0	57.3	54.8	49.5	57.2	280	5	49.3	46.8	41.5	49.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0
Buses/trucks	83	80	61.5	59.0	53.7	61.4	140	0	57.0	54.5	49.2	56.9	280	5	49.0	46.5	41.2	48.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5	combined		60.1	57.7	52.4	60.1	combined		52.1	49.7	44.4	52.0	combined		63.8	61.4	56.0	63.7	combined		53.9	51.5	46.2	53.8
		Leq @ 50 ft.				First Row West				Second Row West				First Row East				Second Row East												
4 lane Alma (35 mph)	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Cars	74	70	69.1	66.7	61.4	69.0	140	0	64.7	62.2	56.9	64.6	280	5	56.7	54.2	48.9	56.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4
Buses/trucks	83	80	66.7	64.2	58.9	66.6	140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0	combined		66.6	64.2	58.8	66.5	combined		58.6	56.1	50.8	58.5	combined		70.3	67.8	62.5	70.2	combined		60.4	57.9	52.6	60.3
		Leq @ 50 ft.				First Row West				Second Row West				First Row East				Second Row East												
Rail + 2 lane Alma	(Churchill)	SEL	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn	Dist.	Shield	Peak	Day	Night	Ldn
Rail + 4 lane Alma	(Meadow and Charlestown)		69.9	66.3	62.7	69.8			60.2	56.6	52.9	60.1			68.3	65.0	61.0	68.2			59.8	56.4	52.5	59.7			62.6	59.6	55.0	62.5
			71.3	68.0	63.9	71.2			62.1	58.9	54.6	62.0			71.8	69.0	64.2	71.7			62.6	59.6	55.0	62.5						

## Underpass Alternatives w/Barrier

Underpass Option 1: Key Assumptions																															
Train parameters	speed	locos	cars	#peak	#day	#night	k																								
Passenger (EMU)	80	3	6	16	6.61	1.65	0																								
Freight	50	2	50	0	0	0.33	-10																								
Rail Speeds = 50 mph																															
Hard Ground (G=0)																															
CR and FR run on same tracks																															
No Horn Soundings																															
Typical Distance to Rail or Roadway CL																															
Typical CR consist = 1 Loco + 6 cars																															
Typical FR consist = 2 locos + 50 cars (night only)																															
Option 1 assume 4 lane Alma																															
Option 2 assume 2 lane Alma																															
12 dBA NR for EMU 1st row + 5 dBA for second row																															
Underpass Option1: Passes under Alma																															
Underpass Option2: Split level Alma																															
Levels at receptors within horn sounding region of grade-crossing (approx. 1/4 mile)																															
Leq @ 50 feet				First Row West				Second Row West				First Row East				Second Row East															
Comm. Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	
EMU pwr cars	77.5	88	58.7	54.9	48.8	56.8	65	12	45.6	41.7	35.7	43.7	205	17	35.6	31.7	25.7	33.7	130	12	42.6	38.7	32.7	40.7	255	17	34.6	30.8	24.8	32.7	
EMU Non-pwr cars	82	80	70.3	66.5	60.4	68.4	65	12	57.2	53.3	47.3	55.3	205	17	47.2	43.3	37.3	45.3	130	12	54.2	50.3	44.3	52.3	255	17	46.2	42.4	36.4	44.3	
Combined train event @ 50 Ft			70.6	66.8	60.7	68.7	combined	57.5	53.6	47.6	55.6	combined	47.5	43.6	37.6	45.6	combined	54.4	50.6	44.6	52.5	combined	46.5	42.7	36.7	44.6					
Leq @ 50 feet				First Row West				Second Row West				First Row East				Second Row East															
Freight Rail Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	
Diesel Loco	92	88	0.0	0.0	54.6	60.3	65	0	0.0	0.0	53.5	59.2	205	5	0.0	0.0	43.5	49.2	130	0	0.0	0.0	50.4	56.2	255	5	0.0	0.0	42.5	48.3	
Cars(wheel/rail)	82	80	0.0	0.0	58.6	64.3	65	12	0.0	0.0	45.4	51.2	205	17	0.0	0.0	35.4	41.2	130	12	0.0	0.0	42.4	48.2	255	17	0.0	0.0	34.5	40.2	
Combined train event @ 50 Ft			0.0	0.0	60.0	65.8	combined	0.0	0.0	54.1	59.8	combined	0.0	0.0	44.1	49.8	combined	0.0	0.0	51.1	56.8	combined	0.0	0.0	43.2	48.9					
Leq @ 50 ft.				First Row West				Second Row West				First Row East				Second Row East															
2 lane Alma (25 mph)	Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn
Cars	74	70	61.7	59.3	54.0	61.7	140	0	57.3	54.8	49.5	57.2	280	5	49.3	46.8	41.5	49.2	60	0	61.0	58.5	53.2	60.9	185	5	51.1	48.6	43.3	51.0	
Buses/trucks	83	80	61.5	59.0	53.7	61.4	140	0	57.0	54.5	49.2	56.9	280	5	49.0	46.5	41.2	48.9	60	0	60.7	58.2	52.9	60.6	185	5	50.8	48.3	43.0	50.7	
Combined Road noise @ 50 ft			64.6	62.2	56.8	64.5	combined	60.1	57.7	52.4	60.1	combined	52.1	49.7	44.4	52.0	combined	63.8	61.4	56.0	63.7	combined	53.9	51.5	46.2	53.8					
Leq @ 50 ft.				First Row West				Second Row West				First Row East				Second Row East															
4 lane Alma (35 mph)	Highway Source	SEL	Lmax	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn	Dist.	Shielc	Peak	Day	Night	Ldn
Cars	74	70	69.1	66.7	61.4	69.0	140	0	64.7	62.2	56.9	64.6	280	5	56.7	54.2	48.9	56.6	60	0	68.3	65.9	60.6	68.3	185	5	58.5	56.0	50.7	58.4	
Buses/trucks	83	80	66.7	64.2	58.9	66.6	140	0	62.2	59.7	54.4	62.1	280	5	54.2	51.7	46.4	54.1	60	0	65.9	63.4	58.1	65.8	185	5	56.0	53.5	48.2	55.9	
Combined Road noise @ 50 ft			71.1	68.6	63.3	71.0	combined	66.6	64.2	58.8	66.5	combined	58.6	56.1	50.8	58.5	combined	70.3	67.8	62.5	70.2	combined	60.4	57.9	52.6	60.3					
		First Row West			Second Row West			First Row East			Second Row East																				
		Peak	Day	Night	Ldn	Peak	Day	Night	Ldn	Peak	Day	Night	Ldn	Peak	Day	Night	Ldn														
Rail + 2 lane Alma (Churchill)		62.0	59.1	56.9	63.7	53.4	50.6	47.7	54.7	64.3	61.7	57.5	64.8	54.7	52.0	48.2	55.4														
Rail + 4 lane Alma (Meadow and Charleston)		67.1	64.5	60.3	67.6	58.9	56.4	51.8	59.3	70.4	67.9	62.9	70.5	60.6	58.1	53.2	60.7														

## Connecting Palo Alto Frequently Asked Questions

### General Questions

1. What is an at-grade crossing?

An at-grade crossing is an intersection of railroad tracks with roads and pedestrian/bicycle at the same street level. Vehicles and pedestrians are forced to stop at the crossing while a train travels through the intersection. At-grade crossings or train crossings have a significant risk of collisions between trains and any other road user (i.e., trucks, cars, bikes and pedestrians).

2. What is grade separation?

A grade separation is shifting/separating the grade of the train from the grade of the road. It allows for the safe movement of vehicles, bicyclists and pedestrians under or over railroad tracks. Generally, these separations come in the form of either an underpass or an overpass structure (bridge). Grade separations eliminate the risks of collisions with trains, which enhances safety and boosts mobility.

3. What is an embankment and what is it used for?

An embankment is a mound of earth that is built to support a roadway or railroad over an area above the existing ground/terrain. The sides of the embankment can be sloped or they can be vertical if used in conjunction with retaining walls. The construction of an embankment allows for a change in elevation of the roadway or railroad, which is typically used in the approach to a grade separation.

4. What is Caltrain Electrification?

Caltrain Electrification will electrify the Caltrain corridor from San Francisco to San Jose. Approximately 75% of Caltrain's diesel service will be replaced with electric service resulting in cleaner, greener, and better service to the Caltrain community and the communities along the corridor. To have more of your questions answered, visit the Caltrain Electrification FAQ at [http://calmod.org/wp-content/uploads/CalMod\\_FAQ\\_1.2018.pdf](http://calmod.org/wp-content/uploads/CalMod_FAQ_1.2018.pdf).

5. Why is Connecting Palo Alto needed?

There are currently seven roadways where motorists can cross the railroad tracks in Palo Alto. These intersections, called at-grade crossings, differ from other intersections because a train crosses them. Two of the intersections have the road below the level of the tracks (at Embarcadero Road, University Avenue, and Oregon Expressway) and four of them cross the tracks at the same level (at Charleston, Meadow, Churchill, and Palo Alto Avenue/Alma Street). Traffic congestion is expected to get worse at these at-grade locations in the future due to additional trains as part of Caltrain's electrification effort and potentially high speed rail. This

will mean that railroad crossing arms will come down many more times each day – as much as 45 seconds every 3 minutes - impacting traffic and safety. If we don't do anything, traffic delays will increase and more traffic will divert to existing grade separations like Embarcadero, University, and San Antonio (in Mountain View) as motorists look for ways to avoid the congestion.

6. What is the purpose of Connecting Palo Alto?

Connecting Palo Alto strives to: recognize and build off of the previous rail corridor planning work, improve safety along the rail corridor, reduce the traffic congestion that occurs at existing at-grade crossings every time a train passes by, minimize right-of-way acquisitions and local road closures, improve circulation and access across the rail corridor for all modes of transportation, separate bicyclists and pedestrians from automobile traffic, deliver grade separations and circulation improvements in a timely manner, reduce train noise and vibrations, minimize visual changes along the rail corridor, and support Caltrain service enhancements.

7. What problem(s) is Connecting Palo Alto trying to solve?

While enhanced rail transit service is important to the City of Palo Alto, the Caltrain corridor creates a physical and visual barrier to east/west connectivity within the City, and is also the source of safety concerns for pedestrians, bicyclists and motorists, especially at existing at-grade crossings. The rail corridor also creates issues in surrounding neighborhoods, such as noise, vibration, traffic, and visual impacts. The City of Palo Alto, through Connecting Palo Alto, is seeking to reduce the impact to the community from increased Caltrain services.

8. Has the City conducted a public outreach process for this project?

Yes. And it continues. The City has maintained a lengthy public community engagement process for this project, and has made a concerted effort to engage community members from the start. The City has held numerous workshops, roundtables, community meetings, a Community Advisory Panel (CAP), Expanded Community Advisory Panel (XCAP), and City Council Rail Committee meetings; built a database of interested stakeholders; sent out a questionnaire that received 800 responses; produced a Connecting Palo Alto e-newsletter; posted extensively on social media; and contacted local media about workshops, roundtables and the process. More information about Connecting Palo Alto can be found on the Connecting Palo Alto website at [www.cityofpaloalto.org/connectingpaloalto](http://www.cityofpaloalto.org/connectingpaloalto)

9. What are other cities doing?

Refer to the following links for information of similar projects being pursued by our neighbors.  
<http://menlopark.org/ravenswood> <https://www.mountainview.gov/depts/pw/transport/services.asp> <https://www.cityofsanmateo.org/3198/Caltrain25th-Avenue-Grade-Separation-Pro> [https://www.burlingame.org/departments/public\\_works/capital\\_improvement\\_projects.php](https://www.burlingame.org/departments/public_works/capital_improvement_projects.php)

10. What is the cost of the project and how will it be paid for?

The City continues to assess the cost of the grade separations. The current estimate for Meadow Charleston can be found here. The estimate for Churchill are forthcoming. The estimates specifically for Palo Alto Avenue have not yet been conducted. A previous [Palo Alto Grade Separation Financing White Paper](#) is available with an overview of costs and potential funding and finance services, though many of the estimates have been updated or the alternatives have changes.

11. How many different grade separation options have been looked at?

Since 2017, 34 options have been considered. The City has undertaken an extensive citywide engagement effort to establish a broad awareness of the need and issues associated with constructing rail grade separations along the Caltrain corridor. This has generated roughly 34 discrete ideas for grade separations. The 34 options for grade separations are a result of that process. The list has been narrowed down to 8 options as of May 2019. For more on the alternatives, go [here](#).

12. What is the timeline for selecting a preferred grade separation alternative?

At the April 22, 2019 meeting, City Council moved the date for a decision on a preferred alternative from April 2019 to October 2019. The Council has narrowed the 34 options to 8. Council continues to thoroughly evaluate the 8 remaining alternatives. XCAP is providing feedback in this process and the [remaining alternatives](#).

13. What are the criteria for selecting a preferred solution?

In September 2017, the City Council adopted the following criteria as guidelines in selecting a preferred solution (a preferred alternative for each crossing): *East-West connectivity* - facilitate movement across the corridor for all modes of transportation; *traffic congestion* - reduce delay and congestion for automobile traffic at rail crossings; *pedestrian / bicycle circulation* - provide clear and safe routes for pedestrians and bicyclists seeking to cross the rail corridor, separate from automobile traffic; *rail operations* - support continued rail operations and Caltrain service improvements; and, *cost* - finance the project with feasible funding sources. Additionally, the following criteria are also important: *environmental impacts* - reduce rail noise and vibration along the corridor; *visual impacts* - minimize visual changes along the rail corridor; *local access* - maintain or improve access to neighborhoods, parks, schools and other destinations along the corridor while reducing regional traffic on neighborhood streets; *cost* - minimize right-of-way acquisition; *construction* - minimize disruption and the duration of construction.

14. What are the Comprehensive Plan Guidelines?

The Comprehensive Plan states the following:

Palo Alto will build and maintain a sustainable network of safe, accessible and efficient transportation and parking solutions for all users and modes, while protecting and enhancing

the quality of life in Palo Alto. Programs will include alternative and innovative transportation processes, and the adverse impacts of automobile traffic on the environment in general and residential streets in particular will be reduced. Streets will be safe, attractive and designed to enhance the quality and aesthetics of Palo Alto neighborhoods. Palo Alto recognizes the regional nature of its transportation system, and will be a leader in seeking regional transportation solutions, prioritizing Caltrain service improvements and railroad grade separations.

15. How are we taking previous studies into account?

Beginning in 2009, the Palo Alto rail corridor has been a subject of considerable discussion and community focus in response to planned rail investments along the Caltrain rail corridor, specifically the California High Speed Rail project and the Caltrain Electrification Project. The 2013 Palo Alto Rail Corridor Study, 2014 Palo Alto Grade Separation and Trenching Study, and the 2030 Comprehensive Plan are the three essential planning studies that inform the present Rail Program planning effort, Connecting Palo Alto. The 2013 Palo Alto Rail Corridor Study, begun in November 2010 and adopted by City Council in January 2013, was initiated in response to California High Speed Rail and the Caltrain Electrification Project. The report focused on the rail corridor itself, circulation and connectivity, land use and urban design, and public facilities within a defined boundary on either side of the rail corridor traversing the entire city. A 17-member task force provided ongoing input and recommendations for consideration by City Council. The 2014 Palo Alto Grade Separation and Trenching Study was a conceptual engineering effort that provided preliminary information on the potential impacts and cost of construction for a range of roadway and railway submersion alternatives. The findings in the Palo Alto Grade Separation and Trenching Study were based on conceptual engineering documents prepared for community discussion. The engineering on both the trench and tunnel have since been updated with more existing conditions factored into the study. The [alternatives page](#) has the most recent trench and tunnel engineering info. When the 2030 Comprehensive Plan was adopted in November 2017, the following policy language was included: “Pursue grade separation of rail crossings along the rail corridor as a City priority” (Policy T-3.15). Additional policies and programs emphasize the desire to maintain access for automobiles, bicyclists, and pedestrians, address near-term safety and accessibility improvements, and call on the City to “Undertake studies and outreach necessary to advance grade separation of Caltrain to become a “shovel ready” project and strongly advocate for adequate State, regional and federal funding for design and construction of railroad grade separations” (Program T3.15.1).

16. Will there be impacts on nearby properties?

The City’s goal is to minimize the need for property acquisition, per the City Council adopted criteria. The environmental and preliminary engineering phases of the project will identify any impacts and mitigation measures, including the need for any right-of-way to construct the project.

17. How do these grade separation options take into account the possibility of High-Speed Rail being implemented in the future?

There are currently a number of uncertainties regarding the timing and configuration of High Speed Rail implementation. The current High Speed Rail business plan has the initial phase only extending as far north as San Jose, with future plans to extend north along the Peninsula. The project is coordinating with High Speed Rail. The grade separation alternatives include the flexibility to allow for the addition of High-Speed Rail without significantly affecting the proposed improvements.

18. Why isn't leaving the at-grade crossing as is being considered?

Caltrain is currently in the process of electrifying its trains as part of their effort to increase both frequency and capacity. This increase in trains will increase gate downtime and will cause more delays to all modes of transportation. With the electrification of the Caltrain Corridor, the gates will be down for 15% of peak hour times. Please review the Connecting Palo Alto Fact Sheet for more information. Traffic backups would also become excessive due to the increased gate downtime at all of the at-grade crossings in Palo Alto. Leaving the at-grade crossing as is (no build) will be considered and evaluated as part of the environmental process.

19. Since Caltrain ridership has decreased significantly, shouldn't we delay making a decision until ridership increases?

City staff believes the transit decrease associated with the Covid-19 and economic downturn is temporary. Caltrain and California High Speed Rail are moving forward with their plans for increased frequency in the Caltrain corridor. These are long term plans, and economic downturns are relatively shorter than the planning horizon for the grade separation project. The grade separation program will take several years to build.

20. Is Caltrain's corridor-wide grade separation study needed for background for the City to make a decision?

The Caltrain corridor-wide grade separation study will look at the Caltrain corridor, including all three counties and grade separations. The Caltrain study will provide additional information that we can build upon into our selected alternatives. However, these are completely independent efforts.

21. How have the economic/social consequences from the pandemic impacted the City Council's decision-making process with regard to the rail crossing agenda?

Projects such as grade separations are multiyear long-term projects and involve several steps. Typically, the economic/social impacts of the economic downturn are not as long-lasting as the project timelines. We are expecting that the pandemic related effects will be diminished in 2-5 years which is significantly shorter than the planning and construction horizon for such projects. We are cautiously proceeding with these alternatives while monitoring other regional transportation plans and efforts under consideration. Also, worth noting is that in previous recession, the Federal government enacted grant programs such as the American Recovery and



Reinvestment Act, an infrastructure-related grant funding program. The City will be better prepared to avail of similar opportunities in the future if such grants are offered in the future for projects.

22. When will a decision be made?

The Expanded Community Advisory Panel, also known as XCAP, is tasked with reviewing the grade separation alternatives and provide recommendations. In addition, the feedback from the virtual townhall will be considered by the City Council. We are hoping to have the recommended alternative selected by the end of this year.

23. Who will pay to design and construct the grade separation alternative selected?

Typically, projects such as grade separation infrastructure projects will require a combination of funding sources to fund the construction. In Santa Clara County, voters have approved Sales Tax Measure B which has earmarked funding of approximately \$700 Million for grade separation projects. The four of the total eight grade separations on the Caltrain corridor are in the City of Palo Alto and therefore shall be eligible for such funding. The City will also explore other Federal, State, and Regional Funding available as grants for such projects. However, applying for Federal and State Grants can only begin after the project is defined.

24. Where are the cost and construction timelines for the various alternatives?

The construction timelines are summarized in Row J of the Evaluation Matrix and the order of magnitude costs are in the row just below that. This information is also included in the Fact Sheets for each alternative. For the Churchill alternatives, the construction timelines are approximately 2 years for the Closure with Mitigations and the Viaduct. The Partial Underpass is expected to take approximately 2.5- 3 years to construct. The closure is the least costly to construct at \$50M to \$65M. There are costs related to the closure because there are mitigations required at 4 intersections to accommodate the diversion of traffic. These improvements are shown in the tabletop map for the Churchill Closure. An animation was not developed for the closure alternative because there are no grade separation structures built for this alternative. The Partial Underpass costs \$160M to \$200M. The most expensive alternative is the Viaduct at approximately \$300M-\$400M.

25. Why isn't leaving the at-grade crossing as is being considered?

Caltrain is currently in the process of electrifying its trains as part of their effort to increase both frequency and capacity. This increase in trains will increase gate downtime and will cause more delays to all modes of transportation. With the electrification of the Caltrain Corridor, the gates will be down for 15% of peak hour times. Please review the Connecting Palo Alto Fact Sheet for more information. Traffic backups would also become excessive due to the increased gate downtime at all of the at-grade crossings in Palo Alto. Leaving the at-grade crossing as is (no build) will be considered and evaluated as part of the environmental process.

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29. Will the public be able to view comments submitted by the community through the Virtual Town Hall?

The frequently asked questions received from the community through the Virtual Townhall were answered in the Question and Answer sessions, scheduled on August 27 and September 3, 2020. These frequently asked questions were also added to the Connecting Palo Alto website the Virtual Townhall also provides the link to the Frequently Asked Questions(FAQ). In addition, all comments received through Virtual Town Hall will be tabulated and included in the meeting summary after the Virtual Town Hall wraps up.

30. Shouldn't a long-term tunneling alternative for the entire Caltrain corridor be considered?

A Citywide Tunnel alternative was reviewed and discussed earlier in the process. After evaluating the costs and complexities associated with the Citywide Tunnel alternative, the City Council eliminated this option from further consideration. Therefore, the Citywide Tunnel alternative is no longer being considered.

Caltrain will be soon initiating a corridor-wide study and we are not anticipating Caltrain considering a corridor-wide tunnel due to the significant costs associated with constructing tunnels. Therefore, we don't believe a long-term tunneling alternative for the entire Caltrain corridor will be considered as part of the corridor-wide study.

31. Is it possible to zoom into the plans using display widget? Can the profile and typical sections be downloaded?

The mouse wheel can be used to zoom. While on a mobile device, pinch/drag out can be used to zoom on the materials. The Connecting Palo Alto website also allows for all layouts, profiles, typical sections, fact sheets, etc. to be downloaded The webpage can be found here:

<https://connectingpaloalto.com/renderings-plans-and-animations/>

32. What does the pump station look like? of the siphons/pump stations? For the alternatives that require pump stations (Trench, Hybrid, Tunnel, Underpass), what are the noise and vibration impacts and what happens if a pump station fails?

Sample photos of pump stations for Fifth Avenue in San Mateo County as well as Paseo Padre Parkway and Mission Boulevard in Fremont as shown below.





Specific required pump types and locations have not been identified at this time. However, as part of the detailed design process, any required pumps would be designed with isolation features so as to not contribute noticeable noise or vibration in the surrounding community. The pump station system would be designed with sufficient reliability and redundancy to meet code requirements. A backup generator will be provided for each pump station in case of loss of power. An alarm system will be designed to alert maintenance staff to mechanical and electrical issues.

33. What happens to XCAP's recommendation? Can the community still provide feedback on the alternatives?

The Extended Community Advisory Committee (XCAP) was created to review the alternatives developed for the rail grade crossings along the Caltrain corridor and to provide a recommended alternative at each location to the Council. City Council is the ultimate authority and makes the final decision.

While the feedback portion of the Virtual Town Hall has closed, residents will have the opportunity to provide their comments and feedback to the City Council when recommendations are considered by the City Council for making the final decision, which is expected to take place in late 2020 or early 2021. In addition, community members may send their feedback/comments to City staff through contact us link on the [www.ConnectingPaloAlto.com](http://www.ConnectingPaloAlto.com) website. Also, residents may send comments or feedback related to any community concern to any member of the City Council.

34. For the Viaduct and the Tunnel options, can the land below the viaduct and above the tunnel within Caltrain right of way be used for another purpose such as a bike path?

In April 2020, Caltrain responded to a similar question regarding the use of Caltrain right-of-way for a bike lane as part of the Churchill Partial Underpass. An excerpt of the response is below. The full response can be found at

[https://storage.net-fs.com/hosting/6566581/3/files/file\\_57182A7B\\_4A1C\\_1626\\_41CD\\_7197F4DB81F3.pdf](https://storage.net-fs.com/hosting/6566581/3/files/file_57182A7B_4A1C_1626_41CD_7197F4DB81F3.pdf)

*“In February 2020, the JPB adopted the Rail Corridor Use Policy (RCUP), which serves as an implementation policy for the Caltrain Business Plan. The RCUP guides the agency’s decision-making about use of JPB property in support of Caltrain’s Long-Term Service Vision – similar to a City’s zoning code guiding its land use decisions. Caltrain receives many proposals for non-railroad uses on its property, similar to the City’s idea above to use the right-of-way for access facilities. The RCUP will be used to determine if a proposed non-railroad use is compatible with the railroad’s current and future needs for its property. As you know, it is anticipated that significant portions of JPB’s property holdings will be needed to deliver future infrastructure and support future train operations to achieve the Long-Term Service Vision. The RCUP protects those areas that are needed for current and future railroad use by limiting the types and durations of non-railroad uses that can be located in those areas.”*

35. Why is the Meadow-Charleston Underpass alternative, which has private property impacts, being considered when previously studied alternatives such as the Churchill Hybrid and the Citywide Tunnel were eliminated due to private property impacts?

Minimizing right-of-way acquisition is one of the City Council-Adopted Criteria and thus, the impact of the proposed alternative to adjacent properties is evaluated with the development of conceptual plans. The alternatives that were developed and evaluated earlier in the process,

such as the Churchill Hybrid and the Citywide Tunnel, identified such impacts and were consequently removed from consideration through City Council review and action in early 2020.

During the same time in early 2020, community members proposed new alternatives (Partial Underpass for Churchill Avenue and Underpass for Meadow-Charleston) that required the development of a conceptual plan and evaluation of its impacts to adjacent properties. City Council directed staff and XCAP to further explore these proposed alternatives. These alternatives have not yet been reviewed by City Council and therefore XCAP or staff does not have the authority to remove these alternatives from consideration at this time. The City Council will be reviewing the new alternatives in late 2020 or early 2021.

36. Does the City of Palo Alto have the experience and resources to manage a large-scale grade separation construction project?

The grade separation projects are no doubt one of the larger projects handled by any local/municipal agency. These projects involve various levels of local, state, and federal government for approval of the design and construction phases. For the grade separation projects on the Caltrain Corridor, however, the final design and construction of the project are typically administered/managed by Caltrain. Therefore, the City will be a partner with Caltrain in design development and community outreach during the final design and construction of the project.

37. Can Caltrain just say no to a design variance? If so, what will happen to the selected alternative?

Yes, it is possible that Caltrain could not allow/approve a design variance. In the case of increased grades, a design variance is being requested to significantly reduce a project impact, such as rebuilding the San Antonio Station. If the design variance is not allowed, then the City would have to follow the design criteria and adjust the scope of the project as needed.

38. Will the polling and information gathered from the Virtual Town Hall feedback be publicized?

The draft meeting summary report was provided to XCAP for discussion at the 10/7/2020 meeting. The document can be found at the link here: [https://connectingpaloalto.com/wp-content/uploads/2020/10/2020-10-07\\_DRAFT-Virtual-Townhall-Rail-Grade-Separation-Project-Meeting-Summary.pdf](https://connectingpaloalto.com/wp-content/uploads/2020/10/2020-10-07_DRAFT-Virtual-Townhall-Rail-Grade-Separation-Project-Meeting-Summary.pdf)

A final version of the summary report will be presented to the City Council, at which point the document will be made public.

39. Why is north Palo Alto (Churchill) allowed to close their crossing, while south Palo Alto (Meadow) is not allowed to close Meadow?

Meadow Drive has about the same daily traffic volume as Churchill Avenue. However, the volume of traffic at Charleston Road is much higher. If Meadow Drive were closed, the traffic would not have a good location to divert to because Charleston Road does not have any extra capacity. Closing Churchill Avenue works because Embarcadero and Page Mill/Oregon will have enough extra capacity to accommodate the diverted traffic given the improvements that have been proposed. There are no comparable capacity improvements possible at Charleston Road unless property acquisitions are considered.

40. What safety features can be implemented to protect cyclists and pedestrians on the sidewalk along Alma Street where the planting strip between the sidewalk and Alma Street is being removed for the Meadow-Charleston Partial Underpass and Churchill Underpass alternatives?

Outside of acquiring a 3-5 foot strip of property from the homes fronting Alma Street to reconstruct the planting strip, reducing the operating speeds on Alma Street could be considered to increase the safety and comfort level of pedestrians on the sidewalk.

41. Has putting the Viaduct in the middle of the Alma Street been considered?

Realignment of the permanent railroad tracks were considered for both viaducts (Churchill and Meadow-Charleston). Realignment to the center of Alma Street has little benefit and complicates the alternative as well as adds construction costs and duration in the following ways:

- Rail track will be outside of Caltrain Right-of-Way, requiring negotiations between the City of Palo Alto and Caltrain
- The viaduct has an elevated retained fill sections of track on either end. At these locations Alma Street will need to conform back to existing alignment on the same side of the tracks, thus introducing curves into the roadway alignment.
- Traffic intersections will need to be enlarged due to the shifting Alma Street alignment.
- Noise related to vehicles will be closer to west side neighborhoods and noise related to trains will be closer to the east side neighborhoods.
- Lastly, existing utilities within existing Alma Street would need to be relocated at a significant expense.

42. Is there an animation for the Churchill Closure alternative?

The animations are very helpful to help the community visualize how a grade separation project will be built and what it will look like when completed. For the Churchill Closure, an animation was not developed because there is no grade separation structure being built for this alternative and how it will be built is not as complicated as the other alternatives being considered. However, renderings of how the Churchill Closure will look once completed were provided.

43. For the Churchill Closure, can Alma Street be raised, or a skylight be added in the middle to the pedestrian undercrossing structure to provide more light in the tunnel?

Raising Alma Street would require modification of the driveways of the homes fronting Alma Street. This would naturally introduce a low point on the driveway adjacent to the home, which would require drainage inlets on private properties. If the inlets were to get clogged, this would create a risk of flooding on those properties. So, although it's physically possible to raise Alma Street, this is not recommended because it introduces issues/risks that far exceed any of its benefits.

Although skylights were used for the Homer Avenue Undercrossing, Caltrain has stated that they would unlikely be approved on future projects due to maintenance issues, and it also limits their flexibility of being able to shift their tracks in the future, if desired.

## Churchill Avenue Grade Separation Alternatives Questions

1. Why is it assumed that the Churchill Avenue at-grade crossing must close?

The traffic study prepared for the project and available on the Connecting Palo Alto website shows that queue lengths associated with traffic backups that would just about double during peak school hours (when traffic is heaviest on Churchill) due to the increased gate downtime. This means that it would take about 5 signal cycles to make a left turn from Alma Street toward the school in the morning, and the eastbound queue would extend on to El Camino Real. This condition could only be mitigated by constructing a grade separation or closing Churchill Avenue along with making other improvements at Embarcadero Road/Alma Street, Embarcadero Road/El Camino Real, Alma Street/Oregon Expressway, and El Camino Real/Oregon Expressway-Page Mill Road.

2. Have Stanford and PAUSD commented publicly on the proposed closure?

Palo Alto Unified School District (PAUSD) and Stanford have been outreached to and have received information about the project and the alternatives. Stanford has not provided any feedback as of yet. PAUSD has provided feedback but has not taken any formal position on any of the alternatives as of yet.

3. Has adequate analysis been done to evaluate how rerouting the traffic due to the Closure will impact other neighborhood streets?

Yes, the traffic study available on the Connecting Palo Alto website includes extensive analysis of the traffic currently using the Churchill railroad crossing and where that traffic would go if the crossing were partially or fully closed. The traffic would go to either the Embarcadero or the Page Mill underpasses. Traffic can get there by using Alma Street. The problem is that the Alma Street/Embarcadero Road interchange does not accommodate all movements without using local streets such as Lincoln Avenue and Emerson Street. Therefore, it would be necessary to modify that interchange in conjunction with closing the Churchill crossing. Details are in the traffic study that can be downloaded from both the Connecting Palo Alto Website and the Virtual Townhall website.

4. Has traffic analysis been done regarding traffic diversions that may impact the ped/bike route north of Embarcadero? (More traffic will flow down the 1100 block of Emerson that runs perpendicular to the bike/ped path.)

Yes, the traffic study includes an estimate of the additional traffic that would use Emerson Street unless changes are made to the interchange of Alma Street at Embarcadero Road. The additional traffic would not be workable; therefore, the alternative to close the Churchill crossing would include revisions to the Alma Street/Embarcadero Road interchange to provide new connections. With the new connections, traffic would not increase on Emerson Street. Revisions to the interchange would accommodate bicycles.

5. Will Embarcadero Road be modified going under Alma Street when the bridge is widened? (applies to the Closure and Partial Underpass)



Yes, the Embarcadero Road profile indicates that the widening of the bridge will require modification to the existing roadway to maintain adequate clearance for the bridge.

6. For the Closure Option 1, could an L-shaped ped/bike undercrossing be considered rather than a U-shape?

The configuration for Option 1, the goal was to provide the tunnel or separation under the tracks. The L-shaped configuration as requested can be done, however, the proposed L-shape would be a variance to Option 2. If L-shaped ped/bike were provided, it would begin on Kellogg Avenue similar to the Partial Underpass alternative.

7. How long will Churchill Avenue, Embarcadero Road and/or Alma Street be closed during construction for each alternative?

Details regarding the closure or reduction in lanes on roadways impacted during construction are noted in the Fact Sheets under "Neighborhood Considerations". For the Closure, Embarcadero Road, Alma Street and Churchill Avenue will be closed intermittently at night and on weekends. Similarly, for the Viaduct, Alma Street and Churchill Avenue will be closed intermittently at night and on weekends. Impacts to local streets during the construction of the Partial Underpass are more extensive. Churchill Avenue between Alma Street and Mariposa Avenue will likely be closed for the majority of construction (total construction duration is estimated at 2.5-3 years). In addition, Alma Street will be one-way northbound for approximately 6+ months.

8. What is the process for Caltrain to consider allowing a greater than 1% grade on the railroad alignment for the Viaduct?

A 1.6% grade for the railroad alignment is proposed for the Viaduct. Per Caltrain's design standards 1% is the maximum allowed. Caltrain has indicated that there is an established process for requesting a design variance and that the requestor is responsible for the cost to support the review and analysis of a request. Supporting documentation would need to be prepared to evaluate impacts to operations, vehicle performance, and maintenance. Other site-specific conditions, such as the proximity to stations would also need to be considered. The City would engage Caltrain in evaluating design variances once a preferred alternative is identified. See also "Caltrain Notices" on the Virtual Town Hall for documents and correspondence with Caltrain.

9. For the Partial Underpass, why is the ped/bike undercrossing at Kellogg Avenue? Could it be at Churchill Avenue?

For the Churchill Avenue Partial Underpass alternative, Alma Street will be lowered creating a T intersection; and therefore, lowering the pedestrian and bike pathway on Churchill Avenue is not feasible. Kellogg Avenue is the nearest opportunity for routing pedestrian and bicycle traffic to Churchill Avenue and therefore, it was considered as a bicycle and pedestrian crossing location. Furthermore, it provides the connection to the existing bicycle-pedestrian pathway on the west side of the railroad tracks adjacent to Palo Alto High School.

In addition to physical constraints, a separate bicycle and pedestrian crossing at a location other than Churchill Avenue will allow the construction of the ped/bike crossing to be performed ahead of the partial underpass grade separation construction at the intersection and therefore be available for bicycle and pedestrian traffic during Churchill Avenue grade separation construction. Other options like Seale Avenue can also be considered and evaluated for bicycle and pedestrian traffic movement alternatives.

### **Meadow-Charleston Grade Separation Alternative Questions**

1. Would construction at Churchill Avenue occur at the same time as construction on Meadow Drive and Charleston Road?

It is highly unlikely that City will pursue the construction of Churchill Avenue grade separation at the same time as Meadow Drive and Charleston Road grade separations. These are long-term projects and require significant efforts for design and construction planning. Furthermore, the funding constraints will also limit the City's ability to fund and construct these improvements simultaneously. Also, if Meadow-Charleston grade separation was to be built simultaneously, we will ensure that at least one of the crossing remains open to traffic during construction.

2. What are the private property impacts for the Meadow-Charleston underpass alternative?

Conceptual private property impacts (full and partial acquisitions) are shown on the Underpass Alternative Fact Sheet, see Figure 1 below.

Figure 1 - Property Impacts

### Conceptual Private Property Impacts



Meadow Drive Private Property Impacts  
(Subject to changes during design development)



Charleston Road Private Property Impacts  
(Subject to changes during design development)

Two parcels will require acquisition due to realignment of Meadow Drive to the north. Three parcels require acquisition on Charleston Road; two are due to the roundabout near Mumford Place, one is at the northeast corner of the Park Blvd/Charleston Rd intersection on the west side of the tracks to accommodate the ped/bike path.

Various partial acquisitions, mostly narrow strips of fronting property, are also required through the project site to accommodate the transportation infrastructure of this alternative.

### 3. What are long-term maintenance costs Meadow-Charleston alternatives?

We have not developed costs for the long-term maintenance items, but we have identified the anticipated items. These can be found in Row M of the Evaluation Matrix. Items include pump stations for dewatering for all the alternatives, except the Viaduct. Lift stations/siphons for the creek diversions for the Trench and the Tunnel alternatives are also identified. Caltrain has provided some clarity on who would be responsible for maintenance costs related to the railroad. Caltrain will take on the maintenance responsibility of new infrastructure that will raise or lower the tracks by embankment, viaduct or bridge; however, the City should assume it is responsible for the cost to maintain a Trench or Tunnel alternative.

4. For the Meadow-Charleston Underpass, could a "box jacking system" method of construction be used to eliminate the shoofly?

The box jacking system in question was used on the Long Island Railroad (LIRR) in New York to install a roadway underpass structure. By use of hydraulic jacks, the underpass structure was pushed into place over a single weekend after removal of the tracks and excavation of the soil under the tracks, took place. A time lapse video of this process can be seen starting at 1:35: [https://www.youtube.com/watch?v=-H4\\_Inc9FAw&t=128s](https://www.youtube.com/watch?v=-H4_Inc9FAw&t=128s)

The advantage of this method of construction is that it avoids the construction of a shoofly track, which would potentially be less costly and reduce the traffic impacts along Alma Street. A preliminary evaluation of the LIRR project revealed many engineering challenges and potential obstacles to using this method. For example, pile foundations are typically used on rail bridges in California to resist lateral and vertical forces during a seismic event, but piles could not be used with this construction method. Groundwater at the project sites in Palo Alto will also need to be considered to determine the feasibility of this construction method. In summary, construction methods, such as the "box jacking system" will be evaluated more closely and discussed with Caltrain during the next phase of the project.

5. Is the Meadow-Charleston Underpass the only alternative that allows through traffic on Charleston and Meadow to cross both the train tracks and Alma without stopping?

Yes, Charleston Underpass allows through traffic to cross both the train tracks and Alma without stopping. This is one of the advantages of this alternative. However, note that a traffic signal is proposed in the Meadow Underpass at the "T" intersection with the off-ramp from southbound Alma Street, so Meadow Drive will not always be free-flow.

6. For the Meadow-Charleston Underpass, could the ramp from southbound Alma Street to Charleston Road be deleted?

The eastbound right turn to go southbound on Alma Street is used heavily by vehicular traffic. The 2030 forecast is 500 right turns during the PM peak hour. Removing this ramp at this intersection will cause the intersection to operate ineffectively.

7. For the Meadow-Charleston Underpass, what turning movements are allowed?

Each intersection has 12 turning movements allowed under existing conditions. At Charleston, all 12 would be retained although some would require traveling through the roundabout. At East Meadow 10 of the 12 would be retained although some would require a U-turn at Alma Village. The two movements that would not be possible would be from either direction on East Meadow to southbound Alma Street.

8. For the Meadow-Charleston Underpass, since some of the turning movements are not allowed is there an opportunity for cut-through traffic on the neighborhood streets?

On the west side of the railroad tracks, there would be some demand to use Wilkie Way although traffic could also use El Camino Real. Traffic could not use Park Boulevard because the connection to Charleston Road would allow only right turns. On the east side of the railroad tracks, there would be a demand to use the streets in the Fairmeadow neighborhood. The turn movements that would not be allowed each comprise about 80 vehicles during peak hours.

9. For the Meadow-Charleston Underpass, will motor traffic increase on Wilkie Way?

Yes, it is likely that traffic would increase on Wilkie Way because it provides a connection from East Meadow to Charleston.

10. For the Meadow-Charleston underpass, was there any additional traffic analysis performed to ensure that streets can handle such traffic due to additional movement around the roundabout or Alma Street?

Yes, the traffic study includes an analysis of the Meadow-Charleston underpass alternative. Yes, the streets, including the roundabout, would be able to accommodate the traffic.

11. For the Meadow-Charleston Underpass, can the sharp corners the cyclists have to navigate be modified?

Some rounding of the 90-degree turns can be made and this can be refined in the next phase of the project. However, large radii for even moderate bicycle speeds (> 10-15 mph) should not be expected due to right-of-way constraints. Please note that many ped/bike facilities, including the Homer Ave Undercrossing require bicyclists to slow down or walk their bikes at sharp (90-degree) corners with limited sight distance.

12. For the Meadow-Charleston Underpass, are the Plan and Section drawings missing some dimensions on vertical clearance? Is an 8-foot vertical clearance adequate?

The profile exhibits have been updated to show additional vertical clearance dimensions.

8 feet of vertical clearance is not ideal, but it does meet the minimum standard per the Caltrans Highway Design Manual. The project team aims to achieve at least 10 feet, where possible. The 8-foot vertical clearance is shown because the descent of the Meadow ped/bike profile cannot begin too far to the west. The elevation of the ped/bike path is governed by the road profile in front of private driveways just east of 2nd St, and the railroad elevation is fixed (it's same as existing in this alternative). That said, the design of this alternative could be refined in the next phase of the project. For example, a slightly raised rail profile could be a variation of this alternative, which would provide additional vertical clearance.

13. For the Meadow-Charleston Underpass, where do pedestrians and bicyclists walk and ride? Where do they connect to the existing bike/ped facilities?

For the Meadow Underpass, pedestrians and bicyclists must cross onto the south side of the street to traverse under Alma Street and the tracks. Crosswalks will be provided at Emerson St and 2<sup>nd</sup> St to allow for the “cross movement”. Users will connect to the existing facilities (sidewalks and Class II bike lanes) just east of Emerson and just west of 2<sup>nd</sup> St at either end of the project.

For the Charleston Underpass, pedestrians and bicyclists must cross onto the north side of the street to traverse under Alma Street and the tracks. Crosswalks will be provided on each side of the roundabout just west of Mumford Place to allow the “cross movement” at the east end of the project. A ped/bike bridge will be provided just west of the tracks to allow users to cross Charleston on the west end of the project. Users will connect to the existing facilities (sidewalks and Class II bike lanes) just east of Mumford Place and just west of Ruthelma Ave at either end of the project.

14. For the Meadow-Charleston Underpass, will there be signalized or controlled crossings on Meadow Drive at Emerson Street and Second Street to allow for pedestrians and bikes to cross?

The City will consider additional improvements in the subsequent phases of the project to determine the appropriate traffic control devices, such as signing, striping, bike/ped crossing signals, etc. at such intersections within the project. The design development phase will include the evaluation and the detailed design of such traffic control devices. The design will be performed in accordance with the California Manual of Uniform Traffic Control Devices to ensure that pedestrian and bicycle traffic movements can safely occur at these locations. These improvements will eventually become part of the overall construction of the project.

15. Is it possible to select the Hybrid Alternative for Meadow crossing and Underpass for Charleston?

The preliminary evaluation indicates that roadway improvements can be accommodated for the two alternatives at each grade separation location independently, however, it may require adjustment of railroad grade at both locations i.e. Meadow and Charleston

The hybrid alternative raises the tracks by 14 feet at Meadow. The distance required to transition the railroad grade from 14 feet to match existing grade in accordance with Caltrain requirements is greater than the distance between the two crossings. As a result, the railroad tracks may need to be elevated at both grade crossing locations. The project will require a longer shoofly than anticipated for the current underpass alternatives at Meadow and Charleston (no rail raise provided at either location). The grade separation at these locations will therefore require additional design work to elevate the railroad at one (or both) locations to accommodate such improvements.

16. Why is tunnel with Freight at-grade considered?

The premise for adding the Tunnel with At-Grade Freight alternative was based on public feedback that there would be cost savings if the Tunnel did not have to be designed to accommodate freight. While there were some cost savings related to the smaller tunnel

diameter, it was not a significant difference. Other design changes, such as reducing the grade and vertical clearance within the tunnel were explored, but ultimately Caltrain indicated that changes to their design criteria could not be assumed. Specifically, Caltrain indicated "any changes to Caltrain's standards must be considered in a way that is careful, deliberate and fully and fairly weighs both the benefits and consequences; and should be undertaken on a system-wide basis."

17. Will the tunnel alternatives reduce the number of lanes on Alma Street?

The tunnel animations cover the traffic diversions in detail and can be reviewed for visual aid.

Links for animations:

Passenger & freight - <https://vimeo.com/444677088/19783b2dae>

Freight at Grade - <https://vimeo.com/444676793/1484b197ec>

During construction of the Tunnel with Passenger and Freight alternative, Alma Street is reduced to one lane in each direction from south of Oregon Expressway to El Verano Avenue, and is reduced to just one single lane from Charleston Road to Ferne Avenue. All lanes are restored to existing conditions once construction is complete and the shoofly tracks are removed.

For the Tunnel with Freight on the surface (at-grade), Alma Street is permanently reduced to one lane in each direction from south of Oregon Expressway to El Verano Avenue and from Charleston Road to Ferne Avenue.

18. For the Meadow-Charleston Viaduct, what is the distance from the viaduct structure to the houses?

The permanent alignment for the tracks will be shifted about 45 feet to the east. The edge of the viaduct structure will be at least 75-80 feet to the homes on Roosevelt Circle, Lindero Drive and Starr King Circle, just east of Alma Street. On the west side of the tracks, the edge of the viaduct structure will be about the same distance to the nearest homes on Park Boulevard, no closer than about 70-75 feet to these homes.

19. For the Meadow-Charleston Viaduct, are bike lanes shown on Meadow Drive and Charleston Road?

Bike lanes are not shown on the renderings; however, the intent is to maintain the existing conditions which means that continuous bike lanes are planned along Meadow and Charleston for the Viaduct alternative. In addition, coordination with the City will be done during the next phase to ensure the striping configuration is consistent with the City's long-term Bike Plan.

20. Will the elevated railroad alignment alternatives, such as the Viaduct and Hybrid, result in more noise?

The Viaduct and Hybrid alternatives would raise the elevation of the rail line above the current ground elevation by 15 to 20 feet in some areas, and this could slightly decrease the noise reduction provided by the first row of buildings for subsequent rows. However, this would be

more than compensated for by the reduction in wheel/rail noise that will be provided by a 6-foot noise barrier mounted on the elevated structure near the train. The Hybrid alternative could also help reduce Alma Street road noise for homes to the west of the rail line by providing a physical barrier between the roadway and the homes.

The Noise and Vibration study, available at the Connecting Palo Alto website and the Virtual Town Hall, provides a comparison of the proposed alternatives in terms of potential noise and vibration benefits and impacts. The biggest reduction in existing noise would come from eliminating horn soundings in the vicinity of the grade crossings. Train operators are required to sound the horn at all grade crossings per the Federal Rail Administration's regulations, so with the grade separations and/or closures this requirement would be eliminated for all alternatives. This results in substantial noise reductions in areas near the existing grade crossings. Aside from the elimination of horn soundings, the alternatives differed by smaller amounts when considering secondary noise benefits between alternatives, such as changes in elevation of the railroad and the roadway geometrics. A more detailed analysis of noise and vibration will be conducted during the environmental and design phases of the project.



# **Expanded Community Advisory Panel (XCAP) Minutes (Verbatim)**

**February 5 2020, 4:00 PM**

Regular Meeting

Community Meeting Room

## **1. Welcome and Roll Call**

Chair Naik: Okay, we have a quorum, so we're going to move forward. Welcome to the XCAP meeting and I'll let Chantal call the roll.

Ms. Cotton Gaines: Alright.

Present: Gregory Brail, Phil Burton, Megan Kanne, Larry Klein, Patricia Lau, Nadia Naik, Keith Reckdahl, Cari Templeton (late), David Shen (late), Inyoung Cho (late)

Absent: Tony Carrasco, (excused), Adina Levin (excused)

Ms. Cotton Gaines: You have a quorum present.

## **2. Oral Communications**

Chair Naik: Thank you. We'll have oral communications first, and is there anyone who wants to speak on an item that is not on today's agenda? Okay, seeing none, we'll move to the next item.

XCAP Member Burton: Greg now has the handouts that I picked up at the Caltrain meeting a week and a half ago. Just please pass them around and return that when you're finished. Thank you.

Pat Burt: For the record, Pat Burt, good evening. So, I will add a little bit of update on the funding aspect, but what I actually want to do, to address was, on the next Town Hall meeting, there, it sounded like there is no intention to include anything about the new alternatives in that meeting, and I appreciate that AECOM is not going to have been able to flush these out and do their thorough analysis and have that presentation for that meeting. But I also think that the public is aware of those, is interested in them, and is going to come into that meeting expecting to learn something about them, and if they hear nothing about them at that meeting, they're likely to be disappointed and frustrated. And we don't want that. And so what I would encourage is figuring out some high-level presentation about those alternatives, perhaps including what are the considerations that are still needing to be evaluated by AECOM without providing the conclusions to those evaluations, so they understand where they are in the process, they understand them conceptually and they understand that there are a lot of questions that remain, so they don't leap to conclusions. Make sure they get enough that they won't walk away highly frustrated with that meeting. Because that's the new information in this timing from

a lot of the public's perspective. Second, on the funding, the Council in their most recent taking up of this, of the business tax, tentatively narrowed it down to looking at a high-end of the range of revenue about \$10 million a year, which if all of that went to grade separations, would be bondable to maybe a maximum of \$150 million. And so, what they're now considering is not what our citizen's group had been hoping they would consider, that would have had a much more substantial potential benefit on it. As Philip mentioned, once there are design selections, then the City can begin the process of pursuing other regional, state, even federal funds. As of right now, those funds are more limited, but at the state and the regional level, they are emerging, and I would expect that in the next year or two, there are likely to be more funding sources starting to emerge for these things. Thanks.

XCAP Member Klein: Thank you.

XCAP Member Brail: To the point of the public meeting, I understand that is staff's meeting. This is not an XCAP, running this public meeting, so I would encourage the staff to put in something about the two new alternatives, so that people aren't confused, but I don't think as XCAP there's a whole lot that we can do about it.

XCAP Member Burton: Well, Greg, you're right. But at the same time, it's a great opportunity to get to engage the people. Personally, I find it, I'll just say this, I found the Midtown Residents Association extremely frustrating in its pacifism and lack of interest and unwillingness to engage on any level beyond letting me write an email to that group, and who knows. I view this as very valuable (crosstalk).

XCAP Member Brail: The meetings are great. I'm just saying we as XCAP can't fix the thing that was addressed.

XCAP Member Burton: Agreed.

XCAP Member Klein: Go ahead.

Penny Ellison: I just wanted to say that I completely agree with what Pat Burt said and also encouragement from Greg that if you don't include something about it, I think it's going to undermine people's confidence in the City's process. And, you know, it's not XCAPs meeting, I understand. But it's going to fall on the City if it isn't in there in some way or another. And also, I'm sort of wondering how you're going to deliberate intelligently on the schedule that I thought I understood is in place without having the details of the engineering assessment of the two alternatives.

XCAP Member Klein: The answer in short, I think, it will become a two-step process.

Ms. Cotton Gaines: Thank you for the feedback related to the meeting. We definitely will put a little bit more in there than we were mentioning now. So, noted on the feedback.

### **3. Presentation and Discussion with Norm Matteoni, Managing Partner at Matteoni, O'Laughlin & Hectman.**

Chair Naiks: So, we have with us Norm Matteoni, who is the Managing Partner of Matteoni, O'Laughlin & Hectman and he is here to speak to us today about property impacts and the law that surrounds that. Thank you so much for coming today. Before I open the floor up to you, I'm going to let our City Attorney, Molly Stump say something and then I'll say a couple more words.

City Attorney Molly Stump: Sure, thank you. Thank you XCAPers and hello. When I heard Norm was going to come and speak to you about property impacts I wanted to be sure to be here and get a chance to listen and just wanted to say briefly upfront a little bit about various roles, and Norm may want to weigh in on this as well. I think what you would describe this type of a session as a kind of a primer to describe this area of the law which is fairly complex, and I look forward to a very preeminent local practitioner doing that for all of you. That said, there are areas in this area of the law where there can be differences of perspective and sometimes folks like Norm and folks like city attorneys like me end up on opposite sides, arguing various perspectives and ultimately courts can decide those questions. I am sure you'll point those areas out. So, I'm here to listen but ultimately, will give this type of advice and description to our City Council when we're going down the road and maybe facing some of these issues, maybe, hopefully not, but if we do in practice, then we will be working in that way. So, just wanted to make sure that I introduced myself and explained why I'm here and I look forward to listening to the conversation today, thank you.

Chair Naik: Thank you Molly and I just wanted to remind the XCAPers, so Norm is here so that as we have to do our deliberations and think about the alternatives and make the recommendations to Council, to the extent that there could potentially be property impacts, I say potentially because we don't know yet what there could be, that we would have as members of this group, a better understanding of what, in making a recommendation to Council, what we could, what would be the potential impact of what we're saying. Again, potential, potential could, if there could possibly be an impact. So, I just really want to stress that, but that is the point of having today's conversation. It's really to educate everybody on what it means and what it doesn't mean. So, with that I will let you take the floor.

Norm Matteoni: Thank you Nadia, thank you Molly. Let me just introduce myself standing, and then I'll sit down and blend in more. I've been a lawyer practicing Eminent Domain for a number of years. I started with the County of Santa Clara and did projects such as Oregon Expressway. A lot of the expressway projects I worked on, but in particular Oregon Expressway affecting Palo Alto and the ramps that I still don't think work right, getting off of Page Mill, but I was involved in, not the design, but the taking of property for those acquisitions. I have worked for school districts over the years. I worked for the County for ten years and probably seven of those were devoted to, no six of them were devoted to Eminent Domain actions, be it for the expressway projects, schools or flood control projects. All of those could touch on residential properties. Of course, it will also affect, depending on where the project is located, commercial, farm property, industrial properties.

So, it cuts across the board. So, I just wanted you to know that background and then after leaving the County, well for a few years in the County I did land use and advising the Planning Commission and Board of Supervisors, and that was a time when the Environmental Quality Act came into existence and I had an opportunity to assist the County of Santa Clara in preparing its own guidelines and implementation of the California Environmental Quality Act as it applied to projects, and I just mention the land use aspect of my practice for one purpose. One of the elements, and we'll discuss it later, in Eminent Domain is the highest and best use of the land. Land is not always to its current highest and best use. I suspect in the cases that may come up for these projects, that's not going to be an argument. Properties that are residential, they are going to stay residential, but I just let you know that. And then after leaving the County I did work in terms of representing the County of San Diego in an acquisition of 600 some odd acres for a new County jail by the border in Southern California with Mexico. I've done work, as I said, for school districts. But primarily I have represented property owners, so that's my perspective in terms of the impacts of a particular project on property owners. I have done that since the mid-70s, representing property owners. I also am the author of a treatise for California lawyers put out by what's called the continuing education. The Bar in its condemnation practice in California. I'm the principal author, there are other authors that contribute, particularly the tax chapter, which is not something I'm really up on, but I know enough to answer some of the questions that have been previewed to me. If those are of issue, we can talk about those. So, I've done that writing for a number of years and have appeared before the California Supreme Court on Eminent Domain issues, and the Appellate Court. So, with that, as I am about to make my move to sit down, I just want you to know how powerful the power of Eminent Domain is. It's the right of the Sovereign. The Sovereign here is the State of California and all of its political subdivisions. It is an absolute right and only in the Constitution is there a limitation, there's two. It has to be for a public use. There's no question that roadway improvements, transportation improvements, transit lines are a public use. And, succeeding on that front, the Government can go forward with what it defines as the project and take the properties necessary to implement that project, subject to paying just compensation, and the term just compensation has many manifestations that we'll discuss as we go through. So, I'm happy if you want to interrupt me at some point. If you think I'm getting off course, that it's not something that relates to what you want to know. You just tell me, and I'll back up and take a new lane. Yes.

XCAP Member Burton: Just a brief question. I had the impression that the railroad companies had or still have the Right of Eminent Domain under some circumstances, and possibly other quasi-utility type businesses. Am I right, am I wrong?

Mr. Matteoni: You're right. Actually, the early Eminent Domain law, and I should mention because that was one of the questions that had been previewed to me, you know, is there a body of Eminent Law? There is statutory law, legislation that dates back to 1872, and then the Eminent Domain Code was substantially revised and expanded in 1975, a 100-year span. So, a lot of things had happened, but the early law of 1872 was primarily based on what the railroads told the legislature they needed in California.

XCAP Member Burton: This is California Law?

Mr. Matteoni: Right, California, and so railroads. There are limitations on that, and backing off of it, but in the 1800s, not mid but 1870s and thereafter railroads were the dominant force that shaped Eminent Domain Law. And they had a lot of things in their favor. Utilities, obviously everybody has read about PG&E, whether it's gas lines or the problems with the electrification lines that have caused fires, they have the power of Eminent Domain. They historically they have been a very difficult agency to deal with. The law probably perked along in the early 1900s. Still serving railroads and urbanization of this State, but in the 1950s into the 60s there was a huge boom in Eminent Domain actions for the California Freeway System, for the aqueduct, and thus, one of the bodies of law that you look at in Eminent Domain is case law, cases that have gone up on appeal, to the Appellate Courts of the State or to the California Supreme Court or beyond. There was just such a volume of acquisitions that a number of them resulted, a substantial number resulted in litigation and a percentage of those went up on appeal. And, really, the Law of Eminent Domain notwithstanding, I told you, in 1975 the Eminent Domain Code was revised. The primary body of law is through individual cases and thus, the book that I contribute to is two volumes discussing the cases and what may have changed or modification of the law because of some new angle that somebody argued that the Court went along with or didn't go along with. But to go back to the Code, the Code is basically the procedure. If the City is going to file a condemnation action, that's the book, the code books that have all these sections and tell the City how it's to initiate a condemnation action, and how it is to pursue it through to trial. The evidence aspect in trial is primarily dictated by case law. So, to try to fulfill the primer aspect of what I can tell you, let me just tell you the procedure that any public agency would have to follow in taking private property for a public project. The procedure starts in the kind of things that you're doing right now in defining a project. Is it needed? What are we trying to accomplish? Where can it best be located to fulfill that public need. Years ago, school districts had a great deal of flexibility within an individual district of where they might locate an elementary school that required about ten acres, because a lot of the land was still in orchards around the subdivisions, but as the subdivisions took those orchards out, it became much more limited where school districts could locate, but they would do a study and determine, this is the best location. It's centrally located. Perhaps they knew the family that owned the farm or the orchard. We won't have to file Eminent Domain, I'm sure we can work it out with them and buy ten acres. They're very community minded. That was an approach that worked for small towns that all of us were at one time, here in the Valley. But things have become much more complicated and the complications, I guess, I can best describe, be it a rail line or a highway is, there isn't that flexibility of getting from point A to point B, and here, back here on the old rail line that Caltrain manages and runs, it's already on the ground, fixed, and we're now looking to another advancement of transportation that would utilize that corridor. So, the engineering has to be done, it has to be studied and since the 70s, it has to undergo an Environmental Review. The party that's going to condemn, be it the City of Palo Alto, Caltrain, Caltrans, whatever agency has to have all of that done beforehand. It is presented to the body, and it's probably presented to the governing body in terms of some alternatives. Again, not much in the way of alternatives for a transportation line, but it, nonetheless, must

be presented and from the aspect of Eminent Domain, that this is a project we want to pursue. The Environmental Impact Report has been analyzed and all mitigations that can be thought of are laid out, whether there needs to be overriding considerations to further it are determined and the properties are identified that are going to be affected. That document itself may provide some information to the property owner whose property is going to be affected. So, when VTA brought the BART line down from Hayward and Fremont, the extension into Milpitas and the Berryessa station, they did, for example, analysis of sound impacts and grade, if they're going below grade at certain intersections, what's around that and there were a lot of apartment houses affected, some homes. Mitigation measures were going to have walls on either side of the corridor. We're going to do some baffling coming out of the tunnels getting back to grade. Those aspects were analyzed, as well as vibrations, which is another big thing in terms of a rail line, and presented in the EIR. Some of those points of information which were more general than a property owner would want three later when the individual's property is taken, well, you didn't look at it from this aspect. You measured the sound over here and projected onto computer modeling or what have you. That's not the impact that I'm going to suffer. None the less, that is a strong starting point to assess those kinds of impacts. So, the government, through the process of environmental review has delivered some information, both to the decision maker and the community affected that weighs on whether there are damages for compensation, because there are going to be residents now that are going to have this extra noise impact and nuisance. The other aspect, and I'm still trying to blend in some of the practical issues of impacts on residents as I tell you the procedure, but I want to stay with the procedure. When a project is decided we're going to go forward. We have the funding for the project. Then the right-of-way people, the acquisition people are called in to obtain appraisals of the lands that will be affected. It's at that time that any affected property owner will be very specifically notified. You're involved, you're going to be following this project, so I don't have any fear of your notification of what's going to happen at various stages, but many property owners aren't up to that speed, and they get a letter from an appraiser adviser, I've been retained by agency X to appraise your property because of the prospect of taking a portion of it for whatever the project is. And you have the right, the law gives the property owner to meet with that appraiser and explain the property and understand what the appraiser can tell the property owner about the project. Is it a total take, it's a partial take, whatever? When I say parcel take, if that's the whole parcel, you may have a situation where only a corner is clipped off, or you're left with just a corner, depending on, you know, how your property is in relation to the project boundaries. Those have, those lines have very significant impact in appraising the property, because it's not just to put a value on the total piece of property. That's a necessary first step, and if it's a purchase of the total piece of property, that's an easier appraisal, or it should be an easier appraisal. But when you start reshaping the property, removing part of somebody's front yard or rear yard or clipping off a room of a house, things change dramatically. The other aspect of Eminent Domain is not just compensation for the land taken, but damage to the remaining land. So, that's a very important meeting and the law directs the public agency to have its appraiser reach out and have this meeting with the property owner. The next step would be for the appraiser to complete the appraisal and it is submitted to the agency for review. The agency gets the first look at it and there are people within

the agency that are also schooled in appraisal so they know what they're looking at. Wait a minute, you missed something, or we don't understand this or how you pulled this piece of information into your appraisal. So, it may be dialogued, depending on how well it's done, before it's released. But the way it's released is also mandated by law. It is released by the agency contacting the property owner, saying that it has an appraisal for the acquisition and it intends to make an offer based on that appraisal. From the agency's standpoint, it's not to spend more than fair market value. So, it has made that determination through this initial step of what it believes, on the basis of an independent appraiser to be the fair market value. And I want to inject a word of caution. Notwithstanding the property owner explaining on a partial take, well, wait a minute did you consider this? That's going to be very detrimental. You removed this whole portion of my backyard. The fence is right up against the pool or the patio. You really, how would I put it? It's just a harder look once the appraisal, that initial appraisal has been made and the property owner receives that, and that is often an area of a great dispute. Severance damage it's called, the damage to the remaining property, much more so than the value of the land or the improvement. I'll explain later on how the appraiser approaches valuing those types of improvements and the land. So, we're back to procedure. The property owner now receives an offer and it contains a summary of the appraisal that was made for that particular property. And the requires and the agency provides notice that the property owner may seek its own independent appraisal and the agency will pay up to \$5,000 towards the cost of that appraisal as a part of attempting to negotiate to a price. So, what the agency is basically asking for, what did we miss in our appraisal? You disagree with this. Show us some reason to revise, because all we pay is just compensation. We're not going to make a gift of taxpayer funds, and we believe we've met that standard. So, the property owner does get the appraisal and usually at about the same time an attorney, and oftentimes the attorney must even assist the property owner in seeking an appraiser. From the standpoint of my job at that point, I'm looking for an appraiser that is not just an appraiser you can find online or in the phone book, but an appraiser who has experience in trial. Particularly if the dollars you're talking about are large, there's room for a great deal of dispute and how well is that appraiser going to be able to translate its investigation to testimony. So, the lawyer begins to work with the property owner at that juncture, may work out a settlement, fine. But let's assume the settlement doesn't occur. It's back in the hands of the agency. It's got a project it needs to pursue. It can only pursue it through Eminent Domain if there is an unwilling seller. Eminent Domain makes the unwilling seller have to sell. The agency is required, again by law, to notice a hearing before be it the City Council, the Caltrans Transportation Committee, the joint Powers Board for Caltrain. Whomever it is that is pursuing the condemnation. It gives the property owner notice of that hearing and the right to object. The right to object has nothing to do with the value. It's whether this is a valid public project which I would tell you 99.9 percent of any such objections would not succeed with the body of law. The definitions of what fits, what types of projects fit public is very well established. But, could be some procedural misstep in terms of the environmental analysis or just the, particularly in smaller towns. At one time I was on the City Council in the City of Saratoga. The City of Saratoga just detested filing Eminent Domain actions. It felt it was a small town and it wanted to work things out. So, if it noticed a hearing to pursue Eminent Domain, the property owner

would come in and object and the City might back off and say, take another effort at negotiating this out. So, there is another aspect in terms of just the politic of a hearing, and I'll give you another example on the VTA extending the line from Fremont/Hayward into Santa Clara County for BART. Periodically they need some electrification stations and somebody came in that I thought was fairly well connected. It wasn't my client but a high-tech firm on what would happen, the interference with that electrification facility to keep the line active at the right whatever, would have a big damage and isn't there another alternative that you can move it? Both on the basis of the argument that you're going expose BART and VTA to large damages, and that it was a company of repute and somebody that the Board decided they wanted to protect, they moved. They moved that, they didn't move the line, but they moved the auxillary facility that served that line. So, those are types of arguments that can be made to the decision makers. The other is, and this used to be fairly frequent with school sites, that there are other alternatives that more reasonably suit your purpose. That's still a very hard argument to make because the governing, not the governing body, but the public agency has gone through all these studies and engineered this project in a specific way, and now somebody is standing up and telling them, you can do it a better way that avoids my property, or minimizes the impact on my property. It's possible, it doesn't usually happen, but in this County and Palo Alto there are some very bright people with engineering background that can make good arguments. At least you hear them in terms of impacts on new development. We don't want that development in our community. So, I'm just trying to give you some examples of how objections can be made, but ultimately, again, you can't say you're not getting enough for the property. You can kind of sneak that in, that you didn't look at this impact, like I told you the electrification booster station did to a high-tech company and its operation, and you'll cause substantial damages that will make a public body rethink some aspect of the project. Aspects that I've seen rethought, Caltrans on a design in Emeryville of an off ramp coming into Emeryville was able to change the curvature a bit so it didn't impact, I don't know if it was a Walmart or whatever, a big-box operation that had truck deliveries off of the local street they were tying into. Caltrans has a very good process that I'm not aware most agencies use, but if somebody makes an objection before it goes to that hearing body, the legislative body, it is referred to the engineers. If there is some modification that can be made and that's to the district engineers, which are located for us in Oakland, and if you're not satisfied with that, it goes up on review to Sacramento before the Transportation Commission hears the presentation by its staff and the objecting party on whether to take the property. But having gotten through all those steps you're probably going to find a resolution that authorizes condemnation and shortly thereafter, a couple of weeks, a month, a lawsuit is filed and served on the property owner. Maybe I should stop there. That gets us to the point of heaviest impact on the property owner and the next step is, what is the property owner to do to defend itself. So, I don't know if there are questions to that?

Chair Naik: I have one questions, and if the XCAPers want to jump in, and then we can move along. Are you familiar with whether or not Caltrain actually has to seek an EIR to do grade separations? Because my understand is that because it's a train, unlike a road, they can't turn so they only, if they have to do one, they can only do it in one spot because it can't really move. I thought Caltrain has always chosen to



do them, but actually that there is an exemption in CEQA and I'm wondering if you're familiar with that at all?

Mr. Matteoni: Well, the exemption would be that there are no alternatives. I can't quite think of the wording. Molly can help us out on CEQA exemptions, perhaps. But I would still think it has to do that because the grade separation is not going to just affect whatever the width of the right-of-way for the rail is. To do that, you've got the street going down, coming up, walls against what were properties to hold back the cut, probably tiebacks into the properties. I remember one in Fremont probably five or six years ago, they weren't residents but I can't quite remember the name of the street, but that had to happen and the street was at grade and it had the arm that came down to protect the people when the trains went by, but now everything is changing and it's going to be much more frequent, so we're going to separate that so the traffic can flow on the local streets while the BART train goes by. There was a business that I represented that had access problems because of how far the grade come back on the local street and intercepted and changed their driveway, and there were tiebacks that came into their property so underneath their property, which parking area, but there was concern does that affect our future development? You have these tiebacks and we can't excavate or we can't change that. So, all that was analyzed in an environmental review. And, thus, I think the answer would be they couldn't avoid it.

XCAP Member Burton: Is it sometime simpler just to do a whole property take to avoid the severance damages issue?

Mr. Matteoni: Yes, sure. If you're going to take all of that and leave me that, you're better off, as a public agency in most cases I can imagine, to acquire the total property. And the law, the Eminent Domain Code specifically authorizes that. To avoid excessive damages, the agency is authorized to take the total property beyond what it owns. So, you'll find, again with an agency such as Caltrans, if you cared to look that there's many remnants for a particular stretch of highway, little triangular pieces, they try to get rid of them and ultimately some adjoining property owner might take that and consolidate it with their holdings, but yes.

Inyoung Cho: When the appraiser, like whether you're an appraiser or city, the agency appraiser appraises your property, what point... You know, the property value changes over a certain period of time, so when would be that time. You know, is it, if they decide to give me money today and you know, construction moves on, like three years later my house could double. Like, I mean, when is the time that...

Mr. Matteoni: Okay. I understand the questions. There are different points that would provide different answers. But I'll start with how the public agency taking your property protects its date of, what's called the date of value. When the lawsuit is filed, if the agency deposits the amount of its appraisal, telling the court that in its judgement this is the probable amount of just compensation, the agency is entitled within 90 days to an order of possession. It may not get that possession, but the key point to your question is, that date of deposit, which usually goes to Sacramento into what's call the State Deposit Fund, sticks as the date of value. Most every agency makes that deposit a few days before or after or on the date they file the lawsuit. You may not get to trial, if you're contesting that, you may not

get to trial in Santa Clara County for 18 to 20 months. Just the way cases are stacked up that have nothing to do with Eminent Domain, but the flow of cases in this County. So, 20 months from now you are arguing on what is the value on February 5, 2020. But there are many variations to what I just told you. I'm going to backup to when you were approached. I'll assume you were approached by the appraiser who came and visited you, and that was seven months ago from February 5, and the agency didn't update that appraisal. It may think, well, the values have just barely risen or they are about the same. That gives rise to lots of arguments, which most often work in the property owner's favor if you can find new sales. Well, your appraisal is dated. I did have a Caltrain condemnation for one of these electrification booster stations that took out almost two acres of property a couple of years ago, and the appraisal was 18 months before they filed the lawsuit. We ultimately settled that case along the lines that I was trying to give you an example of, that we had to produce other sales. The market had changed and so Caltrain, actually it was JPA for Caltrain, went back to their appraiser and their appraiser said, yeah, I have to make an adjustment. Let me look at it and so forth. So, it provided a way to negotiate a settlement, but the settlement was probably 18 months after the lawsuit was filed. Now, another aspect of what I told you in terms of that deposit, you can take that money and still fight for more compensation. You're not prejudiced by having withdrawn the money.

(off mic)

Mr. Matteoni: And you probably want to take it, because the interest rate from the deposit fund is pretty low. It's posted and changes every quarter, but you're entitled, if they take position, they don't always take position, but most of them do within 90 days. If they take position, you're entitled to interest from February 5 until you get your money. If you withdraw it, whatever amount you withdraw, you're not going to get any more interest on, but if you get an increase you would still get on the delta, interest on that money that you eventually derive as the just compensation for your property. Does that answer your question? Okay. Yes.

XCAP Member Burton: If someone has to move there are probably a lot of costs beyond just finding another property. My out-of-pocket might include all kinds of expenses for rentals, moving companies and whatnot. Are those covered by the compensation award?

Mr. Matteoni: No. They're covered under what's called relocation assistance, and it probably works best for homeowners. It came about in and about 1970 from federal legislation, and then the feds, if they were making grants to transportation projects in California, mandated that the local agencies apply those rules and then within a couple of years, California adopted its own relocation assistance. Relocation assistance would be, again, they're taking your home, but before they file a condemnation action, they are supposed to offer you alternatives of where you can move. Very difficult in this area. I don't think most relocation service agencies do a good job on that. They do a particularly bad job on little businesses trying to find them a spot to go. But there must be, at the same time as that environmental review is going on, there must be a relocation plan that's put together. So, that's put together a few years before and, again, I'll give you the experience I know from

the BART extension, now into San Jose, the prospective properties affected a relocation specialist comes and interviews them. But that took place two years ago. There has been no condemnation coming into San Jose for BART yet. Maybe there will be later this year or next year for reasons that we don't have to discuss, but just project delay. And by the time that happens, you might have sold your business to somebody else, different things happen. Or, once it becomes real, you think of a lot more impacts on your business and the difficulty of moving may become much more complicated. In the Caltrain example that I gave you regarding this property just under two acres, it was used for Apple bus service for its employees. It used to be a large lumber yard, but it was a big maintenance building in the middle and big yard. You could park buses and repair them. It was next to, I don't know if you know where Bellarmine Prep is, but 880 at the crossroads that made very good sense for Apple and its employees going out to getting them, transporting them to wherever they transport them. The redevelopment, not redevelopment, the relocation people provided maybe, here's five places you can move. Well, the City of San Jose, they needed to stay in close proximity or the cost of fuel goes up the longer the runs. The deadhead time goes up the longer the runs. There's more wear and tear on the buses. They were at a strategic location. Everything is starting to move them out, and they're very near downtown San Jose, five miles, three miles. The City won't allow outdoor storage of vehicles in this zone. If you want to pursue that property, you're going to have to get it rezoned. So, these problems along the lines that you're mentioning start to multiply when you get to a specific property and moving. So, back to residents, I'm not quite sure when you said rental, if you're renting the residence, they are to give assistance to move the occupant of the property. You would not receive that assistance as the landlord. It would go to that party. They also pay moving expenses. You're required to get two bids, submit them for review and they will pay the lower bid. Where are you moving? Some people are not in a position to relocate. They will do some temporary relocation. There are restrictions that, okay, I've got to put this in storage for a year. I'm not in a position because of health issues with my spouse to find another location and move. We're going to move in with my daughter, but all the furniture has to be stored somewhere. Well, they may store it for you for two years and pay for that, and then that's it. So, there's another whole level of issues in pursuing relocation assistance that's beyond the just compensation. The just compensation I'm talking about and we'll get to as we go down the line towards trial focuses on this piece of property and what's on it, and not moving things.

XCAP Member Brail: Everything you said has been about obtaining pieces of property, but in the case of the BART you mentioned apartment buildings that were the tunnel entrance so there would be an increase in noise and vibration. Where does that whole fit into this whole thing? Because it seems like what we talked about before, the Eminent Domain you know, seizure of land is sort of the last step in the process and there's a whole lot of other impacts on properties that these projects could have, and I'm wondering where that fits in and what your experience has been there.

Chair Naik: Norm if you could just move closer to the mic so the audio guy can, because the meeting is being recorded. Thanks.

Mr. Matteoni: Okay. Sorry. I'm starting to try and relax here. As I paused to put it into perspective, there are those impacts that you've identified to adjacent properties that are not within the scope of the right-of-way, and the law up to, by case law, up to 1980 was, sorry, you know. We didn't take your property. It's more noisy. But their property owners, and there was a case, to just use again examples, if these examples aren't helpful to you, tell me. But I think back to cases to try to illustrate and answer to the question. So, there was a property known as Pierpont Inn in Southern California that was along the coast. The highway was coming along side of it, I think it's in the Santa Barbara area. In any event, there was going to be construction for two plus years, major construction of the highway and the hotel said, hey, all our rooms on the east side of the hotel are going to be affected. We're not going to get the rental charge that we would usually get or they may be vacant. People aren't going to come here to hear all that noise. That case went to the California Supreme Court. Actually, I said in the 80s and that was 1972, and they prevailed in terms of, they had unreasonable damages by reason of the construction. There was a company when I was in college, Jennings Radio was sold to IT&T, and when highway 80 came through, this property in San Jose off of Mclaughlin Avenue, they were an early high-tech company that did these sophisticated radio tubes. I was just a flunky working there, so I can't explain high-tech stuff. And their claim was the dust, not the noise, but whatever traveling on the roadway that was elevated above their, or at the same level as their rooftop was going to create dust and they were going to have to increase their air conditioning system, purifying, because they can't have that in the manufacturing section of their operation. So, that was another example, and that's a reported case of someone getting compensation for being adjacent. Nonetheless, those are cases that usually would require you to bring a lawsuit against the public agency. They do not tend to acknowledge those peripheral impacts. They do nowadays, because of these cases, on sound walls, that became an established approach to mitigate those kinds of damages. Nonetheless, I know when highway 85 went through Saratoga, the roadway had, it was striated or something. It created (crosstalk), and it was below grade and has sound walls, but the residents of a particular area said, we never had the rumble before, and we did not succeed in that case. I represented them, but it's gradually gone away or people have gotten used to it as the serration has decreased on the roadway. But it was a whole neighborhood that was concerned about it because the homeowner's association was reacting to the people most impacted right near the highway. So, yes, I guess the short answer is, there's compensation, but you have to pursue it in most cases.

XCAP Member Kanne: What if relatedly, what if we're changing public land, like loss of a parking space for example, or public benefit that a property owner might have expected that they no longer have access to? Is there any compensation for that sort of loss?

Mr. Matteoni: Well, if I understand the question, I'll take you to the reroute of the El Camino around the University of Santa Clara a number of years ago. Santa Clara pushed and the City endorsed that taking this section of the Alameda out of the middle of the University, the University began moving eastward. There was an old road called Campbell Avenue that had a lot of industry right up against the railroad tracks. There's a walnut plant there. There was very little traffic on that road. The

walnut plant employees all parked on the edge of the road next to the spur track that served the walnut packing company and a piece of the property was taken for the reroute of the Alameda and we're not going to have parking anymore. There was no compensation for the loss of parking because any municipality can, for traffic control, can take away parking or control parking. You can only park here at given times, posted hours. So, if that was your question, if you're losing parking on a public street, no not today. The law doesn't recognize compensation that.

XCAP Member Kanne: Thanks. I had a follow-up question to Greg's too. As you mentioned apartment complexes, if there are tenants on any given property, does that result in any special legal rights? I know there have been expansions in renters' rights recently. So, is there any special process for handling properties that have tenants that, perhaps, if the property were taken, would need to be evicted?

Mr. Matteoni: There are none that I know of beyond what I was telling you regarding relocation, and that's where relocation works the best, with tenants, residents in apartments. There, I don't know if Palo Alto has any, but there were old transient hotels in downtown San Jose years ago, probably still a few. But when that redevelopment was doing its thing to clear land, they would go and move somebody out to another location and then rent that unit from the owner, because they had so many people they had to move, and they couldn't take position of the whole piece of property until they got everybody out, they would rent it to keep it vacant, so the property owner didn't lose anything for that period of time. So, there are variations on how a public agency can approach taking care of tenants or the owner who suffers the loss of a tenant for a time.

XCAP Member Reckdahl: How do you value something like, if you have tiebacks going through your backyard. It may or may not affect the homeowner. How does the homeowner value that, or how does the court value that?

Mr. Matteoni: There's no fixed answer. It's the judgement of the appraiser, you know, what is the depth of the tieback, is it reasonable in that neighborhood that somebody would put in a pool and there would be interference. Otherwise, it's going to be something of a nominal compensation because there is an invasion of the property. But there may be, you know, what's the maintenance of those. Do they erode over a period of time and then the agency has to come back and invade the property and disrupt? So, the property owner would look for as many things as they could find that would change its total control of its property, the side yard, backyard to advise the appraiser and the appraiser is going to have to make a judgement. Again, another case was a utility line was put in the parking strip next to the sidewalk. I think this was a case out of Salinas, and that wasn't much of an impact, but the property owner said, but you have the right to come back and expand that utility, and the city said, but that's all we've done. No, your resolution says you have these rights on my property. I don't know when you're going to do that, 20 years from now, 15 years from now? And the court said, yes you have to compensate for the full scope of the impact of what you may do, not just what you did. But, again, I don't have a fixed answer for you.

XCAP Member Lau: I have a question about the right to object, and alternatives that reasonably meets the interest, and in terms of residents who may not be

articulate or knowledgeable about the law, I'm wondering if there's legal advice for those people who may not be, let's say, as I said, knowledgeable about procedures about how to pursue a lawsuit, or at least even ask questions about what their rights are?

Mr. Matteoni: Again, publications today do a good job in addressing that issue, but it probably works best for English-speaking people, although they can be translated, but you will get with that first offer, a pamphlet of the process. Not as I'm jumbling it in all different directions. But step-by-step and what your rights are, so it's an informational packet that is delivered to the property owner. That, you know, that works well for people that are sophisticated and understand these things. At least, way back when, and still happens that a lot of public projects that have alternatives are located where the property is less valuable and there are people that live there that do not have high income or higher education. There were environmental justice suits in Los Angeles to stop projects for that reason of going through a low-income neighborhood and the displacement of those people. But there is a process and I would say in this County it works pretty well.

XCAP Member Shen: Just so I'm clear, so, if there is like a sound or visual impact, and the example I'm thinking of is, one of the options we've been tossing around is the building of a viaduct potentially and some properties have the backyard right up against the tracks right now and consequently there would be a huge structure behind there, would that be a case where the property owner would still have to do that kind of lawsuit after the fact and on their own? But I could also see potentially it could be where any appraiser could say, oh, I have examples housing values and what happened when something got built so close that there is a drop in the value or a change in the value because of it.

Mr. Matteoni: Was the predicate to your question that a portion of the property was acquired?

XCAP Member Shen: No, there's nothing, it would be like daylight plane or just there's a big visual thing and potentially that could affect my livelihood as I live there or if I sold it, that would affect the value of the sold property versus not having that thing behind there.

Unidentified female: No encroachment on the property? So, in other words, right up against the fence line, two feet actually from the fence line, but no actual encroachment.

Mr. Matteoni: Well, that might be difficult to accomplish, at least for the construction of it. They may need temporary access of the property. So, I don't know if I previously mentioned this or not, but I represented a Police Officer on the Palo Alto Police Department who lives in Sunnyvale, and there was a wall placed on his property, but a piece of the property was taken, so, in that situation you ask for that as damages in the lawsuit that is filed, and if you don't it's forever gone. You know, geez, I didn't realize what an impact or how big the wall is. But your situation would be along the lines of what we were talking about a few minutes ago. You would have to initiate that and, yes, there are damages for that. I have not had a case where there was no taking, but I had a case in Saratoga for a condominium

project and, this was highway 85, and the roadway comes to grade next to the condominium. The wall is 14 and 18 feet high. These people, there were eight units, I think, eight or nine units, had a view of the foothills, Santa Cruz Mountains looking towards what's called the Saratoga Gap and that was gone. The appraiser came up with some diminution in value to each of those condominiums units that no longer had that view. They're looking at a concrete block wall.

XCAP Member Shen: So, in that case that you were describing, that would not require the property owner to kind of state that. It was more automatically built into...

Mr. Matteoni: Only if there was land acquired. There was long acquired from the condominium property owners, the common area I should say, and we folded in, we represented the condominium for the taking of the common land, and then the Board was saying, but there's individual owners that feel they're impacted if this is going to be this high. And so, they were folded into the lawsuit, but we probably did initiate those lawsuits. I can't remember, that was 20 years ago, on their behalf and consolidated then with the suit with the homeowners.

Chair Naik: Norm, is it fair to say that in general, there is a deference to the agency? So, in other words, it certainly from what you described, there seems to be a deference to, you could try to make the case, like they could have picked a different spot for different alternatives, but generally transportation agencies have gone through a very rigorous process to even get to that point, so there is not a lot of – usually deference is given?. Also, when it comes to any potential damages, it certainly would take any resident whose property was not acquired to try to sue for damages, but that generally it is kind of a difficult thing, because there isn't any other place that could have gone, or is it that they could still get damages?

Mr. Matteoni: Well, you're not going to get it moved if it's been constructed, so it's just a matter of damages and the judgement of the diminution in value because of loss of view. Loss of sound, not loss of sound, increased sound is probably easier, because it's been recognized for so long. But that Pierpont Inn case, as I recall, also had an element of somehow the freeway structure on a piece of it cut off the view of the ocean. So, view is important, you know. There are properties that have or move up the hillside and see the sweep of the area here. You're going to pay for that. So, there are ways of measuring it and you could be on the flatlands and still have a great view, and somebody puts up a wall, that's not what you had before. You're diminished. Somebody three blocks away with the same type of house is going to get more money if they sold the house.

XCAP Member Klein: I know each of these cases has its own facts, but how about a ballpark figure as to what the homeowner is likely to get for diminution because of sound and loss of view?

Mr. Matteoni: I think back on the case that I told you about, these were garages on the first floor and you came in behind the garage to a level and then had a second floor with the bedroom. They were in the neighborhood; it was settled \$8,000 to \$9,000 each but that was 20 years ago.

XCAP Member Klein: Right, but I'm more interested in the percentage of the total value of the property

Mr. Matteoni: Oh, I see. Those units were probably in the \$300,000 category at that time.

XCAP Member Klein: So, it sounds like 3 percent or so.

XCAP Member Cho: So, like an Eminent Domain lawyer, is it like you don't pay the lawyer until, unless you win kind of situation? How does it work?

Mr. Matteoni: It works in two ways. One, an hourly rate, the other is a contingency, and the contingency in Eminent Domain is based on that offer you received before you hired the lawyer, and whether the lawyer can get you a difference, a great amount, then the lawyer would take a percentage of that difference.

XCAP Member Cho: I have another question. So, if there is a school, Palo Alto High School, right next to the Caltrain corridor and if the Palo Alto High School somehow gets impacted, if the school, the organization could represent against whatever they're doing...(crosstalk)

Mr. Matteoni: Can Caltrain take school district property?

XCAP Member Cho: Yeah, or take their property or you were talking a lot about environmental impact, I think. You know, school football field is right there and they exercise and that the construction could impact their breathing. I don't know, I live right next to it, so I'm worried about my breathing. You know, things like that.

Mr. Matteoni: Well, there's a couple of parts to the question. School districts are public agencies, and so if another public agency wants to take a second public agency's property, there is a different standard. The law requires that it's a more necessary public use. Historically, transportation in California has been more necessary than other public uses, but there would be a special consideration to damages to a school. When I was with the County, again, if you know the fairgrounds property in South San Jose, there was the Franklin McKinley Elementary School, and the kindergarten was nearest to the street, but they had a crescent drive and the buses came in, let the kids out, picked them up. That was quite a ways removed from the road. Well, Tully Road was widened substantially, and that school district fought the acquisition, the County won on the more necessary public use, but the County paid substantial damages in redoing all the windows to soundproof them. The school said, we can't have the little kids here anymore. We have to change the arrangements within our facility, and those were all costly moves. So, I'm not sure of the particular impacts on a recreation area of the school, but the school certainly would have the right to claim damages.

XCAP Member Kanne: Is there another process that the City could go through with the school district to avoid that sort of situation?

Ms. Matteoni: I guess it would depend on how you design the project, your input on the design.



XCAP Member Kanne: I guess what I'm asking is, it seems to me that if the City wants to acquire private property for any reason, it needs to go through this process. Perhaps I'm wrong about that, but I'm trying to understand if there is like a separate process.

Mr. Matteoni: Oh, is it a different process?

XCAP Member Kanne: Yeah.

Mr. Matteoni: It's exactly the same process, it's just a higher standard of when that first resolution is passed to take the school district, the school has potentially a stronger argument than the private property owner, because of its public status. And, maybe this is a point to, do you guys just keep going or do you take breaks?

Chair Naik: Nope, we keep going. If you would like a break, please say so.

Mr. Matteoni: Let me just take a sip of water.

Chair Naik: Absolutely, and then while you're taking a sip of water, after I'd love for you to talk about the tax consequences.

Mr. Matteoni: Sure. But there is the right to object. You make that argument at the hearing of the City Council or the Joint Powers Board. Incidentally, the Joint Powers Board, at least for the electrification project retained the VTA (Valley Transportation Authority) to do the condemnations. My client went, I did not go, he made an objection, and it was to the VTA Board. But where was I going here? If there is an objection, there is the right to pursue it in court, but I told you at the beginning, as long as it's a public use, you're not likely to win. You might win procedurally, that the environmental review was done improperly and it sidetracks things for a period of time. But I don't see the opportunity for Palo Alto High School or the residents to have an effective right to take objection that would prevail in court. Maybe you all are familiar with what happened in 2005 with Mrs. Kielow in New London, Connecticut. That was a redevelopment type of project for Pfizer Industry that New London said, we want to increase our tax base and these residents here can be moved somewhere else for Pfizer, because that's going to be a great economic boom to our community and help us pay for other public facilities and the like, and Mrs. Kielow, in fact, there is a little film made of her objection, a little pink house. She went all the way to the United States Supreme Court and lost in a 4-1-4 decision. She said it wasn't a public use. It was a public benefit and tried to distinguish the word public use based on the historic understanding of public use. If the public using a road. If the public is riding a train. The public goes to school. And she lost on that close of a decision, but ever since, she has been sort of patron saint of those that want to object, but she lost and most everybody loses the fight. So, where do we want to go.

XCAP Member Reckdahl: Quick question. The government can only pay fair market value. In your experience, is that generous or is it pretty much right on fair market value?

Mr. Matteoni: Well, I told my prejudice. I represent property owners. I think it's usually conservative. Agencies that don't do a volume of business, I think are more generous. PG&E is not. People object to overhead power lines or gas lines through their property, and PG&E has just been, you know, that's not a damage. You've got to have these and you can look through the lines and see your view. Don't worry about EMF. It's nonexistent. Those types of issue. And so, if you're going to take that on, you're going to be in court arguing that, because PG&E will not admit those kinds of damages, so they're not reflected in a PG&E appraisal. Caltrans for years wouldn't recognize noise damage. It does now. Caltrans, just as an example, it's moving away in some locales where a local bond measure has been passed to fund an interchange or some highway improvement, so the locals are putting the money up and Caltrans will come in and do the law suit and contribute something. In those situations, an independent appraiser may be retained these days, but Caltrans had a bank of appraisers that were its employees, and the appraisal, the offer appraisal that you would get is from somebody who works day in and day out for Caltrans. They're not going to be too generous.

XCAP Member unidentified: Conflict of interest.

Mr. Matteoni: Right, and you only got beyond that, Caltrans did not go to trial, I can't say never, but did not go to trial with the in-house appraiser. But when you hired someone to object, then they went to another appraiser. And that always, I can't tell you how big a bump, because it varied, always resulted in a bigger bump up, but still not be satisfactory. The property owner will know the impacts on a partial take of the property much better than the agency, its engineers. They're doing a whole line, looking at it. Their appraisers are going up and down the line and, well, this is a little different, make a little adjustment here or what have you. So, on damage cases, and I'm not telling you all these cases go to a jury, but they go to trial and as the agency understands the problem that it has created, it will bring more money, more money is forthcoming to pay for those damages.

The Panel took a short break.

Chair Naik: There was no property acquisition but let's say it was generally recognized that the property might have an impact, like for example we were talking about the, you know, having something elevated behind your house, but they didn't technically take any of your land. Could the city or does the city ever preemptively just decide, oh, we're just going to compensate you now, rather than waiting for some kind of suit, in a proactive measure. Or is that something that is not typically done?

Mr. Matteoni: It's not typically done, but it is certainly possible, and if I were representing someone, I would approach the city in terms of discussing it with public works, whoever is responsible for the project. I probably wouldn't get too far there, but then would take it to the Council Member that I knew, and you know, I'm going to have to bring a lawsuit, but I think this can be worked out. It's a damage that's recognized and see what the receptivity is there. So, there is an avenue to work that out and claims are worked out. Not everything has to go to trial.

Chair Naik: But my understanding was that part of the reason it's not typically done is because from a public perspective, you could have the risk of, what you don't want is that a city is basically is like, oh, I'm going to come do this apartment building in front of your house so I can pay you an extra 50 grand because I'm impacting your house, right? That way you won't say no. So, there's a public element that balances that.

Mr. Matteoni: For the public agency, they should be treating everybody equal and, you know, three people are complaining and nobody else is. Well, I don't think there's a damage. It's up to the one that wants to pursue it. So, most often they result in lawsuits, but they don't have to. And maybe before we start talking about taxes, implications, consequences, just another word or two about the process. So, the lawsuit has been filed, and I didn't mention in Santa Clara County, if you have to go to trial, you're not going to be in trial for probably 20 to 24 months. An acquisition of someone's home or part of their home, is very traumatic. The only one that likes condemnation are lawyers. All property owners usually do not like condemnation, and I find homeowners particularly are affected, and there are lots of ramifications. You know, this is my folk's home, I've lived here all my life, what have you. I'm going to just tell you one story that worked out well for the woman, although she had to move. When the Guadalupe Expressway, now the Guadalupe Freeway was put past the airport and into downtown San Jose, in this older neighborhood south of Taylor Street just beyond where City Hall was located, were a series of small homes. One of the owners was Mrs. Carowsa (Phonetic), and she had lived there, raised her family, elderly woman, and the attorney was an Italian. I have Italian heritage, Mrs. Carowsa was Italian, the judge, Judge Raconelli (phonetic) was Italian, and the daughter, the attorney for the family explained to the judge, because usually when you call in the jury you want the property owner there, you want to introduced the property owner to the jury and try to catch some good vibes. Now, Mrs. Carowsa can't attend. She is not well, but you honor, if we could at some point during the trial, her daughters could bring her in for a few minutes. And so, a day or two later I see the two daughters on either side of an elderly woman all dressed in black. The attorney tells the judge, I have my client here and if this would be an appropriate time, I just simply would like to introduce her to the jury and then her daughters are going to take her home. Of course, you can do that. So, Mrs. Carowsa sat up and I noted she had a rosary bead and crucifix hanging here, and God bless you and sat down. Mrs. Carowsa got everything she asked for at that trial. So, just to finish up on trial, it's difficult to stay with it when there's the long period of time, the effect of an order of possession. Incidentally, you can object to the timing of an order of position for hardship if you can show to the judge that your elderly mother lives with you and, you know, we can't simply move. We have to make arrangements. The judge might give you another couple of months and stall the public agency. But these are all traumas that personally happen and are not directly compensable unless you come in with the right black clothes and rosary beads. You ought to know as well that most all these cases eventually settle. There were statistics from Caltrans years ago, and I haven't seen any for a long time, that 97 percent of the cases that are filed are settled. On larger cases with arguments on various points, the settlement most often comes, the best settlement for the property owner, in the last few weeks before trial. There are reasons for that. You are required, both sides, 20

days before trial to make a settlement offer, settlement demand it's called, for the property owner, and the court is trying to force the parties together that they make their best judgement after they have taken depositions of the appraisers, they know all they need to know of the case. What would it take to get out of this case? And it's intended to have a compromise aspect to it, but the benefit for the property owner and what does promote a jump in compensation, offer of compensation, is if that offer demand is not accepted, the property owner can recover its litigation expenses, attorney, appraiser, if there is an engineering witness, because of some aspect of damage that needs to be explained. All of those expenses can be ordered paid based on the court after a trial determining that the demand by the property owner was reasonable in light of the verdict and that the condemning agency's offer was unreasonable in light of the verdict. So, if you get a number by verdict over what you were demanding, you should be guaranteed the recovery of your legal expenses in going through the trial. And so that has an impact on eventually settling a case as it goes along. There are a couple of other things, if you had to go to a trial, that the law gives in my judgement as protection to the property owner. One is, I don't know how many are familiar in going through any litigation, but in civil litigation, if you bring a lawsuit for an accident against the party that ran into your car, you have the burden of proving the liability and the damages. In condemnation, there is no burden to either side. It used to be, pre-1975 the burden was on the property owner. That got eliminated on the basis that, what the jury is trying to do is its own appraisal of the property based on all the information that comes forward, and so the property owner isn't at a disadvantage against the government, nor is the government disadvantaged in the way the law looks at it. Both are equal in terms of attempting to prove the right number for compensation. And there is always the recovery of what's called legal or court costs, not litigation expenses, no matter what. You're filing fees, your deposition costs, the jury fees, all of those are on the public agency, and if you settle a case and go through escrow, all of those charges are on the public agency, not the property owner. So, there are other aspects of the law that protect the property owner in these forced acquisitions.

Mr. Matteoni: So, with that you want to talk about taxes. There are a couple of different aspects to taxes. One is, if your property is acquired, do you have to pay capital gains? The law beyond California, IRS law gives you the right in effect, to affect a tax-free exchange, 1035 Exchange. You have, you can receive the money. You don't have to put it in escrow. You can receive the compensation and look for an investment. You don't have to have the reinvestment lined up the day you get the money. You have two years beyond the year in which you receive the money. So, if you got your money February 5, you'd have all of this year and two years beyond to reinvest. If there are damages, the damages go to adjusting the base, but you wouldn't pay on damages when you receive them. So, that was one question, I think, that was raised by Pat when we were taking a break.

XCAP Member unidentified: Does that apply just if you go to trial, or does that apply to any offer?

Mr. Matteoni: Well, you have to document and perhaps I hear recently, the IRS is looking more closely at it, but this was a settlement in lieu of condemnation. So, if

you had that resolution, you're good. If you have a lawsuit filed and settled it, you're good. It's protecting yourself if you negotiate before those things happen, and public agencies are very good in say, providing documentation, either in the recitals to a settlement and/or a letter that it was prepared to pursue condemnation. It's vital to this project, whatever the project is, and this is a settlement in lieu of condemnation. So, that's worked well for property owners over the years. Are there questions on that?

Chair Naik: Not on that one specifically, but can you talk a little bit about the fact that the tax base, particularly in Santa Clara County, and how that's impacted when you...

Mr. Matteoni: Right. I did prepare, I don't know if they're in everybody's hands, an attached the code sections. I said 1035, 1033 I should have said for the IRS Code, but there is the adjustment of the base year property acquired following condemnation. And it can actually be transferred to another county, but not all the counties, and I don't understand how that is in California have it set up. Maybe it's the rural counties, but you can transfer your base on a residence taken in Eminent Domain to your substitute property pursuant to the formulas they established there. I don't typically get involved with the administration of that, but that's another provision in terms of providing protection to the property owner. So, if you had longstanding Prop 13 advantage on your property, you can transfer that.

Chair Naik: XCAPers, do you have another other question, and by the way, I'm going to have to excuse myself soon, so I will let Larry drive, but please go ahead.

XCAP Member Burton: What worries or concerns me is that we have an alternative for the crossing project that requires property takings that the agency may not budget sufficient time for the whole process of negotiation. That's one concern, or they may be unrealistic. Another concern might be political pressure to move the process forward faster than is reasonable for the for the typical situation. Another concern is that opponents of the project may use property taking lawsuits as a lever to try to delay or even kill the project. So, these are my concerns.

Mr. Matteoni: It's very unusual for a project to be accelerated. (crosstalk) Thank you Nadia. I'm going to use the example BART coming into San Jose, North San Jose, Milpitas, in 2000 or 2002, probably both. The environmental reviews were being made for that extension, and it was to extend all the way the way to the Dearden station in downtown San Jose or on the edge of downtown. Because of funding, because of environmental review, the acquisitions of the property in Milpitas and North San Jose did not take place until 2011, with a couple of cases going to trial in 2013, and if you follow the newspapers, the BART line is operational to be checked out, but not operational for passenger service on February 5, 2020. So, the line coming into the San Jose, the extension was approved and they had a big controversy over the tunnel under Santa Clara Street, was there going to be twin tunnels, single tunnel, that took a long time for political considerations, arguments between the City reacting to property owners on what would be less disruptive in the way of construction, not withstanding it's going underground. There's affects above the ground in terms of construction equipment, yards for storing materials and the like, and BART, what it wanted that took probably a year

and a half to be resolved. And last year we were supposed to see the condemnation actions, haven't and I don't think we'll see them, maybe the end of this year till next year. So, it's just hard with political realities and opposition, environmental reviews. I don't know if any funding is coming from the feds on this, but any day the feds can get upset with California and requirement something more, delay funding. Nadia would know how the high-speed rail has been affected. So, those are other considerations that can jam a project. The lawsuits, if there was some lawsuit that had legs on challenging the project itself, certainly that would delay the project. The court could not let it go forward until that litigation was resolved, but if it's a homeowner objecting, like Mrs. Kielow (phonetic) I don't think, and Mrs. Kielow, she took her property long before she got to the Supreme Court. The house was gone. The courts just not going to delay a major project. So, I'll go back to the orders of position, and when a property owner says, God, this is a hardship, I can't move. You're affecting my business. I don't have a place to go. I've got seven employees, whatever the business complications, that hardship is balanced against the public agency saying, it's been funded, the project has been in the planning for so many years. It's needed for these reasons and if we don't implement it, if we don't go to contract by June, we're going to lose the construction season and the cost of the project is going to go up. Judges are very inclined to go with that set of circumstances and, unfortunate that somebody's got some hardship. Maybe give them a month or so or make some exception, but it's really hard to, once it's on its own track, it's not stumbling over itself for federal funding or the like, to slow a project down as an individual property owner. Am I getting to your question?

XCAP Member Burton: Well, I guess, maybe I didn't explain it completely. We know it's going to take years between the time that the City Council says these are the alternatives and we go through all the planning processes before we can start breaking ground, but will the agency necessarily be realistic about the time needed to do the acquisition, or is there going to be some pressure, internal or external, that says minimize that so we look better on paper now?

Mr. Matteoni: Well, I suspect there is always that pressure, but the procedures to me are so set in terms of the reviews that have to be made, that an agency would have great difficulty compressing the time, particularly in a community such as Palo Alto where the constituency is well informed, and if they have a particular point of view that is just not going to be rushed. But I'm not the public agency. I'm looking over here, but I didn't expect an answer.

XCAP Member Shen: I had a question back to the condemnation notice. So, if someone receives one of those, what does that typically look like and I assume there is probably a timeframe that the homeowner, property owner says you've got to vacate this property by some certain time. And then the related question to that is, if there is a lawsuit that a property owner chose to bring against that, would the person still have to vacate that property or could it hold up the, for instance, your 18 to 24 months you said here in the Silicon Valley to wait for a court case. Could it lit literally hold up, could someone live in their house until that lawsuit was taken care of?

Mr. Matteoni: I've never seen that kind of delay. So, the notice you're talking about in terms of having to move, from my standpoint. When the lawsuit is filed, the agency makes a deposit of probably compensation. Before you ever see the papers, the agency has gone to court and asked for a date to set a motion to take position of your property, which will be more than 90 days out, because it still has to serve you. It has to give you 90 days' notice. So, if they anticipate they can serve you next week, they will extend out into April whatever it is, 90 days, to have a hearing by the court, and it's up to you within 30 days of being service to file an objection. One objection could be, if there were a viable right-to-take challenge. They don't have the right to take this property, they didn't do it right, then the court would hold that off and have a trial which is supposed to be expedited, just on the right-to-take. There are very few property owners in California that have ever won a right-to-take challenge. The last biggest one was the City of Oakland in the early 80s trying to take the Oakland Raiders. They weren't smart enough with Joe Alioto and Major Council to achieve that. The Oakland Raiders moved to LA I heard. Now they're gone somewhere else. In any event, back to just the process, if the objection is a hardship, which has only come about, I think, the legislation in 2006 or 2008, that the hardship was introduced. Not that people didn't argue hardship before, but the law recognized the right to protest on hardship. That's buying a few months or not anything, depending on how the judge looks at it. This is a vital project, sorry folks. And if you do not move out, there is a court order telling you you have to deliver position. If you do not do that, the Sheriff will enforce that order and physically move you. Way back when, when I worked for the County, there were a few people that didn't move out. The Sheriff's approach to that, because the Sheriff did not like moving people out of their house, was to go and post a notice that we're bringing in the moving vans next week if you don't obey this order. I never remember anybody not moving out that somebody was going to take over control. So, they control their own situation. And now, as I tell you on relocation assistance, there is provision to assist people to move. But there can be extraordinary circumstances that the court may listen to and, yes, that would delay the project starting but it probably would not affect the ultimate trial date for compensation. That would still be running its course.

XCAP Member Kanne: I had two questions. The first one, I think, will be pretty straightforward, which is, have you experienced any examples of an inducement in traffic being something that a property owner has gotten damages for? So, a road next to them has more cars, there's more noise or more pollution as a result?

Mr. Matteoni: I'm not aware of any recent case addressing that. There is a case out of Sacramento probably from 30 years ago of increased traffic with no compensation, but I think in that case there was not taking of the property. It's just how Sacramento has a lot of one-way streets and things got changed and it was a dump on a particular street. May San Francisco is experiencing that now that it closed part of Market Street. But, just like sound vibrations, maybe, but there has to be, it wouldn't be the city rerouting streets. I think there would have to be some project that expanded the street to take more traffic. Median strips, there's no compensation for median strips, so lots of people, when the light rail came to Santa Clara County, the light rail goes down the middle of the street, and you used to be able to turn, go into a driveway here or there. You can't and there's no

compensation for that. But there is, well, there's exceptions to that. So, circuity of traffic, circuity of travel, I should say. If there is a mile, mile and a half of median strip that you can't cross the center of the street that you had before, and you're a business over here and you have to drive a mile and a half, there are some cases that have challenged on the basis of circuity of traffic, the increased burden to the business of travel time, loss of delivery time or whatever they do, and most of those cases, the court is tolerant of the agency. But in some extraordinary circumstances, the viaduct circumstance is one that's been recognized, large trucks that had to truck and trailer movements when they were pitched this way instead of that way, there's a case that there's compensation for that.

XCAP Member Kanne: Thank you. My second question was, just to be completely clear, when you're modifying a driveway or the edge of a lot, that constitutes an impact certainly, but is the city actually acquiring that land in order to perform that modification? That's just kind of unclear to me.

Mr. Matteoni: It could. If a street is widened, they are and then they're going to conform the driveway. The grade of street may change and thus the driveway isn't what it was coming into your residence. Say the grade was up and now you've got a driveway going down and you're scraping the bottom of your car. Perhaps your whole driveway needs to be conformed, not this abrupt change, but this sort of thing. That's happening on a rural highway in South County where the County is straightening curves on a road that has proved dangerous going into a bridge area. The property owner has a gate within so many feet of the road. The road is going to be moved this way, it is going to be higher and his grade is not going to work. The County acknowledges that. The County says it will conform the grade, which requires it to go further into the property. We didn't talk about temporary construction easements. We barely did in terms of a wall that might be constructed just outside of the property line, but most public projects require some additional strip to the ultimate right-of-way for the construction to take place, whether it's loading railroad ties along the side, roadbed materials, cranes, what have you, and so the law allows the condemning agency to take temporary construction easements they are called, but they're usually long strips. In the past they've been three months, six months, maybe a year. As projects have become more complicated, for example, BART coming to San Jose, they're talking about five-year temporary construction easements. The value of a temporary construction easement is really leasing the land and restoring what might be damaged. So, when VTA went down Tasman Avenue or Boulevard or whatever, in Santa Clara, to put a median strip area, to create sufficient median area for the trains, it was taking landscaped area and parking strips of various businesses along there, and then taking that out of use for a year, two years, the whole parking in the front of a building. They may be able to put the parking back or not. You lose the landscaping. That goes to the nonconforming question that you don't have nice landscaping in front of your property, which municipalities usually demand, but property owners have come to feel that's an advantage. You know, it gives a nice setting to their residents, to their business. So, those things may be replaced. They are compensable.



XCAP Member Cho asked if it was possible to assess the risk of trains so close to structures and possible accidents and compensation for that risk.

Mr. Matteoni reported possibly if the property owner had an example of a disaster that could occur and assess the risk, but the more probable damage recovered is loss of view, noise, vibrations, invasion of privacy and would be claims for compensation.

XCAP Member Cho: My first question is, so they want to build, I'm giving an example here, so they want to build, so Palo Alto building code says that you can build up to 20 feet away from your property line. So, my neighbor built a very beautiful house, \$5 million and it's 20 feet away from their property line. Their property line is right next to the train tracks, and they want to build 15-foot high viaduct next to this fence, which is two feet away, 15 feet high viaduct, and then the train itself is another 15, so 30 feet high. So, 20-foot distance, if the train derails from the top of these 15 feet, like where are they going to land? Isn't that like dangerous situation?

Mr. Matteoni: Yes. I don't know what the statistics are of trains falling off that elevated viaduct. You would have to show, well, years ago before San Bruno, I don't think PG&E had much problem with high-pressure gas lines going next to residential properties in terms of its view of what it owed. That's changed dramatically, that the risk of explosions, and you have an example. So, if you have an example of some sort of damage that could occur and assess the risk. But more probably damage that you would recover for is loss of view, noise, vibrations, privacy, invasion of privacy, people on the train, I don't know how quick...

XCAP Member Cho: Oh, they can see. The train to San Francisco, they can see.

Mr. Matteoni: No, I know they can see, but (crosstalk), but all of those would be claims for compensation. The risk of, aren't they locked on the line?

XCAP Member Cho: So, another question is, do you engage a case that before the Eminent Domain kicks in, before, the part of the process that might happen, does the client hire you to represent them? To affect the decision-making part of a different kind of solution?

Mr. Matteoni: Right. On the BART line coming to San Jose we have several clients that retained us two years ago. We haven't done work for maybe 20 months, but they retained us so, you know, we talked about it initially. We might have talked to the VTA about particular issues affecting that property. And then it has sat. So, people do come more often early, as they learn of this and there is an opportunity in that to see if you can change things. Not that, you know, the owner and the attorney have a lot to work with, but there are certain circumstances, be it driveway conformance, or what have you that, okay, yeah, we need to take care of that. So, yes it happens.

XCAP Member Cho: So, what about the customers. I think about a 50 household is against a particular solution. Like, I mean, we did the petitioning to the city and

etc. but there is also opposing neighborhoods that want this solution. I'm just trying, you know, when is a good time to engage a lawyer?

Mr. Matteoni: Well the description you just described sounds similar to a neighborhood objecting to a new development that everybody is single family and they're going to rezone this strip of land next to you for apartments and they're going to be three stories, and increased traffic. I don't usually get involved early in a condemnation case in that situation, but I think that type of homeowner reaction to a private development that might be approved by the city is a parallel and attorneys are often involved in that. Their target is raising questions about the environmental impact and assisting the homeowners in doing that.

XCAP Member Reckdahl: Families are quite often worried that if they lose their house, their kids are going to have to change school districts? Is there any grandfathering of, if you get evicted at all?

Mr. Matteoni: No.

XCAP Member Reckdahl: You end up where you end up.

Mr. Matteoni: That's my shortest answered, no.

XCAP Member Reckdahl: Okay.

Mr. Matteoni: Where you go is dependent on, the school district. You live there, they receive your children, and I don't see Palo Alto cutting an exception if you're living wherever, Redwood City. Yeah, you can still go to school here.

XCAP Member Klein: Are we winding down or exhausting ourselves on the speaker? Norm, any final words of wisdom to us?

Mr. Matteoni: It's a tough game. You don't like it now, you're spending a lot of time on it, at trying to protect yourselves. The lawsuit is not going to be palatable. There is just, well, I don't know that many people like lawsuits of any type, but the loss of property is a dimension. You know, maybe if you just bought it, well, even if you bought it last year, you spent a lot of time selecting that property and put your heart into it, and those things aren't compensated. You've got to go back to, you know, appraisals. I thought there was a question of how the appraiser reacts, so I just will add, in terms of the damages, which is usually the toughest issue, and if you can demonstrate it to the public agency, then you're going to come out alright or you're going to have to fight it in court. I think I mentioned to you, Patricia, as we were taking a break, that the property owners usually want a jury to decide this, that jurors will relate to them. They have to live somewhere. They work somewhere. Public agencies like juries, because they are spending taxpayer money. So, it's sort of an offset. But both parties like it. It's rare that a case would go to trial just before a judge. It would if it was real small, you know, save expense to go. And now days there's even the prospect of mediation. The court wants cases mediated so you don't wait the 18 to 20 months, although there are exceptions for Eminent Domain. If the parties don't agree, the court can't force you to mediation or arbitration. You're entitled to a jury trial. And that usually works for the property

owner, but what I said to Patricia earlier is, it's not Palo Alto citizens that are on the jury. It cuts across the whole community of San Clara County, so there may or may not be people that really understand your situation. So, there's lots of problems and people aren't happy.

XCAP Member Klein: Norm, maybe a last question. It's certainly an unfair question. Based on your experience, do you think that homeowners in general in California, get a fair shake and are protected by the procedures?

Mr. Matteoni: They don't if they're small, they can't afford the fight. And that's unfortunate and that goes back to the situation I was talking about in LA where lower income community, years ago when 280 went through San Jose, there is a district called the Gardener District, and an attorney, civil rights attorney, John Thorn represented Angela Davis, he came to the fore for those property owners, but he could not try one individual case. So, I don't know how many were there, but they were bundled up and so he represented them as a group and got the court to agree to consolidate the cases. That's very unusual. Your individual case should be addressed to this judge, to this jury. But they were in similar situations and he was able to do a good job for them. But it's hard and the economics of these cases are such beyond the toll on your psyche. It just takes a lot out of you, and expense to go forward. The appraiser's expense goes up as the case goes on. The initial appraisal, the \$5,000 on any case of significance doesn't cover the appraisal costs, but it's the top in the code section, and you may get an appraisal for \$5,000. You go and try to negotiate from it. It doesn't work. Then the appraiser has to do more work, and he has to update things 20 months later. And I didn't tell you that that date of value is fixed, but you can get sales that occur later, because sales are usually negotiated months before they close, and so the court will allow subsequent sales, not two years later, but within a year. And if both sides have a band of sales a year before, a year after, those are all going to be admitted and then you're arguing about what's comparable and what's different on this sale. That's the usual argument. That's also very dry stuff to a jury, so you're looking for ways to make it more entertaining, and that's where the point I told you about an appraiser that has a presence that can deliver in court in explaining the appraisal. Otherwise, you might as well just mail it in and hope the jury reads it and looks at both sides and says, well, here is a middle ground figure. Everybody go home, which is a tendency as well in these cases, to go to the middle if it's complicated and both sides were as weak as each other and as strong as each other.

XCAP Member Reckdahl: You mentioned that 97 percent of the cases that are filed settle before the trial is complete. What percentage of the cases settle early and don't require any lawsuit to be filed at all?

Mr. Matteoni: You know, I'm not privy to that, but I'm just trying to think in terms of the VTA and the BART extension to Milpitas. I knew most of those properties and I would say it was less than 20 percent. But you're going through a highly developed area and most of the properties were business properties along the railroad tracks, not residents. Well, I told you there were some with apartments, but they weren't directly taken. There was one apartment house that had its recreation area removed and that case supposedly settled three years ago this last

month, and hasn't been finalized yet in terms of the settlement worked out in terms of rehabilitation the recreation area foreshortened, and the parties are still arguing about the rehabilitation plan.

XCAP Member Kane: Less than 20 percent settled early?

Mr. Matteoni: In the example I gave you. I don't know what the Statewide statistics are. I think school districts do a good job and very few school districts go to trial. They're kind of locked in where they have to go. They may be a smaller government entity, closer to the people. All of the Saratoga feeling that, geez, we don't like to condemn people's property. We know those guys.

XCAP Member Klein: On that happy note, Norm, thank you very much.

Mr. Matteoni: You're welcome. Thanks for having me.

(crosstalk,)

XCAP Member Burton: Quickly, who has my Caltrain meeting flyers. I just want to get them back before the meeting is over. Yeah, the three of them. There's one more. No below you, that one. Thank you.

XCAP Member Klein: Okay, we have a few items left on the agenda. I'm not sure how much we're going to get done on them. Actually, I think I'm going to skip around. Chantal, I think we'll start with you, skipping down to number seven, Staff Updates.

#### **4. Discussion: XCAP Provide Input in Preparation for Upcoming Town Halls.**

XCAP Member Klein: Well, let's skip over, put the burden on you again, Townhall meetings.

Ms. Cotton Gaines: Yeah, so this item Nadia requested, this is Item number four, Nadia requested to have it on the agenda, so we are going to bring next week, likely an informational item to you that is just the planned power point for the first Town Hall meeting, which is February 20, and that one is at Mitchell Park. The structure will look like you guys have seen for the previous community meetings and the first Town Hall meeting is the one where we're recapping just where we are period. So, there's actually a lot of information to cover in that meeting to bring people up to speed on the seven alternatives where we do have analysis to date. And so, we're going to do an informational item for you next week that just says, here's the power point we're planning to do, and then if you guys have feedback, just let us know. So, we probably won't spend your meeting time on that next time, but it should be, to Greg's point, things you all of seen before. And Nadia want this item on the agenda to see if there was anything that the XCAP had an interest in us trying to incorporate in the Town Hall meeting, if there's a question or something like that that you would like us to post to the attendees of the Town Hall meeting,

she just want you to give us that feedback. It's okay if you don't have anything. There's more than enough to cover.

XCAP Member Klein: You might want to give us an update on where AECOM is on our two additional ideas.

Ms. Cotton Gaines: We are working with them to get a very specific timeframe. I am thinking we will have early level things at some point in March, but I can't speak with more confidence until I get a refined schedule from them, which I think I'll have within the week. So, I can give an update on that next week. And we'll try to incorporate that into the updated Workplan as well, just so you know when it's coming back to you. We are right now scheduling a meeting with the proposers of those new ideas and AECOM and some relevant staff, and your technical working group, so that we can make sure that AECOM is analyzing things the way they are currently, and that we're not missing anything. That we're planning for next week, if everyone's schedule lines up.

XCAP Member Klein: The technical committee members who will participate in that are Phil and Tony and Keith, and I think you've all been notified of the dates. The idea of that, it is really just to make, as Chantal said, to make sure that we're all talking about the same things and if there's any particular technical problems we have our technical people there to help get the things straight. But the AECOM evaluation of our two new ideas will come before this full group whenever they're ready, and obviously, we want to have it in time so that we can take it into account in making our final decisions.

## **5. Discussion: Preliminary Discussion of XCAP Workplan (continued from January 29, 2020 meeting)**

Ms. Cotton Gaines: So, for Item five, which is the Preliminary Discussion of your XCAP Workplan, last week we passed out, I'm just going to keep talking, last week we passed out a spreadsheet as well as a document behind it by dates and it described like what is planned. I met with Larry and Nadia yesterday, so we're making some updates to that, but if you guys can look over the document shared at last weeks' meeting, I think it was Item Five last week. Yes, Phil is holding up the spreadsheet. It's actually easier to read in black and white, so if you want to look at the printed on instead of the one uploaded. Please just look at that and we will bring the discussion back. We're adding some other things into it and trying to figure out how to maximize your time to keep you guys on schedule for April 30<sup>th</sup>.

XCAP Member Klein: Well, let me add to that is the way we're looking at things now is that we'll begin making decisions on February 26<sup>th</sup>. What that looks like, I don't know but we're certainly going to have an item on the agenda that would call for the possibility of making some decision. That's three weeks away, or looking at it another way, it's two months from our deadline.

XCAP Member Burton: But that's before some of the community meetings, you know, the public hearings.

XCAP Member Klein: Well, we have the Townhall meetings.

XCAP Member Burton: That's what I mean, the Townhall meetings, yes.

XCAP Member Klein: Well, that's an interesting point, but the Townhall meetings aren't really for that purpose, since we're not outline everything to them anyway. There's no lack of opportunity for the public to speak.

XCAP Member Brail: Can I ask that in preparation for that, we just make sure the documents and the presentations on all the various options are, I think the website is up-to-date, but I know that some of them, like I'm very familiar with, because I was on the old CAP, but I don't know that everybody has seen the presentation. There's an AECOM video, there are diagrams, there are elevations, there are maps, there are the fact sheets. I think it's important that if we're going to start talking about actually, you know, doing things, that we should all take the time to make sure we fully understand all the options that are currently in front of us. And maybe it's just a matter of looking on one link on the webpage, but I certainly hope to do that by the, and I think others should do the same.

XCAP Member Klein: Absolutely, which is why I mentioned giving three weeks of notice. If you were the college student who waited till the last week to do all your, to study for you exam, now is your notice that, when the exam is going to start.

Ms. Cotton Gaines: And there is a link on the website that, I think it is with renderings and animations or something, so if you wanted to look at all the animations of our stuff and alternatives, now nine technically, there are animations for six of them, and then the Churchill closure has all its different elements to it and then we are doing further analysis on the two new ideas. But that's a good starting place, if you want to see the videos again and look at the layout and plan view, all that type of stuff.

Meeting moved to Item number four.

## **6. XCAP Member Updates and Working Groups Updates**

XCAP Member unidentified: Larry, can you explain again what we will do on February 26<sup>th</sup>?

XCAP Member Klein: We're not sure yet. I said, I deliberately used vague words to begin deciding.

(off mic)

XCAP Member Klein: Well, for example, we're not committed to this. Nadia and I and the staff are going to have a further meeting on this after next week's meeting. Here is one possibility and that is, start at the bottom. Eliminate ideas that have the least amount of support, so that people, we might start just with a going around the table and getting each individual's views on things. I'm pretty sure we will divide up and not discuss all three areas, but, well, Charleston and Meadow are really one thing, but we might have done meeting devoted to Charleston and

Meadow and the next meeting devoted to Churchill and its various ramifications. So, we might ask people to, without any motion on the floor, just give us your thoughts and see what everybody has to say, and then see where we go from there. But anyway, there are a variety of things. It's more complicated than having just a yes/no, are you in favor of daylight-saving time, or something like that. You can pretty easily take a vote on that. We know that these are much more complicated than that, so how do we make sure that everybody has a voice and we hear everybody else's views, so that we can all benefit from the give and take on that, and then it may also be that we have several iterations of decisions and maybe set some tentative things. Obviously, we don't need to make final decisions on February 26<sup>th</sup> or March, what is it, 3<sup>rd</sup>, 4<sup>th</sup>, but within a pretty short time thereafter, because it's going to take us a while to produce the final report as well.

XCAP Member Burton: Larry, will we have any indication of funding ranges or anything like that to help guide us in thinking about what's called financial feasibility by the 26<sup>th</sup>?

XCAP Member Klein: No. I think all we're going to have are cost, I'm assuming we will have cost, well, we do have cost estimates from AECOM. Whether we're going to get, it's a chicken and egg situation. The Council is not going to give us a budget. They're going to say, well, how do we give you a budget until we know what you expect to build.

XCAP Member Brail: I mean realistically, the only money available is the Measure B funding in the County that's shared with Sunnyvale and Mountain View.

XCAP Member Klein: Well, that's all at the moment.

XCAP Member Brail: So, the Council would have to get some money somewhere, and it doesn't sound like this business tax is nearly going to be enough or used for this purpose.

XCAP Member Burton: Let's say the combination of Measure B and business taxes could carry certain bond load.

XCAP Member Brail: It would be helpful to do some back-of-the-envelope forecasting. I agree with you.

XCAP Member Burton: Exactly. So, we know let's say, I don't know, the tunnel, South Palo Alto tunnel is so far beyond the realm of financial feasibility, we shouldn't spend more time on it. I'm just using that as an example.

XCAP Member Klein: Well, you're going to hear Pat and I'm guessing that Pat's going to tell you how his idea is to find the funding. I'll get to that in a minute. Yes, we will get there. The public, I think you're half the public.

Philip Kamhi, Chief Transportation Official: So, if I can really quickly, I just want to say that it's very unlikely that we'll have funding information after April as well, but the reality is, we can potentially apply for other funding sources once a project is determined. So, at this point it's not really a project.

XCAP Member Klein: The other thing is in the paper today is the introduction of legislation in the State Legislature for the oft mentioned idea of having a Bay Areawide sales tax of 1 percent, which would raise, Pat, what's the number, \$500 billion, something like that, \$50 billion, (off mic) \$100 billion, yeah. But that's spread out over nine counties. It's not just for grade separations. But that may very well, if it gets through the legislature could be on the ballot as early as this November, and that would be a potential source. Anyway, lots of potential things. Go ahead Megan.

XCAOP Member Kanne: Well, I just had a comment which is kind of to Phil's point which is that you haven't really gotten an update from the Measurable Criteria Group, because we've kind of been like, holding our cards close, so maybe that would be useful to like agendize specifically. And if you have any, like, specific questions for that group or things you would like to see. Because certainly my expectation would be that the criteria would matter in these decisions that we're potentially making this month and next month.

XCAP Member Klein: Thank you for that. Well, we'll hear from members of the public now. Pat.

The meeting moved to Item #2, Oral Communications.

## **7. Staff Updates.**

Ms. Cotton Gaines: Oh, okay. So, Larry, also I think Nadia, for Item number five, just wanted that to be an announcement, so I can do that really quickly, if you want.

XCAP Member Klein: Anything else for the good of the cause? No. We're adjourned.

## **8. Adjourn**

The meeting adjourned at 6:40 P.M.



## **Feb. 5, 2020 XCAP Meeting**

Agenda Item #3 - Presentation and Discussion with Norm Matteoni, Managing Partner at Matteoni, O'Laughlin & Hechtman

Materials Shared at Meeting

### **Description:**

The following documents were handed out by Mr. Norm Matteoni during his presentation to the XCAP at the February 5, 2020 XCAP Meeting during his presentation about property impacts.

Shared at Meeting  
XCAP Meeting  
Feb. 5, 2020  
Agenda Item #3



*(This is informational material. It is not intended to give a complete statement of the laws and regulations governing the acquisition of property for public use.)*

## Overview of the Eminent Domain Process and the Property Owner's Rights Under Eminent Domain Law

### 1. Eminent Domain

Eminent domain is the power given to a government agency to acquire property for public use. The power of eminent domain is balanced with the constitutional obligation to pay just compensation. A majority of acquisitions are settled by agreement. However, if the owner and the acquiring entity cannot agree to the terms of the proposed acquisition, the acquiring entity may invoke the eminent domain process to avoid delaying the project. At any time during this process, the owner has the right to consult with and/or hire an attorney.

### 2. Public Use

A public use is a use that promotes a public interest in relation to any legitimate government or public utility objective. Examples of public uses include acquisition of property for highway and street purposes, for school facilities, for a municipal airport and for electric power lines and gas pipelines and associated equipment and facilities.

### 3. Required Findings

Before an action in eminent domain can be filed, the acquiring entity usually must hold a hearing and adopt a Resolution of Necessity. The owner has the opportunity to appear and be heard on the issues of public use and necessity. The power of eminent domain may be exercised to acquire property for a proposed project if it is established that: (a) the public interest and necessity require the project; (b) the project is planned or located in the manner that will be most compatible with the greatest public good and the least private injury; and (c) the property sought to be acquired is necessary for the project.

If the property is already dedicated to a public use an additional finding must be made that the proposed use is a more necessary public use.

#### **4. Just Compensation**

The measure of just compensation is fair market value. The fair market value of the property or property interest taken is defined as the highest price on the date of valuation that would be agreed to by a seller, being willing to sell but under no particular or urgent necessity for so doing, nor obliged to sell, and a buyer, being ready, willing and able to buy, but under no particular necessity for so doing, each dealing with the other with full knowledge of all the uses and purposes for which the property is reasonably adaptable and available.

#### **5. Fair Market Value**

The fair market value of the property will be determined by an independent appraiser. The appraiser will contact the owner and the owner will be given an opportunity to accompany the appraiser and provide relevant information to the appraiser about the property.

#### **6. Severance Damages**

When an acquiring entity takes only a portion of a parcel, the owner is entitled to compensation for the value of the land taken and the diminution in value to the remainder parcel caused by the project or the take. If the owner's remaining property will be benefitted by the proposed public project, then the value of these benefits may be offset against severance damages.

#### **7. Fixtures and Equipment**

All "improvements pertaining to realty" (IPTR) are to be valued and compensated. IPTR refers to fixtures, machinery or equipment installed for use on the property that cannot be removed without substantial economic loss or without substantial damage to the property on which the IPTR is installed. Buildings are not IPTR and are valued as part of the real estate.

#### **8. Crop Loss and/or Damage to Property as a Result of the Project**

The property owner is entitled to receive just compensation for crop loss and/or damage to its property as a result of the project. Generally, the value of crop loss is measured by taking the market value of the estimated crop and deducting marketing and production costs.

## **9. Loss of Goodwill**

The owner of a business conducted on a property to be acquired or conducted on the remaining property which will be affected by the purchase of the required property, may be entitled to compensation for the loss of goodwill. Entitlement is contingent upon the Business Owner's ability to prove such loss in accordance with Sections 1263.510 and 1263.520 of the Code of Civil Procedure.

## **10. What is a Pre-Condemnation Offer?**

The acquiring entity shall establish an amount that it believes to be just compensation and shall make an offer to the owner to acquire the property or property interest for the full amount so established. The acquiring entity should provide the owner a written statement and a summary of the basis for the amount it established as just compensation. The amount shall not be less than the acquiring entity's approved appraisal of the fair market value of the property. The written statement and summary should contain detail sufficient to clearly indicate the basis for the offer.

## **11. Owner is Entitled to Its Own Appraisal**

The acquiring entity is required to pay the reasonable costs, not to exceed \$5,000, of an independent appraiser ordered by the owner of a property. The independent appraisal shall be conducted by an appraiser licensed by the Office of Real Estate Appraisers.

## **12. Commencing an Action**

If no agreement is reached, the acquiring entity may file an eminent domain action and will serve the owner with a copy of the summons and the complaint in eminent domain. The parties can continue to negotiate a settlement even though a complaint has been filed.

## **13. Answering the Complaint**

An answer is the owner's written response to the eminent domain complaint and is filed with the court and served on the acquiring entity.

## **14. What is a Prejudgment Possession Order?**

In some instances, the acquiring entity may need early possession of the property. After filing the complaint and depositing the probable amount of compensation, the

acquiring entity may file with the court an ex-parte application or a noticed motion for a prejudgment possession order. The occupants will usually have 90 days before possession is granted. Possession for unoccupied property can be had after 30 days. The owner may file an opposition or objection to the application or motion. If the court grants an application or motion for a prejudgment possession order, the public entity may enter the property and construct the project while the parties continue to negotiate or litigate the amount of compensation.

#### **15. Withdrawal of Deposit of Probable Amount of Compensation**

At any time prior to entry of judgment, the owner may apply to the court for the withdrawal of all or any portion of the amount of probable compensation deposited. Doing so waives the owner's right to object to the taking but does not foreclose the owner from seeking greater compensation.

#### **16. Alternative Dispute Resolution (ADR)**

The parties may agree to participate in a form of ADR to try and settle a case. ADR has many forms including arbitration, mediation and settlement conference. The parties usually split the costs of ADR.

#### **17. Trial**

If the parties cannot settle, the court will conduct a trial to determine the amount of compensation. Each side will be given an opportunity to present evidence of value. A jury will determine the amount of compensation after being instructed as to the law by the judge. In cases where the parties choose not to have a jury, the judge will determine the amount of compensation. If the owner challenges the acquiring entity's right to take the owner's property, the court will conduct a trial on the owner's right to take challenge before the valuation trial.

#### **18. Costs of Trial**

The acquiring entity will pay its own attorney and expert fees, legal costs and expenses. In addition, the public entity will pay jury fees if applicable and will pay the owner recoverable costs allowed by law. The fee incurred by the owner for filing an Answer to the Complaint is an example of recoverable cost. Furthermore, if the judge determines that the acquiring entity's final settlement offer before trial was unreasonable and the owner's final settlement offer was reasonable in light of the evidence and the verdict, the public entity will be required to pay the owner's attorney fees. Absent such a

determination, the owner bears the cost of its own attorney fees, experts and other litigation expenses.

## **19. Relocation Benefits**

If eligible, relocation benefits are recovered through an administrative process that is not part of an eminent domain action. The general focus on relocation is the actual, necessary and reasonable cost to move personal property to a replacement site and includes the cost of re-installing the old machinery and equipment at the replacement site.



## CONDEMNATION – TAX CONSEQUENCES

**Internal Revenue Code section 1033.** This statute (attached), provides if the owner of property that is condemned buys a qualified replacement property, within certain time limits provided under the statute, the capital gain realized from the condemnation may be *deferred*.

**California Rev. & Tax Code section 68.** This statute (attached), provides the replacement of property taken through condemnation is exempt from rules requiring reassessment on a *change of ownership*. The statute describes how the assessor is to compute the adjusted base year value of the replacement property.



## 26 USCS § 1033

Current through Public Law 116-91, approved December 19, 2019. Some sections may be more current; please check the History segment.

*United States Code Service > TITLE 26. INTERNAL REVENUE CODE (§§ 1 — 9834) > Subtitle A. Income taxes (Chs. 1 — 6) > CHAPTER 1. Normal taxes and surtaxes. (Subchs. A — Z) > Subchapter O. Gain or loss on disposition of property. (Pts. I — IX) > Part III. Common nontaxable exchanges. (§§ 1031 — 1045)*

### § 1033. Involuntary conversions.

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**(a) General rule.** If property (as a result of its destruction in whole or in part, theft, seizure, or requisition or condemnation or threat or imminence thereof) is compulsorily or involuntarily converted—

**(1) Conversion into similar property.** Into property similar or related in service or use to the property so converted, no gain shall be recognized.

**(2) Conversion into money.** Into money or into property not similar or related in service or use to the converted property, the gain (if any) shall be recognized except to the extent hereinafter provided in this paragraph:

**(A) Nonrecognition of gain.** If the taxpayer during the period specified in subparagraph (B), for the purpose of replacing the property so converted, purchases other property similar or related in service or use to the property so converted, or purchases stock in the acquisition of control of a corporation owning such other property, at the election of the taxpayer the gain shall be recognized only to the extent that the amount realized upon such conversion (regardless of whether such amount is received in one or more taxable years) exceeds the cost of such other property or such stock. Such election shall be made at such time and in such manner as the Secretary may by regulations prescribe. For purposes of this paragraph—

**(i)** no property or stock acquired before the disposition of the converted property shall be considered to have been acquired for the purpose of replacing such converted property unless held by the taxpayer on the date of such disposition; and

**(ii)** the taxpayer shall be considered to have purchased property or stock only if, but for the provisions of subsection (b) of this section, the unadjusted basis of such property or stock would be its cost within the meaning of section 1012 [[26 USCS § 1012](#)].

**(B) Period within which property must be replaced.** The period referred to in subparagraph (A) shall be the period beginning with the date of the disposition of the converted property, or the earliest date of the threat or imminence of requisition or condemnation of the converted property, whichever is the earlier, and ending—

**(i)** 2 years after the close of the first taxable year in which any part of the gain upon the conversion is realized, or

**(ii)** subject to such terms and conditions as may be specified by the Secretary, at the close of such later date as the Secretary may designate on application by the taxpayer. Such application shall be made at such time and in such manner as the Secretary may by regulations prescribe.

**(C) Time for assessment of deficiency attributable to gain upon conversion.** If a taxpayer has made the election provided in subparagraph (A), then—

## 26 USCS § 1033

(i) the statutory period for the assessment of any deficiency, for any taxable year in which any part of the gain on such conversion is realized, attributable to such gain shall not expire prior to the expiration of 3 years from the date the Secretary is notified by the taxpayer (in such manner as the Secretary may by regulations prescribe) of the replacement of the converted property or of an intention not to replace, and

(ii) such deficiency may be assessed before the expiration of such 3-year period notwithstanding the provisions of section 6212(c) [26 USCS § 6212(c)] or the provisions of any other law or rule of law which would otherwise prevent such assessment.

(D) Time for assessment of other deficiencies attributable to election. If the election provided in subparagraph (A) is made by the taxpayer and such other property or such stock was purchased before the beginning of the last taxable year in which any part of the gain upon such conversion is realized, any deficiency, to the extent resulting from such election, for any taxable year ending before such last taxable year may be assessed (notwithstanding the provisions of section 6212(c) or 6501 [26 USCS § 6212(c) or 6501] or the provisions of any other law or rule of law which would otherwise prevent such assessment) at any time before the expiration of the period within which a deficiency for such last taxable year may be assessed.

(E) Definitions. For purposes of this paragraph—

(i) Control. The term "control" means the ownership of stock possessing at least 80 percent of the total combined voting power of all classes of stock entitled to vote and at least 80 percent of the total number of shares of all other classes of stock of the corporation.

(ii) Disposition of the converted property. The term "disposition of the converted property" means the destruction, theft, seizure, requisition, or condemnation of the converted property, or the sale or exchange of such property under threat or imminence of requisition or condemnation.

**(b) Basis of property acquired through involuntary conversion.**

**(1) Conversions described in subsection (a)(1).** If the property was acquired as the result of a compulsory or involuntary conversion described in subsection (a)(1), the basis shall be the same as in the case of the property so converted—

(A) decreased in the amount of any money received by the taxpayer which was not expended in accordance with the provisions of law (applicable to the year in which such conversion was made) determining the taxable status of the gain or loss upon such conversion, and

(B) increased in the amount of gain or decreased in the amount of loss to the taxpayer recognized upon such conversion under the law applicable to the year in which such conversion was made.

**(2) Conversions described in subsection (a)(2).** In the case of property purchased by the taxpayer in a transaction described in subsection (a)(2) which resulted in the nonrecognition of any part of the gain realized as the result of a compulsory or involuntary conversion, the basis shall be the cost of such property decreased in the amount of the gain not so recognized; and if the property purchased consists of more than 1 piece of property, the basis determined under this sentence shall be allocated to the purchased properties in proportion to their respective costs.

**(3) Property held by corporation the stock of which is replacement property.**

(A) In general. If the basis of stock in a corporation is decreased under paragraph (2), an amount equal to such decrease shall also be applied to reduce the basis of property held by the corporation at the time the taxpayer acquired control (as defined in subsection (a)(2)(E)) of such corporation.

(B) Limitation. Subparagraph (A) shall not apply to the extent that it would (but for this subparagraph) require a reduction in the aggregate adjusted bases of the property of the corporation below the taxpayer's adjusted basis of the stock in the corporation (determined immediately after such basis is decreased under paragraph (2)).

## 26 USCS § 1033

**(C) Allocation of basis reduction.** The decrease required under subparagraph (A) shall be allocated—

- (i) first to property which is similar or related in service or use to the converted property,
- (ii) second to depreciable property (as defined in section 1017(b)(3)(B) [\[26 USCS § 1017\(b\)\(3\)\(B\)\]](#)) not described in clause (i), and
- (iii) then to other property.

**(D) Special rules.**

(i) Reduction not to exceed adjusted basis of property. No reduction in the basis of any property under this paragraph shall exceed the adjusted basis of such property (determined without regard to such reduction).

(ii) Allocation of reduction among properties. If more than 1 property is described in a clause of subparagraph (C), the reduction under this paragraph shall be allocated among such property in proportion to the adjusted bases of such property (as so determined).

**(c) Property sold pursuant to reclamation laws.** For purposes of this subtitle [\[26 USCS §§ 1 et seq.\]](#), if property lying within an irrigation project is sold or otherwise disposed of in order to conform to the acreage limitation provisions of Federal reclamation laws, such sale or disposition shall be treated as an involuntary conversion to which this section applies.

**(d) Livestock destroyed by disease.** For purposes of this subtitle [\[26 USCS §§ 1 et seq.\]](#), if livestock are destroyed by or on account of disease, or are sold or exchanged because of disease, such destruction or such sale or exchange shall be treated as an involuntary conversion to which this section applies.

**(e) Livestock sold on account of drought, flood, or other weather-related conditions.**

**(1) In general.** For purposes of this subtitle [\[26 USCS §§ 1 et seq.\]](#), the sale or exchange of livestock (other than poultry) held by a taxpayer for draft, breeding, or dairy purposes in excess of the number the taxpayer would sell if he followed his usual business practices shall be treated as an involuntary conversion to which this section applies if such livestock are sold or exchanged by the taxpayer solely on account of drought, flood, or other weather-related conditions.

**(2) Extension of replacement period.**

**(A) In general.** In the case of drought, flood, or other weather-related conditions described in paragraph (1) which result in the area being designated as eligible for assistance by the Federal Government, subsection (a)(2)(B) shall be applied with respect to any converted property by substituting "4 years" for "2 years".

**(B) Further extension by Secretary.** The Secretary may extend on a regional basis the period for replacement under this section (after the application of subparagraph (A)) for such additional time as the Secretary determines appropriate if the weather-related conditions which resulted in such application continue for more than 3 years.

**(f) Replacement of livestock with other farm property in certain cases.** For purposes of subsection (a), if, because of drought, flood, or other weather-related conditions, or soil contamination or other environmental contamination, it is not feasible for the taxpayer to reinvest the proceeds from compulsorily or involuntarily converted livestock in property similar or related in use to the livestock so converted, other property (including real property in the case of soil contamination or other environmental contamination) used for farming purposes shall be treated as property similar or related in service or use to the livestock so converted.

**(g) Condemnation of real property held for productive use in trade or business or for investment.**

**(1) Special rule.** For purposes of subsection (a), if real property (not including stock in trade or other property held primarily for sale) held for productive use in trade or business or for investment is (as the result of its seizure, requisition, or condemnation, or threat or imminence thereof) compulsorily or

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involuntarily converted, property of a like kind to be held either for productive use in trade or business or for investment shall be treated as property similar or related in service or use to the property so converted.

**(2) Limitation.** Paragraph (1) shall not apply to the purchase of stock in the acquisition of control of a corporation described in subsection (a)(2)(A).

**(3) Election to treat outdoor advertising displays as real property.**

**(A)**In general. A taxpayer may elect, at such time and in such manner as the Secretary may prescribe, to treat property which constitutes an outdoor advertising display as real property for purposes of this chapter [26 USCS §§ 1 et seq.]. The election provided by this subparagraph may not be made with respect to any property with respect to which an election under section 179(a) [26 USCS § 179(a)] (relating to election to expense certain depreciable business assets) is in effect.

**(B)**Election. An election made under subparagraph (A) may not be revoked without the consent of the Secretary.

**(C)**Outdoor advertising display. For purposes of this paragraph, the term "outdoor advertising display" means a rigidly assembled sign, display, or device permanently affixed to the ground or permanently attached to a building or other inherently permanent structure constituting, or used for the display of, a commercial or other advertisement to the public.

**(D)**Character of replacement property. For purposes of this subsection, an interest in real property purchased as replacement property for a compulsorily or involuntarily converted outdoor advertising display defined in subparagraph (C) (and treated by the taxpayer as real property) shall be considered property of a like kind as the property converted without regard to whether the taxpayer's interest in the replacement property is the same kind of interest the taxpayer held in the converted property.

**(4) Special rule.** In the case of a compulsory or involuntary conversion described in paragraph (1), subsection (a)(2)(B)(i) shall be applied by substituting "3 years" for "2 years".

**(h) Special rules for property damaged by federally declared disasters.**

**(1) Principal residences.** If the taxpayer's principal residence or any of its contents is located in a disaster area and is compulsorily or involuntarily converted as a result of a federally declared disaster—

**(A)**Treatment of insurance proceeds.

**(i)**Exclusion for unscheduled personal property. No gain shall be recognized by reason of the receipt of any insurance proceeds for personal property which was part of such contents and which was not scheduled property for purposes of such insurance.

**(ii)**Other proceeds treated as common fund. In the case of any insurance proceeds (not described in clause (i)) for such residence or contents—

**(I)**such proceeds shall be treated as received for the conversion of a single item of property, and

**(II)**any property which is similar or related in service or use to the residence so converted (or contents thereof) shall be treated for purposes of subsection (a)(2) as property similar or related in service or use to such single item of property.

**(B)**Extension of replacement period. Subsection (a)(2)(B) shall be applied with respect to any property so converted by substituting "4 years" for "2 years".

**(2) Trade or business and investment property.** If a taxpayer's property held for productive use in a trade or business or for investment is located in a disaster area and is compulsorily or involuntarily converted as a result of a federally declared disaster, tangible property of a type held for productive use

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in a trade or business shall be treated for purposes of subsection (a) as property similar or related in service or use to the property so converted.

**(3) Federally declared disaster; disaster area.** The terms “federally declared disaster” and “disaster area” shall have the respective meaning given such terms by section 165(i)(5) [[26 USCS § 165\(i\)\(5\)](#)].

**(4) Principal residence.** For purposes of this subsection, the term “principal residence” has the same meaning as when used in section 121 [[26 USCS § 121](#)], except that such term shall include a residence not treated as a principal residence solely because the taxpayer does not own the residence.

**(i) Replacement property must be acquired from unrelated person in certain cases.**

**(1) In general.** If the property which is involuntarily converted is held by a taxpayer to which this subsection applies, subsection (a) shall not apply if the replacement property or stock is acquired from a related person. The preceding sentence shall not apply to the extent that the related person acquired the replacement property or stock from an unrelated person during the period applicable under subsection (a)(2)(B).

**(2) Taxpayers to which subsection applies.** This subsection shall apply to—

**(A)** a C corporation,

**(B)** a partnership in which 1 or more C corporations own, directly or indirectly (determined in accordance with section 707(b)(3) [[26 USCS § 707\(b\)\(3\)](#)]), more than 50 percent of the capital interest, or profits interest, in such partnership at the time of the involuntary conversion, and

**(C)** any other taxpayer if, with respect to property which is involuntarily converted during the taxable year, the aggregate of the amount of realized gain on such property on which there is realized gain exceeds \$100,000.

In the case of a partnership, subparagraph (C) shall apply with respect to the partnership and with respect to each partner. A similar rule shall apply in the case of an S corporation and its shareholders.

**(3) Related person.** For purposes of this subsection, a person is related to another person if the person bears a relationship to the other person described in section 267(b) or 707(b)(1) [[26 USCS § 267\(b\)](#) or [707\(b\)\(1\)](#)].

**(j) Sales or exchanges under certain hazard mitigation programs.** For purposes of this subtitle [[26 USCS §§ 1](#) et seq.], if property is sold or otherwise transferred to the Federal Government, a State or local government, or an Indian tribal government to implement hazard mitigation under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (as in effect on the date of the enactment of this subsection [enacted April 15, 2005]) or the National Flood Insurance Act (as in effect on such date), such sale or transfer shall be treated as an involuntary conversion to which this section applies.

**(k) Cross references.**

**(1)** For determination of the period for which the taxpayer has held property involuntarily converted, see section 1223 [[26 USCS § 1223](#)].

**(2)** For treatment of gains from involuntary conversions as capital gains in certain cases, see section 1231(a) [[26 USCS § 1231\(a\)](#)].

**(3)** For exclusion from gross income of gain from involuntary conversion of principal residence, see section 121 [[26 USCS § 121](#)].

## History

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### HISTORY:

## Cal Rev & Tax Code § 68

Deering's California Codes are current through all 870 Chapters of the 2019 Regular Session.

*Deering's California Codes Annotated > REVENUE AND TAXATION CODE (§§ 1 — 61050) > Division 1 Property Taxation (Pts. 0.5 — 14) > Part 0.5 Implementation of Article XIII A of the California Constitution (Chs. 1 — 8) > Chapter 2 Change in Ownership and Purchase (§§ 60 — 69.5)*

### **§ 68. “Change in ownership”; Adjusted base year value of property acquired following condemnation**

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(a) For purposes of [Section 2](#) of Article XIII A of the Constitution, the term “change in ownership” shall not include the acquisition of real property as a replacement for comparable property if the person acquiring the real property has been displaced from property in this state by eminent domain proceedings, by acquisition by a public entity, or by governmental action which has resulted in a judgment of inverse condemnation.

The adjusted base year value of the property acquired shall be the lower of the fair market value of the property acquired or the value which is the sum of the following:

(1) The adjusted base year value of the property from which the person was displaced.

(2) The amount, if any, by which the full cash value of the property acquired exceeds 120 percent of the amount received by the person for the property from which the person was displaced.

The provisions of this section shall apply to eminent domain proceedings, acquisitions, or judgments of inverse condemnation after March 1, 1975, and shall affect only those assessments of that property which occur after June 8, 1982.

(b)

(1) A person acquiring replacement property shall request assessment under this section. A request made after four years following the date the property was acquired by eminent domain or purchase, or the date the judgment of inverse condemnation becomes final, shall be subject to subdivision (c).

(2) A change in the adjusted base year value of the replacement property acquired, resulting from the application of the provisions of this section, shall be deemed to be effective on the first day of the month following the month in which the property is acquired. The change in value shall be treated as a change in ownership for the purpose of placing supplemental assessments on the supplemental roll pursuant to Chapter 3.5 (commencing with [Section 75](#)). The assessor shall, however, appraise the replacement property acquired in accordance with the provisions of this section rather than the provisions of [Section 75.10](#). The provisions of Chapter 3.5 shall be liberally construed in order to provide the benefits of this section and [Section 2 of Article XIII A of the California Constitution](#) to affected property owners at the earliest possible date.

(c) A request for assessment under this section that is made after four years following the date the property was acquired by eminent domain or purchase, or the date the judgment of inverse condemnation becomes final, shall apply to the lien dates for the last four fiscal years with appropriate roll corrections, refunds, or cancellations. Under an assessment granted pursuant to that request, the assessor shall adjust the base year value of the replacement property acquired in accordance with this section and make adjustments for both of the following:

(1) Inflation, as annually determined in accordance with paragraph (1) of subdivision (a) of [Section 51](#).

## Cal Rev &amp; Tax Code § 68

(2) Any subsequent new construction occurring with respect to the subject real property.

## History

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Added Stats 1982 ch 1465 § 5.5. Amended Stats 1983 ch 662 § 2, effective September 7, 1983; Stats 1985 ch 186 § 5; [Stats 2015 ch 454 § 3 \(SB 803\)](#), effective January 1, 2016.

Annotations

## Notes

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### Editor's Notes—

### Amendments:

### Note—

### Editor's Notes—

For legislative intent, see the 1983 Note following Rev & Tax C § [60](#).

### Amendments:

#### 1983 Amendment:

Amended the second paragraph by (1) substituting "value which is the sum of the following:" for "adjusted base year value of the property from which the person was displaced."; and (2) adding subds (a) and (b).

#### 1985 Amendment:

Added the last paragraph.

#### 2015 Amendment:

(1) Added subdivision designations (a), (b)(1), and (b)(2); (2) redesignated former subds (a) and (b) to be subds (a)(1) and (a)(2); (3) amended the first sentence of subd (b)(1) by (a) substituting "A person" for "Persons"; (b) deleting "between March 1, 1975, and January 1, 1983," after "property"; and (c) deleting "with the assessor on or before January 1, 1987." at the end; (4) amended the second sentence of subd (b)(1) by (a) substituting "A request made after four years following" for "Persons acquiring replacement property on and after January 1, 1983, shall request assessment within four years of"; (b) adding the comma after "or purchase"; and (c) adding ", shall be subject to subdivision (c)"; (5) substituted "A change" for "Any change" in the first sentence of subd (b)(2); and (6) added subd (c).

### Note—

Stats 1983 ch 662 provides:

# **Expanded Community Advisory Panel (XCAP) Minutes (Verbatim)**

**February 5 2020, 4:00 PM**

Regular Meeting

Community Meeting Room

## **1. Welcome and Roll Call**

Chair Naik: Okay, we have a quorum, so we're going to move forward. Welcome to the XCAP meeting and I'll let Chantal call the roll.

Ms. Cotton Gaines: Alright.

Present: Gregory Brail, Phil Burton, Megan Kanne, Larry Klein, Patricia Lau, Nadia Naik, Keith Reckdahl, Cari Templeton (late), David Shen (late), Inyoung Cho (late)

Absent: Tony Carrasco, (excused), Adina Levin (excused)

Ms. Cotton Gaines: You have a quorum present.

## **2. Oral Communications**

Chair Naik: Thank you. We'll have oral communications first, and is there anyone who wants to speak on an item that is not on today's agenda? Okay, seeing none, we'll move to the next item.

XCAP Member Burton: Greg now has the handouts that I picked up at the Caltrain meeting a week and a half ago. Just please pass them around and return that when you're finished. Thank you.

Pat Burt: For the record, Pat Burt, good evening. So, I will add a little bit of update on the funding aspect, but what I actually want to do, to address was, on the next Town Hall meeting, there, it sounded like there is no intention to include anything about the new alternatives in that meeting, and I appreciate that AECOM is not going to have been able to flush these out and do their thorough analysis and have that presentation for that meeting. But I also think that the public is aware of those, is interested in them, and is going to come into that meeting expecting to learn something about them, and if they hear nothing about them at that meeting, they're likely to be disappointed and frustrated. And we don't want that. And so what I would encourage is figuring out some high-level presentation about those alternatives, perhaps including what are the considerations that are still needing to be evaluated by AECOM without providing the conclusions to those evaluations, so they understand where they are in the process, they understand them conceptually and they understand that there are a lot of questions that remain, so they don't leap to conclusions. Make sure they get enough that they won't walk away highly frustrated with that meeting. Because that's the new information in this timing from



a lot of the public's perspective. Second, on the funding, the Council in their most recent taking up of this, of the business tax, tentatively narrowed it down to looking at a high-end of the range of revenue about \$10 million a year, which if all of that went to grade separations, would be bondable to maybe a maximum of \$150 million. And so, what they're now considering is not what our citizen's group had been hoping they would consider, that would have had a much more substantial potential benefit on it. As Philip mentioned, once there are design selections, then the City can begin the process of pursuing other regional, state, even federal funds. As of right now, those funds are more limited, but at the state and the regional level, they are emerging, and I would expect that in the next year or two, there are likely to be more funding sources starting to emerge for these things. Thanks.

XCAP Member Klein: Thank you.

XCAP Member Brail: To the point of the public meeting, I understand that is staff's meeting. This is not an XCAP, running this public meeting, so I would encourage the staff to put in something about the two new alternatives, so that people aren't confused, but I don't think as XCAP there's a whole lot that we can do about it.

XCAP Member Burton: Well, Greg, you're right. But at the same time, it's a great opportunity to get to engage the people. Personally, I find it, I'll just say this, I found the Midtown Residents Association extremely frustrating in its pacifism and lack of interest and unwillingness to engage on any level beyond letting me write an email to that group, and who knows. I view this as very valuable (crosstalk).

XCAP Member Brail: The meetings are great. I'm just saying we as XCAP can't fix the thing that was addressed.

XCAP Member Burton: Agreed.

XCAP Member Klein: Go ahead.

Penny Ellison: I just wanted to say that I completely agree with what Pat Burt said and also encouragement from Greg that if you don't include something about it, I think it's going to undermine people's confidence in the City's process. And, you know, it's not XCAPs meeting, I understand. But it's going to fall on the City if it isn't in there in some way or another. And also, I'm sort of wondering how you're going to deliberate intelligently on the schedule that I thought I understood is in place without having the details of the engineering assessment of the two alternatives.

XCAP Member Klein: The answer in short, I think, it will become a two-step process.

Ms. Cotton Gaines: Thank you for the feedback related to the meeting. We definitely will put a little bit more in there than we were mentioning now. So, noted on the feedback.

### **3. Presentation and Discussion with Norm Matteoni, Managing Partner at Matteoni, O'Laughlin & Hectman.**

Chair Naiks: So, we have with us Norm Matteoni, who is the Managing Partner of Matteoni, O'Laughlin & Hectman and he is here to speak to us today about property impacts and the law that surrounds that. Thank you so much for coming today. Before I open the floor up to you, I'm going to let our City Attorney, Molly Stump say something and then I'll say a couple more words.

City Attorney Molly Stump: Sure, thank you. Thank you XCAPers and hello. When I heard Norm was going to come and speak to you about property impacts I wanted to be sure to be here and get a chance to listen and just wanted to say briefly upfront a little bit about various roles, and Norm may want to weigh in on this as well. I think what you would describe this type of a session as a kind of a primer to describe this area of the law which is fairly complex, and I look forward to a very preeminent local practitioner doing that for all of you. That said, there are areas in this area of the law where there can be differences of perspective and sometimes folks like Norm and folks like city attorneys like me end up on opposite sides, arguing various perspectives and ultimately courts can decide those questions. I am sure you'll point those areas out. So, I'm here to listen but ultimately, will give this type of advice and description to our City Council when we're going down the road and maybe facing some of these issues, maybe, hopefully not, but if we do in practice, then we will be working in that way. So, just wanted to make sure that I introduced myself and explained why I'm here and I look forward to listening to the conversation today, thank you.

Chair Naik: Thank you Molly and I just wanted to remind the XCAPers, so Norm is here so that as we have to do our deliberations and think about the alternatives and make the recommendations to Council, to the extent that there could potentially be property impacts, I say potentially because we don't know yet what there could be, that we would have as members of this group, a better understanding of what, in making a recommendation to Council, what we could, what would be the potential impact of what we're saying. Again, potential, potential could, if there could possibly be an impact. So, I just really want to stress that, but that is the point of having today's conversation. It's really to educate everybody on what it means and what it doesn't mean. So, with that I will let you take the floor.

Norm Matteoni: Thank you Nadia, thank you Molly. Let me just introduce myself standing, and then I'll sit down and blend in more. I've been a lawyer practicing Eminent Domain for a number of years. I started with the County of Santa Clara and did projects such as Oregon Expressway. A lot of the expressway projects I worked on, but in particular Oregon Expressway affecting Palo Alto and the ramps that I still don't think work right, getting off of Page Mill, but I was involved in, not the design, but the taking of property for those acquisitions. I have worked for school districts over the years. I worked for the County for ten years and probably seven of those were devoted to, no six of them were devoted to Eminent Domain actions, be it for the expressway projects, schools or flood control projects. All of those could touch on residential properties. Of course, it will also affect, depending on where the project is located, commercial, farm property, industrial properties.

So, it cuts across the board. So, I just wanted you to know that background and then after leaving the County, well for a few years in the County I did land use and advising the Planning Commission and Board of Supervisors, and that was a time when the Environmental Quality Act came into existence and I had an opportunity to assist the County of Santa Clara in preparing its own guidelines and implementation of the California Environmental Quality Act as it applied to projects, and I just mention the land use aspect of my practice for one purpose. One of the elements, and we'll discuss it later, in Eminent Domain is the highest and best use of the land. Land is not always to its current highest and best use. I suspect in the cases that may come up for these projects, that's not going to be an argument. Properties that are residential, they are going to stay residential, but I just let you know that. And then after leaving the County I did work in terms of representing the County of San Diego in an acquisition of 600 some odd acres for a new County jail by the border in Southern California with Mexico. I've done work, as I said, for school districts. But primarily I have represented property owners, so that's my perspective in terms of the impacts of a particular project on property owners. I have done that since the mid-70s, representing property owners. I also am the author of a treatise for California lawyers put out by what's called the continuing education. The Bar in its condemnation practice in California. I'm the principal author, there are other authors that contribute, particularly the tax chapter, which is not something I'm really up on, but I know enough to answer some of the questions that have been previewed to me. If those are of issue, we can talk about those. So, I've done that writing for a number of years and have appeared before the California Supreme Court on Eminent Domain issues, and the Appellate Court. So, with that, as I am about to make my move to sit down, I just want you to know how powerful the power of Eminent Domain is. It's the right of the Sovereign. The Sovereign here is the State of California and all of its political subdivisions. It is an absolute right and only in the Constitution is there a limitation, there's two. It has to be for a public use. There's no question that roadway improvements, transportation improvements, transit lines are a public use. And, succeeding on that front, the Government can go forward with what it defines as the project and take the properties necessary to implement that project, subject to paying just compensation, and the term just compensation has many manifestations that we'll discuss as we go through. So, I'm happy if you want to interrupt me at some point. If you think I'm getting off course, that it's not something that relates to what you want to know. You just tell me, and I'll back up and take a new lane. Yes.

XCAP Member Burton: Just a brief question. I had the impression that the railroad companies had or still have the Right of Eminent Domain under some circumstances, and possibly other quasi-utility type businesses. Am I right, am I wrong?

Mr. Matteoni: You're right. Actually, the early Eminent Domain law, and I should mention because that was one of the questions that had been previewed to me, you know, is there a body of Eminent Law? There is statutory law, legislation that dates back to 1872, and then the Eminent Domain Code was substantially revised and expanded in 1975, a 100-year span. So, a lot of things had happened, but the early law of 1872 was primarily based on what the railroads told the legislature they needed in California.

XCAP Member Burton: This is California Law?

Mr. Matteoni: Right, California, and so railroads. There are limitations on that, and backing off of it, but in the 1800s, not mid but 1870s and thereafter railroads were the dominant force that shaped Eminent Domain Law. And they had a lot of things in their favor. Utilities, obviously everybody has read about PG&E, whether it's gas lines or the problems with the electrification lines that have caused fires, they have the power of Eminent Domain. They historically they have been a very difficult agency to deal with. The law probably perked along in the early 1900s. Still serving railroads and urbanization of this State, but in the 1950s into the 60s there was a huge boom in Eminent Domain actions for the California Freeway System, for the aqueduct, and thus, one of the bodies of law that you look at in Eminent Domain is case law, cases that have gone up on appeal, to the Appellate Courts of the State or to the California Supreme Court or beyond. There was just such a volume of acquisitions that a number of them resulted, a substantial number resulted in litigation and a percentage of those went up on appeal. And, really, the Law of Eminent Domain notwithstanding, I told you, in 1975 the Eminent Domain Code was revised. The primary body of law is through individual cases and thus, the book that I contribute to is two volumes discussing the cases and what may have changed or modification of the law because of some new angle that somebody argued that the Court went along with or didn't go along with. But to go back to the Code, the Code is basically the procedure. If the City is going to file a condemnation action, that's the book, the code books that have all these sections and tell the City how it's to initiate a condemnation action, and how it is to pursue it through to trial. The evidence aspect in trial is primarily dictated by case law. So, to try to fulfill the primer aspect of what I can tell you, let me just tell you the procedure that any public agency would have to follow in taking private property for a public project. The procedure starts in the kind of things that you're doing right now in defining a project. Is it needed? What are we trying to accomplish? Where can it best be located to fulfill that public need. Years ago, school districts had a great deal of flexibility within an individual district of where they might locate an elementary school that required about ten acres, because a lot of the land was still in orchards around the subdivisions, but as the subdivisions took those orchards out, it became much more limited where school districts could locate, but they would do a study and determine, this is the best location. It's centrally located. Perhaps they knew the family that owned the farm or the orchard. We won't have to file Eminent Domain, I'm sure we can work it out with them and buy ten acres. They're very community minded. That was an approach that worked for small towns that all of us were at one time, here in the Valley. But things have become much more complicated and the complications, I guess, I can best describe, be it a rail line or a highway is, there isn't that flexibility of getting from point A to point B, and here, back here on the old rail line that Caltrain manages and runs, it's already on the ground, fixed, and we're now looking to another advancement of transportation that would utilize that corridor. So, the engineering has to be done, it has to be studied and since the 70s, it has to undergo an Environmental Review. The party that's going to condemn, be it the City of Palo Alto, Caltrain, Caltrans, whatever agency has to have all of that done beforehand. It is presented to the body, and it's probably presented to the governing body in terms of some alternatives. Again, not much in the way of alternatives for a transportation line, but it, nonetheless, must

be presented and from the aspect of Eminent Domain, that this is a project we want to pursue. The Environmental Impact Report has been analyzed and all mitigations that can be thought of are laid out, whether there needs to be overriding considerations to further it are determined and the properties are identified that are going to be affected. That document itself may provide some information to the property owner whose property is going to be affected. So, when VTA brought the BART line down from Hayward and Fremont, the extension into Milpitas and the Berryessa station, they did, for example, analysis of sound impacts and grade, if they're going below grade at certain intersections, what's around that and there were a lot of apartment houses affected, some homes. Mitigation measures were going to have walls on either side of the corridor. We're going to do some baffling coming out of the tunnels getting back to grade. Those aspects were analyzed, as well as vibrations, which is another big thing in terms of a rail line, and presented in the EIR. Some of those points of information which were more general than a property owner would want three later when the individual's property is taken, well, you didn't look at it from this aspect. You measured the sound over here and projected onto computer modeling or what have you. That's not the impact that I'm going to suffer. None the less, that is a strong starting point to assess those kinds of impacts. So, the government, through the process of environmental review has delivered some information, both to the decision maker and the community affected that weighs on whether there are damages for compensation, because there are going to be residents now that are going to have this extra noise impact and nuisance. The other aspect, and I'm still trying to blend in some of the practical issues of impacts on residents as I tell you the procedure, but I want to stay with the procedure. When a project is decided we're going to go forward. We have the funding for the project. Then the right-of-way people, the acquisition people are called in to obtain appraisals of the lands that will be affected. It's at that time that any affected property owner will be very specifically notified. You're involved, you're going to be following this project, so I don't have any fear of your notification of what's going to happen at various stages, but many property owners aren't up to that speed, and they get a letter from an appraiser adviser, I've been retained by agency X to appraise your property because of the prospect of taking a portion of it for whatever the project is. And you have the right, the law gives the property owner to meet with that appraiser and explain the property and understand what the appraiser can tell the property owner about the project. Is it a total take, it's a partial take, whatever? When I say parcel take, if that's the whole parcel, you may have a situation where only a corner is clipped off, or you're left with just a corner, depending on, you know, how your property is in relation to the project boundaries. Those have, those lines have very significant impact in appraising the property, because it's not just to put a value on the total piece of property. That's a necessary first step, and if it's a purchase of the total piece of property, that's an easier appraisal, or it should be an easier appraisal. But when you start reshaping the property, removing part of somebody's front yard or rear yard or clipping off a room of a house, things change dramatically. The other aspect of Eminent Domain is not just compensation for the land taken, but damage to the remaining land. So, that's a very important meeting and the law directs the public agency to have its appraiser reach out and have this meeting with the property owner. The next step would be for the appraiser to complete the appraisal and it is submitted to the agency for review. The agency gets the first look at it and there are people within

the agency that are also schooled in appraisal so they know what they're looking at. Wait a minute, you missed something, or we don't understand this or how you pulled this piece of information into your appraisal. So, it may be dialogued, depending on how well it's done, before it's released. But the way it's released is also mandated by law. It is released by the agency contacting the property owner, saying that it has an appraisal for the acquisition and it intends to make an offer based on that appraisal. From the agency's standpoint, it's not to spend more than fair market value. So, it has made that determination through this initial step of what it believes, on the basis of an independent appraiser to be the fair market value. And I want to inject a word of caution. Notwithstanding the property owner explaining on a partial take, well, wait a minute did you consider this? That's going to be very detrimental. You removed this whole portion of my backyard. The fence is right up against the pool or the patio. You really, how would I put it? It's just a harder look once the appraisal, that initial appraisal has been made and the property owner receives that, and that is often an area of a great dispute. Severance damage it's called, the damage to the remaining property, much more so than the value of the land or the improvement. I'll explain later on how the appraiser approaches valuing those types of improvements and the land. So, we're back to procedure. The property owner now receives an offer and it contains a summary of the appraisal that was made for that particular property. And the requires and the agency provides notice that the property owner may seek its own independent appraisal and the agency will pay up to \$5,000 towards the cost of that appraisal as a part of attempting to negotiate to a price. So, what the agency is basically asking for, what did we miss in our appraisal? You disagree with this. Show us some reason to revise, because all we pay is just compensation. We're not going to make a gift of taxpayer funds, and we believe we've met that standard. So, the property owner does get the appraisal and usually at about the same time an attorney, and oftentimes the attorney must even assist the property owner in seeking an appraiser. From the standpoint of my job at that point, I'm looking for an appraiser that is not just an appraiser you can find online or in the phone book, but an appraiser who has experience in trial. Particularly if the dollars you're talking about are large, there's room for a great deal of dispute and how well is that appraiser going to be able to translate its investigation to testimony. So, the lawyer begins to work with the property owner at that juncture, may work out a settlement, fine. But let's assume the settlement doesn't occur. It's back in the hands of the agency. It's got a project it needs to pursue. It can only pursue it through Eminent Domain if there is an unwilling seller. Eminent Domain makes the unwilling seller have to sell. The agency is required, again by law, to notice a hearing before be it the City Council, the Caltrans Transportation Committee, the joint Powers Board for Caltrain. Whomever it is that is pursuing the condemnation. It gives the property owner notice of that hearing and the right to object. The right to object has nothing to do with the value. It's whether this is a valid public project which I would tell you 99.9 percent of any such objections would not succeed with the body of law. The definitions of what fits, what types of projects fit public is very well established. But, could be some procedural misstep in terms of the environmental analysis or just the, particularly in smaller towns. At one time I was on the City Council in the City of Saratoga. The City of Saratoga just detested filing Eminent Domain actions. It felt it was a small town and it wanted to work things out. So, if it noticed a hearing to pursue Eminent Domain, the property owner

would come in and object and the City might back off and say, take another effort at negotiating this out. So, there is another aspect in terms of just the politic of a hearing, and I'll give you another example on the VTA extending the line from Fremont/Hayward into Santa Clara County for BART. Periodically they need some electrification stations and somebody came in that I thought was fairly well connected. It wasn't my client but a high-tech firm on what would happen, the interference with that electrification facility to keep the line active at the right whatever, would have a big damage and isn't there another alternative that you can move it? Both on the basis of the argument that you're going expose BART and VTA to large damages, and that it was a company of repute and somebody that the Board decided they wanted to protect, they moved. They moved that, they didn't move the line, but they moved the auxillary facility that served that line. So, those are types of arguments that can be made to the decision makers. The other is, and this used to be fairly frequent with school sites, that there are other alternatives that more reasonably suit your purpose. That's still a very hard argument to make because the governing, not the governing body, but the public agency has gone through all these studies and engineered this project in a specific way, and now somebody is standing up and telling them, you can do it a better way that avoids my property, or minimizes the impact on my property. It's possible, it doesn't usually happen, but in this County and Palo Alto there are some very bright people with engineering background that can make good arguments. At least you hear them in terms of impacts on new development. We don't want that development in our community. So, I'm just trying to give you some examples of how objections can be made, but ultimately, again, you can't say you're not getting enough for the property. You can kind of sneak that in, that you didn't look at this impact, like I told you the electrification booster station did to a high-tech company and its operation, and you'll cause substantial damages that will make a public body rethink some aspect of the project. Aspects that I've seen rethought, Caltrans on a design in Emeryville of an off ramp coming into Emeryville was able to change the curvature a bit so it didn't impact, I don't know if it was a Walmart or whatever, a big-box operation that had truck deliveries off of the local street they were tying into. Caltrans has a very good process that I'm not aware most agencies use, but if somebody makes an objection before it goes to that hearing body, the legislative body, it is referred to the engineers. If there is some modification that can be made and that's to the district engineers, which are located for us in Oakland, and if you're not satisfied with that, it goes up on review to Sacramento before the Transportation Commission hears the presentation by its staff and the objecting party on whether to take the property. But having gotten through all those steps you're probably going to find a resolution that authorizes condemnation and shortly thereafter, a couple of weeks, a month, a lawsuit is filed and served on the property owner. Maybe I should stop there. That gets us to the point of heaviest impact on the property owner and the next step is, what is the property owner to do to defend itself. So, I don't know if there are questions to that?

Chair Naik: I have one questions, and if the XCAPers want to jump in, and then we can move along. Are you familiar with whether or not Caltrain actually has to seek an EIR to do grade separations? Because my understand is that because it's a train, unlike a road, they can't turn so they only, if they have to do one, they can only do it in one spot because it can't really move. I thought Caltrain has always chosen to

do them, but actually that there is an exemption in CEQA and I'm wondering if you're familiar with that at all?

Mr. Matteoni: Well, the exemption would be that there are no alternatives. I can't quite think of the wording. Molly can help us out on CEQA exemptions, perhaps. But I would still think it has to do that because the grade separation is not going to just affect whatever the width of the right-of-way for the rail is. To do that, you've got the street going down, coming up, walls against what were properties to hold back the cut, probably tiebacks into the properties. I remember one in Fremont probably five or six years ago, they weren't residents but I can't quite remember the name of the street, but that had to happen and the street was at grade and it had the arm that came down to protect the people when the trains went by, but now everything is changing and it's going to be much more frequent, so we're going to separate that so the traffic can flow on the local streets while the BART train goes by. There was a business that I represented that had access problems because of how far the grade come back on the local street and intercepted and changed their driveway, and there were tiebacks that came into their property so underneath their property, which parking area, but there was concern does that affect our future development? You have these tiebacks and we can't excavate or we can't change that. So, all that was analyzed in an environmental review. And, thus, I think the answer would be they couldn't avoid it.

XCAP Member Burton: Is it sometime simpler just to do a whole property take to avoid the severance damages issue?

Mr. Matteoni: Yes, sure. If you're going to take all of that and leave me that, you're better off, as a public agency in most cases I can imagine, to acquire the total property. And the law, the Eminent Domain Code specifically authorizes that. To avoid excessive damages, the agency is authorized to take the total property beyond what it owns. So, you'll find, again with an agency such as Caltrans, if you cared to look that there's many remnants for a particular stretch of highway, little triangular pieces, they try to get rid of them and ultimately some adjoining property owner might take that and consolidate it with their holdings, but yes.

Inyoung Cho: When the appraiser, like whether you're an appraiser or city, the agency appraiser appraises your property, what point... You know, the property value changes over a certain period of time, so when would be that time. You know, is it, if they decide to give me money today and you know, construction moves on, like three years later my house could double. Like, I mean, when is the time that...

Mr. Matteoni: Okay. I understand the questions. There are different points that would provide different answers. But I'll start with how the public agency taking your property protects its date of, what's called the date of value. When the lawsuit is filed, if the agency deposits the amount of its appraisal, telling the court that in its judgement this is the probable amount of just compensation, the agency is entitled within 90 days to an order of possession. It may not get that possession, but the key point to your question is, that date of deposit, which usually goes to Sacramento into what's call the State Deposit Fund, sticks as the date of value. Most every agency makes that deposit a few days before or after or on the date they file the lawsuit. You may not get to trial, if you're contesting that, you may not



get to trial in Santa Clara County for 18 to 20 months. Just the way cases are stacked up that have nothing to do with Eminent Domain, but the flow of cases in this County. So, 20 months from now you are arguing on what is the value on February 5, 2020. But there are many variations to what I just told you. I'm going to backup to when you were approached. I'll assume you were approached by the appraiser who came and visited you, and that was seven months ago from February 5, and the agency didn't update that appraisal. It may think, well, the values have just barely risen or they are about the same. That gives rise to lots of arguments, which most often work in the property owner's favor if you can find new sales. Well, your appraisal is dated. I did have a Caltrain condemnation for one of these electrification booster stations that took out almost two acres of property a couple of years ago, and the appraisal was 18 months before they filed the lawsuit. We ultimately settled that case along the lines that I was trying to give you an example of, that we had to produce other sales. The market had changed and so Caltrain, actually it was JPA for Caltrain, went back to their appraiser and their appraiser said, yeah, I have to make an adjustment. Let me look at it and so forth. So, it provided a way to negotiate a settlement, but the settlement was probably 18 months after the lawsuit was filed. Now, another aspect of what I told you in terms of that deposit, you can take that money and still fight for more compensation. You're not prejudiced by having withdrawn the money.

(off mic)

Mr. Matteoni: And you probably want to take it, because the interest rate from the deposit fund is pretty low. It's posted and changes every quarter, but you're entitled, if they take position, they don't always take position, but most of them do within 90 days. If they take position, you're entitled to interest from February 5 until you get your money. If you withdraw it, whatever amount you withdraw, you're not going to get any more interest on, but if you get an increase you would still get on the delta, interest on that money that you eventually derive as the just compensation for your property. Does that answer your question? Okay. Yes.

XCAP Member Burton: If someone has to move there are probably a lot of costs beyond just finding another property. My out-of-pocket might include all kinds of expenses for rentals, moving companies and whatnot. Are those covered by the compensation award?

Mr. Matteoni: No. They're covered under what's called relocation assistance, and it probably works best for homeowners. It came about in and about 1970 from federal legislation, and then the feds, if they were making grants to transportation projects in California, mandated that the local agencies apply those rules and then within a couple of years, California adopted its own relocation assistance. Relocation assistance would be, again, they're taking your home, but before they file a condemnation action, they are supposed to offer you alternatives of where you can move. Very difficult in this area. I don't think most relocation service agencies do a good job on that. They do a particularly bad job on little businesses trying to find them a spot to go. But there must be, at the same time as that environmental review is going on, there must be a relocation plan that's put together. So, that's put together a few years before and, again, I'll give you the experience I know from

the BART extension, now into San Jose, the prospective properties affected a relocation specialist comes and interviews them. But that took place two years ago. There has been no condemnation coming into San Jose for BART yet. Maybe there will be later this year or next year for reasons that we don't have to discuss, but just project delay. And by the time that happens, you might have sold your business to somebody else, different things happen. Or, once it becomes real, you think of a lot more impacts on your business and the difficulty of moving may become much more complicated. In the Caltrain example that I gave you regarding this property just under two acres, it was used for Apple bus service for its employees. It used to be a large lumber yard, but it was a big maintenance building in the middle and big yard. You could park buses and repair them. It was next to, I don't know if you know where Bellarmine Prep is, but 880 at the crossroads that made very good sense for Apple and its employees going out to getting them, transporting them to wherever they transport them. The redevelopment, not redevelopment, the relocation people provided maybe, here's five places you can move. Well, the City of San Jose, they needed to stay in close proximity or the cost of fuel goes up the longer the runs. The deadhead time goes up the longer the runs. There's more wear and tear on the buses. They were at a strategic location. Everything is starting to move them out, and they're very near downtown San Jose, five miles, three miles. The City won't allow outdoor storage of vehicles in this zone. If you want to pursue that property, you're going to have to get it rezoned. So, these problems along the lines that you're mentioning start to multiply when you get to a specific property and moving. So, back to residents, I'm not quite sure when you said rental, if you're renting the residence, they are to give assistance to move the occupant of the property. You would not receive that assistance as the landlord. It would go to that party. They also pay moving expenses. You're required to get two bids, submit them for review and they will pay the lower bid. Where are you moving? Some people are not in a position to relocate. They will do some temporary relocation. There are restrictions that, okay, I've got to put this in storage for a year. I'm not in a position because of health issues with my spouse to find another location and move. We're going to move in with my daughter, but all the furniture has to be stored somewhere. Well, they may store it for you for two years and pay for that, and then that's it. So, there's another whole level of issues in pursuing relocation assistance that's beyond the just compensation. The just compensation I'm talking about and we'll get to as we go down the line towards trial focuses on this piece of property and what's on it, and not moving things.

XCAP Member Brail: Everything you said has been about obtaining pieces of property, but in the case of the BART you mentioned apartment buildings that were the tunnel entrance so there would be an increase in noise and vibration. Where does that whole fit into this whole thing? Because it seems like what we talked about before, the Eminent Domain you know, seizure of land is sort of the last step in the process and there's a whole lot of other impacts on properties that these projects could have, and I'm wondering where that fits in and what your experience has been there.

Chair Naik: Norm if you could just move closer to the mic so the audio guy can, because the meeting is being recorded. Thanks.

Mr. Matteoni: Okay. Sorry. I'm starting to try and relax here. As I paused to put it into perspective, there are those impacts that you've identified to adjacent properties that are not within the scope of the right-of-way, and the law up to, by case law, up to 1980 was, sorry, you know. We didn't take your property. It's more noisy. But their property owners, and there was a case, to just use again examples, if these examples aren't helpful to you, tell me. But I think back to cases to try to illustrate and answer to the question. So, there was a property known as Pierpont Inn in Southern California that was along the coast. The highway was coming along side of it, I think it's in the Santa Barbara area. In any event, there was going to be construction for two plus years, major construction of the highway and the hotel said, hey, all our rooms on the east side of the hotel are going to be affected. We're not going to get the rental charge that we would usually get or they may be vacant. People aren't going to come here to hear all that noise. That case went to the California Supreme Court. Actually, I said in the 80s and that was 1972, and they prevailed in terms of, they had unreasonable damages by reason of the construction. There was a company when I was in college, Jennings Radio was sold to IT&T, and when highway 80 came through, this property in San Jose off of Mclaughlin Avenue, they were an early high-tech company that did these sophisticated radio tubes. I was just a flunky working there, so I can't explain high-tech stuff. And their claim was the dust, not the noise, but whatever traveling on the roadway that was elevated above their, or at the same level as their rooftop was going to create dust and they were going to have to increase their air conditioning system, purifying, because they can't have that in the manufacturing section of their operation. So, that was another example, and that's a reported case of someone getting compensation for being adjacent. Nonetheless, those are cases that usually would require you to bring a lawsuit against the public agency. They do not tend to acknowledge those peripheral impacts. They do nowadays, because of these cases, on sound walls, that became an established approach to mitigate those kinds of damages. Nonetheless, I know when highway 85 went through Saratoga, the roadway had, it was striated or something. It created (crosstalk), and it was below grade and has sound walls, but the residents of a particular area said, we never had the rumble before, and we did not succeed in that case. I represented them, but it's gradually gone away or people have gotten used to it as the serration has decreased on the roadway. But it was a whole neighborhood that was concerned about it because the homeowner's association was reacting to the people most impacted right near the highway. So, yes, I guess the short answer is, there's compensation, but you have to pursue it in most cases.

XCAP Member Kanne: What if relatedly, what if we're changing public land, like loss of a parking space for example, or public benefit that a property owner might have expected that they no longer have access to? Is there any compensation for that sort of loss?

Mr. Matteoni: Well, if I understand the question, I'll take you to the reroute of the El Camino around the University of Santa Clara a number of years ago. Santa Clara pushed and the City endorsed that taking this section of the Alameda out of the middle of the University, the University began moving eastward. There was an old road called Campbell Avenue that had a lot of industry right up against the railroad tracks. There's a walnut plant there. There was very little traffic on that road. The

walnut plant employees all parked on the edge of the road next to the spur track that served the walnut packing company and a piece of the property was taken for the reroute of the Alameda and we're not going to have parking anymore. There was no compensation for the loss of parking because any municipality can, for traffic control, can take away parking or control parking. You can only park here at given times, posted hours. So, if that was your question, if you're losing parking on a public street, no not today. The law doesn't recognize compensation that.

XCAP Member Kanne: Thanks. I had a follow-up question to Greg's too. As you mentioned apartment complexes, if there are tenants on any given property, does that result in any special legal rights? I know there have been expansions in renters' rights recently. So, is there any special process for handling properties that have tenants that, perhaps, if the property were taken, would need to be evicted?

Mr. Matteoni: There are none that I know of beyond what I was telling you regarding relocation, and that's where relocation works the best, with tenants, residents in apartments. There, I don't know if Palo Alto has any, but there were old transient hotels in downtown San Jose years ago, probably still a few. But when that redevelopment was doing its thing to clear land, they would go and move somebody out to another location and then rent that unit from the owner, because they had so many people they had to move, and they couldn't take position of the whole piece of property until they got everybody out, they would rent it to keep it vacant, so the property owner didn't lose anything for that period of time. So, there are variations on how a public agency can approach taking care of tenants or the owner who suffers the loss of a tenant for a time.

XCAP Member Reckdahl: How do you value something like, if you have tiebacks going through your backyard. It may or may not affect the homeowner. How does the homeowner value that, or how does the court value that?

Mr. Matteoni: There's no fixed answer. It's the judgement of the appraiser, you know, what is the depth of the tieback, is it reasonable in that neighborhood that somebody would put in a pool and there would be interference. Otherwise, it's going to be something of a nominal compensation because there is an invasion of the property. But there may be, you know, what's the maintenance of those. Do they erode over a period of time and then the agency has to come back and invade the property and disrupt? So, the property owner would look for as many things as they could find that would change its total control of its property, the side yard, backyard to advise the appraiser and the appraiser is going to have to make a judgement. Again, another case was a utility line was put in the parking strip next to the sidewalk. I think this was a case out of Salinas, and that wasn't much of an impact, but the property owner said, but you have the right to come back and expand that utility, and the city said, but that's all we've done. No, your resolution says you have these rights on my property. I don't know when you're going to do that, 20 years from now, 15 years from now? And the court said, yes you have to compensate for the full scope of the impact of what you may do, not just what you did. But, again, I don't have a fixed answer for you.

XCAP Member Lau: I have a question about the right to object, and alternatives that reasonably meets the interest, and in terms of residents who may not be

articulate or knowledgeable about the law, I'm wondering if there's legal advice for those people who may not be, let's say, as I said, knowledgeable about procedures about how to pursue a lawsuit, or at least even ask questions about what their rights are?

Mr. Matteoni: Again, publications today do a good job in addressing that issue, but it probably works best for English-speaking people, although they can be translated, but you will get with that first offer, a pamphlet of the process. Not as I'm jumbling it in all different directions. But step-by-step and what your rights are, so it's an informational packet that is delivered to the property owner. That, you know, that works well for people that are sophisticated and understand these things. At least, way back when, and still happens that a lot of public projects that have alternatives are located where the property is less valuable and there are people that live there that do not have high income or higher education. There were environmental justice suits in Los Angeles to stop projects for that reason of going through a low-income neighborhood and the displacement of those people. But there is a process and I would say in this County it works pretty well.

XCAP Member Shen: Just so I'm clear, so, if there is like a sound or visual impact, and the example I'm thinking of is, one of the options we've been tossing around is the building of a viaduct potentially and some properties have the backyard right up against the tracks right now and consequently there would be a huge structure behind there, would that be a case where the property owner would still have to do that kind of lawsuit after the fact and on their own? But I could also see potentially it could be where any appraiser could say, oh, I have examples housing values and what happened when something got built so close that there is a drop in the value or a change in the value because of it.

Mr. Matteoni: Was the predicate to your question that a portion of the property was acquired?

XCAP Member Shen: No, there's nothing, it would be like daylight plane or just there's a big visual thing and potentially that could affect my livelihood as I live there or if I sold it, that would affect the value of the sold property versus not having that thing behind there.

Unidentified female: No encroachment on the property? So, in other words, right up against the fence line, two feet actually from the fence line, but no actual encroachment.

Mr. Matteoni: Well, that might be difficult to accomplish, at least for the construction of it. They may need temporary access of the property. So, I don't know if I previously mentioned this or not, but I represented a Police Officer on the Palo Alto Police Department who lives in Sunnyvale, and there was a wall placed on his property, but a piece of the property was taken, so, in that situation you ask for that as damages in the lawsuit that is filed, and if you don't it's forever gone. You know, geez, I didn't realize what an impact or how big the wall is. But your situation would be along the lines of what we were talking about a few minutes ago. You would have to initiate that and, yes, there are damages for that. I have not had a case where there was no taking, but I had a case in Saratoga for a condominium

project and, this was highway 85, and the roadway comes to grade next to the condominium. The wall is 14 and 18 feet high. These people, there were eight units, I think, eight or nine units, had a view of the foothills, Santa Cruz Mountains looking towards what's called the Saratoga Gap and that was gone. The appraiser came up with some diminution in value to each of those condominiums units that no longer had that view. They're looking at a concrete block wall.

XCAP Member Shen: So, in that case that you were describing, that would not require the property owner to kind of state that. It was more automatically built into...

Mr. Matteoni: Only if there was land acquired. There was long acquired from the condominium property owners, the common area I should say, and we folded in, we represented the condominium for the taking of the common land, and then the Board was saying, but there's individual owners that feel they're impacted if this is going to be this high. And so, they were folded into the lawsuit, but we probably did initiate those lawsuits. I can't remember, that was 20 years ago, on their behalf and consolidated then with the suit with the homeowners.

Chair Naik: Norm, is it fair to say that in general, there is a deference to the agency? So, in other words, it certainly from what you described, there seems to be a deference to, you could try to make the case, like they could have picked a different spot for different alternatives, but generally transportation agencies have gone through a very rigorous process to even get to that point, so there is not a lot of – usually deference is given?. Also, when it comes to any potential damages, it certainly would take any resident whose property was not acquired to try to sue for damages, but that generally it is kind of a difficult thing, because there isn't any other place that could have gone, or is it that they could still get damages?

Mr. Matteoni: Well, you're not going to get it moved if it's been constructed, so it's just a matter of damages and the judgement of the diminution in value because of loss of view. Loss of sound, not loss of sound, increased sound is probably easier, because it's been recognized for so long. But that Pierpont Inn case, as I recall, also had an element of somehow the freeway structure on a piece of it cut off the view of the ocean. So, view is important, you know. There are properties that have or move up the hillside and see the sweep of the area here. You're going to pay for that. So, there are ways of measuring it and you could be on the flatlands and still have a great view, and somebody puts up a wall, that's not what you had before. You're diminished. Somebody three blocks away with the same type of house is going to get more money if they sold the house.

XCAP Member Klein: I know each of these cases has its own facts, but how about a ballpark figure as to what the homeowner is likely to get for diminution because of sound and loss of view?

Mr. Matteoni: I think back on the case that I told you about, these were garages on the first floor and you came in behind the garage to a level and then had a second floor with the bedroom. They were in the neighborhood; it was settled \$8,000 to \$9,000 each but that was 20 years ago.

XCAP Member Klein: Right, but I'm more interested in the percentage of the total value of the property

Mr. Matteoni: Oh, I see. Those units were probably in the \$300,000 category at that time.

XCAP Member Klein: So, it sounds like 3 percent or so.

XCAP Member Cho: So, like an Eminent Domain lawyer, is it like you don't pay the lawyer until, unless you win kind of situation? How does it work?

Mr. Matteoni: It works in two ways. One, an hourly rate, the other is a contingency, and the contingency in Eminent Domain is based on that offer you received before you hired the lawyer, and whether the lawyer can get you a difference, a great amount, then the lawyer would take a percentage of that difference.

XCAP Member Cho: I have another question. So, if there is a school, Palo Alto High School, right next to the Caltrain corridor and if the Palo Alto High School somehow gets impacted, if the school, the organization could represent against whatever they're doing...(crosstalk)

Mr. Matteoni: Can Caltrain take school district property?

XCAP Member Cho: Yeah, or take their property or you were talking a lot about environmental impact, I think. You know, school football field is right there and they exercise and that the construction could impact their breathing. I don't know, I live right next to it, so I'm worried about my breathing. You know, things like that.

Mr. Matteoni: Well, there's a couple of parts to the question. School districts are public agencies, and so if another public agency wants to take a second public agency's property, there is a different standard. The law requires that it's a more necessary public use. Historically, transportation in California has been more necessary than other public uses, but there would be a special consideration to damages to a school. When I was with the County, again, if you know the fairgrounds property in South San Jose, there was the Franklin McKinley Elementary School, and the kindergarten was nearest to the street, but they had a crescent drive and the buses came in, let the kids out, picked them up. That was quite a ways removed from the road. Well, Tully Road was widened substantially, and that school district fought the acquisition, the County won on the more necessary public use, but the County paid substantial damages in redoing all the windows to soundproof them. The school said, we can't have the little kids here anymore. We have to change the arrangements within our facility, and those were all costly moves. So, I'm not sure of the particular impacts on a recreation area of the school, but the school certainly would have the right to claim damages.

XCAP Member Kanne: Is there another process that the City could go through with the school district to avoid that sort of situation?

Ms. Matteoni: I guess it would depend on how you design the project, your input on the design.

XCAP Member Kanne: I guess what I'm asking is, it seems to me that if the City wants to acquire private property for any reason, it needs to go through this process. Perhaps I'm wrong about that, but I'm trying to understand if there is like a separate process.

Mr. Matteoni: Oh, is it a different process?

XCAP Member Kanne: Yeah.

Mr. Matteoni: It's exactly the same process, it's just a higher standard of when that first resolution is passed to take the school district, the school has potentially a stronger argument than the private property owner, because of its public status. And, maybe this is a point to, do you guys just keep going or do you take breaks?

Chair Naik: Nope, we keep going. If you would like a break, please say so.

Mr. Matteoni: Let me just take a sip of water.

Chair Naik: Absolutely, and then while you're taking a sip of water, after I'd love for you to talk about the tax consequences.

Mr. Matteoni: Sure. But there is the right to object. You make that argument at the hearing of the City Council or the Joint Powers Board. Incidentally, the Joint Powers Board, at least for the electrification project retained the VTA (Valley Transportation Authority) to do the condemnations. My client went, I did not go, he made an objection, and it was to the VTA Board. But where was I going here? If there is an objection, there is the right to pursue it in court, but I told you at the beginning, as long as it's a public use, you're not likely to win. You might win procedurally, that the environmental review was done improperly and it sidetracks things for a period of time. But I don't see the opportunity for Palo Alto High School or the residents to have an effective right to take objection that would prevail in court. Maybe you all are familiar with what happened in 2005 with Mrs. Kielow in New London, Connecticut. That was a redevelopment type of project for Pfizer Industry that New London said, we want to increase our tax base and these residents here can be moved somewhere else for Pfizer, because that's going to be a great economic boom to our community and help us pay for other public facilities and the like, and Mrs. Kielow, in fact, there is a little film made of her objection, a little pink house. She went all the way to the United States Supreme Court and lost in a 4-1-4 decision. She said it wasn't a public use. It was a public benefit and tried to distinguish the word public use based on the historic understanding of public use. If the public using a road. If the public is riding a train. The public goes to school. And she lost on that close of a decision, but ever since, she has been sort of patron saint of those that want to object, but she lost and most everybody loses the fight. So, where do we want to go.

XCAP Member Reckdahl: Quick question. The government an only pay fair market value. In your experience, is that generous or is it pretty much right on fair market value?



Mr. Matteoni: Well, I told my prejudice. I represent property owners. I think it's usually conservative. Agencies that don't do a volume of business, I think are more generous. PG&E is not. People object to overhead power lines or gas lines through their property, and PG&E has just been, you know, that's not a damage. You've got to have these and you can look through the lines and see your view. Don't worry about EMF. It's nonexistent. Those types of issue. And so, if you're going to take that on, you're going to be in court arguing that, because PG&E will not admit those kinds of damages, so they're not reflected in a PG&E appraisal. Caltrans for years wouldn't recognize noise damage. It does now. Caltrans, just as an example, it's moving away in some locales where a local bond measure has been passed to fund an interchange or some highway improvement, so the locals are putting the money up and Caltrans will come in and do the law suit and contribute something. In those situations, an independent appraiser may be retained these days, but Caltrans had a bank of appraisers that were its employees, and the appraisal, the offer appraisal that you would get is from somebody who works day in and day out for Caltrans. They're not going to be too generous.

XCAP Member unidentified: Conflict of interest.

Mr. Matteoni: Right, and you only got beyond that, Caltrans did not go to trial, I can't say never, but did not go to trial with the in-house appraiser. But when you hired someone to object, then they went to another appraiser. And that always, I can't tell you how big a bump, because it varied, always resulted in a bigger bump up, but still not be satisfactory. The property owner will know the impacts on a partial take of the property much better than the agency, its engineers. They're doing a whole line, looking at it. Their appraisers are going up and down the line and, well, this is a little different, make a little adjustment here or what have you. So, on damage cases, and I'm not telling you all these cases go to a jury, but they go to trial and as the agency understands the problem that it has created, it will bring more money, more money is forthcoming to pay for those damages.

The Panel took a short break.

Chair Naik: There was no property acquisition but let's say it was generally recognized that the property might have an impact, like for example we were talking about the, you know, having something elevated behind your house, but they didn't technically take any of your land. Could the city or does the city ever preemptively just decide, oh, we're just going to compensate you now, rather than waiting for some kind of suit, in a proactive measure. Or is that something that is not typically done?

Mr. Matteoni: It's not typically done, but it is certainly possible, and if I were representing someone, I would approach the city in terms of discussing it with public works, whoever is responsible for the project. I probably wouldn't get too far there, but then would take it to the Council Member that I knew, and you know, I'm going to have to bring a lawsuit, but I think this can be worked out. It's a damage that's recognized and see what the receptivity is there. So, there is an avenue to work that out and claims are worked out. Not everything has to go to trial.

Chair Naik: But my understanding was that part of the reason it's not typically done is because from a public perspective, you could have the risk of, what you don't want is that a city is basically is like, oh, I'm going to come do this apartment building in front of your house so I can pay you an extra 50 grand because I'm impacting your house, right? That way you won't say no. So, there's a public element that balances that.

Mr. Matteoni: For the public agency, they should be treating everybody equal and, you know, three people are complaining and nobody else is. Well, I don't think there's a damage. It's up to the one that wants to pursue it. So, most often they result in lawsuits, but they don't have to. And maybe before we start talking about taxes, implications, consequences, just another word or two about the process. So, the lawsuit has been filed, and I didn't mention in Santa Clara County, if you have to go to trial, you're not going to be in trial for probably 20 to 24 months. An acquisition of someone's home or part of their home, is very traumatic. The only one that likes condemnation are lawyers. All property owners usually do not like condemnation, and I find homeowners particularly are affected, and there are lots of ramifications. You know, this is my folk's home, I've lived here all my life, what have you. I'm going to just tell you one story that worked out well for the woman, although she had to move. When the Guadalupe Expressway, now the Guadalupe Freeway was put past the airport and into downtown San Jose, in this older neighborhood south of Taylor Street just beyond where City Hall was located, were a series of small homes. One of the owners was Mrs. Carowsa (Phonetic), and she had lived there, raised her family, elderly woman, and the attorney was an Italian. I have Italian heritage, Mrs. Carowsa was Italian, the judge, Judge Raconelli (phonetic) was Italian, and the daughter, the attorney for the family explained to the judge, because usually when you call in the jury you want the property owner there, you want to introduced the property owner to the jury and try to catch some good vibes. Now, Mrs. Carowsa can't attend. She is not well, but you honor, if we could at some point during the trial, her daughters could bring her in for a few minutes. And so, a day or two later I see the two daughters on either side of an elderly woman all dressed in black. The attorney tells the judge, I have my client here and if this would be an appropriate time, I just simply would like to introduce her to the jury and then her daughters are going to take her home. Of course, you can do that. So, Mrs. Carowsa sat up and I noted she had a rosary bead and crucifix hanging here, and God bless you and sat down. Mrs. Carowsa got everything she asked for at that trial. So, just to finish up on trial, it's difficult to stay with it when there's the long period of time, the effect of an order of possession. Incidentally, you can object to the timing of an order of position for hardship if you can show to the judge that your elderly mother lives with you and, you know, we can't simply move. We have to make arrangements. The judge might give you another couple of months and stall the public agency. But these are all traumas that personally happen and are not directly compensable unless you come in with the right black clothes and rosary beads. You ought to know as well that most all these cases eventually settle. There were statistics from Caltrans years ago, and I haven't seen any for a long time, that 97 percent of the cases that are filed are settled. On larger cases with arguments on various points, the settlement most often comes, the best settlement for the property owner, in the last few weeks before trial. There are reasons for that. You are required, both sides, 20

days before trial to make a settlement offer, settlement demand it's called, for the property owner, and the court is trying to force the parties together that they make their best judgement after they have taken depositions of the appraisers, they know all they need to know of the case. What would it take to get out of this case? And it's intended to have a compromise aspect to it, but the benefit for the property owner and what does promote a jump in compensation, offer of compensation, is if that offer demand is not accepted, the property owner can recover its litigation expenses, attorney, appraiser, if there is an engineering witness, because of some aspect of damage that needs to be explained. All of those expenses can be ordered paid based on the court after a trial determining that the demand by the property owner was reasonable in light of the verdict and that the condemning agency's offer was unreasonable in light of the verdict. So, if you get a number by verdict over what you were demanding, you should be guaranteed the recovery of your legal expenses in going through the trial. And so that has an impact on eventually settling a case as it goes along. There are a couple of other things, if you had to go to a trial, that the law gives in my judgement as protection to the property owner. One is, I don't know how many are familiar in going through any litigation, but in civil litigation, if you bring a lawsuit for an accident against the party that ran into your car, you have the burden of proving the liability and the damages. In condemnation, there is no burden to either side. It used to be, pre-1975 the burden was on the property owner. That got eliminated on the basis that, what the jury is trying to do is its own appraisal of the property based on all the information that comes forward, and so the property owner isn't at a disadvantage against the government, nor is the government disadvantaged in the way the law looks at it. Both are equal in terms of attempting to prove the right number for compensation. And there is always the recovery of what's called legal or court costs, not litigation expenses, no matter what. You're filing fees, your deposition costs, the jury fees, all of those are on the public agency, and if you settle a case and go through escrow, all of those charges are on the public agency, not the property owner. So, there are other aspects of the law that protect the property owner in these forced acquisitions.

Mr. Matteoni: So, with that you want to talk about taxes. There are a couple of different aspects to taxes. One is, if your property is acquired, do you have to pay capital gains? The law beyond California, IRS law gives you the right in effect, to affect a tax-free exchange, 1035 Exchange. You have, you can receive the money. You don't have to put it in escrow. You can receive the compensation and look for an investment. You don't have to have the reinvestment lined up the day you get the money. You have two years beyond the year in which you receive the money. So, if you got your money February 5, you'd have all of this year and two years beyond to reinvest. If there are damages, the damages go to adjusting the base, but you wouldn't pay on damages when you receive them. So, that was one question, I think, that was raised by Pat when we were taking a break.

XCAP Member unidentified: Does that apply just if you go to trial, or does that apply to any offer?

Mr. Matteoni: Well, you have to document and perhaps I hear recently, the IRS is looking more closely at it, but this was a settlement in lieu of condemnation. So, if

you had that resolution, you're good. If you have a lawsuit filed and settled it, you're good. It's protecting yourself if you negotiate before those things happen, and public agencies are very good in say, providing documentation, either in the recitals to a settlement and/or a letter that it was prepared to pursue condemnation. It's vital to this project, whatever the project is, and this is a settlement in lieu of condemnation. So, that's worked well for property owners over the years. Are there questions on that?

Chair Naik: Not on that one specifically, but can you talk a little bit about the fact that the tax base, particularly in Santa Clara County, and how that's impacted when you...

Mr. Matteoni: Right. I did prepare, I don't know if they're in everybody's hands, an attached the code sections. I said 1035, 1033 I should have said for the IRS Code, but there is the adjustment of the base year property acquired following condemnation. And it can actually be transferred to another county, but not all the counties, and I don't understand how that is in California have it set up. Maybe it's the rural counties, but you can transfer your base on a residence taken in Eminent Domain to your substitute property pursuant to the formulas they established there. I don't typically get involved with the administration of that, but that's another provision in terms of providing protection to the property owner. So, if you had longstanding Prop 13 advantage on your property, you can transfer that.

Chair Naik: XCAPers, do you have another other question, and by the way, I'm going to have to excuse myself soon, so I will let Larry drive, but please go ahead.

XCAP Member Burton: What worries or concerns me is that we have an alternative for the crossing project that requires property takings that the agency may not budget sufficient time for the whole process of negotiation. That's one concern, or they may be unrealistic. Another concern might be political pressure to move the process forward faster than is reasonable for the for the typical situation. Another concern is that opponents of the project may use property taking lawsuits as a lever to try to delay or even kill the project. So, these are my concerns.

Mr. Matteoni: It's very unusual for a project to be accelerated. (crosstalk) Thank you Nadia. I'm going to use the example BART coming into San Jose, North San Jose, Milpitas, in 2000 or 2002, probably both. The environmental reviews were being made for that extension, and it was to extend all the way the way to the Dearden station in downtown San Jose or on the edge of downtown. Because of funding, because of environmental review, the acquisitions of the property in Milpitas and North San Jose did not take place until 2011, with a couple of cases going to trial in 2013, and if you follow the newspapers, the BART line is operational to be checked out, but not operational for passenger service on February 5, 2020. So, the line coming into the San Jose, the extension was approved and they had a big controversy over the tunnel under Santa Clara Street, was there going to be twin tunnels, single tunnel, that took a long time for political considerations, arguments between the City reacting to property owners on what would be less disruptive in the way of construction, not withstanding it's going underground. There's affects above the ground in terms of construction equipment, yards for storing materials and the like, and BART, what it wanted that took probably a year

and a half to be resolved. And last year we were supposed to see the condemnation actions, haven't and I don't think we'll see them, maybe the end of this year till next year. So, it's just hard with political realities and opposition, environmental reviews. I don't know if any funding is coming from the feds on this, but any day the feds can get upset with California and requirement something more, delay funding. Nadia would know how the high-speed rail has been affected. So, those are other considerations that can jam a project. The lawsuits, if there was some lawsuit that had legs on challenging the project itself, certainly that would delay the project. The court could not let it go forward until that litigation was resolved, but if it's a homeowner objecting, like Mrs. Kielow (phonetic) I don't think, and Mrs. Kielow, she took her property long before she got to the Supreme Court. The house was gone. The courts just not going to delay a major project. So, I'll go back to the orders of position, and when a property owner says, God, this is a hardship, I can't move. You're affecting my business. I don't have a place to go. I've got seven employees, whatever the business complications, that hardship is balanced against the public agency saying, it's been funded, the project has been in the planning for so many years. It's needed for these reasons and if we don't implement it, if we don't go to contract by June, we're going to lose the construction season and the cost of the project is going to go up. Judges are very inclined to go with that set of circumstances and, unfortunate that somebody's got some hardship. Maybe give them a month or so or make some exception, but it's really hard to, once it's on its own track, it's not stumbling over itself for federal funding or the like, to slow a project down as an individual property owner. Am I getting to your question?

XCAP Member Burton: Well, I guess, maybe I didn't explain it completely. We know it's going to take years between the time that the City Council says these are the alternatives and we go through all the planning processes before we can start breaking ground, but will the agency necessarily be realistic about the time needed to do the acquisition, or is there going to be some pressure, internal or external, that says minimize that so we look better on paper now?

Mr. Matteoni: Well, I suspect there is always that pressure, but the procedures to me are so set in terms of the reviews that have to be made, that an agency would have great difficulty compressing the time, particularly in a community such as Palo Alto where the constituency is well informed, and if they have a particular point of view that is just not going to be rushed. But I'm not the public agency. I'm looking over here, but I didn't expect an answer.

XCAP Member Shen: I had a question back to the condemnation notice. So, if someone receives one of those, what does that typically look like and I assume there is probably a timeframe that the homeowner, property owner says you've got to vacate this property by some certain time. And then the related question to that is, if there is a lawsuit that a property owner chose to bring against that, would the person still have to vacate that property or could it hold up the, for instance, your 18 to 24 months you said here in the Silicon Valley to wait for a court case. Could it lit literally hold up, could someone live in their house until that lawsuit was taken care of?

Mr. Matteoni: I've never seen that kind of delay. So, the notice you're talking about in terms of having to move, from my standpoint. When the lawsuit is filed, the agency makes a deposit of probably compensation. Before you ever see the papers, the agency has gone to court and asked for a date to set a motion to take position of your property, which will be more than 90 days out, because it still has to serve you. It has to give you 90 days' notice. So, if they anticipate they can serve you next week, they will extend out into April whatever it is, 90 days, to have a hearing by the court, and it's up to you within 30 days of being service to file an objection. One objection could be, if there were a viable right-to-take challenge. They don't have the right to take this property, they didn't do it right, then the court would hold that off and have a trial which is supposed to be expedited, just on the right-to-take. There are very few property owners in California that have ever won a right-to-take challenge. The last biggest one was the City of Oakland in the early 80s trying to take the Oakland Raiders. They weren't smart enough with Joe Alioto and Major Council to achieve that. The Oakland Raiders moved to LA I heard. Now they're gone somewhere else. In any event, back to just the process, if the objection is a hardship, which has only come about, I think, the legislation in 2006 or 2008, that the hardship was introduced. Not that people didn't argue hardship before, but the law recognized the right to protest on hardship. That's buying a few months or not anything, depending on how the judge looks at it. This is a vital project, sorry folks. And if you do not move out, there is a court order telling you you have to deliver position. If you do not do that, the Sheriff will enforce that order and physically move you. Way back when, when I worked for the County, there were a few people that didn't move out. The Sheriff's approach to that, because the Sheriff did not like moving people out of their house, was to go and post a notice that we're bringing in the moving vans next week if you don't obey this order. I never remember anybody not moving out that somebody was going to take over control. So, they control their own situation. And now, as I tell you on relocation assistance, there is provision to assist people to move. But there can be extraordinary circumstances that the court may listen to and, yes, that would delay the project starting but it probably would not affect the ultimate trial date for compensation. That would still be running its course.

XCAP Member Kanne: I had two questions. The first one, I think, will be pretty straightforward, which is, have you experienced any examples of an inducement in traffic being something that a property owner has gotten damages for? So, a road next to them has more cars, there's more noise or more pollution as a result?

Mr. Matteoni: I'm not aware of any recent case addressing that. There is a case out of Sacramento probably from 30 years ago of increased traffic with no compensation, but I think in that case there was not taking of the property. It's just how Sacramento has a lot of one-way streets and things got changed and it was a dump on a particular street. May San Francisco is experiencing that now that it closed part of Market Street. But, just like sound vibrations, maybe, but there has to be, it wouldn't be the city rerouting streets. I think there would have to be some project that expanded the street to take more traffic. Median strips, there's no compensation for median strips, so lots of people, when the light rail came to Santa Clara County, the light rail goes down the middle of the street, and you used to be able to turn, go into a driveway here or there. You can't and there's no

compensation for that. But there is, well, there's exceptions to that. So, circuity of traffic, circuity of travel, I should say. If there is a mile, mile and a half of median strip that you can't cross the center of the street that you had before, and you're a business over here and you have to drive a mile and a half, there are some cases that have challenged on the basis of circuity of traffic, the increased burden to the business of travel time, loss of delivery time or whatever they do, and most of those cases, the court is tolerant of the agency. But in some extraordinary circumstances, the viaduct circumstance is one that's been recognized, large trucks that had to truck and trailer movements when they were pitched this way instead of that way, there's a case that there's compensation for that.

XCAP Member Kanne: Thank you. My second question was, just to be completely clear, when you're modifying a driveway or the edge of a lot, that constitutes an impact certainly, but is the city actually acquiring that land in order to perform that modification? That's just kind of unclear to me.

Mr. Matteoni: It could. If a street is widened, they are and then they're going to conform the driveway. The grade of street may change and thus the driveway isn't what it was coming into your residence. Say the grade was up and now you've got a driveway going down and you're scraping the bottom of your car. Perhaps your whole driveway needs to be conformed, not this abrupt change, but this sort of thing. That's happening on a rural highway in South County where the County is straightening curves on a road that has proved dangerous going into a bridge area. The property owner has a gate within so many feet of the road. The road is going to be moved this way, it is going to be higher and his grade is not going to work. The County acknowledges that. The County says it will conform the grade, which requires it to go further into the property. We didn't talk about temporary construction easements. We barely did in terms of a wall that might be constructed just outside of the property line, but most public projects require some additional strip to the ultimate right-of-way for the construction to take place, whether it's loading railroad ties along the side, roadbed materials, cranes, what have you, and so the law allows the condemning agency to take temporary construction easements they are called, but they're usually long strips. In the past they've been three months, six months, maybe a year. As projects have become more complicated, for example, BART coming to San Jose, they're talking about five-year temporary construction easements. The value of a temporary construction easement is really leasing the land and restoring what might be damaged. So, when VTA went down Tasman Avenue or Boulevard or whatever, in Santa Clara, to put a median strip area, to create sufficient median area for the trains, it was taking landscaped area and parking strips of various businesses along there, and then taking that out of use for a year, two years, the whole parking in the front of a building. They may be able to put the parking back or not. You lose the landscaping. That goes to the nonconforming question that you don't have nice landscaping in front of your property, which municipalities usually demand, but property owners have come to feel that's an advantage. You know, it gives a nice setting to their residents, to their business. So, those things may be replaced. They are compensable.

XCAP Member Cho asked if it was possible to assess the risk of trains so close to structures and possible accidents and compensation for that risk.

Mr. Matteoni reported possibly if the property owner had an example of a disaster that could occur and assess the risk, but the more probable damage recovered is loss of view, noise, vibrations, invasion of privacy and would be claims for compensation.

XCAP Member Cho: My first question is, so they want to build, I'm giving an example here, so they want to build, so Palo Alto building code says that you can build up to 20 feet away from your property line. So, my neighbor built a very beautiful house, \$5 million and it's 20 feet away from their property line. Their property line is right next to the train tracks, and they want to build 15-foot high viaduct next to this fence, which is two feet away, 15 feet high viaduct, and then the train itself is another 15, so 30 feet high. So, 20-foot distance, if the train derails from the top of these 15 feet, like where are they going to land? Isn't that like dangerous situation?

Mr. Matteoni: Yes. I don't know what the statistics are of trains falling off that elevated viaduct. You would have to show, well, years ago before San Bruno, I don't think PG&E had much problem with high-pressure gas lines going next to residential properties in terms of its view of what it owed. That's changed dramatically, that the risk of explosions, and you have an example. So, if you have an example of some sort of damage that could occur and assess the risk. But more probably damage that you would recover for is loss of view, noise, vibrations, privacy, invasion of privacy, people on the train, I don't know how quick...

XCAP Member Cho: Oh, they can see. The train to San Francisco, they can see.

Mr. Matteoni: No, I know they can see, but (crosstalk), but all of those would be claims for compensation. The risk of, aren't they locked on the line?

XCAP Member Cho: So, another question is, do you engage a case that before the Eminent Domain kicks in, before, the part of the process that might happen, does the client hire you to represent them? To affect the decision-making part of a different kind of solution?

Mr. Matteoni: Right. On the BART line coming to San Jose we have several clients that retained us two years ago. We haven't done work for maybe 20 months, but they retained us so, you know, we talked about it initially. We might have talked to the VTA about particular issues affecting that property. And then it has sat. So, people do come more often early, as they learn of this and there is an opportunity in that to see if you can change things. Not that, you know, the owner and the attorney have a lot to work with, but there are certain circumstances, be it driveway conformance, or what have you that, okay, yeah, we need to take care of that. So, yes it happens.

XCAP Member Cho: So, what about the customers. I think about a 50 household is against a particular solution. Like, I mean, we did the petitioning to the city and



etc. but there is also opposing neighborhoods that want this solution. I'm just trying, you know, when is a good time to engage a lawyer?

Mr. Matteoni: Well the description you just described sounds similar to a neighborhood objecting to a new development that everybody is single family and they're going to rezone this strip of land next to you for apartments and they're going to be three stories, and increased traffic. I don't usually get involved early in a condemnation case in that situation, but I think that type of homeowner reaction to a private development that might be approved by the city is a parallel and attorneys are often involved in that. Their target is raising questions about the environmental impact and assisting the homeowners in doing that.

XCAP Member Reckdahl: Families are quite often worried that if they lose their house, their kids are going to have to change school districts? Is there any grandfathering of, if you get evicted at all?

Mr. Matteoni: No.

XCAP Member Reckdahl: You end up where you end up.

Mr. Matteoni: That's my shortest answered, no.

XCAP Member Reckdahl: Okay.

Mr. Matteoni: Where you go is dependent on, the school district. You live there, they receive your children, and I don't see Palo Alto cutting an exception if you're living wherever, Redwood City. Yeah, you can still go to school here.

XCAP Member Klein: Are we winding down or exhausting ourselves on the speaker? Norm, any final words of wisdom to us?

Mr. Matteoni: It's a tough game. You don't like it now, you're spending a lot of time on it, at trying to protect yourselves. The lawsuit is not going to be palatable. There is just, well, I don't know that many people like lawsuits of any type, but the loss of property is a dimension. You know, maybe if you just bought it, well, even if you bought it last year, you spent a lot of time selecting that property and put your heart into it, and those things aren't compensated. You've got to go back to, you know, appraisals. I thought there was a question of how the appraiser reacts, so I just will add, in terms of the damages, which is usually the toughest issue, and if you can demonstrate it to the public agency, then you're going to come out alright or you're going to have to fight it in court. I think I mentioned to you, Patricia, as we were taking a break, that the property owners usually want a jury to decide this, that jurors will relate to them. They have to live somewhere. They work somewhere. Public agencies like juries, because they are spending taxpayer money. So, it's sort of an offset. But both parties like it. It's rare that a case would go to trial just before a judge. It would if it was real small, you know, save expense to go. And now days there's even the prospect of mediation. The court wants cases mediated so you don't wait the 18 to 20 months, although there are exceptions for Eminent Domain. If the parties don't agree, the court can't force you to mediation or arbitration. You're entitled to a jury trial. And that usually works for the property

owner, but what I said to Patricia earlier is, it's not Palo Alto citizens that are on the jury. It cuts across the whole community of San Clara County, so there may or may not be people that really understand your situation. So, there's lots of problems and people aren't happy.

XCAP Member Klein: Norm, maybe a last question. It's certainly an unfair question. Based on your experience, do you think that homeowners in general in California, get a fair shake and are protected by the procedures?

Mr. Matteoni: They don't if they're small, they can't afford the fight. And that's unfortunate and that goes back to the situation I was talking about in LA where lower income community, years ago when 280 went through San Jose, there is a district called the Gardener District, and an attorney, civil rights attorney, John Thorn represented Angela Davis, he came to the fore for those property owners, but he could not try one individual case. So, I don't know how many were there, but they were bundled up and so he represented them as a group and got the court to agree to consolidate the cases. That's very unusual. Your individual case should be addressed to this judge, to this jury. But they were in similar situations and he was able to do a good job for them. But it's hard and the economics of these cases are such beyond the toll on your psyche. It just takes a lot out of you, and expense to go forward. The appraiser's expense goes up as the case goes on. The initial appraisal, the \$5,000 on any case of significance doesn't cover the appraisal costs, but it's the top in the code section, and you may get an appraisal for \$5,000. You go and try to negotiate from it. It doesn't work. Then the appraiser has to do more work, and he has to update things 20 months later. And I didn't tell you that that date of value is fixed, but you can get sales that occur later, because sales are usually negotiated months before they close, and so the court will allow subsequent sales, not two years later, but within a year. And if both sides have a band of sales a year before, a year after, those are all going to be admitted and then you're arguing about what's comparable and what's different on this sale. That's the usual argument. That's also very dry stuff to a jury, so you're looking for ways to make it more entertaining, and that's where the point I told you about an appraiser that has a presence that can deliver in court in explaining the appraisal. Otherwise, you might as well just mail it in and hope the jury reads it and looks at both sides and says, well, here is a middle ground figure. Everybody go home, which is a tendency as well in these cases, to go to the middle if it's complicated and both sides were as weak as each other and as strong as each other.

XCAP Member Reckdahl: You mentioned that 97 percent of the cases that are filed settle before the trial is complete. What percentage of the cases settle early and don't require any lawsuit to be filed at all?

Mr. Matteoni: You know, I'm not privy to that, but I'm just trying to think in terms of the VTA and the BART extension to Milpitas. I knew most of those properties and I would say it was less than 20 percent. But you're going through a highly developed area and most of the properties were business properties along the railroad tracks, not residents. Well, I told you there were some with apartments, but they weren't directly taken. There was one apartment house that had its recreation area removed and that case supposedly settled three years ago this last

month, and hasn't been finalized yet in terms of the settlement worked out in terms of rehabilitation the recreation area foreshortened, and the parties are still arguing about the rehabilitation plan.

XCAP Member Kane: Less than 20 percent settled early?

Mr. Matteoni: In the example I gave you. I don't know what the Statewide statistics are. I think school districts do a good job and very few school districts go to trial. They're kind of locked in where they have to go. They may be a smaller government entity, closer to the people. All of the Saratoga feeling that, geez, we don't like to condemn people's property. We know those guys.

XCAP Member Klein: On that happy note, Norm, thank you very much.

Mr. Matteoni: You're welcome. Thanks for having me.

(crosstalk,)

XCAP Member Burton: Quickly, who has my Caltrain meeting flyers. I just want to get them back before the meeting is over. Yeah, the three of them. There's one more. No below you, that one. Thank you.

XCAP Member Klein: Okay, we have a few items left on the agenda. I'm not sure how much we're going to get done on them. Actually, I think I'm going to skip around. Chantal, I think we'll start with you, skipping down to number seven, Staff Updates.

#### **4. Discussion: XCAP Provide Input in Preparation for Upcoming Town Halls.**

XCAP Member Klein: Well, let's skip over, put the burden on you again, Townhall meetings.

Ms. Cotton Gaines: Yeah, so this item Nadia requested, this is Item number four, Nadia requested to have it on the agenda, so we are going to bring next week, likely an informational item to you that is just the planned power point for the first Town Hall meeting, which is February 20, and that one is at Mitchell Park. The structure will look like you guys have seen for the previous community meetings and the first Town Hall meeting is the one where we're recapping just where we are period. So, there's actually a lot of information to cover in that meeting to bring people up to speed on the seven alternatives where we do have analysis to date. And so, we're going to do an informational item for you next week that just says, here's the power point we're planning to do, and then if you guys have feedback, just let us know. So, we probably won't spend your meeting time on that next time, but it should be, to Greg's point, things you all of seen before. And Nadia want this item on the agenda to see if there was anything that the XCAP had an interest in us trying to incorporate in the Town Hall meeting, if there's a question or something like that that you would like us to post to the attendees of the Town Hall meeting,

she just want you to give us that feedback. It's okay if you don't have anything. There's more than enough to cover.

XCAP Member Klein: You might want to give us an update on where AECOM is on our two additional ideas.

Ms. Cotton Gaines: We are working with them to get a very specific timeframe. I am thinking we will have early level things at some point in March, but I can't speak with more confidence until I get a refined schedule from them, which I think I'll have within the week. So, I can give an update on that next week. And we'll try to incorporate that into the updated Workplan as well, just so you know when it's coming back to you. We are right now scheduling a meeting with the proposers of those new ideas and AECOM and some relevant staff, and your technical working group, so that we can make sure that AECOM is analyzing things the way they are currently, and that we're not missing anything. That we're planning for next week, if everyone's schedule lines up.

XCAP Member Klein: The technical committee members who will participate in that are Phil and Tony and Keith, and I think you've all been notified of the dates. The idea of that, it is really just to make, as Chantal said, to make sure that we're all talking about the same things and if there's any particular technical problems we have our technical people there to help get the things straight. But the AECOM evaluation of our two new ideas will come before this full group whenever they're ready, and obviously, we want to have it in time so that we can take it into account in making our final decisions.

## **5. Discussion: Preliminary Discussion of XCAP Workplan (continued from January 29, 2020 meeting)**

Ms. Cotton Gaines: So, for Item five, which is the Preliminary Discussion of your XCAP Workplan, last week we passed out, I'm just going to keep talking, last week we passed out a spreadsheet as well as a document behind it by dates and it described like what is planned. I met with Larry and Nadia yesterday, so we're making some updates to that, but if you guys can look over the document shared at last weeks' meeting, I think it was Item Five last week. Yes, Phil is holding up the spreadsheet. It's actually easier to read in black and white, so if you want to look at the printed on instead of the one uploaded. Please just look at that and we will bring the discussion back. We're adding some other things into it and trying to figure out how to maximize your time to keep you guys on schedule for April 30<sup>th</sup>.

XCAP Member Klein: Well, let me add to that is the way we're looking at things now is that we'll begin making decisions on February 26<sup>th</sup>. What that looks like, I don't know but we're certainly going to have an item on the agenda that would call for the possibility of making some decision. That's three weeks away, or looking at it another way, it's two months from our deadline.

XCAP Member Burton: But that's before some of the community meetings, you know, the public hearings.

XCAP Member Klein: Well, we have the Townhall meetings.

XCAP Member Burton: That's what I mean, the Townhall meetings, yes.

XCAP Member Klein: Well, that's an interesting point, but the Townhall meetings aren't really for that purpose, since we're not outline everything to them anyway. There's no lack of opportunity for the public to speak.

XCAP Member Brail: Can I ask that in preparation for that, we just make sure the documents and the presentations on all the various options are, I think the website is up-to-date, but I know that some of them, like I'm very familiar with, because I was on the old CAP, but I don't know that everybody has seen the presentation. There's an AECOM video, there are diagrams, there are elevations, there are maps, there are the fact sheets. I think it's important that if we're going to start talking about actually, you know, doing things, that we should all take the time to make sure we fully understand all the options that are currently in front of us. And maybe it's just a matter of looking on one link on the webpage, but I certainly hope to do that by the, and I think others should do the same.

XCAP Member Klein: Absolutely, which is why I mentioned giving three weeks of notice. If you were the college student who waited till the last week to do all your, to study for you exam, now is your notice that, when the exam is going to start.

Ms. Cotton Gaines: And there is a link on the website that, I think it is with renderings and animations or something, so if you wanted to look at all the animations of our stuff and alternatives, now nine technically, there are animations for six of them, and then the Churchill closure has all its different elements to it and then we are doing further analysis on the two new ideas. But that's a good starting place, if you want to see the videos again and look at the layout and plan view, all that type of stuff.

Meeting moved to Item number four.

## **6. XCAP Member Updates and Working Groups Updates**

XCAP Member unidentified: Larry, can you explain again what we will do on February 26<sup>th</sup>?

XCAP Member Klein: We're not sure yet. I said, I deliberately used vague words to begin deciding.

(off mic)

XCAP Member Klein: Well, for example, we're not committed to this. Nadia and I and the staff are going to have a further meeting on this after next week's meeting. Here is one possibility and that is, start at the bottom. Eliminate ideas that have the least amount of support, so that people, we might start just with a going around the table and getting each individual's views on things. I'm pretty sure we will divide up and not discuss all three areas, but, well, Charleston and Meadow are really one thing, but we might have done meeting devoted to Charleston and

Meadow and the next meeting devoted to Churchill and its various ramifications. So, we might ask people to, without any motion on the floor, just give us your thoughts and see what everybody has to say, and then see where we go from there. But anyway, there are a variety of things. It's more complicated than having just a yes/no, are you in favor of daylight-saving time, or something like that. You can pretty easily take a vote on that. We know that these are much more complicated than that, so how do we make sure that everybody has a voice and we hear everybody else's views, so that we can all benefit from the give and take on that, and then it may also be that we have several iterations of decisions and maybe set some tentative things. Obviously, we don't need to make final decisions on February 26<sup>th</sup> or March, what is it, 3<sup>rd</sup>, 4<sup>th</sup>, but within a pretty short time thereafter, because it's going to take us a while to produce the final report as well.

XCAP Member Burton: Larry, will we have any indication of funding ranges or anything like that to help guide us in thinking about what's called financial feasibility by the 26<sup>th</sup>?

XCAP Member Klein: No. I think all we're going to have are cost, I'm assuming we will have cost, well, we do have cost estimates from AECOM. Whether we're going to get, it's a chicken and egg situation. The Council is not going to give us a budget. They're going to say, well, how do we give you a budget until we know what you expect to build.

XCAP Member Brail: I mean realistically, the only money available is the Measure B funding in the County that's shared with Sunnyvale and Mountain View.

XCAP Member Klein: Well, that's all at the moment.

XCAP Member Brail: So, the Council would have to get some money somewhere, and it doesn't sound like this business tax is nearly going to be enough or used for this purpose.

XCAP Member Burton: Let's say the combination of Measure B and business taxes could carry certain bond load.

XCAP Member Brail: It would be helpful to do some back-of-the-envelope forecasting. I agree with you.

XCAP Member Burton: Exactly. So, we know let's say, I don't know, the tunnel, South Palo Alto tunnel is so far beyond the realm of financial feasibility, we shouldn't spend more time on it. I'm just using that as an example.

XCAP Member Klein: Well, you're going to hear Pat and I'm guessing that Pat's going to tell you how his idea is to find the funding. I'll get to that in a minute. Yes, we will get there. The public, I think you're half the public.

Philip Kamhi, Chief Transportation Official: So, if I can really quickly, I just want to say that it's very unlikely that we'll have funding information after April as well, but the reality is, we can potentially apply for other funding sources once a project is determined. So, at this point it's not really a project.

XCAP Member Klein: The other thing is in the paper today is the introduction of legislation in the State Legislature for the oft mentioned idea of having a Bay Areawide sales tax of 1 percent, which would raise, Pat, what's the number, \$500 billion, something like that, \$50 billion, (off mic) \$100 billion, yeah. But that's spread out over nine counties. It's not just for grade separations. But that may very well, if it gets through the legislature could be on the ballot as early as this November, and that would be a potential source. Anyway, lots of potential things. Go ahead Megan.

XCAOP Member Kanne: Well, I just had a comment which is kind of to Phil's point which is that you haven't really gotten an update from the Measurable Criteria Group, because we've kind of been like, holding our cards close, so maybe that would be useful to like agendize specifically. And if you have any, like, specific questions for that group or things you would like to see. Because certainly my expectation would be that the criteria would matter in these decisions that we're potentially making this month and next month.

XCAP Member Klein: Thank you for that. Well, we'll hear from members of the public now. Pat.

The meeting moved to Item #2, Oral Communications.

## **7. Staff Updates.**

Ms. Cotton Gaines: Oh, okay. So, Larry, also I think Nadia, for Item number five, just wanted that to be an announcement, so I can do that really quickly, if you want.

XCAP Member Klein: Anything else for the good of the cause? No. We're adjourned.

## **8. Adjourn**

The meeting adjourned at 6:40 P.M.

October 22, 2019

Palo Alto Fire Department

XCAP Memo

The Palo Alto Fire Department (PAFD) was asked to identify potential impacts on operations as it relates to the Alma/Churchill street grade separation proposal. It is our goal to strategize so we can maintain our response standard of arriving at an emergency in eight minutes or less, ninety percent of the time. Road access is essential when it comes to responding to the scene of an emergency. Ideally, the preference is to have access to all roads to get emergency resources to the incident for the quickest possible mitigation of the incident. However, access to all streets is regularly not available due to temporary closures e.g., construction projects or special events. In these cases, emergency responders must navigate around the obstacles but ultimately get to the destination with some delay that may or may not meet our response time standard.

When PAFD is tasked with modifying the operational deployment model, we have worked with a company that uses a modeling tool that can model and test emergency dispatch rules, department configuration, and deployment, perform retrospective and prospective analysis, and statistical calculations.

For this exercise, the vendor performed an analysis of input data provided by PAFD with an assessment of any potential adverse impacts.

All models included station locations, unit roles, personnel qualifications, overlay polygons (mapping) incident classifications dispatch policies, and other attributes developed in prior studies. All models dispatched based on simulated Automatic Vehicle Location (AVL) analysis, sending the closest appropriate unit to every incident.

For historical modeling, roughly five years of incident history (March 18, 2014, through January 21, 2019) were simulated against the current "base" model using Alma/Churchill intersection opened and closed. 40,611 events were simulated in both cases. Of these events, 122 (0.35) were found to have response differences of 0.01 minutes (approximately 2/3 of a second).

Three models were used to test the effects of the intersection closure:

- If only the closest engine was available
- If only the 2nd closest engine was available
- If both the closest and 2nd closest engines were available

The impact of the potential closure is predicted to represent significant delays (30-90 seconds) within a narrow geographic area, for less than 0.5% of PAFD's responses. The number of incidents affected by the closure is predicted to be extremely low, as a proportion of overall incident volume.

Variability across methods was significant, but all suggested that the number of incidents affected would be minimal, though delays in individual cases might be moderately substantial.



Simulation Method	Predicted % of Incidents Affected
40,668 Historical incidents, 2015-2018	0.30%
29,278 Addresses of record, PAF3/PAF6 contingent availability	0.26%
29,278 Addresses of record, PAF3/PAF6 both available	0.05%

In the cases where incident responses are predicted to be affected by the closure, delay effects vary by scenario:

Response Scenario	Predicted Typical Range of Delays
PAF3 SW of Alma/Churchill	0:58-1:28
PAF6 NE of Alma/Churchill	0:30-0:47

Conclusion: The data available clearly indicate that only a very small number of incidents (probably fewer than 0.5%, city-wide) will be affected by the closure. Response time delays for these few incidents may be on the order of a minute or more.

October 22, 2019

Palo Alto Police Department

XCAP Memo

It is important to note that the Police Department's responses to emergency calls can differ significantly from those in the Fire Department. Police officers are routinely patrolling the city, and can begin their response to a call from anywhere in town (e.g. not from a fixed location, such as a fire station). Also, the target of a police response is not always at a static location as is common with a Fire Department call; rather, suspects routinely flee from crime scenes, and the police response must take that into account as officers make changes in the path of their response to intercept them. Flexibility and options are key to a police response.

While the closure of the Churchill crossing would prevent officers from driving directly across the tracks as we do now, the proposed traffic mitigations and use of signal preemption technology would offset the potential impacts. Suspects in vehicles would also be impacted just the same as police vehicles; a closure would actually reduce an avenue of vehicular escape from a nearby crime scene. With the viaduct option, the elimination of the grade crossing would have a positive impact on police responses; without having to wait for a train to cross, east/west access would be improved, but the same could be said for suspects in vehicles as well.

The Police Department recognizes the local and regional importance of this project, and will be able to successfully adapt their responses to whichever option is ultimately selected.

**From:** [Murphy, Seamus](#)  
**To:** [Council, City](#)  
**Cc:** [Fromson, Casey](#); [Ledezma, Paola](#); [Bouchard, Michelle](#); [Reggiardo, Melissa](#); [Petty, Sebastian](#)  
**Subject:** Calrain Grade Separation responses  
**Date:** Wednesday, December 19, 2018 10:41:51 AM  
**Attachments:** [City of PA Caltrain Response 12-18-18.pdf](#)

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Mayor Kniss and Councilmembers,

Please see the attached letter responding to the City's questions about grade separation requirements.

Please feel free to let me know if you have questions or need more information.

**Seamus P. Murphy** | **Caltrain, SamTrans, SMCTA**

Chief Communications Officer

1250 San Carlos Avenue | San Carlos, CA 94070

650.508.6388 | [murphys@samtrans.com](mailto:murphys@samtrans.com)



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EXECUTIVE DIRECTOR

December 18, 2018

Mayor Liz Kniss  
City of Palo Alto  
Office of the Mayor and City Council  
P.O. Box 10250  
Palo Alto, CA 94063

Dear Mayor Kniss:

Thank you for your letter regarding grade separation considerations. I understand Caltrain has discussed these issues with the City in various other venues, but wanted to make sure you have a consolidated response to the questions posed in the letter.

1. *Under what conditions would Caltrain accept a grade variance from 1 percent to 2 percent, and what would the approval process be?*

Caltrain has a standard procedure for design variances. It outlines the approval process and required supporting documentation. The allowable maximum grade takes into consideration factors such as operational impacts, vehicle performance, proximity to stations, other site specific conditions, and maintenance impacts. A comprehensive study including operational simulations is required to support the design variance request. Additionally, the requestor is responsible for the costs to support the variance review/analysis.

2. *Under what conditions would Caltrain accept a variance to the existing vertical clearance for poles and wires, and what would the approval process be?*

Caltrain minimum clearance to the pole and wires is established to meet California Public Utilities Commission requirements such as General Order 95 and SED 2. Union Pacific Railroad also requires minimum clearances.

3. *How are grade separation design criteria and constraints likely to change in the future?*

The Caltrain Business Plan will help shape a long range vision for the corridor and will address how train service will grow over time and the kinds of supporting infrastructure that may be needed to support this growth. This work will include significant focus on the issue of grade-crossings and an effort to develop a corridor-wide strategy to support the funding and

implementation of grade separations. Any changes to Caltrain's standards must be considered in a way that is careful, deliberate and fully and fairly weighs both benefits and consequences, and should be undertaken on a system-wide basis. We anticipate working with the City of Palo Alto and other corridor communities in the coming year to begin this discussion.

4. *What should the City of Palo Alto assume regarding freight on the Caltrain right-of-way in the future?*

The City of Palo Alto should assume that freight will continue to operate diesel locomotives along the corridor, even after Caltrain electrifies the line. UPRR use of the Caltrain Corridor is governed by the Surface Transportation Board. Subsequently, Caltrain has a trackage rights agreement with UPRR that specifies the terms of freight operations. After the electrification of the Corridor, it is anticipated that a short-line freight operator will replace UPRR. In addition, the Caltrain Corridor is included in the STRACNET Corridor which specifies additional requirements to allow shipments of military equipment, if needed.

5. *What is Caltrain's criteria regarding shooflies that are likely needed for several grade separations during construction?*

In general, the shoofly track shall be designed for timetable speed for both passenger and freight trains per Caltrain track standards and operating requirements. Except for approved construction windows during cut over operations, the proposed grade separation design shall keep all Caltrain tracks fully operational at all times and shall cause no interruption to train operations during construction. The construction of the grade separation shall not temporarily or permanently reduce the future demand on the Caltrain operating system and shall meet future Caltrain standards and requirements.

6. *What level of funding support needed to grade separate because of the PCEP can or could be expected from Caltrain?*

The Peninsula Corridor Electrification Project (PCEP) does not include any grade separations. As stated previously, the Business Plan will identify a long term service vision for the corridor and the infrastructure needed to support that service. The Plan will also include a strategy for funding these investments over time. It is anticipated that a variety of local, regional, state and federal funding sources will be needed to support these corridor-wide investments.

///

7. *The cost of maintenance for grade separation alternatives may vary greatly. What should the City of Palo Alto assume regarding who will pay for the cost of maintenance?*

Environmental and economic life-cycle assessments should be performed for all alternatives. For a traditional grade separation such as raising and/or lowering the track by embankment, viaduct and bridge, the City of Palo Alto may assume that Caltrain will take on the maintenance responsibility for such new infrastructure. However, the City of Palo Alto may assume it is responsible for the cost to maintain trench and/or tunnel alternatives as they are anticipated to be significantly more expensive to maintain. Additionally, a mixed operation with freight (diesel powered locomotive) and passenger trains in a tunnel is not desired and requires special attention by FRA under High-Speed Passenger Rail Operations. Ultimately, the specific terms of a maintenance agreement would need to be negotiated between Caltrain and the City.

Again, thank you for these thoughtful questions. As the City continues its assessment of potential options, please let us know if more information is needed.

Sincerely,



Jim Hartnett  
Executive Director

cc: Peninsula Corridor Joint Powers Board  
Palo Alto City Council

# Caltrain Business Plan

APRIL 2019

LPMG

April 25, 2019



# Continuing to Build a Business Case



# What is the Caltrain Business Plan?

**What** Addresses the future potential of the railroad over the next 20-30 years. It will assess the benefits, impacts, and costs of different service visions, building the case for investment and a plan for implementation.

**Why** Allows the community and stakeholders to engage in developing a more certain, achievable, financially feasible future for the railroad based on local, regional, and statewide needs.

# What Will the Business Plan Cover?

## Technical Tracks



### Service

- Number of trains
- Frequency of service
- Number of people riding the trains
- Infrastructure needs to support different service levels



### Business Case

- Value from investments (past, present, and future)
- Infrastructure and operating costs
- Potential sources of revenue



### Community Interface

- Benefits and impacts to surrounding communities
- Corridor management strategies and consensus building
- Equity considerations



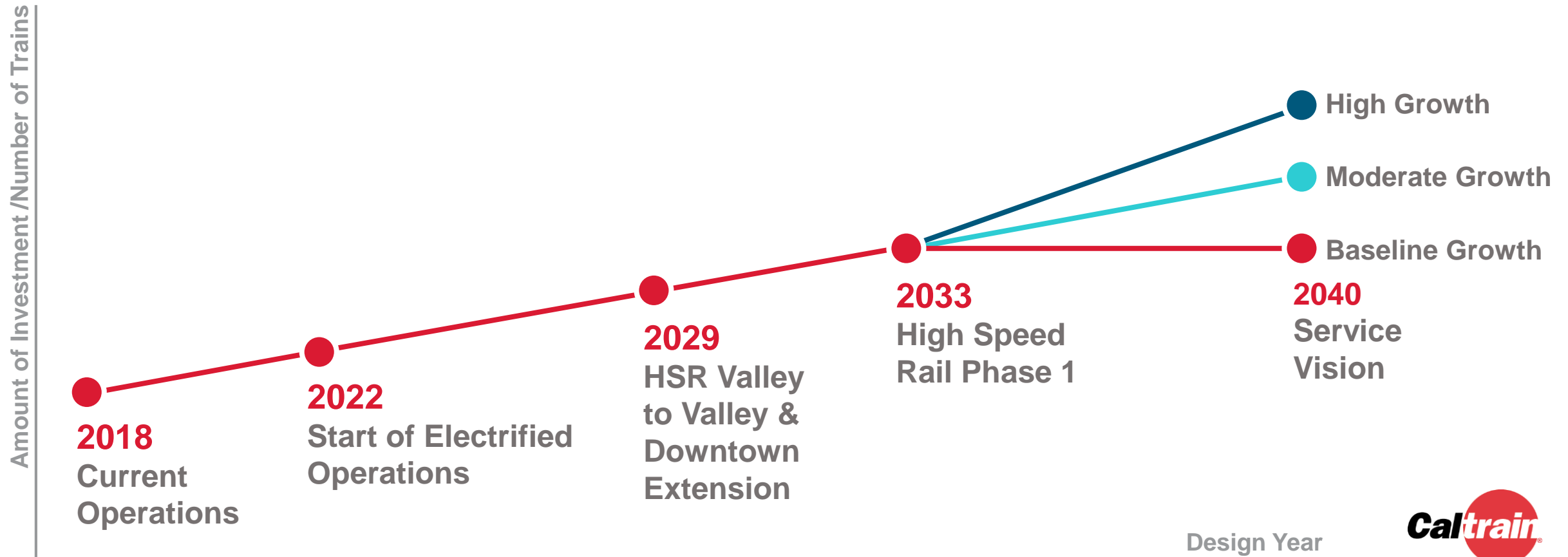
### Organization

- Organizational structure of Caltrain including governance and delivery approaches
- Funding mechanisms to support future service

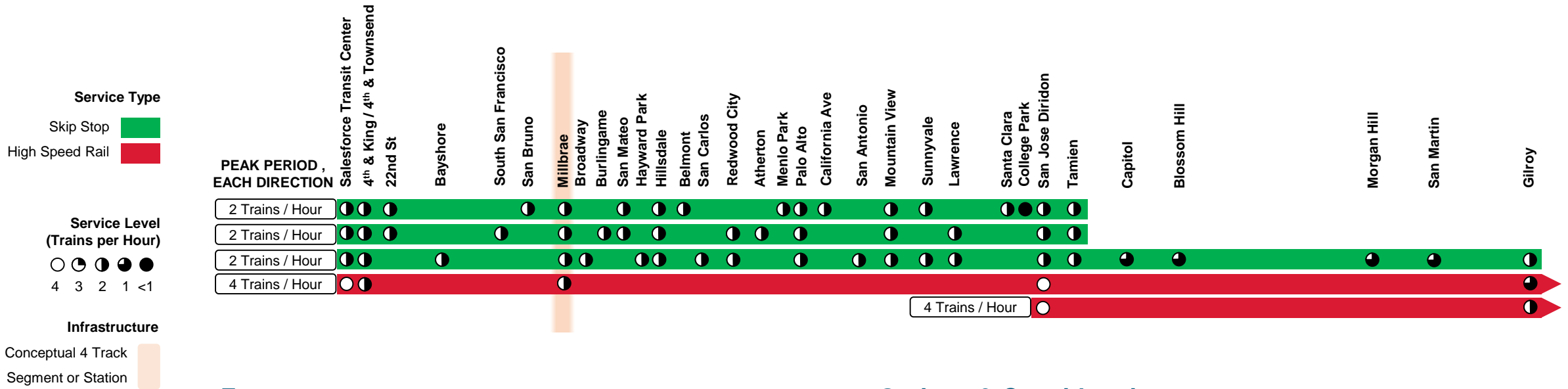
# Where Are We in the Process?



# 2040 Service Scenarios: Different Ways to Grow



# 2040 Baseline Growth Scenario (6 Caltrain + 4 HSR)



## Features

- Blended service with up to 10 TPH north of Tamien (6 Caltrain + 4 HSR) and up to 10 TPH south of Tamien (2 Caltrain + 8 HSR)
- Three skip stop patterns with 2 TPH – most stations are served by 2 or 4 TPH, with a few receiving 6 TPH
- Some origin-destination pairs are not served at all

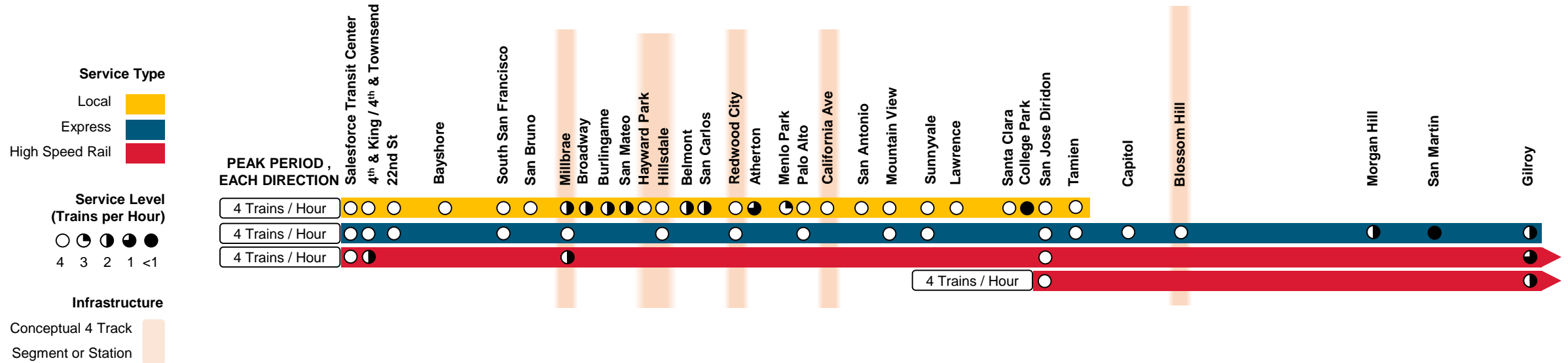
## Passing Track Needs

- Less than 1 mile of new passing tracks at Millbrae associated with HSR station plus use of existing passing tracks at Bayshore and Lawrence

## Options & Considerations

- Service approach is consistent with PCEP and HSR EIRs
- Opportunity to consider alternative service approaches later in Business Plan process

# Moderate Growth Scenario (8 Caltrain + 4 HSR)



## Features

- A majority of stations served by 4 TPH local stop line, but Mid-Peninsula stations are serviced with 2 TPH skip stop pattern
- Express line serving major markets – some stations receive 8 TPH
- Timed local/express transfer at Redwood City

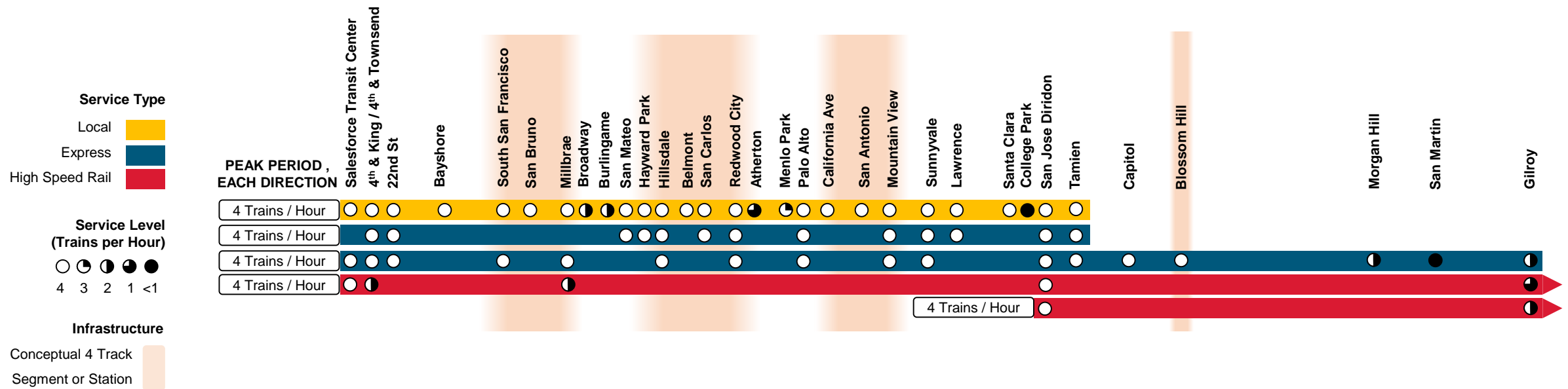
## Passing Track Needs

- Up to 4 miles of new 4-track segments and stations: Hayward Park to Hillsdale, at Redwood City, and a 4-track station in northern Santa Clara county (Palo Alto, California Ave, San Antonio or Mountain View. California Ave Shown)

## Options & Considerations

- To minimize passing track requirements, each local pattern can only stop twice between San Bruno and Hillsdale - in particular, San Mateo is underserved and lacks direct connection to Millbrae
- Each local pattern can only stop once between Hillsdale and Redwood City
- Atherton, College Park, and San Martin served on an hourly or exception basis

# High Growth Scenarios (12 Caltrain + 4 HSR)



## Features

- Nearly complete local stop service – almost all stations receiving at least 4 TPH
- Two express lines serving major markets – many stations receive 8 or 12 TPH

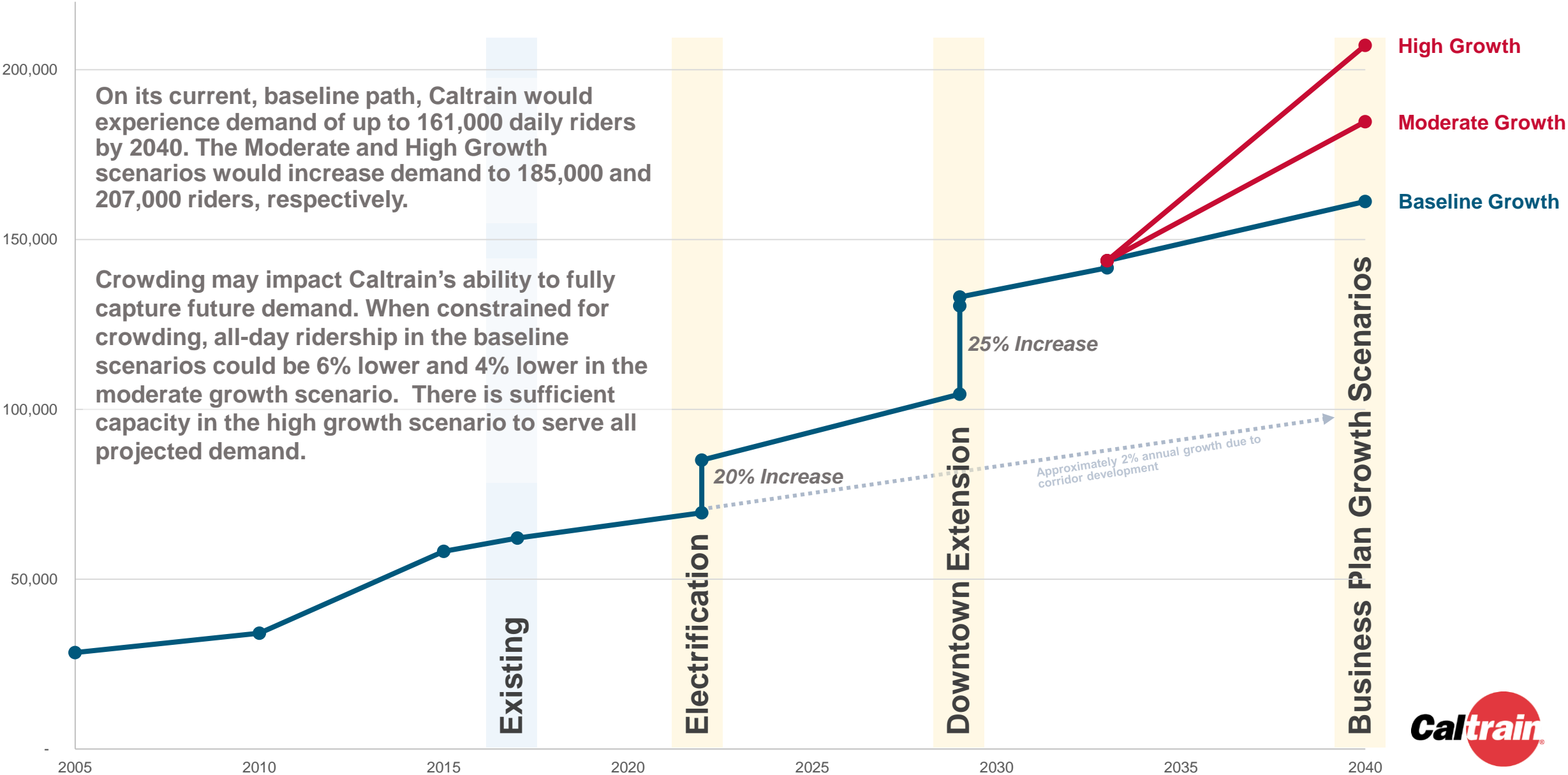
## Passing Track Needs

- Requires up to 15 miles of new 4 track segments: South San Francisco to Millbrae, Hayward Park to Redwood City, and northern Santa Clara County between Palo Alto and Mountain View stations (shown: California Avenue to north of Mountain View)

## Options & Considerations

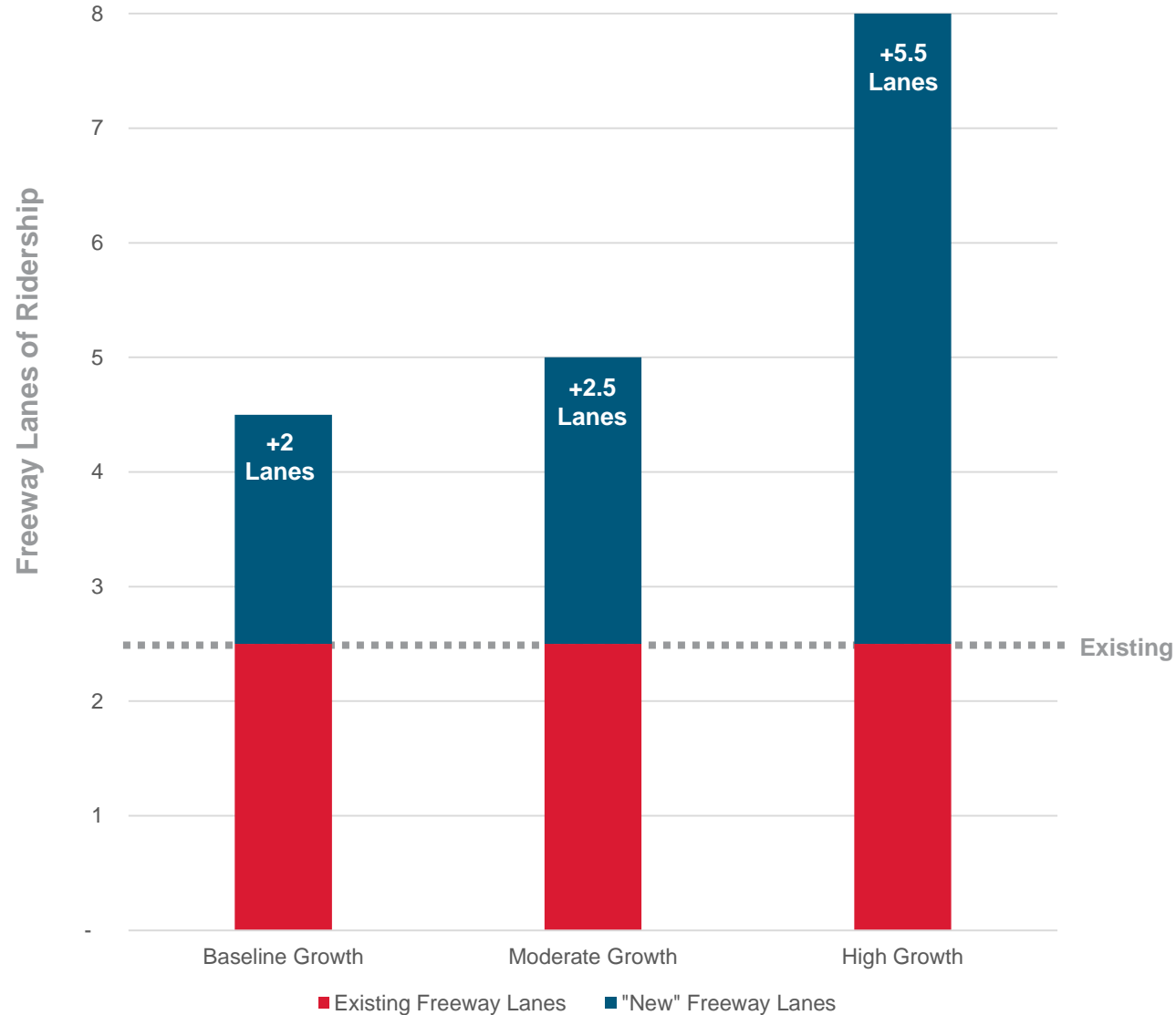
- SSF-Millbrae passing track enables second express line; this line cannot stop north of Burlingame
- Tradeoff between infrastructure and service along Mid-Peninsula - some flexibility in length of passing tracks versus number and location of stops
- Flexible 5 mile passing track segment somewhere between Palo Alto and Mountain View
- Atherton, College Park, and San Martin served on an hourly or exception basis

# Ridership Projections





# Peak Hour Throughput as Freeway Lanes



Caltrain's peak load point occurs around the mid-Peninsula. Today, Caltrain serves about 3,900 riders per direction during its busiest hour at this peak load point. This is equivalent to 2.5 lanes of freeway traffic.

The **Baseline Growth Scenario** increases peak hour ridership to about 6,400 riders at the peak load point – equivalent to widening US-101 by 2 lanes. Peak hour demand exceeds capacity by about 40%.

The **Moderate Growth Scenario** increases peak hour ridership to about 7,500 riders at the peak load point – equivalent to widening US-101 by 2.5 lanes. Peak hour demand exceeds effective capacity by about 35% due to higher demand for express trains.

The **High Growth Scenario** increases peak hour ridership to over 11,000 at the peak load point – equivalent to widening US-101 by 5.5 lanes. All ridership demand is served.

*Assumes 135% max occupancy load*





# Grade Crossings & Grade Separations

# Purpose

- Provide a corridor wide background and perspective on at-grade crossings and grade separations
- Discuss ongoing city-led grade separation plans and projects
- Quantify the range of investment in grade crossings to be incorporated into the 2040 “Service Vision”
- Discuss next steps



## Background

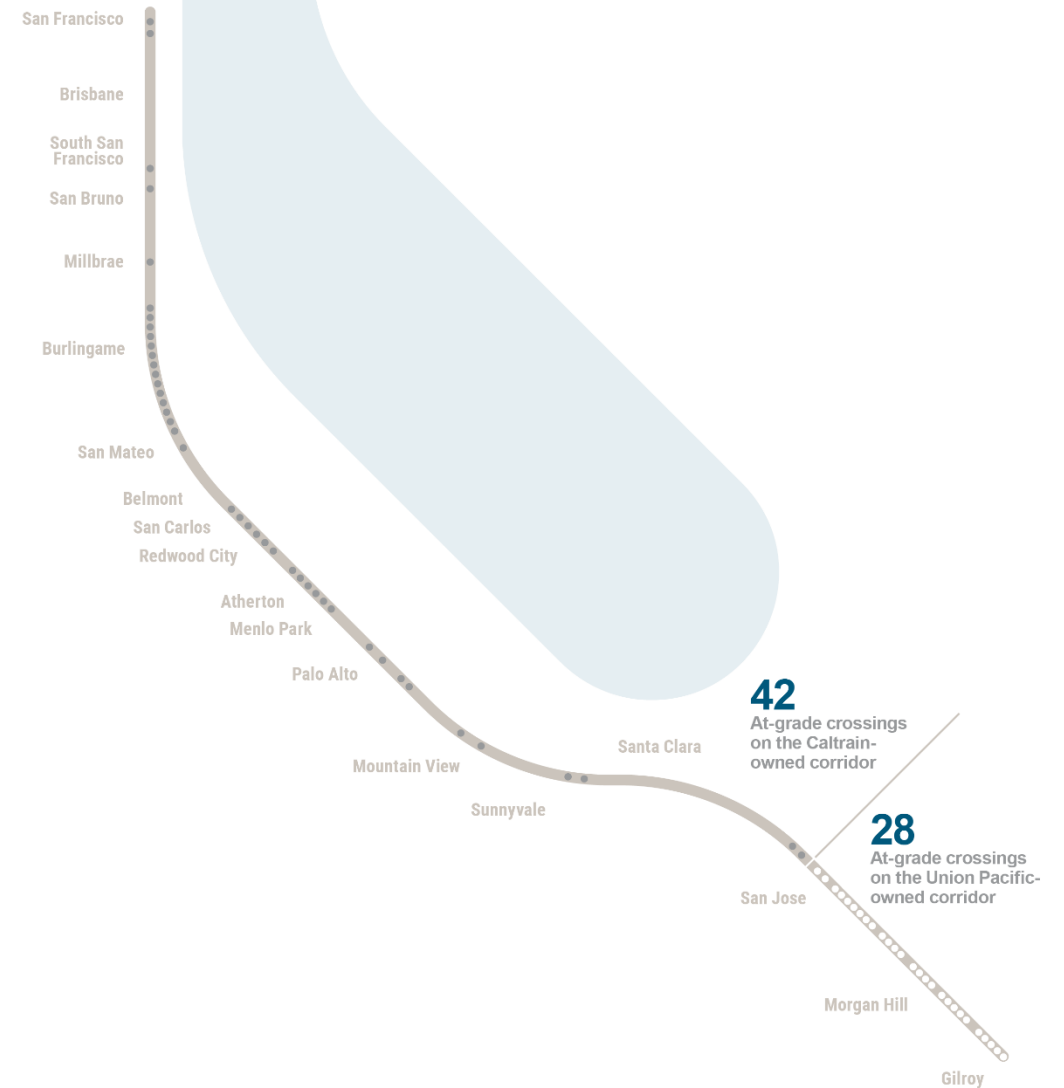
# Context

- 42 at-grade crossings on the corridor Caltrain owns between San Francisco and San Jose
- 28 additional at-grade crossings on the UP-owned corridor south of Tamien

### At-Grade Crossing by County in Caltrain Territory

- San Francisco: 2 at-grade crossings
- San Mateo: 30 at-grade crossings
- Santa Clara: 10 at grade crossings (with 28 additional crossings on the UP-owned corridor)

*Most of the data shown in this presentation pertains to the Caltrain-owned corridor north of Tamien Station*



## Background

# History

Today, 71 of 113 crossings along the Caltrain corridor have already been separated (63%) and 12 of 30 crossings along the UP corridor have been separated (29%)

The grade separations have been constructed (and reconstructed) at various points during the corridor's 150-year history

Planning for, funding, and constructing grade separations has been a decades-long challenge for the Caltrain corridor



*Bayshore Tunnels under construction, 1907*

## Background - History

# Grade Separations Have Been an Enduring Challenge

“In 1929, Palo Alto City Mayor, C.H. Christen, and Stanford University Engineering Professor Emeritus, W.F. Durand, organized political leaders from San Francisco, San Mateo, and Santa Clara counties to form the Peninsula Grade Crossing Conference, also referred to as the Peninsula Grade Crossing Association. Professor Durand and the association, with help from the San Francisco City Engineer, Southern Pacific Railroad, and the California Railroad Commission, studied the grade crossing situation on the San Francisco Peninsula throughout 1930 and sought ways to eliminate grade crossings.

In 1931, the association’s engineering subcommittee released a detailed, \$9 million two-phase proposal to eliminate grade crossings on the peninsula. The “Primary Program” of the plan called for construction of grade separations at the 15 most traveled and hazardous grade crossings and closure of the 17 least important grade crossings. The “Secondary Program” would have completed the elimination of all major grade crossings in San Francisco, San Mateo, and Santa Clara counties. The conference’s aim was to permit travelers to cross railroad tracks only via grade separations. At an average cost of \$270,000 per grade separation, the Peninsula Grade Crossing Conference proposed legislation to fund these projects through a portion of the state’s gasoline tax.”

- *Historic Context Statement. Roadway Bridges of California 1936-1959.*  
Published by Caltrans in 2003

## Background

# History

The following grade separation projects have been completed since the JPB assumed ownership of the Caltrain Service in 1992;

- Millbrae: Millbrae Ave (1990s)
- North Fair Oaks: 5<sup>th</sup> Ave (1990s)
- Redwood City: Jefferson Ave (1990s)
- Belmont: Ralston, Harbor (1990s)
- San Carlos: Holly, Britain Howard (1990s)
- San Bruno: San Bruno, San Mateo, Angus (2014)

There is one grade separation project under construction:

- San Mateo: 25th Avenue (estimated 2021 completion)

Funding for Grade Separation provided through San Mateo County's "Measure A" sales tax (1988, 2004) has been instrumental in completing these projects, while dedicated funding has previously not been available in San Francisco or Santa Clara Counties

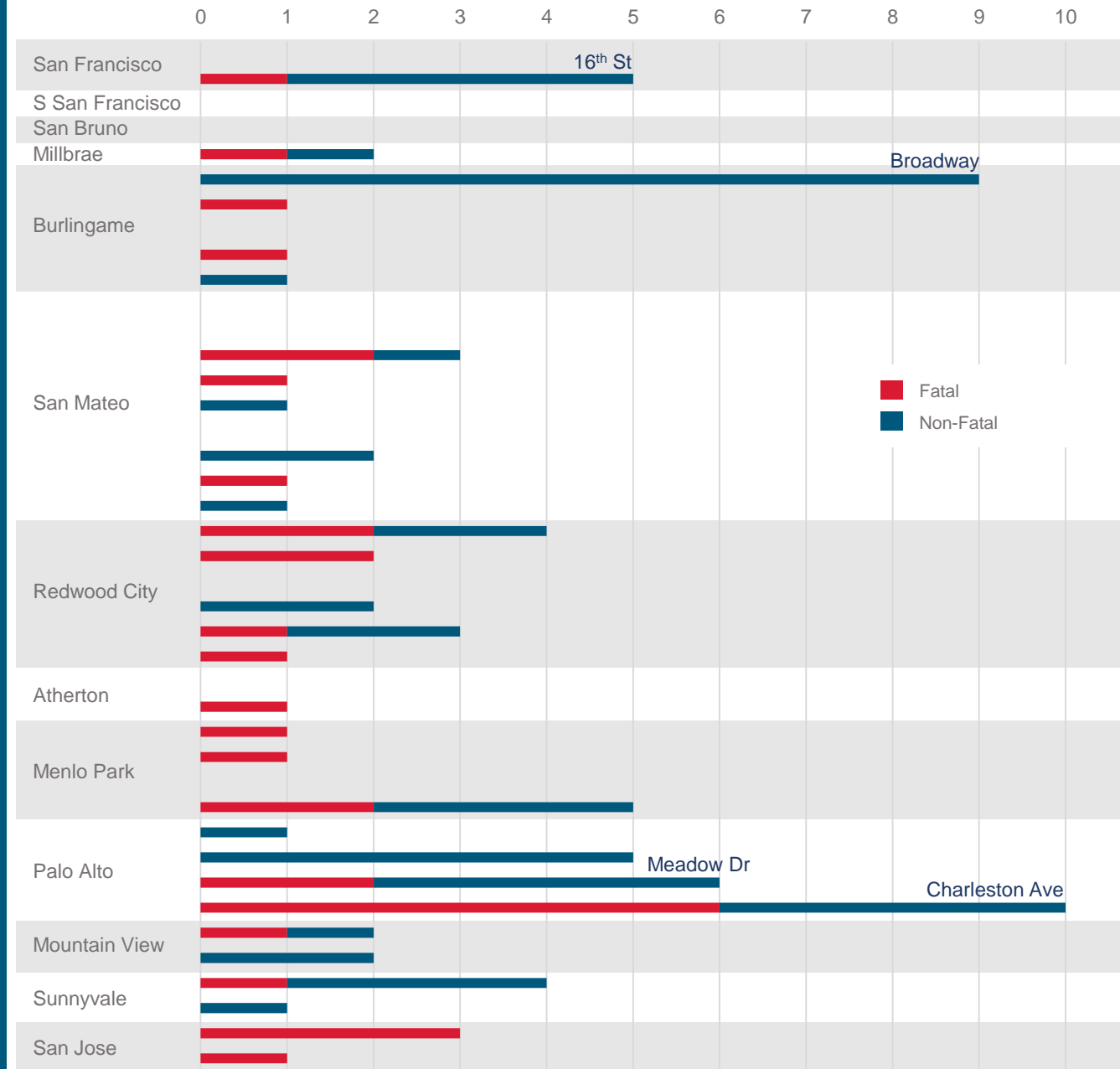


# Background Safety

Over 80 collisions occurred at Caltrain's grade crossings in the 10 years from 2009-2018. More than 30 of these collisions involved a fatality

- 11 crossings had 0 collisions
- 8 crossings had 4 or more collisions
- 21 crossings had 1 or more fatalities

Collisions at Caltrain Grade Crossings: 2009-2018



Data presented for Caltrain-owned corridor Only. Collision data from FRA reports



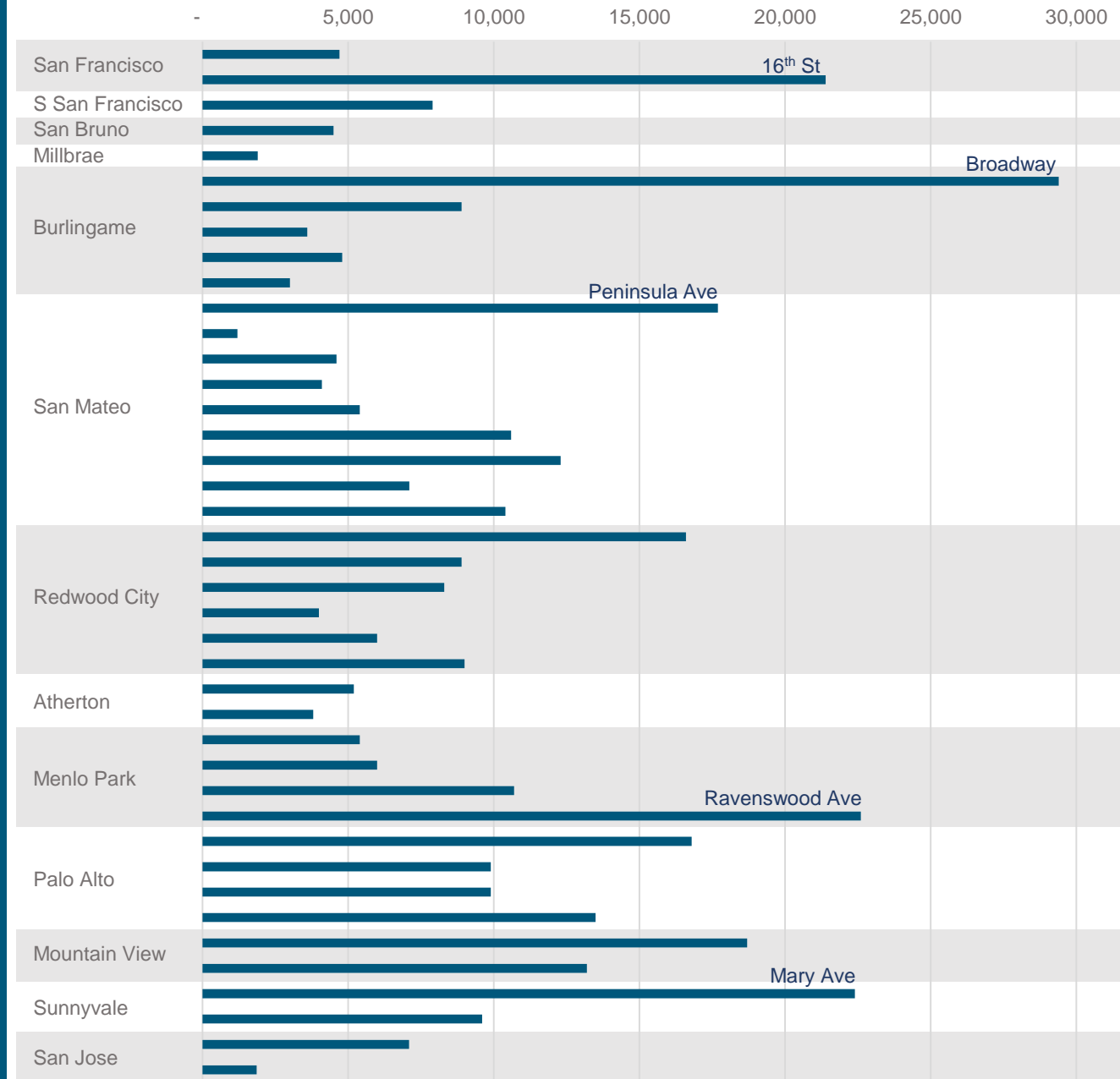
## Background

# Usage

Today, during a typical weekday, Caltrain's at-grade crossings are traversed by approximately 400,000 cars. This is equivalent to the combined traffic volumes on the Bay Bridge and San Mateo Bridge

The 10 busiest at-grade crossings account for half of all traffic volumes

## Existing Daily Traffic Crossing Caltrain Grade Crossings



## Background

# Regulation

Caltrain understands that the requirement for grade separation set by the current regulatory framework may be out of pace with the ongoing plans and desires of many communities on the corridor

The 2040 “Vision” will consider substantially expanded investment in grade crossing improvements and separations

## When is Grade Separation or Closure of a Crossing Required?

Grade crossings are regulated by the Federal Railroad Administration (FRA) and, in California, by the California Public Utilities Commission

Under current regulations, the separation or closure of an at-grade crossing is required in the following circumstances:

- When maximum train speeds exceed 125 mph (FRA regulation)
- When the crossing spans 4 or more tracks (CPUC guidance interpreted into Caltrain Standards)

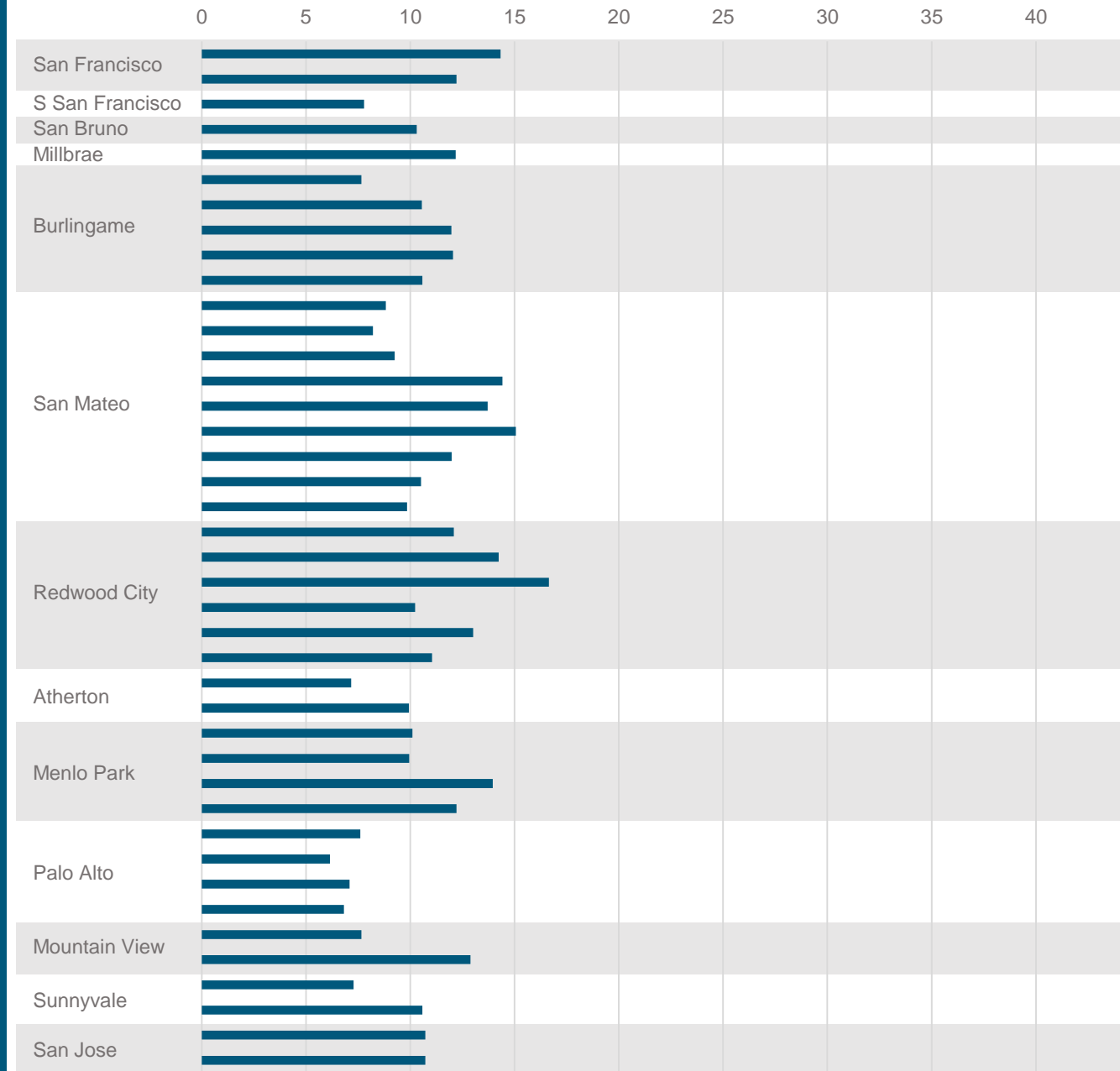
# Existing Gate Downtimes

Today, Caltrain's crossing gates are down for an average of about 11 minutes during the peak weekday commute hour. Gate down times range from 6 minutes up to nearly 17 minutes.

*Note: Gate downtimes shown reflect the average time crossing gates are down only. Depending on individual crossing and roadway configuration traffic signals may stay red for longer and auto users may experience longer delays*

*Data presented for Caltrain-owned corridor only.*

Gate Down Time: Existing (Minutes per Peak Hour)



# 2040 Gate Downtimes

In 2040, projected crossing gate down times vary by scenario. This evaluation does not take into consideration planned or potential grade separations

## Gate Down Time by Scenario

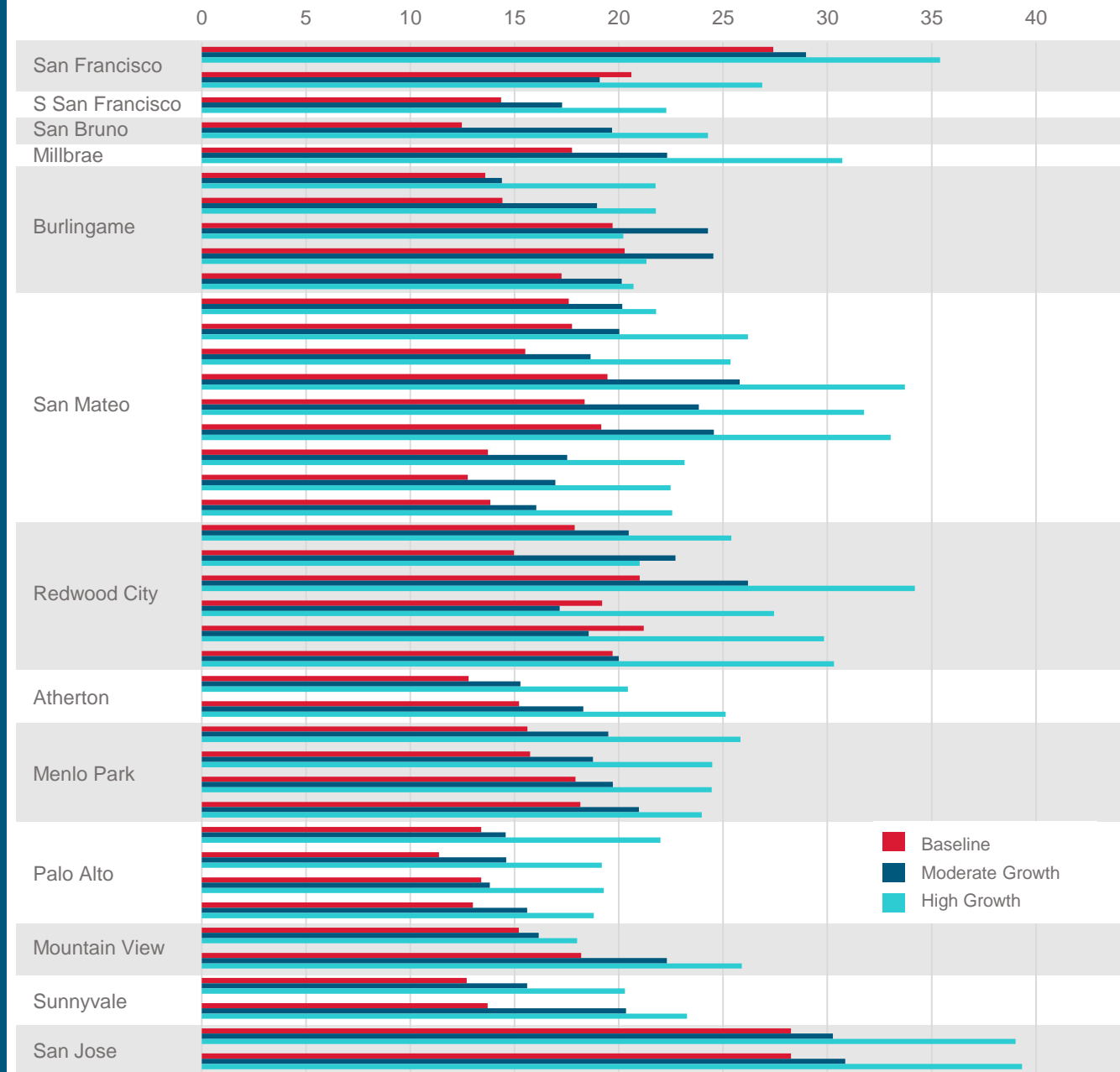
	Shortest	Average	Maximum
Baseline	11	17	28
Moderate	14	20	31
High	18	25	39

*Minutes per Peak Hour*

*Note: Gate downtimes shown reflect the average time crossing gates are down only. Depending on individual crossing and roadway configuration traffic signals may stay red for longer and auto users may experience longer delays*

*Data presented for Caltrain-owned corridor only.*

Estimated Gate Down Time: 2040 (Minutes per Peak Hour)



# What Total Investment is Needed in Grade Separations?

**The purpose of this analysis is to generate a defensible estimate of the overall financial investment in grade separations that might be needed to support different levels of future train service in the corridor**

Understanding the total financial need is an essential part of developing a “business case” for increased Caltrain service – it is required to fairly represent and align the potential costs of new service with the benefits claimed

**This work is not an attempt to redefine standards for grade separation nor is it intended to prescribe individual treatments or outcomes at specific crossings**

# Weighing the Cost of Grade Crossing Improvements

## Purpose

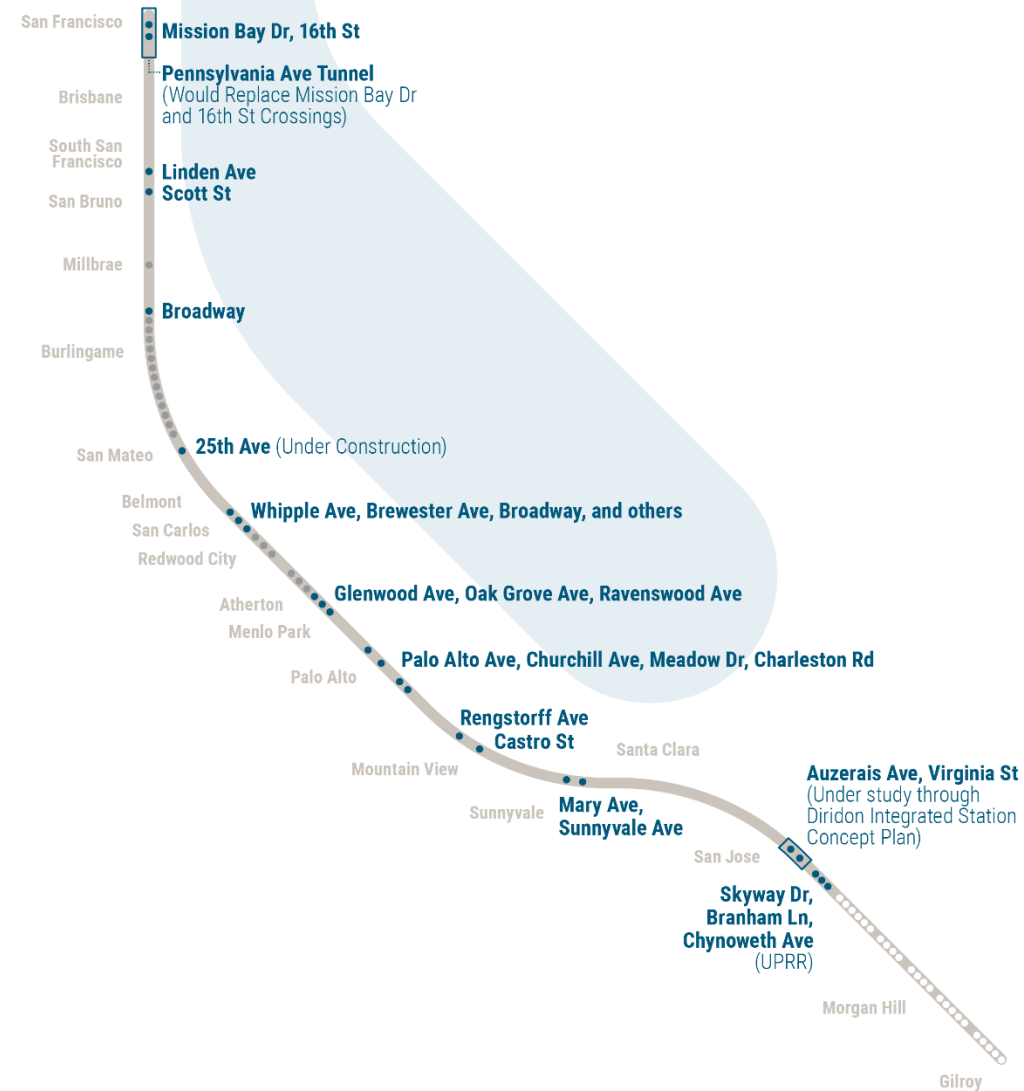
- Ensure that the overall capital costs developed for each service scenario include a reasonable level of **total, corridor wide** investment in grade separations and grade-crossing improvements

## Overall Methodology

- Review and utilize and City-led plans for each grade separations or closures
- Develop generic investment types and costs for crossings where no plans are currently contemplated
- Develop ranges of potential investment costs varied by:
  - Service Scenario
  - Intensity of investment (low, medium, high)

# City Studies, Plans and Projects

- Many cities along the corridor are actively planning or considering grade separations
- Each of these represents a major community effort to plan a significant and impactful project
- These projects, including their estimated and potential costs (as available), have been incorporated into the Business Plan



# Types of Investments Considered

Today, many crossings on the corridor are not actively being studied for grade separation but may require investment or intervention in the future. A range of generic costs were developed to help estimate the aggregate potential costs of these investments

## City-Generated Cost

Project type and cost already specified or estimated by city

Cost varies



## Grade Separation

Full grade separation of an existing crossing, or a new crossing

\$255 - 355 M unit cost



## Mitigated Closure

Road closure with separated bike/ped access or equivalent investment

\$35M unit cost



## Crossing Improvement

Quad gates and/or other safety improvements and treatments

\$1M unit cost





# City-led Grade Separation and Closure Plans

Caltrain has incorporated or accounted for grade separation concepts, plans and cost estimates from the following city-led studies into the Business Plan

City	Crossings Under Study	Status of Plan or Study	City Generated Cost Estimate or Range	Included in Business Plan?
San Francisco	Pennsylvania Ave Tunnel (includes both Mission Bay Dr and 16 <sup>th</sup> St Crossings)	Feasibility / 1% Design	\$1.4B*	✓
South San Francisco	Linden Ave	PSR	TBD	✓
San Bruno	Scott St	PSR	TBD	✓
Burlingame	Broadway	EIR	\$274M	✓
San Mateo	25th Ave	Construction	\$180M	✓
Redwood City	Whipple Ave, Brewster Ave, Broadway (Maple, Main and Chestnut under potential consideration)	PSR	\$350 - 500M (Whipple, Brewster and Broadway)	✓

*In many cases cities have not yet selected a single preferred option or have not approved specific cost estimates. In these instances standardized unit costs may be used for Business Planning purposes. These can costs can be updated at a later point in the planning process based on City decisions and input*

*\*Cost shown is highly preliminary and subject to change*

# City-led Grade Separation and Closure Plans

Caltrain has incorporated or accounted for grade separation concepts, plans and cost estimates from the following city-led studies into the Business Plan

City	Crossings Under Study	Status of Plan or Study	City Generated Cost Estimate or Range	Included in Business Plan?
Menlo Park	Glenwood Ave Oak Grove Ave Ravenswood Ave	PSR	\$310M – 380M	✓
Menlo Park	Middle Ave (Ped. xing only)	Feasibility	TBD	✓
Palo Alto	Palo Alto Ave	Under Study through Coordinated Area Plan	TBD	✓
Palo Alto	Churchill Ave	Alternatives Analysis	TBD	✓
Palo Alto	East Meadow Dr Charleston Rd	Alternatives Analysis	\$200 - 950M	✓
Mountain View	Rengstorff Ave	PE/EIR	\$150M	✓
Mountain View	Castro St	PE/EIR	\$44 - 64M	✓

*In many cases cities have not yet selected a single preferred option or have not approved specific cost estimates. In these instances standardized unit costs may be used for Business Planning purposes. These can costs can be updated at a later point in the planning process based on City decisions and input*

# City-led Grade Separation and Closure Plans

Caltrain has incorporated or accounted for grade separation concepts, plans and cost estimates from the following city-led studies into the Business Plan

City	Crossings Under Study	Status of Plan or Study	City Generated Cost Estimate or Range	Included in Business Plan?
Sunnyvale	Mary Ave	Feasibility Study with 15% Design	\$100 - 200M	✓
Sunnyvale	Sunnyvale Ave	Feasibility Study with 15% Design	\$40 - 250M	✓
San Jose	Azurais Ave Virginia Ave	Under study through Diridon Integrated Station Concept Plan	TBD	✓
San Jose	Skyway Dr Branham Ln Chynoweth Ave	Feasibility Study	\$366M – \$1,054M	✓

*Crossings are part of UP-Owned Corridor*

*In many cases cities have not yet selected a single preferred option or have not approved specific cost estimates. In these instances standardized unit costs may be used for Business Planning purposes. These can costs can be updated at a later point in the planning process based on City decisions and input*

# Building Ranges of Investment

## Variation by Service Scenario

The potential need and desire for grade separations and grade crossing improvements is significant across all scenarios.

The details of potential investments will vary between scenarios based on the location and extent of 4-track segments as well as the amount of gate downtime projected

## Key Variables between Scenarios

### Estimated Number of Crossings in 4-Track Segments\*

- Baseline : 0
- Moderate: 2
- High: 12

### Estimated Gate Downtime Ranges

- Baseline: 11 – 28
  - Moderate: 14 – 31
  - High: 18 – 39
- Minutes per Peak Hour*

*\*A range of options are discussed for potential 4-track segments within the Moderate and High Growth service scenarios. Number of crossings impacted by 4-track segments are indicative estimates only and subject to variation based on more detailed design and feasibility studies*

# Potential Planning Level Grade Crossing Cost Estimates

## Legal Minimum Investments

	Type	Baseline Growth	Moderate Growth	High Growth
<b>Corridor Wide Cost Estimate</b>	Auto	\$221M	\$926M	\$4.1B
	Bike / Ped	-	-	-
	<b>Total</b>	<b>\$221M</b>	<b>\$926M</b>	<b>\$4.1B</b>
<b>Auto Crossing Treatments</b>	Quad Gates & Safety Improvements	41	39	30
	Mitigated Closure	0	0	0
	Grade Separation	1	3	12

*The legal minimum investments in grade separation and at-grade crossings would include grade separation at all crossings in 4-track segments and installation of quad gates at all remaining crossings. City-generated projects are not included in this estimate except for the 25th Avenue Grade Separation (which is already under construction)*

# Union Pacific Corridor (Tamien to Gilroy)

Caltrain does not own the Union Pacific Corridor

Plans for expanded service on this corridor are relatively new and the details of potential future train volumes are highly dependent on HSR's future plans and service levels

For Business Planning purposes, Caltrain has proposed carrying a single general allocation cost to capture the need for grade crossing improvements on this corridor. This allocation assumes estimated costs for City-planned separations in San Jose as well as potential additional investments throughout the UP corridor

## Legal Minimum

- Quad gates at all crossings
- Total costs = approx. \$28M

## Recommended Approach for Business Planning

- City planned separations at Skyway Dr, Branham Ln, and Chynoweth Ave
- Two additional separations
- 3 mitigated closures
- Quad gates at remaining crossings
- Total cost = approx. \$1.4B

# Building Ranges of Investment

## Variation by Level of Investment

Caltrain understands that local plans and interest in grade separation go significantly beyond current regulatory requirements.

The Business Plan team has developed three different “levels” of corridor wide investments that represent different approaches to grade separation- all significantly exceeding minimum legal requirements

These ranges are simply intended to convey different approaches to investment- they do not define new standards nor do they prescribe specific plans at individual crossings

## Investment Included

### Lower Intensity Investment

- All city-planned projects
- Recommended UP corridor investments
- Separation and/or mitigated closure of remaining crossings with **highest** ADT and gate downtimes
- Quad gates at remaining crossings

### Medium Intensity Investment

- All city-planned projects
- Recommended UP corridor investments
- Separation and/or mitigated closure of **many** remaining crossings with higher ADT and gate downtimes
- Quad gates at remaining crossings

### Higher Intensity Investment

- All city-planned projects
- Recommended UP corridor investments
- Separation and/or mitigated closure of **most or all** remaining crossings
- Quad gates at remaining crossings (if any)

# Potential Planning Level Grade Crossing Cost Estimates: Low

	Type	Baseline Growth	Moderate Growth	High Growth
<b>Total Corridor Wide Cost Estimate for Crossings</b>	Auto	\$8.4B	\$8.6B	\$9.6B
	Bike / Ped	\$140M	\$140M	\$140M
	<b>Total</b>	<b>\$8.5B</b>	<b>\$8.7B</b>	<b>\$9.7B</b>
<b>Investments on JPB-owned Corridor</b>	Quad Gates & Safety Improvements	14	14	10
	Mitigated Closure	3	3	6
	Grade Separation	24	24	25
<b>Investments on UP-owned Corridor</b>	Quad Gates & Safety Improvements	20	20	20
	Mitigated Closure	3	3	3
	Grade Separation	5	5	5

*Builds on and accounts for costs associated with all City-led separation and closure plans*



# Potential Planning Level Grade Crossing Cost Estimates: Medium

	Type	Baseline Growth	Moderate Growth	High Growth
<b>Total Corridor Wide Cost Estimate for Crossings</b>	Auto	\$8.7B	\$8.9B	\$10.1B
	Bike / Ped	\$140M	\$140M	\$140M
	<b>Total</b>	<b>\$8.8</b>	<b>\$9.0B</b>	<b>\$10.2B</b>
<b>Investments on JPB-owned Corridor</b>	Quad Gates & Safety Improvements	12	11	6
	Mitigated Closure	4	5	8
	Grade Separation	25	25	27
<b>Investments on UP-owned Corridor</b>	Quad Gates & Safety Improvements	20	20	20
	Mitigated Closure	3	3	3
	Grade Separation	5	5	5

*Builds on and accounts for costs associated with all City-led separation and closure plans*

# Potential Planning Level Grade Crossing Cost Estimates: High

	Type	Baseline Growth	Moderate Growth	High Growth
<b>Total Corridor Wide Cost Estimate for Crossings</b>	Auto	\$8.9B	\$9.8B	\$11.0B
	Bike / Ped	\$140M	\$140M	\$140M
	<b>Total</b>	<b>\$9.0B</b>	<b>\$9.9B</b>	<b>\$11.1B</b>
<b>Investments on JPB-owned Corridor</b>	Quad Gates & Safety Improvements	10	5	0
	Mitigated Closure	5	8	11
	Grade Separation	26	28	30
<b>Investments on UP-owned Corridor</b>	Quad Gates & Safety Improvements	20	20	20
	Mitigated Closure	3	3	3
	Grade Separation	5	5	5

*Builds on and accounts for costs associated with all City-led separation and closure plans*

# Next Steps

There is a significant body of work remaining to address the issue of at grade crossings in the Caltrain corridor

Caltrain plans to continue advancing a corridor wide conversation regarding the construction, funding and design of grade separations while continuing to support the advancement of individual city-led projects

## **Within the Business Plan**

- Incorporate grade crossing investment estimates into overall corridor costing and business case analysis
- Continue peer review of corridor wide grade separation case studies and examples

## **Beyond the Business Plan**

- Develop corridor wide grade separation strategy, potentially addressing;
  - Construction standards and methods
  - Project coordination and sequencing
  - Community resourcing and organizing
  - Funding analysis and strategy

## **For individual City projects**

- Continue working with cities and county partners to support advancement of individual grade separation plans and projects

FOR MORE INFORMATION

[WWW.CALTRAIN.COM](http://WWW.CALTRAIN.COM)



## Memorandum

**From:** Staff  
**To:** XCAP  
**Date:** January 23, 2020  
**Subject:** Agenda Item #3: Presentation and Discussion with Sebastian Petty of Caltrain

The list of questions generated by the XCAP Caltrain Working Group are attached to this memo (**Attachment 3a**) and were previously distributed at the January 15, 2020 XCAP meeting.

In addition to the list of questions, Mr. Petty will also cover the Council-adopted Criteria of “D: Support continued rail operations and Caltrain service improvements” with the XCAP.

Lastly, the XCAP Chairperson asked that the following reference links also be shared with the XCAP in preparation of this discussion in addition to **Attachments 3b and 3c** to this memo.

- The latest business plan update that mentions total 8 trains in each direction per hour is in this document (pages 34-78):  
[http://www.caltrain.com/Assets/\\_Agendas+and+Minutes/JPB/WPLP+Committee+Agenda+Packet.pdf](http://www.caltrain.com/Assets/_Agendas+and+Minutes/JPB/WPLP+Committee+Agenda+Packet.pdf)
- Page 89-94 of this document: <https://www.caltrain2040.org/wp-content/uploads/Caltrain-Organizational-Assessment-Full-Report.pdf> is the excerpt which discusses what Caltrain is contemplating to help do large capital projects.
- [https://caltrain2040.org/wp-content/uploads/Caltrain\\_ServiceVisionFactSheet\\_V12-1.pdf](https://caltrain2040.org/wp-content/uploads/Caltrain_ServiceVisionFactSheet_V12-1.pdf)
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- [https://caltrain2040.org/wp-content/uploads/CBP\\_FrequentlyAskedQuestions\\_January2019.pdf](https://caltrain2040.org/wp-content/uploads/CBP_FrequentlyAskedQuestions_January2019.pdf)
- [https://caltrain2040.org/wp-content/uploads/CBP\\_KeyTerms.pdf](https://caltrain2040.org/wp-content/uploads/CBP_KeyTerms.pdf)

# Questions for Caltrain

Initial draft 2020-01-13

Note: I am going to try to chair this meeting so that Sebastian isn't answering every question everyone has ever had related to Caltrain - and instead is focused on answering questions we have as XCAP members that we feel we'd really need to understand in order to make formal recommendations. I will reiterate that, similar to the consultants, Sebastian Petty and Caltrain are going through their own planning exercises and many answers might end up being - we don't know yet but we're working on it. I also understand, however, that some folks need to understand Caltrain a bit better - so we need to leave some space for folks getting up to speed.

With that in mind, are these questions what we need to know to make a decision?

## Caltrain operations now

1. Is there any reason that Caltrain can't increase schedules to 6 trains/hour in each direction before electrification is complete, to alleviate overcrowding and standees on many trains?
2. Why doesn't Caltrain run more midday service now?

## Electrification Construction Schedule

1. Is the overall electrification project on schedule? If not, what is the new estimated completion date?
2. What are the risks to the schedule?

## Caltrain Operations After Electrification

1. According to best information, current Caltrain funding is sufficient for new EMU trainsets to replace only 75% of the current fleet. Is this true? How much of the current fleet of diesel engines and diesel-hauled coaches will remain in operation to support current schedules? Are there any plans to get funding to replace the remaining 25% of the diesel engine and coach fleet with EMU trainsets?
2. How is mixing diesel and electric expected to impact the schedules in the short term and does this delay more frequent midday service until Caltrain is fully electrified?
3. How much of the current fleet of engines and coaches will be needed to cover a service increase to 6 trains/hour/direction? Are there any plans to get funding for the additional EMU trainsets needed?
4. How will diesel-engine powered trains affect overall schedules as headways are reduced, since diesel engine powered trains cannot accelerate or decelerate as fast EMU trainsets?
5. How many years until the current EMD F40-PH2 or the MPI MP36PH-3C engines reach end of life? Will they be replaced with new diesel engines or with EMU trainsets?
6. We know Caltrain plans to run more trains once electrified and the Business Plan shows Caltrain will run much more frequent all day service in the future. When will Caltrain release information of

what happens in the in between (2023 - ?) When might midday service significantly increase? We are trying to understand when we will “feel the pain” of gridlock - so any understanding of even the process to determine the service post 2023 is helpful.

## Passing Tracks in South Palo Alto

1. What is our contingency plan if we need passing lane(s) in Palo Alto? How do we get some more definitive information about four-tracking requirements from Caltrain?
2. Caltrain has said they would like cities to select an alternative that doesn't “preclude” four tracks - which of these options doesn't preclude 4 tracks: viaduct, hybrid, trench, tunnel?
3. Can we overlay any possible future four-track passing sections against the current maps of alternatives?
4. If passing tracks are required as part of a grade crossing separation design, will Caltrain pay for the incremental cost of design and construction? Ongoing maintenance?
5. Will Caltrain share costs for a four-track alternative, in advance of when Caltrain would actually need to use the passing tracks?
6. How could a trench or a viaduct be widened to accommodate 4 tracks?

## Business Plan and Overall Planning

1. Does Caltrain intend to develop a comprehensive plan for replacement of all the grade crossings between San Francisco and San Jose?
2. Does Caltrain intend to develop a funding mechanism to support such a comprehensive plan?
3. Are there state and local agencies that we can work with better so that we are all planning a regional solution rather than a town-by-town solution?
4. In the absence of a comprehensive plan, does Caltrain intend to provide assistance to crossing elimination projects, city by city?
5. On average, what percentage of funding have cities contributed to grade separations in the past? What was the main source of funding for these grade separations historically? Has any tax measure ever been raised just to pay for grade separations (and not other general transit capital projects)?
6. Are there any legal requirements for Embarcadero grade separation to continue to include a Stanford stop (if changed in the future for any reason)? Who is responsible for Stanford Station? Does the City or Caltrain have an arrangement with Stanford that must be considered? **Are there any scenarios contemplated in Caltrain's business plan service vision that continue to provide service to the Stanford station?**
7. If a viaduct or a tunnel is built, can the City have amenities, such as bike paths, as part of an easement, or would all of the land be controlled by Caltrain. If there are no amenities, is Caltrain accountable to control weeds, graffiti, etc.?
8. If existing tracks are removed **for viaducts or tunnels**, will Caltrain create bike paths? If not, what is the intended use of this space?

9. Is there anything that regulates how long of a stretch between crossover switches? Is there a requirement for the maximum spacing in miles between crossover switches?
10. Are there any large projects that are in the works but have not been completed that might change the technical requirements (like 1% grade) on the Caltrain corridor in the future in a way that could impact our decision? For example, is there a plan to remove freight that is in the works but has stagnated? What is the likelihood of any surprises through the design review process (re Caltrain, etc.)?
11. Has Caltrain developed standards for tunnels that have only electric trains (same standards that will be used for going into TransBay terminal),? If not, when are they expected?
12. How will Union Pacific (or a future short line operator) operate trains on a 2% grade? More power on each train, or shorter trains? What would be the noise impact of more power or engines operating at full throttle on a 2% grade?
13. Will Caltrain be ready to speak about Union Pacific Railroad exceptions related to freight?
14. For design exceptions such as 2% vertical grades, is the City required to negotiate with Caltrain, or can the City negotiate directly with Union Pacific RR?

Documents for Chantal to give to XCAP prior to meeting:

- 1) Letter from Caltrain to HSR re: who pays for passing tracks if/when HSR comes to the Peninsula
- 2) Letter from Mayor Sam Liccardo and former Mayor Ed Lee asking UP to consider requiring a short-line operator to allow 2% grade
- 3) Excerpt of Caltrain Organizational Assessment (starting page 89) describing the two entities Caltrain is considering for dealing with Grade Separations
- 4) Do we have some document that is an "guide to Caltrain" for newbies that might be useful for XCAPers to read before the meeting? Something that explains the board make up and how they don't have dedicated funding in a succinct and readable way??





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August 22, 2019

Brian Kelly, Chief Executive Officer  
California High Speed Rail Authority  
770 L Street, Suite 620  
Sacramento, CA 95814

**RE: High-Speed Rail Preferred Alternatives in Northern California**

Dear Mr. Kelly,

The Peninsula Corridor Joint Powers Board (JPB) appreciates the ongoing, collaborative effort our agencies are engaged in to plan for the successful development and operation of a Blended System in the San Francisco Bay Area. The Authority's completion of project-level environmental clearance describing the infrastructure needed to introduce High Speed Rail operations into the Bay Area is an important step in this ongoing process and we congratulate the Authority on reaching the important milestone of identifying Preferred Alternatives for high-speed rail in the areas it has defined as the "San Francisco to San Jose" and "San Jose to Merced" project sections.

This letter serves both to indicate Caltrain's concurrence with the staff recommendation at this stage in the Authority's environmental process as well as to affirm our perspective that significant further planning and agreement between our agencies will be required to successfully advance the implementation of the Blended System in the Bay Area. This letter briefly describes Caltrain's rationale for our concurrence with the staff selection of a Preferred Alternative in each project section and highlights areas where we anticipate that additional coordination and discussions will be required. Please note that this letter is narrowly focused on the Authority's selection of Preferred Alternatives from among the options studied in each project segment and is not intended to provide a detailed assessment or comment on the Authority's overall plans. We anticipate writing a more comprehensive comment letter at such time as the full draft environmental documents for the "San Francisco to San Jose" and "San Jose to Merced" segments are released.

In the "**San Francisco to San Jose**" project section, which includes the majority of the JPB-owned corridor, our teams have worked for the last several years to jointly evaluate various service plan and passing track options. Based on that analysis, we are in agreement with the Authority that prototypical blended service plans similar to those previously studied as part of the Peninsula Corridor Electrification Project EIR/EIS, and included in the "baseline" scenario of our Business Plan, can be operated on the mainline infrastructure included in "Alternative A" of the Authority's environmental analysis (infrastructure that assumes no new mainline passing tracks).

Brian Kelly, Chief Executive Officer

August 22, 2019

Page 2 of 2

We note, however, that the Caltrain Business Plan has demonstrated that additional infrastructure, including passing tracks, may be needed both in order to expand rail service over time as well as to allow for the operation of a wider range of alternative blended service patterns on the corridor. As the corridor owner and manager, Caltrain anticipates the Authority's full support and participation in the process of planning for and implementing future passing tracks and overtakes that may be used in Blended operations. These ongoing collaborative efforts will lead to the processes and agreements by which the implementation and operation of both systems' improvements can proceed apace.

In the **"San Jose to Merced"** project section, we are supportive of the Authority's selection of Alternative 4 as the Preferred Alternative as that is the only alternative that helps expand the electrification of the Caltrain service south of Tamien Station to Gilroy. The Business Plan considers the electrification of this corridor and the provision of improved service to South San Jose and the rest of Southern Santa Clara County as a significant priority for the railroad and we appreciate that the design of Alternative 4 has been developed in a way that would make that service possible.

While we are supportive of the selection of Alternative 4 for the reason indicated above, we do note that this alternative has significant and complicated implications for the blended operations of both High Speed Rail and Caltrain systems from CP Coast in Santa Clara, through the Diridon Station and south to Gilroy. This southward extension of the blended system is a significant departure from many aspects of the planning and agreement work undertaken previously by our agencies. We look forward to continuing discussions and analysis related to this alternative, both within the context of the Authority's environmental process as well as in relation to ongoing negotiations between the State and the Union Pacific Railroad, the Diridon Integrated Station Concept Plan, and our own process of interagency planning and agreements.

Since the landmark agreement in 2012 that set us on the path to develop a blended system, significant investment from the High Speed Rail Authority as well as from our other regional, state and federal partners is already helping transform our corridor and service through the Peninsula Corridor Electrification Project. We again congratulate the Authority on its designation of preferred alternatives for the San Francisco to San Jose and San Jose to Merced Segments, and we look forward to continued partnership between our organizations as we move forward in planning shared investments and delivering enhanced rail service to our customers, our communities, our region and our state.

Regards,



Jim Hartnett

cc: Boris Lipkin  
Michelle Bouchard  
Sebastian Petty



October 9, 2019

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Ms. Adina Levin  
Friends of Caltrain  
3921 E Bayshore Rd  
Palo Alto, CA 94303

**Re: Preferred Alternative for the San Francisco to San Jose Project Section**

Dear Adina:

Thank you for taking the time to provide feedback on the California High-Speed Rail Authority (Authority) Preferred Alternative for the San Francisco to San Jose Project Section. Friends of Caltrain has been a valuable member of our Community Working Groups and we look forward to continuing to work with members of your organization.

In your letter, you raised concerns about the relationship between the Authority's proposed project that is undergoing environmental review and other planning efforts including the Caltrain Business Plan and the Diridon Integrated Station Concept Plan.

The Authority has been working collaboratively with Caltrain to plan, evaluate, and develop the blended system since 2012. Caltrain in 2015 completed environmental clearance for the Peninsula Corridor Electrification Project (PCEP). After completion of the PCEP environmental clearance, the agencies worked together to develop and assess the infrastructure needed to add high-speed rail service to the corridor in addition to those previously-evaluated and adopted plans by Caltrain. That work (along with substantial input from other stakeholders) resulted in the two alternatives under study in the San Francisco to San Jose project section.

Our efforts have taken place concurrently with Caltrain's development of a business plan to lay out a long-range vision for the corridor and the Diridon Integrated Station Concept Plan (both of which are ongoing). These efforts are important planning work for the future and are still evolving meaningfully. The Authority's environmental documents will take both of these efforts into account but they will both require separate environmental clearance at the time that they are further developed, finite and stable.

The Authority's efforts will not preclude either the Caltrain Business Plan or the Diridon Integrated Station Concept Plan from moving forward. Additionally, we

Ms. Adina Levine

October 7, 2019

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plan to stay actively engaged and to work collaboratively with Caltrain and our other partners on the development and long-term plans for the rail corridor between San Francisco, San Jose, and Gilroy. I am attaching Caltrain's letter to the Authority that lays out some of those future collaborative steps while also concurring with the Authority's identification of the Preferred Alternatives in Northern California.

As all of these efforts continue to advance, we look forward to an open and frequent dialogue with Friends of Caltrain.

Sincerely,

A handwritten signature in blue ink, appearing to read "Boris Lipkin". The signature is written in a cursive style with a large initial "B" and "L".

Boris Lipkin  
Northern California Regional Director

September 30, 2019

Honorable Chair Gillian Gillett  
Peninsula Corridor Joint Powers Board (Caltrain)  
1250 San Carlos Avenue – P.O. Box 3006  
San Carlos, CA 94070-1306

RE: CALTRAIN BUSINESS PLAN – ADOPTION OF LONG RANGE SERVICE VISION

Dear Chair Gillett:

The City of Palo Alto appreciates the opportunity to share with you its comments regarding the proposed adoption of the Caltrain Business Plan - Long Range Service Vision scheduled for review at the October 3, 2019 Joint Powers Board meeting. Producing a long range vision is a difficult endeavor, and we want to thank Caltrain staff for the high caliber work in preparing this document. As you proceed with reviewing adoption of this and other Caltrain Business Plan documents, we request that you consider the following issues:

1. **Grade separations:** Grade separations are essential to providing safe and reliable service, especially considering the increases in service frequency envisioned in the Long Range Service Vision. The Long Range Service Vision acknowledges that it is dependent on grade separations but does not commit to addressing grade separations prior to the adoption of the Long Range Service Vision. Due to the criticality of grade crossings to an enhanced service vision, we request that a commitment to address these issues be included with the adoption of this document.
2. **A coordinated approach to funding and construction:** As Caltrain moves forward with the remaining components of the Business Plan, it is necessary for Caltrain to consider incorporating options for a corridor-wide approach to grade crossing design criteria, funding, and timely implementation/construction. We support the revised staff recommendations which provides enhanced language towards “Completing the Caltrain Business Plan including additional analyses of issues related to funding, connectivity and access, and equity as well as the identification of a detailed implementation program of next steps and follow on work.” As Caltrain conducts additional analyses of funding, we would request that Caltrain also investigate its ability to participate in grade separation bond financing.

September 30, 2019

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- 3. Evolving the organization and governance:** The continued development of the business plan represents an opportunity to think broadly and expansively about Caltrain’s governance model for the delivery of rail service on the Peninsula. As such, the City supports the revised staff recommendation which recommends “evolving Caltrain in a manner that best prepares the railroad to deliver the service vision by deliberately and transparently addressing the issues of service delivery, internal organization and governance.” We look forward to seeing a robust inter-agency engagement process for future discussions surrounding this issue.

Thank you for the opportunity to comment on the adoption of Caltrain’s Long Range Service Vision.

Sincerely,



Eric Filseth, Mayor  
City of Palo Alto

cc: Jim Hartnett, Caltrain Executive Director  
Sebastien Petty, Caltrain Director of Policy Development  
Casey F Casey Fromson, Caltrain Government and Community Affairs Director  
Jeannie Bruins, JPB Board Member, representing a city in Santa Clara County  
Cindy Chavez, JPB Board Vice Chair, representing Santa Clara Board of Supervisors  
Palo Alto City Council  
Ed Shikada, Palo Alto City Manager  
Chantal Gaines, Assistant to the City Manager  
Philip Kamhi, Chief Transportation Official



## **Expanded Community Advisory Panel (XCAP) Minutes (Verbatim)**

**January 29, 2020, 4:00 PM**

Special Meeting

Community Meeting Room

### **1. Welcome and Roll Call**

Chair Naik: We have a quorum, so we're going to start. Chantal, if you want to call the roll, then we'll start oral communications.

Ms. Cotton Gaines: Sure

Present: Gregory Brail, Phil Burton, Tony Carrasco, InYoung Cho, Megan Kanne, Larry Klein, Patricia Lau, Adina Levin, Nadia Naik, Keith Reckdahl, David Shen (said he would be a little late today), Cari Templeton

Absent: Judy Kleinberg (excused)

Ms. Cotton Gaines: You do have a quorum.

### **2. Oral Communications**

Chair Naik: Okay. So, as you guys know who have been following along, we have Caltrain presenting today, but before that, I'm going to open it up to any oral communications for items not on the agenda. Do we, a show of hands how many people want to speak on something not on the agenda. We've got one, two. Is there anybody else. Roland, I'm going to ask if you can go second, because she's working on getting your video up, so, whoever wanted to go first, yeah. Thank you. You have two minutes.

David Kennedy: You've heard from me before. This may have come up already, but if Charleston is closed or the Michael Price alternative which is the suggested name, is selected, I would encourage as a mitigation measure, some way of looking at safe turns onto Alma for people going west out of Professorville and Old Palo Alto area. Right now, the only intersection where that can be done with a signal is Church Hill between Homer and, it's really Meadow. It's the only place there is a signal, and so for people who are reluctant to take their lives in their hands and try to turn left onto Alma, I would hope there would be something else done. Obviously, that has all sorts of implications too, because I don't think any street in Old Palo Alto or Professorville wants to turn into a neighborhood alternative. One more thing for the XCAP to put on your plate. Thank you.

Chair Naik: Thank you. Okay, Roland.

Roland LeBrun: Yeah, so I had the (not understood), but anyway, let's go. I'm explaining to you why I'm showing this to you. (Not understood) Good. Alright, so this is how we did the pedestrian underpass at Santa Clara. The VTA did this. It's

not the way Caltrain did it. The other half Caltrain spent six months. We did this in three days. It was basically a closure of the track over Thanksgiving weekend. So, the first section, we're ripping the tracks up. While this is going on, let me explain to you why I'm showing this to you. So, first of all it's for you to understand what it is going to take to do what Elizabeth is suggesting at Meadow and Charleston. That is basically we can, we close the track, we rip everything out. You're going to see what's going to go in in a minute here. So, this is the underpass. You see all these blocks over there, these concrete blocks. This is how that works. But for you in Palo Alto it's actually more important than Alma and I'll explain to you why. We know we are going to have to replace the bridge. This is the fastest way to replace that bridge. But, if you bring in the right people, you can replace the bridge and grade separate Alma, both of them at the same time in a three-day closure. I'm not saying Caltrain and their consultants are capable of doing this. I can assure you I know people who can actually do this, and to it in three days both. I want you to start thinking about four tracks and the reason I do is because you're going to get somebody else to pay for this, because now this is a project of regional significance, which is going to get them (not understood), everybody else, high-speed rail authority and you're setting yourselves up for a four-track station, and there it is for your consideration.

Chair Naik: Thank you. Anybody else want to comment on something that's not on the agenda?

### **3. Presentation and Discussion with Sebastian Petty of Caltrain**

Chair Naik: Okay, so we can move on to our main item, which is a presentation and discussion with Sebastian Petty of Caltrain. Sebastian, thank you so much for coming. When I tell you, we've been waiting many months to see you, really, we're excited. So, thanks for being here.

Sebastian Petty, Caltrain: Okay, well thank you so much for having me. I am happy to be here. I hope that I don't end up disappointing you or letting your expectations down. Let me give you just a little bit of background about who I am, kind of what my role at Caltrain is and in particular, the kinds of things that I'll be fairly adept at answering questions about versus the kinds of things where I'm going to have to take it back and get back to you later. I'm the Deputy Chief of Planning. That's a newer role for me. I've been working on the Caltrain Business Plan, which is sort of a long-range planning effort for the corridor as a whole. I've now sort of taken over the larger Planning Program at Caltrain. What that means is I can speak a lot to Caltrain's future plans at a corridor-wide level and that includes thinking about how we may need to address at-grade crossings at a corridor-wide level in the future. Sort of our long-range plans for how our service may evolve over time, numbers of trains at different times, sharing the corridor with high-speed rail, things like that. I can also talk about agency policy and processes. So, when we're talking about things like design exceptions or issues there, I can provide guidance. Not, and this is where the disappointing part may come in, I'm not an engineer. I can't sort of respond to engineering concepts or construction ideas on the spot, nor will I try to. But I can talk a little bit about kind of the overall agency process in terms of how we might consider different kinds of construction methodologies or design



exceptions. My answers to some questions may be less specific than you might like them to be, and that's in part because this is very serious and impactful stuff and I don't want to tell you something one day and then come back and tell you something different another day. The presentation I've put together is, there's not a whole lot to it. Really, what it is, sorry, Chair Nadia was kind enough to provide me a number of questions in advance, and so I've kind of just put those into a power point and I'll speak through them as I go. And then in some instances where I have materials that are relevant to the question, I've sort of threaded those into the presentation to help with that. And again, just expectations, there are definitely questions in there that I'm not going to be able to answer specifically, so I may answer them more in generalities. And there are some that aren't really answerable at this point. In terms of kind of format of how you want me to proceed, should I just keep going?

Chair Naik: Just go for it, and then what we'll do is afterwards I'll take, I'll have the XCAP ask questions. We'll probably do public comment and come back for a second round of questions.

Mr. Petty: Okay. So, again, really, I've structured this presentation in terms of just responding to the questions I received, and so I've reordered a few of them. Basically, they're just in the order I've received them. So, the first couple of questions were really about Caltrain's operations today, and the questions related to is there a reason why Caltrain can't increase our current service to six or more trains per hour. Today, with the diesel fleet we operate, to alleviate crowding and why don't we run more midday service now. So, the answer to the second question is simpler. There is no technical reason why we couldn't run more midday service now. There's a financial reason. We're limited in our funding. There's also a contractual reason. We are constructing electrification on the corridor right now, so we, as part of making that project, part of the contracts that govern the delivery of that project, we've reduced our midday service to 90-minute windows. So, unfortunately, we're not able to add more midday service now. There's also a financial component to that. But all other things being equal, we could provide more midday service than we typically do. In terms of going up to six trains per hour, it's a combination of different factors. Some of it is equipment availability, some of it is really the limitations of diesel equipment. Five trains per hour per direction with kind of our current system as it exists today is a lot for the corridor, so in some cases between the limitations of the diesel trains and the signaling system that's in place today, that's really about what we can fit while still operating a service that looks roughly like what we do operate to day. So, while we're sort of in our current mode, five trains per hour per direction is pretty much the max. There were also some questions around the electrification project, so this is not an area of my direct responsibility, and so I'm going to give you some fairly canned answers to this. Is the overall electrification project on schedule? If not, what is the new estimated completion date? The estimated completion date is still 2022. So, there is sort of ongoing conversations. It's a design build contract and so there is, you know, a relationship between Caltrain, the project's sponsor, and the contractor has a responsibility for meeting that schedule. So, we as the owners of the contract have not changed the date that we're estimating completion and that's our intent to hold the contractor to that. What are the risks to the schedule? I'm not, this is

again, not really my area, but what I can say is if you go to the Caltrain website, there is a monthly report that goes through a lot of the project risks in detail, and talks about which ones are potentially on a critical path. So, for folks who really want to dive deep into this topic, I'd encourage you to go there. Before I move on, I'm not sure if there was sort of any larger question behind kind of the electrification schedule and how that relates to grade separations in Palo Alto. If there is sort of an overarching question there, I'm happy to try to address that.

Chair Naik: I think it was just mostly to understand whether electrification will be finished in the near future and what that does for operations.

Mr. Petty: Yeah, I think the assumption, and certainly the agency's assumption is that it will be completed in the near future.

XCAP Member Levin: And if I can chime in for a second. There are probably a few issues that you'll touch on that will be relevant in terms of how frequently is Palo Alto likely to see more frequent service and more gate down time and there are several different dimensions that would probably apply to that, including this one.

Mr. Petty: So, operations after electrification, now we're getting into an area where I'm a little more comfortable in. But, so according to the best information, Caltrain funding is sufficient for new EMU trainsets to replace 75 percent of the current fleet. Is this true? I think the answer is not exactly. Just to provide some context, this was when we originally planned and procured the project, this was the case that we were replacing about 75 percent of our fleet. Since that time, we were awarded another State grant to purchase additional EMUs and also to expand the EMUs we were originally buying from six-car trainsets to seven-car trainsets. So, as part of that the percentage of the fleet that is being replaced is higher now, the relative percentage. Probably more meaningful than just the fleet replacement is how those EMUs would be used. So, what percentage of them would actually be operating, and that percentage, so the percentage of the service that would be operated with electric trains is certainly higher than 75 percent. We're still kind of fine tuning where the margin is, but generally it would be a handful of trips a day, mainly during the peak and the trains that are serving down to Gilroy that would be operated by diesel trains, and the rest of the trip, so everything in the midday, evening and then most of the rest of the service would be operated with electric vehicles. So, we have purchased more EMUs when we went out and procured the contract with our car builder, Stadler, we put a series of options on those contracts, so as we get more funding and we have the ability to kind of keep their production line going and buy more trains, we've exercised a few of those options to do the fleet expansion I talked about. In the next several years, if we're able to get more funding we would look to continue to exercise some of those options. (inaudible) procurement with them

XCAP Member Reckdahl: What timeframe are you looking at to go all electric?

Mr. Petty: It's highly funding contingent. You know, ideally, we would like to be all electric on the main corridor, so the corridor between San Jose and San Francisco, really as soon as we can. You know, in terms of when that would likely occur, it would likely, you know, funding permitting, sometime in the late 2020's. It's hard

to see a path to it's happening sooner than that. How is mixing diesel and electric expected to impact schedules in the short term, and does this delay more frequent midday service until Caltrain is fully electrified? So, the impact is, when we plan our schedules, we have to make sure that at least a subset of the individual train schedules we're running are ones that could be operated by diesel trainsets. So, one of the reasons we're excited about moving to an electrified system is those trains do have better performance, they can accelerate and decelerate more quickly. While we still have diesel on the line, we can still realize a lot of those performance benefits, we just need to make sure that as we design the schedule, whatever trains we think will be operated potentially by a diesel train can meet that performance or can conform to those performance specifications. So, it's, there is an affect, but it doesn't prevent the majority of the benefits of electrification from being realized, including, it certainly doesn't delay more frequent midday service. So, we would, from a technical standpoint, certainly be able to operate more frequent midday service. Whether we have the ability to do so, it is likely more contingent on funding. How much of the current fleet of engines and coaches will be needed to cover a service increase to six trains per hour per direction? Are there any plans to get funding for additional new trainsets? So, we did get some funding of the current fleet. We're still, I would say, fine tuning that analysis, and by that I mean we've got a lot of diesel vehicles that are near the end of their useful life, and so the calculation of how many do we keep around is a little different in that instance, but generally we're talking about getting, I want to be careful quoting exact numbers, but I think less than 11 locomotives and probably less than that, certainly less than that would really be needed for revenue service on a day-to-day basis. And as I said, were we able to secure some more funding to buy more EMUs, then that's certainly something we're thinking about in terms of our future plans. So, this next one is, how will diesel-engine powered trains affect overall schedules as headways are reduced, since diesel-engine powered trains cannot accelerate or decelerate as fast as the EMU trainsets? So, it's really something we have to take into account as we design our service, and again, there's sort of a lot of materials that I can get into and I believe it may have been in some of the presentations that Nadia provided that I have provided to the Business Plan context, where we've done a lot of service planning work to essentially plan around the reality that we know that there are some trains in the peak that will be diesel. So, for example, if we have a service that has an express train in it, it would likely be the express train that would be operated as a diesel train since that doesn't need to stop and start as frequently.

(Inaudible)

Mr. Petty: In terms of years until the current MP-36 and F-40 engines reach the end of their useful life, the F-40s are pretty much there, you know, and so we're kind of keeping them alive, but they're really at the end of their useful life. The MP-36s generally could make it in terms of a defined useful life, through the end of the 2020s, and so those would remain in use as long as we need to have them in use, through the end of the 2020s. Again, I think our hope would be to replace of those with electric trainsets as soon as we're able to. I think folks here may know, but if you're not aware, the current electrification project goes from San Francisco through Tamien Station in San Jose, that's just south of Dearden Station. That's the

corridor that Caltrain owns. South of that we operate a very limited service on Union Pacific territory down to Gilroy. That territory is not being electrified, so one of the questions the agency will have to wrestle with is, as we get to a place where we fully electrified the main line fleet, how do we continue to provide service to Gilroy, and is that as a diesel shuttle of some kind or do we look into kind of longer range plans to procure some sort bimodal vehicle or in the longer term, hopefully, have a corridor that is electrified all the way. How much of the current fleet of engines and coaches will be needed to cover a service increase to six trains per hour? I think we might have touched on this one. Sorry, if that's a repeat. So, the next question is sort of a big question, and I pulled in a few slides from a couple of presentations I've given to kind of talk to this, which is really Caltrain has done a long work as part of our Business Plan process to look at sort of our big picture, long-term vision, so thinking out to 2040 and beyond. That was a lot of work that happened during 2018 and 2019 and our Board made a policy decision on that that I'll talk about a little bit. A lot of the work we're doing now is really focused on what happens before then. So, as we're electrifying the system, how will we use the electrified system, what are some of the incremental investments that would come after that and what does that mean for our service? When do we think we might start operating more trains? So, the next few slides are really pulled from Business Plan presentations, but we did a lot of work over the course of 2019 to identify a long-range service vision for Caltrain, so you'll see a few of these diagrams on the right as I present them. Let me just sort of orient what they are. Basically, what you're seeing from the top of the screen to the bottom is the corridor from north to south, San Francisco all the way down to Gilroy. And then the lines you're seeing represent one hour of one direction of service. And so, in this case what you're seeing is three lines that represent different types of trains. The blue line on the left would represent high-speed rails, future service. The red line represents an express train and the grey line represents sort of a local Caltrain train. Each of those repeats four times in an hour, and so that would get you to twelve total trains per hour per direction on the main line corridor. The little circles basically represent the number of, or the stopping pattern of those patterns of trains. So, this is the long-range service vision that the Board adopted. This is an illustrative example of that service, and I'll talk about this later as I go a well. What the Board adopted was broad policy language that describes this kind of service, but it doesn't get down to the detail of saying you know, a station-by-station level exactly how many stops per hour a station might get. So, we use a lot of illustrative analysis to support the development of that policy and that's what's pictured here. But the overall language the Board adopted is at a little bit of a higher level. So, that's where we're trying to go and that's what our Board is...

XCAP Member Brail: Just to ask a stupid question, I assume that when coming up with this schedule, like an actual rail planner calculated in dwell times and acceleration and train speed and the clock.

Mr. Petty: Yes.

XCAP Member Brail: This is not just, (crosstalk). So, this is like a schedule that might actually work, given the EMU and all that?

Mr. Petty: Yeah. There was extensive technical effort into this. This has also been fully simulated and (crosstalk) yeah. So, I mean it is, maybe proof of concept would be a better version. We've done variations of this, but there was a lot of technical work to basically support a broader policy statement, and I think the goal in doing that, which again will become important as we keep going, is that this was not to, was to acknowledge that we can't always predict exactly what's going to happen 20 or 30 years in the future. It's important to set goals, but have them be flexible enough that some variation can be accommodated.

XCAP Member Brail: Yeah. Thanks.

Mr. Petty: I guess the other thinks, before I show some astronomical price numbers, the other thing I should acknowledge is that that vision includes some pretty big projects as part of it by 2040, so you're seeing service all the way to downtown San Francisco which presumes the construction of the downtown extension. You're seeing high-speed rail as part of this, which is obviously a major statewide project. You're also seeing kind of continuous electrified Caltrain service all the way down to Gilroy, which presumes a change in ownership of the corridor that's currently UP as well as electrification. So, there's some really big investments assumed in this. The other one I'll touch on, and this is a topic we'll come back to, is the sort of shaded areas of gray you see in background are areas where, as well as, and it's a little hard to see on this screen, but I'll point them out, where you see the A, B, C and there as sort of little dotted lines. Those are areas where, if we were to fully introduce this level of service, including the high-speed rail, we would need four track segments. So, that's basically a four-track segment at Millbrae, a very short sort of overtake in San Mateo between Haywood Park and Hillsdale, a four-track station in Redwood City. And then what we identified as a four-track station somewhere out of the four stations shown, Palo Alto, California Ave, San Antonio or Mountain View. That would be a station-based overtake, so it's not a multi-mile kind of thing. It would be creating a four-track station where in this instance, for the ones that are relevant to Palo Alto, that would be specifically to facilitate the passing movement of a high-speed rail train passing a Caltrain train.

Chair Naik: Do you remember offhand if that fits in all four of the stations that are identified? Palo Alto it does, Cal Ave I don't remember.

Mr. Petty: Yeah, I think, so I want to – this was not an engineered analysis, so we did a, I would say preconceptional engineering on these to sort of understand that we wouldn't be doing something truly incredibly impossible, but it fits as a relative term, so I would not want to present that this kind of infrastructure wouldn't have impacts.

XCAP Member unidentified: Sebastian, I have a question about speed. How fast the trains will go, excuse me, in terms of electrification and then, of course, you've integrated high-speed rail into this.

Mr. Petty: So, with electrification, the project we're building now, the maximum speed on the corridor would remain 79 miles per hour. That's the maximum speed today and you know, practically up and down the corridor the trains are often going much slower than that. So, when we electrify it will remain at 79 miles per hour. At

such time as high-speed rail is introduced into the corridor, their plans called to upgrade the maximum speed to 110 miles per hour. Similar to today, that would not mean the trains were going 110 miles per hour everywhere. They have stops and starts along the line, albeit fewer and there are some curves that would remain, but that would become the new maximum speed. I don't, there are no active Caltrain plans to increase speed on the corridor in advance of that. It's not to say that it's not something we would ever think about or do, but we have not thought about it or done it outside of the long-term commitment.

XCAP Member Lau: Right, but if, for example, if you said some of these trains now travel at 79 or under that, let's say 60, so this is perhaps, you know, again, almost doubling 50 to 60 miles per hour, and then you're going up to 110.

Mr. Petty: In some parts of the corridor it would be a significant increase in the speed. So, the costs of building out that full vision are quite substantial, and to just kind of enumerate again the big infrastructure items that would be assumed in that, one of that is grade separations and so we did our best to look up and down the corridor. There are 42 at-grade crossings on the corridor Caltrain's zones. There are 33, I want to say, on the corridor that UP owns. We looked at all of the crossings that are under active consideration of some kind by a city up and down the corridor and that could be something like the process Palo Alto is going through up to. In some cases, cities have picked a preferred alternative and have advanced a project through engineering or beyond, so we incorporated, to the best of our ability kind of cost estimates for that. We also looked at crossings that haven't been thought about, so that's what got us to about a, near a \$10 million number. That's not sufficient to fully grade separate the entire corridor. It's certainly a majority of the grade separations. That also includes an assumption that some crossings might be closed. Other than including the ones that cities are actively planning, we didn't specify, make specific assumptions about other crossings. This was really an exercise to get a kind of corridor-wide sense of the magnitude of cost. Some of the other big projects that are included here are, again, terminal improvements. That includes the extension to downtown San Francisco as well as a major station and rail infrastructure rebuild that's being thought about at Dearden Station, rail infrastructure and systems, thinks like a new signal system for Caltrain, station improvements and that could include modernization of stations, improved access facilities, these platform extensions and level boarding and then fleet upgrades. So...

XCAP Member unidentified: Would that include safety measures?

Mr. Petty: Of what nature?

XCAP Member unidentified: Infrastructure.

Mr. Petty: Well, certainly the grade separations would be sort of the biggest investment in safety. To the extent there would be any at-grade crossings remaining there would be an assumption that those would have quad gates and channelization and other kinds of safety improvements.

(Inaudible)

Mr. Petty: Yeah.

XCAP Member Brail: It would be helpful to know how much of these numbers, this is like, this would be the price tag is, I think what you're saying. How much of this is already funded, by whom is helpful, but I know in the grade separation it's not nearly that much.

Mr. Petty: Yeah. The vast majority of this is not funded, and that's actually some work we're doing now. So, in the next couple of months through the Business Plan process you can expect to see sort of a discussion of funding that will talk about sources that could be used for this, sources that already exist. But in general, the vast majority of it is not funded.

XCAP Member Carrasco: I didn't get the issue of four tracks in the 2040 plan that you have with high-speed rail. Would in Palo Alto, require four tracks or is it two tracks?

Mr. Petty: So, the quick answer is four tracks, and if you'll bear with me there are some more slides where I get into that in more detail.

XCAP Member Carrasco: And the second question that I had is, working under the assumption that if one street is closed in Palo Alto and we need to mitigate those, that closure, would the money that might come from somewhere be allowed for that mitigation, or that reconfiguration of another intersection?

Mr. Petty: So, that's a question that I can't answer because it's one that really is dependent on the source of funding. I can talk about, in a few slides, I can talk about it in kind of a general sense in terms of some of the policy work that Caltrain is going to be doing. Because in a general sense I think we would like to see that kind of option be available to cities, but as of today it's very dependent on what source of funding is used in terms of whether it would be flexible to use on something like traffic mitigation rather than a grade separation itself. So, that's the big long-range vision. The question that I was sort of responding here was really what might happen in a few years, or what might happen in five years or ten years. So, to answer that we have to look at kind of the different steps on the path between where sort of the railroad would like to be in 2040, where we are today, and what the points in between are. So, what you're seeing on this slide would be the kind of steps you would see if maybe a few months ago you had gone out and looked at every agency's plan and said, when do you think they're going to be doing something. So, we have Caltrain today as a diesel operation. In 2022 we'll begin electrified operations and have six trains per hour. After that, really the next plan has been that high-speed rail would start operating on the corridor in 2029. That's the date they have published. And then in 2033 is when they have sort of said they would achieve their full build out of their system and have all their trains operating in the corridor. That was kind of it. That was what was there and so when we did our long-range visioning we said, well okay, let's look beyond that to 2040 and we'll make sure we're incorporating everything before that and then some more. The reality in what we're looking at now is that, as I mentioned, most of these projects are not funded, so there is a huge amount of uncertainty around when they may actually come to bear and what may happen first or second, and

when things may happen, and so one of the reasons we've been doing this sort of Business Plan work is to set a long-range goal for what we want this system to be, so that we can begin thinking strategically or even opportunistically about what kinds of investments we might be able to make earlier or ways that we can improve Caltrain's service earlier that are still consistent with all of the plans of the other agencies we work with, and are still consistent with the long-range vision. I hope that makes sense. It's kind of setting the long-range vision and then figuring out how to work backwards to get there and figuring out if there is a way to make certain improvements faster than other ones. There is a reason we're thinking that way and it's because of the kind of demand that we see in the corridor. We've done a lot of sort of land-use analysis throughout this process and for a variety of reasons, Caltrain carries about 60,000 riders on a weekday today. We think there is sort of ample reason to believe that by the end of the 2020s, so a decade from now, that there is pretty conservatively demand for over 90,000 passengers a day out there in the corridor. That is based on factors like latent demand, where today Caltrain doesn't provide super frequent service at many stations, but the land use characteristics around those stations suggests that if there were more frequent service there, people would probably want to ride it. There is a lot of population and employment growth occurring along the peninsula and quite a lot of it is within the typical catchment of Caltrain stations. And then in some instances, we have improved connectivity to the system. Things like the central subway that's being built up in San Francisco that will provide a very direct, pretty high capacity transit feet right into one of our major stations. So, we've done, and again this is sort of a jumbled subset of a series of larger presentations. When we've done sort of ridership modeling on that, generally what we see is electrification and the kinds of service patterns we would be able to operate with that. We anticipate we'll add about 20,000 riders to the system, assuming those riders will sort of build up over time in kind of the first half of the 2020s. Beyond that we're going to start pushing our capacity limit on the trains, again on the peak hour trains so there will be some growth, but we think it will slow. Then, what I'm about to talk about is if we were to add more service to this system, we think there would be demand there for about another 20,000 riders. So, on that last point, we do think if we're sort of running just the basic electrification schedule, we do think as we start to get towards the end of the 2020s that we're likely to begin getting pretty full during commute hours again. We're particularly, I think, concerned that if the downtown extension project to downtown San Francisco does come on line, then our service will be really overwhelmed at six trains per hour, because that will be a direct connection between the peninsula and what continues to be kind of just absolute core of jobs in the region. So, there are a variety of kind of incremental measures or smaller incremental measures that Caltrain might be able to look at to kind of increase capacity at the margin. The next really big increment and what we would do would be to go from a maximum of six trains per hour per direction to eight. So, as part of the Business Plan we've looked at kind of are there some incremental smaller investments that we could make that would get us to eight trains per hour. Not the \$23 billion kind of 2040 investment. It turns out there are some options there. They don't do everything, so it isn't quite the ideal service. There are challenges to Caltrain, the lengthening our trains which I can talk about if people are interested, but a lot of it has to do with how our maintenance facility is set up. So, essentially what we've looked at in some detail is, there does seem to be a path to, once



Caltrain is electrified, going from six trains per hours to eight trains per hour. There are some constraints on what we can do, but with a significantly expensive but much more modest than \$23 billion set of investments, there does seem to be a viable path to get us to eight trains per hour in the future.

Chair Naik: Sabastian, could you just answer the question about whether there needs to be, so Caltrain has the legal right to run more trains per hours. They don't need any additional clearance from the California Public Utilities Commission or the State or anybody else, correct? Or grade separations necessary to get to eight trains per hour.

Mr. Petty: That's correct. I think there is a conversation we would want to have with the High-Speed Rail Authority around that and our future agreements with them, but in terms of grade separations or public CPUC, no. And again, just to highlight the reason we do that beyond the capacity is that's the set of investments that starts to really increase the frequency of service to stations on the corridor. So, you can see kind of an aggregate the number of stops per hour per direction stations are getting with the existing service, where most are getting less than four trains per hour and you've got a handful that get four to five. How that in aggregate corridor wide would change with electrification, and then how it might change if we were to go to an eight train per our service plan where at that point about half of the stations are getting eight trains per hour per direction, really sort of a BART-like frequency of service and many of the rest are getting about four trains an hour. This next slide, and again I think Nadia may have provided this full presentation, but a subset of kind of what that might mean at service levels. I'm going through this fairly quickly because I know there are other questions that folks have. One thing that is important, probably, to touch on is what kinds of investments would be needed to achieve that eight train per hour level of service I think the first important thing to say is there are a whole range of programmatic investments that are part of our long-range vision that we're working on today, and we would want to continue working on. Grade separations are first on that list. Station improvements similarly, as well as some of the big mega projects on the corridor. So, the presumption was Caltrain to go this route, and that is a question, would be that we would continue working on all of those efforts. In terms of directly operating eight trains per hour per direction, really the major investments we would need to make would be an expanded EMU fleet. We're running more trains. They need to be fully electrified. We would need to provide more storage for those trains, so we think we can make it work with the existing maintenance facility, but we would need a place to store trains overnight. We would need to eliminate the hold-out rule, which is a, we've got some substandard stations.

XCAP Member unidentified: What does that mean?

Mr. Petty: Sure. So, the holdout rule refers to a sort of an older configuration of station platforms where, I'm thinking about how best to describe it, but it is essentially where you have the two-track system. You have a platform in the middle that hasn't been built up to current standards where the trains may overhang it. So, the only remaining ones in the system are at College Park, which doesn't receive regular service, and then at Atherton and Broadway. There used to

be a lot more of them in the system. We've since eliminated them. The big issue for the system as a whole is that if there is one train in the station, another train can't go through because there is a safety issue of people having to cross between platforms.

XCAP Member unidentified: I'm sorry, did you say it's an island platform?

Mr. Petty: It's like an island platform. It's in sort of the middle of the tracks.

XCAP Member unidentified: But it's too narrow to accommodate two trains in the station at the same time?

Mr. Petty: That's correct, and there's more open pedestrian access across it, so we put in an operational rule. (crosstalk) Yeah, and so there's an operational rule in effect called the holdout rule where basically a train coming from the opposing direction has to wait outside.

XCAP Member unidentified: There's not underground access, like say California Avenue?

Mr. Petty: Exactly. So, there really are basically just three stations left like this on the line, College Park, which doesn't receive regular weekday service, and then Atherton and Broadway stations,

XCAP Member Levin: When you said the station improvements, and maybe this is something that you will get to, what is the additional difference? Is the Redwood City four-track section, it's not needed for the eight trains, so what incremental difference would be made by the Redwood City four-track passing station, at such time that that's done?

Mr. Petty: Yeah, so it would allow us to – while we are with a more limited set of investments while we are able to offer eight trains per hour per direction, it's highly constrained in terms of the pattern of service we can operate. It's pretty much what you're looking at on this screen. So, in our long-range service vision, one of the things we, our Board adopted, was the idea that you would have express and local trains, you would have a coordinated transfer between those trains that could happen at a four-track, two-platform station or four-platform face station in Redwood City or somewhere in the mid-peninsula. Without having that kind of overtake infrastructure in the middle of the corridor you can't really operate a local train in the peaks. You don't get that all stop connectivity. Similarly, if we were to put eight trains per hour per direction in the corridor, you wouldn't really have exactly express trains. You would have what you're seeing here, which is sort of kind of a zone express type service. Sort of the other major really big-ticket investment we think would be needed to make this happen is level boarding to keep sort of the overall run times consistent and keep the system reliable when it's running at those levels of service. We do think that would be a pretty critical investment to making this happen. I think one of the challenges in terms of what we're looking at is it leaves a real question about what would happen to the Gilroy service, you know, at the low end that could manifest as sort of a separate diesel shuttle service with a coordinated transfer in San Jose. Like I said, there are other

options we could look into like dual mode vehicles and so there are a range of issues there, but it does create a challenge. And then some minor improvements around Dearden. I don't have cost numbers associated with this, but generally the capital expenditure cost we're talking for this kind of capital improvement program would be more than a billion dollars, but less than, significantly less than two billion dollars. So, very expensive, but quite a bit less than the \$23 billion.

XCAP Member unidentified: That's just for the Gilroy to San Jose piece?

Mr. Petty: No, that's for all of that.

XCAP Member unidentified: All of it needed to get to eight trains an hour?

Mr. Petty: Yes.

XCAP Member Brail: So just – I'm still trying to understand all, how this works, but let's imagine that we needed to upgrade all of the stations in Palo Alto. I guess we only have two, to level boarding, who would pay for that?

Mr. Petty: That would be a – I mean Caltrain and I'm saying Caltrain in quotes because it would be a variety of (crosstalk) but it would be a Caltrain project.

XCAP Member Brail: It would not be a City of Palo Alto project, most likely?

Chair Naik: Just to be very clear, Caltrain is funded by the three counties voluntarily giving money, so it's not us but it's us.

(Crosstalk)

XCAP Member Carrasco: Sabastian, when would that train platform leveling happen? Is it in 2023?

Mr. Petty: I think if we were to move forward with this program of investments, so it's something that we've always assumed we want to get to in the long term. If we were to say we want to do this sooner, I think we would be looking at the late 2020s. So, it's not going to happen in 2023. There's a variety of work that would need to be done. If we were successful in doing that and finding funding, the late 2020s would be kind of the earliest realistic date. So, hopefully, that gives folks some sense of kind of what might be possible in the near term. So, just to put a range of numbers, these aren't in the slides but they're drawn from other sources that are out there. So, when we did the environmental document for electrification, we talked about, I've been talking about trains per peak hour, to talk about kind of total train volumes throughout the day. When we did the environmental document, we run 92 total trains a day today, when we did the initial environment document for electrification, I believe we talking about 114 trains. With the electrified system, we have the ability to operate more trains than that, so the peak would be the same. We wouldn't go above six trains per hour per direction in the peak, but we certainly would be technically capable of operating more midday service than that, and we do see there is marked demand for more midday service. So, dependent on funding, the kind of range of train numbers we could be talking about in the

relatively near future could be anywhere between probably the 114 at the low end to something more in the 160 trains a day at the higher end, and that would be if we were to put out the level of midday service that satisfies demand. So, to give you some sense of what might happen in the relatively near term, that's sort of the range that we might be talking about. If we were to go to an eight-train service, that could start to creep up towards around 200 trains a day.

XCAP Member unidentified: Do we have a passing track right now in Palo Alto?

Mr. Petty: No. So, moving on to kind of the next subject of questions, which was passing tracks in Palo Alto, what is our contingency plan if we need passing lanes in Palo Alto, how do we get some more definitive information about four-track requirements from Caltrain and can we overlay any possible feature of four-track passing sections against the current map of alternatives. So, before jumping into passing tracks, it's I think probably helpful to provide just a little background or reminder of kind of where that information about passing tracks is coming from. So, as we developed the long-range vision for Caltrain, we looked at a range of different scenarios. We called them the baseline growth, the moderate growth and the high growth, so there were again different long-range scenarios, all of which met Caltrain's sort of overall commitments to high-speed rail and other partners, but looked at basically different levels of potential future train traffic on the corridor. I won't dwell on these in detail, but there are three of them. The baseline is consistent with what is currently in high-speed rail's environmental document. So, that looked at a future where Caltrain operated basically six trains for ever and we never increase beyond that and then someday high-speed rail showed up with their trains. There are no passing tracks required in that, other than a four-track station at Millbrae. So, fewer trains overall, no substantial growth in Caltrain's service, and no passing tracks.

XCAP Member unidentified: I'm sorry, does that assume 79 miles an hour?

Mr. Petty: No, that's 110.

XCAP Member unidentified: Okay, so in that scenario there are no passing tracks, but we have 110 mile an hour high-speed rail trains, four an hour?

Mr. Petty: Right. Then we did the moderate, which is what the Board sort of adopted as the first part of the service vision, which goes up to eight Caltrain trains per hour in the long term, combined with the same high-speed rail trains. And to do that, that's where we need to start introducing some passing tracks, mainly at stations or for short distances, and I'll talk about those in more detail subsequently. Then we looked at something we call the high-growth scenario, which looked at really maxing out the corridor and kind of really pushing the boundaries of what would primarily still a two-track corridor. So, this actually looked at operating twelve Caltrain trains per hour per direction plus the same four high-speed rail trains. To do this, the passing tracks would need to start getting longer, so we would have some pretty long segments of passing tracks at various points in the corridor, including potentially a fairly long segment in the vicinity of Palo Alto through Mountain View. I'm saying vicinity, because there is some squishiness to it. Again, this isn't engineered. There is some flexibility in terms of

speeding up a train or dropping a stop and having a track be shifted south or north or a little shorter or a little longer. There's some tradeoff, but in general we know that it would need to be somewhere in that area.

XCAP Member Brail: Would it be possible for, and we have some people who like to look at maps clearly, and design things, to find out some technical information on the lengths of the required passing track sections in these scenarios? And we could imagine where they might be able to go?

Mr. Petty: Yeah. I think, what I will say is you're seeing about as much information in terms of geography as there is, but what we can provide and is in the appendices of some of the presentations, is the exact train schedules and string lines that were used to generate these. And that will show, you can look at those and get a precise answer where they would need to go. I guess what I would emphasize is that precision is inaccuracy in this case, which is to say, as I mentioned, these are sort of illustrative train service assumptions, so you know, were we to go out and build the passing track and want it to be, you know, 2,000 feet to the north, that train schedule could be adjusted or changed in some way to accommodate that.

XCAP Member Brail: Right, but is there data that says, hey, we need a one-mile passing track section somewhere between Palo Alto and Mountain View, then someone in this room might look at a map and say, hmm, you know, this might affect us depending on exactly where that goes. But if we don't know if it's 500 meters or a mile or five miles, then we can't do that.

Mr. Petty: Yeah, we can provide that very sort of rough level of, roughly this length to achieve this kind of service, roughly this length between.

Chair Naik: And it's actually on the bottom of the slide, you see moderate growth is less, it's about five miles and then less than 15, 20, but the one in our area would be, if I recall, it's five miles somewhere in the vicinity of Palo Alto to Mountain View.

XCAP Member unidentified: Was I supposed to get these slides before the meeting?

Chair Naik: No, you didn't but it was in the other presentation, but that's okay. It's an important thing to bring up.

XCAP Member Levin: So, in terms of thinking about timelines and how to interpret what's happening in the world, is it accurate to say that the passing tracks in Palo Alto wouldn't be needed until, for high-speed rail service?

Mr. Petty: Yeah, that is wholly accurate. Regardless of the scenario we're talking about here, the passing infrastructure in this part of the corridor is to facilitate the movement of high-speed trains.

Chair Naik: And I would like to point out that in the packet that you can see that's on line one of the attachments for today, one of the things that we linked to was a letter from Caltrain responding to high-speed rail on their environmental impact report, basically saying, hey, we understand that if you come along the corridor, we're going to share tracks, but we also understand that if you high-speed rail need

to add more tracks, you will go through your own environmental process and you will pay for those tracks. So, there's a letter saying that.

XCAP Member unidentified: It was a little more diplomatic than that.

Chair Naik: Oh yeah. Read it for the diplomacy That was the short version.

XCAP Member Reckdahl: Sebastian, you're talking about passing tracks, you're always talking about four. Could you have two sets of three? Would that give you the same functionality, or do you actually need four? Because the width is so challenging for four?

Mr. Petty: Yeah, I think – I want to be careful not to give an answer that boxes me in too much, because a lot of this is really a – that answer is that there is flexibility on all of this. There are just trade-offs. So, for example, if we were in the future where we were really building out all of this, you know, and we were to look at the corridor and say there's just no way we can do it, it's too infeasible, this track can't be five miles long, it's got to be shorter. We can make that work. There would just be service compromises to it. And those could take the form of stations not getting as much service or trains having to slow down and wait as other trains pass them. So, it's not – I mean, I recognize in a world where we're talking about engineering, that can be kind of a difficult answer to swallow. But the reality is we're way out in the far future when we're talking about this stuff. Twelve trains per hour per direction is a very ambitious, long-term goal. I do want to, as I get through this, then talk about what it specifically was that the Board adopted and how that's relevant. But, were we to arrive at that future, I think there is room to have the conversation about what's feasible, what isn't and how we kind of weight that against some tradeoffs in terms of service?

XCAP Member unidentified: Sebastian, is there even a rough idea of the total time from let's do this to end of construction, how many years would elapse?

Mr. Petty: So, I mean, the answer being when we, so somewhere in the depths of this there is a capital cost model that has individual projects and shows them profiled over time. The reason I'm saying, you know, and you could do it all by 2040 using sort of reasonable construction assumptions around kind of timeframes

XCAP Member unidentified: What I had in mind was the number of years – you know, Palo Alto is going to undergo a lot of construction impact, and if we layer some four-track section in or even near Palo Alto, yet more years of traffic impact and noise impact. So, I just want to get a sense of that.

Mr. Petty: No, I couldn't give you an exact answer on that.

XCAP Member Brail: Yeah, I mean, the thing we're trying to avoid is spending many years and all of our money building grade separations that then have to be torn up in ten years and replaced with a wider grade separation.

XCAP Member unidentified: So, one just further question, has it ever come up in any discussions about achieving the passing tracks by building a viaduct, assuming the right-of-way is too narrow? Has that even ever come up at all?

Mr. Petty: No. In the sense that what you're seeing is what you're seeing, so there wasn't an assumption about (crosstalk).

XCAP Member unidentified: So, the implicit assumption is that there is enough room in the right-of-way to accommodate passing, two additional tracks?

Mr. Petty: Broadly, and in some cases I would say there likely is not enough room in the right-of-way. I think, I don't want to at all imply that this has been designed or that there wouldn't be impacts. So, again, just to highlight, we're talking about things that are in the future. We're talking about blending Caltrain service with high-speed rail service, and so one of the kind of challenging conversations we had with our Board as we made recommendations around this as really, how do you balance, you know, the need to make concrete plans and advance projects with what is really a lot of uncertainty. So, this is just to highlight, these are the, when we look at the moderate and the high growth scenarios, sort of identified and then the ones in red are the ones that area really driven by non-Caltrain or non-regional service. So, essentially the infrastructure that is associated with having the high-speed rail on the corridor is what you're seeing highlighted in red. It's a largely two-track corridor when you're introducing trains that are going fast and not making a lot of stops, it means they have to get around a lot of other trains. The more trains they have to get around, the more four-track infrastructure you would need. It's illustrated, I know no one can read it up there. The reason I'm swinging back to this is that we did all of this work to look at three different scenarios and did a whole bunch of technical analysis supporting it. What the Board ultimately adopted was a policy document that was several pages long and essentially says this is the long-range vision of Caltrain and then spells that out in text format. So, the Board did not adopt locations of passing tracks. They didn't adopt, you know, exactly how many trains per hour individual stations would get. What they adopted was a set of long-range guiding policy. So, this is not a project. It's not, again, an engineered set of plans or anything like that. And I think it's important for this group to be aware of that and I would recommend reading through that policy statement, because that actually, everything else we've been talking about is just analysis. You know, it's a lot of analysis and it's helpful and it explains things, but the actual sort of policy that the Board adopted is really what kind of guides Caltrain's disposition going forward and what starts to become pretty relevant when we're talking about Caltrain's disposition to grade separations and how those proceed. So, I would recommend folks take a look at that to help understand kind of what's illustrative and supporting analysis versus what's actual Board adopted policy. That gets particularly relevant when we're talking about how passing tracks and how that relates to grade separation, and so in a high-level there were kind of two parts to what the Board adopted. So, staff's recommendation was that the Board adopt the middle scenario, the moderate-growth scenario, the twelve total trains per hour as the recommended vision for Caltrain. There was a lot of Board and stakeholder interest in adopting the higher-growth scenario, and so the way we kind of managed that was essentially specifying the details of the moderate-growth

scenario, and then saying that Caltrain would continue to work with regional partners towards thinking about something like the high-growth scenario. And we did that, and as staff I think we took a hard line around not wanting to fully embrace the high-growth scenario because there was in some respects, a lot of data that didn't point there and there's also so much uncertainty around that level of train service. I think we had a lot of concerns about whether it was responsible to sort of go whole-hog on that level of growth, knowing that there's so much funding uncertainty. One of the things I'll just say in general as we kind of keep going in this conversation is, there is a real challenge that Caltrain has as the manager of a corridor. We do have long-term responsibilities to the State Transportation Network to manage the corridor as a system and as a regional asset. At the same time, we have very real responsibilities to our communities on the corridor and to how we're asking people to spend local money. And those things can be in tension with each other at some times. We'd like to plan for the most optimistic future possible, but if that future seems like it's very, very speculative, it starts to become pretty hard to ask someone to spend a lot of their near-term money and take near-term impacts on that basis. So, there's no answer to that, but that is the kind of needle we try to thread with some of that policy. So, one part of the policy that the Board adopted was that Caltrain's long-range service vision further directs the railroad to continue planning for a potential higher growth level of service, and so that is our Board telling us to take certain actions to think about what it would mean if we ever were in that high-growth level of service. The specific part of the policy that gets relevant to grade separation conversations is that the Board directed us to take certain specific actions to anticipate and were feasible and financially practicable facilitate a higher level of service. That includes as it relates to grade separations. So, there's a lot of wiggle words in there, but I think the Caltrain interpretation of that is, we need to think about the potential for four-track segments in the corridor, including as that relates to grade separation. So, we need to anticipate it. We can't ignore it. And then we need to look at whether there are actions. We don't need to go out and build them, but we do need to think about what whether there are actions that are feasible and financially practicable that could be taken to not preclude those kinds of investments in the future, or to help facilitate them. Again, fairly a little bit loose, but that's the guidance we have, and that's relevant to these questions here. I don't have an answer for these questions today in terms of whether there are certain kinds of alternatives that we would view as effectively precluding four tracks and that would mean Caltrain would just say no to them out of hand. I think we have work to do with the City, as the City continues to narrow down alternatives to come up with a more concrete answer to that. I think intuitively there would be concerns around any option where, if we were to build it, it would look like it would make it impossible or significantly financially more challenging to come back and build more tracks later. But at the same time, as I said, we're not asking anyone to go out and build a four-track system that is not environmentally clear, that is linked to long-term very speculative levels of service.

XCAP Member Burton: So, to be clear, when the City submits its preferred alternatives to Caltrain, you know, through engineering, doing all that review process, will Caltrain explicitly consider four-track feasibility as one of the acceptance/rejection criteria?



Mr. Petty: I think we would consider it if there were a difference between the alternatives that were submitted, yes, and I think that's what the policy directs us to do.

XCAP Member Burton: Well, we'll probably submit one. We'll say, this is the choice for Charleston Meadow, this is the choice for Church line, and eventually this is the choice for Palo Alto Avenue.

Mr. Petty: Right.

XCAP Member Burton: So, we're not going to say, hey, pick one out of three submitted. It's hard enough to pick one.

XCAP Member Levin: And this group has been asked by City Council to make recommendations. Is there any way that Caltrain can help out and say, like, don't even consider things like X because they are incompatible with what, you know, what would preclude something that Caltrain has to keep an option open for?

XCAP Member unidentified: Or would you pay for the difference in costs?

XCAP Member unidentified: Well, those are two different questions.

(crosstalk)

Mr. Petty: I've got some slides on that one.

Chair Naik: Let's let Sebastian continue then.

Mr. Petty: So, I think it's a really difficult question, so I'm trying to be very intellectually honest about how we would approach it. If the City were to present Caltrain with an option that, let's say effectively precluded four tracks or would make it a very expensive project to come back and do it later, I think what we would generally look at would be were there other alternatives that did not do that, or was this a situation where just four tracks never would have been feasible. So, are we, you know, was there a choice between one where four tracks could have eventually happen versus not? And then if not, I mean in this instance I think it's something where we would probably do a set of technical analysis and then frame it up to our Board for a decision.

XCAP Member Burton: So, we're on a fairly tight timetable to come up with a set of recommended alternatives based on City Council criteria. I think we'd be foolish not to at least consider Caltrain's go/no go criteria. Is there any way you can work with us sooner than – by the way speaking just for myself here, but work with us to give us some guidance on this issue?

XCAP Member Levin: Otherwise this group might spend all of its time coming up and recommending something that was knowable in advance that it was going to be impossible. And that would be (crosstalk) use of human capital.

Mr. Petty: So, okay, the guidance I would provide would be, I think, it would provide less risk to the City of Caltrain rejecting an option to try to pick an option that would have some degree of compatibility.

XCAP Member unidentified: We don't know what that means.

Mr. Petty: Well, again, not being an engineer but you've got AECOM as a consulting team, and I would imagine they are largely the consultant that does a lot of our grade separation work. I imagine they could provide some guidance around...

XCAP Member Burton: Well, they'll just say, we can build anything if you spend the money. I've seen other transportation projects where there were provisions made for additional lanes or additional tracks. It may not ever get built. And so, the question is, it really comes down to do you want provision for four tracks. If we pick the trenches, and just as an example, and then the next question follows right away is, who is going to pay that delta?

Chair Naik: So, maybe one way to handle this is to have an off-line conversation with staff and we can figure out how maybe we can get more detailed information from either AECOM or from Caltrain's more technical folks, because it's really not what Sebastian does. That's why I think he's being super careful.

(crosstalk)

Mr. Petty: No, I understand the issue, and I think, you know, I mean this is a relevant issue. It's one that's going to be relevant, it is relevant in Mountain View as well, because that City advances its grade separation process. And so, I think what Caltrain likely owes the City to help with that guidance would be just at least a memo that provides some guidance around how to approach that decision, and I...

(crosstalk)

XCAP Member Klein: Can I ask some questions in regard to financing here? Thank you for your presentation. I think it was very clear and cogent and I know you may have some other things to say, but I think you're sensing that it's question time. You've got \$9 billion in hoped for money to provide for grade separations. Right now, you've got zero money for grade separations, correct?

Mr. Petty: That is directly controlled by Caltrain, yes.

XCAP Member Klein: Assume for the moment that your \$9 billion doesn't come in over the next ten years, what do you see happening with regard to grade separations between now and 2030?

Mr. Petty: I would anticipate, if there were no significant new source of funding for grade separations, I would anticipate that they will continue as they have, which is being built slowly, largely based on the availability of County funding. So, the grade separations that have been built more recently on the Caltrain corridor have largely been built in San Mateo County, because San Mateo set money aside for that purpose. VTA in Santa Clara County has now done that through Measure B and so I

would expect that some of those grade separations, whether they are in Palo Alto, Mountain View or Sunnyvale, would likely during that time period move forward.

XCAP Member Klein: Well, we know that's not near enough money.

Mr. Petty: Sure.

XCAP Member Klein: It seems to me that there is an inconsistency between having the \$9 billion in your hoped for budget and what seems to be the expectation that the local government agencies, either cities or the county, will be paying some or all of the portion, all of the costs of grade separations.

Mr. Petty: Right.

XCAP Member Klein: How do you explain that?

Mr. Petty: Well, I don't think it's an inconsistency. I mean, I think they are two different conversations. I think one is a conversation that says, we think that if we want to achieve the long-term goals of the corridor, and I'm using the work corridor advisedly to not include just the goals of the railroad, but also what we've heard to be the goals of the cities, we need to have a substantially grade-separated corridor, and that's going to take a lot of money to do that. I think as part of the work we need to do in this plan and beyond it is to look at what would be sources of funding that could be brought to bear on it, and for the grade separations, no one has that money right now. We're in the realm of needing to go out and find new public money.

XCAP Member Klein: I'm concerned about the timing of – as I'm understanding things right now, you're expecting Palo Alto and Mountain View, Sunnyvale, other places particularly in Santa Clara County, to pay some portion of the grade separations in their community, the costs in excess of whatever Measure B money we get and some other sources. Is that correct?

Mr. Petty: I think I would frame it less as an expectation as just a reality of there is no other money, and so if the project is going to move forward, money will have to be found. The railroad doesn't have it. If the counties don't have it, there are very limited state or federal sources, so...

XCAP Member Klein: Well, you have that \$9 billion figure in there. Is that assuming that the cities are going to come up with some money now and the \$9 billion would be on top of the money that the cities and the counties come up with?

Mr. Petty: No. That's a cost number, not a funding number.

XCAP Member Klein: Well, let's assume that we, in the 20s, that Palo Alto and other communities pay some amount for grade separations, and then the, but other cities don't. And then Caltrain comes in to some money, maybe all of the \$9 billion, and they pay for the communities that, grade separations in the communities that haven't come up with their own money. Is that fair? Are we going to get some money back?

Mr. Petty: No, I don't think you likely would get any money back. And I don't necessarily think that any of this is fair. Grade separations have been an issue on this corridor for nearly 100 years. It's probably not fair that there are nine at-grade crossings in the City of San Mateo. That's an historic accident of their street grid, you know, and it's probably similarly not fair that there are only a couple left in San Francisco. You know, so I'm not really sure how to answer the question. When we talk about it as though it's Caltrain money, I think, you know, there's not really a universe where Caltrain gets \$9 billion that's just for Caltrain and then kind of decides how to dole it out. To achieve the kinds of funding levels we're talking about, that is always going to need to be made up of multiple sources, including existing sources versus new sources, new sources dedicated to rail, new sources probably dedicated to the issue of grade separations. It's going to be a multi-decade sort of patchwork of funding to put that kind of money together.

XCAP Member Klein: Are you familiar with other systems around the country, where the local communities are being asked to pay the costs of grade separations, rather than the carrier itself?

Mr. Petty: I think that's typical around the U.S. for commuter rail or standard gauge rail systems. I think, because the regulations are national, and fairly or not, what the regulations are right now is that in most situations, unless you're going over a certain speed or grade separations are not required, there is a California requirement through the CPUC that if you go sort of four track or more across, then you're likely triggering a grade separation. But, and again this is what it is. I'm not suggesting it's fair necessarily, but the standard of when a grade separation is required in the U.S. is quite high.

XCAP Member Klein: If I understood what you said earlier, if a community decides not to come up with whatever money is necessary for grade separations, that won't affect going forward with Caltrain's Business Plan?

Mr. Petty: I think it would not necessarily directly affect us being able to increase service on the corridor, that's correct. I think in adopting a long-range vision, and again, I would really recommend that people look at the language the Board adopted, one of the statements is that if we're going to achieve the buildout of the system that we hope for, it's the desire of Caltrain as expressed through policy language the Board adopted, that that be through a corridor that is substantially grade separated.

XCAP Member Klein: I wasn't totally clear as to when you would anticipate the seven-train option going into effect.

Mr. Petty: Well, there's a six-train option that would go in effect in the early 2020s. The earliest an eight-train option might go into effect would be in the late 2020s, if we were, if Caltrain decided to move forward with that.

XCAP Member Levin: I think you may be mixing the number of cars and it would be seven cars when electrification goes live versus frequency, where I think there is a six and an eight, but not a seven?

XCAP Member Klein: That's what I'm getting at. Is that right?

Mr. Petty: There is a six train per hour service and a potential eight train per hour service.

XCAP Member Klein: Thank you Adina. One last question before I stop dominating things here. High-speed rail, a lot of what you have written here, and I understand why, is based on the assumption that sooner or later high-speed rail is coming through here.

Mr. Petty: Sure.

XCAP Member Klein: Well, two questions. One, are you still looking for any high-speed rail money for any of this?

Mr. Petty: So, no not, well, how would I frame that? I think we are expecting that the High-Speed Rail Authority would pay a fair share of their contribution to the total infrastructure demands that we're putting on the corridor. So, I don't think we're not looking for high-speed rail money to pay for improvements to Caltrain, but to the extent that their presence on the corridor requires new infrastructure or places an incremental burden on the operating costs of the system. We would expect them to pay for that at such time as was appropriate.

XCAP Member Klein: How much of what you've reported and put into your Business Plan would have to be changed if high-speed rail finally recognizes political reality and folds its tent?

Mr. Petty: I think if you, again, a lot of the analysis would look very different, but if you look at the actual policy language the Board adopted, a lot of that would be quite consistent regardless of whether high-speed rail was there or not. There are some pieces of it that would need to change, and I think if that decision were ever made in a very formal way, and I think it's important to say Caltrain has deep, legal policy and financial commitments to high-speed rail and we take those seriously. If something were to happen that were to end those, we would revisit our long-range vision and that would be a major, major change to the long-range plan of the system. But, largely the kind of Caltrain service we're talking about would be, I think, of benefit to the corridor in terms of serving the markets and the demand we see regardless of whether high-speed rail was there or not.

XCAP Member Klein: Thank you.

Chair Naik: So, in the interest of time, Sebastian, I want to let you finish your presentation and then we'll try to think of questions, because we do also have to take public comment. I knew this was going to run long, so Chantal and I are already whisper, whisper about how we're going to alter the agenda, but I do want to let Sebastian at least finish the presentation. (crosstalk) Yes, go for it, Sebastian.

Mr. Petty: So, if passing tracks are required as part of a grade crossing, separation, design, will Caltrain pay for the incremental costs of designing, construction and ongoing maintenance? Will Caltrain share costs for a four-track alternative in

advance of when Caltrain would actually need to use the passing tracks? So, a tricky question. So, let me kind of frame how we would approach this. A grade separation is required in California when you have four or more tracks. So, again, this is just sort of the legal framework around it. If you have a two-track corridor, in many situations from a railroad perspective a grade separation is not required there. It may be desired, the railroad may agree with it, the community may want it, but it doesn't affect the railroad's ability to run trains, so there isn't necessarily direct railroad funding that would be applied.

XCAP Member Brail: Can I just double confirm that? So, even with 110 mile an hour speed limits, with two tracks, still there is no FRA requirement for grade separation.

Mr. Petty: The FRA requirement is 125.

XCAP Member Brail: Okay. That's surprising. Thank you.

XCAP Member unidentified: Do you have the width of right-of-way in Palo Alto for four lanes, four tracks?

Mr. Petty: I mean, we do have right-of-way and standard widths. I don't have those.

Chair Naik: Yes, in South Palo Alto there's enough room for four tracks, 100 feet, there's enough room.

XCAP Member unidentified: Thank you.

XCAP Member unidentified: But there's no room on the north.

Chair Naik: Not at Churchill, but that's not where the passing tracks would be, they would be south. It's Cal Ave south.

XCAP Member unidentified: And then four tracks, you can build tracks on Churchill?

Chair Naik: No, it would be south, so the Cal Ave. There are no four tracks required or contemplated at Churchill at all.

XCAP Member unidentified: But the way that he explained...

Chair Naik: No, it's from Cal Ave south. So, this presentation is a little more muddled, but there is a previous presentation that has a little more specificity that it has to be from California Avenue, from the Cal Ave station further south.

XCAP Member unidentified: But this presentation...

(crosstalk)j

Chair Naik: So alright, let Sebastian keep going, and then – sorry guys.

Mr. Petty: So, if you have four tracks across the CPUC, the California Public Utilities Commission, their guidance is that it needs to be grade separated at that point, so

then it starts to become more of the railroad's problem, to kind of put it in those terms. I think the tricky question here is, at what point does Caltrain say, okay this is our problem and we're going to pay for it, and I think that starts to get to the issue of right now the four tracks we're talking about are pretty speculative. They're not kind of part of the hard plan. They're in the section of division we adopted that says, you know, let's aim for this but in a way that's feasible and financially practicable. So, that's a long way of saying I don't have a clear answer to this. If you ask Caltrain to turn around and pay for a four-track overtake segment and grade separations today, we would tell you that we don't have the money to do it. But in a longer, more general way what I would say is, were a four-track grade separation to move forward, that would have a level of railroad utility that's different from just a two-track one, and so there would be a different kind of funding interest potentially in play there.

XCAP Member Levin: There is a version of this question that's a little different based on what the, you know, likely sequences and scenarios are, because right now a four-track section in Palo Alto is only required at such time as there is upcoming high-speed rail service. So, if Palo Alto right now is saying, you know, what grade separation is warranted, then planning for a four-track version may be, you know - so the question is, does it make sense to plan for a two-track that would be expanded if that is at all possible, and then at such time as high-speed rail were showing up, who would pay for the legal expansion to four tracks?

XCAP Member Brail: So, it doesn't say in here under the moderate growth scenario whether or not four tracks are required. There's no moderate growth minus HSR scenario.

XCAP Member Levin: Correct. Is Caltrain working on scenarios before or after high-speed rail?

Mr. Petty: Well, I mean I think that sort of initial interim eight train plan is showed as an example of that. I think, you know, in the case of the Palo Alto, Mountain View area in the moderate growth, that four-track station need is associated to high-speed rail. Were it just to be Caltrain alone on this system, you would not need the four tracks?

XCAP Member Levin: And the other thing that we're hearing from Caltrain is that there's a possibility for an eight-train frequency Caltrain service by 2030, and the most recent published schedule for high-speed rail getting here is 2029 with no evidence that things are going that fast. And so, from the perspective of Palo Alto it seems like a reasonable thing to be planning for grade separation in anticipation of more frequent trains, and then the question is, who would pay if that would need to be either changed or done differently later. That's a different way of phrasing a similar question, but based on different scenarios or what might happen in what order.

XCAP Member Burton: Which goes back to the discussion we had about 15 minutes ago.

Chair Naik: Yeah. Let's let Sebastian finish, guys.

Mr. Petty: Okay. So, this one is a little easier to deal with.

(off mic)

Mr. Petty: Yeah. Does Caltrain intend to develop – the answers are a little different. Does Caltrain intend to develop a comprehensive plan for replacement of all grade crossings between San Francisco and San Jose? Does Caltrain intend to develop a funding mechanism to support such a comprehensive plan? Are there state and local agencies that we can work with better, so that we're planning a regional solution? I think the answer is, hopefully yes. As part of the work we've done in the Business Plan, one of the things we've said is that we really do need to do a corridor-wide grade separation strategy, and this slide here just kind of outlines what we've talked about that being. The things, so, this is going to happen. We have funding to do this study now. I anticipate that it should start relatively soon. I need to hire staff to lead it and I also anticipate that the, really the first section of this work would be a lot of scoping work and figuring out how a kind of a study of this magnitude that really has such a direct impact on cities would even be organized and governed. What I will say about doing this kind of analysis is that it's not the intent of Caltrain to go through and say, you know, here's our alternative for what should happen at a particular crossing. We know that there are a lot of communities that are doing a lot of work to think about that and that that's really a community-based decision. I think where we believe that there is a need for the, sort of a corridor-wide look is around a number of different issues. One is starting to look at things like standards on a corridor-wide basis. I know there has been a lot of conversation through this group around design exemptions. That's a challenging conversation for the railroad to have on a project-by-project basis, but we do think that it might be time to at least think about it a little bit more on a corridor-wide scale. Similarly, construction issues on a corridor-wide scale, we have a particular way that we've constructed these projects in the past, and that's sort of reflected in our standards, and I think your consultant, AECOM is pretty well versed in those. Were we to ever think about what it would look like to do them differently or if we had to do a bunch of them at once or how we might get some economies of scale out of it in a scenario where there were more funding available, that's really a corridor-wide question that we'd want to approach here. There, I think, are a range of policy issues that we've been asked that are also corridor wide in nature. People ask us to prioritize the at-grade crossings, and that's not really an exercise that we felt at all comfortable doing. Or some of the questions that the gentleman raised earlier around if you were to close a crossing, would there be a way to get money for other kinds of mitigations that aren't necessarily a grade separation, but might be just as effective and more cost effective. So, addressing those kinds of considerations. And then the big one is funding. We know that the need for grade separation in the corridor far outstrips any available source of funding, and so there is, I think, really a question about how if we as a corridor are serious about implementing this scale of projects up and down the corridor, how are we going to pay for that. What kinds of sources might be available? Are there new sources that need to be created? And kind of getting to a place where we're ready to have that conversation. So, at a very high level, that's the scope of that effort. It's, I think, going to be a really significant undertaking for Caltrain. Again, it is funded. We have to bring on the staff to do it and figure out how that study would be organized. It



would likely be an effort that would play out over the next two to three years. In the absence of a comprehensive plan, does Caltrain intend to provide assistance to crossing elimination projects city by city? The answer is now. Caltrain has no funding to do that. The kind of assistance, you know, generally we work with the counties who have, for the last many decades been the major source of grade separation funding, and we will provide technical assistance to cities, but it's generally the way the world is today, they are viewed as local projects that the railroad implements or are implemented on the railroad and our role has been more limited on them. And then on average, what percentage of funding have cities contributed to grade separations in the past? Cities have, I don't have the exact percentage. Cities have contributed to grade separation funding before. It's generally been a minority percentage. The vast majority is county funded. There are also little bits that come from the state. There is a state fund for grade separation. It's quite small in terms of relative to the total cost of these. High-speed rail did participate financially on the grade separation at 25<sup>th</sup> Avenue that's being built in San Mateo. They did that because they view that as a location where passing track may be. So, that's been the general landscape. The vast majority has been county-based sources for the last few of these that have been done. This is a tricky one. Are there any legal requirements to continue to include a Stanford stop? I'll just talk about this generally. So, there is a Stanford station. It's only used a handful of times a year, basically to service football games. Our Business Plan is basically silent on the future of this station, which is to say it's not a station that we ever imagine would get sort of regular weekday peak hour service, so that's certainly not there. That said, there is nothing in the Business Plan that would preclude us from continuing to serve it irregularly on weekends to support sporting events. I don't have an answer in terms of if Palo Alto were to come up with a concept that required that that station go away, I think we'd have to figure out how to confront that. If we got to it, and I think that would be a conversation with the City and Stanford and probably our Board in terms of how to weight that tradeoff and what kinds of mitigations could be provided. A couple of questions in terms of if a viaduct or tunnel was built, what could be possible on kind of the right-of-way. Again, this is sort of probably a very unsatisfying answer. It's we'd have to negotiate it. I think, you know, certainly those kinds of spaces have been used for things like bike paths and in other places, including over on the east bay with BART. So, you know, theirs is clearly a precedent there. It would just be kind of a conversation or negotiation we would have to have with the City around the use of that land and what could be possible there. I think the railroad's primary lens for looking at this stuff is always safety first, and then after that, you know, considerations around maintenance and upkeep and those kinds of things.

XCAP Member Brail: There is a question there about maintenance, about graffiti and stuff like that. So, even if it's not turned over, who sprays the graffiti and you know, mows the lawn?

Mr. Petty: So, generally if it remains as Caltrain right-of-way and Caltrain property, we would retain the maintenance responsibility for it. Typically, when these kinds of projects get built and if there is a city interest in the project, part of the project would be a long-term maintenance agreement. So, like many of our stations, there is an agreement that governs which entity is responsible for what aspects of

maintenance. Is there anything that regulates how long a of a stretch between crossover switches? I don't have the answer for this. I think there is, certainly there are places that switches will be needed based on the operation of the railroad. If there is a specific technical question here behind this that's being driven by a specific alternative that's being looked at, I'm happy to get that to the right people. There were a series of questions that I think basically get to the issue of standards and exemptions and freight use of the corridor. Rather than answer those specifically, because some of them I can't, here's what I'll generally say. There are long-term commitments to freight's use of the corridor that is not something that is envisioned as changing in Caltrain's plan. There is a discussion about a short line operator that could replace U's direct operation on the corridor that is all still to be negotiated, and those negotiations are not moving particularly quickly right now. I think UP has gone through a series of corporate restructurings and some of this kind of work has not been on their front burner for a while. So, for now, 1 percent remains the standard. We have looked at exemptions to that in the past and there's a process we can go through on a case-by-case basis to analyze an exemption. It's important, I think, as I mentioned, at a corridor-wide level and through the right process, we're not adverse to considering comprehensively how the standards change. I think what we don't want to do as a railroad is kind of iteratively back into new standards, and so if we are looking at an exemption, it's important that it be kind of grounded in enough analysis to understand very specifically why that exemption is being requested and that there is enough there that we can do a pretty serious analysis to understand if it's something we can live with or not. So, that process of granting exemptions is one we've gone through, but we do take it pretty seriously and need to make sure there is enough of a design there and it takes some work on our part to do that.

Ed Shikada, City Manager: And to that point, Sebastian, just for clarification and for XCAP's understanding, it is Caltrain's practice that the analysis required is done at the cost of the City, correct?

Mr. Petty: That's correct. Because, you know, there's a lot of time spent by engineers. Usually we're running a dynamic simulation of the railroad to understand what the impacts to freight trains and other operations might be which, at this point, is something that's typically done for a consultant. So, it is, you know, generally I think our approach has been, if we're making that request, we want it to be a pretty serious request that's around a focused issue, not kind of an open-ended conversation.

XCAP Member unidentified: I'm kind of surprised though. You're running conceivably hundreds of trains a day and with these three freight trains, it really complicates your life. I'm kind of surprised that you tolerate that any more. Is there not an appetite to get rid of that?

Mr. Petty: I think it's a very legally complicated and long-term conversation. I think when we look to the future, what we would assume is that freight is confined to a fairly narrow window at night. So, it's not that they're intermixing with the service throughout the day. I think these are kind of more in that same vein of issues

around the grade and I know that there are other standards that are of interest that many of which have to do with the presence of freight on the corridor.

XCAP Member unidentified: You could address that second question though, because I think there has been some confusion.

Mr. Petty: Oh yeah, that one I can. It's with us. So, it wouldn't be a direct negotiation with you. Caltrain owns the corridor, so we're both an operator, but we're also the corridor manager. We are the ones who hold the agreements with UP and so, you know. Negotiation, I don't know if that would be the exact word. It's more is there a circumstance where we would be willing to grant an exemption to our standards. That process would run through Caltrain. We are the ones who would then have to have that conversation with UP and make sure that was an exemption that we were actually able to grant.

XCAP Member unidentified: So, if part of the grade separation solution was the viaduct in any city, do you foresee that Caltrain is going to build that viaduct, or do you think each city is responsible for building that viaduct?

Mr. Petty: So, in terms of the actual construction? Generally, it is Caltrain's strong preference at this time, so absent again, absent a larger corridor-wide conversation or, you know, long-term discussion about construction authorities or things like that, it is Caltrain's strong preference that we deliver grade separation projects ourselves. That the ultimate contracts be with us, and that we're the ones building them, and that's, doing construction on an active railroad is very challenging. Our railroad is getting more complicated. We have positive train control systems in place now. We're going to have an electrified railroad. You know, that's including ongoing conversations with VTA around the use of funding. I think there is a strong preference on Caltrain's part to control the actual construction activities. Again, that doesn't preclude a longer term or broader conversation around kind of a bigger picture construction and whether you would ever make sense to have a Construction Authority or a grade separation district or something like that. But in terms of, if you're asking today on a project-by-project basis, it's our strong preference, and in some cases our requirement that we would be the ones constructing.

XCAP Member unidentified: Thank you.

Chair Naik: Okay XCAPers, if it's okay with you guys, I'm going to take public comment, so that it gives you guys a chance to kind of think through what other questions you might have, and then we can come back to XCAP for any final questions before Sebastian leaves us. So, if we have folks who would like to comment on this item, if you could please line up and raise your hand actually for me, so I get a sense of how many people want to speak on this item. I see one, two, three. Anybody else want to speak on this item? Okay, you each get two minutes please. Neva, go ahead.

Neva Yarkin: So, Neva Yarkin. I live on Churchill. I was just wondering if you could talk about eminent domain and what Caltrain procedures are for this? Thanks.

Chair Naik: He's not going to be able to answer specific questions, but we're going to be talking about eminent domain next week, so that's...

Ms. Yarkin: No, I get that. But I just wanted to know what Caltrain's feel is for eminent domain.

Mr. Petty: I'm happy to answer that on a very general sense, which is...

Chair Naik: Can you turn to the mic.

Mr. Petty: I think there are two things I would say. One, Caltrain is currently constituted, has the power of eminent domain through our partner agencies, and so to the extent that we've had to use that as part of the electrification project, have little slivers of land that comes to us through the partners. It's not inherent in the JPB. Beyond that, we follow the same procedures that any public agency does, which projects have to go through environmental clearance. We would make fair market value valuations and offers, and if there wasn't a willing seller, the last resort would be to go to an eminent domain route where there would be fair market compensation. So, it would be the exact same procedure that any other public entity would follow.

Chair Naik: Thank you Sebastian.

XCAP Member unidentified: So, I have a following question. (crosstalk).

Chair Naik: But if you could just hold it, then maybe he might answer it.

Roland LeBrun: Thank you and hopefully I will have time to get to these slides and explain to you what's going on with Measure B. Thank you for the presentation Sebastian. On the video presentation I showed you I forgot to mention that the cost for the three days' work was \$4.7 million. The total cost of the project was fourteen, \$1.4 million. Capacity, the six 7-car EMUs will actually have less capacity, less than 10 percent increase in capacity over five 6-car Bombardiers. And last week's bomb shell from Sebastian is that the reason we cannot have 8-car EMUs is because they just cannot handle it. Passing tracks, the biggest problem is that we're not using the current infrastructure property. When they bought the right-of-way from Union Pacific, we had passing tracks at Redwood Junction. The reason we're not using them is that there is no station. The reason we are going to have the station is four ways. First of all, Redwood City is moving north, Atherton is getting closed, we need a connection to Dunbarton Rail and you can trust Stanford to go and expand Stanford a half a mile from Redwood Junction. There is no need for passing tracks in (not understood) if every train stops there. That's why (not understood) passing tracks, because the train stops. In regards to speeds, the first EMU will be tested (not understood) ten miles an hour (not understood) testing facility in Colorado. The others will be tested at 90 miles an hour on the Caltrain right-of-way, probably between (not understood) and Lawrence. And the FRA could allow 90 miles an hour after (not understood) PTC is installed, as long as they improved the tracks. On high-speed rail, Deutchbon (phonetic) has a pretty good business plan which shows how we could actually have, as part of the Caltrain fleet,

eight real high-speed trains. Real baby bullets, real bullets. No bikes. They will have more capacity because we would have a hundred seats more. And my time's up.

Chair Naik: Thank you. Last comment, next person.

Mr. LeBrun: Yeah, I have one last one.

Chair Naik: No, no, Roland. I'm saying the next person has to go. Thank you.

(no mic)

Chair Naik: You can always email us.

Unidentified male: A very simple question. Will the freight trains be able to be upgraded to electric?

Mr. Petty: I couldn't tell you the answer to that.

Chair Naik: Sorry. We'll just take the questions and then will have to answer them at a different time. Sorry, because I don't want to set up this dynamic where everyone is just asking Sebastian questions or we'll never get through the rest of the agenda. But thank you for the question. Next.

Unidentified female: Hi. I would like to urge XCAP and Caltrain to please adopt a more long-term vision and for regional planning. So, for example, getting to collaborations and alliances between cities and communities to keep pedestrians and cars and landscaped usable areas which are usable by city folks at grade and move everything else below grade. So, if you can actually create those collaborations and alliances between cities all along San Francisco and San Jose. I know it's easier said than done, but that's what I would really urge you to adopt for two main reasons. Number one, cities become more usable. Number two, get economies to scale by actually having collaborations between different communities and different cities. And number three, all the emissions which are going to happen because of cars and vehicles actually jammed up against each other, if you don't separate the grade can be avoided. So, I don't know if we have done actually a cost benefit analysis between electrification and actually having emissions with cars being jammed up and all those long wait times, it would be worth doing that as well. So, both for scale and environment and feasibility of the city, I would really urge for you to do that. Thank you.

Unidentified female: I just have a really simple question. Can we get your presentation on line? I mean, will it be posted somewhere where we can get it.

Chair Naik: It will be posted by Chantal. Okay. We're going to bring it back to XCAP now. InYoung, you had an outstanding question.

XCAP Member Cho: So, I know you said there is no room to build, you know, there is the four track – it seems to me the four track is chosen parts of the region, not whole through of the corridor. Where can I get that information?

Mr. Petty: So, I think generally the information that you would see on it is in the presentation. So, it's not, you're correct, it's not throughout the corridor and, in fact, Caltrain is legally prohibited as part of the original blended system agreement. I'm happy to follow back up with Chantal and Nadia to kind of point to the best information that we have, but again, it's not a project that has been engineered or designed, so it's not. And I would emphasize there is long-range flexibility around exactly where those tracks are located

XCAP Member Cho: Okay, so if you look – so you kind of know where it's going to be four tracks. Was there a case that you have to take the houses around surroundings?

Mr. Petty: So, again, I think we looked at a very high level at areas of the corridor where right-of-way was sort of broadly larger, but I think you would need to do a lot more engineering and design to really understand the extent of whether and the extent to which there might be property impacts. And like I said, this hasn't been engineered so I don't want to in any way represent that there would not be impacts.

XCAP Member Cho: Okay, thank you.

Chair Naik: Megan, and then Tony.

XCAP Member Kanne: I had two questions. The first one was about encroachment of any of the alternatives onto the Caltrain right-of-way. Obviously, a lot of them would be under or anything like that, but sort of taking space for Alma in our case, which is next to the right-of-way, taking some of the right-of-way space for those local streets. How would Caltrain approach that sort of request?

Mr. Petty: So, I think we would want to look at it comprehensively in the sense of if it's being proposed as part of a grade separation project...

XCAP Member Kanne: Specifically, as part of a grade separation.

Mr. Petty: Yeah. It would be part of sort of a comprehensive analysis of, you know, if the City were to advance with this, then us partnering with the City to look at how that project would be delivered. So, in that instance I don't think it's, you know, I can't say yes, but I don't know, it wouldn't be a no. It wouldn't be the same reaction as if the City were to just independently want to take a piece of the right-of-way to use for something. So, I think if that's – I wouldn't discourage the City from thinking about that, if that's something that makes sense as part of an option. I think if it's part of delivering the project, we would certainly be open to at least having that conversation.

XCAP Member Kanne: Okay. And my second question was about these exceptional cases where there has been an incident or something on the tracks. What is sort of the maximum number of trains that we could ever expect to be – like if we had trains queued up for example, because there was an accident in San Mateo, or something like that, is there sort of a maximum, like there will never be any more than 20 trains passing a crossing?

Mr. Petty: In a certain amount of time?

XCAP Member Kanne: Yes.

Mr. Petty: Yeah. I'm trying to kind of do the math in my head. I mean, I think at some point, you know, trains come from one end of the system to the other and then they go back down, so there's only so many that are going to queue in one direction. I can't give you a precise answer on that, but I don't think it would be 20.

XCAP Member unidentified: There's not a policy that prevents anything?

Mr. Petty: No. In terms of if we were recovering from sort of an extreme incident or something like that, sure, you might have trains that were operated more closely together and there might be a span of time where there were more of them running through.

Chair Naik: Okay, Tony and then Greg.

XCAP Member Carrasco: So, I'm still trying to figure out whether we should plan for four trains or two trains.

Chair Naik: Four tracks or two tracks, you mean?

XCAP Member Carrasco: Oh, tracks, sorry. But it seems like, if I read through the tea leaves here that you tend to be talking more about the high-growth one rather than the low growth one. You're talking about more moderate to high, and the question is mainly for Adina and for you, Sebastian, to ask is the Board tending to go in the direction of high-growth, or moderate to high or? Which tells us what we should.

XCAP Member Levin: I work for an independent nonprofit organization where we are knowledgeable about Caltrain, but do not in any way represent the agency.

Mr. Petty: So, I'll try to put a slightly sharper bend on the answer I provided before, which is what the Board adopted as policy was to plan affirmatively for the middle, the moderate-growth scenario, while continuing to think about and anticipate and take certain actions to facilitate the high. If I were advising the City of Palo Alto in terms of thinking about how to narrow down options, I would consider whether an option could potentially accommodate four tracks as likely an important criteria in part to reduce the risk that Caltrain or its Board might say, we don't want to do this because we're worried it's going to impede the future growth. And I recognize that I think Caltrain owes the City a little more specificity about how to consider that choice. I can't give you a precise answer. The language is a little vague and I think if we ended up in a situation where something that seemed like it really precluded four tracks was being proposed, we would likely need to write up an analysis and probably take that to our Board to make a decision. Because I think that sort of rises to the level of decision where we'd really want to make sure that we have their guidance. So, that's, if we were to be in that situation where we couldn't, from a technical perspective say this could work with four tracks but the City is asking us to do this, you know, I think we'd kind of push it as far as we could, have staff say

here's the technical facts and then probably have to go to our Board for a decision, if that situation were to arise.

XCAP Member Levin: Can I, it sounds like I was asked for an opinion, so can I share it?

Chair Naik: Yeah.

XCAP Member Levin: So, I don't think that it would be wise for the City of Palo Alto to propose something that would preclude four tracks, because the Caltrain Board would likely say no, which is a more direct way of saying what Sebastian said. But planning for something to require four tracks has a lot of uncertainty, because that depends on high-speed rail, which might show up, you know, like years in the future. So, like designing for four tracks seems maybe excessive and designing for something that was, depending on when it was expected to happen, but if we're thinking that Caltrain's more increased service for local use might happen sooner, then planning for something that was two tracks but didn't preclude something else requiring like state money to expand, that would seem like a reasonable middle path in the middle there.

Chair Naik: I did want to add, because I pointed this out in a conversation I had off line with Sebastian, but I'm similarly – so besides the four track discussion we're having, I'm similarly concerned, as you guys know, because I've raised it before, about, I can't remember if it's the viaduct or the hybrid right now where they proposed that the track swing out closer to Alma and away from the homes, because despite the fact that they – yeah, the viaduct – despite the fact that they followed the design criteria, I know from an operational perspective with my work with CARRD, that Caltrain is actually looking to straighten the right-of-way. So, Sebastian, one other potential thing that we might ask for is more guidance along whether that kind of shift which would still fall within the existing design guidelines, but would not necessarily be great for operations, is something that we should be considering or not. Because I'm afraid that there is a segment of the community who might be more excited about one elevated alternative over the other, especially if their homes directly back up against that where they're like, oh, in that version the train moves slightly further away from me. And I don't know that that's really an option that we have, and I'm concerned that there have been videos that show that as a potential thing even though, of course, all of this is conceptual and it would have to go through review. But I just wanted to make sure I get that out there.

XCAP Member Brail: Can I ask? Now Adina is gone, so that was opinion, but we clarified that the moderate-growth scenario, if there were no HSR, and by the way, I'm not – it's very popular to assume that HSR will never happen, but I'm not in that camp. But if HSR was not an option for a long time, it sounded like in the moderate growth scenario, we don't require four tracks in Palo Alto, but in the high-growth scenario even with no HSR, do we still need passing tracks? No, okay. My second question is about safety. We mentioned, Megan mentioned extreme events, which we have a lot of on Caltrain. We have a lot of them in Palo Alto, and is there any source of funding or history of source of funding from anywhere in the world that could be applied to safety, especially since we're considering more trains,



faster trains, maybe not immediately but you know, Roland mentioned 90 miles an hour. EMUs accelerate quicker, so they're faster when they get to the grade. Is there any history of communities saying, hey, you know, getting some grade separation funding out of the state or federal government strictly based on safety?

Mr. Petty: Not that I am – for grade separations in particular, not that I am specifically aware of. I don't have the data base of every grade separation that's been funded, you know, in my head, and I think, you know, I'm kind of punting on the questions, but I think as part of the corridor work one of the things we really do intend to do is really look hard at funding. What I would call the surface level and then even the secondary kinds of sources that are available for grade separations today are pretty limited. There is a lot of categories where it's small dollars relative to the cost of the projects. There are very few kinds of big dollar categories, and that's why the counties have shouldered the burden of them in the past.

XCAP Member Reckdahl: Kind of a follow up, we've had some suicides in Palo Alto and they have always accessed at the grade crossings, but if we now have grade separations, you can't access that. The weak point would be the stations. At the stations you still would have access to the tracks. Is Caltrain considering any type of gates or fences or something to, when passing, trains passing through, to prevent pedestrians from accessing the tracks?

Mr. Petty: At this time, we haven't. I think, you know within \$23 billion there is a lot of kind of conceptual money that was set aside in there for station improvements, and so I think that's an ongoing conversation about kind of various types of treatments or mitigations that can be used to kind of make stations safer than they are today. I don't know...

XCAP Member Reckdahl: But you have done some investigation in what might work and not work?

Mr. Petty: Yeah. I don't want to overplay what we've done. I think it's a conversation that's out there. It's been a conversation with the High-Speed Rail Authority too, and I think as we look at levels of train traffic increasing, it will continue to be something that we look at.

XCAP Member Brail: So, I'm going to be a pain in the butt. We had five grade crossing accidents in Palo Alto in 2017, and three in 2018. None of them were intentional. They were all vehicles that were stopped on the tracks accidentally, and at least in one case there were injuries and \$40,000 in damage to a car. So, it's not just that, it's...

(off mic)

XCAP Member Reckdahl: But those vehicle accidents will not happen at the station once grade separation occurs.

(off mic)

XCAP Member unidentified: I have a question about those stations, you were saying the platform and boarding, there are some issues about safety as well as far as that design is concerned. That design is really important too when people board, if there's a gap. So, that's one concern. And the other concern would be public education. If you're going to have this many trains, the frequency as well as the speed. Will Caltrain be involved with a public education campaign?

Mr. Petty: Sure. I mean, I think we would do that as these kinds of changes were closer to actually being implemented, but yes.

Chair Naik: Sebastian: I did want to – I think we had someone from the audience whether there are plans for freight to be electrified. I wanted to give you a chance to answer that.

Mr. Petty: No, not plans that I'm aware of, and I think particularly not while the freight operation continues to be a UP operation. You know, I think were a transition to a short line operator to be effective, there might be more flexibility to negotiate things, but there are no concrete plans.

Chair Naik: And one other question. I heard you say very clearly that Caltrain has no intention, and none of the schedules that you've contemplated in the 2040 vision plan have discussed going beyond 79 miles an hour, which is the maximum operating speed today. Is that correct?

Mr. Petty: Yeah, so let me be very clear. Once high-speed rail is introduced to the corridor, there is, really, it's a max speed for the corridor as a whole.

Chair Naik: Right, but not for Caltrain's own trains, is what I'm saying.

Mr. Petty: Yeah, we're high-speed, well some of the Caltrain trains might be going, if they're having to keep us with or move around a high-speed rail train, at that point then they are also going up to that speed at times. But, in absence of high-speed rail, there are no defined plans for Caltrain to operate over 79 miles per hour.

Chair Naik: But I just wanted to clarify that even if you went 110 miles an hour for whatever reason, there is no additional legal requirements to build grade separations because of the way the FRA's rules work and CPUC's rules. In other words, just because you went from 79 to 100 doesn't trip off the need to have grade separation, correct?

Mr. Petty: That's correct.

XCAP Member Burton: Let me just point out that if you're doing stop-to-stop local service, trains probably couldn't accelerate and then decelerate much past 79 miles per hour.

Chair Naik: This is a different issue. (crosstalk) Someone come up repeatedly and try to say, oh, well if you increase from 79 beyond that you need them, and we do not.

XCAP Member Burton: It's probably most relevant for baby bullet limited-stop type trains.

XCAP Member Kanne: Is there anything to consider if the type of grade separation that we are proposing is not for cars, but is simply for bikes and pedestrians? Are there any differences, anything specific to consider in that case?

Mr. Petty: I think there are different design standards and construction approaches you might take, but from the railroad's perspective I don't think so. I think in general those have tended to be cheaper projects that are less invasive to construct and there are different approaches to doing them. I wouldn't think so particularly, beyond what you would need to do to just conform to standards generally.

XCAP Member unidentified: So, if we decide to build a bike pass under Caltrain, do you think Caltrain will build that or the City will build this?

Mr. Petty: So, again, the general preference of Caltrain is to control construction, especially invasive construction that is happening in our right-of-way, and that preference is moving towards becoming more of a requirement than a preference. That has not always been the case in the past, and so I know that in the past Palo Alto constructed a bike/pedestrian path and in the past, we've had cities construct grade separations before. That was pre-electrification. It was pre-positive train control and so the stance of the railroad now is that for those kinds of projects we really have a strong preference, in some cases a requirement. If we're the ones doing the contract and constructing.

Chair Naik: I want to draw a distinction between who manages the construction and who is paying for it. So, Caltrain would construct it but that does not mean Caltrain would pay for it. Yeah, okay.

XCAP Member Carrasco: So, Sebastian, I have a question about the delivery system. Caltrain prefers to construct it themselves because of all the complications. It turns out that costs are pretty high in the public sector and Caltrain's costs. Is there an openness to another kind of delivery system, if we can save say 30 percent?

Mr. Petty: I think there is an openness to having that conversation, and I realize this is sort of a challenging way to frame it. I think there is an openness to having a broader corridor-wide conversation about how we approach the delivery of these projects but if you were to come to Caltrain tomorrow and say, this is what I want to build, the answer would be, we're going to build it. So, I recognize that is kind of a hard answer, but it's one where, you know, when our corridor is, the corridor we manage is 50 miles long, there are grade separation and construction projects all up and down it and so the way we are set up to manage construction is a particular way. Our standards are set up corridor-wide as a particular way, so it's challenging for us and introduces a lot of risk potentially to kind of, in one-off cases, do something that's very different. But, where I'm trying to kind of open the door a little bit is, I think in a kind of a more comprehensive corridor-wide way, I think there is an openness to having that conversation, but if, and I didn't say this before, but I think it's sort of what I would emphasize, I think at a stage of design

where things are very conceptual and the City is looking at a lot of alternatives, the way to mitigate risk is to sort of assume the default. You know, and I think if you're assuming something different than that, there is a lot of risk that you're introducing into the decision you're making.

XCAP Member unidentified: So, you know, when cities manage these projects, they have a public bidding and all, you know, like you would follow the same practice?

Mr. Petty: Yes.

XCAP Member unidentified: Okay. So, Nadia, it sounds like we're paying for it, they are managing the project. We are not managing the project. Okay, thank you.

Chair Naik: I did want to ask, so for the XCAPers, we had page 89 to 94 of the Caltrain organizational assessment, which Sebastian, to remind you is the part that talks about the two different potential structures that would be, deliver grade separation projects on a broad scale. Could you give us just an update on where that has been in terms of the Board process and how that's going. I know it relates to the grade separation project.

Mr. Petty: Yeah. So, the Caltrain organizational assessment looked at a whole range of organizational issues for Caltrain, including sort of the overall governance of the Caltrain system. One big picture issue that's kind of parallel to governance is around big, expensive construction projects, and whether Caltrain builds those themselves or who does build them. And so a couple of models that were looked at, not in a ton of depth, but were talked about were a grade separation district, which is sort of a legal entity that is allowable under California law, which could have a range of responsibilities and powers from raising funding to doing things like issuing contracts and managing construction. Another option that would pertain to more than just grade separations, it could pertain to other kinds of projects, would be something like a regional or a sub-regional construction authority. So, more of a single purpose entity that really just existed to build projects. I will say, we had a major workshop with our Board to talk about governance. Those kinds of vehicles were not the focus of what they were focused on. They're kind of very interested in talking about the core governance of the Caltrain system. There continues to be a lot of discussion at a regional level about the possibility of a regional construction authority. That's something that's relevant to projects all over the Bay Area. Things like the downtown extension to San Francisco or how some other major projects may be built. So, it is an active conversation. I think that's some analysis we as Caltrain would want to get back into as we look at a comprehensive corridor-wide study. Like I've said, right now because these projects are so hard to fund, we haven't had to deal with a whole bunch of them at the same time. They've kind of been one every few years that happens, so we've had an approach to managing them. Were there a circumstance where there were quite a few needing to be built on the corridor, I think it would be prudent for us to think about whether there are structures that would allow us to better manage those, or allow the public to better manage those projects or deliver them more efficiently going forward. So, again, not a project-by-project conversation, but kind of a big picture, long-term one that we're open to having.

XCAP Member Reckdahl: I was very interested in Roland's video that showed that undercrossing being built. We're considering building underpasses and would love to do that without having to do shoe-fly tracks. What's your attitude towards something like that for a vehicle underpass?

Mr. Petty: So, I am not a good person to answer that question, in that I don't have the engineering background to tell you if there is a reason you could do it or why it would be fatally flawed. It's not how we have typically constructed grade separations to date, so I think we're not adverse to having a conversation about potential different construction options. We kind of go back to the statement I made at this state of the analysis. I would assume something other than the standard approach kind of at your own peril. Because that is introducing a lot of questions of risk. That's not a now, but it's just, you know, something that I could sort of say on the fly, oh yeah, that could work. Sure, go ahead based on that.

XCAP Member Reckdahl: But we're able to do that for the bike underpass. So, what would be different? Apart from size, what would be different being that bike underpass and what we would want to do?

Mr. Petty: Again, I really don't want to speculate into the engineering area, because I'm going to say something that's probably wrong.

XCAP Member Reckdahl: Okay. Thank you.

Chair Naik: I will say I have turned into Caltrain information about the Long Island Railroad, so that when they look at scoping their future set of projects, because I actually had sent, when Sebastian was developing the Business Plan, I sent him the research I did about how grade separations used to be paid for and how it's changed over the years. So, historically they were built mostly for traffic reasons, no train reasons. And in some ways, as you're hearing, we may need to build grade separations not because it's going to help us run more trains, but more because we want them because we will have traffic otherwise. But it's important to note that they are now going to be thinking about, well how do you build 41 at the same time, and do we have to do things a little bit differently. So, he has been, he has received more than one person. All of the Melbourne Australia examples, right? I've sent him the Long Island Railroad, so rest assured stuff that you guys are being distributed, Sebastian gets a copy from me or Elizabeth at least.

XCAP Member Reckdahl: From a business plan point of view, your slides showed a lot of high-speed rail, which is kind of outside of your control, right? So, how do you deal with, you're trying to plan something when you make your own business plan, how to you plan your own business when you have this big variable in it?

Mr. Petty: I mean, it's one of the things that is challenging to deal with. And I think we have to treat them not as a variable, again, because we've got long-standing commitments to them, but it does make doing the work more complicated. It would be a much simpler plan if we were the only operator who is every going to run on the corridor. So, yeah, they are reflected in all of our long-range plans. Now that we're kind of looking at what's happening more in the next decade, I think that's where there are conversations that are more along the lines of, well, they may not

be here in ten years and we might need to plan for that eventuality, but maybe they are, and we may need to come up with a plan for what that looks like. So, it's a real challenge.

XCAP Member Reckdahl: So, if high-speed rail is kind of slow rolled, then will you accelerate your trains and have more express trains to replace?

Mr. Petty: That's one potential option. I think, you know, if we got to that place, we would need to look at whether that made sense from a market standpoint and a business standpoint. I think generally what we're trying to do, and what the overall philosophy has been in terms of setting a long-range vision, one of the reasons it costs that much money is because we really went up and down the corridor and said we would need to make sure this reflects everyone else's plans and visions in it. And that allows us to work backwards and sort of see a path where we can say, hey, you know, these four things aren't ready, but we are ready to make these investments and then we can demonstrate they're compatible with the long term. We're not building something that we need to rip out later. It's part of the puzzle. We're just putting it together in a different way.

XCAP Member Reckdahl: Thank you.

Chair Naik: Sebastian, what would it take officially for Caltrain to remove high-speed rail from their plans? In other words, my understanding is that until there was an official discussion somewhere where high-speed rail came out at a Board meeting and had to admit that they're not going to be running trains and then, therefore, the letter would get sent to Caltrain and that would get sent to the Board. In other words, there's a number of steps that would have to happen publicly before Caltrain could change any of their plans because my understanding is that all of your long-range planning simply has to include whatever has been approved and has not thus been rescinded. Is that accurate?

Mr. Petty: That's correct. I mean, the blended system is enshrined in State law, and we have any number of funding agreements and other agreements with high-speed rail. So, undoing that would be a very serious process that would involve probably also State law.

Chair Naik: Okay, XCAPers, are there any other burning questions that you would need to know from Sebastian to be able to deliberate in the coming weeks, because now is your last shot before we let him go?

XCAP Member Burton: I would like to ask you how you stay sane in the face of all this huge uncertainty?

Mr. Petty: It's a running challenge.

(Off mic)

XCAP Member Burton: Thank you. You have my sympathies.

Chair Naik: Sebastian, thank you so much. We really appreciate you coming.

(off mic)

Chair Naik: Yes. Thanks again.

#### **4. XCAP Recommendation to the Traffic Consultant – Requests for Additional Analysis to Help with Decision**

Okay, so time check. We have 45 minutes left and way more than that on our agenda. So, I believe the thing we most need to prioritize, Chantal, tell me if I'm wrong, is the questions for the traffic consultant, since we agreed that we had to give him enough time to answer, since Gary Block will become the week of February 12<sup>th</sup>. Yeah, estimated, okay. So, for that item, XCAPers, we have, Megan pulled together (crosstalk) with help from InYoung, thank you, the proposed traffic questions, which is kind of the amalgamation of what we sent. So, Megan, I'll let you take the lead here and let us know what you thought.

XCAP Member Kanne: Sure, so I just removed duplicates and rearranged the questions into three parts. So, the first part is just the list of things that were straight-up questions or that at least I thought were straight-up questions. My proposal would be to just send those to Gary and get answers. Then there were questions about work feasibility, which I kind of separated out into a different section, but are also just, we need an answer from him about whether or not certain types of work can be done. And then there is a list of ten work requests. I took all the questions that people had that sort of were, can we have this and can we have that and I tried to distill them into a list of requests for new work from the traffic consultants, with footnotes looking into those questions as you can see there. So, my proposal would be that we read through those ten work requests and then vote on which ones we want to actually want to spend the money on.

(off mic)

XCAP Member Kanne: I have no idea. These were all questions for staff. I mean, we kind of also need to prioritize them, right? Like they're vaguely prioritized in what they seemed to be importance order to me, based on like the number of footnotes, but that is what the discussion is for.

Chair Naik: I see Ed with a finger on the button.

Mr. Shikada: Well, I was just going to, perhaps, verbalize what I'm thinking, which is these – well to the question, is there a limit. And perhaps the answer to that question is, well, we don't know how much these will cost. I do suspect that the question of whether to proceed with these would be informed by conversation with Gary, and some discussion of, so what's the goal of number one? You know, what is it that XCAP is hoping to achieve by getting an answer to that question. And have a discussion of that relative to the other alternatives that are being evaluated by Gary and Hexagon. So, again, I think you may not be able to prioritize these tonight until you have that conversation. And ultimately, we don't know how much these will cost either. I can't tell you tonight whether I would recommend we spend more money on these questions until we have that discussion.

XCAP Member Kanne: Okay. To kind of use the words that Nadia has been using, is there anything like, I think, for me it would be helpful to know whether the group thinks that there is any of these ten items that you absolutely would need in order to make a decision.

(off mic)

XCAP Member Kanne: We are looking at the work requests, page two.

XCAP Member unidentified: Number two seems to be really on point, really critical.

Chair Naik: Actually, if I could – so, no, no what I was going to say was I have a list of the Council criteria which, unfortunately, I didn't print for everybody, but I can read them off. But actually, they're lettered A through J are the ones that the Council gave us, and by my count there's four of them that relate very specifically to traffic, so I can read those out loud and I think we ought to keep those in mind when we're looking at what are the things that we need to answer that we will have criteria that specifically speak to those. So, the first one is: facilitate movement across the corridor for all modes of transportation. It's kind of a more generic one. Second is: reduce delay and congestion for vehicular traffic at rail crossings. Again, somewhat nebulous. Three: provide clear, safe routes for pedestrians and cyclists crossing the rail corridor separate from vehicles. And four, which is letter H, so the first ones are A, B and C: maintain access to neighborhoods, parks, schools along the corridor while reducing regional traffic on neighborhood streets. So, the rest of them are related to kind of construction things, but those were all the most traffic related, and as you can see, they're also again no super specific. I mean, in my mind, reduce delay and congestion for vehicular traffic at rail crossings, if we are now creating grade separations, we will no longer have rail crossings where cars are waiting, so we will have achieved that. So, that's sort of not necessarily going to change. Facilitate movement across the corridor for all modes of transportation. All of the alternatives we're looking at will have a bike and a ped and a car mode to cross. So, again, not necessarily super specific. But I did want to read those out before we go through this work thing, so you can hear those. So, in my mind for the first one, impact of eight trains per hour per direction at peak hour. I guess my biggest question, and I don't know if Hexagon can actually model this is, whether running eight trains an hour all day long would create new peak hours that we just don't have now. That may be a dumb question. I just don't know enough about traffic to understand what that is.

XCAP Member Brail: So, I've been the one insisting on this question and sort of my motivation was, you know, marketing which is to counter the we don't need to do anything argument. So, if we all, unless we have significant people on this committee who are for the we don't need to do anything argument, we don't need this question.

XCAP Member Burton: I'll just observe that the peak traffic volumes occur probably what we classically call the rush hours. So, even if Caltrain ran eight trains an hour other hours, we'd have delays, but not the same length. So, really the long pole of the tent will always be the rush hours.



Chair Naik: I think, so I'm not proposing, I wasn't proposing, Greg, I think it's a good question. I'm just adding, does it have an impact all day. And the only reason I'm – I hear you that there's sort of always the rush hour is kind of the longest, but there is this funky thing that happens. So, in the morning the rush hour and the school rush hour are the same. That's not true in the afternoon, and I don't understand what happens in the afternoon. If you shutdown Churchill and now everyone is at Embarcadero, and it just so happens that Embarcadero is also the entrance to Paly, so that also – how would that change things? Yeah, and I'm also not clear, by the way, whether the models are sophisticated enough to put all those things into it and spit out something that useful, but...

XCAP Member Burton: I think the real issue is going to be, do we have the traffic data to do – do we have reasonably good traffic data to model as opposed to just turning the crank for some sake. I have no idea what the answer is.

XCAP Member Klein: Well, I like question number one as is and I don't have any trouble with one A, though it may be more difficult to ascertain. But I hope question number one stays, for the reason that Gary raised, marketing, but marketing to a different group, our general public. And I thought Gary indicated that he could do number one pretty easily.

XCAP Member Cho: I just want to make a comment. So, the traffic at Churchill in the afternoon, when school is finished is not bad as 4 o'clock or 5 o'clock. That's where they line up all the cars all the way to El Camino to Alma. So, I don't know if that helps. Because when school finishes, I don't think that's like really peak hours. Even train doesn't go through at 3 o'clock.

Chair Naik: Well, another thing is that it's about all modes of transportation, so another thing that I've been thinking about is that, for example, some of the bike/ped options that we've seen for the closure of Churchill involve the kids queuing at one side, waiting for a light, having to cross the street in front of cars and then go down a ramp and then there's the other one where it's kind of a constant flow under the underpass. So, my question is about, you know, if you now have eight trains an hour at rush hour when those kids are going through at the same time, does that create a new bike rush hour that means that you need to change the design of the tunnel to be able to accommodate those number of bikes. I just don't know. I see you shaking your head. I'm just saying there is a reasonable question and, to be honest, I don't know whether we can get an answer, but I think it's interesting. I'm good with number one. Does anyone want to take that off or are we all good with keeping it? Okay. Moving on to the next one then. Megan did you have a comment?

XCAP Member Kanne: No.

XCAP Member Cho: I have a comment. So, this one, when I read it like it's, I mean, so we have options, right? So, these questions are diverting from our questions, right? So, you have Embarcadero mitigation with the Churchill closure. That's one option, but this is like branching out more, so it's asking more options and I don't know why.

XCAP Member Shen: That was my question, but I actually was not referring to the Churchill closure in these. I just meant, when we do the price full study of it, that we...

XCAP Member Cho: Yeah, that's an expense time three, because we have a closure, viaduct and Mike Price (phonetic) right?

XCAP Member Shen: Yes, but I'm just saying that when we do the price option study, that we study the traffic with and without the Embarcadero mitigations. That's all.

Chair Naik: Well, maybe Ed can clarify for us, is there, with the new alternatives that have been added, is there new traffic analysis that's been assumed by the City, or what?

Mr. Shikada: We've asked for a cost estimate and scope of work for two A. So, that would be, again, with the additional alternatives in this particular case related to the, what's it been called, the ditch or whatever.

Chair Naik: Mike Price.

Mr. Shikada: I think we're also trying to depersonalize the alternatives, right, so not, yes. Partial underpass, okay. So, the partial underpass to get a traffic impact analysis of that. And that is two A, so I think two B would be the underpass but also the additional work at Embarcadero, and that's not currently what we've asked.

(off mic)

(crosstalk)

Mr. Shikada: No, we've asked for a cost estimate. We haven't received it yet.

XCAP Kanne: Have you currently asked for cost estimates on any traffic analysis for the South Palo Alto options?

Mr. Shikada: Yes, so all of the above. I mean all above, below, what have you. So, all of the options.

XCAP Member Shen: And just to be clear, I did not ask for any Embarcadero options with the Alexis version. So, it's a little bit incorrectly written there.

XCAP Kanne: Yeah, sorry. I said Price plan with, Price plan without. It's just kind of confusing, yeah.

Chair Naik: And I just want to echo what Ed is saying. I think it's really important that we kind of depersonalize them and so sort of refer to them as the partial underpass going forward, and the constant flow underpass. So, we've got some, yeah, or the Churchill partial underpass and the Meadow Charleston, you know, constant flow underpass. Just we that – constant flow is what we put in there. I don't know if it's the best name, but...

Mr. Shikada: I'm not sure, yeah, I would go with that.

Chair Naik: Underpass, well yeah.

(crosstalk)

Chair Naik: Okay, I'm hearing Charleston Meadow underpass. You know, that's fine. Okay, so two A is already being done. Two B would be something that we would need to understand if it's worth doing and C sounds like we're going to get at least a price about A, two C A, and we would have to know about two C B. Thanks to my English teacher. She was about outlines. Okay.

XCAP Member Kanne: For part three, for number three, the way I was approaching that was really, like I kind of listed them all out, but basically from the perspective that for the measurable criteria subgroup, we have a bunch of things that are measurable for the Churchill closure because we know what the traffic impacts are, because we have numbers. But for every other option we currently have no numbers, so we have to way to say, we're going to spend \$300 million on this and it's going to improve delay times by this amount of average time. So, that is what I was trying to get at. I know there's like G a through g, but basically just, can we get an understanding of what the improvement is numerically for all of the other options?

XCAP Member unidentified: And it's not very accurate to fully predict.

Chair Naik: It's true.

(off mic)

Chair Naik: So, one of the criteria is maintain access to neighborhood parks and schools along the corridor while reducing regional traffic on neighborhood streets. So, we do have to have some metrics to show us what doing these things will do. In some cases, it's just, well I don't know. Ed did you, I saw that you...

Mr. Shikada: Well, yeah. Let me just add, again, as I was suggesting earlier, I think it's actually best to have a conversation with Gary because I believe we are getting the level of service. I'm not sure that it will be delayed. So, there's different methods used in calculating levels of service. So, it would be important to get Gary in the conversation to be able to describe how far we're going to be able to define the responses to these questions.

XCAP Member Kanne: And the only reason I bring it up for the South is because we now have options, the, what are we calling it, the Charleston Meadow underpass, which might have a different traffic impact than the other four options that are on the table, so that's why before it was like we can just assume these are all equivalent, but now perhaps we cannot.

Mr. Shikada: Agreed, yup.

XCAP Member Kanne: So, that was my concern.

Mr. Shikada: Agreed. So, I do think that Gary should be able to illuminate what we can expect from that analysis.

XCAP Member Burton: Is there any specific way that we could have a discussion, is it – sorry, I’m not saying this right. How could we have that discussion with him in short order?

Mr. Shikada: Well, he’ll be here in, what, two weeks.

XCAP Member Burton: Do we want to have a discussion with him before that?

Chair Naik: I don’t think we have time in the schedule, because we have the eminent domain attorney coming to the next meeting. So, yeah. What I hear you saying is, we’ll have to have that conversation then potentially then a third have Gary back or... What are we thinking based on what you’re saying?

Mr. Shikada: Well, I think the conversation should be helpful at multiple levels. In two weeks, I don’t think the analysis will be done anyway, so you know, it may be a way to check in on, again, both expectations of what will come out of it, as well as how far they have gotten.

Chair Naik: I’m just going to remind people that we may have all these questions, but we as a group are going to still have to figure out okay, well, what is it that, you know, how are we going to be able to make a decision knowing that we may not get some of these answers. And that’s kind of an ongoing, and I know you guys are going to be sick of me saying that, that that’s kind of where we’re going to be.

XCAP Member unidentified: I think it’s a question of how soon till we – we may have to make a decision before we might have the answers available.

Chair Naik: Hopefully, it will come in before then. Do we have a time estimate for when we are getting any of the other analysis regarding the AECOM new options? Just trying to think about how that weaves into future traffic and the rest of the schedule.

Mr. Shikada: We do not.

Chair Naik: Okay. So, number four was just a question of how many cars fit in that piece of Kingsley. So, hopefully, that one we can get an answer to, because I think it’s just a distance number.

XCAP Member unidentified: I wanted to actually look at that during the school time. That’s where the kids are dropped off, is that correct? Children are dropped off and then they supposedly walk from there?

Chair Naik: I think I understood that they get dropped off on Embarcadero Road, not on the Kingsley strip, but that was just the one speaker that I remember hearing, because I remember I made a note about that. But this is different. This related to one of the mitigations is not allowing the cars to queue there, and there being a traffic light at Kingsley and Alma, and you could now turn left or right, and

the question was, how many cars can queue in that spot without it spilling over into Embarcadero itself. So, that was really what the question was about.

XCAP Member Lau: So, I eliminate the question about asking Polly about the drop off locations, Nadia. I've asked because I doubt that they can answer that, and also when these kids get dropped off, depending on the traffic, if traffic is really bad, they get dropped before, so it's a lot of different variables. So, I think it's a really hard question, so I said just drop it, because I don't think anybody could answer it.

XCAP Member Kanne: I moved it down into the last section.

Chair Naik: Okay, so then number five is traffic impacts of closure. So, this relates to the Park Boulevard piece, and then the local streets piece, and I guess the question is, has the City thought about adding that in, given that it's come up a few times?

Mr. Shikada: We have not. So, again, this is reopening, what's the reopening? Is it the...?

Chair Naik: So, when Southgate, if you close off Churchill, then the only way that Southgate can "get out" of their neighborhood is to either go out to El Camino or turn onto the west side of Churchill, and then go the El Camino. But there is Park Boulevard back there is closed off to bikes.

Mr. Shikada: Bikes only.

Chair Naik: It's a bike only, sorry. It's closed off to cars and so the question of, could you open it back up so the Southgate folks could get out onto Page Mill and Oregon Expressway in that sort of area.

XCAP Member Shen: It's Castilleja that connects to Park Boulevard, I think. It's the end of Castilleja.

(off mic)

XCAP Member Shen: Yeah, but right now there's a barrier. You can't...

XCAP Member unidentified: (off mic) If Park Boulevard reopened, then it's really easy for Southgate people to access Oregon Expressway from Alma, not going all the way to El Camino.

Mr. Shikada: Well, so at this point, I guess, I may be wrong here, but I would venture that there has not been an identified traffic impact in that area based on the closure, and so I think we might be conflating things if we talk about the Park reopening as a means of improving circulation within the neighborhood with any impacts from the Churchill closure itself. You know, I certainly think that the question of closure of neighborhood streets, especially related to bike boulevards is this is an ongoing conversation, multigenerational conversation. So, that will always be a possibility. I just wouldn't conflate it with the grade separation discussion, quite frankly.

XCAP Member Cho: Well, I understand that it is a very historical piece, but you know, it's part of traffic improvement, closing Churchill. I think you can add that.

Mr. Shikada: So, let's just go down the road a little bit. Help me understand this. Is the suggestion that it should be, if Churchill is closed, under that scenario, that Park should be reopened and that it needs to be reopened?

XCAP Member Cho: The reason is that College Terrace, not (crosstalk)

Mr. Shikada: I don't want to argue the point. Again, I think that's always a possibility. I guess the question is whether it's a necessity in order to make a decision on the Churchill closure or not.

(off mic)

XCAP Member unidentified: Opening up another can of worms and separate cans.

(crosstalk)

XCAP Member Cho: Especially if you have bike paths on the seal, also.

Mr. Shikada: Well, another can of worms. So, you know, quite frankly, so direct answer to the original question is no, we're not suggesting that as a part of the alternative's analysis for the grade separation. I think there can always be a discussion separate, but I wouldn't suggest you add that to this as another camp.

Chair Naik: Megan, can you speak to five B.

XCAP Kanne: Yeah, that's just Dave's question, footnote 12, about, sorry, 13 I guess, about whether there is any additional modeling that can be one of Professorville streets, assuming mitigations that, Gary's mitigations were implemented.

Chair Naik: So, Ed, I don't know if you caught that. This is five B, which relates to footnote number 13, which is, if there was a closure and there were mitigations at Embarcadero, could we model the affects of local streets in Professorville? Would your response be the models were already looked at and there isn't anything further, other than the mitigations we've proposed that would be needed?

Mr. Shikada: Once again, it could be informed just by getting Gary's perspective on this. I suspect he would say what you just said, you know, that the impacts are at a level below significant. But, again, that doesn't preclude other changes that might be desirable within the context of neighborhood traffic calming or what have you.

Chair Naik: So, what I'm hearing from you is, there's must haves and nice-to-haves that complement each of these.

Mr. Shikada: I think I'm acknowledging that sort of spectrum of situations, and then actions caused by, or potential actions based on those situations. I'm trying to

avoid actually giving you an opinion as to whether we can or not to defer to our expert that we've brought in.

Chair Naik: I think the additional counts, so at least six B which I know, I think I might have asked for both of these. I think we have the numbers, it's just a matter of making sure the map includes those numbers when we discuss them, because there's been some questions about that. And the bike and pedestrian routes question was about, I spoke to somebody who does traffic things, and they were noting that we don't have, we have very robust understanding of what are all the movements of the cars, but we don't have such a well-developed understanding of what happens to bikes and pedestrians. So, in order to be able to answer the Council's criteria of, for all modes we need to at least have some drawing that shows that the impact would be for bikes/peds, and I don't know what that looks like, but that was just the feedback that I got back from folks. So, that's what that relates to.

XCAP Member Cho: So, I looked at this question and actually, I didn't go in there but I looked at Google. My husband rides bikes, so I did route it. There is a route that you can go from east and west and the other side, but I think it's not very clear when you're looking at the drawings, because the drawings don't show you can cross.

Chair Naik: I think there are residents who are going to be comfortable looking at the maps that we have of what happens to cars and there are going to be those who are like, well where is the bike one. So, we're going to need this.

XCAP Member Cho: Yeah, so we need to put the bike routes in.

XCAP Member Carrasco: And I would add to that suggestion that we shift it a little bit more to the priority of caring about bikes and ped a little bit more than we have before.

XCAP Member unidentified: Yes, and I'd like to add to that too, Tony, we don't really have accurate numbers of how many people ride bikes. We actually had a number, and it seemed really low.

Chair Naik: Yea, that was the one question mark in the presentation, when they gave us the bike number, everyone was like, it was like 200 bikes which did not match. Yeah, it was very low.

(off mic)

Chair Naik: So, on number seven, we've had this conversation before, and Gary mentioned it in his last presentation to us. It's about the unclearable queues. So, we have it here at Churchill, but just a question of, is that something that we're looking at doing to make the case for, you know, potentially eight trains an hour and 27 and what that queuing looks like and what that network delay looks like.

XCAP Member Burton: I would like to add, I would like to question, I would like to contrast this with the animations of the different grade crossing options where we

could see clearly there is a viaduct or trench or whatever. It's hard to imagine, aside from sort of an Uber map, an Uber application like map of showing cars moving across streets, what do we gain by this?

Chair Naik: So, I think you personally, from the discussions I have had with you, have already bought into the idea that we need grade separations. I think there are many in the community who do not understand that if you do not make grade separations, that the traffic will get worse. So, the point of these, my understanding from what Gary said at the last meeting, and correct me if I'm wrong, but he said there is something that looks like dots or whatever, where they could show cars waiting and how long that waiting is.

XCAP Member Burton: I guess what I'm saying is, no I'm not, yes, I've obviously bought into the idea of grade separations. But I don't know how much more convincing power an animation would have as opposed to simple slides to say, this is without the grade separation, this is with. Here you've got a queue this long, here you've got a queue that much longer. And maybe one or two bullets that say, six traffic cycles. I don't know how much more intellectual or even emotional impact animation would have.

Chair Naik: I just want to understand

XCAP Member Burton: That's my only question. (crosstalk) And it would cost money to do these.

Chair Naik: Right, but this has been brought up many times also by Council Members, so I'm just trying to understand. We might be asking about it, but it might already be in the plans. So, I'm kind of looking at them saying, are we already doing this and we don't need to worry about it.

Mr. Shikada: Not that I'm aware of, but I think, again, this is a conversation we can have. In terms of prioritizing where money needs to be spent, further discussion is certainly possible. And I think at this point there is enough work that's been done on this particular issue that it's, time will be the concern. It's really a question, really as Phil points out, is it worthwhile, once we get a price tag.

Chair Naik: So, for the collision history data.

XCAP Member Brail: So, can I, I have done – Berkley maintains an excellent on-line resource where you can get the collision history for all of California. It only seems to include collisions that included accidents or maybe injury accidents actually. Because all the ones I found had injuries. But if you want to know what the most dangerous intersections are in Palo Alto in terms of injuries, that data is available for free. I know where to get it and Churchill is nowhere near the worst part of Palo Alto. Yes, for all of California, but yeah. If we want more detailed information, I don't know where to go for that, but some of this information is available for free. We don't have to ask any consultants.

Chair Naik: I think it would also be useful, just from understanding where mitigations are necessary, if the City has, collects collision history on, for bikes and



ped and cars. That would be helpful, because there may be something that when we look at the data, we're like, oh yeah, on this one corner that we didn't think about, as long as we have to make improvements in that area, we should also add that block. I don't know what that is.

XCAP Member Brail: Well, I'll see if I can export the data from this site, but it's not very good in that part, so I'll see. I'll do some work on it over the weekend.

XCAP Member unidentified: Ed, wouldn't the Police Department have this?

Mr. Shikada: Yes, and in fact, Philip, do you want to weight in on, I'm not exactly sure what the question is, but certainly you're familiar with the status of our collision data collection and reporting. I think what Greg is referring to is the SWITRS Data that's reported. As you know, there's significant - yeah, transportation injury mapping system, but it's based on what's called SWITRS, the Statewide Integrated Traffic Records System, which is notoriously, yeah, like years out of date, in terms of the collision data.

Philip Kamhi, Chief Transportation Official: Yeah, just jumping in. We experience about a two-year delay in the SWITRS Data. Currently VTA is trying to work on getting that upgraded so it's more instant, but there's also a component of that that involves our own PD and you know, getting that data out. So, it's a kind of collaboration and something that I'm planning to discuss with Chief Johnson and, of course, we want to support VTA in their effort to get us the data faster, because it's helpful in making decisions.

Chair Naik: So, the last two are just, again, whatever information we have that's available. I think he mentioned that they had done some calibrations. Just that they should note those in whatever report so that it's part of the appendix. And then provide network delay diagrams. That relates specifically to the Council thing about looking at the regional, well, reducing regional traffic. We can't really know if we're reducing regional traffic if we don't have any numbers about regional traffic, and my understanding is there is some kind of network map delay thing that you could do that we've never seen. So, that's what that relates to, because it's very specifically Council criteria.

XCAP Member Cho: So, the network delay and the queue. What is the difference?

Chair Naik: Yeah, I think it's per street versus the entire network, the grid citywide, end-to-end, what does it do.

XCAP Member Cho: So, when they give you a network delay information, they give you each street, how many the delay is, or the network delay overall?

Chair Naik: Ed, can you describe a network delay map.

Mr. Shikada: I think you're looking at, if you think of WAZE, the app, it would look like that, the red streets, the yellow streets and the ones without colors. I think this number seven on the animations is more of an actual simulation of what happens at an individual street.

Chair Naik: Okay, XCAPers, I have to take public comment and then we'll bring it back to us, if that's okay, so we can read over things while... It looks like I have two speakers. Anybody else who wants to speak on this item? Three, okay. Roland, make it fast, and Susan. You've got one minute. I'm sorry to push you

Susan: I've been very, very fast on all my other comments. I'll be as fast as I can. Some questions came up that aren't kind of captured here in the sort of community response, and also one of these got mentioned earlier today. Somebody asked about the adequacy of the data that they had gathered, and I know there was a lot of discussion about the fact that the data is based on just the sort of local Palo Alto model up to the year that things would probably actually be starting to be built. So, the model of how much traffic is going to be there is, perhaps, you know, grossly inadequate to sort of prove the point that the mitigations work as Gary expects. And then another thing that I discovered talking to Gary one-on-one, and reading his report carefully is that one of the things that isn't captured is flow, and I think this is the network effects question. So, as someone living in Southgate having to go onto Churchill only to get out of my neighborhood to go anywhere, it really matters what's already happening on those streets and what's likely to happen as things kind of, as the ripple effects occur. And then there is another thing that...

Chair Naik: Susan, you're out of time. Can you just mention it quickly?

Susan: Yes. There are certain assumptions about driver behavior, why drivers make the choices they do, and I talked with Gary about this at some length too. He assumed that it's all based on distance. So, the shortest distance is the way they will go, and it doesn't take into account hassle factor and other things that affect where people go.

Chair Naik: Thank you. Okay, Roland. And if the next person could queue up right after him, so we go as fast as we can, that would be great.

Roland LeBrun: Yeah, so very briefly, on number six. The problem that you've got is what Caltrain's expectations are. Beyond ridiculous in terms of numbers of trains, and especially high-speed rail. I'll give you an example. Eurostar has actually cut down the number of trains that run down to 29 a day. And the way they did that is by increasing the capacity of each train to 900 seats. If you look at what Caltrain, the equivalent of Caltrain is doing in London, during peak they run eight and then there are two high-speed trains during peak. Off-peak they run four and one high-speed train. Okay. So, moving forward, I think what we need to do here is to look at running longer trains during peak. So, the bullets, Mayor Pat **Burk** has been saying this forever, okay. So, let's run double-length trains during peak, and then we just run half the trains off-peak. You know, it makes sense. But Palo Alto and others need to start thinking about having double-length platforms. Thank you.

David Kennedy: This may have been covered already, but I think it would be helpful for XCAP to ask Gary a little bit more about how this model, which is apparently what he is using factors in human behavior and what limitations there are around human behavior, because we make a lot of different choices to go places.

Chair Naik: So, it doesn't seem like we have to take action on this, because it sounds like we can just have that conversation with Gary. So, we don't really have to do anything.

## **5. Discussion: Preliminary Discussion of XCAP Workplan**

Chair Naik: Okay, do we have any – Sorry, I realized that I moved to six and moved to five, but we're going to have to move five to next week. That's why. I did want to point out that for the XCAP Workplan you did get some documents from me. They are by no means perfect, and I won't go into any detail other than to say that you may find some typos. I was trying to get something out to you guys beforehand, so please try to read them for the next meeting. It attempts to lay out how many meetings we have going forward and I did want to point out that there is a question mark about March 4<sup>th</sup> because we might have the State of the City. Well, we'll definitely have the State of the City, but I think it may start at 7 PM, so as long as we have the meeting that ends within two hours or two and a half hours, we could still make it to the State of City or figure something out. So, just hold out. We'll talk more about that the next time. But it would be super helpful if there's folks, I've already gotten a few emails from people who might be traveling or out of town, so if anybody is not going to be around for things, if you could just please let us know. Chantal, I do want to remember, can we reconfirm Dave Matteoni, can we just make sure that he's definitely coming next week?

Ms. Cotton Gaines, Assistant to the City Manager: Yeah, the last I heard he was, but Dave, yeah (crosstalk).

Chair Naik: Could you reach out again. I just want to be sure that we triple check.

Ms. Cotton Gaines: And then for clarification on the 4<sup>th</sup>, we Doodled the group to see if you guys could do the 3<sup>rd</sup> or the 5<sup>th</sup>, and not everyone did the Doodle, but regardless of the outcome of the Doodle, because of Finance hearings happening and just starting the conversation about our budget process, the 5<sup>th</sup> and the 3<sup>rd</sup> are not very plausible dates for this room anyway. So, I think we are going to try to keep the 4 to 6 on the same day as State of the City, and just make sure we're really diligent with our time that day, because I know you all are going to leave here and go to Mitchell Park so you can listen to that. So, I think that just may be the easiest thing. So, if anyone does have a conflict now with March 4<sup>th</sup>, please let me know. And then the other once that's on the Doodle, which I would appreciate if you guys still fill out is in April. We're trying to replace one of your meeting dates with the day before or after. So, if you can let me know what dates work for you, that would be great.

XCAP Member Cho: So, I forgot to say something, so you know, what was the new name for Mike Price's?

Chair Naik: The Churchill partial underpass.

XCAP Member Cho: The partial underpass at Churchill, the house at Alma and Churchill, the corner house they have a garage right next to that corner. So, if that

plan, they cannot access their garage. That's my neighbor. That's what their concern was, so we need to put that somewhere.

Chair Naik: I'm assuming when we get more detailed work back from AECOM that's totally going to be addressed, because again, those are all conceptual.

## **6. XCAP Member Updates and Working Groups Updates**

Chair Naik: For the next items on the agenda we've only got a few minutes. I did want to leave some time for Chantal to give us an update. For the workings groups, I think we're chugging along. I don't know that the working groups have any updates, but if there is anything that you wanted to do, we could do it. You could send it to Chantal and she could distribute it to the group.

XCAP Member Burton: I went to last night's Caltrain electrification meeting and so did Philip. So, the very short answer, the very short key points were, they are talking only about the wires above the tracks. There were questions from several people in the audience about grade crossing issues and I restrained myself, because it wasn't our meeting. But they were very clear that they were open to discussion, but the speaker was very vague beyond that. The other key point, which was interesting was that the information was Palo Alto specific. So, if anybody has any curiosity about the actual construction in Palo Alto, it has probably been posted on the Caltrain website. Okay.

Philip Kamhi, Chief Transportation Official: I was just going to add that they have weekly updates that you can sign up for regarding that. And also, InYoung was there.

XCAP Member Burton: I'm sorry.

XCAP Member Cho: Yeah, I get those updates. It's pretty cool. So, all the construction, what's happening in the corridor.

XCAP Member unidentified: How far along are they in Palo Alto now?

XCAP Member Burton: It looks like the bulk of the work will be done this year, you know, starting and ending at different point, this year. That's the electrification work. Nothing about station platform extensions, which is way out of scope of this discussion. That's all I have to say.

Mr. Kamhi: I think one of the things that maybe would be of interest to this group is that there will probably be some temporary closure of Alma related to the construction, but emphasize the word temporary. I think they were saying a couple of days potentially.

Chair Naik: That seems to me like an excellent time to practice what it might be like to shut down Alma and maybe potentially look at what driver behavior is when Alma is shut down and what kind of mitigations are alternative routes people might take.

Mr. Kamhi: I would say not necessarily, because this might be weekends, this might be nights. It's pretty – and it might just be one lane.

Chair Naik: If it's multiple weeks, though, if it's long enough to have changed modes, cause a mode shift in traffic, then that would be fascinating.

Mr. Kamhi: Yeah, so they said a couple of days, so it's very unlikely.

XCAP Member Burton: It sounds like a couple of days. It will be the kind of thing where you're driving along and suddenly you see a sign that says "detour". No real advance warning unless you get those weekly emails and then you'll change on the fly and you'll never have to do that the following weekend, or something like that. They also made the key point in response to a question, they can't tell you much in advance whether somebody will be working opposite your house on a given day, because day-in, day-out they can't predict the speed of construction.

Mr. Kamhi: Yeah, they will only tell us Citywide that there is construction, but just note that if they're closing Alma or any detours like that, they will have to get a permit from the City, so there will be some advance notice. The City can provide it, maybe potentially faster than that weekly email.

Chair Naik: Do we have any public comments on the working group updates? No. Thank you. I appreciate seeing none.

## **7. Staff Updates**

Chair Naik: And then, Chantal, just so you know, this one that I did with the things that are highlighted, those are all questions that we should talk about in terms of what staff needs from us. You know, kind of some milestones going forward in terms of Townhall stuff and when we might be able to expect more answers to some of the criteria questions that we had, so we can keep going on the criteria piece and then start to apply those. So, we can talk offline about that, but that's what those highlights meant. Chantal, did you have anything for us?

Ms. Cotton Gaines: Only one small announcement. The Chamber of Commerce will be stepping down from the XCAP, so Judy Kleinberg will no longer be serving on the XCAP and the Chamber as a whole decided that they wanted to step down at this time. So, I wanted to let you guys know your total number now is twelve members and Judy sends her regards and she loved spending time with all of you.

(crosstalk)

Ms. Cotton Gaines: I think it's just a variety of the commitments already made and the time constraints required, etc. for the XCAP.

Chair Naik: So, XCAPers, just be mindful that that means that our Brown Act number has just dropped again, so our number is now?

Ms. Cotton Gaines: You're at twelve and quorum is...

(off mic)

Chair Naik: No, we're at twelve, so our quorum is seven, but then the Brown Act means we can't talk more than five, yeah.

XCAP Member unidentified: Not more than six.

Ms. Cotton Gaines: Just don't go over your quorum. You're save with five.

Chair Naik: Five is safe. Twelve people, so five is safe as the most people on a conversation. I just want to be sure we're careful of that.

(off mic)

XCAP Member unidentified: So, Chantal, how is the business community going to be represented, because they're going to complain if you don't.

Ms. Cotton Gaines: Thank you for reminding me of that So, similar to us continuing to be in constant contact with Palo Alto Unified, we will do the same with staying in touch with Judy and trying to reach out. We have plans to have a meeting during the day with businesses and so that was something that I follow up with Judy about sure we are going to do, and just making sure their perspective is still heard.

XCAP Member Klein: I would suggest we do more than that. I don't Judy is the sole representative of business in the community. I think that, for example, Town and Country is sort of off on its own and they have a much more direct interest than almost any other business you can think of. So, I would suggest that we talk directly with the Town and Country management and the Chamber has never really included the Stanford Research Park and I think you ought to really reach out, or we should somehow reach out to the management of the Stanford Research Park and talk to them.

Ms. Cotton Gaines: Thank you. And we have contacts at those places and Judy actually recently spoke with Town and Country and has a contact person, so we will follow up through that contact person, in the management of Town and Country.

XCAP Member Klein: We've got to do it directly, no rely on...

Ms. Cotton Gaines: Right, I agree, but I'm saying the conversation has been initiated, so we're following up.

Chair Naik: So, one thing I was thinking about was how do we formally, so for example you guys are doing the interface with PAUSD, but to the extent that they have formal feedback, I want to be sure that we have that in writing in some way, so that when we do our deliberations, like let's say for example, if we're deliberating the closure of Churchill, if there was something that PAUSD was sent back, then we have something in writing that could be both included in an eventual appendix and also would be considered. I think it's important that we have something similar to the extent we can, from anybody that we reach out to in the business community formally where they've got some official comments, because I

want to be sure we've got everything in front of us when we have to go to work, and I would also, I know XCAP is already doing a lot, but to the extent that we've got our own connections in the community, that might be able to pull those people in like let's try to help, because we want to make sure we're getting everybody.

XCAP Member Reckdahl: If I had a business at Alma Plaza, I'd be a little nervous about this metal work.

XCAP Member unidentified: And I agree. I think, you know, you're trying to have certain domains represented. The schools and business are very important, so there has to be a mechanism for us to communicate with them so, as you said, when we look back at this historically, we did try to include them.

Chair Naik: So, Chantal, I do have for the agenda for next time, to make sure that we leave some time to discuss anything that XCAP might have as feedback for the Townhalls. Like if they could actively solicit information for us, to what extent possible the Townhall. I mean, obviously it has its limitations. Whoever shows up, it's not everybody. But to the extent that if there was something that we thought would be useful to ask, I want to make sure we have that conversation next week, so that we can give that to their teams, so they can incorporate those as possible. Anybody else?

XCAP Member Cho: I just have a question. You know, I just looked at these pictures again.

Chair Naik: Let the record show she is showing the traffic improvements at Embarcadero and Alma.

XCAP Member Cho: So, it's kind of intrusive like, you know, like it's a tree, you turn this way. Why is it not turned this way, in order to go to Embarcadero from east to west?

Chair Naik: InYoung, I'm going to have you save that for the traffic control team. I can talk off line, but I think.

XCAP Member Cho: I think you guys already know these answers.

Chair Naik: I think what I'm hearing you say is that it might be useful for there to be some other type of diagram that explains the different traffic movements. Would that be helpful.

XCAP Member Cho: Yeah. I'll just take it off.

Chair Naik: Okay. We're a couple of minutes over, but I think that's it. Thank you so much guys, and remember we're doing Norm Matteoni, the attorney who will be coming to speak about eminent domain next week, so I hope you guys will come.

## **8. Adjourn**

The meeting adjourned at 7:02 P.M.

# Palo Alto XCAP

January 29 2020

Agenda Item #3-Presentation,  
Shared at Meeting  
XCAP Meeting - Jan. 29, 2020





# Overview

## **Presenter:**

- Sebastian Petty, Deputy Chief of Planning

## **Focus:**

- Caltrain Business Plan
- Caltrain Long-Range Plans
- Agency Policy and Process

*Not able to provide detailed answers to questions about specific standards, engineering or construction concepts or specific comments on individual alternatives being considered*

# Questions

# Caltrain Operations Now

- Is there any reason that Caltrain can't increase schedules to 6 trains/hour in each direction before electrification is complete, to alleviate overcrowding and standees on many trains?
- Why doesn't Caltrain run more midday service now?

# Electrification Schedule

- Is the overall electrification project on schedule? If not, what is the new estimated completion date?
- What are the risks to the schedule?

# Operations After Electrification

- According to best information, current Caltrain funding is sufficient for new EMU trainsets to replace only 75% of the current fleet. Is this true? How much of the current fleet of diesel engines and diesel-hauled coaches will remain in operation to support current schedules? Are there any plans to get funding to replace the remaining 25% of the diesel engine and coach fleet with EMU trainsets?
- How is mixing diesel and electric expected to impact the schedules in the short term and does this delay more frequent midday service until Caltrain is fully electrified?
- How much of the current fleet of engines and coaches will be needed to cover a service increase to 6 trains/hour/direction? Are there any plans to get funding for the additional EMU trainsets needed?

# Operations After Electrification

- How will diesel-engine powered trains affect overall schedules as headways are reduced, since diesel engine powered trains cannot accelerate or decelerate as fast EMU trainsets?
- How many years until the current MP 36 and F40 engines reach end of life? Will they be replaced with new diesel engines or with EMU trainsets?
- How much of the current fleet of engines and coaches will be needed to cover a service increase to 6 trains/hour/direction? Are there any plans to get funding for the additional EMU trainsets needed?

# Operations After Electrification

- We know Caltrain plans to run more trains once electrified and the Business Plan shows Caltrain will run much more frequent all day service in the future. When will Caltrain release information of what happens in the in between (2023 - ?) When might midday service significantly increase? We are trying to understand when we will “feel the pain” of gridlock - so any understanding of even the process to determine the service post 2023 is helpful.

# Caltrain's 2040 Service Vision

## Illustrative Service Details

**Trains per Hour, per Direction** Peak: 8 Caltrain + 4 HSR  
Off-Peak: Up to 6 Caltrain + 3 HSR

**Stopping Pattern** Local / Express with timed transfer in Mid Peninsula

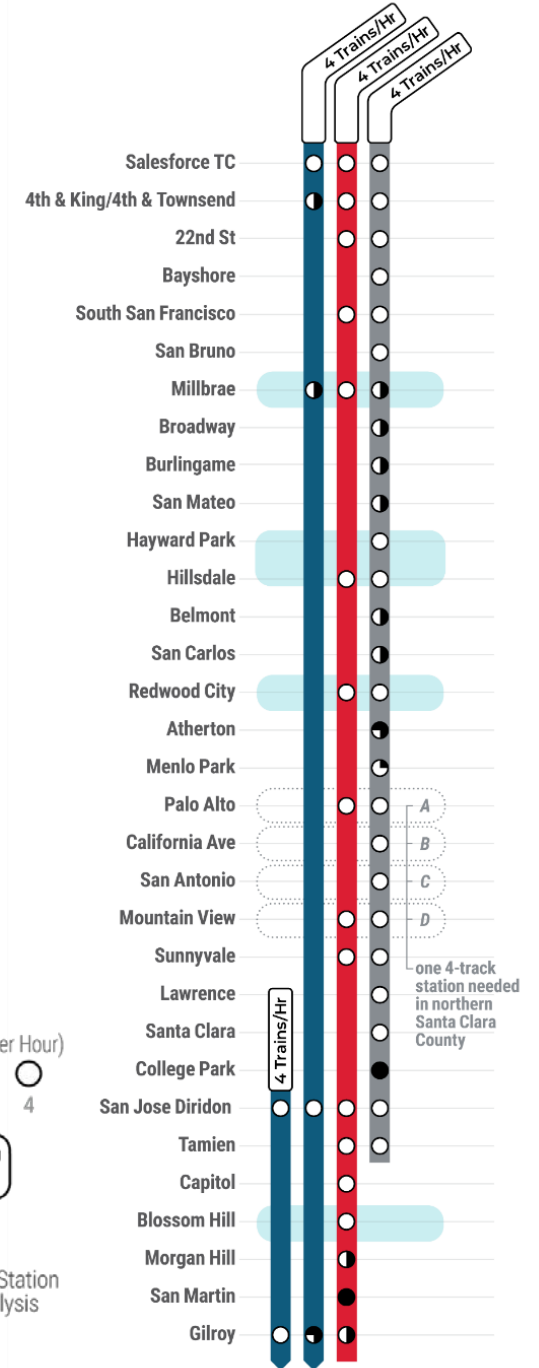
**Travel Time, STC-Diridon** 61 Min (Express)  
85 Min (Local)

**New Passing Tracks** Millbrae, Hayward Park-Hillsdale, Redwood City area, Northern Santa Clara County, Blossom Hill

- Service Plan Description**
- Local and Express trains each operating at 15-minute frequencies with timed cross-platform transfer at Redwood City
  - All trains serve Sales For Transit Center
  - Trains serve Capitol and Blossom Hill every 15 minutes and Morgan Hill and Gilroy every 30 minutes
  - Skip stop pattern for some mid-Peninsula stations



Conceptual 4 Track Segment or Station to be refined through further analysis and community engagement.





# Caltrain's 2040 Service Vision - Investments

## CAPITAL COSTS



**\$23 BILLION**  
TOTAL CAPITAL COSTS\*

Capital costs include all projects from SF to Gilroy, knitting together a connected corridor with greatly improved service.



**\$9.4B**  
GRADE  
SEPARATIONS



**\$7.8B**  
TERMINAL  
IMPROVEMENTS



**\$3.3B**  
RAIL INFRASTRUCTURE  
AND SYSTEMS



**\$1.4B**  
STATION  
IMPROVEMENTS



**\$1.1B**  
FLEET  
UPGRADES

## OPERATING COSTS



**\$370 MILLION**  
2040 ANNUAL OPERATING COSTS\*

Caltrain is one of the leanest, most efficient transit services in the country. Today's annual operating and maintenance costs are \$135 million, and 73% is covered by fares. The vision would benefit from a similarly high farebox recovery ratio.

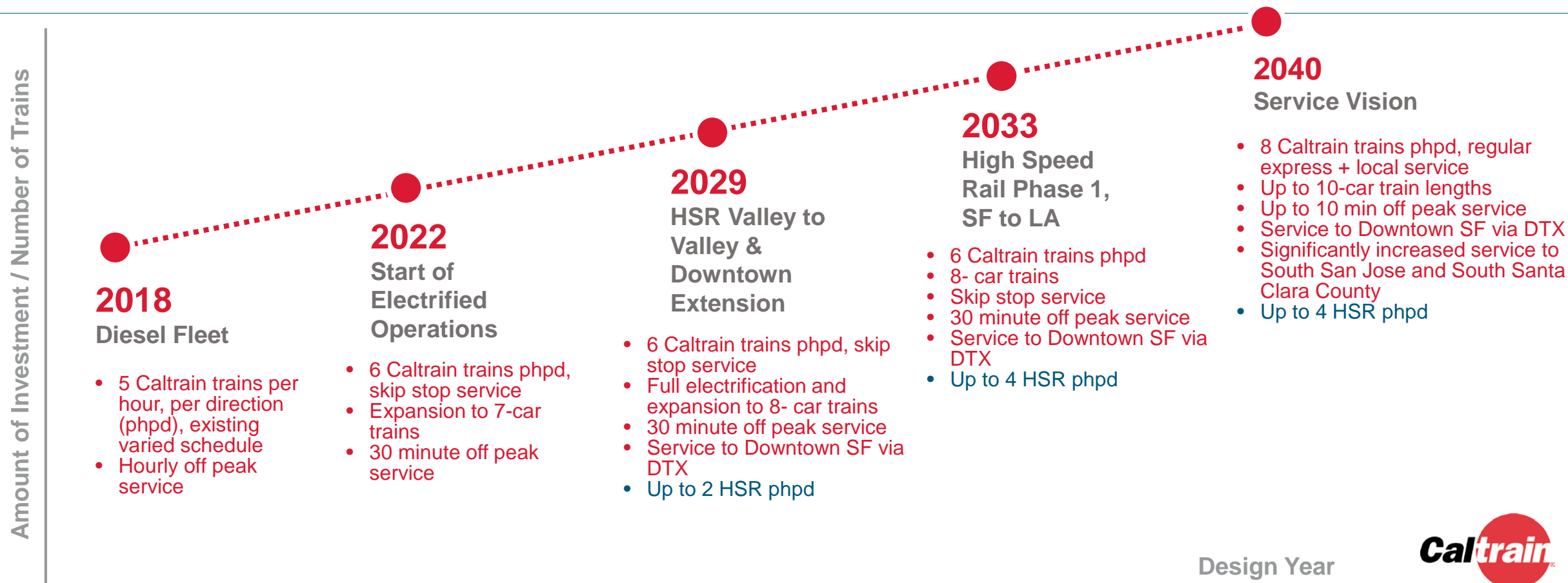
**\$266M**  
OPERATING  
COSTS  
COVERED BY  
FAREBOX (72%)



**\$104M**  
ANNUAL  
OPERATING  
INVESTMENT  
NEEDED (28%)

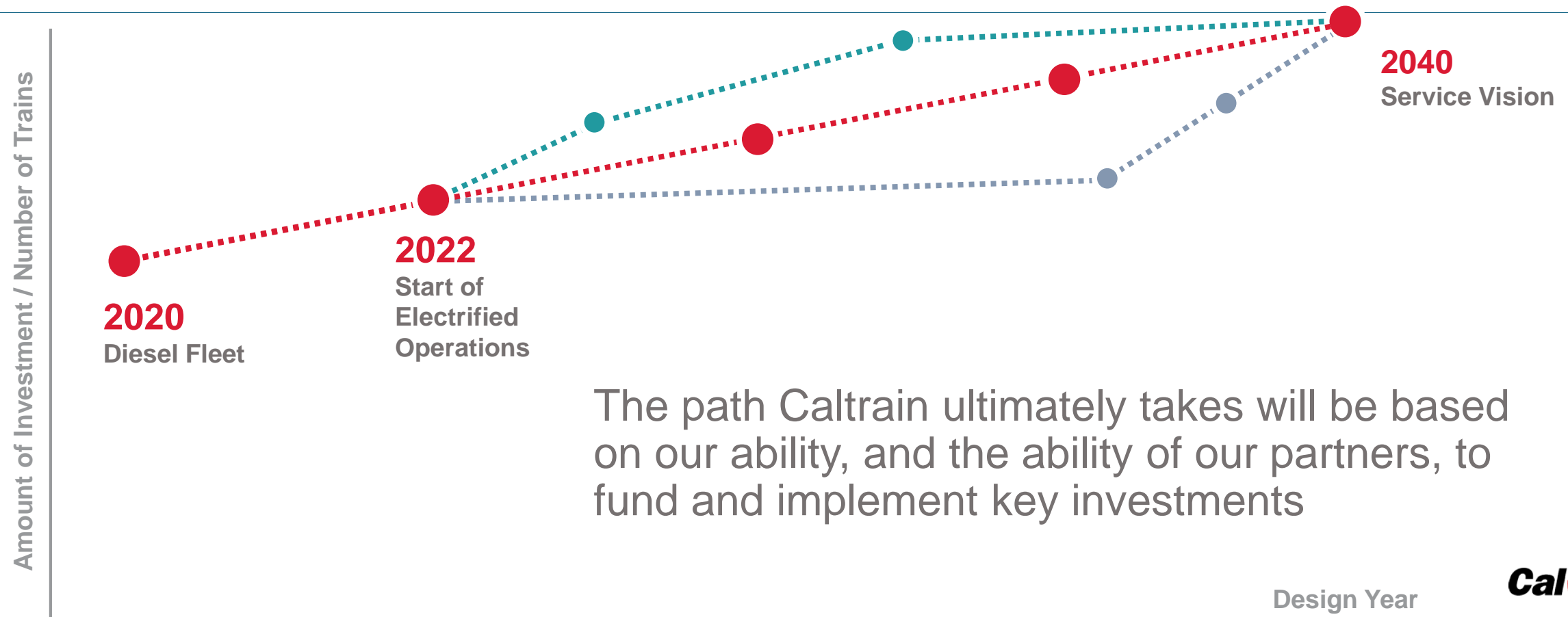
# Getting to the 2040 Vision

The “path” of milestone service improvements and investments used in initial Business Plan work was based on a simplified version of the existing plans of Caltrain and its partner agencies



# Getting to the 2040 Vision

With a long-range Service Vision established, we can optimize our approach. We can explore different “paths” or incremental steps that allow us to deliver improved service sooner



# Understanding Demand

Daily ridership demand for Caltrain service will likely exceed 90,000 passengers in the next decade. This growth is driven by several factors:



## Latent Demand

Improving Caltrain service and increasing capacity will make Caltrain more appealing for a wider range of trips



## Population and Employment Growth

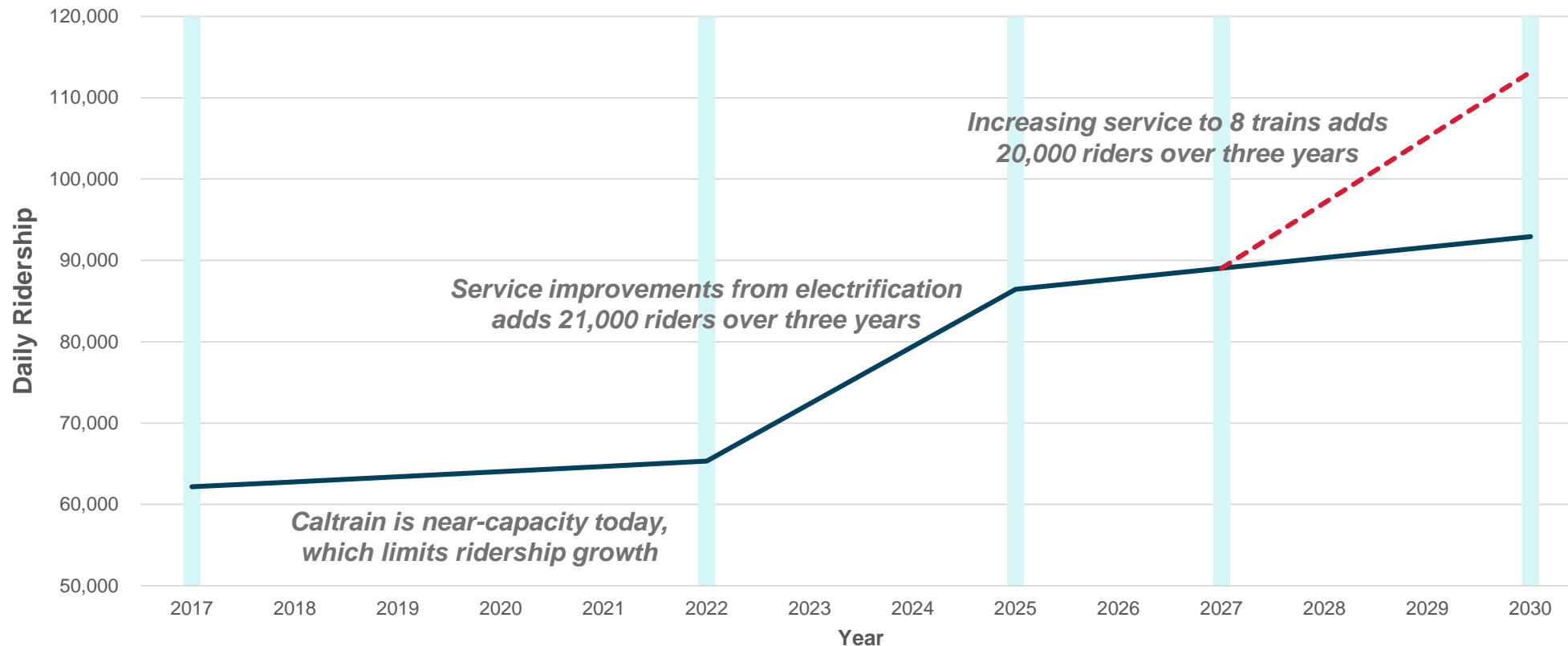
Station areas will add over 100,000 new residents and employees within ½ mile of Caltrain stations, a ~30% increase over existing



## Improved Connectivity

New connections like the Central Subway will extend Caltrain's reach

# Change in Weekday Ridership Over Time



— Electrification Service Plans (6 TPH Peak in 2022)

- - - Expanded Service (8 TPH in 2027)



# Adding Capacity and Increasing Service to Grow Ridership

**Toward the end of the 2020s, Caltrain is expected to reach capacity during peak hours.**

Caltrain will not be able to accommodate additional ridership growth in the 2030s without adding capacity. This poses a challenge for accommodating land use growth, DTX, Dumbarton rail, and other potential changes on the corridor.

**While smaller, interim improvements may ease capacity, the most significant improvement to service and capacity involves expanding service to eight trains per hour, per direction.**

# An Interim Step- Not the Full 2040 Service Vision

Increasing mainline service in the mid- to late 2020's would be an interim step- not the full implementation of the 2040 Service Vision.

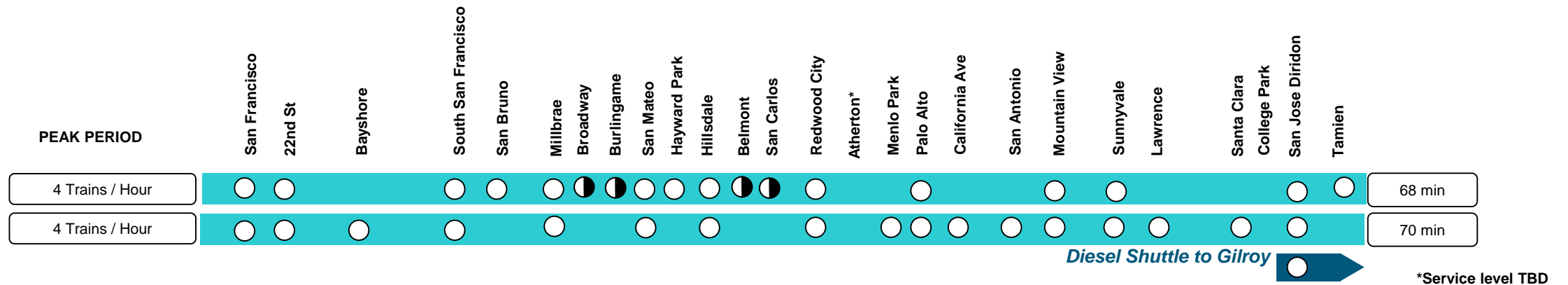
Major investments at terminals and in passing tracks infrastructure are not assumed.

Making near-term, tactical investments to increase service to 8 trains per hour per direction would *precede* the full buildout of the 2040 Service Vision. As such, many important aspects of the 2040 Service Vision would not yet be fully achieved, including:

- Ability to operate a peak-hour express / local service pattern with timed transfers
- Ability to lengthen trains to 8- or 10-cars
- Direct service to downtown San Francisco
- Greatly expanded and electrified service south of Tamien Station to Gilroy

Fully achieving the 2040 Service Vision would require the overall buildout discussed and documented in the Business Plan process to date.

# 8 Train Illustrative Service Plan



- An 8-train Caltrain service would likely look like a hybrid of the zone express and skip stop patterns with 8 trains per hour, per direction.
- There is limited flexibility in the service structure due to lack of new passing tracks and the constraints of Caltrain's existing signal system.
- Diesel service to/from Gilroy would terminate at San Jose with a timed transfer mainline service. This service could be increased to 5 round trips per day and would have more flexibility to customize departure and arrival times based on public input.

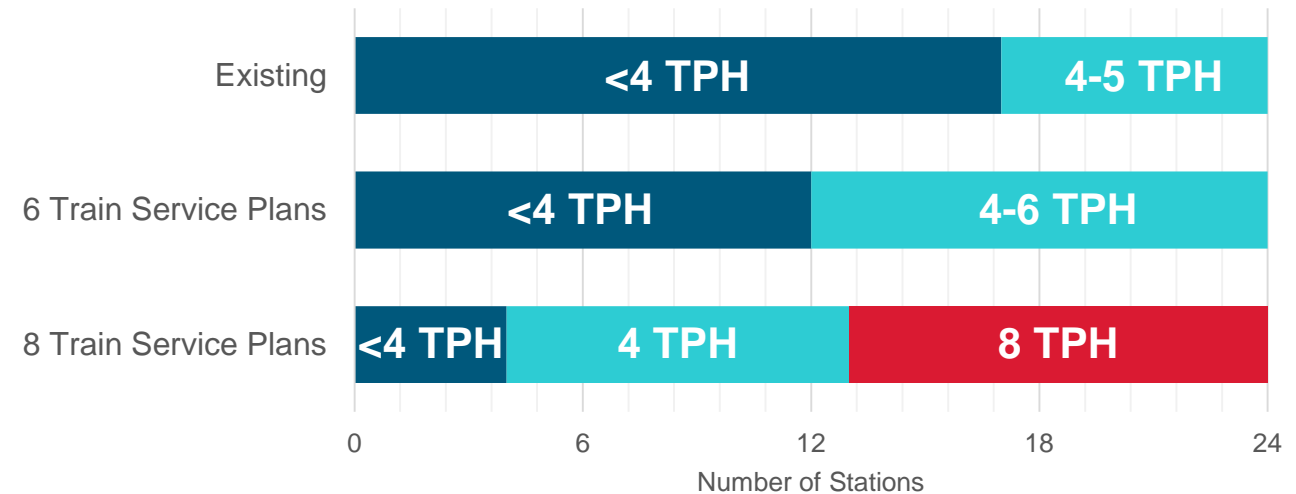




# Increasing Service at Stations

**Increasing service from six to eight trains per hour, per direction enables more frequent service to more stations.**

With an interim 8 tphpd service, 20 of 24 mainline stations would receive at least four trains per hour, per direction, and nearly half of stations would receive eight trains per hour, per direction.

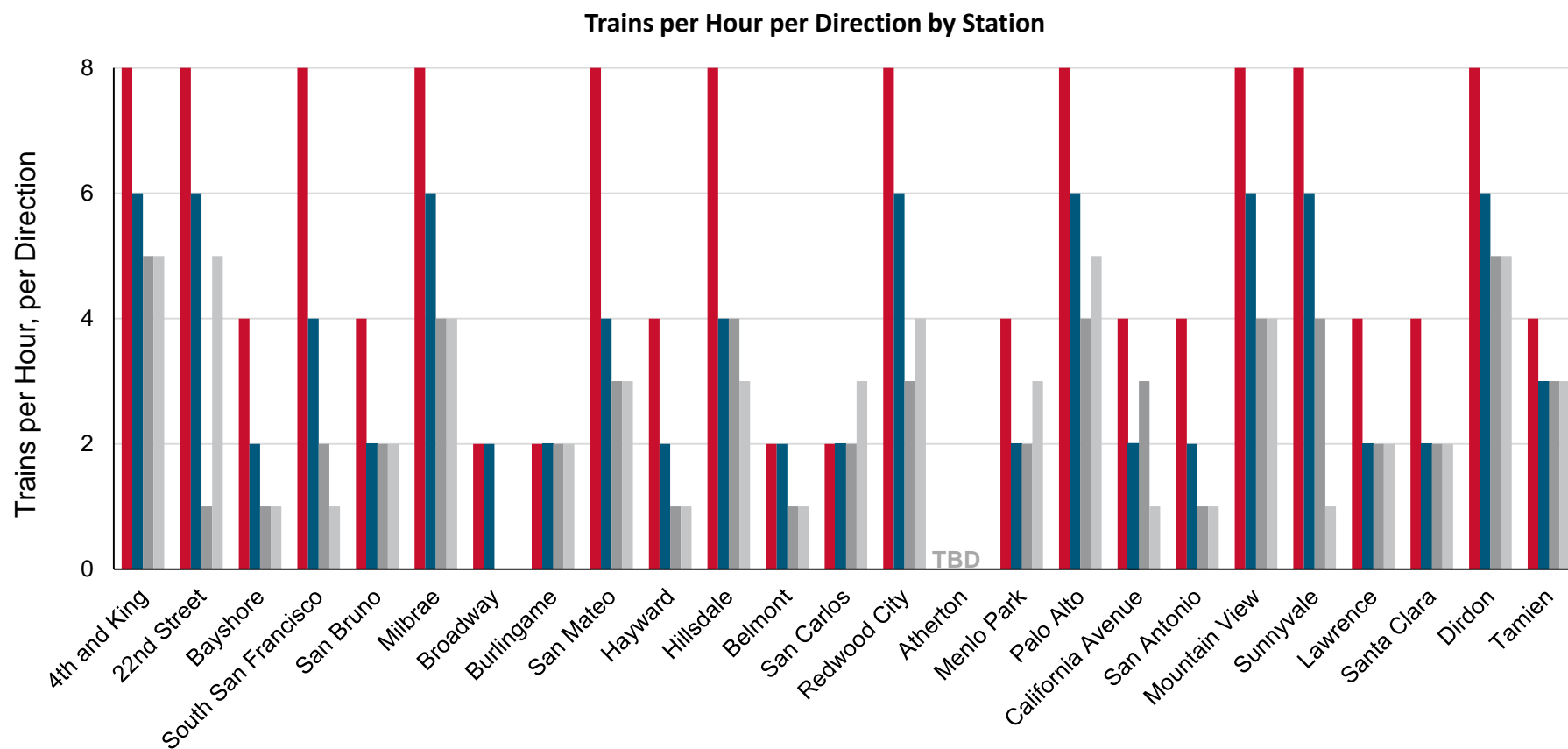


# Increasing Service to Stations

20 stations could receive at least four trains per hour, per direction.

## Illustrative Change in Peak Period Service Levels

- Illustrative service at expanded "8tph plan"
- Illustrative service at initial CalMod level
- Existing NB AM/SB PM
- Existing SB AM/NB PM



# Overall Investments

The following parallel and programmatic investments are assumed to be occurring throughout the 2020's- they are needed to support the overall success of the system and the full implementation of the 2040 Service Vision



## Grade Separations

Planning and construction of grade separations and grade crossing improvements



## Station Improvements

Programmatic improvements to Caltrain stations and investments in station access and connectivity



## Major Investments

Work on major terminal projects (including Diridon and DTX), major station investments, and partner projects including HSR

# What Specific Incremental Investments and Changes Would be Needed?

The following key investments would specifically be needed to implement an interim 8-tph service. These investments are consistent with the overall program assumed in the 2040 Service Vision



## Expanded EMU Fleet

To provide 8 tphpd direction mainline service, Caltrain will need to expand its EMU fleet



## More Train Storage

The railroad will need to add storage capacity to accommodate additional trainsets



## Holdout Rule Elimination

Once 8 trains per hour per direction are operating on the corridor, remaining “holdout” rule stations will need to be rebuilt or closed

# What Specific Incremental Investments and Changes Would be Needed?

The following key investments would specifically be needed to implement an interim 8-tph service. These investments are consistent with the overall program assumed in the 2040 Service Vision



## Level Boarding

Level boarding is needed to ensure reliability and to keep dwell times as short as possible



## Gilroy-SJ Shuttle Service

Remaining diesel service south of Tamien would be converted to a shuttle service until the UP corridor is rebuilt and electrified. Service levels could be increased to 5 round trips per day under existing agreements with UP



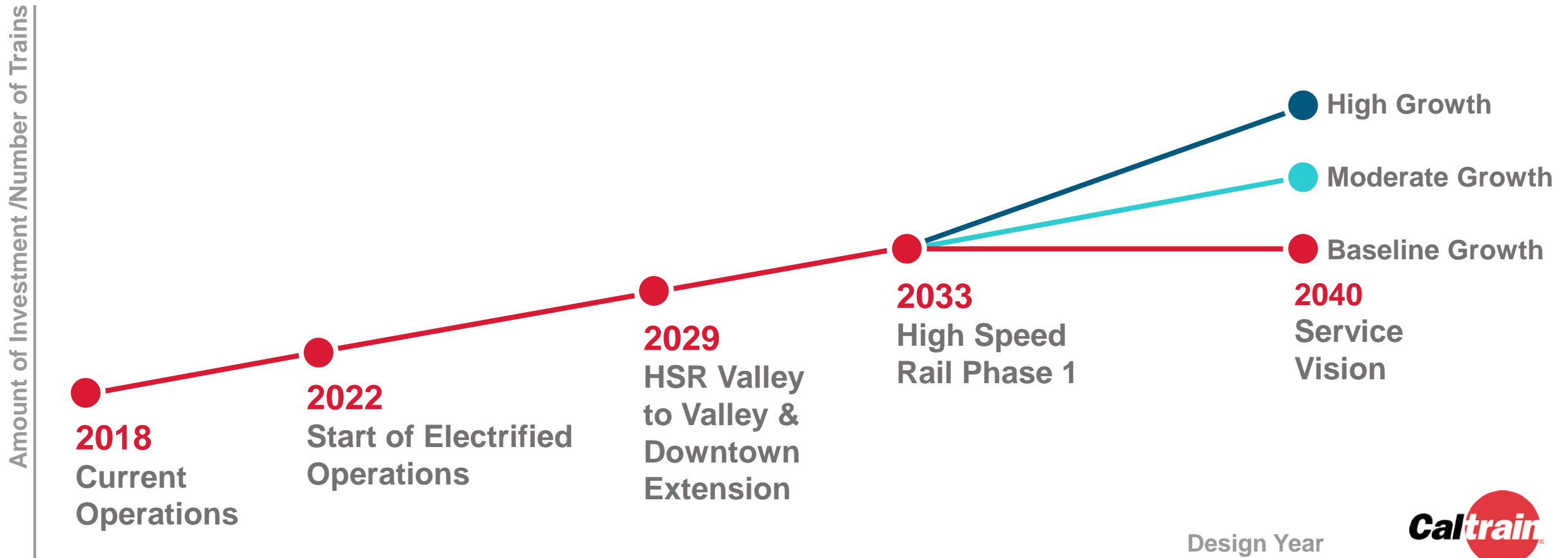
## Minor Track Work

Minor track work would be needed to accommodate increased train volumes around Diridon Station

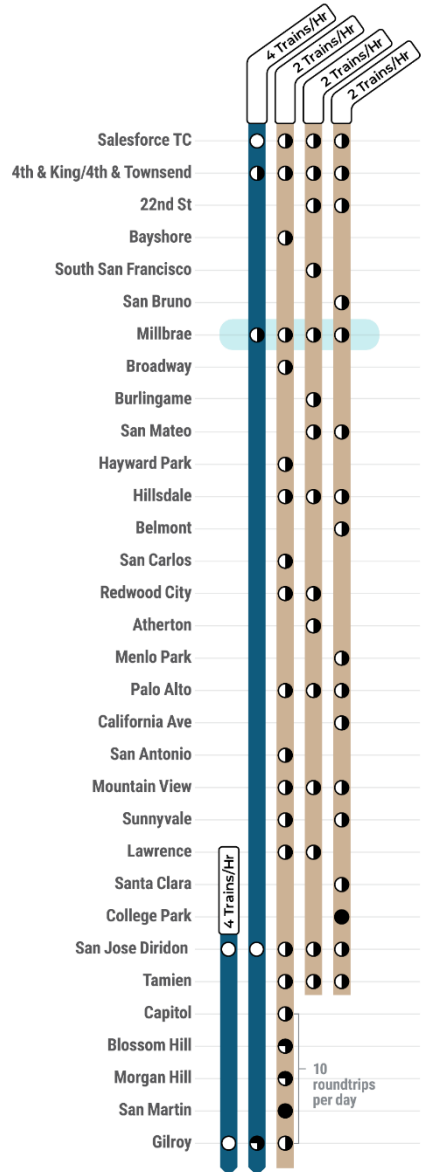
# Passing Tracks in Palo Alto

- What is our contingency plan if we need passing lane(s) in Palo Alto? How do we get some more definitive information about four-tracking requirements from Caltrain?
- Can we overlay any possible future four-track passing sections against the current maps of alternatives?

# How Much Service Should Caltrain Provide?



# 2040 Baseline Growth Scenario



## Trains per Hour, per Direction

Peak: 6 Caltrain + 4 HSR  
Off-Peak: 3 Caltrain + 3 HSR

## Stopping Pattern

Skip stop

## Travel Time, STC-Diridon

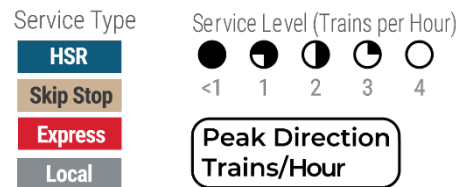
69-73 Min

## New Passing Tracks

Millbrae

## Service Plan Description

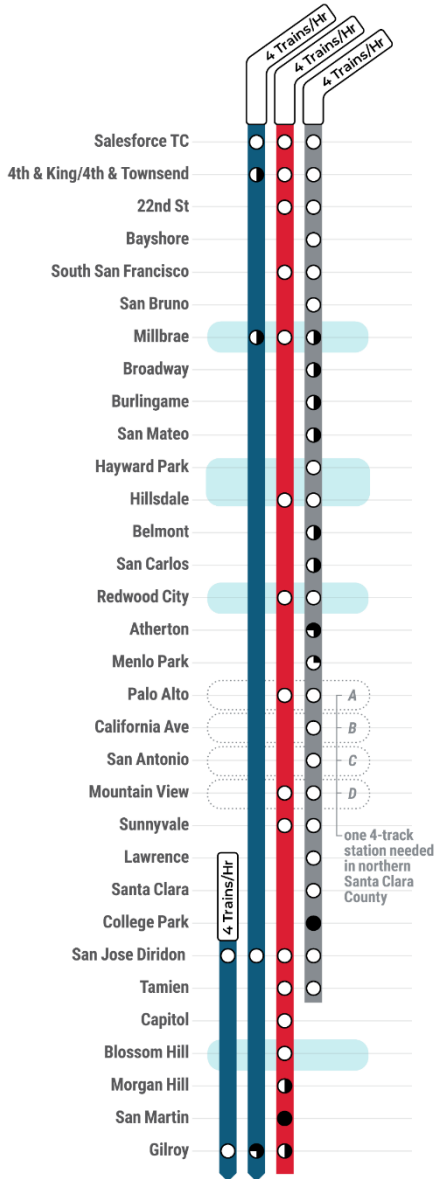
- Bunched service results in irregular Caltrain headways; each pattern arrives over span of 10 minutes, then a 20-minute gap between trains
- Three half-hourly skip stop patterns each with similar travel times
- South of Tamien, peak-direction skip stop service with 10 round trips per day



Conceptual 4 Track Segment or Station to be refined through further analysis and community engagement.



# 2040 Moderate Growth Scenario



## Trains per Hour, per Direction

Peak: 8 Caltrain + 4 HSR  
 Off-Peak: 6 Caltrain + 3 HSR

## Stopping Pattern

Local / Express with timed transfer at Redwood City

## Travel Time, STC-Diridon

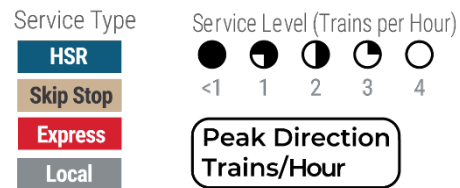
61 Min (Express)  
 85 Min (Local)

## New Passing Tracks

Millbrae, Hayward Park-Hillsdale, Redwood City, Northern Santa Clara County, Blossom Hill

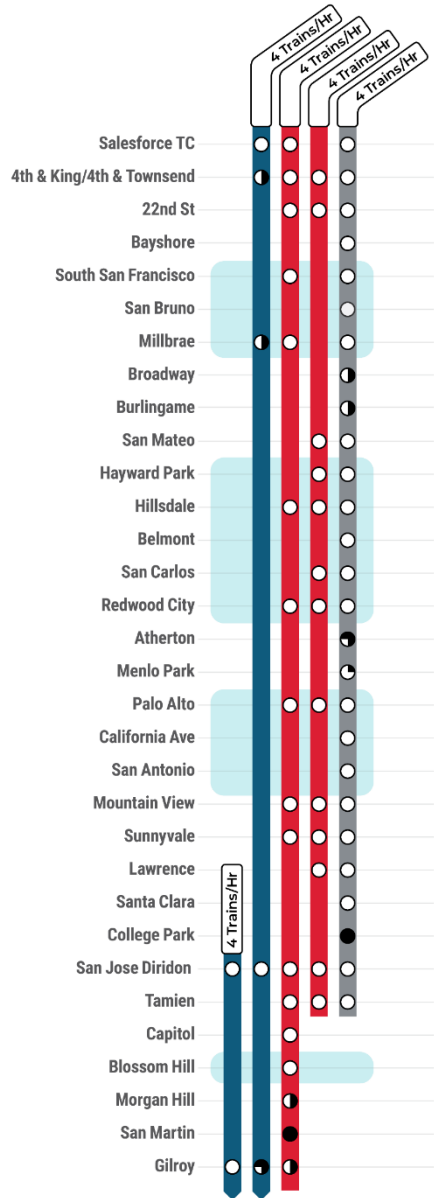
## Service Plan Description

- Local and Express trains each operating at 15-minute frequencies with timed cross-platform transfer at Redwood City
- Skip stop pattern for some mid-Peninsula stations; some origin-destination pairs not served at all
- Trains serve Capitol and Blossom Hill every 15 minutes and Morgan Hill and Gilroy every 30 minutes



Conceptual 4 Track Segment or Station to be refined through further analysis and community engagement.

# 2040 High Growth Scenario



## Trains per Hour, per Direction

Peak: 12 Caltrain + 4 HSR  
Off-Peak: 6 Caltrain + 3 HSR

## Stopping Pattern

Local / Express A / Express B with timed transfer at Redwood City

## Travel Time, STC-Diridon

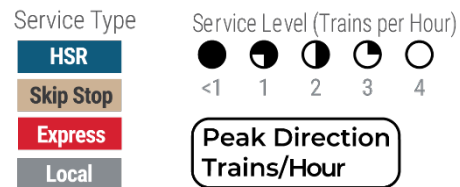
61 Min (Express A)  
82 Min (Local)

## New Passing Tracks

South San Francisco-Millbrae, Hayward Park-Redwood City, northern Santa Clara County, Blossom Hill

## Service Plan Description


- Local and Express A trains each operating at 15-minute frequencies with timed cross-platform transfer at Redwood City
- Express B trains operate every 15 minutes between 4th & King and Tamien
- Local trains make nearly all stops
- Trains serve Capitol and Blossom Hill every 15 minutes and Morgan Hill and Gilroy every 30 mins

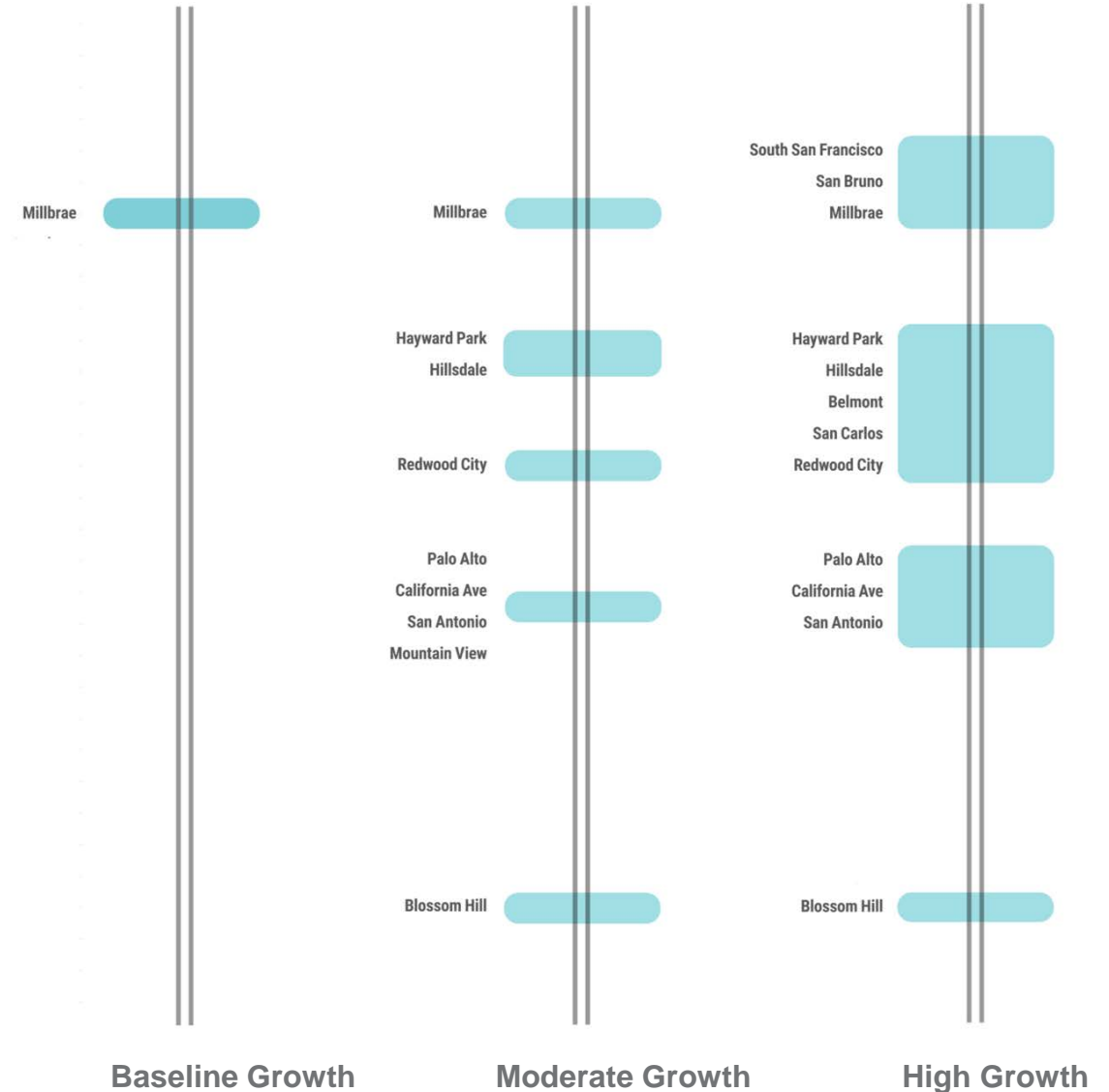



Conceptual 4 Track Segment or Station to be refined through further analysis and community engagement.

# New 4 Track Infrastructure Required

The **Moderate and High Growth** service plans require passing track infrastructure to support blended service with HSR, so that faster trains can pass slower trains at multiple points in the corridor

 Conceptual 4 Track Segment or Station to be refined through further analysis and community engagement.



	Metric	Baseline Growth	Moderate Growth	High Growth
 <b>Infrastructure</b>	Passing Tracks Needed	<1 Mile	<5 Miles	15-20 Miles

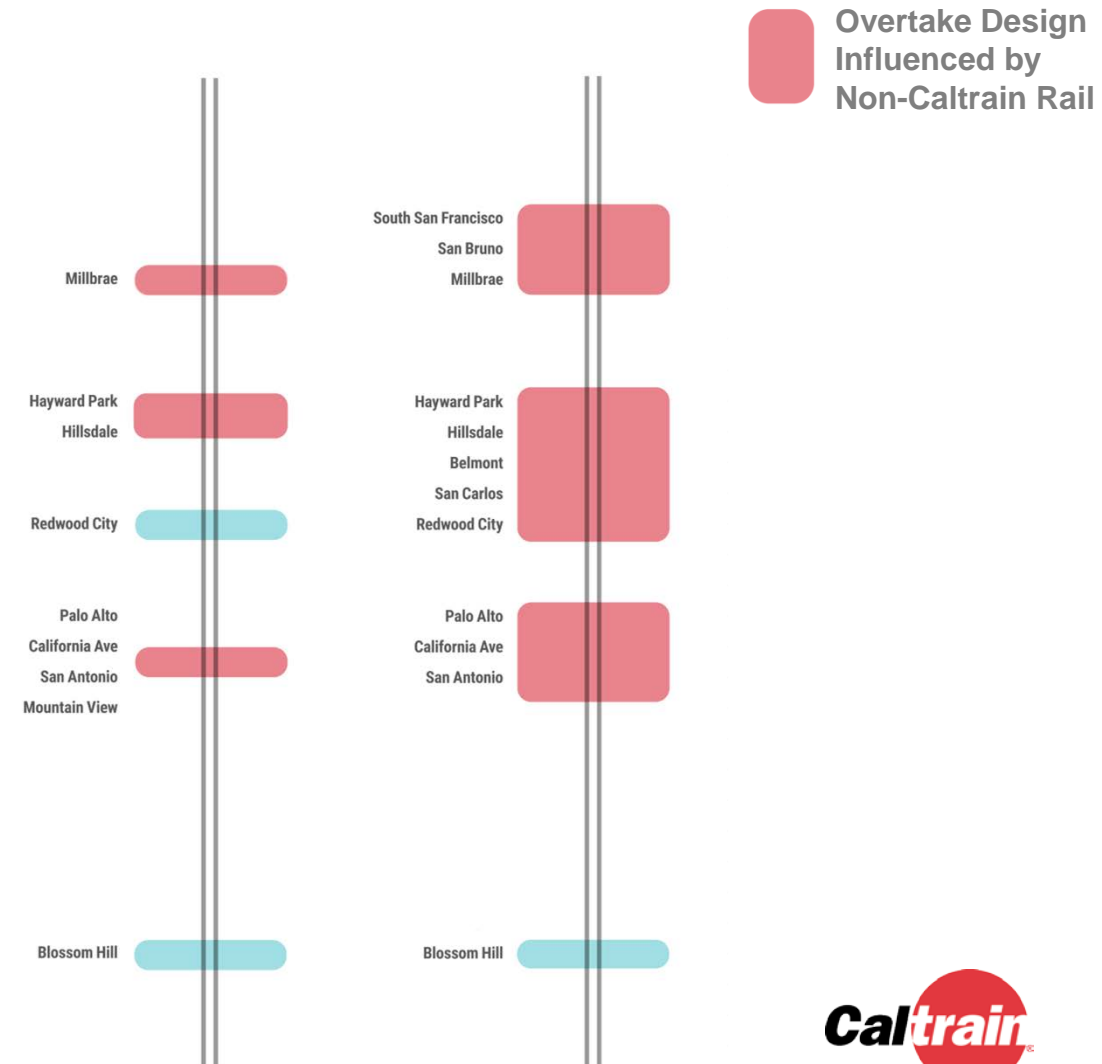
# Implications of Uncertainty to Growth Scenarios

The **High Growth Scenario** most directly accommodates large-scale corridor sharing and expanded service, but the details of this scenario - including potential stopping patterns and location and extent of required infrastructure - are also highly influenced by state and regional projects.

The **Moderate Growth Scenario** does not directly accommodate the same level of growth but has infrastructure that can be more discretely planned. It has the potential to scale up as regional projects are further confirmed, defined, and funded.

## 4-Track Infrastructure Uncertainty

Segments Dependent on Design Input/Timing of Regional and State Projects



# Board Policy

The Board Adopted A Long Range Service Vision in October of 2019. This document define agency policy

<https://caltrain2040.org/wp-content/uploads/Caltrain-Business-Plan-Final-Service-Vision.pdf>

## THE CALTRAIN 2040 LONG RANGE SERVICE VISION

*The following "Caltrain 2040 Long Range Service Vision" has been adopted by the Peninsula Corridor Joint Powers Board to guide the long-range development of the Caltrain rail service and supporting plans, policies and projects. This Long Range Service Vision has been based on detailed technical analysis undertaken by Caltrain and its partner agencies as part of the "Caltrain Business Plan" process during 2018 and 2019. This Long Range Service Vision will be periodically reaffirmed and updated by the Board as described in section 4.*

- 1) Caltrain's Long Range Service Vision directs the railroad to plan for substantially expanded rail service that, by 2040, will address the local and regional mobility needs of the corridor while supporting local economic development activities. When fully realized, this service will provide;
  - A. A mixture of express and local Caltrain services operated in an evenly spaced, bi-directional pattern
  - B. Minimum peak hour frequencies of:
    - 8 trains per hour per direction on the JPB-owned corridor between Tamien Station in San Jose and San Francisco, extended to Salesforce Transit Center at such time as the Downtown Extension is completed
    - 4 trains per hour per direction between Blossom Hill and Tamien Stations, subject to the securing of necessary operating rights
    - 2 trains per hour per direction between and Gilroy and Blossom Hill Stations, subject to the securing of necessary operating rights
  - C. Off-peak and weekend frequencies of between 2 and 6 trains per hour per direction north of Blossom Hill and hourly between Gilroy and Blossom Hill, with future refinements to be based on realized demand
  - D. Accommodation of California High Speed Rail, Capitol Corridor, Altamont Corridor Express and freight services in accordance with the terms of existing agreements
  - E. Delivery of these services will occur through the incremental development of corridor projects and infrastructure to be further defined through individual planning process, feasibility studies and community engagement. At this time, such infrastructure is conceptually understood to include:
    - i. Investments in rail systems including a new, high performance signal system

ngthening, level boarding, and amenities to support growing

facilities in the vicinity of electrified Caltrain fleet es at various points

projects including: Salesforce Transit Center and surrounding rail

of the rail corridor south of on the operation of High Speed Francisco e corridor as well as safety crossings, undertaken in a y the desires of individual urements associated with

road to continue its planning tential new regional and service Vision directs the

plan for and study the nded regional and mega- ng related to the Dumbarton the potential for expanded vices, a potential extension of ng related to the California

ere feasible and financially nd connections as they

ilities and re 4-track segments may be

nd storage yards



# Board Policy

The Board Adopted A Long Range Service Vision in October of 2019. This document define agency policy

<https://caltrain2040.org/wp-content/uploads/Caltrain-Business-Plan-Final-Service-Vision.pdf>

2) Caltrain's Long Range Service Vision further directs the railroad to continue its planning for a potential "higher" growth level of service as well as potential new regional and mega-regional connections. Specifically, the Long Range Service Vision directs the railroad to:

A. Work with regional and state partners to collectively plan for and study the feasibility of higher levels of service as well as expanded regional and mega-regional rail connections. This work includes planning related to the Dumbarton Rail Corridor, a potential second Transbay Crossing, the potential for expanded Altamont Corridor Express and Capitol Corridor services, a potential extension of rail service to Monterey county, and ongoing planning related to the California High Speed Rail system.

B. To take certain specific actions to anticipate and, where feasible and financially practicable, facilitate, such higher levels of service and connections as they specifically relate to:

- i. The planning of rail terminals and related facilities
- ii. The sale or permanent encumbrance of JPB land
- iii. The design of grade separations in areas where 4-track segments may be required
- iv. The sizing of future maintenance facilities and storage yards

# Passing Tracks in Palo Alto

- Caltrain has said they would like cities to select an alternative that doesn't "preclude" four tracks - which of these options doesn't preclude 4 tracks: viaduct, hybrid, trench, tunnel?
- How could a trench or a viaduct be widened to accommodate 4 tracks?

# Passing Tracks in Palo Alto

- If passing tracks are required as part of a grade crossing separation design, will Caltrain pay for the incremental cost of design and construction? Ongoing maintenance?
- Will Caltrain share costs for a four-track alternative, in advance of when Caltrain would actually need to use the passing tracks?



# Business Plan And Overall Planning

- Does Caltrain intend to develop a comprehensive plan for replacement of all the grade crossings between San Francisco and San Jose?
- Does Caltrain intend to develop a funding mechanism to support such a comprehensive plan?
- Are there state and local agencies that we can work with better so that we are all planning a regional solution rather than a town-by-town solution?

# Caltrain's Systemwide Steps on Grade Separations

There is a significant body of work remaining to address the issue of at grade crossings in the Caltrain corridor

Caltrain plans to continue advancing a corridor wide conversation regarding the construction, funding and design of grade separations while continuing to support the advancement of individual city-led projects

## Within the Business Plan

- Incorporate grade crossing investment estimates into overall corridor costing and business case analysis
- Continue peer review of corridor wide grade separation case studies and examples

## Beyond the Business Plan

- Develop corridor wide grade separation strategy, potentially addressing;
  - Risk assessment and prioritization factors
  - Construction standards and methods
  - Project coordination and sequencing
  - Community resourcing and organizing
  - Funding analysis and strategy

## For individual City projects

- Continue working with cities and county partners to support advancement of individual grade separation plans and projects

# Business Plan And Overall Planning

- In the absence of a comprehensive plan, does Caltrain intend to provide assistance to crossing elimination projects, city by city?
- On average, what percentage of funding have cities contributed to grade separations in the past? What was the main source of funding for these grade separations historically? Has any tax measure ever been raised just to pay for grade separations (and not other general transit capital projects)?

# Business Plan And Overall Planning

- Are there any legal requirements for Embarcadero grade separation to continue to include a Stanford stop (if changed in the future for any reason)? Who is responsible for Stanford Station? Does the City or Caltrain have an arrangement with Stanford that must be considered? Are there any scenarios contemplated in Caltrain's business plan service vision that continue to provide service to the Stanford station?
- If a viaduct or a tunnel is built, can the City have amenities, such as bike paths, as part of an easement, or would all of the land be controlled by Caltrain. If there are no amenities, is Caltrain accountable to control weeds, graffiti, etc.?
- If existing tracks are removed for viaducts or tunnels, will Caltrain create bike paths? If not, what is the intended use of this space?

# Business Plan And Overall Planning

- Is there anything that regulates how long of a stretch between crossover switches? Is there a requirement for the maximum spacing in miles between crossover switches?
- Are there any large projects that are in the works but have not been completed that might change the technical requirements (like 1% grade) on the Caltrain corridor in the future in a way that could impact our decision? For example, is there a plan to remove freight that is in the works but has stagnated? What is the likelihood of any surprises through the design review process (re Caltrain, etc.)?
- Has Caltrain developed standards for tunnels that have only electric trains (same standards that will be used for going into TransBay terminal),? If not, when are they expected?

# Business Plan And Overall Planning

- Is there anything that regulates how long of a stretch between crossover switches? Is there a requirement for the maximum spacing in miles between crossover switches?
- Are there any large projects that are in the works but have not been completed that might change the technical requirements (like 1% grade) on the Caltrain corridor in the future in a way that could impact our decision? For example, is there a plan to remove freight that is in the works but has stagnated? What is the likelihood of any surprises through the design review process (re Caltrain, etc.)?
- Has Caltrain developed standards for tunnels that have only electric trains (same standards that will be used for going into TransBay terminal),? If not, when are they expected?

# Business Plan And Overall Planning

- How will Union Pacific (or a future short line operator) operate trains on a 2% grade? More power on each train, or shorter trains? What would be the noise impact of more power or engines operating at full throttle on a 2% grade?
- For design exceptions such as 2% vertical grades, is the City required to negotiate with Caltrain, or can the City negotiate directly with Union Pacific RR?

**FOR MORE INFORMATION**

**WWW.CALTRAIN2040.ORG**

**BUSINESSPLAN@CALTRAIN.COM**

**650-508-6499**





# CALTRAIN RAIL CORRIDOR USE POLICY

## Overview and Background on the Rail Corridor Use Policy

The Rail Corridor Use Policy is a policy that has been adopted by the Peninsula Corridor Joint Powers Board (JPB) to guide the use of its property and support delivery of Caltrain's Long-Term Service Vision.

The JPB frequently receives proposals for "non-railroad uses" of its property, such as utilities, commercial businesses, development proposals, or community facilities. In accordance with the JPB's Policy of Property Conveyance<sup>1</sup> (Resolution 2010-45), the agency has an extensive review process for such proposals, including design, engineering, and regulatory review, and non-railroad uses of JPB property that have been reviewed and approved by the JPB are issued a Property Access Agreement. The first step in the review process for Property Access Agreements is for Caltrain staff to determine if the proposed use is compatible with the railroad's current and future needs.

The railroad's future needs for its property are directly connected to achieving Caltrain's Long-Term Service Vision, which was unanimously adopted by the Caltrain Board of Directors on October 3, 2019. Developed through the Caltrain Business Plan process, the Long-Term Service Vision describes a substantially expanded rail service on the Caltrain corridor by 2040, with a minimum of eight trains per hour operating in the peak period in each direction between San Francisco and San Jose. In order to support this growth in train service, the Caltrain Business Plan also identified the conceptual infrastructure that will be needed to operate more trains on the corridor and achieve the Long-Term Service Vision. It is anticipated that significant portions of the JPB's property will be needed to deliver this future infrastructure and support future train operations for the Long-Term Service Vision. Therefore, it is essential that the JPB make thoughtful, strategic decisions regarding non-railroad uses on its property to ensure that it can deliver the railroad's vision for its future.

The Rail Corridor Use Policy is intended to provide a Board-adopted policy to guide decision-making regarding the compatibility of proposed non-railroad uses of JPB property. Stated another way, the Rail Corridor Use Policy is intended to be used by the JPB to determine if a proposed non-railroad use of JPB property is compatible with the railroad's current and future needs for its property – a policy to guide decision-making for the first step in the Property Access Agreement review process. For proposed uses that are determined to be compatible with the railroad's current and future needs, it is important to note that in accordance with the Policy of Property Conveyance, additional design, engineering, and regulatory review is required before a Property Access Agreement can be approved and issued by the JPB.

## What Does the Rail Corridor Use Policy Contain?

The Rail Corridor Use Policy is a policy framework that consists of two components: **an administrative document** and **a map series** displaying the JPB's property along the Caltrain corridor. The administrative document is intended to be used in conjunction with the maps to guide decision-making regarding the compatibility of proposed non-railroad uses with the railroad's current and future needs.

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<sup>1</sup> The JPB's Policy of Property Conveyance from 2010 can be accessed on Caltrain's website at [http://www.caltrain.com/Assets/\\_Contracts+and+Procurement/pdf/2010-45+Property+Conveyance+!\\$26+Fee+Schedule.pdf](http://www.caltrain.com/Assets/_Contracts+and+Procurement/pdf/2010-45+Property+Conveyance+!$26+Fee+Schedule.pdf).

# CALTRAIN RAIL CORRIDOR USE POLICY DRAFT ADMINISTRATIVE DOCUMENT

This section of the Rail Corridor Use Policy contains the administrative components of the policy framework, including the following:

- **Definitions** of the terms used in the policy framework, including the Property Use Zones and the Service Vision Capital Project Overlay;
- **Decision-making process** for proposed non-railroad uses to determine if they are compatible with the railroad's current and future needs;
- **Allowable non-railroad uses** that would be considered to be compatible with the railroad's current and future needs, including an overview and a list of allowable uses for each Property Use Zone; and,
- **Procedures** for updating the Rail Corridor Use Policy.

## DEFINITIONS

### PROPERTY USE ZONES

#### OVERVIEW OF PROPERTY USE ZONES

The Property Use Zones serve as the base land use districts for Peninsula Corridor Joint Powers Board (JPB) property along the Caltrain corridor. The Property Use Zones apply to all JPB property and JPB operating easements along the Caltrain corridor from San Francisco to San Jose. Each Property Use Zone has a list of non-railroad uses that may be located within its borders, which are described later in this document.

#### WHAT ARE “NON-RAILROAD USES?”

Non-railroad uses are uses of JPB property that do not have a primary purpose of supporting the delivery of Caltrain rail service and the safe operation of the railroad. Non-railroad uses may be located below, on, or above JPB property. Some examples of non-railroad uses on JPB property include:

- The many third party utilities that must cross the rail corridor to support the surrounding communities, such as water, electricity, or sewer facilities, which are the most common non-railroad uses on the corridor;
- A residential building, office building, restaurant, or museum near a Caltrain station; or,
- An access facility to improve mobility in a community, such as walkway or bikeway along or across the rail corridor.

In each of these examples, the primary purpose for which the land or building thereon is designed, arranged or intended, or for which it is occupied, maintained, or leased, is not directly related to supporting the delivery of Caltrain rail service and the safe operation of the railroad; therefore, they are considered to be non-railroad uses.

#### WHAT ARE THE PROPERTY USE ZONES AND HOW DO THEY WORK?

##### PROPERTY USE ZONE 1: OPERATING RIGHT-OF-WAY

Property Use Zone 1 is the Operating Right-of-Way (ROW) land use district, and it includes property that is required for the safe operation of the railroad in its current configuration and for the Peninsula Corridor Electrification Project (PCEP). Land in Property Use Zone 1 is intended to serve railroad operations and is generally not available for non-railroad uses, except compatible utility uses.

##### PROPERTY USE ZONE 2: STATION RIGHT-OF-WAY

Property Use Zone 2 is the Station Right-of-Way land use district, and it includes property that is located at and near Caltrain’s stations. Property in Property Use Zone 2 includes facilities that support the functioning of the railroad station, including station buildings, facilities that facilitate access to the railroad (such as sidewalks, driveways, loading and unloading areas, car parking facilities, bike parking facilities, etc.), passenger waiting areas, etc. Property Use Zone 2 could potentially have non-railroad land uses that are compatible with the functioning of the station and the safe operation of the railroad, including development projects, commercial leases, community uses, etc.

##### PROPERTY USE ZONE 3: NON-OPERATING RIGHT-OF-WAY

Property Use Zone 3 is the Non-Operating Right-of-Way land use district, and it includes all JPB property that is not already included in Property Use Zones 1, 2, and 4. Property in Property Use Zone 3 could potentially have non-railroad land uses that are compatible with the safe operation of the railroad, including development projects, commercial leases, community uses, etc.

### **PROPERTY USE ZONE 4: SPECIAL STUDY AREA**

Property Use Zone 4 Zone is the Special Study Area land use district, and it includes JPB property that is currently involved in a defined planning process that formally involves multiple stakeholders. Examples include areas of the corridor associated with the railroad terminal studies at San Francisco and San Jose. Land in Property Use Zone 4 is generally not available for non-railroad uses, except compatible utility uses, and future use of the property will generally be determined through the defined planning process in each area.

## SERVICE VISION CAPITAL PROJECT OVERLAY

### **OVERVIEW**

The Service Vision Capital Project Overlay serves as an overlay district that is applied on top of the Property Use Zones to JPB property along the Caltrain corridor. This overlay conceptually represents areas of JPB property along the Caltrain corridor that may be needed for potential future capital projects to support achievement of Caltrain’s Long-Term Service Vision.

### **WHAT IS INCLUDED IN THE SERVICE VISION CAPITAL PROJECT OVERLAY?**

The Service Vision Capital Project Overlay includes all known potential future capital projects that may be delivered on the corridor to support achievement of Caltrain’s Long-Range Service Vision. Consistent with the Caltrain Business Plan, the program of capital investments included in the Service Vision Capital Project Overlay is intended to be “visionary;” it has been developed to be comprehensive and inclusive of all the projects and plans that are already ongoing in the corridor. This means that many of the capital investments are related to projects and plans that are already under development by Caltrain’s partner agencies and local jurisdictions.

The Service Vision Capital Project Overlay’s collection of potential future capital projects includes the following:

- Near-term future maintenance and rehabilitation projects of existing rail infrastructure;
- Potential future changes to the rail infrastructure to accommodate a blended system;
- Potential future passing tracks to support increased rail service, as described by the Caltrain Business Plan;
- Potential future terminal projects at San Francisco and San Jose;
- Potential future grade separation projects at each current at-grade vehicular crossing; and,
- Potential future grade separation projects for bikes and pedestrians only, as defined by cities along the corridor.

### **HOW DOES THE SERVICE VISION CAPITAL PROJECT OVERLAY WORK FOR THE RCUP?**

Because it is known that the property within its boundaries may be needed for a potential capital project in the future, the Service Vision Capital Project Overlay is intended to identify areas that need to be protected to ensure that JPB property would not become permanently encumbered or used in a way that would make it difficult or impossible to deliver the potential future capital project. This overlay is applied on top of the Property Use Zones, and it establishes more restrictive land use regulations than the underlying base Property Use Zone.

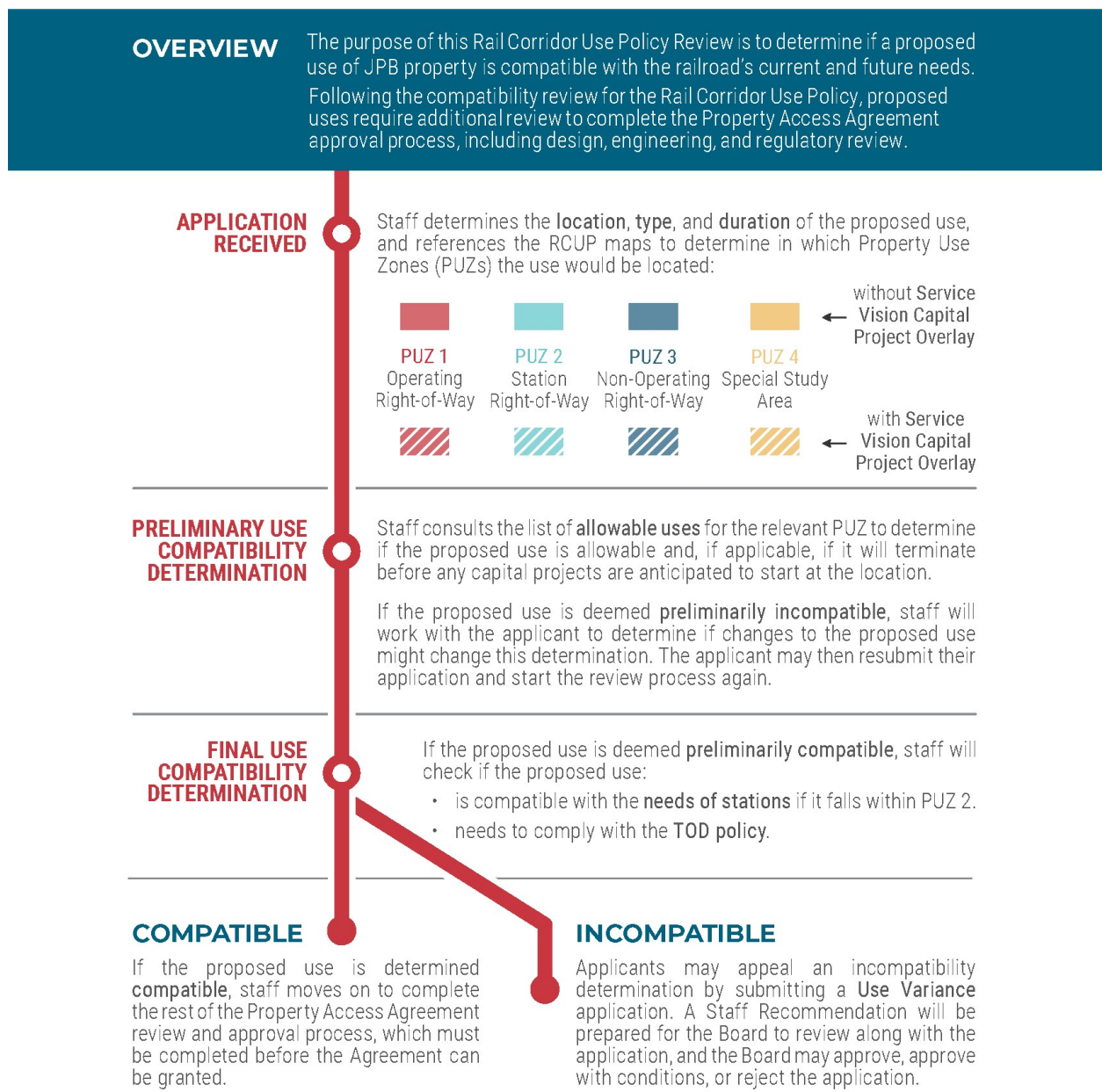
The Service Vision Capital Project Overlay could potentially have non-railroad land uses that are compatible with the safe operation of the railroad and that will be terminated before the anticipated start of the potential future capital project. The Service Vision Capital Project Overlay could also be available for a future, long-term, non-railroad use of the land that is co-designed with the potential future capital project, that is co-delivered with the potential future capital project, or that is delivered after completion of the potential future capital project.

## RAIL CORRIDOR USE POLICY DECISION-MAKING PROCESS

The section describes the JPB’s process to review a proposed use and make a decision if it is compatible with the railroad’s current and future needs. This process is summarized and illustrated in a flow chart in Figure 1, while a step-by-step overview describes the process below.

**FIGURE 1**

### DECISION-MAKING FRAMEWORK FOR PROPOSED NON-RAILROAD USES OF JPB PROPERTY



## STEP-BY-STEP OVERVIEW OF DECISION-MAKING PROCESS

1. **Application Received.** Staff receive an application for a proposed non-railroad use of JPB property.
  - a. Based on the application, staff determine:
    - i. The location of the proposed use on JPB property,
    - ii. The type of proposed use, and
    - iii. The proposed duration of the use.
  - b. Staff consult the Rail Corridor Use Policy maps to determine:
    - i. The Property Use Zone(s) where the proposed use would be located; and
    - ii. Whether or not the Service Vision Capital Project Overlay occurs where the proposed use would be located.
2. **Preliminary Use Compatibility Determination.** Staff complete a preliminary compatibility review of the proposed use with current and future railroad needs.
  - a. If the proposed use is not within the Service Vision Capital Project Overlay, staff consult the Rail Corridor Use Policy’s list of allowable non-railroad uses for each applicable Property Use Zone (Tables 1A, 2A, 3A, 4A in this document) to determine if the proposed use is listed as an allowable use.
    - i. If it is listed as an allowable use, then it is considered “preliminarily compatible” with the railroad’s current and future needs.
    - ii. If it is not listed as an allowable use, then it is considered “preliminarily incompatible” with the railroad’s current and future needs.
  - b. If the proposed use is within the Service Vision Capital Project Overlay, staff consult the Rail Corridor Use Policy’s list of allowable uses for each applicable Property Use Zone and the Service Vision Capital Project Overlay (Tables 1B, 2B, 3B, 4B in this document) to determine if the proposed use is listed as an allowable use. Staff also determine if the proposed use would terminate before the anticipated start of the potential capital project in the area.
    - i. If it is listed as an allowable use and the proposed use would terminate before the anticipated start of the potential capital project, then it is considered “preliminarily compatible” with the railroad’s current and future needs.
    - ii. If it is not listed as an allowable use or if the proposed use would not terminate before the anticipated start of the potential capital project, then it is considered “preliminarily incompatible” with the railroad’s current and future needs.
3. **Final Use Compatibility Determination.** Staff complete the steps below to make a final determination of compatibility with the railroad’s current and future needs.
  - a. **Preliminarily Compatible.** If the proposed use is determined to be “preliminarily compatible” with the railroad’s current and future needs, staff complete final compatibility review by checking if the Steps 3A – i. and ii. below would apply to the proposed use. If they do not apply, staff jump to Step 3C to make a final determination.



be resolved through the Property Access Agreement review process, or if there are any conditions or terms that would need to be included in the Property Access Agreement itself before it was granted.

- b. Based on these assessments, a Staff Recommendation on the Use Variance is developed for the Board to approve, approve with conditions, or reject the Use Variance. The Use Variance and Staff Recommendation are reviewed by the Chief Operating Officer for Rail and the General Manager before they are submitted to the Board for review, along with the Use Variance application.
- c. The Board may approve, approve with conditions, or reject a Use Variance. The Board's determination is the final decision about the compatibility of the proposed use with current and future railroad needs.
- d. If the Use Variance is approved or approved with conditions by the Board, then the proposed use is considered to be compatible with the railroad's current and future needs, and staff commence the rest of the Property Access Agreement review process.



## ALLOWABLE NON-RAILROAD USES

### OVERVIEW

Each Property Use Zone has a range of non-railroad uses that may be allowed to be located within that zone. Allowable uses will vary depending on whether or not the proposed location is within the Service Vision Capital Project Overlay. The lists of allowable uses for each Property Use Zone are meant to be broad enough to give flexibility but also clear enough to provide sufficient direction regarding the expected type, location, and relation of proposed uses of JPB property along the rail corridor.

There are three general types of non-railroad uses, which each contain a variety of different types of uses: utilities; commercial and development uses; and community uses. Allowable uses are categorized by the duration of the proposed use of JPB property: short-term uses are for non-railroad uses that would be on JPB property for less than five years, while long-term uses are for non-railroad uses that would be on JPB property for more than five years.

In general, future capital projects (including vehicular grade separation projects) for the railroad are not considered non-railroad uses and are generally exempt from the Rail Corridor Use Policy's review process to determine their compatibility with the railroad's current and future needs. Instead, the review and approval of future capital projects, including any joint development elements that are integrated with the capital projects, should generally proceed via the railroad's approval process for capital projects. This general guidance applies to most capital projects that affect the railroad corridor; however, there may be exceptions with new potential capital projects that are proposed for the Caltrain corridor, which may, at the discretion of Caltrain staff, be required to undergo the Rail Corridor Use Policy's review process to ensure compatibility with the railroad's current and future needs. One notable exception from this general guidance is new crossings for bicycles and pedestrians in a location where a crossing does not currently exist. New bicycle and/or pedestrians crossings across the rail corridor (above the tracks or under the tracks) are considered to be a non-railroad use – specifically, they are considered to be community uses for a new access facility, not capital projects for the railroad. Additionally, as a final note on potential future capital projects, no new at-grade crossings of the railroad tracks are allowed for any mode of transportation at any location along the corridor.

All proposed uses must be compliant with local land use regulations. All proposed uses are subject to the JPB's fee schedule. All leases are expected to comply with requirements for fair market value. All proposed uses are subject to further review and approval from the JPB, in accordance with the Property Conveyance Policy.

### TABLES OF ALLOWABLE USES

Tables 1A, 2A, 3A, and 4A present the allowable uses for each Property Use Zone without the Service Vision Capital Project Overlay. Tables 1B, 2B, 3B, and 4B present the allowable uses for each Property Use Zone within the Service Vision Capital Project Overlay. When applicable, the tables note when additional review may be needed to determine compatibility with the current and future needs of the railroad.

## OPERATING RIGHT-OF-WAY

 **Table 1A: Operating Right-of-Way (Property Use Zone 1) – No Service Vision Capital Project Overlay**

<i>Non-Railroad Short-term Uses (&lt; 5 Years)</i>	<i>Non-Railroad Long-term Uses (&gt; 5 Years)</i>
<b>Utilities:</b> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve as a conduit for vital public services</li> </ul>	<b>Utilities:</b> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve as a conduit for vital public services</li> </ul>
<b>Commercial and development uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Commercial and development uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>
<b>Community uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Community uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>
<b>Notes for Review Process:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Notes for Review Process:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>

 **Table 1B: Operating Right-of-Way (Property Use Zone 1) – With Service Vision Capital Project Overlay**

<i>Non-Railroad Short-term Uses (&lt; 5 Years)</i>	<i>Non-Railroad Long-term Uses (&gt; 5 Years)</i>
<b>Utilities:</b> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve as a conduit for vital public services</li> </ul>	<b>Utilities:</b> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve as a conduit for vital public services</li> </ul>
<b>Commercial uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Commercial uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>
<b>Community uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Community uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>
<b>Notes for Review Process:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Notes for Review Process:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>

## STATION RIGHT-OF-WAY

**Table 2A: Station Right-of-Way (Property Use Zone 2) – No Service Vision Capital Project Overlay**

<i>Non-Railroad Short-term Uses (&lt; 5 Years)</i>	<i>Non-Railroad Long-term Uses (&gt; 5 Years)</i>
<p><b>Utilities:</b></p> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve vital public services could be considered</li> </ul>	<p><b>Utilities:</b></p> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve vital public services could be considered</li> </ul>
<p><b>Commercial and development uses:</b></p> <ul style="list-style-type: none"> <li>- Within existing structures on JPB property:                             <ul style="list-style-type: none"> <li>o Eating and drinking establishments</li> <li>o Retail establishments</li> <li>o Offices</li> <li>o Museums</li> </ul> </li> <li>- Other uses that serve commercial purposes that are compatible with the railroad could be considered</li> </ul>	<p><b>Commercial and development uses:</b></p> <ul style="list-style-type: none"> <li>- Within existing structures on JPB property:                             <ul style="list-style-type: none"> <li>o Eating and drinking establishments</li> <li>o Retail establishments</li> <li>o Offices</li> <li>o Museums</li> </ul> </li> <li>- New, long-term buildings or structures on JPB property to be used as offices, hotels, residences, retail space, etc.</li> <li>- Other uses that serve commercial purposes that are compatible with the railroad could be considered, including the use of air rights.</li> </ul>
<p><b>Community uses:</b></p> <ul style="list-style-type: none"> <li>- Access facilities, such as walking or bicycling paths</li> <li>- Recreational facilities, such as a park or community garden</li> <li>- Community event, such as a farmers market</li> <li>- Other uses that serve public purposes and are compatible with the railroad could be considered</li> </ul>	<p><b>Community uses:</b></p> <ul style="list-style-type: none"> <li>- Access facilities, such as walking or bicycling paths</li> <li>- Recreational facilities, such as a park or community garden</li> <li>- Community event, such as a farmers market</li> <li>- Other uses that serve public purposes and are compatible with the railroad could be considered</li> </ul>
<p><b>Notes for Review Process:</b></p> <ul style="list-style-type: none"> <li>- Station Compatibility: The proposed use’s compatibility with the needs and functioning of the train station must be confirmed through the RCUP review process.</li> </ul>	<p><b>Notes for Review Process:</b></p> <ul style="list-style-type: none"> <li>- Station Compatibility: The proposed use’s compatibility with the needs and functioning of the train station must be confirmed through the RCUP review process.</li> <li>- TOD Policy must be consulted for any proposed use that is more than 50 years in duration or for any proposed use that is on a site that could be contemplated for joint development.</li> </ul>

**Table 2B: Station Right-of-Way (Property Use Zone 2) – With Service Vision Capital Project Overlay**

<i>Non-Railroad Short-term Uses (&lt; 5 Years)</i>	<i>Non-Railroad Long-term Uses (&gt; 5 Years)</i>
<p><b>Utilities:</b></p> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve vital public services could be considered</li> </ul>	<p><b>Utilities:</b></p> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve vital public services could be considered</li> </ul>
<p><b>Commercial and development uses:</b></p> <ul style="list-style-type: none"> <li>- Within existing structures on JPB property:                             <ul style="list-style-type: none"> <li>o Eating and drinking establishments</li> <li>o Retail establishments</li> <li>o Offices</li> <li>o Museums</li> </ul> </li> <li>- Other uses that serve commercial purposes that are compatible with the railroad could be considered</li> </ul>	<p><b>Commercial and development uses:</b></p> <ul style="list-style-type: none"> <li>- Within existing structures on JPB property:                             <ul style="list-style-type: none"> <li>o Eating and drinking establishments</li> <li>o Retail establishments</li> <li>o Offices</li> <li>o Museums</li> </ul> </li> <li>- New, long-term buildings or structures that are designed and/or delivered in conjunction with the potential future capital project on JPB property (offices, hotels, residences, retail space, etc.), or that will be constructed after delivery of the potential future capital project.</li> <li>- Other uses that serve commercial purposes that are compatible with the railroad could be considered, including the use of air rights.</li> </ul>
<p><b>Community uses:</b></p> <ul style="list-style-type: none"> <li>- Community event, such as a farmers market</li> </ul>	<p><b>Community uses:</b></p> <ul style="list-style-type: none"> <li>- None</li> </ul>
<p><b>Notes for Review Process:</b></p> <ul style="list-style-type: none"> <li>- Station Compatibility: The proposed use’s compatibility with the needs and functioning of the train station must be confirmed through the RCUP review process.</li> <li>- Staff must determine that the proposed non-railroad use has a duration that concludes before the anticipated start of delivery of the potential capital project.</li> </ul>	<p><b>Notes for Review Process:</b></p> <ul style="list-style-type: none"> <li>- Station Compatibility: The proposed use’s compatibility with the needs and functioning of the train station must be confirmed through the RCUP review process.</li> <li>- Staff must determine that that the proposed non-railroad use has a duration that concludes before the anticipated start of delivery of the potential capital project.</li> <li>- TOD Policy must be consulted for any proposed use that is more than 50 years in duration or for any proposed use that is on a site that could be contemplated for joint development.</li> </ul>

## NON-OPERATING RIGHT-OF-WAY

**Table 3A: Non-Operating Right-of-Way (Property Use Zone 3) – No Service Vision Capital Project Overlay**

<i>Non-Railroad Short-term Uses (&lt; 5 Years)</i>	<i>Non-Railroad Long-term Uses (&gt; 5 Years)</i>
<p><b>Utilities:</b></p> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve vital public services could be considered</li> </ul>	<p><b>Utilities:</b></p> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve vital public services could be considered</li> </ul>
<p><b>Commercial and development uses:</b></p> <ul style="list-style-type: none"> <li>- Within existing structures on JPB property:                             <ul style="list-style-type: none"> <li>o Eating and drinking establishments</li> <li>o Retail establishments</li> <li>o Offices</li> <li>o Museums</li> </ul> </li> <li>- Vehicle sales, rentals, and service establishments</li> <li>- Staging ground for nearby non-railroad construction projects</li> <li>- Other uses that serve commercial purposes that are compatible with the railroad could be considered</li> </ul>	<p><b>Commercial and development uses:</b></p> <ul style="list-style-type: none"> <li>- Within existing structures on JPB property:                             <ul style="list-style-type: none"> <li>o Eating and drinking establishments</li> <li>o Retail establishments</li> <li>o Offices</li> <li>o Museums</li> </ul> </li> <li>- Vehicle sales, rentals, and service establishments</li> <li>- New, long-term buildings or structures on JPB property to be used as offices, hotels, residences, retail space, etc.</li> <li>- Other uses that serve commercial purposes that are compatible with the railroad could be considered, including the use of air rights.</li> </ul>
<p><b>Community uses:</b></p> <ul style="list-style-type: none"> <li>- Access facilities, such as walking or bicycling paths</li> <li>- Recreational facilities, such as a park or community garden</li> <li>- Community event, such as a farmers market</li> <li>- Other uses that serve public purposes and are compatible with the railroad could be considered</li> </ul>	<p><b>Community uses:</b></p> <ul style="list-style-type: none"> <li>- Access facilities, such as walking or bicycling paths</li> <li>- Recreational facilities, such as a park or community garden</li> <li>- Community event, such as a farmers market</li> <li>- Other uses that serve public purposes and are compatible with the railroad could be considered</li> </ul>
<p><b>Notes on Review Process:</b></p> <ul style="list-style-type: none"> <li>- None</li> </ul>	<p><b>Notes on Review Process:</b></p> <ul style="list-style-type: none"> <li>- TOD Policy must be consulted for any proposed use that is more than 50 years in duration or for any proposed use that is on a site that could be contemplated for joint development.</li> </ul>

**Table 3B: Non-Operating Right-of-Way (Property Use Zone 3) – With Service Vision Capital Project Overlay**

<i>Non-Railroad Short-term Uses (&lt; 5 Years)</i>	<i>Non-Railroad Long-term Uses (&gt; 5 Years)</i>
<p><b>Utilities:</b></p> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve vital public services could be considered</li> </ul>	<p><b>Utilities:</b></p> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve vital public services could be considered</li> </ul>
<p><b>Commercial and development uses:</b></p> <ul style="list-style-type: none"> <li>- Within existing structures on JPB property:                             <ul style="list-style-type: none"> <li>o Eating and drinking establishments</li> <li>o Retail establishments</li> <li>o Offices</li> <li>o Museums</li> </ul> </li> <li>- Vehicle sales, rentals, and service establishments</li> <li>- Staging ground for nearby non-railroad construction projects</li> <li>- Other uses that serve commercial purposes that are compatible with the railroad could be considered</li> </ul>	<p><b>Commercial and development uses:</b></p> <ul style="list-style-type: none"> <li>- Within existing structures on JPB property:                             <ul style="list-style-type: none"> <li>o Eating and drinking establishments</li> <li>o Retail establishments</li> <li>o Offices</li> <li>o Museums</li> </ul> </li> <li>- Vehicle sales, rentals, and service establishments</li> <li>- New, long-term buildings or structures that are designed and/or delivered in conjunction with the potential future capital project on JPB property (offices, hotels, residences, retail space, etc.), or that will be constructed after delivery of the potential future capital project.</li> <li>- Other uses that serve commercial purposes that are compatible with the railroad could be considered, including the use of air rights.</li> </ul>
<p><b>Community uses:</b></p> <ul style="list-style-type: none"> <li>- Community event, such as a farmers market</li> </ul>	<p><b>Community uses:</b></p> <ul style="list-style-type: none"> <li>- None</li> </ul>
<p><b>Notes for Review Process:</b></p> <ul style="list-style-type: none"> <li>- Staff must determine that the proposed non-railroad use has a duration that concludes before the anticipated start of delivery of the potential capital project.</li> </ul>	<p><b>Notes for Review Process:</b></p> <ul style="list-style-type: none"> <li>- Staff must determine that the proposed non-railroad use has a duration that concludes before the anticipated start of delivery of the potential capital project.</li> <li>- TOD Policy must be consulted for any proposed use that is more than 50 years in duration or for any proposed use that is on a site that could be contemplated for joint development.</li> </ul>

## SPECIAL STUDY AREA

**Table 4A: Special Study Area (Property Use Zone 4) – No Service Vision Capital Project Overlay**

<i>Non-Railroad Short-term Uses (&lt; 5 Years)</i>	<i>Non-Railroad Long-term Uses (&gt; 5 Years)</i>
<b>Utilities:</b> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve as a conduit for vital public services</li> </ul>	<b>Utilities:</b> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve as a conduit for vital public services</li> </ul>
<b>Commercial uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Commercial uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>
<b>Community and development uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Community and development uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>
<b>Notes for Review Process:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Notes for Review Process:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>

**Table 4B: Special Study Area (Property Use Zone 4) – With Service Vision Capital Project Overlay**

<i>Non-Railroad Short-term Uses (&lt; 5 Years)</i>	<i>Non-Railroad Long-term Uses (&gt; 5 Years)</i>
<b>Utilities:</b> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve as a conduit for vital public services</li> </ul>	<b>Utilities:</b> <ul style="list-style-type: none"> <li>- Facilities and infrastructure that support electricity, gas, water, sewer, telecommunications, etc.</li> <li>- Other uses that serve as a conduit for vital public services</li> </ul>
<b>Commercial uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Commercial uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>
<b>Community and development uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Community and development uses:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>
<b>Notes for Review Process:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>	<b>Notes for Review Process:</b> <ul style="list-style-type: none"> <li>- None</li> </ul>

## **POLICIES AND PROCEDURES FOR UPDATING THE RCUP**

The Rail Corridor Use Policy is intended to be updated as conditions change on the Caltrain corridor. Changes may be made by staff to ensure that the Rail Corridor Use Policy is kept up-to-date, and staff should regularly report any changes that have been made to the Board. The following list provides examples of circumstances under which the RCUP may be updated; however, this is not an exhaustive list and staff may make other changes as needed, so long as changes are reported to the Board.

### **MAP CHANGES:**

- The Property Use Zones should be updated as construction projects are completed. These updates should be completed to ensure that all property and facilities needed for the safe operation of the railroad are included in Property Use Zone 1 (Operating Right-of-Way).
- The Property Use Zones should be updated as conditions change on the corridor. For example, if there are any station closures in the future, that property should be converted from Property Use Zone 2 (Station Right-of-Way) to Property Use Zone 3 (Non-Operating Right-of-Way). As another example, if Caltrain enters into a formal, complex, multi-stakeholder planning process for one of its stations, that property may be changed to Property Use Zone 4 (Special Study Area).
- The Service Vision Capital Project Overlay should be updated as construction projects are completed. These updates should include removing the Overlay from areas where the construction project has been completed.
- The Service Vision Capital Project Overlay may have its component projects updated, including details about the projects and the projects' footprints, as partner agencies and cities take action on proposed alignments and alternatives, or as the projects reach the final phase of design.
- The Service Vision Capital Project Overlay should be updated to include all potential future capital projects that may be needed to deliver Caltrain's Long-Term Service Vision, including any new, yet-to-be-conceived capital projects.
- The Service Vision Capital Project Overlay should be updated if it is determined conclusively that a potential future capital project is not needed to deliver the Long-Term Service Vision and will not occur on the Caltrain corridor in the future.
- The maps should be updated to be consistent with the JPB's property holdings, including property which the agency owns in fee simple and property on which the agency has a perpetual operating easement. As the JPB's property holdings change over time, the RCUP maps should be updated to include all current JPB property holdings with assigned Property Use Zones. For example, if the JPB purchases additional property to support a capital project, the RCUP maps should be updated to include that new property holding, and Property Use Zones should be appropriately assigned when adding the new property holding to the RCUP maps.

### **DECISION-MAKING FRAMEWORK**

- While it is not anticipated that there will be substantial or significant changes to the RCUP's decision-making framework in the near future, any substantial or significant change that does arise will be reported to the Board. An example of this could be a substantial change to the types of uses that are allowed in a Property Use Zone.



## CALTRAIN RAIL CORRIDOR USE POLICY DRAFT MAP SERIES FOR THE CALTRAIN CORRIDOR

The following section of the Rail Corridor Use Policy contains a map series of the JPB's property and operating easements along the Caltrain corridor, beginning with a summary overview of the map contents and a quick reference guide to the Property Use Zones and Service Vision Capital Project Overlay.

### OVERVIEW:

- The RCUP is being developed to provide a Board-adopted policy framework around the use of Peninsula Corridor Joint Powers Board (JPB) property to support the achievement of the vision in the Caltrain Business Plan.
- The RCUP will include an administrative policy framework and a series of maps to facilitate decision-making regarding use of space on the JPB's limited property along the rail corridor. This PDF presents the maps for the RCUP project.

### PROJECT OBJECTIVES:

- Provide a Board-adopted policy framework that supports the delivery of Caltrain's long-term service vision while also clarifying nearer-term opportunities for the use of JPB property.
- Develop a process for considering and approving the range of proposed uses and projects on JPB property.
- Provide transparency and clarity on the decision-making process and outcomes.

### PROPERTY USE ZONES

#### Property Use Zone 1 – Operating Right-of-Way

- Property Use Zone 1 is the Operating Right-of-Way (ROW) land use district, and it includes property that is required for the safe operation of the railroad in its current configuration and for the Peninsula Corridor Electrification Project (PCEP).
- Land in Property Use Zone 1 is intended to serve railroad operations and is generally not available for non-railroad uses, except compatible utility uses.

#### Property Use Zone 2 – Station Right-of-Way

- Property Use Zone 2 is the Station Right-of-Way land use district, and it includes property that is located at and near Caltrain's stations.
- Property in the Station Right-of-Way includes facilities that support the functioning of the railroad station, including station buildings, access facilities (such as sidewalks, driveways, loading and unloading areas, car parking facilities, bike parking facilities, etc.), passenger waiting areas, etc.
- Property Use Zone 2 could potentially have non-railroad land uses that are compatible with the functioning of the station and the safe operation of the railroad.

#### Property Use Zone 3 – Non-Operating Right-of-Way

- Property Use Zone 3 is the Non-Operating Right-of-Way land use district, and it includes all JPB property that is not already included in Property Use Zones 1, 2, and 4.
- Property in Property Use Zone 3 could potentially have non-railroad land uses that are compatible with the safe operation of the railroad, including development projects, commercial leases, community uses, etc.

#### Property Use Zone 4 – Special Study Area

- Property Use Zone 4 is the Special Study Area land use district, and it includes JPB property that is currently involved in a defined planning process that formally involves multiple stakeholders.
- Examples include areas of the corridor associated with the railroad terminal studies at San Francisco and San Jose.
- Land in Property Use Zone 4 is generally not available for non-railroad uses, except compatible utility uses, and future use of the property will generally be determined through the defined planning process in each area.

### SERVICE VISION CAPITAL PROJECT OVERLAY

#### Service Vision Capital Project Overlay

- The Service Vision Capital Project Overlay serves as an overlay district that is applied on top of the Property Use Zones to JPB property along the Caltrain corridor.
- This overlay conceptually represents areas of JPB property along the Caltrain corridor that may be needed for potential future capital projects.
- Because it is known that the property within its boundaries may be needed for a potential capital project in the future, the Service Vision Capital Project Overlay is intended to ensure that JPB property would not become permanently encumbered or used in a way that would make it difficult or impossible to deliver the potential future capital project.
- The Service Vision Capital Project Overlay could potentially have non-railroad land uses that are compatible with the safe operation of the railroad and that will be terminated before the anticipated start of the potential future capital project.
- The Service Vision Capital Project Overlay could also be potentially available for a future, long-term, non-railroad use of the land that is co-designed with the potential future capital project, that is co-delivered with the potential future capital project, or that is delivered after completion of the potential future capital project.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 1 OF 34



Legend

Property Use Zones

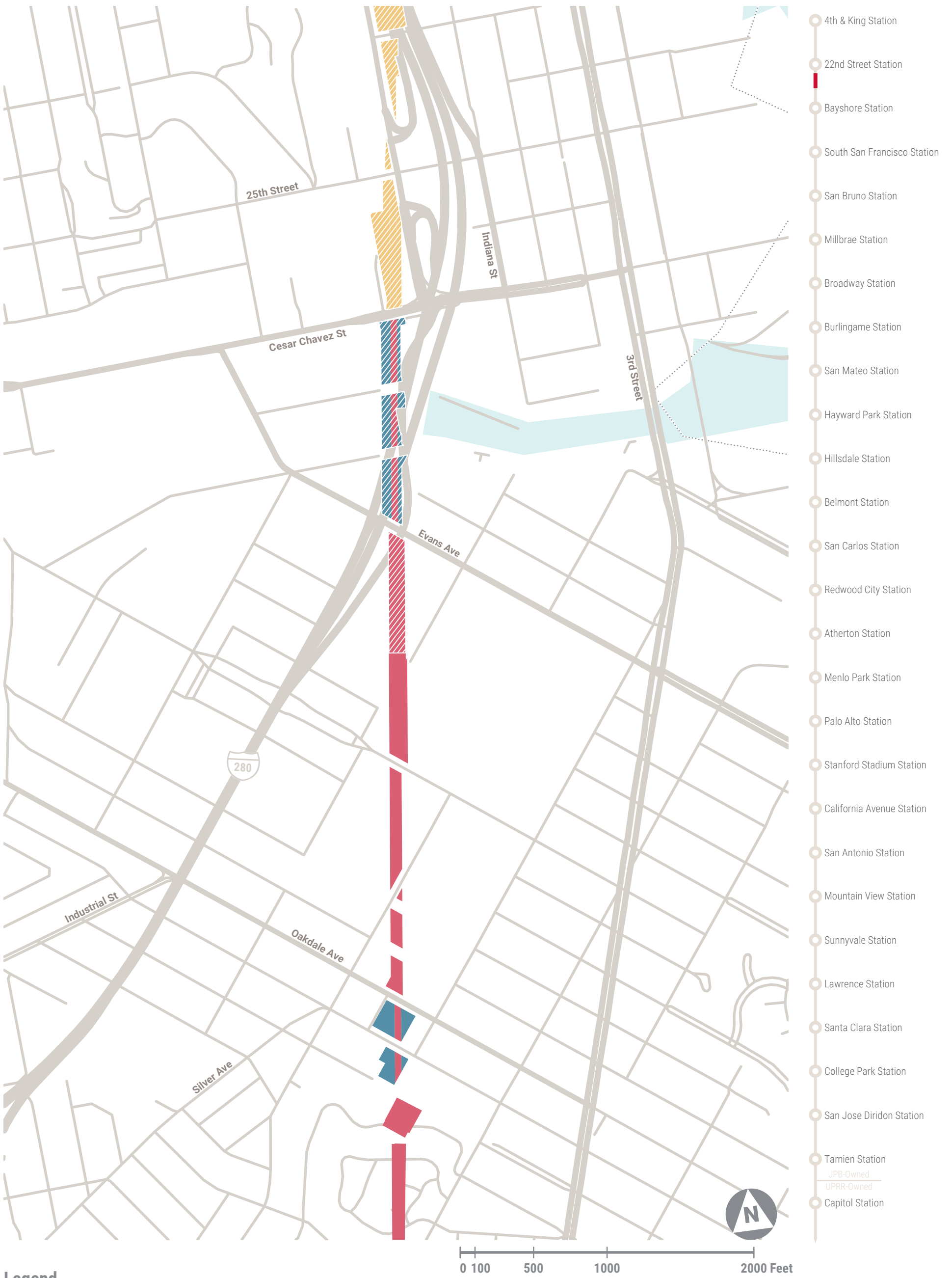
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 2 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 3 OF 34



Legend

Property Use Zones

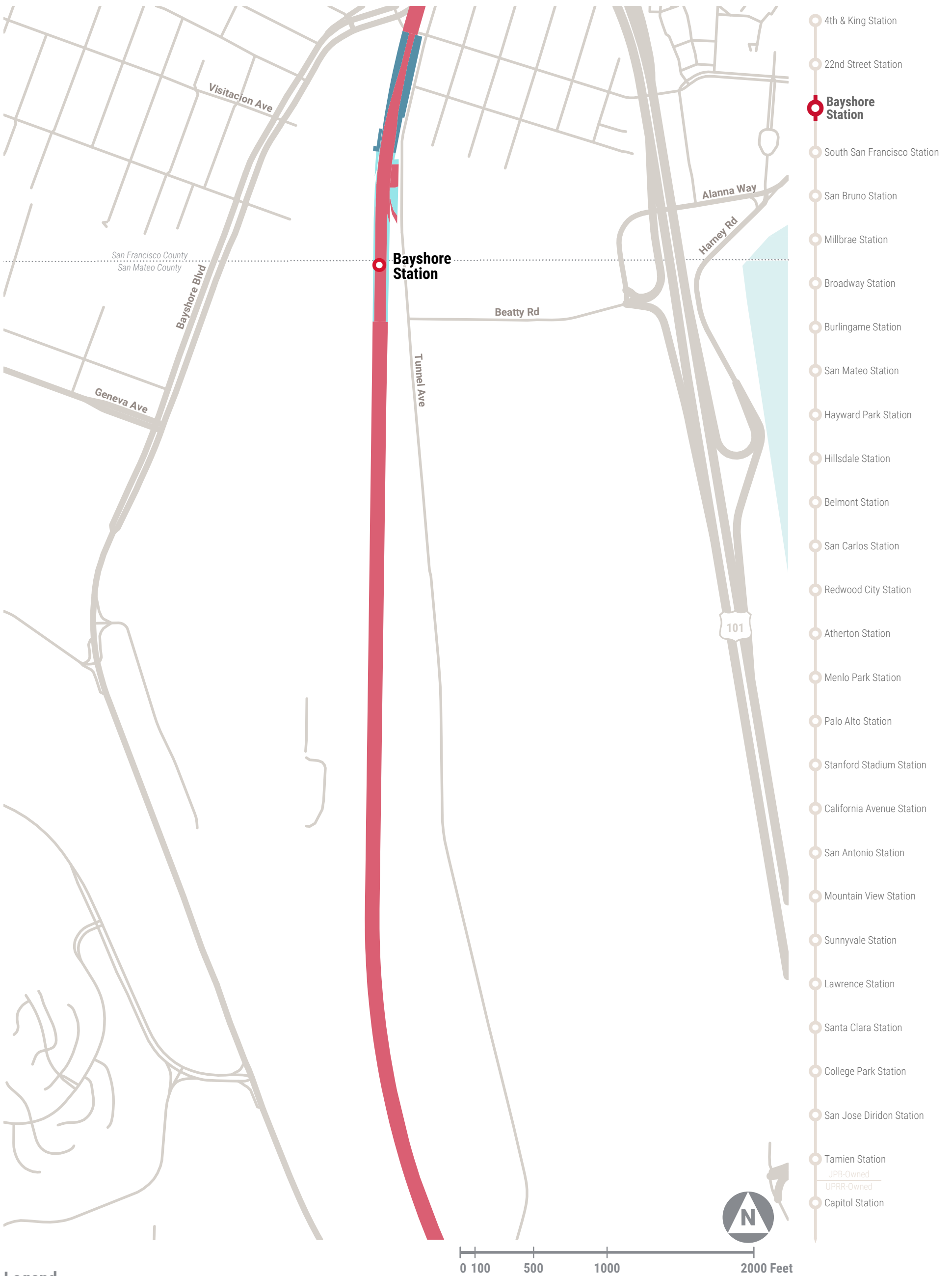
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 4 OF 34



- 4th & King Station
- 22nd Street Station
- Bayshore Station
- South San Francisco Station
- San Bruno Station
- Millbrae Station
- Broadway Station
- Burlingame Station
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
- Belmont Station
- San Carlos Station
- Redwood City Station
- Atherton Station
- Menlo Park Station
- Palo Alto Station
- Stanford Stadium Station
- California Avenue Station
- San Antonio Station
- Mountain View Station
- Sunnyvale Station
- Lawrence Station
- Santa Clara Station
- College Park Station
- San Jose Diridon Station
- Tamien Station
- JPB-Owned
- UPRR-Owned
- Capitol Station

Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

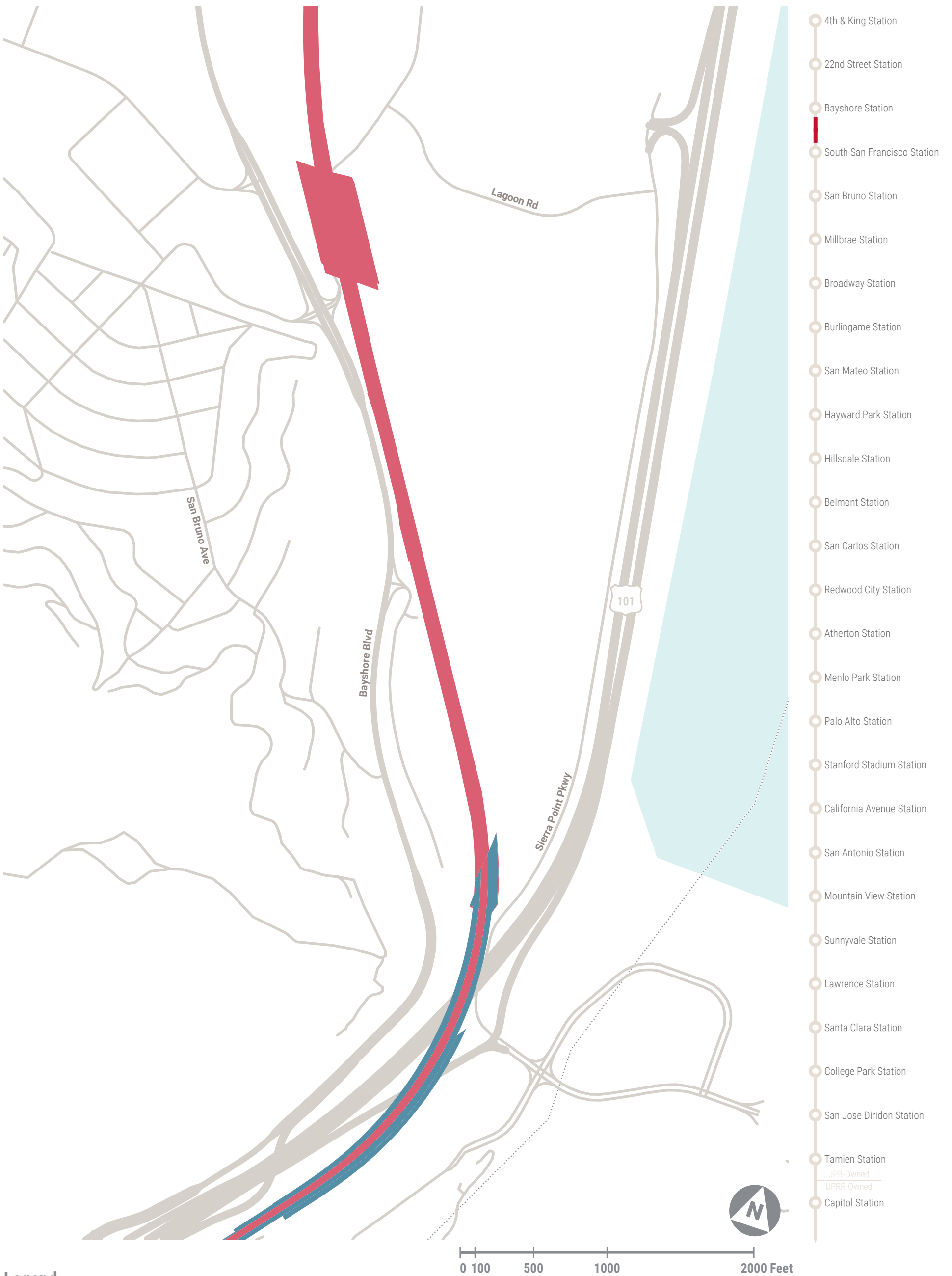
Service Vision Capital Project Overlay

- ▨ Service Vision Capital Project Overlay

0 100 500 1000 2000 Feet

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 5 OF 34



- 4th & King Station
- 22nd Street Station
- Bayshore Station
- South San Francisco Station
- San Bruno Station
- Millbrae Station
- Broadway Station
- Burlingame Station
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
- Belmont Station
- San Carlos Station
- Redwood City Station
- Atherton Station
- Menlo Park Station
- Palo Alto Station
- Stanford Stadium Station
- California Avenue Station
- San Antonio Station
- Mountain View Station
- Sunnyvale Station
- Lawrence Station
- Santa Clara Station
- College Park Station
- San Jose Diridon Station
- Tamien Station
- Capitol Station

**Legend**

**Property Use Zones**

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

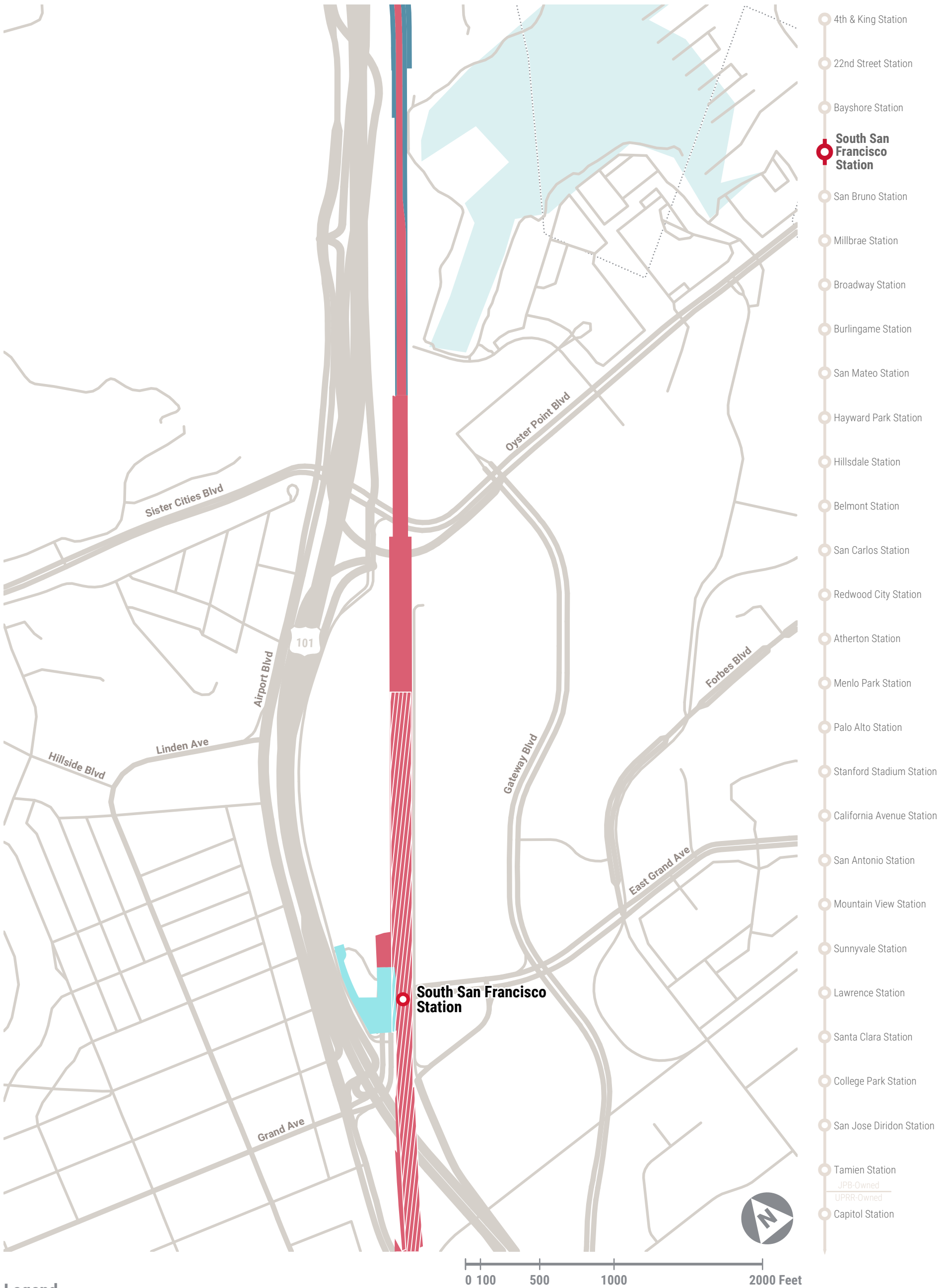
**Service Vision Capital Project Overlay**

- ▨ Service Vision Capital Project Overlay

0 100 500 1000 2000 Feet

**Note:** Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 6 OF 34



- 4th & King Station
- 22nd Street Station
- Bayshore Station
- **South San Francisco Station**
- San Bruno Station
- Millbrae Station
- Broadway Station
- Burlingame Station
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
- Belmont Station
- San Carlos Station
- Redwood City Station
- Atherton Station
- Menlo Park Station
- Palo Alto Station
- Stanford Stadium Station
- California Avenue Station
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- Mountain View Station
- Sunnyvale Station
- Lawrence Station
- Santa Clara Station
- College Park Station
- San Jose Diridon Station
- Tamien Station
- JPB-Owned
- UPRR-Owned
- Capitol Station

**Legend**

**Property Use Zones**

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

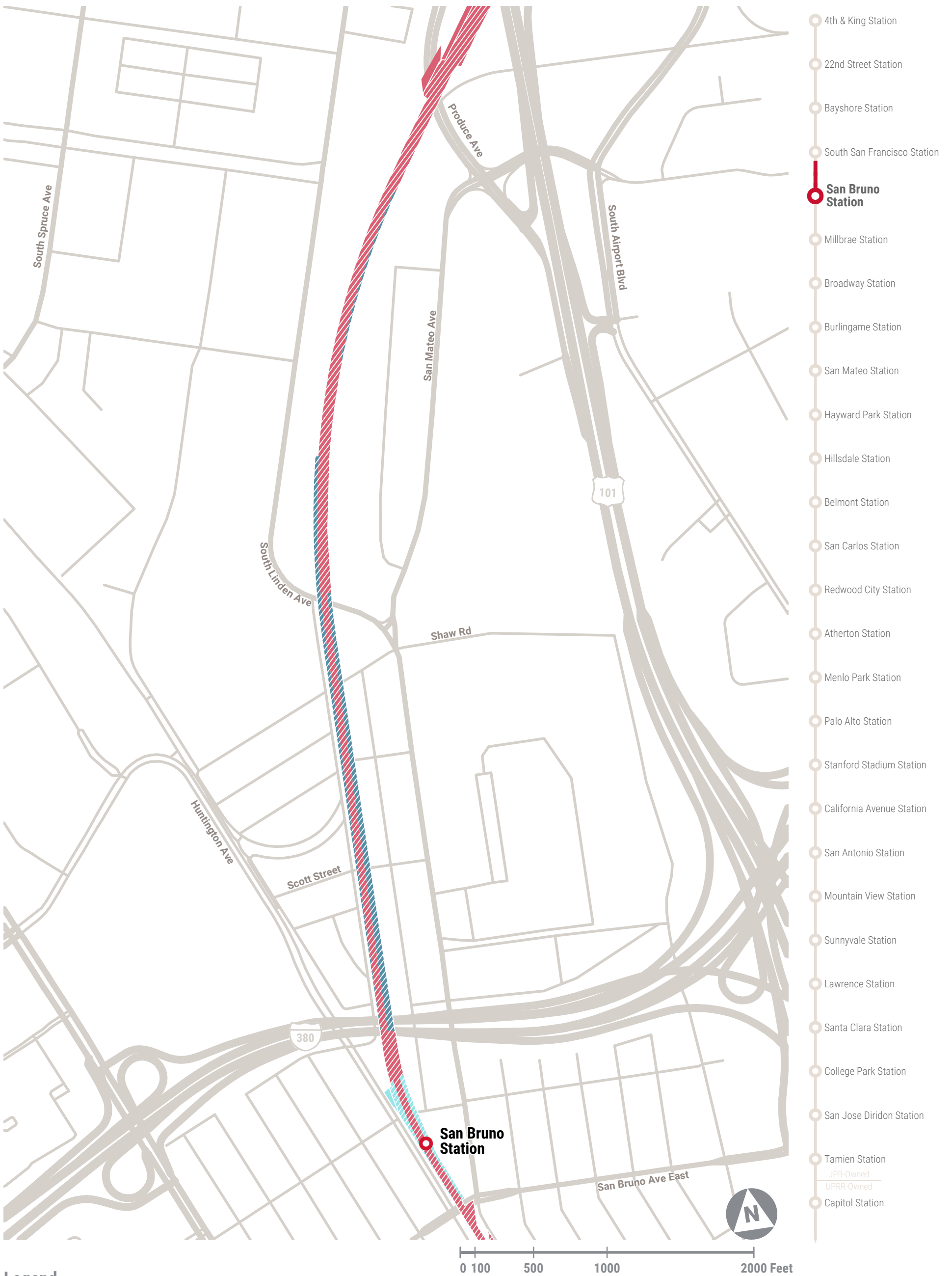
**Service Vision Capital Project Overlay**

- ▨ Service Vision Capital Project Overlay

**Note:** Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.



CALTRAIN RAIL CORRIDOR USE POLICY: MAP 7 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 8 OF 34



- 4th & King Station
- 22nd Street Station
- Bayshore Station
- South San Francisco Station
- San Bruno Station
- Millbrae Station
- Broadway Station
- Burlingame Station
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
- Belmont Station
- San Carlos Station
- Redwood City Station
- Atherton Station
- Menlo Park Station
- Palo Alto Station
- Stanford Stadium Station
- California Avenue Station
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- Mountain View Station
- Sunnyvale Station
- Lawrence Station
- Santa Clara Station
- College Park Station
- San Jose Diridon Station
- Tamien Station
- JPB-Owned
- UPRR-Owned
- Capitol Station

Legend

Property Use Zones

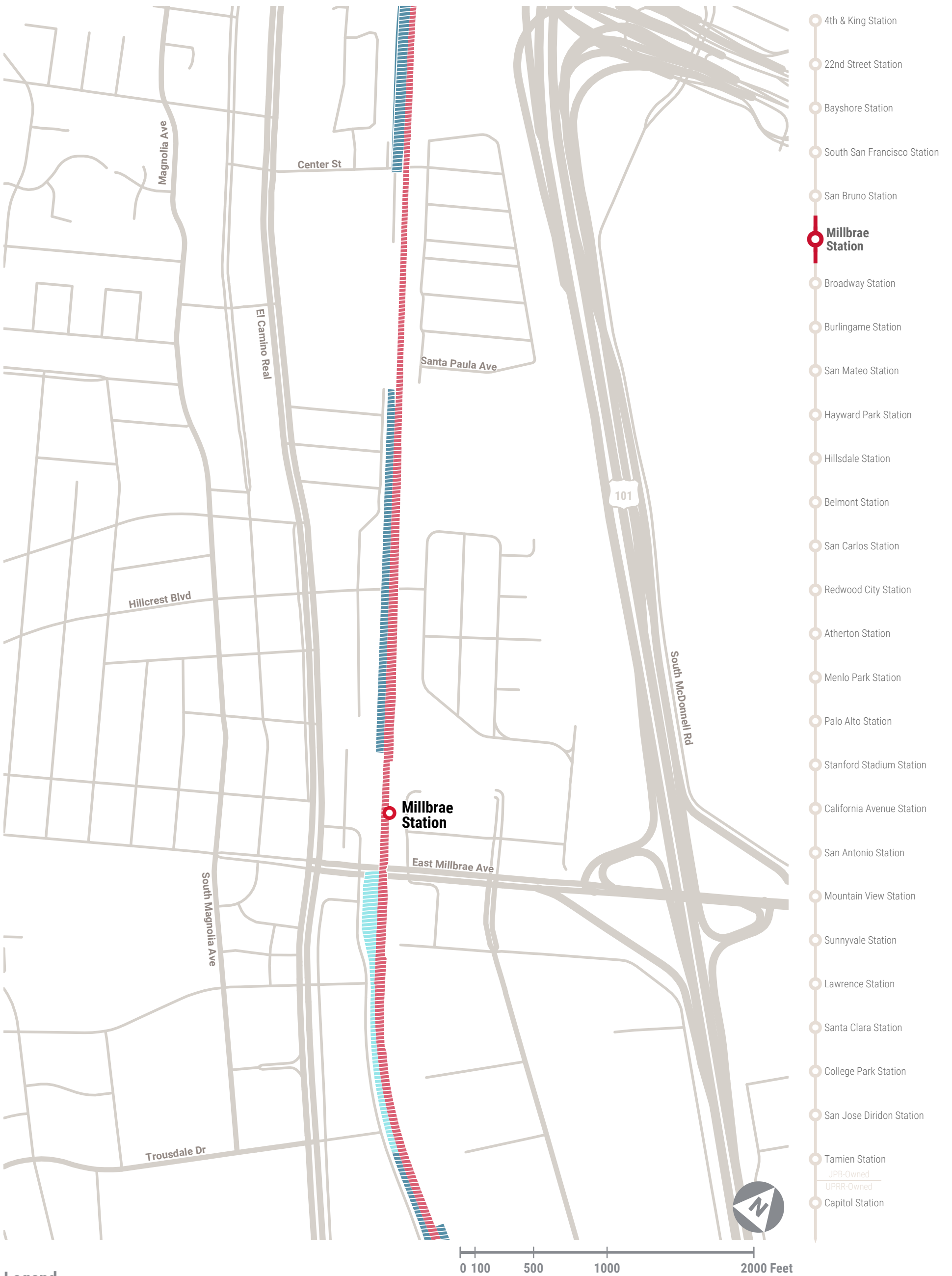
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- ▨ Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 9 OF 34



Legend

Property Use Zones

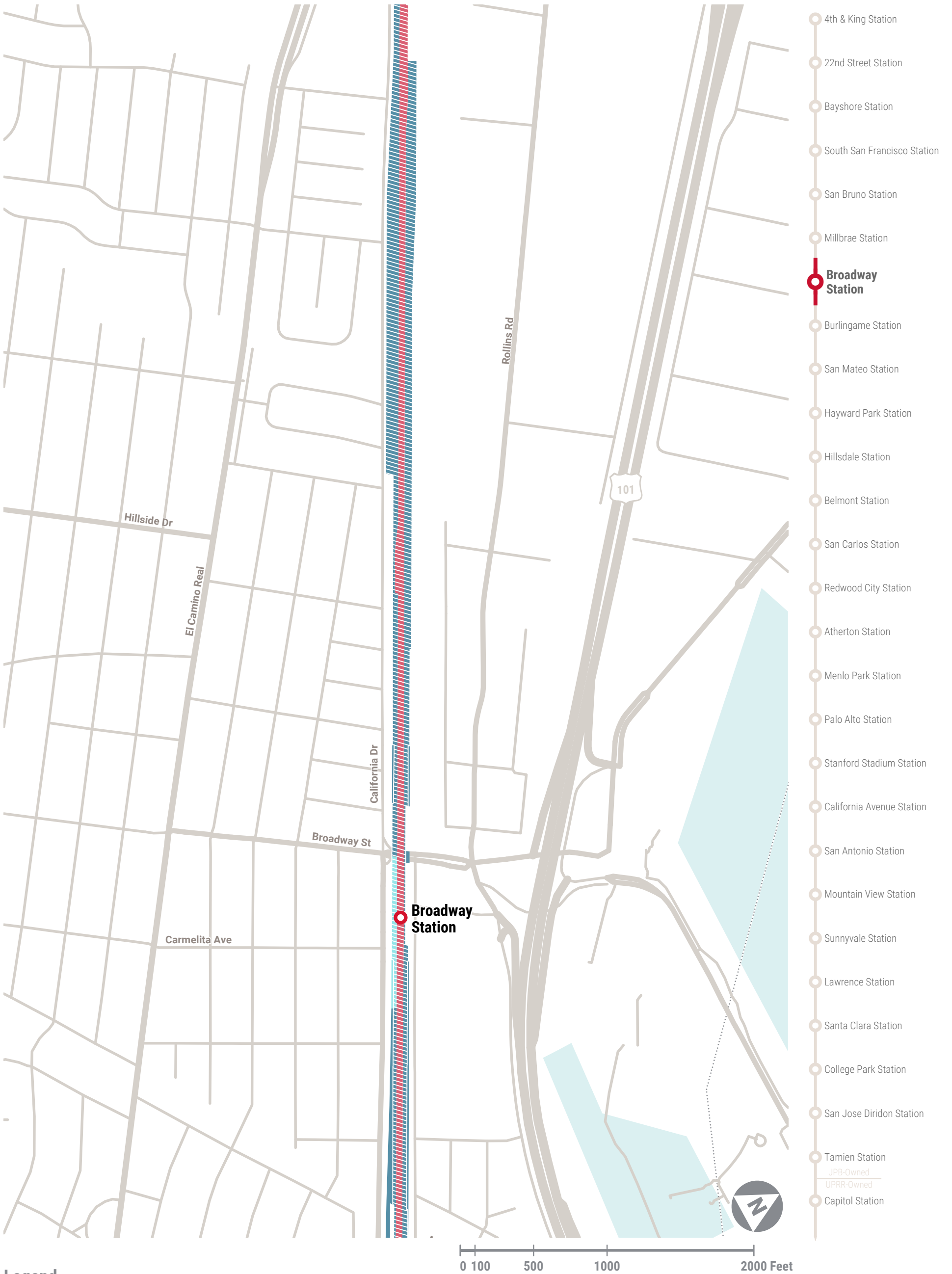
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 10 OF 34



Legend

Property Use Zones

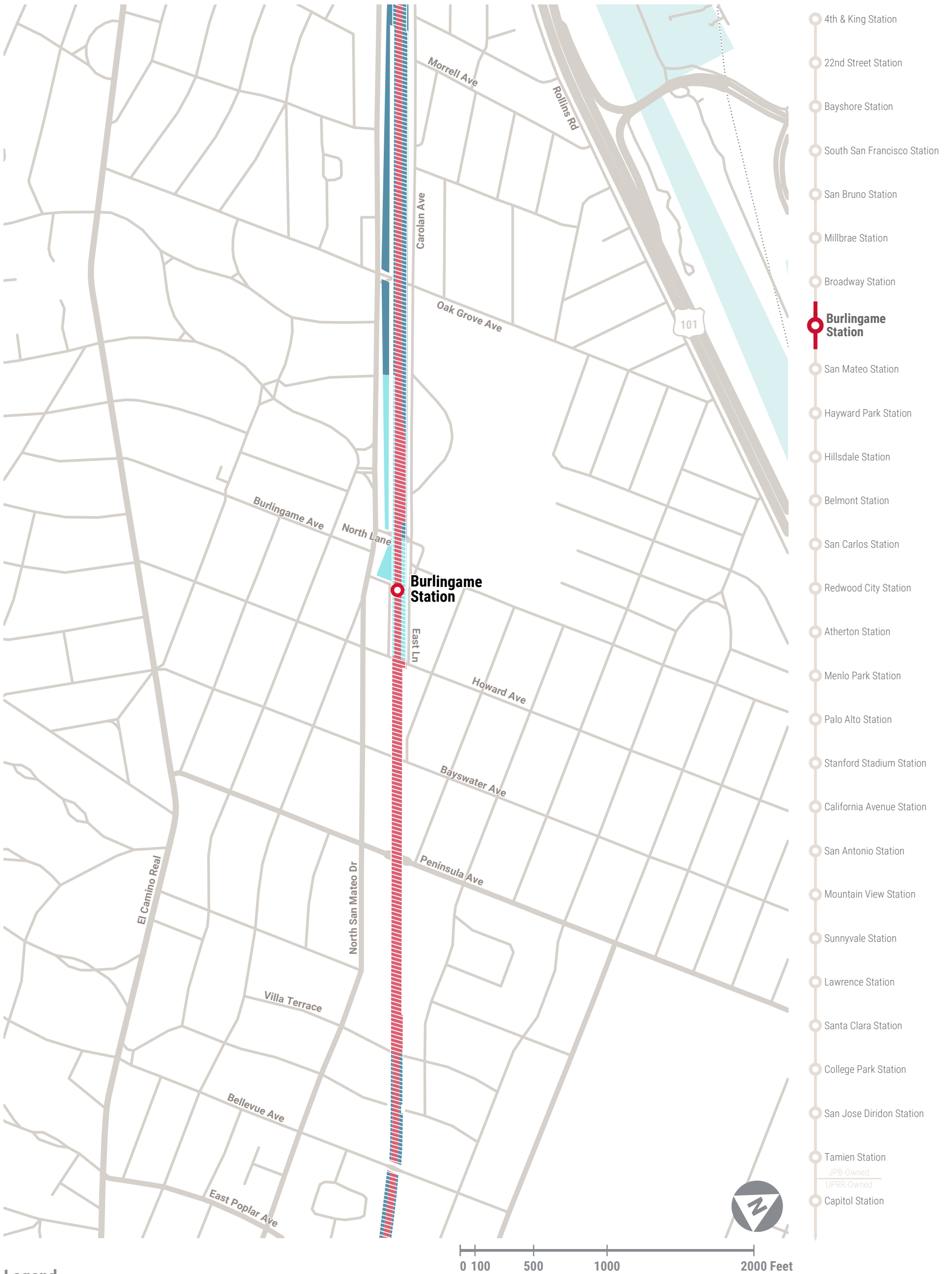
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 11 OF 34



- 4th & King Station
- 22nd Street Station
- Bayshore Station
- South San Francisco Station
- San Bruno Station
- Millbrae Station
- Broadway Station
- **Burlingame Station**
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
- Belmont Station
- San Carlos Station
- Redwood City Station
- Atherton Station
- Menlo Park Station
- Palo Alto Station
- Stanford Stadium Station
- California Avenue Station
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- Mountain View Station
- Sunnyvale Station
- Lawrence Station
- Santa Clara Station
- College Park Station
- San Jose Diridon Station
- Tamien Station
- JPB-Owned
- UPRR-Owned
- Capitol Station

**Legend**

**Property Use Zones**

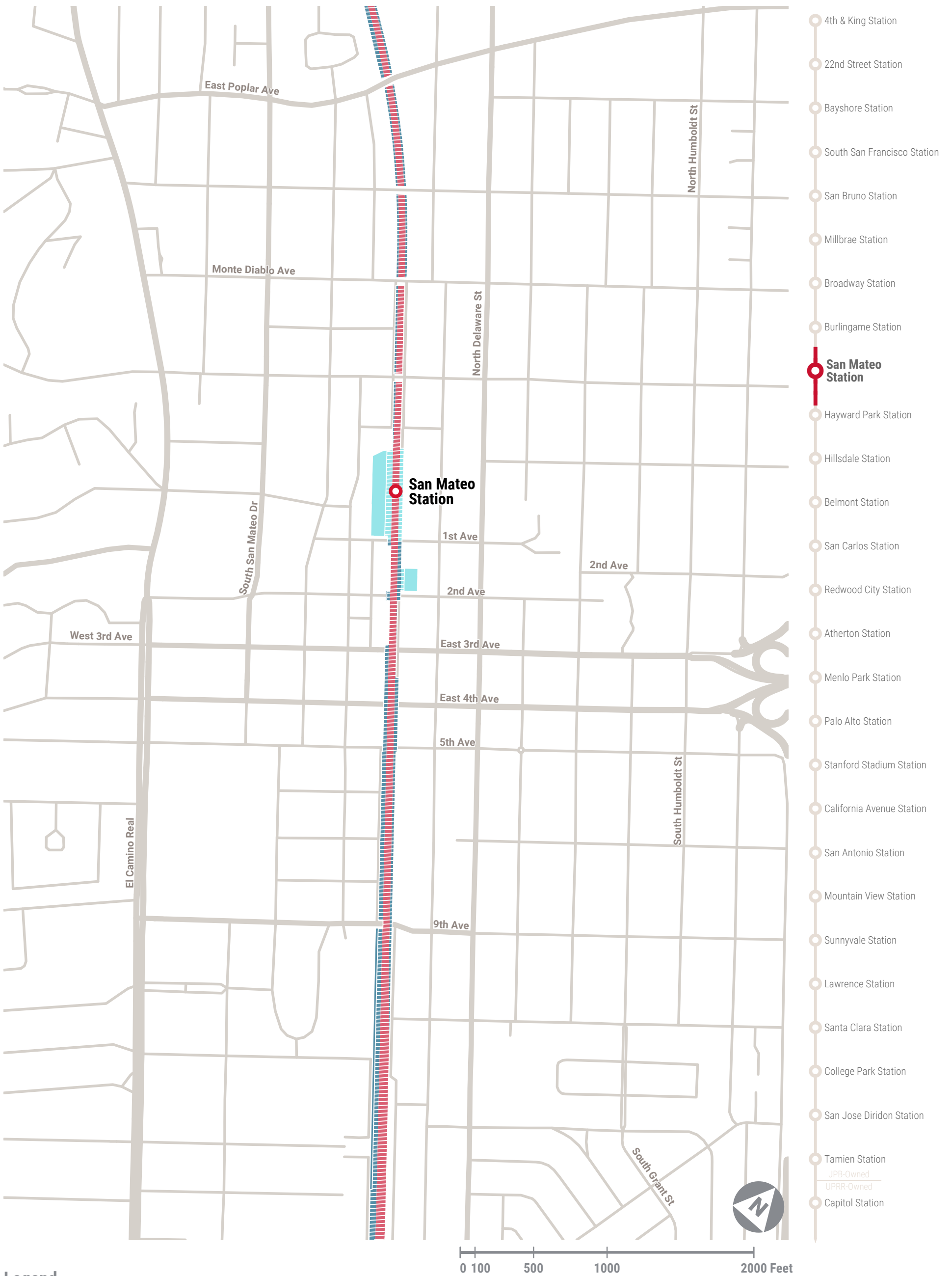
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

**Service Vision Capital Project Overlay**

- ▨ Service Vision Capital Project Overlay

**Note:** Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 12 OF 34



Legend

Property Use Zones

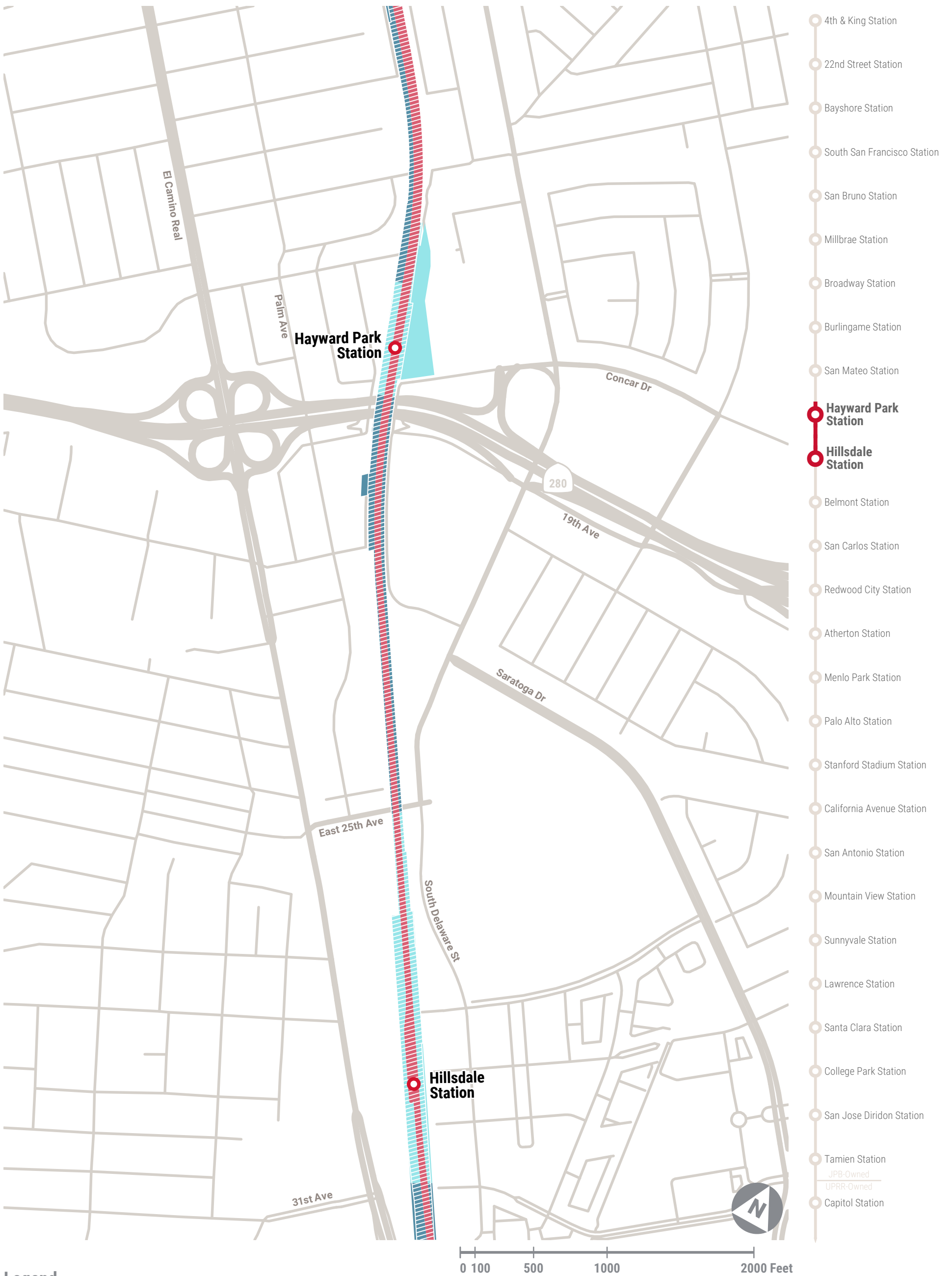
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 13 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 14 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

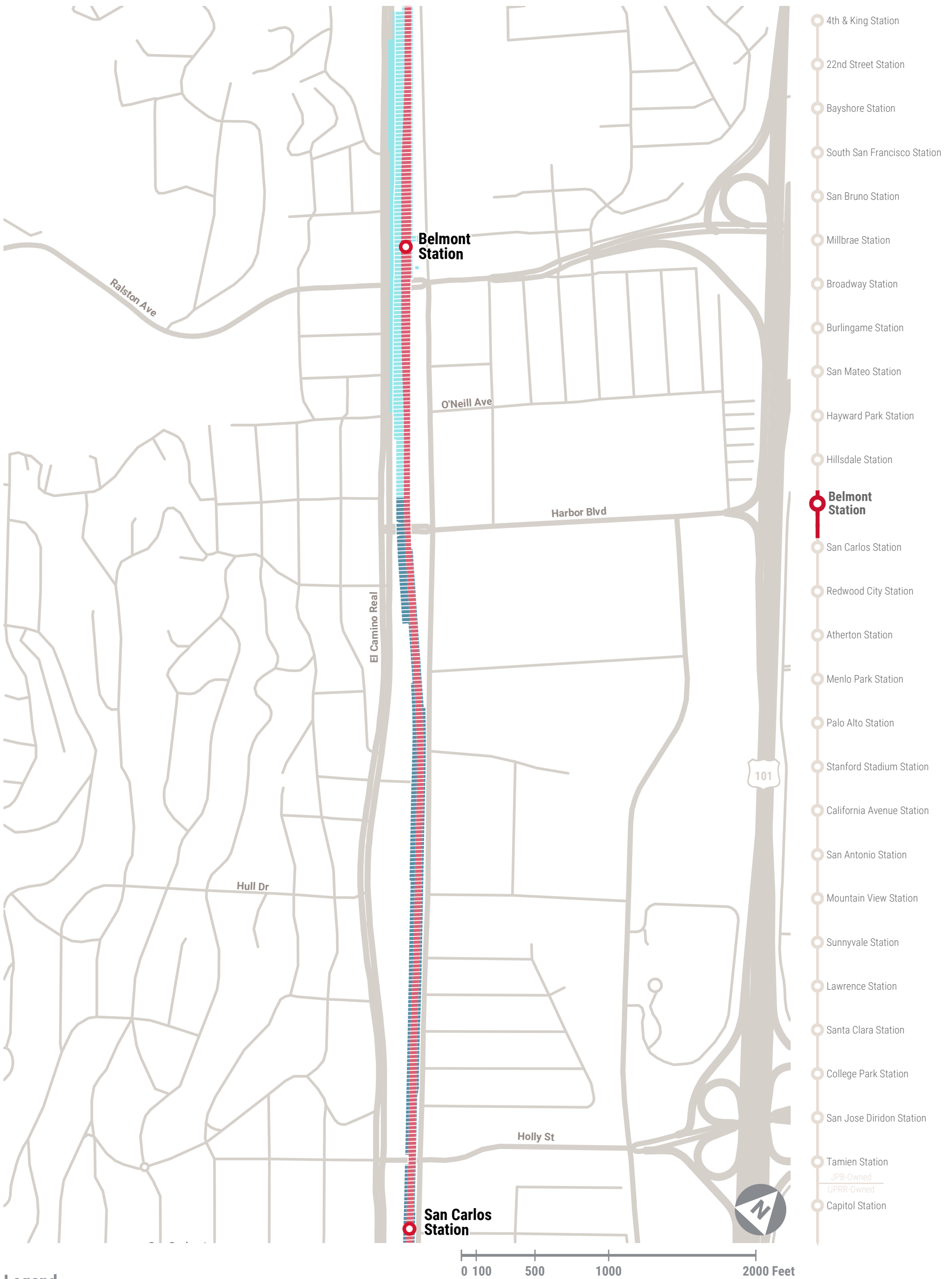
Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.



CALTRAIN RAIL CORRIDOR USE POLICY: MAP 15 OF 34



Legend

Property Use Zones

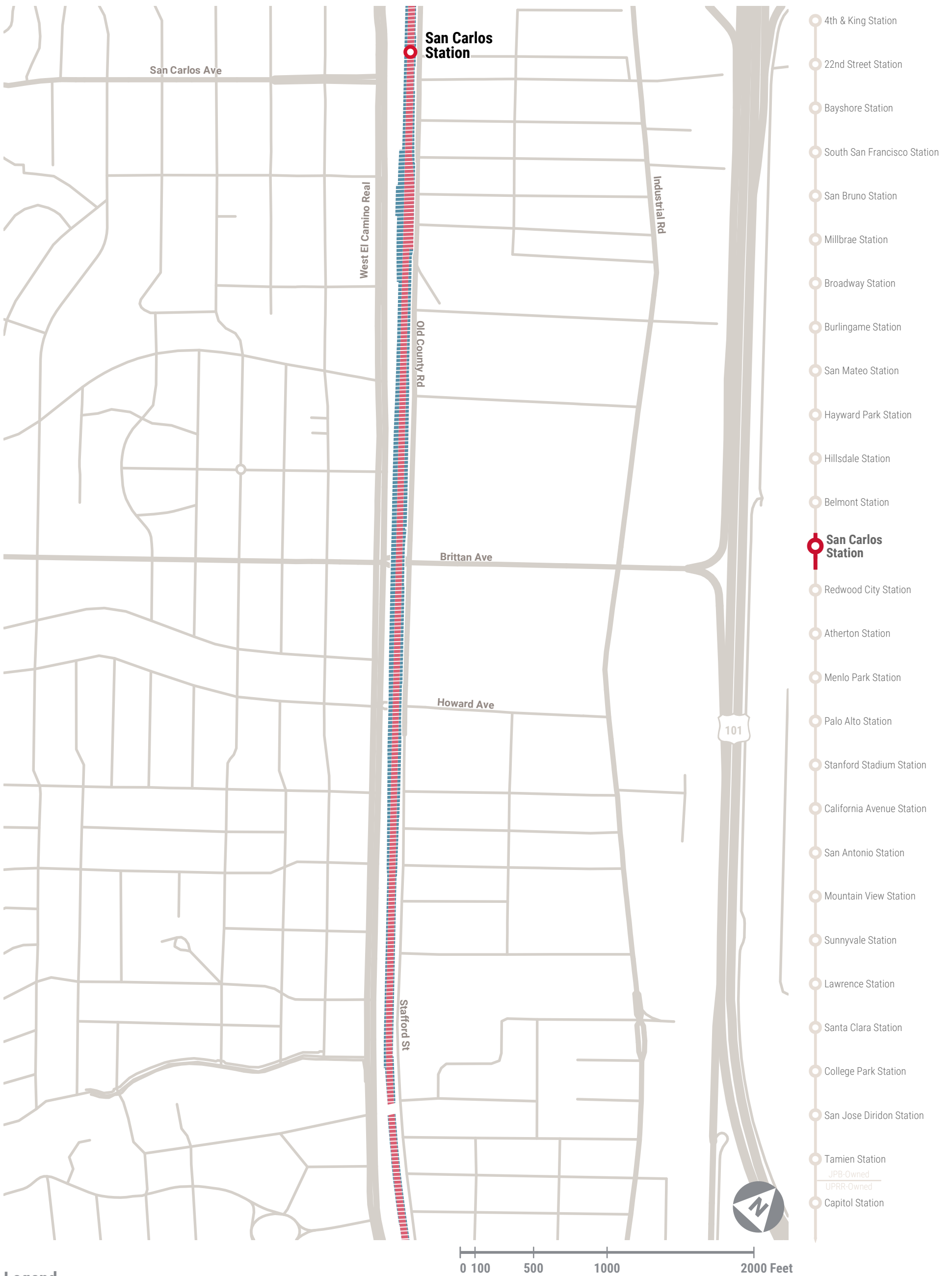
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 16 OF 34



Legend

Property Use Zones

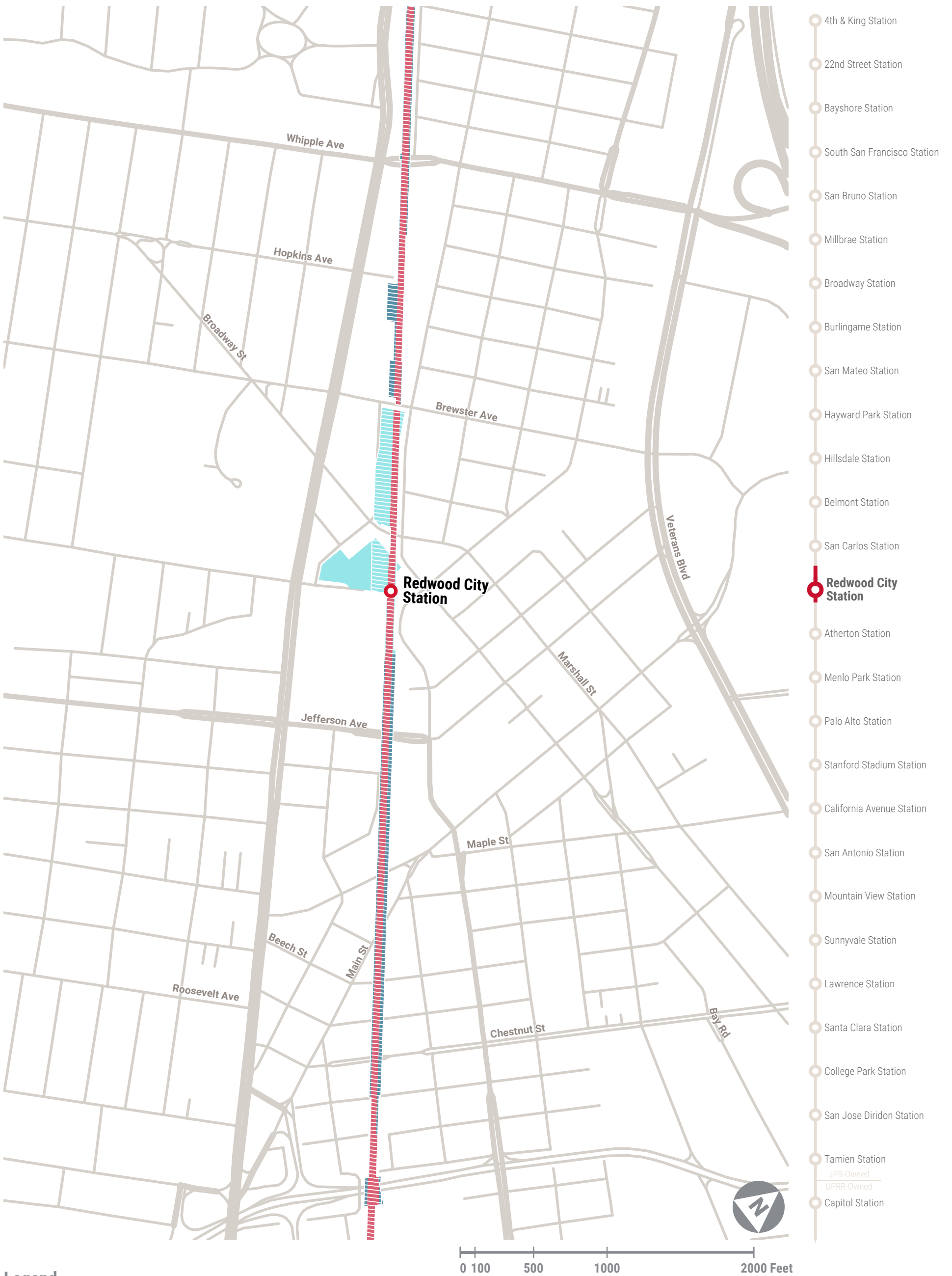
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 17 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 18 OF 34



Legend

Property Use Zones

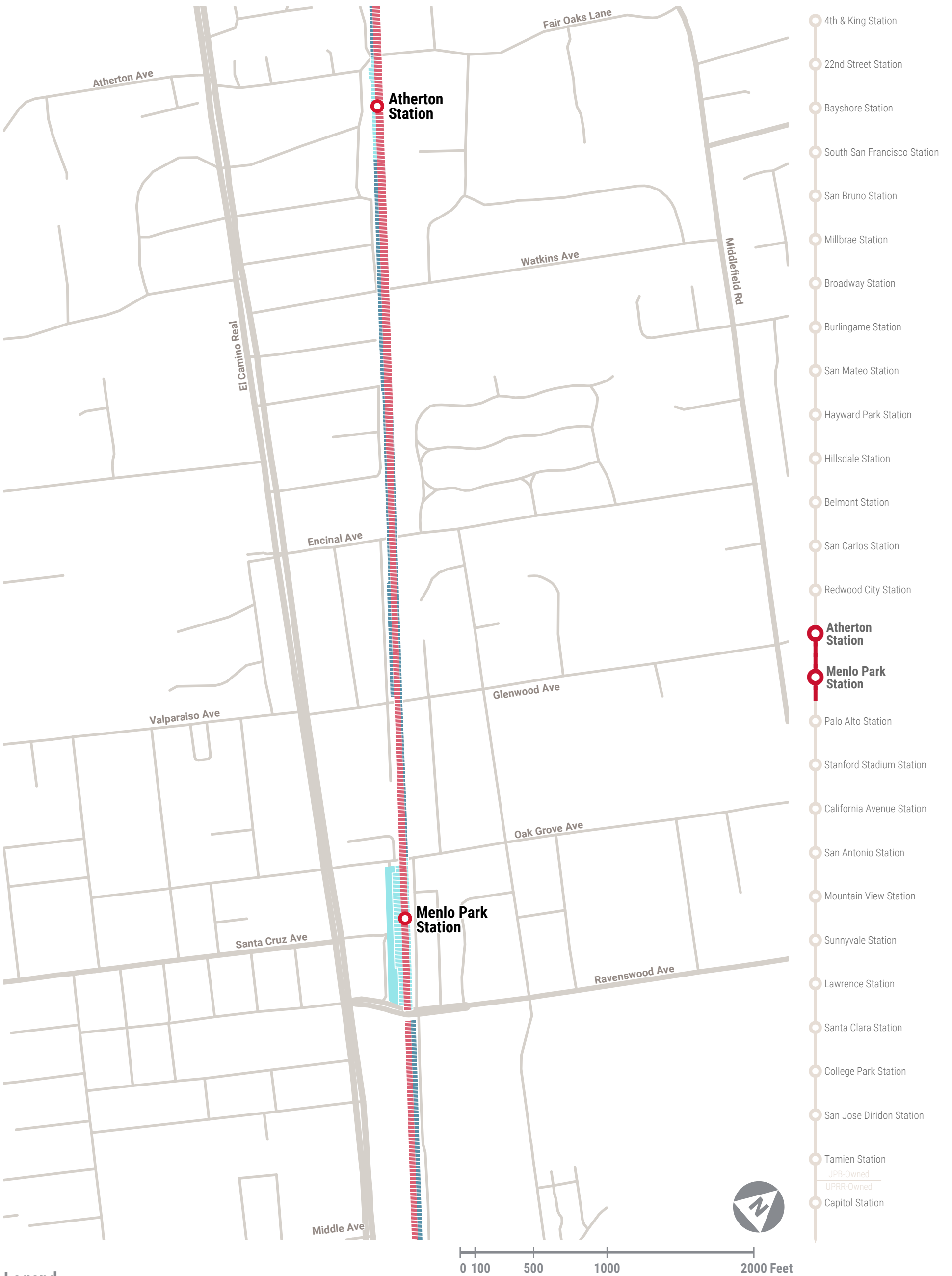
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 19 OF 34



Legend

Property Use Zones

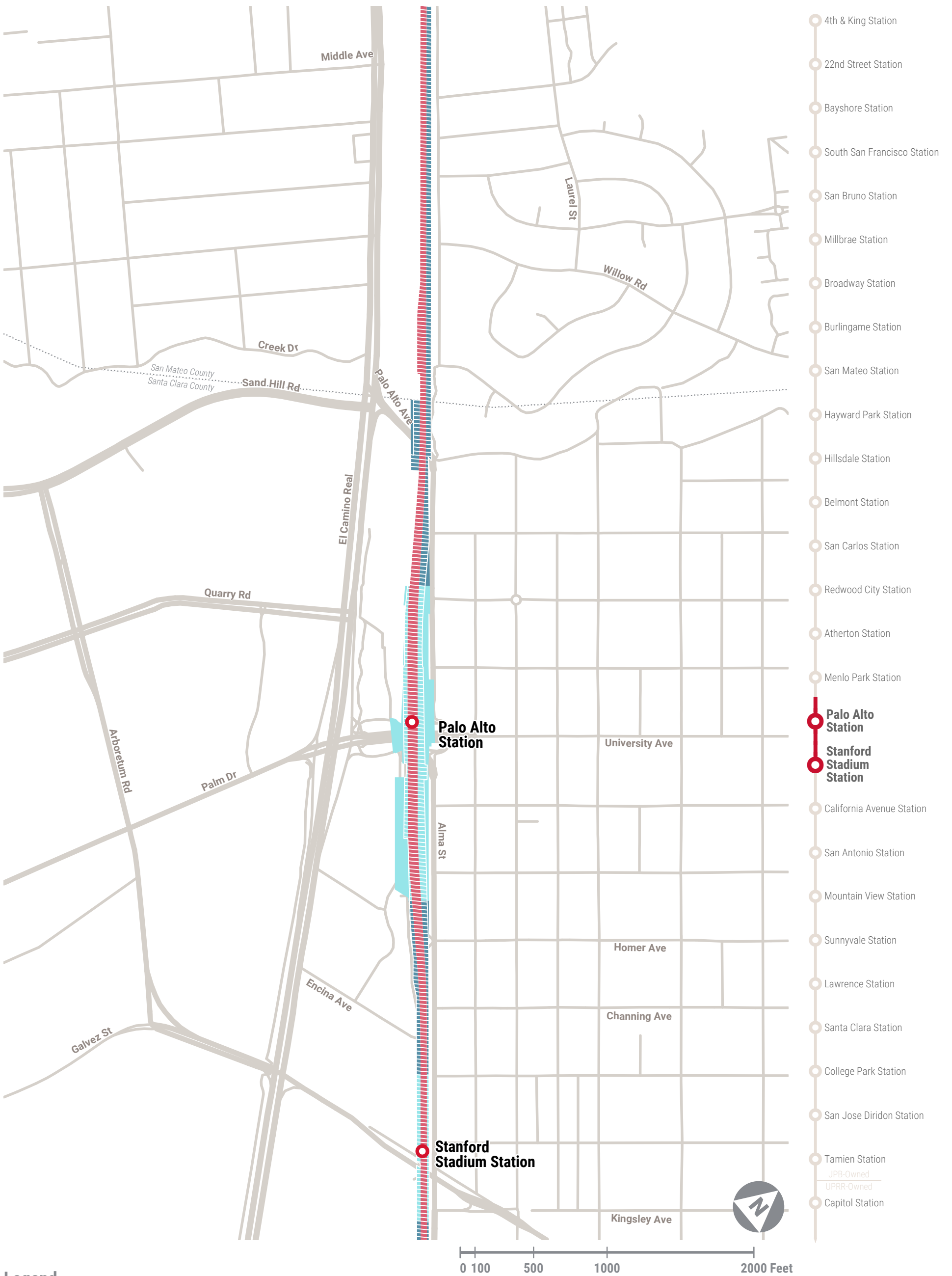
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 20 OF 34



Legend

Property Use Zones

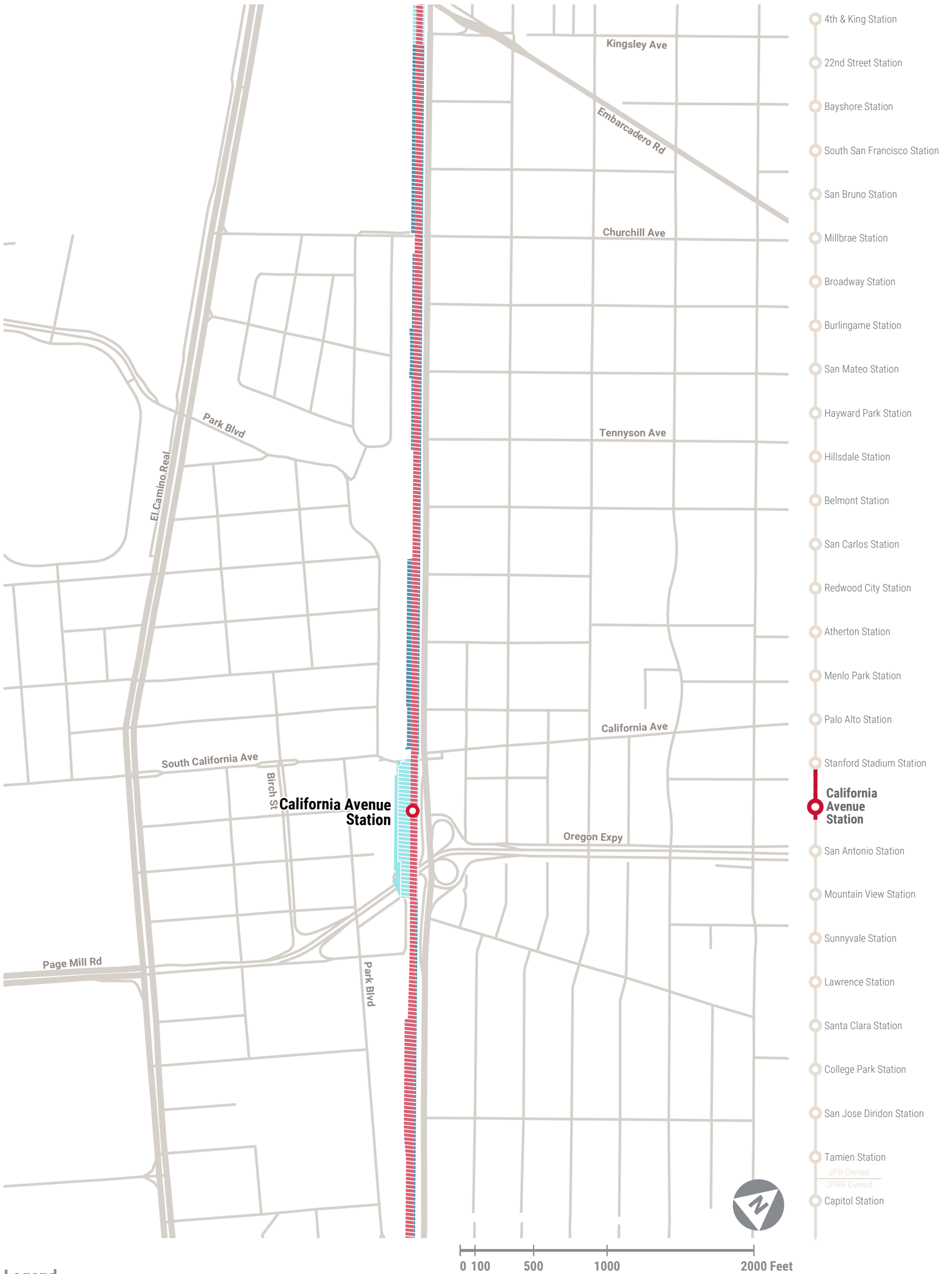
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 21 OF 34



Legend

Property Use Zones

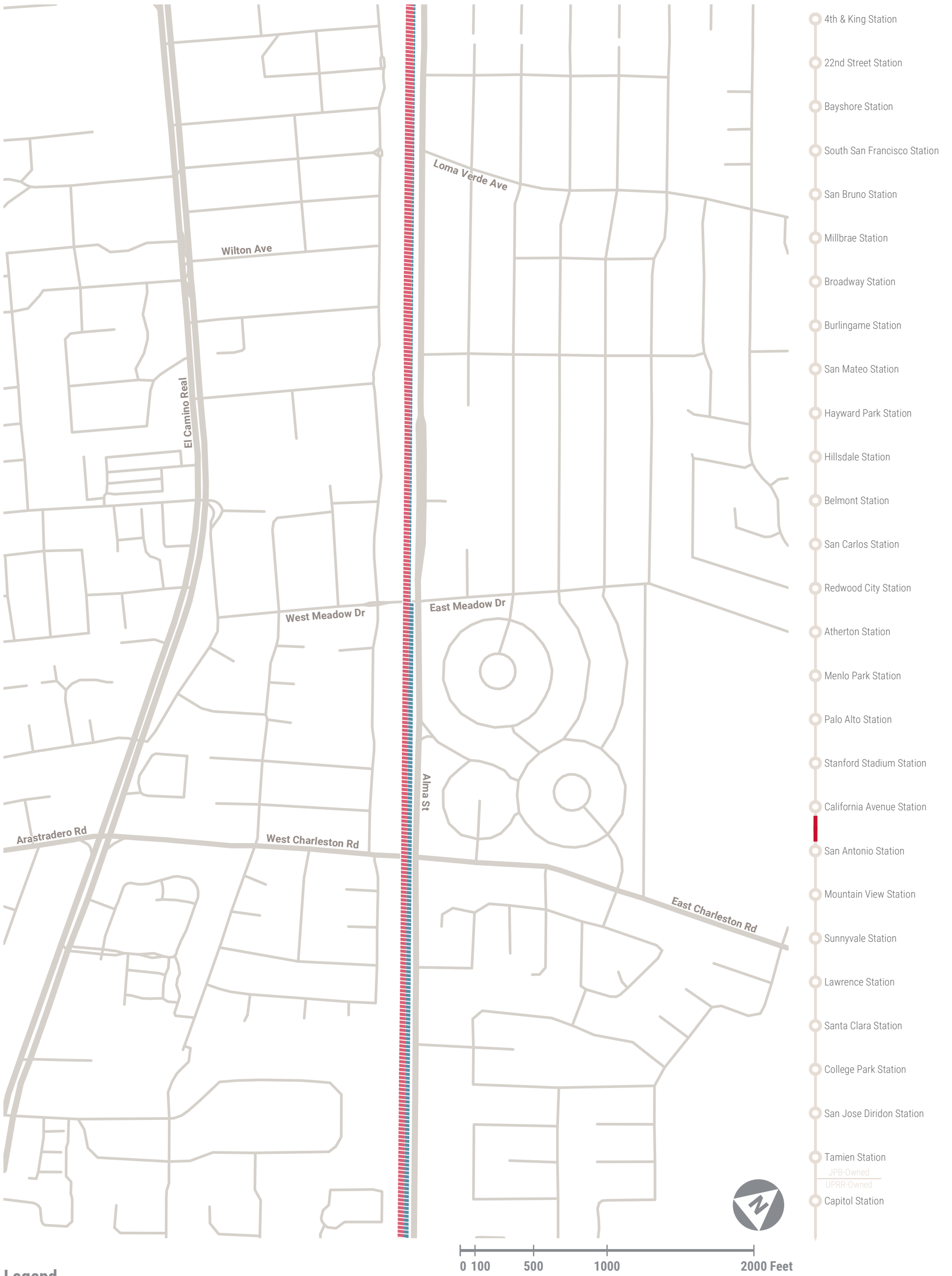
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 22 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.



CALTRAIN RAIL CORRIDOR USE POLICY: MAP 23 OF 34



Legend

Property Use Zones

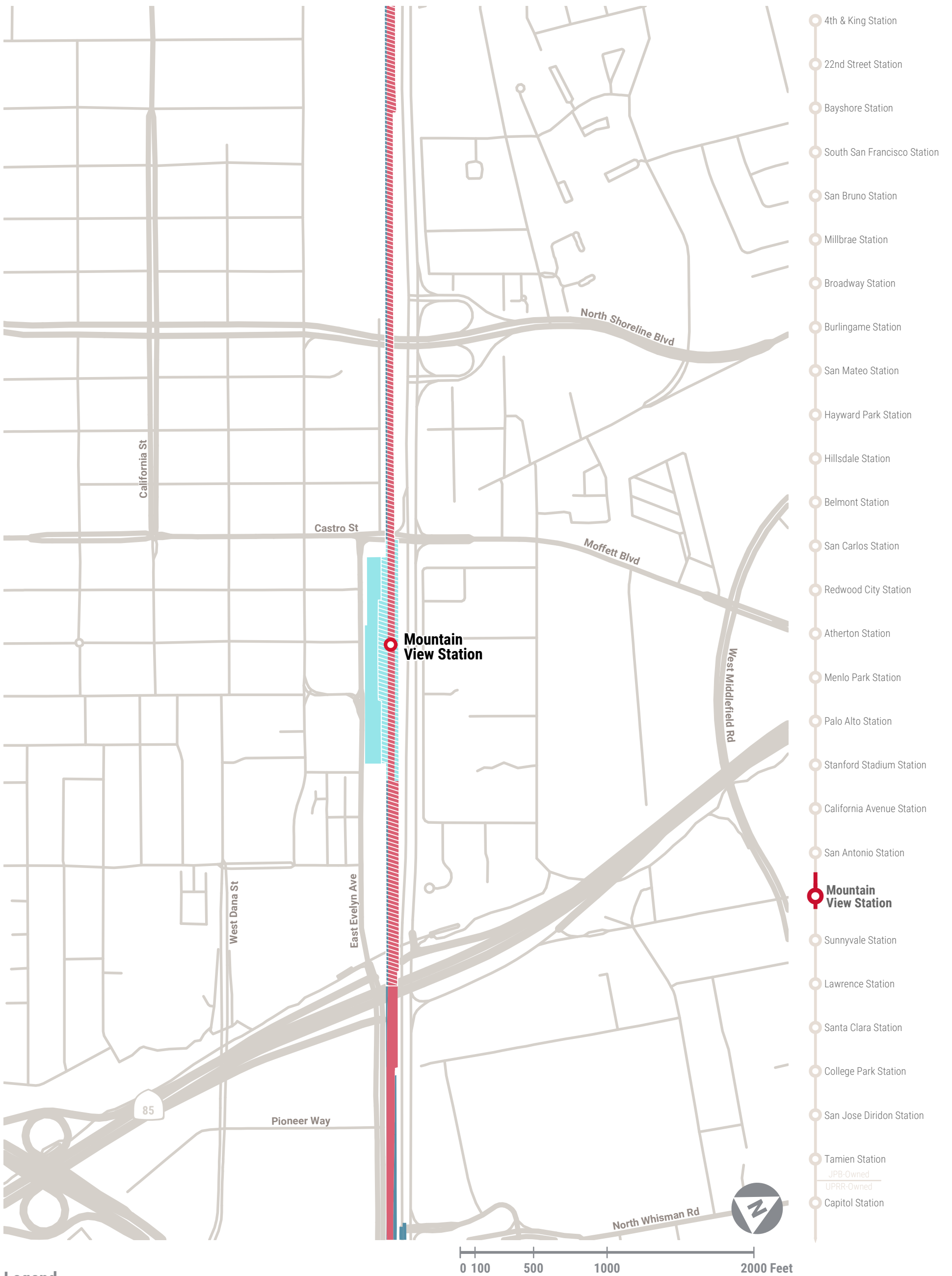
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 24 OF 34



- 4th & King Station
- 22nd Street Station
- Bayshore Station
- South San Francisco Station
- San Bruno Station
- Millbrae Station
- Broadway Station
- Burlingame Station
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
- Belmont Station
- San Carlos Station
- Redwood City Station
- Atherton Station
- Menlo Park Station
- Palo Alto Station
- Stanford Stadium Station
- California Avenue Station
- San Antonio Station
- **Mountain View Station**
- Sunnyvale Station
- Lawrence Station
- Santa Clara Station
- College Park Station
- San Jose Diridon Station
- Tamien Station
- Capitol Station

**Legend**

**Property Use Zones**

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

**Service Vision Capital Project Overlay**

- ▨ Service Vision Capital Project Overlay

**Note:** Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 25 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

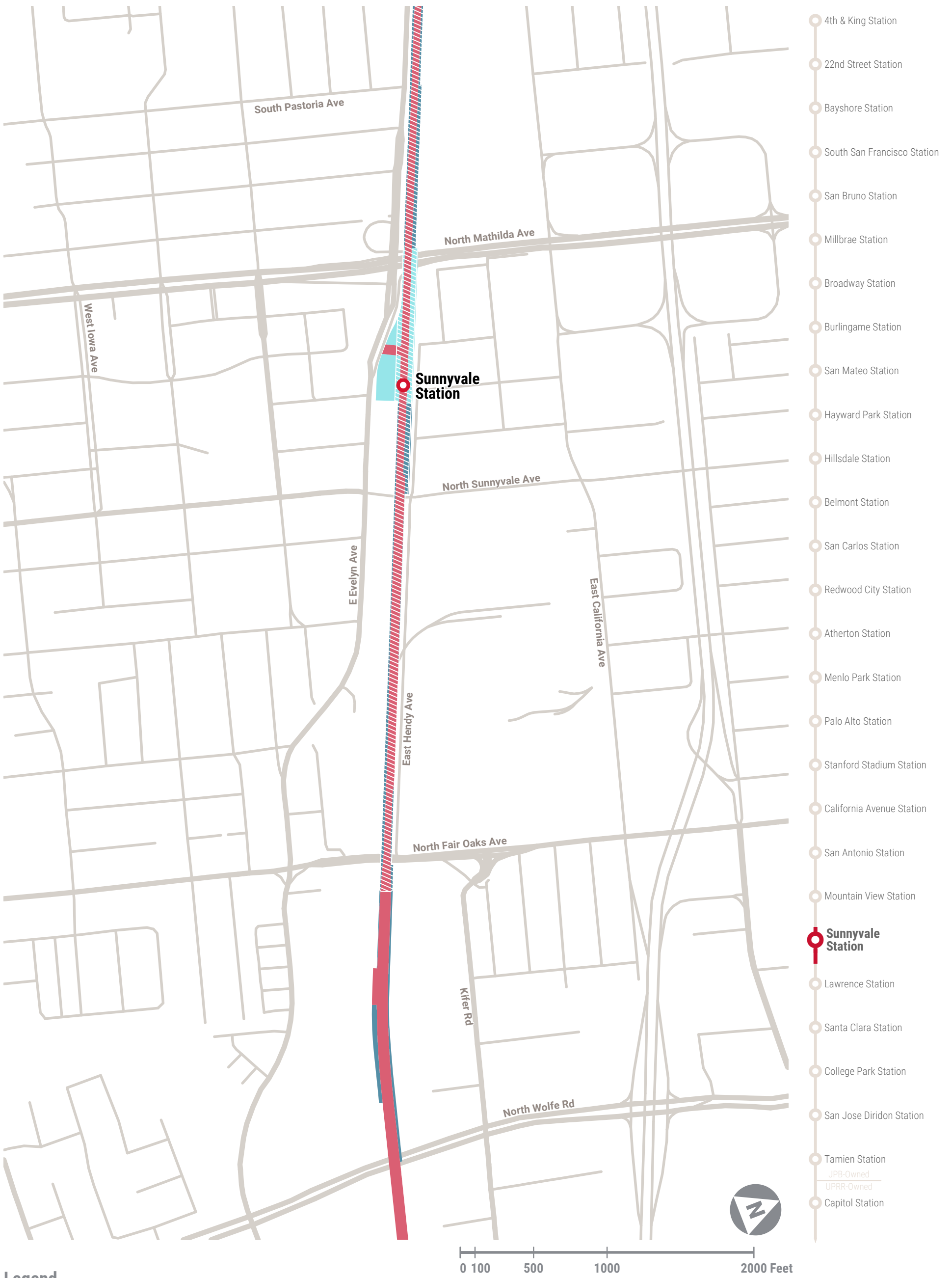
Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

- 4th & King Station
- 22nd Street Station
- Bayshore Station
- South San Francisco Station
- San Bruno Station
- Millbrae Station
- Broadway Station
- Burlingame Station
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
- Belmont Station
- San Carlos Station
- Redwood City Station
- Atherton Station
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- Sunnyvale Station
- Lawrence Station
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- San Jose Diridon Station
- Tamien Station
- JPB-Owned
- UPRR-Owned
- Capitol Station

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 26 OF 34



Legend

Property Use Zones

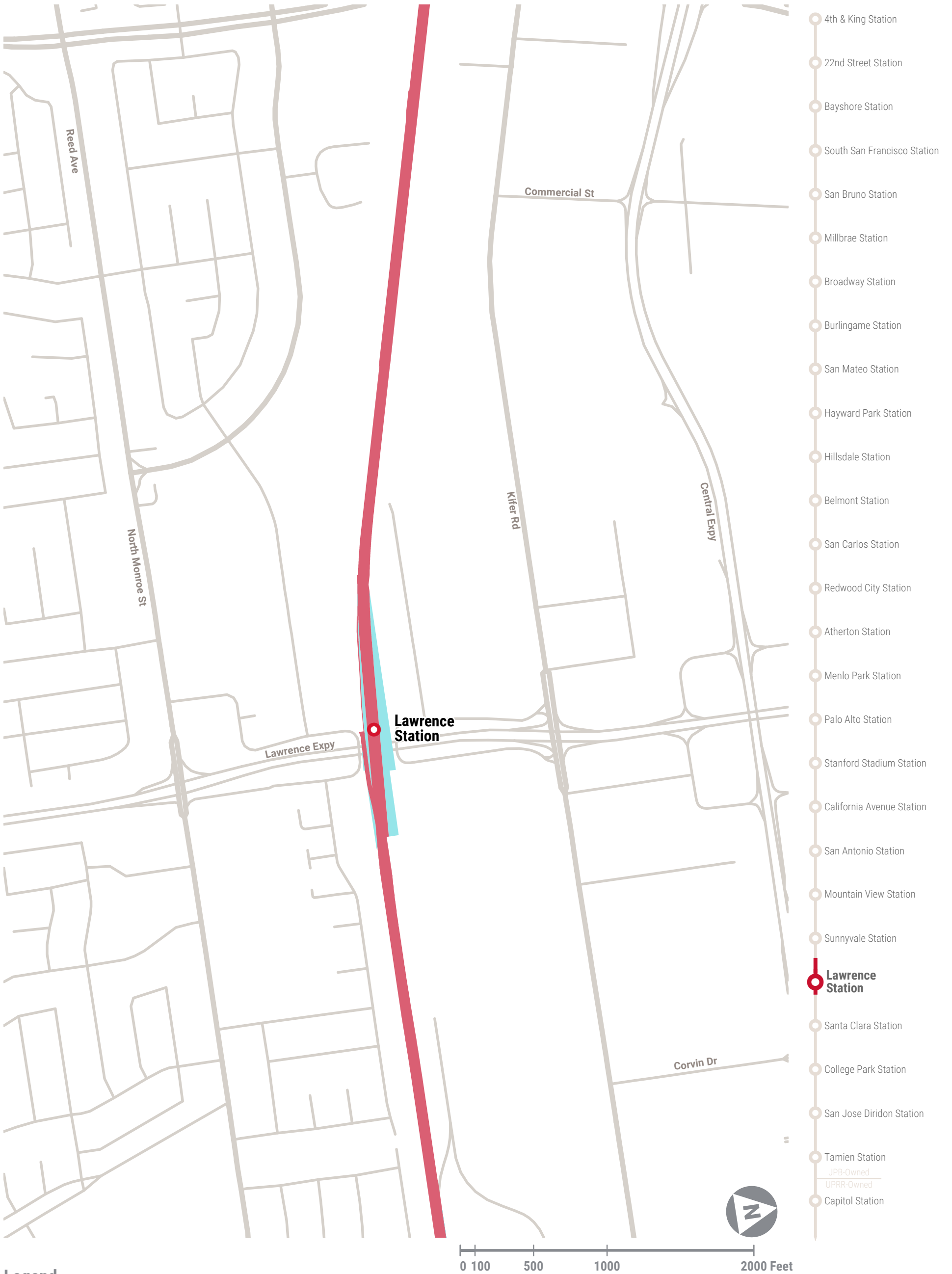
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 27 OF 34



- 4th & King Station
- 22nd Street Station
- Bayshore Station
- South San Francisco Station
- San Bruno Station
- Millbrae Station
- Broadway Station
- Burlingame Station
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
- Belmont Station
- San Carlos Station
- Redwood City Station
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- Sunnyvale Station
- Lawrence Station
- Santa Clara Station
- College Park Station
- San Jose Diridon Station
- Tamien Station
- JPB-Owned
- UPRR-Owned
- Capitol Station

Legend

Property Use Zones

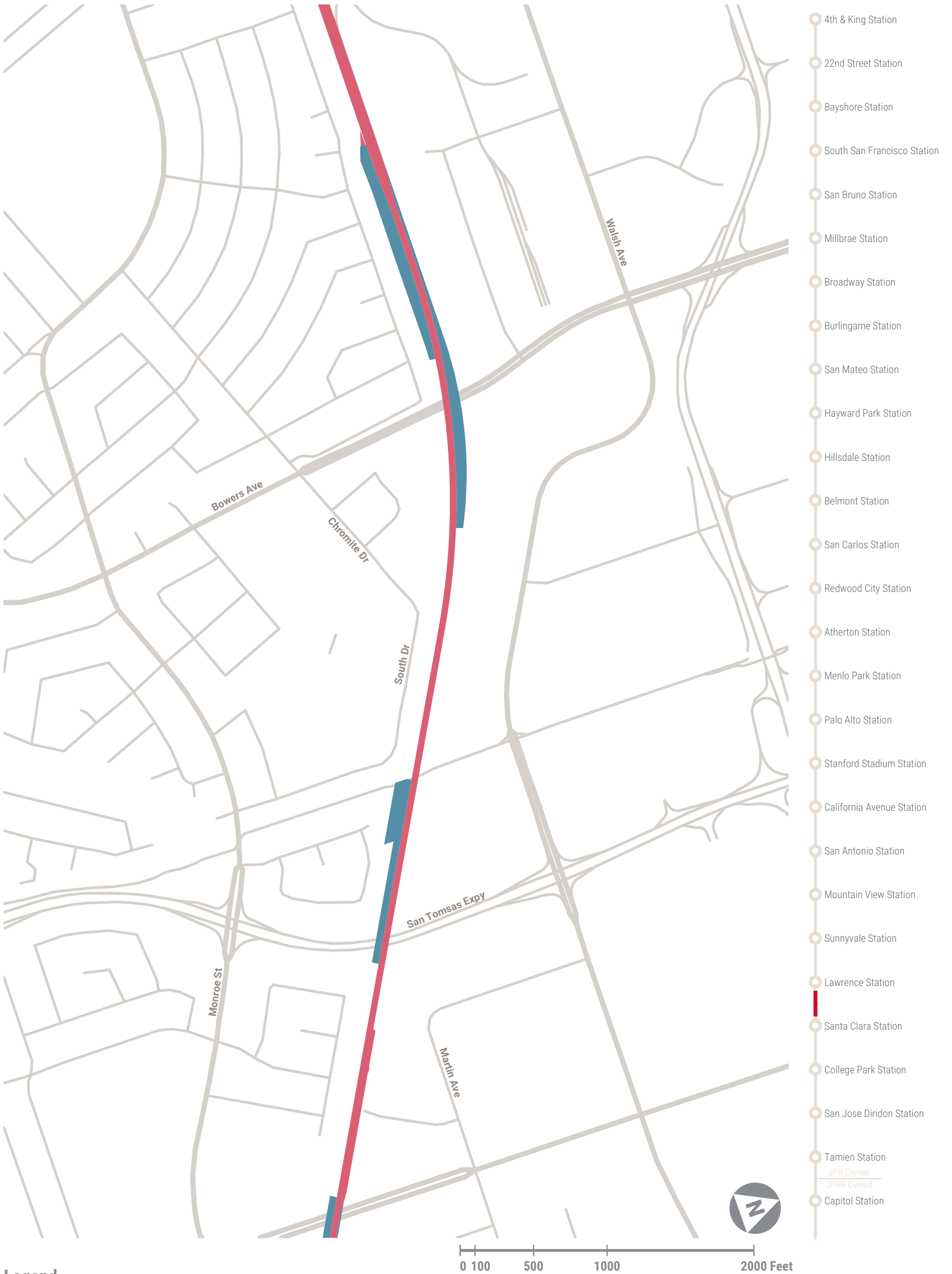
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- ▨ Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 28 OF 34



Legend

Property Use Zones

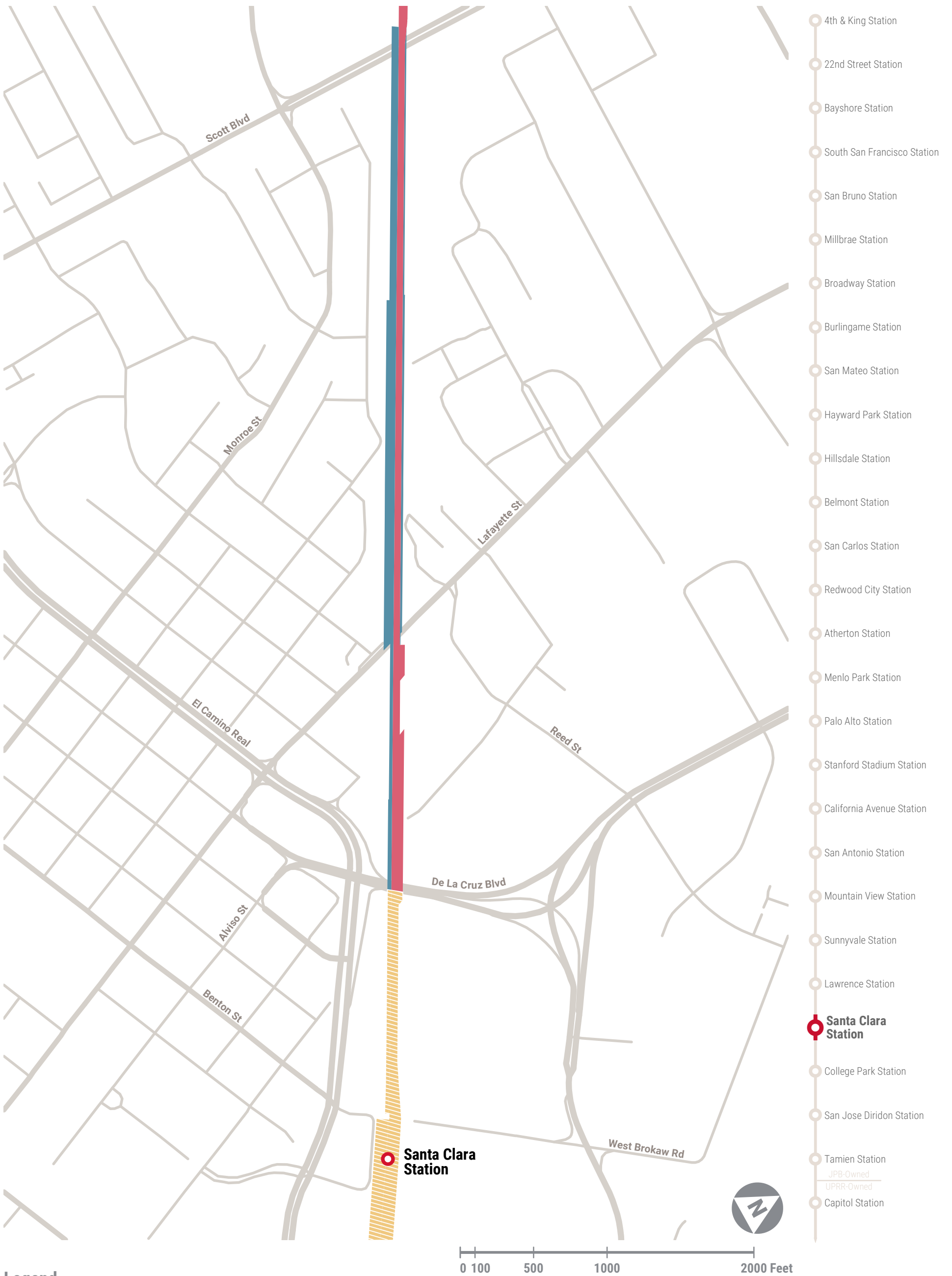
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 29 OF 34



Legend

Property Use Zones

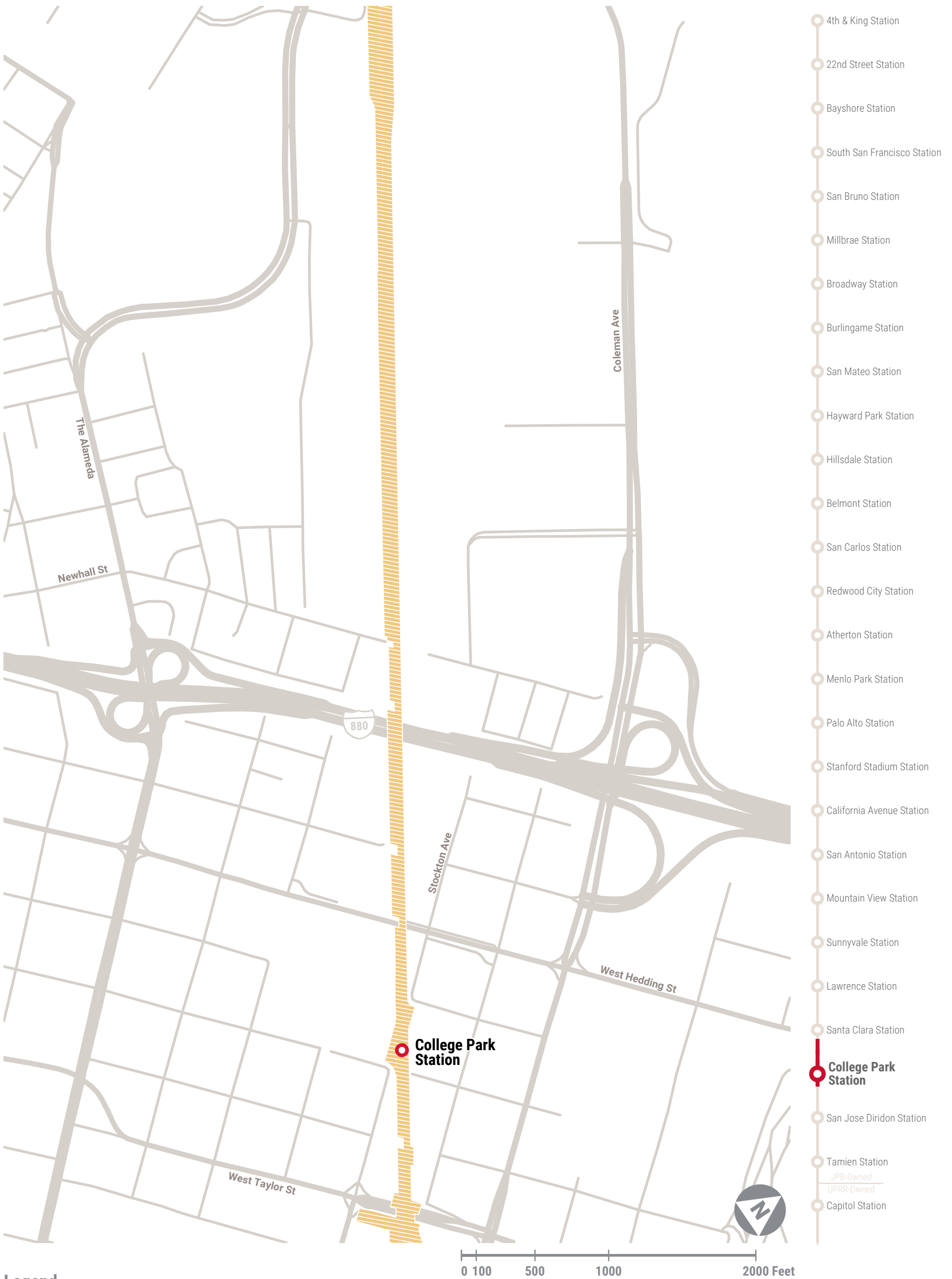
- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 30 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.



CALTRAIN RAIL CORRIDOR USE POLICY: MAP 31 OF 34



- 4th & King Station
- 22nd Street Station
- Bayshore Station
- South San Francisco Station
- San Bruno Station
- Millbrae Station
- Broadway Station
- Burlingame Station
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
- Belmont Station
- San Carlos Station
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- Atherton Station
- Menlo Park Station
- Palo Alto Station
- Stanford Stadium Station
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- San Antonio Station
- Mountain View Station
- Sunnyvale Station
- Lawrence Station
- Santa Clara Station
- College Park Station
- **San Jose Diridon Station**
- Tamien Station
- Capitol Station

**Legend**

**Property Use Zones**

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

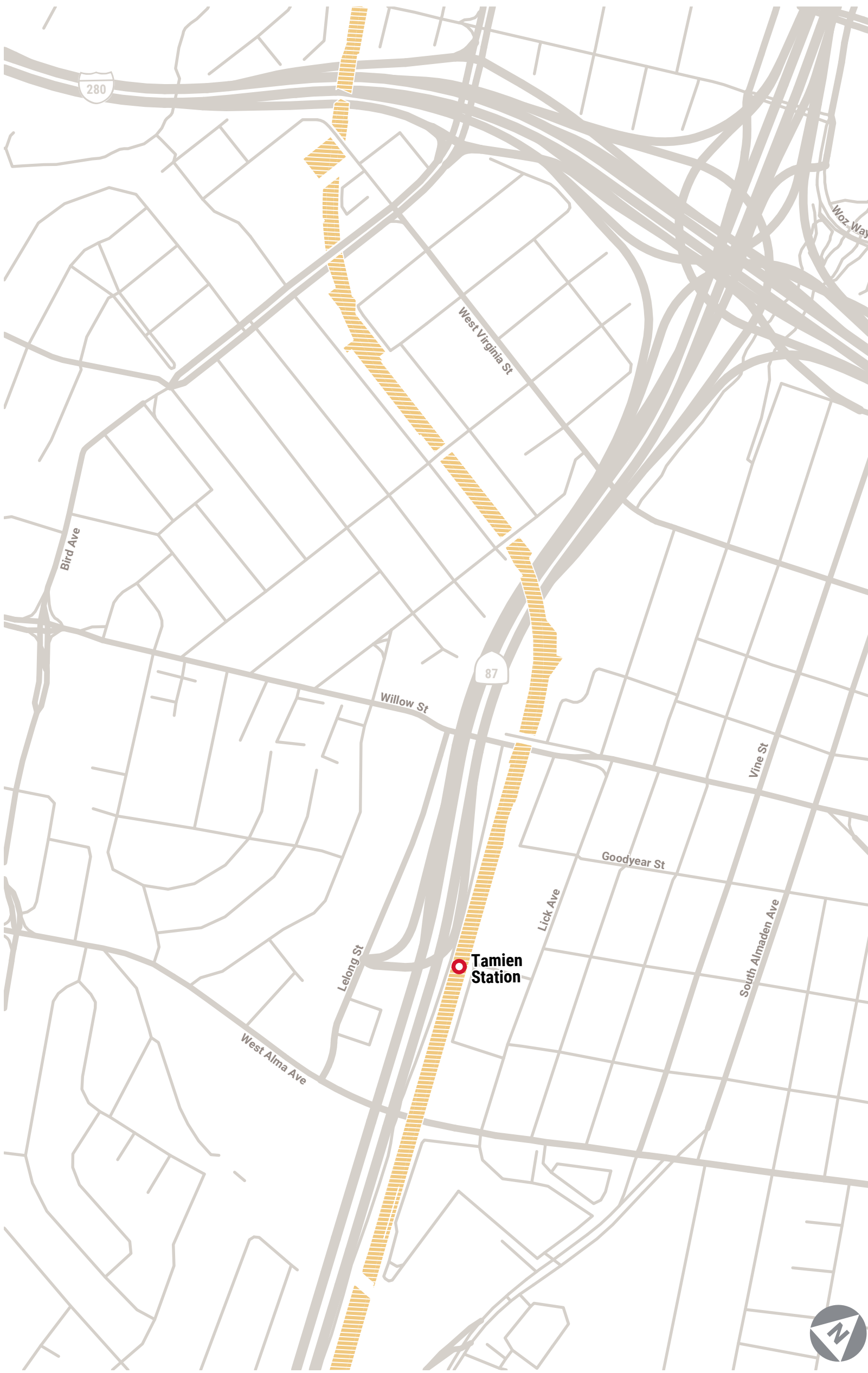
**Service Vision Capital Project Overlay**

- ▨ Service Vision Capital Project Overlay

0 100 500 1000 2000 Feet

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CALTRAIN RAIL CORRIDOR USE POLICY: MAP 32 OF 34



- 4th & King Station
- 22nd Street Station
- Bayshore Station
- South San Francisco Station
- San Bruno Station
- Millbrae Station
- Broadway Station
- Burlingame Station
- San Mateo Station
- Hayward Park Station
- Hillsdale Station
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- Sunnyvale Station
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- College Park Station
- San Jose Diridon Station
- **Tamien Station**
- JPB-Owned
- UPRR-Owned
- Capitol Station

0 100 500 1000 2000 Feet

**Legend**

**Property Use Zones**

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

**Service Vision Capital Project Overlay**

- ▨ Service Vision Capital Project Overlay

**Note:** Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 33 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN RAIL CORRIDOR USE POLICY: MAP 34 OF 34



Legend

Property Use Zones

- 1: Operating Right-of-Way
- 2: Station Right-of-Way
- 3: Non-Operating Right-of-Way
- 4: Special Study Area

Service Vision Capital Project Overlay

- Service Vision Capital Project Overlay

Note: Map is for general information only. Peninsula Corridor Joint Powers Board property lines are approximate and for illustrative purposes only.

CALTRAIN BUSINESS PLAN

# DEVELOPING A LONG-RANGE VISION FOR CALTRAIN



## CITY OF PALO ALTO BOOKLET

MAY 2019



# CALTRAIN BUSINESS PLAN

## A 2040 VISION FOR THE CORRIDOR



 Daily Riders  
**62,000**

 Local Jurisdictions  
**21**

**Caltrain is one of the busiest commuter rail systems in the country and demand for our service is growing.**

The Caltrain Business Plan is a joint effort with agency partners and communities along the corridor to plan for this growth. The Business Plan will help us develop a better understanding of the region's future transportation needs and will identify opportunities and strategies for how the Caltrain system can help.

**WHY THINK ABOUT THE FUTURE OF THE CORRIDOR?**  
The Bay Area population and economy have continued to grow, leading to:



Traffic congestion and longer, unreliable commutes



Over-crowded trains



Increased cost of transportation and housing

**Caltrain provides a cost effective, convenient alternative to driving and connects jobs and housing, but the system will need to grow to meet current and future demand.**



Electrification of the Caltrain corridor is already underway and will allow Caltrain to run faster, more frequent service while reducing noise and emissions.



Electrification also creates the potential for expanded Caltrain service that will meet the current and future needs of our region. The Business Plan will identify the best strategies for maximizing this potential by developing a long-term service vision for the corridor, defining the infrastructure needed to support that service vision, and identifying opportunities to fund the implementation of these improvements.

**WHAT IS THE CALTRAIN BUSINESS PLAN?**  
The Caltrain Business Plan includes four major focus areas that address key questions shaping the future of the railroad:



### SERVICE

What is the best service Caltrain can provide to meet the needs of our customers and the communities we serve? How many trains should we run? How do we best match service to riders' needs? What infrastructure improvements will be needed to provide the service? How can Caltrain effectively connect to other transit services?



### COMMUNITY INTERFACE

What are the benefits and impacts of increasing service on the corridor to each community? How can we work together to grow the railroad in a way that balances the needs of all communities along the corridor with the need to expand service and operate a safe and efficient railroad? How can we ensure this planning process and the outcomes are equitable?



### BUSINESS CASE

Why should we choose one service vision over another? How can we maximize the value of current and future investments in the Caltrain corridor? How much will the service cost to operate? How will we fund it?



### ORGANIZATION

What is the best organizational structure for overseeing and growing Caltrain service in the future?



## WHAT IS THIS BOOKLET?

The Caltrain Business Plan is evaluating the benefits and costs of different service visions for the railroad in order to address the question of how Caltrain should grow. This booklet was developed to help your community understand – at both a corridor-wide and jurisdiction-specific scale – the details, opportunities and challenges of three illustrative 2040 “Growth Scenarios” that are being considered as part of the Business Plan process.

This booklet describes how the Caltrain system interfaces with and is used by your community today and presents analysis illustrating how that could change in the future based on the different ways that the railroad could grow.

## WHO IS INVOLVED?

The Caltrain Business Plan is a collaborative effort led by Caltrain with funding and participation from Stanford University and other organizations. We are working closely with policymakers, stakeholders, Caltrain riders, and community members to make sure the Caltrain Business Plan considers everyone’s needs.

We understand that each of the local jurisdictions we serve has a unique set of priorities, projects, and plans for growth. For this reason, we have emphasized coordination with corridor communities and update local jurisdiction staff and elected officials about the Caltrain Business Plan on a monthly basis through our City / County Staff Coordinating Group and our Local Policy Maker Group. This booklet is intended to provide further information about what the Caltrain Business Plan could mean to each of the communities we serve.

## WHEN IS IT HAPPENING?



# CALTRAIN RIDER STATS

Today, Caltrain operates a commuter-focused service that carries more than 60,000 riders every weekday.



## Daily Riders

62,000

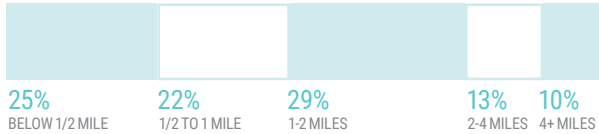


## Riding 5+ Days Per Week

52%



## Access Distance to Station



## Weekday Trains

92

62 PEAK 30 OFF-PEAK

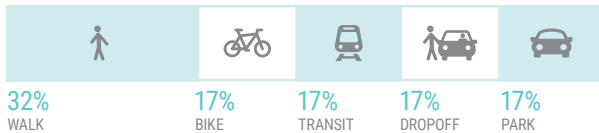


## Riding to Work

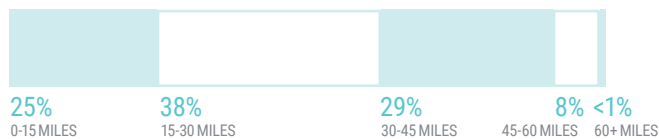
~85%



## Mode of Access



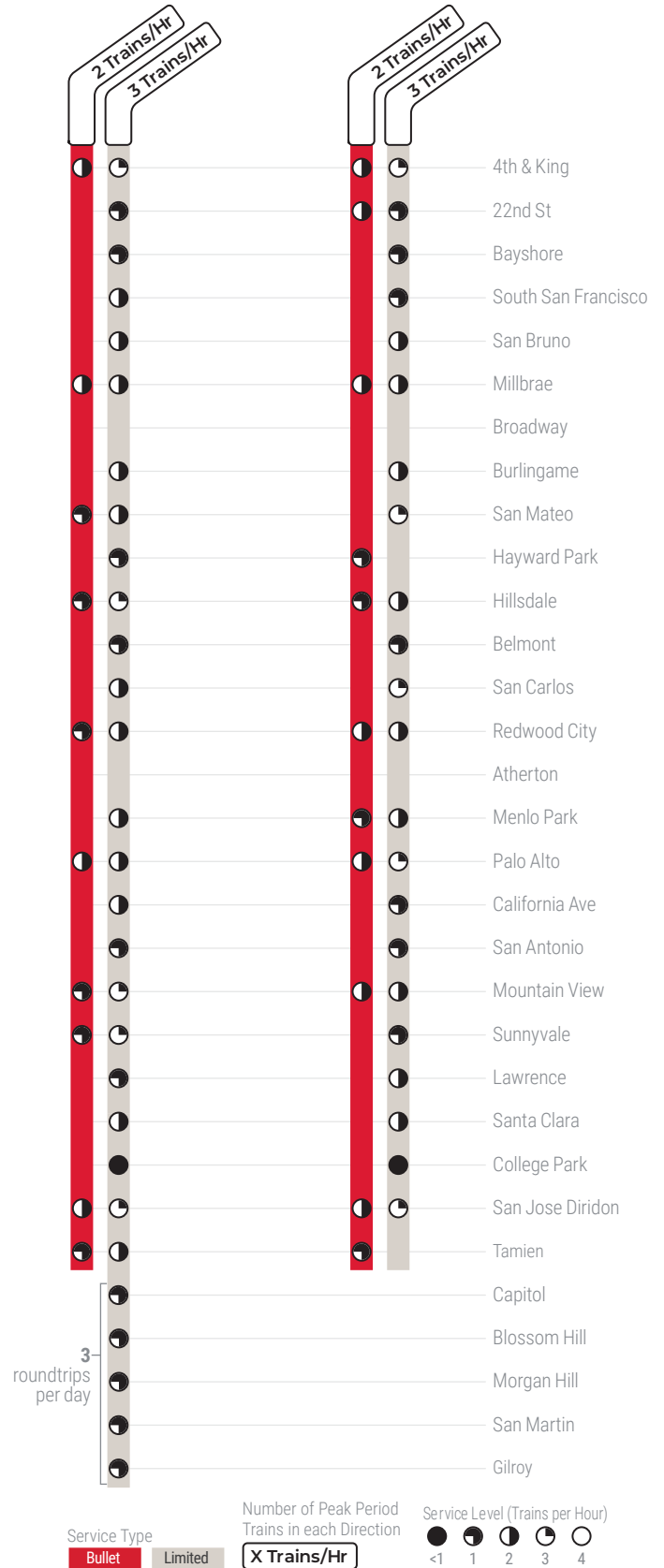
## Distance on Train



# EXISTING PEAK HOUR SERVICE

AM Northbound/  
PM Southbound  
(5 Trains)

AM Southbound/  
PM Northbound  
(5 Trains)

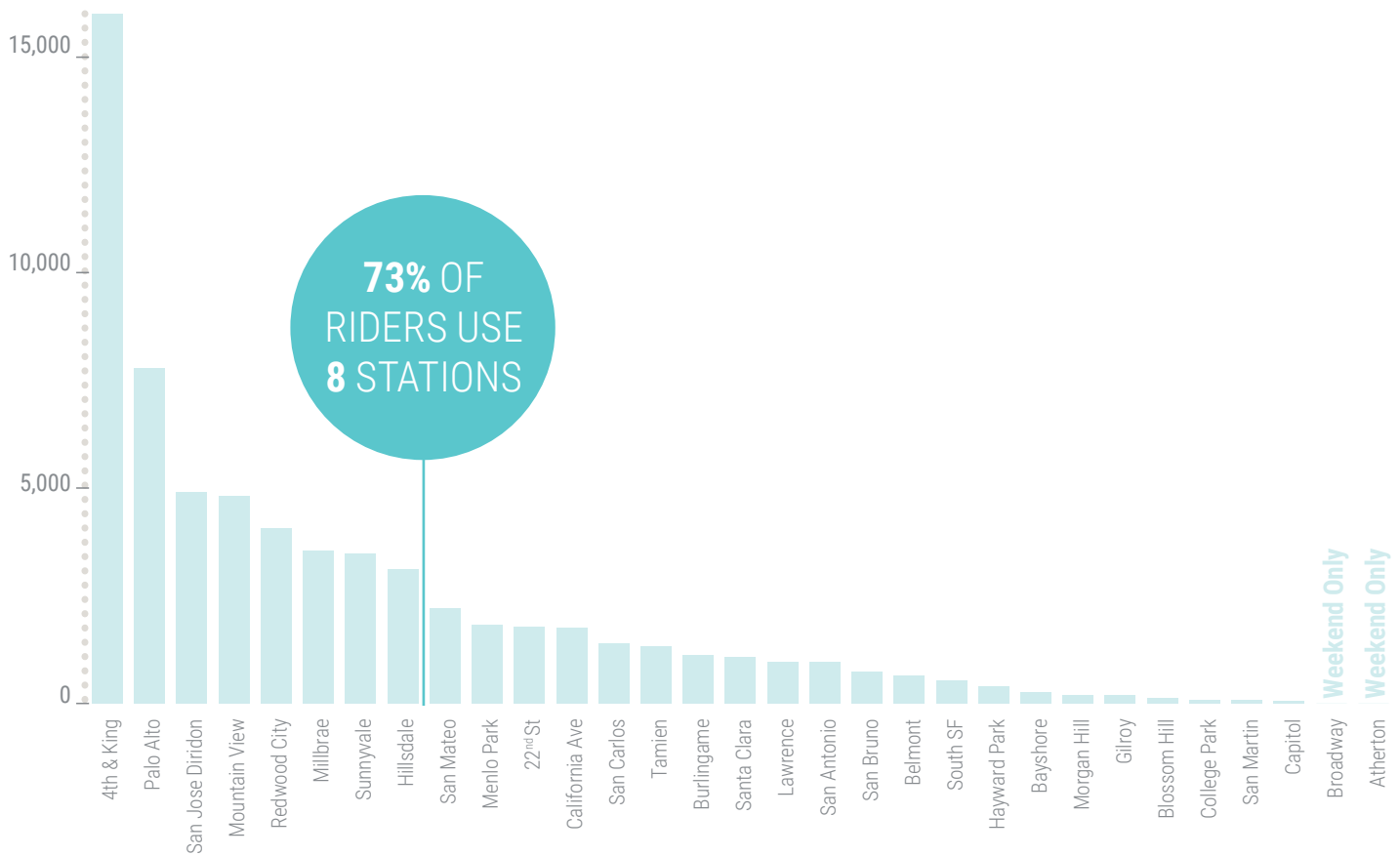


Notes: This diagram provides a simplified representation of one hour of peak period service.

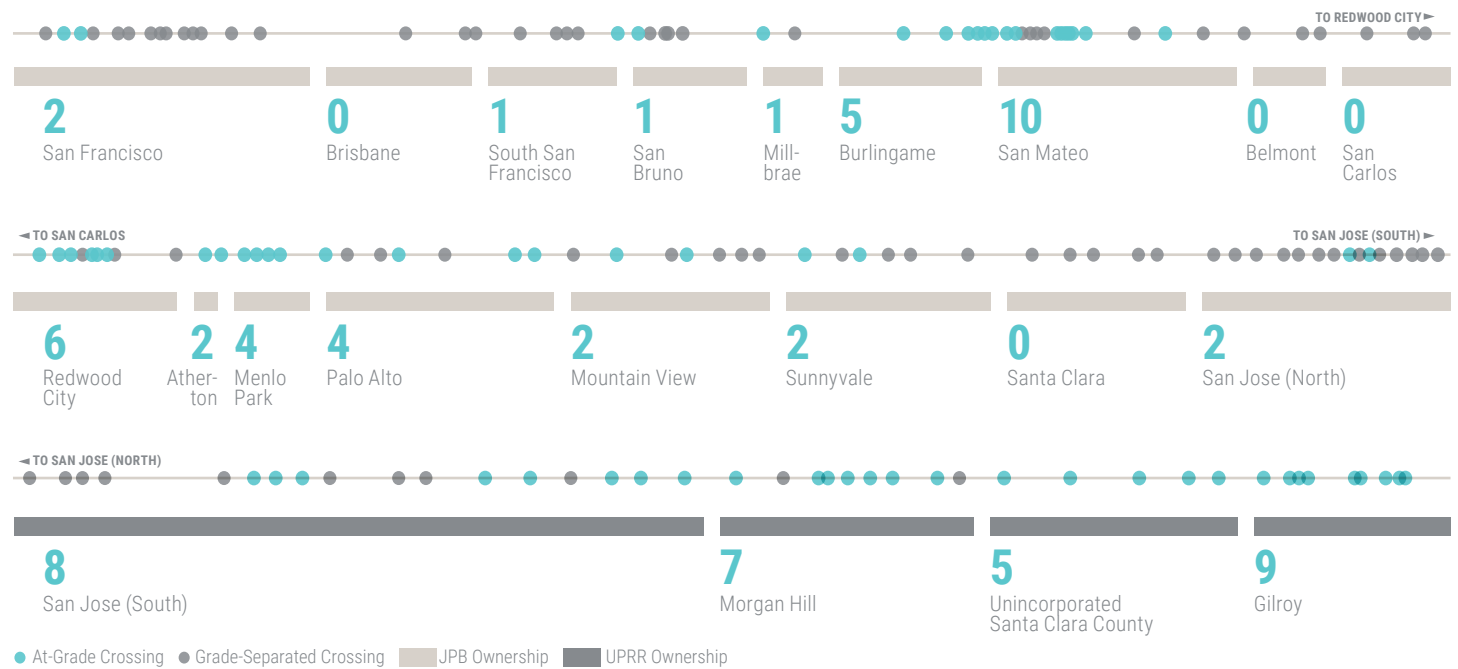
THE CORRIDOR TODAY



# STATIONS BY WEEKDAY RIDERSHIP



# CORRIDOR TRACK CROSSINGS



Sources: Caltrain Ridership Data, 2017; Caltrain Timetables, 2018; Caltrain Parking Occupancy Report, 2017; Caltrain 2014 On-Board Transit Survey; CPUC Collision Database, 2016; Fehr&Peers Traffic Counts, 2016; Caltrain Electrification EIR; US Census Bureau Population Estimates Program.

# HOW CALTRAIN IN PALO ALTO IS USED TODAY



Riders Living in the City

1,576



Riders Working in the City

2,166



Residents or Employees Riding 5+ Days Per Week

48%



Resident Riders Per Capita

2.3%

## STATION CHARACTERISTICS



Station

**Palo Alto**

Local  
Limited  
Bullet

**California Avenue**

Local  
Limited



Parking Spaces

**389/272**

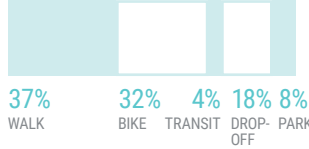
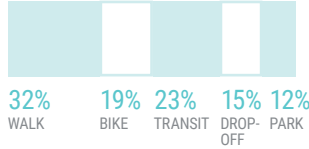
99%  
VEHICLE PARKING OCCUPANCY (MAX.)

**185/75**

61%  
VEHICLE PARKING OCCUPANCY (MAX.)



Mode of Access



Top 3 Origins/Destinations

San Francisco  
22nd Street  
San Jose

San Francisco  
San Jose  
San Mateo

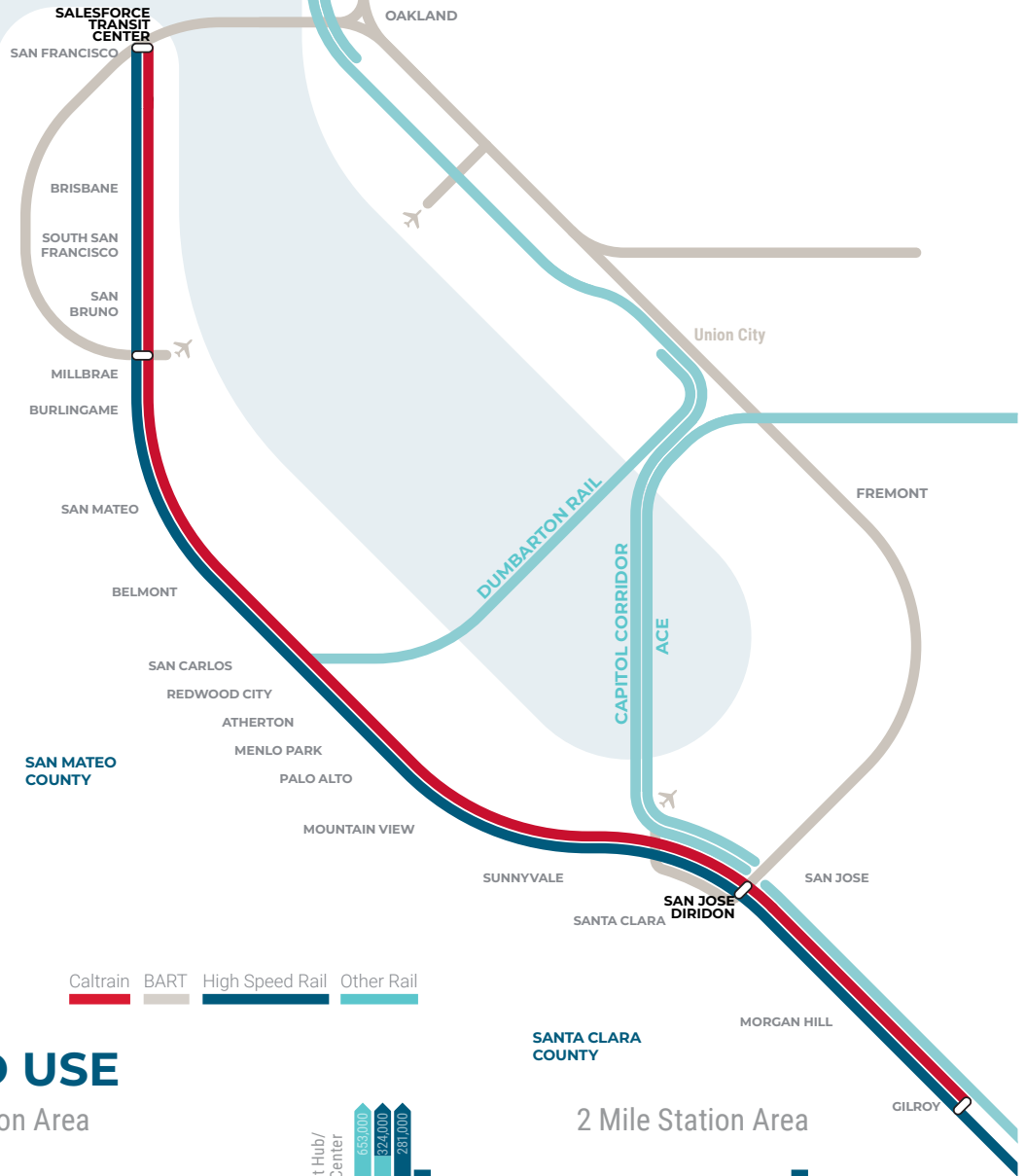
THE CORRIDOR TODAY



# CALTRAIN IN 2040

The Caltrain Business Plan is asking the question "How should Caltrain Grow?" To do this we are considering what the corridor and region will look like in 2040, including how many people will want to live and work along the Caltrain corridor and what the role of the railroad should be in helping keep everyone moving.

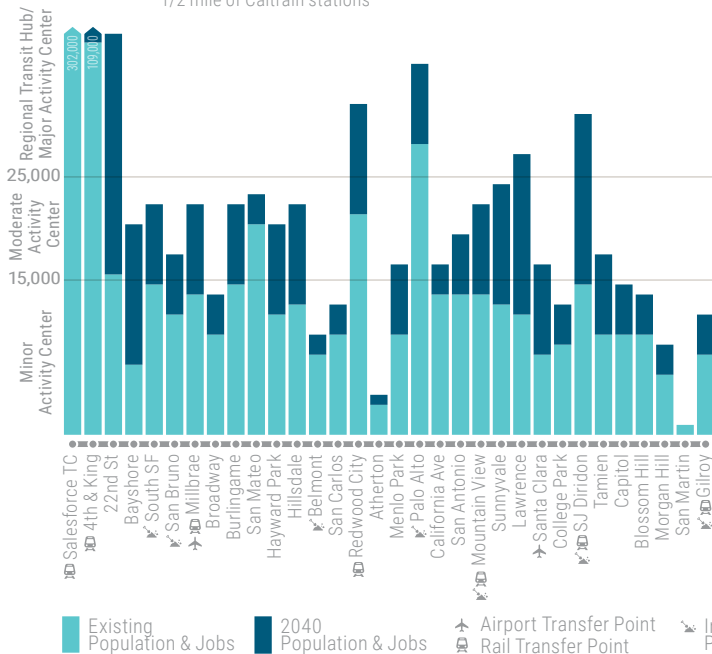
The Business Plan team has developed three distinct, illustrative "growth scenarios" or "visions" for how Caltrain could grow to serve expanded demand for rail service. The following pages provide an overview of these "growth scenarios" and show what they could mean for communities along the corridor.



## CHANGING LAND USE

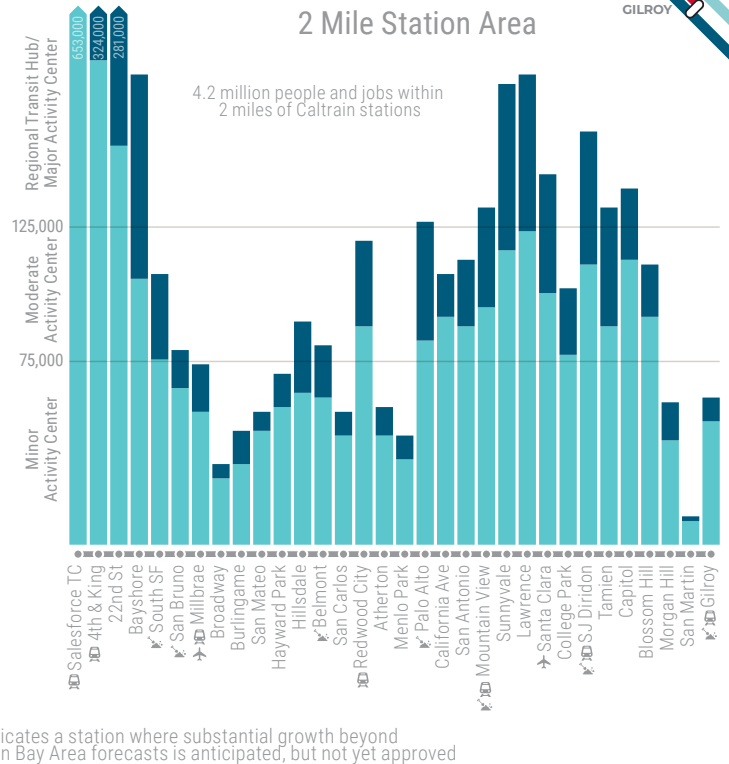
### 1/2 Mile Station Area

1 million people and jobs within 1/2 mile of Caltrain stations



### 2 Mile Station Area

4.2 million people and jobs within 2 miles of Caltrain stations



# SERVICE VISION DEVELOPMENT

## How we want to grow:

The team developed service plans that attempt to balance coverage and market demand goals, emphasize clock-face schedules, integration with the state and regional transportation network and timed-transfers.



**BALANCING  
MARKET &  
COVERAGE  
SERVICE**



**CLOCK-FACE  
SCHEDULING**



**SEAMLESS  
NETWORK  
INTEGRATION**



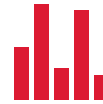
**COORDINATED  
TRANSFERS**

## Growing in a constrained corridor:

All of the service concepts developed are an exercise in compromise. The Caltrain corridor is physically constrained and the Joint Powers Board must balance competing objectives of changing markets and land uses, historic station spacing, and multiple types and speeds of train service. There are no perfect solutions and any future service plan must reconcile technical challenges related to service differentiation, infrastructure investments, and the total volume of trains running in the corridor.



**SERVICE  
DIFFERENTIATION**

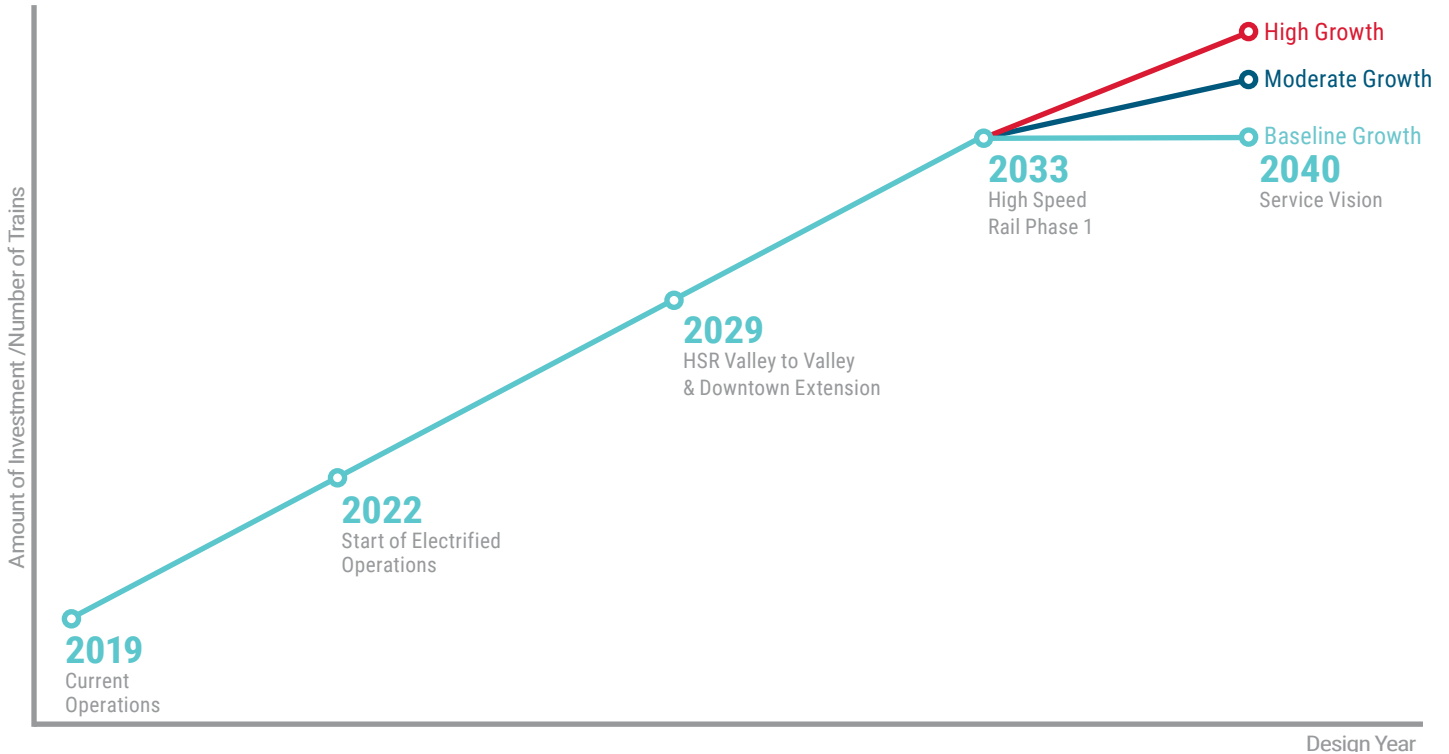


**PEAK  
SERVICE  
VOLUME**



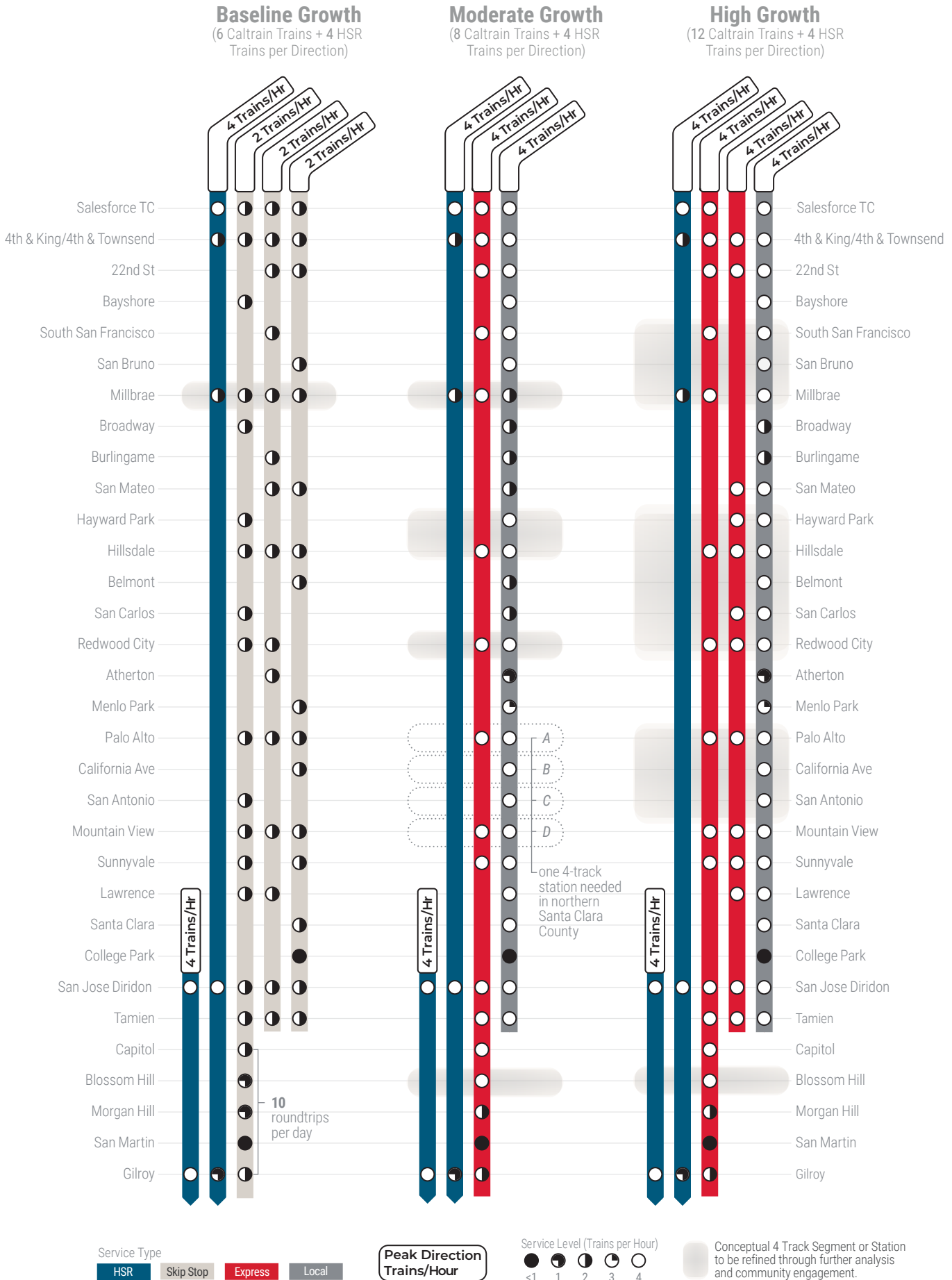
**SERVICE  
INVESTMENTS**

# DIFFERENT WAYS TO GROW



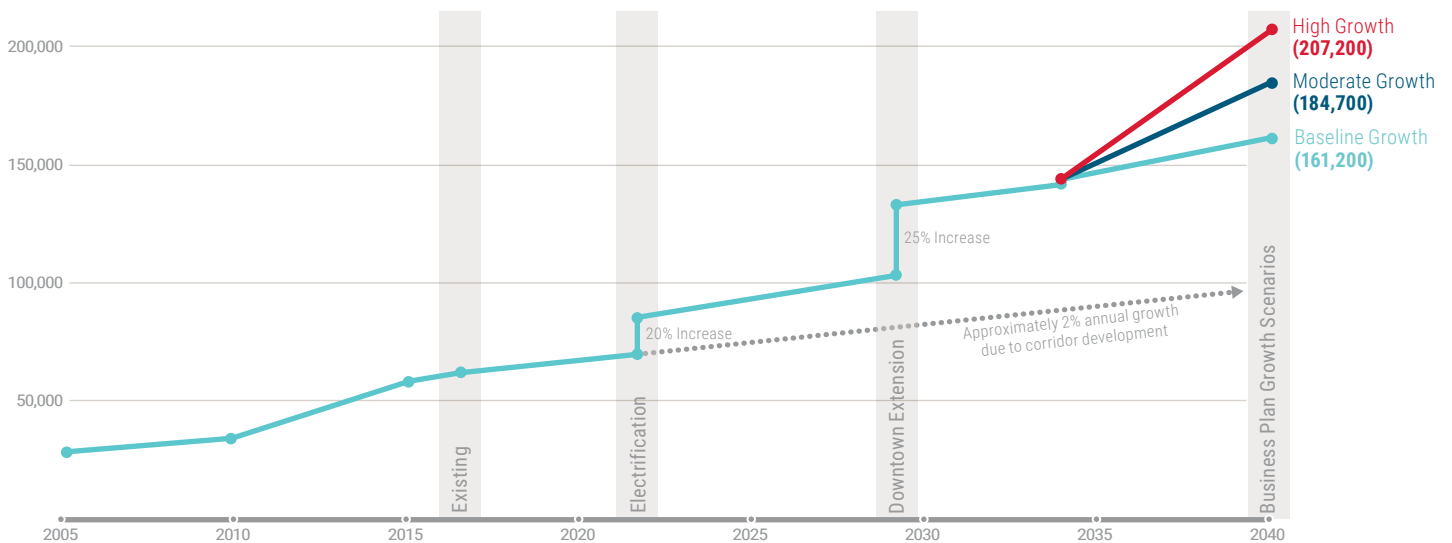
Caltrain has developed three long-range service scenarios that illustrate different choices for how the railroad could grow over time. Each of these scenarios incorporates and builds on the existing projects and policy commitments in the corridor. Although these scenarios are illustrative, they have been developed at a high level of detail to provide a realistic and nuanced picture of how rail service in the corridor could grow and what kinds of trade-offs might be required.

# CONCEPTUAL PEAK HOUR SERVICE SCENARIOS



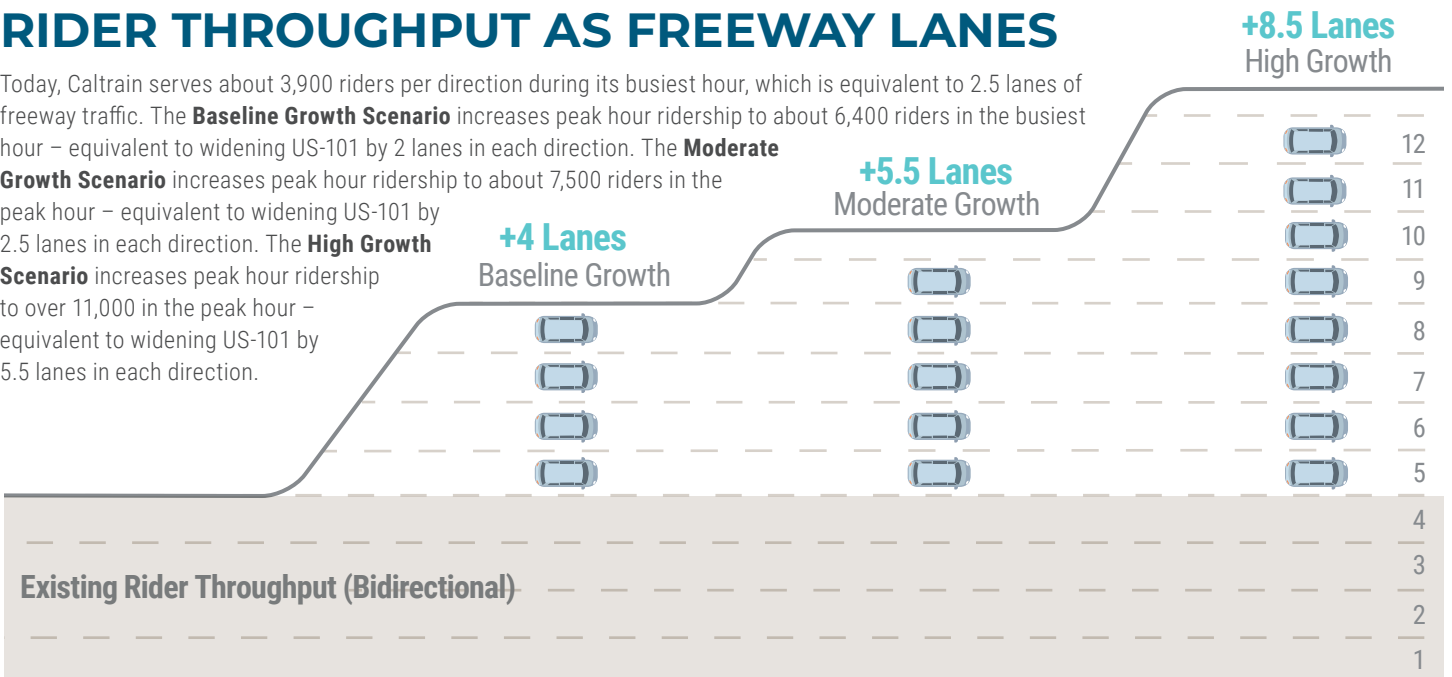
**Notes:** These service patterns and infrastructure projects represent illustrative concepts carried forward for business planning purposes. Actual service patterns and infrastructure may vary depending on corridor-wide and jurisdiction-specific feedback and will be refined and confirmed based on Board direction and subsequent planning and analysis. Ridership projections are derived from analysis of potential service patterns and land use changes included in Plan Bay Area or subsequently approved by local jurisdictions.

# WEEKDAY RIDERSHIP DEMAND OVER TIME



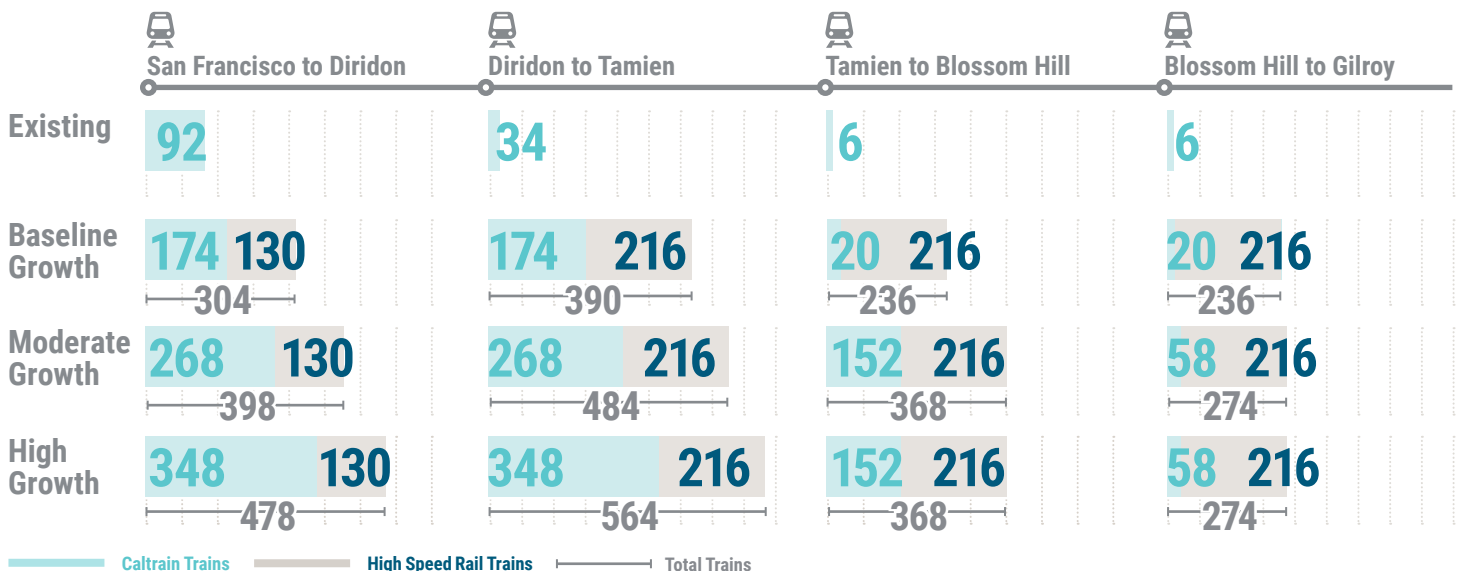
# RIDER THROUGHPUT AS FREEWAY LANES

Today, Caltrain serves about 3,900 riders per direction during its busiest hour, which is equivalent to 2.5 lanes of freeway traffic. The **Baseline Growth Scenario** increases peak hour ridership to about 6,400 riders in the busiest hour – equivalent to widening US-101 by 2 lanes in each direction. The **Moderate Growth Scenario** increases peak hour ridership to about 7,500 riders in the peak hour – equivalent to widening US-101 by 2.5 lanes in each direction. The **High Growth Scenario** increases peak hour ridership to over 11,000 in the peak hour – equivalent to widening US-101 by 5.5 lanes in each direction.



\*Assumes vehicle occupancy of 1.1 persons/vehicle and lane capacity of 1,500 vehicles/hour.

# HOW MANY TRAINS PER DAY?



Note: Graphic includes only Caltrain and HSR service and does not account for ACE, Capitol Corridor, or Freight/Amtrak trains.

# SERVICE CONCEPTS IN PALO ALTO



Station



Weekday Train Stops



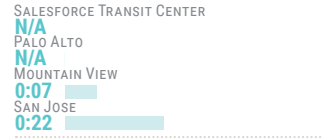
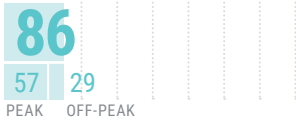
Daily Boardings



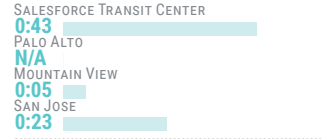
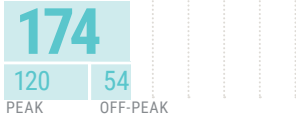
Quickest Travel Time (min)

## Palo Alto

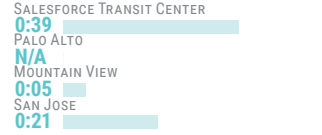
Existing



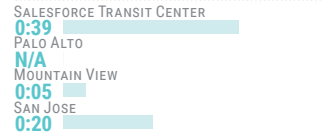
Baseline Growth



Moderate Growth

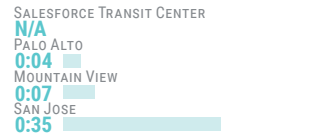


High Growth

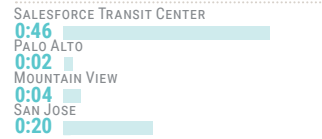


## California Ave

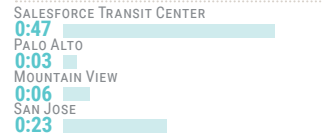
Existing



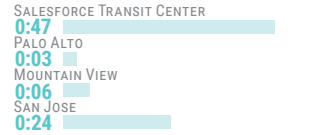
Baseline Growth



Moderate Growth



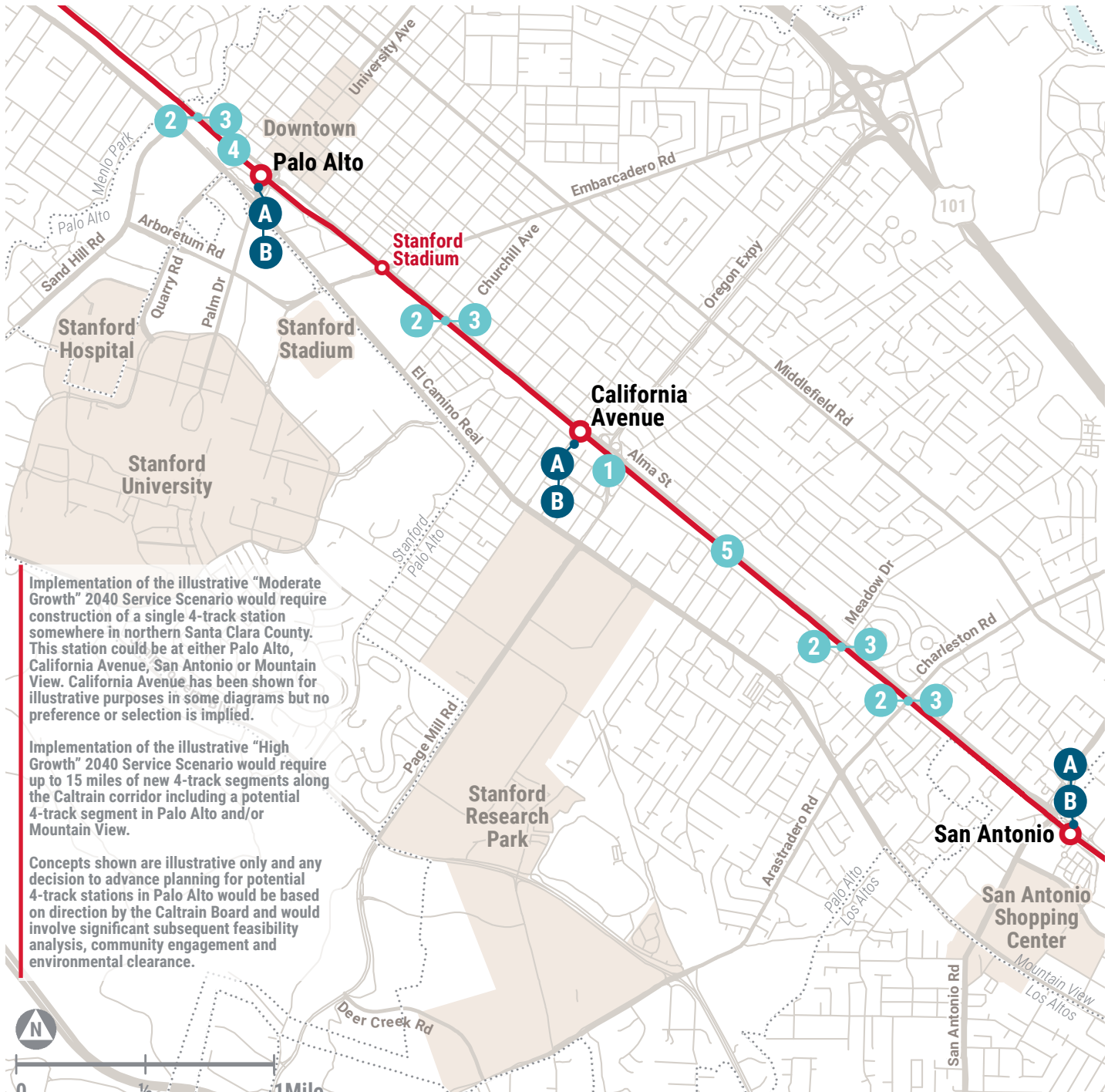
High Growth



**Notes:** These service patterns represent illustrative concepts carried forward for business planning purposes. Actual service patterns may vary depending on corridor-wide and jurisdiction-specific feedback as well as Board direction and subsequent analysis. Ridership projections are derived from analysis of potential service patterns and land use changes in Plan Bay Area or subsequently approved by local jurisdictions.

# CORRIDOR CONTEXT & CAPITAL PROJECTS

2040 VISION



Implementation of the illustrative "Moderate Growth" 2040 Service Scenario would require construction of a single 4-track station somewhere in northern Santa Clara County. This station could be at either Palo Alto, California Avenue, San Antonio or Mountain View. California Avenue has been shown for illustrative purposes in some diagrams but no preference or selection is implied.

Implementation of the illustrative "High Growth" 2040 Service Scenario would require up to 15 miles of new 4-track segments along the Caltrain corridor including a potential 4-track segment in Palo Alto and/or Mountain View.

Concepts shown are illustrative only and any decision to advance planning for potential 4-track stations in Palo Alto would be based on direction by the Caltrain Board and would involve significant subsequent feasibility analysis, community engagement and environmental clearance.



- Legend**
- Caltrain line
  - Key Destination

- Current Projects**
- 1 Paralleling Station
  - 2 Connecting Palo Alto Grade Separation Study
  - 3 Caltrain Grade Crossing Improvements - Palo Alto Ave, Churchill Ave, Meadow Dr, Charleston Rd
  - 4 Everett Ave Bike/Ped Grade Separation
  - 5 Loma Verde Ave Bike/Ped Grade Separation
  - Electrification

**Potential Projects**

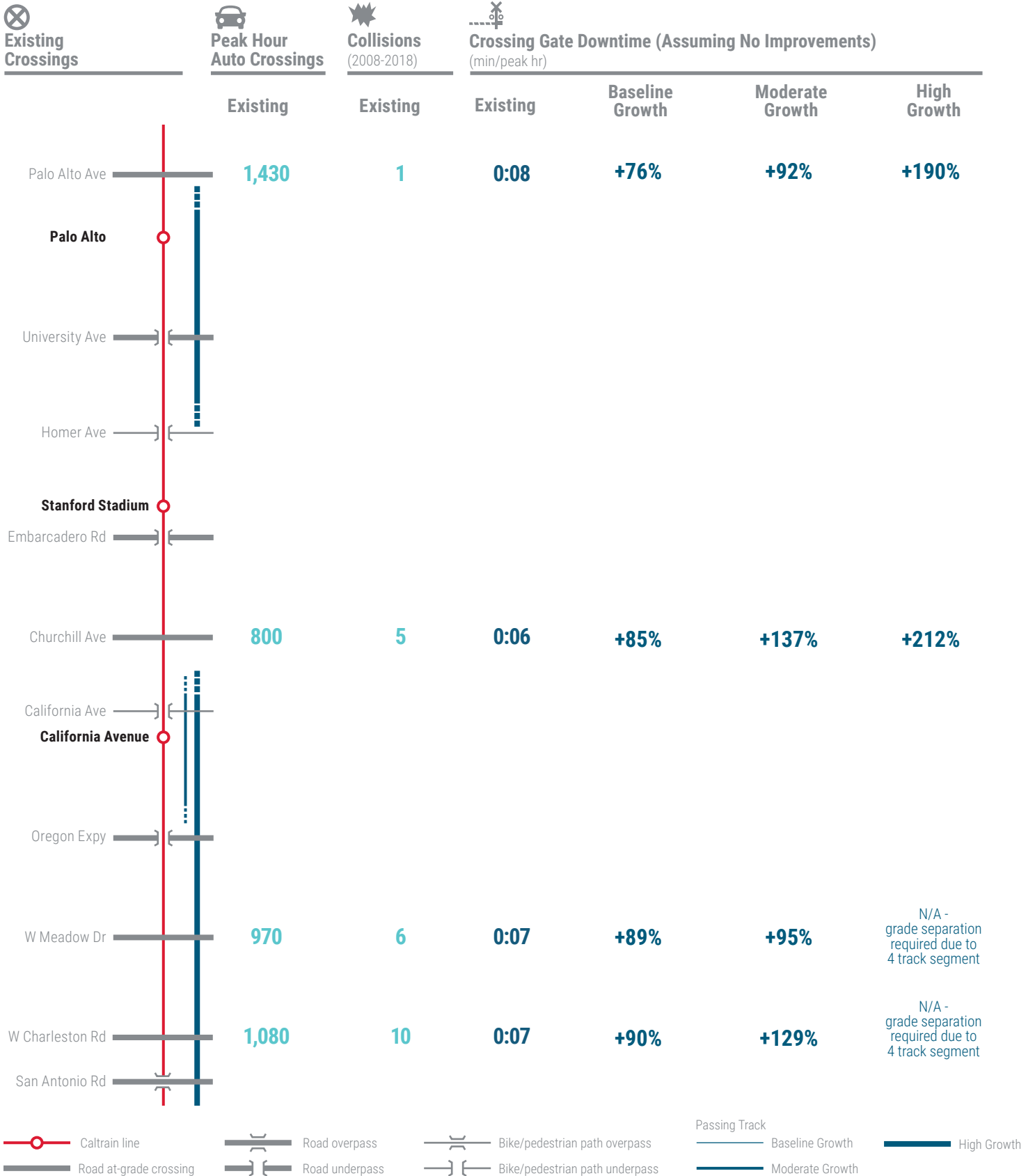
	Station enhancements and platform extensions		
<b>A</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>B</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Baseline Growth			
Moderate Growth			
High Growth			

**Notes:** These infrastructure projects represent concepts carried forward for business planning purposes. Actual infrastructure may vary depending on corridor-wide and jurisdiction-specific feedback.  
**Sources:** Caltrain Ridership Data, 2017; Caltrain Timetables, 2018; Caltrain Parking Occupancy Report, 2017; Caltrain 2014 On-Board Transit Survey; CPUC Collision Database, 2016; Fehr&Peers Traffic Counts, 2016; Caltrain Electrification EIR; US Census Bureau Population Estimates Program.






# CROSSING THE TRACKS

Gate down times shown are indicative projections extrapolated from existing crossing performance. They are examples of "worst case" gate downtimes that could occur if no grade separations or grade crossing improvements were made. The financial component of the Caltrain Business Plan is planning for substantial investments in grade separation and crossing improvements across all scenarios.



**Note:** Conceptual 4 Track Segment to be refined through further analysis and community engagement.

 [Caltrain2040.org](http://Caltrain2040.org)  650.508.6499  [BusinessPlan@Caltrain.com](mailto:BusinessPlan@Caltrain.com)





FALL 2020

# Caltrain Pandemic Rider Survey

## TOPLINE REPORT

Prepared by

**COREY, CANAPARY & GALANIS**

447 Sutter Street – Penthouse North

San Francisco, CA 94108

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## INTRODUCTION

This report provides topline findings from an onboard survey of Caltrain riders. The fieldwork was conducted October 26, 2020 through November 18, 2020.

Key objectives of the survey include:

- Reporting trip characteristics, such as peak/off-peak/weekend use.
- Reporting personal travel characteristics, such as frequency of Caltrain use and primary reasons for riding Caltrain.
- Reporting demographic characteristics, such as race/ethnicity, national origin, age, income, etc.
- Indication of ridership changes since the onset of shelter-in-place and related impacts from the COVID-19 Pandemic.

Percentages included in this report may not total 100% due to statistical rounding.

Questions regarding this project may be directed to: Julian Jest, Caltrain, 650.508.6245.

### Methodology

The survey was conducted onboard, a self-administered questionnaire was distributed to Caltrain riders. Surveyors boarded pre-selected trains and attempted to distribute questionnaires to all riders on up to three randomly selected cars of the assigned train. Completed surveys were also collected by these surveyors (who stayed onboard during the train trip).

Specific steps were taken to ensure the highest possible response rate. This included using professional, experienced onboard surveyors on the project, making the questionnaire available in English and Spanish, and providing both an online option and a business reply mail-back option for persons who did not have time to complete the survey onboard.

Field interviewing on this project was conducted from Monday, October 26, 2020, through Wednesday, November 18, 2020. Weekday shifts were allocated to allow for surveying during morning and afternoon peak periods, as well as off-peak periods. Saturday and Sunday trains were also surveyed at various times of the day. The dates of the fieldwork were scheduled to avoid surveying during particularly heavy maintenance or other events that would unduly impact ridership.

Surveyors returned completed questionnaires to Corey, Canapary & Galanis' office following the completion of the fieldwork. Editing, coding, and inputting were done in-house once the questionnaires were returned.

## Weighting

The existing data is weighted based on Strata as follows:

Weekday Peak ridership (trains leaving from start of service until 9 am and from 3 pm to 7 pm): 58%

Weekday Offpeak (trains Monday through Friday departing at all other times): 25%

Weekend (Sat/Sun all day): 18%

This weighting is based on the ridership figures for October 26-31, 2020, which was the first week of surveying, using the Caltrain onboard conductor counts for this period. For the final figures, weighting may be adjusted, as the weighting will include data for the first three weeks of November 2020 once it is available.

Because of this, *figures presented in this report may change in the final summary report, once November ridership data becomes available and weighting is applied.* The trends called out in the summary on the following pages exist in both weighted and unweighted data.

## SUMMARY OF RESULTS

Note: 2020 results are from the current (2020 Caltrain Pandemic Rider) survey. 2019 results are from the 2019 Caltrain Triennial Customer survey.

### Ridership Characteristics

- Riders are less likely to ride Caltrain frequently compared to 2019.
  - In 2019, 53% of riders used Caltrain 5 days per week or more. In 2020, that number dropped to 43%.
  - In 2019, only 8% of riders used Caltrain 3 days per month or less. However, in 2020, nearly a quarter of all riders (24%) use Caltrain 3 days per month or less.
- Riders are less likely to use monthly passes and more likely to use other types of fare payment.
  - While in 2019, 59% of riders used either a Go Pass or Caltrain monthly pass to pay for their fare, 39% of Caltrain riders used one of these passes in the 2020 survey.
  - A higher share of riders are using fare payment such as a regular one-way ticket (19% in 2020 vs 7% in 2019), Clipper cash (28% in 2020 vs 23% in 2019), or a mobile one way or day pass (8% in 2020 vs 5% in 2019).
- A smaller share of riders use Caltrain for work or school in 2020.
  - While in 2019, 87% were going to work or school on Caltrain (81% work, 6% school), 65% are going to work or school in 2020 (62% work, 2% school).
  - Notably a higher share of riders in 2020 were using the train for social or recreational purposes (20% in 2020 vs 9% in 2019).
- Respondents in 2020 are less likely to access Caltrain by driving and parking. While 24% drove and parked to reach Caltrain in 2019, only 12% did so in 2020. Conversely, while only 1% used SamTrans or another bus to access Caltrain in 2019, 11% used this mode in 2020.
- While 51% said they had a car available to make the surveyed trip in 2019, only 36% said they had a vehicle for the trip available in 2020. Moreover, those who said they use Caltrain because they do not have access to a car rose from 23% in 2019 to 46% in 2020. In 2020, this was the top reason given for riding Caltrain.

### COVID Impact

- Most of those surveyed in 2020 (78%) said they had used Caltrain even prior to shelter in place in March 2020.
- About half (53%) say they ride about the same as they did prior to March 2020, while 32% ride less frequently, and 15% ride more frequently.
- Only 20% say they are more likely to ride for work purposes, while 17% say they are less likely to ride for work related purposes, and 63% say they ride about the same amount for work.

- Among safety measures to address COVID, 86% said mask wearing was among the most important safety measure taken. This was followed by social distancing (61%), cleaning (54%), and ventilation (34%). Only 0.2% said measures were not needed.

### Demographics

- The average Caltrain rider in 2020 is slightly older (average 38 years) than in 2019 (average 36 years).
- The average household income of Caltrain riders has dropped from about \$158,000 in 2019 to about \$95,000 in 2020.
- In 2020, passengers are twice as likely to identify as Hispanic/Latino (12% in 2019 vs 26% in 2020) or Black (4% in 2019 vs 8% in 2020) compared to 2019.

On Apr 20, 2020, at 9:00 AM, Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)> wrote:

Hi Chantal,

You are correct regarding the “illustrative” extent of the 4-track segments considered in the Business Plan and shown in various diagrams / booklets. The exact location of a potential four track segment are yet to be defined, however. For the purposes of RCUP, which governs Caltrain’s use of its own property, we took the most conservative approach and considered the potential for a 4-track segment between San Francisquito Creek Bridge in Palo Alto to just through the Mountain View Station (the area in which a 4-tracks segment is operationally viable for the intended purpose). The ultimate extent of the area preserved for 4-tracks does not need to encompass this full length. However, we would need to work with the City to advance thinking about the City’s potential capital projects along the corridor to then make decisions that could constrain the extent of the area under consideration. Until that time, Caltrain will take a very conservative approach – as specified through the RCUP – when it comes to any potential long term encumbrance of our property. You are getting this conservative answer in response to a very specific question, which is whether we would allow the City to have long term/ permanent use of our property in this area for a non-rail purpose.

Let me know if you would like to discuss further.

Thanks,  
Melissa

**From:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>  
**Sent:** Friday, April 17, 2020 5:08 PM  
**To:** Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>; Litzinger, Millette <[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>  
**Cc:** Lightbody, James <[James.Lightbody@aecom.com](mailto:James.Lightbody@aecom.com)>; Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>; Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>  
**Subject:** Re: Encroachment at Churchill

Thank you so much for the thorough information Melissa! One very quick clarification question, for the four track information, our understanding was that Caltrain was looking at the area south of Oregon expressway and into Mountain View which will cover our other two crossings and not Churchill. Is that different now with the policy that you’re referring to? Just want to make sure I’m clear on what is current.

Thanks  
Chantal

Sent from my mobile device. Please excuse brevity and typos.

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**From:** Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>  
**Sent:** Friday, April 17, 2020 4:54:19 PM



**To:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>; Litzinger, Millette <[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>  
**Cc:** Lightbody, James <[James.Lightbody@aecom.com](mailto:James.Lightbody@aecom.com)>; Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>; Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>  
**Subject:** RE: Encroachment at Churchill

Hi Chantal,

See our answers to your questions below. Note that I'm still developing a response to question 2 and I expect to be able to provide an answer sometime next week.

1. In one of the new ideas (at Churchill), the design calls for us to encroach into the Caltrain Right of Way. We wanted to know what the likelihood is that Caltrain would be willing to grant us the ability to do so. This is in the area where the existing bike path is already in the Caltrain ROW (though I don't have the exact dimensions of the ROW. If we are unable to encroach into the Caltrain ROW, it would require us to do full acquisitions to many properties that front Alma in the Churchill area.

To clarify, the City is asking to use Caltrain right-of-way for public access facilities including a bike/ped path and a roadway. In February 2020, the JPB adopted the Rail Corridor Use Policy (RCUP), which serves as an implementation policy for the Caltrain Business Plan. The RCUP guides the agency's decision-making about use of JPB property in support of Caltrain's Long-Term Service Vision – similar to a City's zoning code guiding its land use decisions. Caltrain receives many proposals for non-railroad uses on its property, similar to the City's idea above to use the right-of-way for access facilities. The RCUP will be used to determine if a proposed non-railroad use is compatible with the railroad's current and future needs for its property. As you know, it is anticipated that significant portions of JPB's property holdings will be needed to deliver future infrastructure and support future train operations to achieve the Long-Term Service Vision. The RCUP protects those areas that are needed for current and future railroad use by limiting the types and durations of non-railroad uses that can be located in those areas.

This is directly applicable to the portion of Corridor in which the City is inquiring about a potential encroachment for access facilities. This is an area with multiple potential future capital projects identified in the RCUP to support the Long-Term Service Vision. While a potential grade separation at Churchill is identified, this is also an area of the corridor that could be needed for a potential four-track segment to support increased train service under the Business Plan's High Growth Scenario, which the JPB declared not be precluded in its adopted Long-Term Service Vision. Because of these potential future railroad uses in the area near Churchill, non-railroad uses are limited in this area of the corridor in the RCUP.

While the City could initiate the RCUP review process to have Caltrain staff review the compatibility of the proposed use of JPB property for the access facilities, the City's proposal would most likely be found to be an incompatible use of JPB property. In order to be considered for an exception to the RCUP and be considered compatible, the onus would be on the City to show via conceptual designs that a potential future four track segment would not be precluded in this area – then it would be possible for the encroachment to be potentially viable as a non-railroad use of JPB property. It's important to note that even if the City did this and the proposal was able to be considered "potentially viable" by receiving a compatibility exception through

the RCUP, it would still need to undergo substantial design, engineering, and regulatory review before it would be approved as a use for JPB property.

Following the recent adoption of the RCUP by the JPB, Caltrain staff have been in the process of implementing the RCUP, and more information will be provided on Caltrain's website soon. In the meantime, more information about the steps associated with the RCUP process is located [here](#):

[http://www.caltrain.com/Assets/\\_\\_\\_Agendas+and+Minutes/JPB/2020/Regular+JPB+Session+following+closed.pdf](http://www.caltrain.com/Assets/___Agendas+and+Minutes/JPB/2020/Regular+JPB+Session+following+closed.pdf)

Sebastian, copied here, is happy to discuss this issue further if you have questions about this particular situation.

2. Lastly, what would it take for Caltrain to say no shoofly is needed of that some other construction method would be considered or allowed?

[A response to this question is still being developed – more to come next week.](#)

3. Added Question on 3/25/2020 by Chantal: Does Caltrain have an agreement with Stanford for the Stanford Game Day station and is that something we can see?

[As discussed over the phone, Caltrain does not have an agreement with Stanford to provide service to the Stanford football games. The service has largely been marketing-driven, with Caltrain wanting to serve weekend events such as the Stanford football games.](#)

Thanks,  
Melissa

**From:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>

**Sent:** Monday, April 13, 2020 1:20 AM

**To:** Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>; Litzinger, Millette

<[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>

**Cc:** Lightbody, James <[James.Lightbody@aecom.com](mailto:James.Lightbody@aecom.com)>; Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>

**Subject:** [EXTERNAL] Re: Encroachment at Churchill

Hi everyone,

Thanks again for the call last week. I think it was very productive with bringing everyone up to speed. Melissa, is it possible you could let us know the expected timeline for Caltrain by the end of this week? We have to update our Council on our overall workplan and it would be great to include some version of estimated timing from Caltrain in that (as much as realistic to include).

Thanks,

Chantal C. G.

---

**From:** Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>  
**Sent:** Friday, April 3, 2020 11:45 AM  
**To:** Litzinger, Millette <[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>  
**Cc:** Lightbody, James <[James.Lightbody@aecom.com](mailto:James.Lightbody@aecom.com)>; Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>; Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>  
**Subject:** RE: Encroachment at Churchill

That sounds great! Thanks, Millette.

Regards,  
Melissa

**From:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>  
**Sent:** Thursday, March 26, 2020 2:52 PM  
**To:** Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>; Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>; Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>; Lightbody <[lightbody@yahoo.com](mailto:lightbody@yahoo.com)>  
**Cc:** Litzinger, Millette <[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>  
**Subject:** RE: follow-up on conference call

Ok. Got it. Yes, anything with some additional guidance on the 4-tracks issue would be great. I understand the complexity you reference. Let us know if you want to further discuss.

Re the other questions, that sounds great. Peter will also get you the drawings regarding the encroachment questions.

Thanks,  
Chantal

<image004.png>

**Chantal Cotton Gaines**

Assistant to the City Manager | City Manager's Office  
(650) 329-2572 | [chantal.gaines@cityofpaloalto.org](mailto:chantal.gaines@cityofpaloalto.org) \_  
[www.cityofpaloalto.org](http://www.cityofpaloalto.org)

**From:** Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>  
**Sent:** Thursday, March 26, 2020 2:49 PM  
**To:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>; Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>; Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>; Lightbody <[lightbody@yahoo.com](mailto:lightbody@yahoo.com)>  
**Cc:** Litzinger, Millette <[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>  
**Subject:** RE: follow-up on conference call

Hi Chantal,

Sorry for the confusion. We will work to get you answers to the questions below.

The “policy” issue is related to the 4-tracks. I can provide you with the basic illustrative information that was used in the business plan. Developing a policy is looking a bit more complex than I had hoped- that’s what I hoped to discuss with you.

**From:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>  
**Sent:** Thursday, March 26, 2020 2:37 PM  
**To:** Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>; Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>; Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>; Lightbody <[lightbody@yahoo.com](mailto:lightbody@yahoo.com)>  
**Cc:** Litzinger, Millette <[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>  
**Subject:** RE: follow-up on conference call

Hi Sebastian,

Thanks for getting back to us. That sounds like a good plan regarding the 4 track next steps. A memo would be great.

I am not sure if I read the email correctly below regarding the other items. Are you saying the encroachment conversation is one you are looking at from a policy standpoint or the shoofly? (It is fine if the answer is “both,” I just want to make sure I understand correctly). And if pursuing it as a policy, do you have a general sense of timing? The encroachment issue is a bigger issue for us than the shoofly though it is important too.

Lastly, just making sure you saw the question about the Stanford game day station. Please let me know if you have an agreement on the books somewhere and if we can view a copy of it.

Thanks,  
Chantal

<image006.png>

**Chantal Cotton Gaines**

Assistant to the City Manager | City Manager’s Office  
(650) 329-2572 | [chantal.gaines@cityofpaloalto.org](mailto:chantal.gaines@cityofpaloalto.org) \_  
[www.cityofpaloalto.org](http://www.cityofpaloalto.org)

**From:** Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>  
**Sent:** Wednesday, March 25, 2020 5:29 PM  
**To:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>; Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>; Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>; Lightbody <[lightbody@yahoo.com](mailto:lightbody@yahoo.com)>  
**Cc:** Litzinger, Millette <[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>  
**Subject:** RE: follow-up on conference call

**CAUTION: This email originated from outside of the organization. Be cautious of opening attachments and clicking on links.**

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Hi Chantal,

Thanks for the follow up and the added question. We are having an internal discussion at Caltrain about some of these issues later this week.

In terms of the 4-tracks, I apologize for the delay. My recollection is that you wanted specific information regarding the illustrative mileposts assumed for 4-track segments and that, separately, we had discussed Caltrain providing a memo or letter with further guidance around how we were interpreting the potential for 4-tracks relative to the alternatives being considered by Palo Alto.

On the first, I will work to get the information over to you shortly. The second item will take more time. We are wrestling with how to put this policy guidance into practice on the corridor in a manner that is consistent and fair to cities and the project's they are interested in advancing. I realize this is a pressing consideration for Palo Alto's process but it is also a significant policy determination for the railroad. It may be helpful for us to have another phone discussion on this topic soon.

Thanks

**Sebastian Petty, Deputy Chief, Planning**  
Peninsula Corridor Joint Powers Board  
1250 San Carlos Ave. San Carlos, CA 94070  
Phone: 650-730-8858 Website: [www.caltrain.com](http://www.caltrain.com)

<image007.png>

**From:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>  
**Sent:** Wednesday, March 25, 2020 3:26 PM  
**To:** Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>; Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>; Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>; Lightbody <[lightbody@yahoo.com](mailto:lightbody@yahoo.com)>  
**Cc:** Litzinger, Millette <[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>  
**Subject:** RE: follow-up on conference call

Hello everyone,

I know there is a ton going on right now, but I just wanted to follow up on this and I added another question below. AECOM has put together some drawings related to the encroachment questions below. I am including Peter DeStefano and Millette Litzinger from AECOM on this email so they can provide the most recent drawings related to the encroachment questions for further discussion with Melissa and whomever else you all designate.

Please let us know if you have any questions.

Best,  
Chantal C. G.

<image009.png>

**Chantal Cotton Gaines**

Assistant to the City Manager | City Manager's Office  
(650) 329-2572 | [chantal.gaines@cityofpaloalto.org](mailto:chantal.gaines@cityofpaloalto.org) \_  
[www.cityofpaloalto.org](http://www.cityofpaloalto.org)

**From:** Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>

**Sent:** Wednesday, March 11, 2020 2:35 PM

**To:** Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>; Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>;  
Lightbody <[lightbody@yahoo.com](mailto:lightbody@yahoo.com)>

**Cc:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>

**Subject:** follow-up on conference call

Hi Sebastian and team,

I hope you are well. I am emailing you to find out where we are on the follow up items that we discussed on our last conference call in terms of getting that information to the City. I think the major item was follow up about the 4 tracks.

Also, I am bothering AECOM to get you and Melissa the explanation of exceptions information. I really hope we can get it from them by no later than early next week.

In further conversations we have had with the XCAP and the proposers of the new ideas, we came up with a few additional questions that we wanted to discuss with Caltrain and have some sort of response to. They are:

1. In one of the new ideas (at Churchill), the design calls for us to encroach into the Caltrain Right of Way. We wanted to know what the likelihood is that Caltrain would be willing to grant us the ability to do so. This is in the area where the existing bike path is already in the Caltrain ROW (though I don't have the exact dimensions of the ROW. If we are unable to encroach into the Caltrain ROW, it would require us to do full acquisitions to many properties that front Alma in the Churchill area.
2. Lastly, what would it take for Caltrain to say no shoofly is needed of that some other construction method would be considered or allowed?
3. Added Question on 3/25/2020 by Chantal: Does Caltrain have an agreement with Stanford for the Stanford Game Day station and is that something we can see?

Best,

<image011.png>

**Philip Kamhi**

Chief Transportation Official, Office of Transportation  
City of Palo Alto  
Phone: 650.329.2520  
E-mail: [Philip.kamhi@cityofpaloalto.org](mailto:Philip.kamhi@cityofpaloalto.org)  
[www.cityofpaloalto.org](http://www.cityofpaloalto.org)

## Caltrain Follow-Up Regarding Shoofly – Discussed at 5/20/2020 XCAP meeting

**From:** Reggiardo, Melissa <[reggiardom@samtrans.com](mailto:reggiardom@samtrans.com)>

**Sent:** Monday, May 18, 2020 2:29 PM

**To:** Kamhi, Philip <[Philip.Kamhi@CityofPaloAlto.org](mailto:Philip.Kamhi@CityofPaloAlto.org)>

**Cc:** Gaines, Chantal <[Chantal.Gaines@CityofPaloAlto.org](mailto:Chantal.Gaines@CityofPaloAlto.org)>; DeStefano, Peter <[peter.destefano@aecom.com](mailto:peter.destefano@aecom.com)>; Litzinger, Millette <[millette.litzinger@aecom.com](mailto:millette.litzinger@aecom.com)>; Lightbody, James <[James.Lightbody@aecom.com](mailto:James.Lightbody@aecom.com)>; Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>; Shikada, Ed <[Ed.Shikada@CityofPaloAlto.org](mailto:Ed.Shikada@CityofPaloAlto.org)>; Petty, Sebastian <[Pettys@samtrans.com](mailto:Pettys@samtrans.com)>

**Subject:** RE: Encroachment at Churchill

Hi Philip,

I hope this email finds you all well.

I'm finally getting back to the second question in your previous email:

2. Lastly, what would it take for Caltrain to say no shoofly is needed of that some other construction method would be considered or allowed?

In order to make a determination, Caltrain would need more information on construction sequencing so as to understand associated operating impacts in detail. This would include determining the extent of proposed closures and single tracking, including the duration of these events. Decisions related to whether or not Caltrain would accept certain operational impacts to accommodate the construction of a specific, local project are ultimately a system-wide policy issue. In terms of construction sequencing, Caltrain would need to examine designs and construction phasing plans (approximately 15 percent or conceptual planning phase). Part of Caltrain's design review would also focus on the ability of the project to build abutments and drive piles within a safe distance from electrified system components.

Also of note is that Caltrain staff believe that such construction scenarios will likely take longer to build while construction in an electrified environment will introduce more complexity.

In advance of reviewing a detailed proposal, Caltrain staff generally believe that there is a low probability that such a request would be approved. Should the City decide to provide the level of design detail needed for Caltrain to undertake a more detailed review, the City and railroad would need to discuss the substantial level of effort needed to review such a request and the associated agreements and funding commitments that would be required. In the absence of the required design detail or a formal review, the default answer to such a question would be no.

At early stages of project development – when many alternatives are being considered and detailed review by the railroad has yet to occur – we generally encourage communities to adhere to established railroad standards and construction methodologies as they develop concepts and alternatives. While this is a conservative approach, doing anything less heightens the risk that project impacts or costs may be understated at this early stage and that decisions may be made based on overly optimistic assumptions.

Caltrain is planning to undertake a corridor-wide grade separation analysis over the coming years that will comprehensively address issues like standards and alternative construction methodologies on a system-wide scale. We encourage Palo Alto to engage in this process and hope to begin the effort in the second half of 2020.

As always, let us know if you want to discuss further.

Thanks,  
Melissa



**PALO ALTO**  
UNIFIED SCHOOL DISTRICT

25 Churchill Avenue  
Palo Alto, CA 94306

Office of the Superintendent

To: Ed Shikada, City Manager  
From: Don Austin, Superintendent of Schools  
Date: February 20, 2020  
Subject: Potential Closing of Churchill Avenue

The Palo Alto Unified School District (PAUSD) has not taken an official position regarding proposed options to mitigate increased rail traffic. As the Superintendent of Schools, I want to provide some context about District use of Churchill Avenue (Churchill).

On any given day, Palo Alto High School (Paly) averages a little under 1,000 bicycles. The majority of bicycles enter from Churchill, although exact data is not easily obtainable. Clearly, student safety is the top concern of the District and a full closure of Churchill may negatively impact student safety related to bicycle commuters.

PAUSD deploys 22 busses each day to various parts of Palo Alto and East Palo Alto. Currently, our busses cross Alma Street at Churchill over 20 times per day as part of routine business. This does not include athletic or other extra-curricular trips. Our only entrance to our transportation yard is on Churchill. Practically speaking, a closure of Churchill would force every bus onto El Camino to make a right or left turn.

Our Maintenance and Operations fleet crosses Alma and Churchill approximately 175 times per day. This includes vans, trucks, and trailers. As described for our busses, the maintenance yard also depends upon a single entry/exit point on Churchill.

It is our understanding that proposals exist or may arise restricting large vehicle access to some mitigation options. PAUSD would contend that restrictions to large vehicles would negatively impact our busses and maintenance vehicles.

Finally, while traffic is the main focus of mitigation efforts, PAUSD would also like to raise the point that increased rail use negatively impacts the learning environment at Paly. Current rail use is already a major distraction for students in classes paralleling the rail line. The staff and students at Paly would benefit greatly by any mitigating efforts connected to sound barriers.

PAUSD is thankful for the efforts of our City leadership and the volunteers serving on the committee to propose solutions.





**PALO ALTO**  
UNIFIED SCHOOL DISTRICT

OFFICE OF THE SUPERINTENDENT

25 Churchill Avenue  
Palo Alto, CA 94306  
(650)329-3737

[www.pausd.org](http://www.pausd.org)

December 7, 2020

Palo Alto City Council  
City Manager Ed Shikada  
250 Hamilton Ave.  
Palo Alto, CA 94301

Dear City Council and City Manager Shikada,

We understand XCAP has been continuing to work on the grade separation issue during COVID and will be providing their report to City Council soon. We appreciate their efforts. However, PAUSD, parents, and the community have been focused on contending with the COVID emergency and have been unable to provide adequate engagement or representation in this critical process.

Since our last letter to XCAP in February 2020, new alternatives have been considered by XCAP. Due primarily to the COVID pandemic and the unprecedented impact on schools and school families, our District and our stakeholders have not been able to meaningfully engage with these new ideas. Our understanding is that the XCAP is recommending closing Churchill which could have very significant impacts on access to Paly High School, the PAUSD bus yard at Paly, the District headquarters at 25 Churchill, and bikes, pedestrians, and vehicles to Paly and by parents driving to Walter Hays and Greene schools. While the report is not complete, from meeting notes on the XCAP's website they seem to indicate additional information is needed.

Our understanding is that XCAP will be making a recommendation to close Churchill, but will defer decisions on Meadow/Charleston. We would ask that in light of the limited participation from PAUSD and our various stakeholders, including PTAC, PABAC and PTA Traffic Safety Committee, and the PAUSD school community in general, the City should hold off on any decisions until additional information is provided on alternatives and until the COVID emergency has transitioned to a degree of normalcy that allows PAUSD and our stakeholders to participate fully in these important decisions.

Some of the issues and areas we believe our stakeholders will have strong interest in include:

- **Detailed review of bike/ped improvements:** If Churchill is ultimately closed, the rerouting of cars impacts streets like Embarcadero. While some traffic mitigations have been studied, we support further study to specifically understand the impacts to existing and potential future bike/ped paths - particularly the bike path along Embarcadero that could be impacted by the potential addition of a traffic signal at Embarcadero/High. In addition, further review of the proposed pedestrian overpass on the west side of the Embarcadero grade separation should be reviewed. And, any alternative at

Meadow/Charleston could potentially increase the number of cars along the streets requiring mitigations to ensure adequate bike/ped safety. Finally, potential diversion of auto traffic from Churchill to neighborhood streets that serve as school routes should also be considered.

- **Increasing potential Bike/Ped Only crossings:** Any bike/ped crossings that are completely separated from cars provide a safer experience. We support the study of additional potential crossings at additional locations, such as Seale/Alma and the vicinity of Loma Verde/Alma. If possible, these crossings could be a mitigation during construction to provide safe routes to school and could potentially provide additional ways to cross the tracks more safely. The need for safe, grade separated crossings of the rail corridor and Alma Expressway in South Palo Alto (where currently there are none) remains a critical issue that was highlighted in the 2012 Bike Plan and the 2012 Rail Corridor Study and the updated Comprehensive Plan.
- **Formal participation from PAUSD:** As the City moves forward with future iterations of the different grade separation designs, we would like to see active involvement of Pedestrian and Bicycle Advisory Committee (PABAC) and Safe Routes to School (PTAC Traffic Safety Committee and PTA councils for affected school sites). We should develop a formal method review and participation by PAUSD, and not rely on the informal mechanisms that are in place today. This helps ensure the City arrives at complete intersection designs for all students and families of the Palo Alto Unified School District.

We understand the City's desire to move forward with decisions relating to rail crossings. I'm sure you agree that changes of such magnitude are best done with the full engagement of impacted stakeholders. The pandemic unfortunately has made this impossible during the last several months. We appreciate your consideration of our request to slow the process to enable the District and our stakeholder groups to effectively engage and participate, so we can all support the final recommendations.

Sincerely,  
Donald B. Austin, Ed.D.  
Superintendent of Schools

# Greene Middle School

## WALK AND ROLL TO SCHOOL SUGGESTED ROUTES

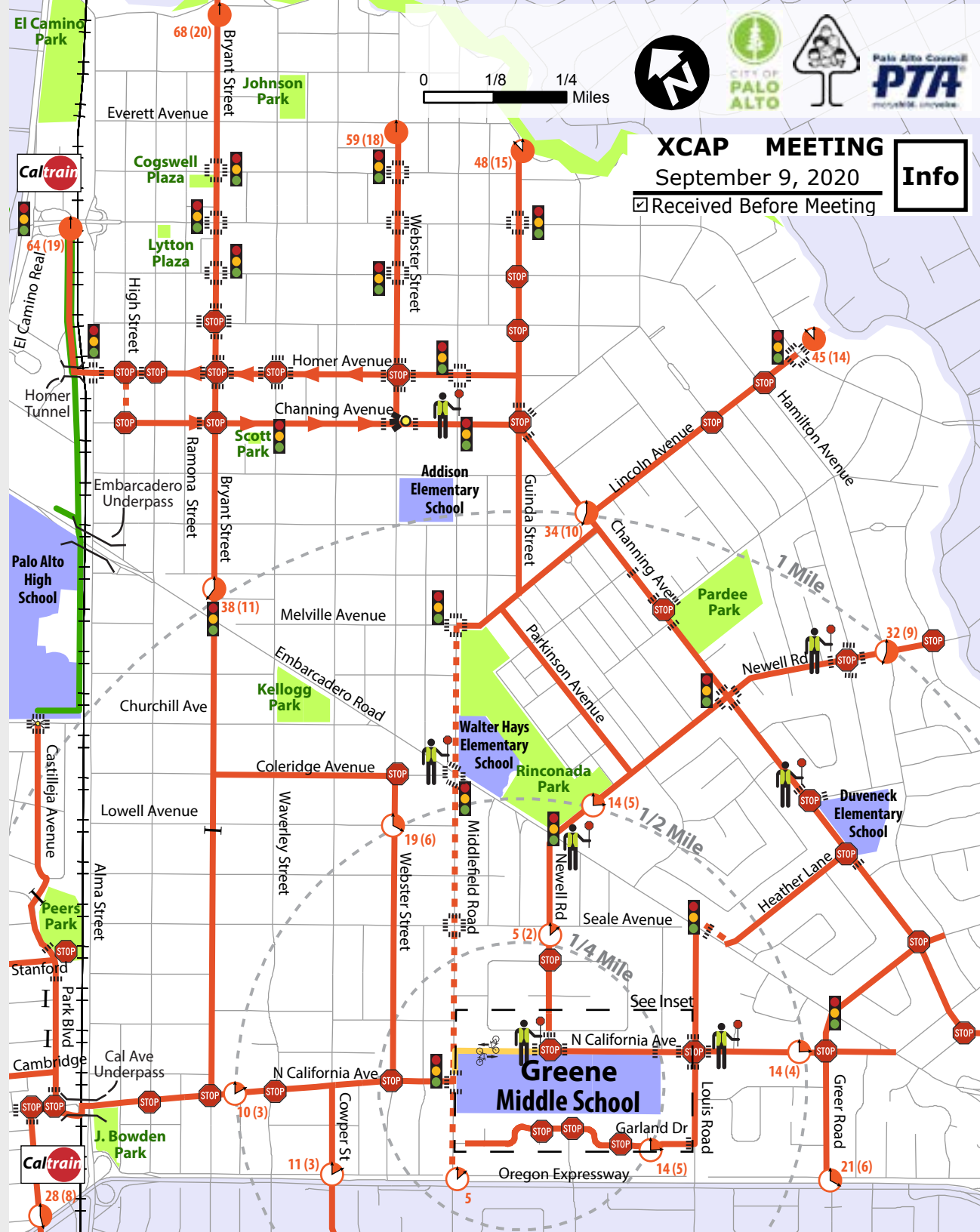
- Suggested Route (Walking and Biking)
- Suggested Route (Walking Only)
- Est. Walking Time (Biking Time)
- Crossing Guard Location
- Pedestrian and Bicycle Access
- Pedestrian-Only Access
- Multi-use Path
- Vehicle Barrier
- Bicycle Parking
- Bike Fix-it Station/Pump
- Pedestrian Beacon
- Traffic Signal
- All-Way Stop Marked
- Crosswalk Attendance
- Area Parks and Open Space
- Space
- School

Inset



For more Safe Routes to School information, please visit: [www.cityofpaloalto.org/saferoutes](http://www.cityofpaloalto.org/saferoutes)

The Palo Alto Safe Routes to School Partnership encourages Greene parents and students to use this map to explore options for commuting between home and school. Parents are responsible for choosing the most appropriate option based on their knowledge of conditions on the different routes and the experience level of their student.



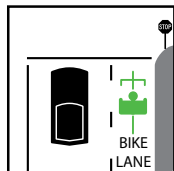
**XCAP MEETING**  
 September 9, 2020  
 Received Before Meeting

**Info**

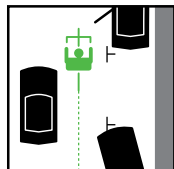
**Share the road safely with all other users, no matter how you choose to get to and from school.** Use extra caution near younger students walking or biking to school.

**Obey adult crossing guards.** They are there to help everyone cross congested intersections safely.

## Bike Safely



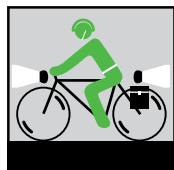
**Be predictable.** Obey ALL stop signs and traffic signals. Never ride wrong way. The best way to avoid crashes as well as traffic tickets is to follow the same rules of the road as apply to car drivers.



**Be alert.** Watch out for drivers turning left or right, or coming out of driveways. Avoid car doors opening in front of you by riding out of the door zone. Yield to pedestrians.



**Wear your helmet and buckle it every time.** It's the law. To best protect your brain, your helmet must fit properly: snug and level on your head, just above your eyebrows.



**Be visible.** Use a bright headlight and taillight at night.

**Avoid texting, phone calls, or music while biking.**

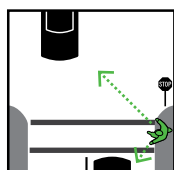
## Walk or Skate Safely



check all directions

**Be alert.** Look for cars coming from all directions before entering the street - including from behind you.

**Cross at corners and crosswalks.** This is where drivers expect pedestrians.



**Don't assume drivers see you.** Make eye contact before crossing intersections.

## Drive Safely

- Slow down and use extra caution in school zones, along commute routes and when approaching roundabouts or construction zone, signal your turns and yield to pedestrians and bicycles.
- Help reduce traffic congestion near Greene and neighboring schools by carpooling with a neighbor and avoiding the last minute rush whenever possible.
- Obey adult crossing guards and "No Right Turn on Red" signs posted at designated school intersections. This allows students to cross safely without cars turning through crosswalks.
- Don't make U-turns and other unsafe maneuvers that put other road users at risk.
- When dropping off or picking up your student, follow school guidelines and always ensure that he/she exits or enters the car from the curb side.
- Never double park, block access ramps or stop where prohibited.
- **Avoid texting, phone calls and other distractions when driving.**

## Street Design Changes!



Two-way bikeways are physically separated bike lanes that allow bicyclists to travel in both directions on the same side of the road. When approaching the signalized N. California/Middlefield intersection, cyclists should wait in the green box until the pedestrian crossing signal appears.

We welcome volunteers to help with Safe Routes to School events and programs at this school!

Contact your PTA or email [saferoutes@cityofpaloalto.org](mailto:saferoutes@cityofpaloalto.org).

**City of Palo Alto Safe Routes to School**

[www.cityofpaloalto.org/saferoutes](http://www.cityofpaloalto.org/saferoutes)

[saferoutes@cityofpaloalto.org](mailto:saferoutes@cityofpaloalto.org)

650.329.2520
















# WALK AND ROLL TO SCHOOL

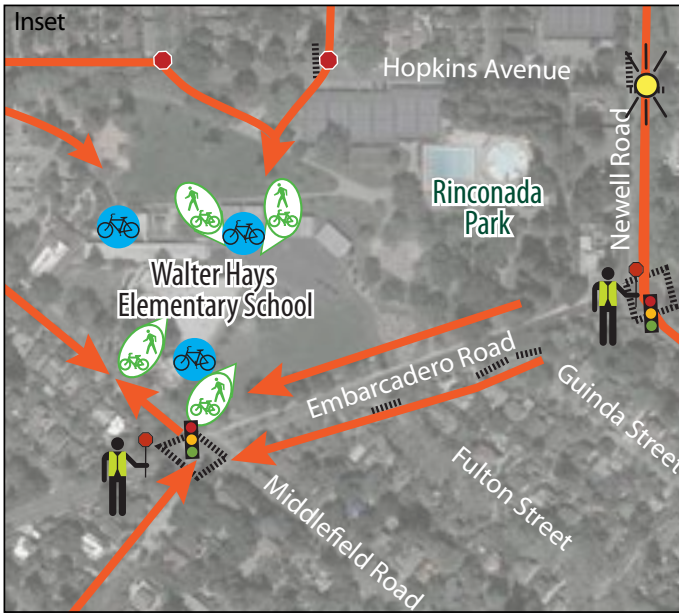
## Suggested Routes

# Greene Middle School

# Walter Hays Elementary School

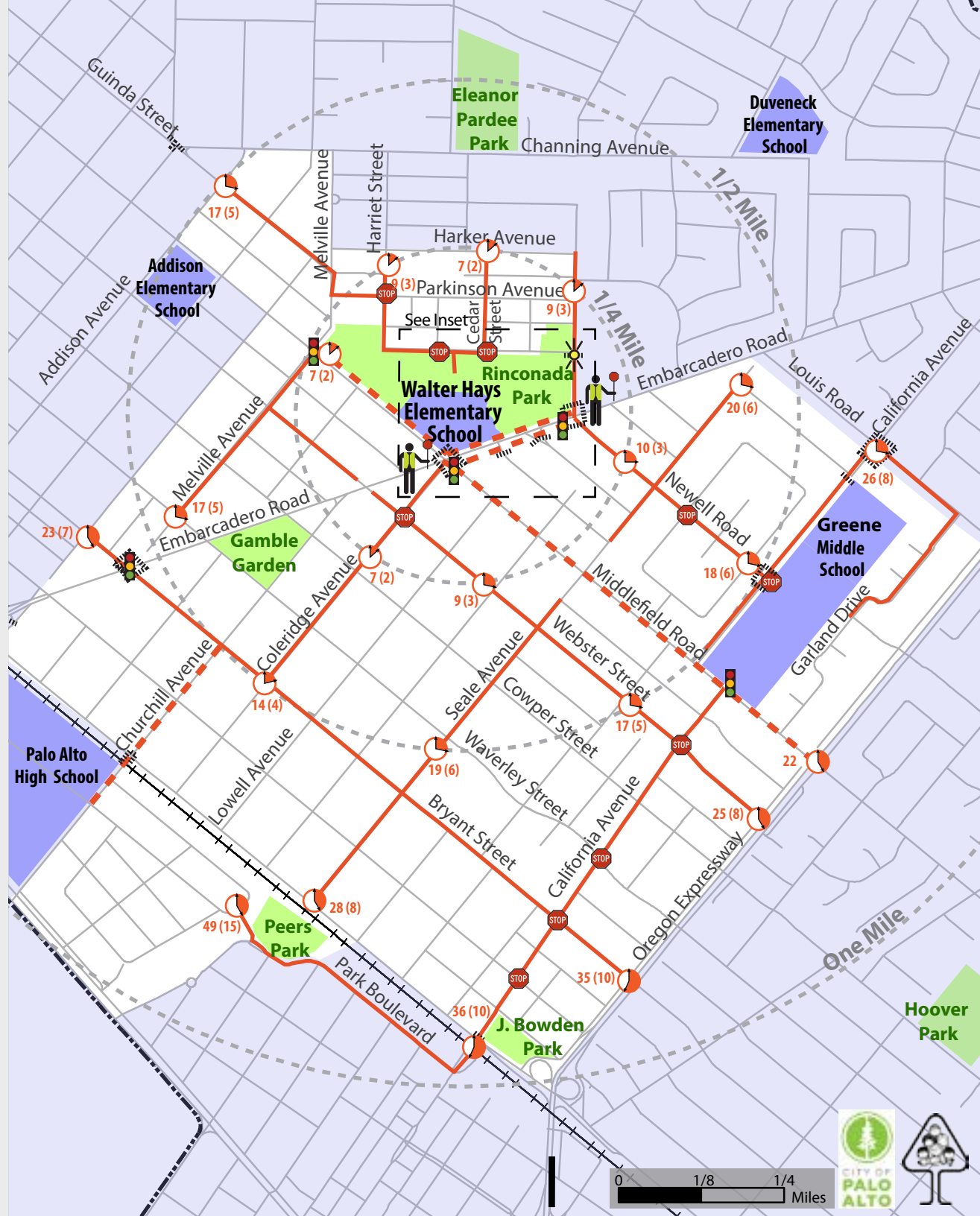
## WALK AND ROLL TO SCHOOL SUGGESTED ROUTES

-  School
-  Suggested Route (Walking and Biking)
-  Suggested Route (Walking Only)
-  Est. Walking Time (Biking Time)
-  Crossing Guard Location
-  Pedestrian and Bicycle Access
-  Bicycle Parking
-  Traffic Signal
-  All-Way Stop
-  Pedestrian Beacon
-  Marked Crosswalk
-  Enrollment Area
-  Parks and Open Space



For more Safe Routes to School information, please visit: [www.cityofpaloalto.org/saferoutes](http://www.cityofpaloalto.org/saferoutes)

The Palo Alto Safe Routes to School Partnership encourages parents to walk or bike with students and use this mapping tool to explore options for commuting from home to school. Parents are responsible for choosing the most appropriate route based on their knowledge of conditions on the route between home and school and the experience level of their child.



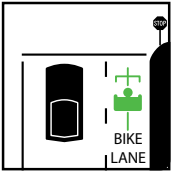
**Parents: Help your student learn how to share the road safely with other users.** Children who regularly practice safe walking and biking skills are more likely to make safer choices as teenagers.

**Obey adult crossing guards.** They are there to help everyone cross congested intersections safely.

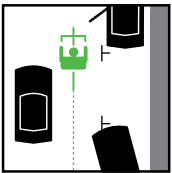
## Bike Safely



**Wear your helmet and buckle it every time.** It's the law. To best protect your brain, your helmet must fit properly: snug and level on your head, just above your eyebrows.

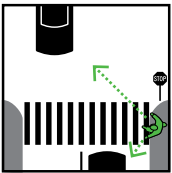


**Be predictable.** Obey ALL stop signs and traffic signals. Never ride the wrong way. The best way to avoid bike crashes as well as traffic tickets is to follow the same rules of the road as apply to car drivers.



**Be alert.** Watch out for drivers turning left or right, or cars coming out of driveways. Avoid car doors opening in front of you by riding out of the door zone. Yield to pedestrians.

## Walk or Skate Safely



**Be alert.** Look for cars coming from all directions before entering the street - including behind you.



**Cross at corners and crosswalks.** This is where drivers expect pedestrians.

**Don't assume drivers see you.** Make eye contact before crossing intersections.

## Drive Safely

- Slow down and use extra caution in school zones and along commute routes! Signal your turns and yield to pedestrians.
- Help reduce traffic congestion near Walter Hays and neighboring schools by carpooling with a neighbor and avoiding the last minute rush whenever possible.
- Obey adult crossing guards and "No Right Turn on Red" signs posted at designated school intersections. This allows students to cross safely without cars turning through crosswalks.
- Don't make U-turns and other unsafe maneuvers that put other road users at risk.
- When dropping off or picking up your student, follow school guidelines and always ensure that he/she exits or enters the car from the curb side.
- Never double park, block access ramps or stop where prohibited.
- **Avoid texting, phone calls and other distractions when driving.**



### New Street Marking!

Cyclists should ride down the center of this "sharrow" symbol to stay outside the "door zone" on streets without bike lanes. Sharrows also remind drivers to watch for cyclists.

We welcome volunteers to help with Safe Routes to School events and programs at this school!

Contact your PTA or email  
[saferoutes@cityofpaloalto.org](mailto:saferoutes@cityofpaloalto.org).

### City of Palo Alto Safe Routes to School

[www.cityofpaloalto.org/saferoutes](http://www.cityofpaloalto.org/saferoutes)

[saferoutes@cityofpaloalto.org](mailto:saferoutes@cityofpaloalto.org)

650.329.2156



# WALK AND ROLL TO SCHOOL

## Suggested Routes

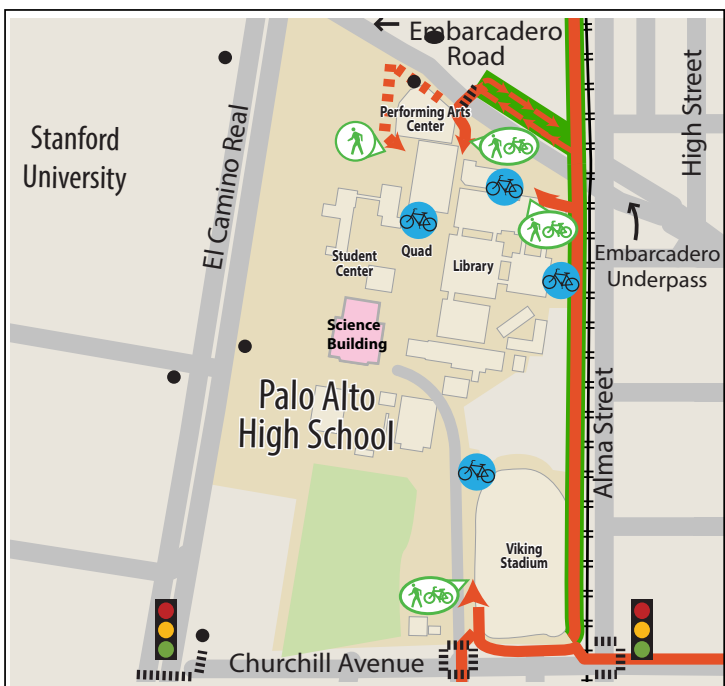
# Walter Hays Elementary

# Palo Alto High School

## WALK AND ROLL TO SCHOOL

### SUGGESTED ROUTES

- Suggested Route (Walking and Biking)
- Suggested Route (Walking Only)
- Est. Walking Time (Biking Time)
- Crossing Guard Location
- Multi-use Path
- Bus Stop
- Two-way Bikeway
- Vehicle Barrier
- Pedestrian and Bicycle Access
- Undercrossing (Please walk bikes)
- Bicycle Parking
- Traffic Signal
- All-Way Stop
- Marked Crosswalk
- Attendance Area
- Parks and Open Space
- School
- Pedestrian-Only Access
- Construction Zone



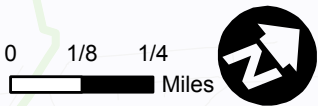
For more Safe Routes to School information, please visit:  
[www.cityofpaloalto.org/saferoutes](http://www.cityofpaloalto.org/saferoutes)

The Palo Alto Safe Routes to School Partnership encourages Palo Alto High School parents and students to use this map to explore options for commuting between home and school. Parents are responsible for choosing the most appropriate option based on their knowledge of conditions on the different routes and the experience level of their student. See [www.cityofpaloalto.org/saferoutes](http://www.cityofpaloalto.org/saferoutes) for more info.



For more information about bus and trail connections, see:

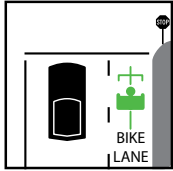
- VTA Routes 22 and 522: [www.vta.org](http://www.vta.org)
- SamTrans Routes 280 and 281: [www.samtrans.com](http://www.samtrans.com)
- TECH Line: <https://tinyurl.com/stanfordtechline>
- City of Palo Alto Embarcadero and Crosstown Shuttles: [www.cityofpaloalto.org/shuttle](http://www.cityofpaloalto.org/shuttle)
- Stanford's off-road paths: <http://transportation.stanford.edu/alt-transportation/midpen-bike-map.html>



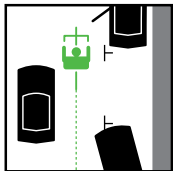
Share the road safely with all other users, no matter how you choose to get to and from school. Use extra caution near younger students walking or biking to school.

**Obey adult crossing guards.** They are there to help everyone cross congested intersections safely.

## Bike Safely



**Be predictable.** Obey ALL stop signs and traffic signals. Never ride wrong way. The best way to avoid crashes as well as traffic tickets is to follow the same rules of the road as apply to car drivers.



**Be alert.** Watch out for drivers turning left or right, or coming out of driveways. Avoid car doors opening in front of you by riding out of the door zone. Yield to pedestrians.



**Wear your helmet and buckle it every time.** It's the law if you are under 18, and wise at any age. To best protect your brain, your helmet must fit properly: snug and level on your head, just above your eyebrows.



**Be visible.** Use a bright headlight and taillight at night.

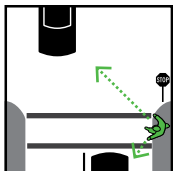
**Avoid texting, phone calls, or music while biking.**

## Walk or Skate Safely



**Be alert.** Look for cars coming from all directions before entering the street - including behind you.

**Cross at corners and crosswalks.** This is where drivers expect pedestrians.



**Don't assume drivers see you.** Make eye contact before crossing intersections.

## Drive Safely (Teens and Parents)

- Westbound drivers on Churchill may not proceed across the Caltrain tracks on weekdays, 7:45 am to 8:30 am. You must turn left onto Alma.
- Slow down and use extra caution in school zones and along commute routes. Signal your turns and yield to pedestrians.
- Help reduce traffic congestion near Palo Alto High School and neighboring schools by carpooling with a neighbor and avoiding the last minute rush whenever possible.
- Obey adult crossing guards and "No Right Turn on Red" signs posted at designated school intersections. This allows students to cross safely without cars turning through crosswalks.
- Don't make U-turns and other unsafe maneuvers that put other road users at risk.
- Never double park, block access ramps or stop where prohibited.
- **Avoid texting, phone calls and other distractions when driving.**

### Pedestrian Hybrid Beacon

A Pedestrian Hybrid Beacon (PHB) is a flashing signal which warns drivers when pedestrians are crossing the roadway. If you are on foot,

- Push the button to activate the pedestrian beacon
- Wait for the walk signal
- Look to be sure cars have stopped before entering the crosswalk

We welcome volunteers to help with Safe Routes to School events and programs at this school!

Contact your PTA or email [saferoutes@cityofpaloalto.org](mailto:saferoutes@cityofpaloalto.org).

**City of Palo Alto Safe Routes to School**

[www.cityofpaloalto.org/saferoutes](http://www.cityofpaloalto.org/saferoutes)

[saferoutes@cityofpaloalto.org](mailto:saferoutes@cityofpaloalto.org)

650.329.2520



# WALK AND ROLL TO SCHOOL

## Suggested Routes

# Palo Alto High School



# PALO ALTO RAIL CORRIDOR STUDY

The Report of the Task Force



Approved by City of Palo Alto City Council  
January 22, 2013

Figure 4.1: Framework of Crossings & Connectivity



Figure 4.3: Priority Rail Crossing Locations

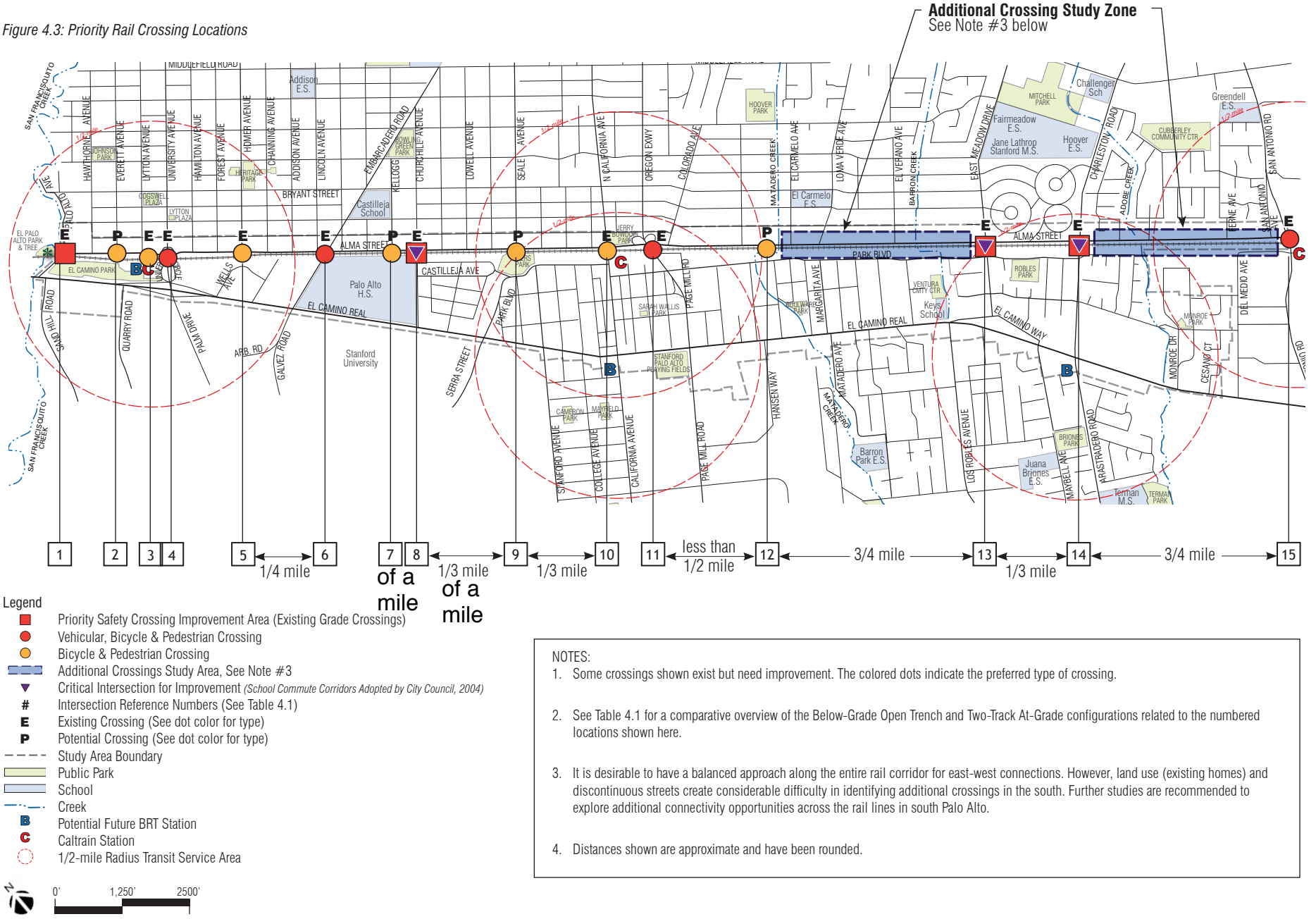
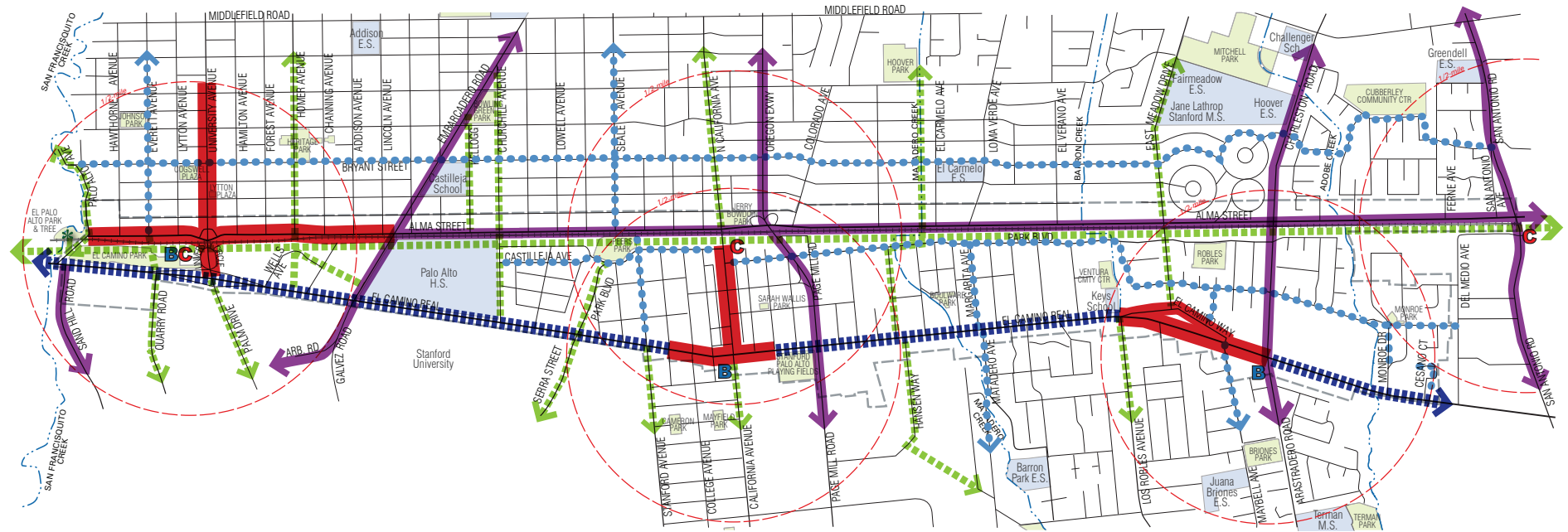


Figure 4.7: Layered Street Framework



- Legend**
- Major Vehicular Street
  - ▬▬▬ Primary Multi-Modal Transportation Corridor
  - ▬▬▬ Main Street in the Mixed-Use Centers
  - ▬▬▬ Inter-neighborhood Pedestrian/Bicycle Connector
  - Bicycle Boulevard
  - Local Streets
  - ▬▬▬ Study Area Boundary
  - ▭ Public Park
  - ▭ School
  - ~ Creek
  - B Potential Future BRT Station
  - C Caltrain Station
  - 1/2-mile Radius Transit Service Area



For purposes of this study, roadways and streets have been described using terms that differ from the Comprehensive Plan to allow for a discussion about the character of the streets, the function they play in the community and the multi-modal aspects of certain corridors.

**PALO ALTO'S COMPREHENSIVE PLAN'S ROADWAY HIERARCHY (for reference only)**

**Freeway:** Major roadway with controlled access; devoted exclusively to traffic movement, mainly of a through or regional nature. (ex. 101, 280)

**Expressway:** Major roadway with limited access to adjacent properties; devoted almost exclusively to traffic movement, mainly serving through-traffic. (ex. Oregon Expy)

**Arterial:** Major roadway mainly serving through-traffic; takes traffic to and from expressways and freeways; provides access to adjacent properties. (ex. Alma Street, El Camino Real, Sand Hill Road, San Antonio Road)

**Residential Arterial:** Major roadway mainly serving through-traffic; takes traffic to and from expressways and freeways; provides access to adjacent properties, most of which are residential properties located on both sides of the roadway with direct frontages and driveways on that roadway. (ex. Embarcadero Road east of Alma, East Charleston Road, Arastradero Road)

**Collector:** Roadway that collects and distributes local traffic to and from arterial streets, and provides access to adjacent properties. (ex. East Meadow Drive, California Avenue, El Camino Way)

**Local:** Minor roadway that provides access to adjacent properties only.





January 22, 2020

Honorable City Council Members,

We are writing on behalf of the Palo Alto Council of PTAs (PTAC) Traffic Safety Committee. PTAC works with the district staff, the Board of Education, community partners and the PTAs at the 17 schools to support the students and families of the Palo Alto Unified School District and to improve the education, health and welfare of all children and youth. This letter is written in strong support of completion of 2012 Bike-Ped Plan including the Neighborhood Traffic Safety and Bicycle Boulevard Projects.

The 2019 Palo Alto Safe Routes to School student travel tally data indicates that we have roughly 70% of middle school, 60% of high school and 40% of elementary school kids walking or biking to school - these represent roughly 2% growth YoY since 2016. The bike rack count data for high schools, captured since 1985, shows the highest numbers ever recorded, please see the chart on page 2.

The envisioned bike-ped plan and bike boulevard network overlaps city-wide K-12 Palo Alto school commute routes. When complete, it will provide a network for people of all ages and abilities who walk, bike, drive and ride transit, including our youngest, most vulnerable commuters on their way to school. These projects include multi-modal improvements such as:

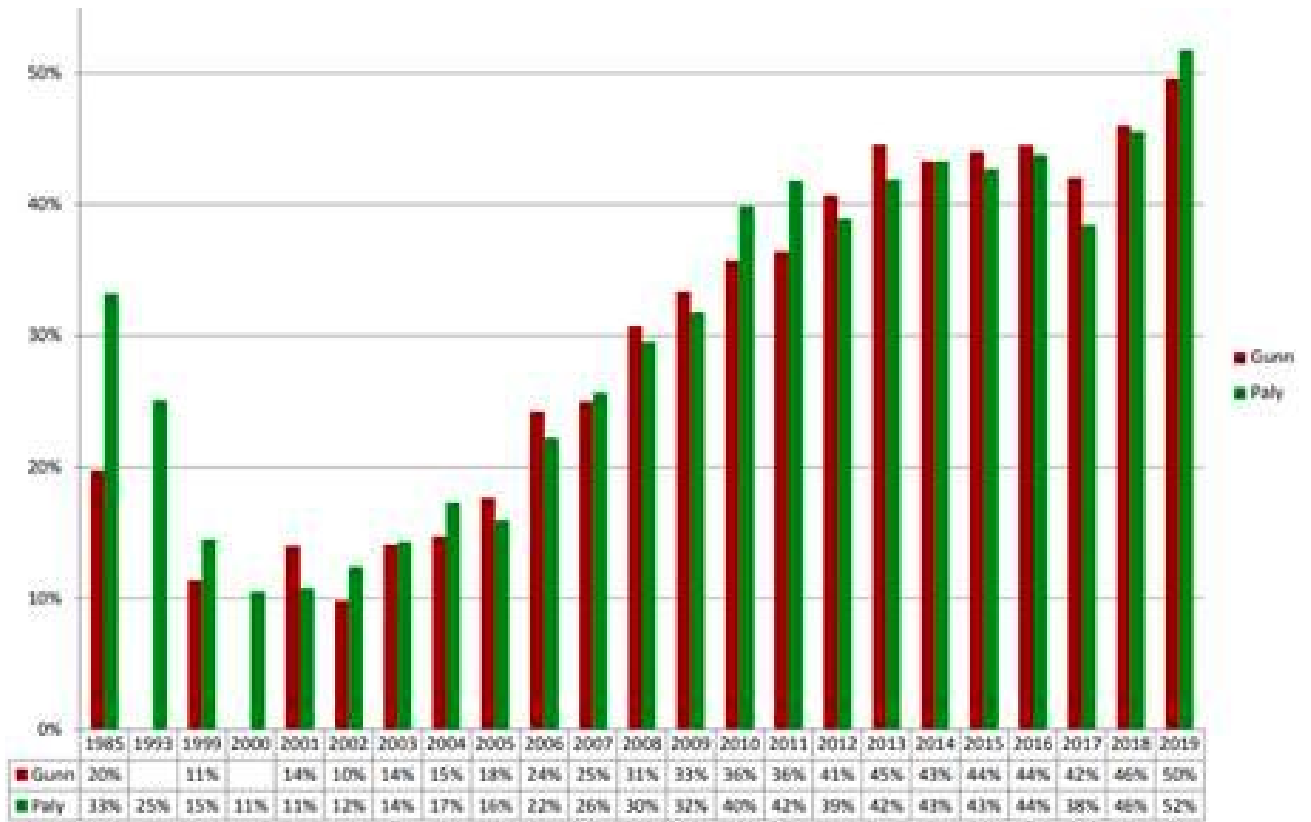
- moderating vehicle speeds on school routes
- improving visibility at intersections, and
- creating better safe routes to school connections for Palo Alto families.

These projects support safe, healthy, active, and sustainable non-SOV modes of travel which are critically important in the face of increasing auto traffic. The PTAC Traffic Safety Committee worked closely with city staff on community outreach and project review through development of the Neighborhood Traffic Safety & Bicycle Boulevard projects. We hope that, as the City Council weighs infrastructure project options, you will consider how each project supports PAUSD families living and traveling to and from school in Palo Alto.

As the city's Safe Routes to School PTA partners, we thank you for your previous support of these projects and we ask you to continue to implement the long-awaited city-wide network to support the growth and success of the city's most successful transportation demand management program. Thank you for considering our comments.

PTAC Traffic Safety Committee  
Co-Chairs: Jim Pflasterer & Peter Phillips

cc: Palo Alto Council of PTAs, PAUSD Board of Education & Superintendent, PAUSD PTA Presidents





January 18, 2021

Palo Alto City Council  
City Manager Ed Shikada  
250 Hamilton Ave.  
Palo Alto, CA 94301

Dear City Council and City Manager Shikada,

We are writing on behalf of the Palo Alto Council of PTAs (PTAC) to request formal collaboration with Staff on the grade separation projects. PTAC works with the Palo Alto Unified School District (PAUSD) Board of Education, the PAUSD District Staff, various Community Partners, and the PTAs at all 17 schools. Our goal is to support all students and families in PAUSD.

As one of the key partners of the Safe Routes to School (SRTS) program, PTAC has not had a chance to fully participate in any designs or decisions that may impact, *positively or negatively*, thousands of school families. The SRTS program focuses on the needs of the bicyclists and pedestrians in our community, especially school-aged children. And the focus extends not only to school commutes but also the thousands of trips made daily to/from after school activities and social activities. We believe that we can bring greater understanding regarding the needs of the school community if we participate in the formal process on this issue.

As we wrote in our letter last January, we strongly support the completion of the 2012 Bike-Ped Plan including the Neighborhood Traffic Safety and Bicycle Boulevard Projects that, once completed, will provide a network for people of all ages and abilities who walk, bike, drive and ride transit, including our youngest, most vulnerable commuters on their way to school. These projects include multi-modal improvements such as moderating vehicle speeds on school routes, improving visibility at intersections, and creating better safe routes to school connections for Palo Alto families. We believe working with Staff we can help ensure that the designs of the grade separation projects and any mitigations can also help achieve these goals.

In the past, the PTAC Traffic Safety Committee worked closely with city staff on community outreach and project review through the development of the Neighborhood Traffic Safety & Bicycle Boulevard projects and we can play a similar role with grade separation projects.

We thank the City Council for its continued support of school families and hope that, as the City Council weighs infrastructure project options, you will consider how each project supports



PAUSD families living and traveling to and from school in Palo Alto. PTA Council is grateful for the opportunity to be a voice for the community in all matters involving traffic safety and we would welcome the opportunity to work closely with City staff in the future to ensure the best outcome for our school families and our community at large.

Sincerely yours,

Christina Schmidt, President

Jim Pflasterer & Peter Phillips, Co-Chairs,  
Traffic Safety Committee (PTAC Safe Routes to School)

<https://saferoutes.paloaltopta.org/>

cc:

Nadia Naik, Expanded Community Advisory Panel (XCAP)  
Donald B. Austin, Ed.D., Superintendent of Schools, PAUSD  
PAUSD Board of Education Trustees  
Palo Alto Council of PTAs Presidents

Attachment:

PTAC Letter of Support for the 2012 Bike-Ped Plan

The following is an excerpt of Palo Alto’s 2030 Comprehensive Plan.

Portions of the plan have been highlighted to identify opportunities that may overlap with future grade separation plans.

# IMPLEMENTATION

**VISION:** Palo Alto's Implementation Plan is intended to provide an overview of priorities for future actions to accomplish the goals of the Comprehensive Plan. It provides a key mechanism to link Comprehensive Plan implementation to Palo Alto's budget process, and it will ultimately be a yardstick against which Palo Alto can measure its Comprehensive Plan accomplishments.

Palo Alto's Comprehensive Plan will be implemented both through the day-to-day decisions that rely on its vision, goals and policies, as well as the implementation programs identified in this chapter. All substantive decisions about development projects, capital improvements, zoning changes and other plans and policies affecting land use, transportation and the physical environment will be reviewed for conformance with this Comprehensive Plan, thus advancing the Plan's overall vision and policy framework. To complement the implementation of this plan that will occur as a review of individual decisions are made, the City has identified a list of implementation programs intended to provide an overall sense of the priorities for future actions in support of accomplishing the goals of the Comprehensive Plan.

## FORMAT OF THE IMPLEMENTATION TABLE

The following table presents programs the City wants to undertake to help achieve the goals in the Comprehensive Plan, to the extent that resources are available. The programs in the Implementation Table describe and prioritize actions to implement various aspects of the Comprehensive Plan goals and policies. Some programs are already budgeted and ongoing, while the City Council will need to identify resources during future budget cycles in order to implement other programs. The Planning & Transportation Commission may recommend changing priorities or adding or subtracting programs in the course of their annual review, and staff may likewise

recommend prioritization or funding during the annual budget process. The City Council may change the prioritization of programs through the regular five-year review cycle of the Comprehensive Plan's implementation.

For each program, the Implementation Plan identifies the following:

- **Lead Department or Agency:** The City Department that would have primary responsibility for tracking and completing the program. Note that many programs will require collaboration between multiple departments as well as outside agencies; collaboration with appropriate parties would be coordinated by the Lead Department named in this column.
- **Timing:** This column identifies the timing for each program. While it would be desirable to pursue every program and policy immediately, the Comprehensive Plan is a long-range document that will be implemented over a number of years and priorities must be established to focus the City's efforts and to allocate the City's resources (City Council emphasis, staff time and budget resources). With resource constraints and changing circumstances, it is expected that the timing identified here may change. For example, as short-term programs begin, they will change to "In Progress." Also, given these constraints together with the breadth of programs included, the City anticipates and expects that it may not be able to complete all of the programs listed within a specified timeframe. Five categories are used:
  - **R:** "Routine" activities that are part of the normal course of business for staff;
  - **IP:** "In progress" – programs that are already underway to complete a specific, defined work effort;
  - **S:** "Short-term" – programs planned for implementation within the first five years after Comprehensive Plan adoption;
  - **M:** "Medium-term" – typically means programs that would be implemented or completed roughly within five to ten years after Comprehensive Plan adoption; and
  - **L:** "Long-term" – programs that would be implemented or completed more than ten years after Comprehensive Plan adoption.
- **Anticipated Level of Effort:** Gives an order-of-magnitude of cost in terms of staff and monetary resources required to implement the program. It is difficult

to determine the exact cost of most of the programs and the specific staffing requirements needed to support the scope of future detailed work plans. In general, physical improvements and major planning efforts are the most expensive type of investment the City can make; revisions to existing plans or studies would likely fall in the middle of the range; and some ongoing staff roles, such as providing education or some one-time activities, would be least expensive.

## RESOURCES

Although Palo Alto would like to implement all programs during the term of this Plan, there are capital resource and staffing limitations, as well as limitations to the amount of work that the City and the City Council can focus on effectively during this period. The completion of actions is contingent upon the availability of funding resources. Issues that cannot be anticipated may arise in the future that may act to divert resources from the programs and priorities of the Comprehensive Plan. It is hoped that by acknowledging and focusing on Comprehensive Plan priorities, the City can avoid diversion of resources and attention.

## REVIEW AND UPDATE

The Comprehensive Plan is a living document. Palo Alto's priorities will evolve through the life of this Plan, and therefore changes will need to be made to the Implementation Plan. Annually, as required by State Law and the Municipal Code, the Planning and Transportation Commission will submit a report to the City Council on the status of the Comprehensive Plan and its implementation. This review can be combined with the Commission's review of the City's Capital Improvement Program (CIP), which also occurs on an annual basis.

## CONCLUSION

The Implementation Plan was designed to advance the overarching vision and themes of the Comprehensive Plan. The City recognizes there are resource constraints and a need to focus those resources.

Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$/\$/\$)
<b>2. Land Use Element</b>				
<b>Goal L-1: A compact and resilient city providing residents and visitors with attractive neighborhoods, work places, shopping districts, public facilities, and open spaces.</b>				
L1.6.1	Review regulatory tools available to the City and identify actions to enhance and preserve the livability of residential neighborhoods and the vitality of commercial and employment districts, including improved code enforcement practices.	Planning & Community Environment Department	S	\$\$
L1.8.1	Maintain and update as appropriate the 1985 Land Use Policies Agreement that sets forth the land use policies of the City, Santa Clara County, and Stanford University with regard to Stanford unincorporated lands.	Planning & Community Environment Department	IP	\$
L1.10.1	Reevaluate the cumulative cap when the amount of new office/R&D square footage entitled since January 1, 2015 reaches 67 percent of the allowed square footage, or 1,139,000 square feet. Concurrently consider removal or potential changes to the cap and/or to the amount of additional development permitted by the City's zoning ordinance.	Planning & Community Environment Department	M	\$
<b>Goal L-2: An enhanced sense of "community" with development designed to foster public life, meet citywide needs and embrace the principles of sustainability.</b>				
L2.2.1	Explore whether there are appropriate locations to allow small-scale neighborhood-serving retail facilities such as coffee shops and corner stores in residential areas.	Planning & Community Environment Department	M	\$
L2.4.1	Amend the Housing Element to eliminate housing sites along San Antonio Road and increase residential densities in Downtown and the California Avenue area to replace potential units from the sites eliminated.	Planning & Community Environment Department	S	\$
L2.4.2	Allow housing at Stanford Shopping Center, provided that adequate parking and vibrant retail is maintained and no reduction of retail square footage results from the new housing.	Planning & Community Environment Department	S	\$

a. S = Short, M = Medium, L = Long, IP = In Progress; R = Routine

Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$\$/\$\$\$)
<b>2. Land Use Element</b>				
L2.4.3	Allow housing on the the El Camino Real frontage of the Stanford Research Park. Explore multi-family housing elsewhere in Stanford Research Park and near the SUMC.	Planning & Community Environment Department	S	\$
L2.4.4	Assess non-residential development potential in the Community Commercial, Service Commercial and Downtown Commercial Districts (CC, CS and CD) and the Neighborhood Commercial District (CN), and convert non-retail commercial FAR to residential FAR, where appropriate. Conversion to residential capacity should not be considered in Town and Country Village.	Planning & Community Environment Department	S	\$
L2.4.5	Update the municipal code to include zoning changes that allow a mix of retail and residential uses but no office uses. The intent of these changes would be to encourage a mix of land uses that contributes to the vitality and walkability of commercial centers and transit corridors.	Planning & Community Environment Department	S	\$
L2.4.6	Explore changing the Transfer of Development Rights (TDR) ordinances for both buildings of historic significance and for seismic retrofits so that transferred development rights may only be used for residential capacity.	Planning & Community Environment Department	M	\$
L2.4.7	Explore mechanisms for increasing multi-family housing density near multimodal transit centers.	Planning & Community Environment Department	S	\$\$
L2.4.8	Identify development opportunities for BMR and more affordable market rate housing on publicly owned properties in a way that is integrated with and enhances existing neighborhoods.	Planning & Community Environment Department	S	\$\$
L2.5.1	Collaborate with PAUSD in exploring opportunities to build housing that is affordable to school district employees.	Planning & Community Environment Department	M	\$

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Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$/\$/\$)
<b>2. Land Use Element</b>				
L2.7.1	Review development standards to discourage the net loss of housing units.	Planning & Community Environment Department	S	\$
L2.8.1	Conduct a study to evaluate various possible tools for preventing displacement of existing residents.	Planning & Community Environment Department	M	\$\$
L2.8.2	Develop and implement a system to inventory the characteristics of existing housing units and track changes in those characteristics on a regular basis. Make the information publicly available.	Planning & Community Environment Department	M	\$\$
L2.10.1	Collaborate with PAUSD to plan for space to accommodate future school expansions or new school sites, and evaluate zoning space to accommodate new schools.	Planning & Community Environment Department	IP	\$\$
<b>Goal L-3: Safe, attractive residential neighborhoods, each with its own distinct character and within walking distance of shopping, services, schools, and/or other public gathering places.</b>				
L3.2.1	Evaluate and implement strategies to prevent conversion of residential and neighborhood-serving retail space to office or short-term vacation rentals.	Planning & Community Environment Department	IP	\$
L3.5.1	Develop a program to assess and manage both the positive and negative impacts of basement construction in single family homes on the community and the environment, including: <ul style="list-style-type: none"> <li>▪ Impacts to the natural environment, such as potential impacts to the tree canopy, groundwater supply or quality, and soil compaction.</li> <li>▪ Safety issues such as increased surface flooding increased groundwater intrusion with sea level rise, emergency access and egress, or sewage backflows.</li> </ul>	Planning & Community Environment Department	S	\$\$

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Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$\$/\$\$\$)
<b>2. Land Use Element</b>				
<b>Goal L-4: Inviting pedestrian scale centers that offer a variety of retail and commercial services and provide focal points and community gathering places for the city's residential neighborhoods and employment districts.</b>				
L4.2.1	Study the overall viability of ground-floor retail requirements in preserving retail space and creating an active street environment, including the types of locations where such requirements are most effective.	Planning & Community Environment Department	M	\$\$
L4.2.2	Evaluate the effectiveness of formula retail limits adopted for California Avenue. Develop incentives for local small businesses where warranted.	Planning & Community Environment Department	M	\$\$
L4.2.3	Explore and potentially support new, creative and innovative retail in Palo Alto.	Planning & Community Environment Department	L	\$\$
L4.4.1	Study the feasibility of using public and private funds to provide and maintain landscaping and public spaces such as parks, plazas, sidewalks and public art within commercial areas.	Planning & Community Environment Department	M	\$
L4.4.2	Through public/private cooperation, provide well-signed, clean, and accessible restrooms.	Planning & Community Environment Department	R	\$
L4.4.3	Collaborate with merchants to enhance the appearance of streets and sidewalks within all Centers. Encourage the formation of business improvement districts and undertake a proactive program of maintenance, repair, landscaping and enhancement.	Planning & Community Environment Department	R	\$\$
L4.4.4	Identify priority street improvements that could make a substantial contribution to the character of Centers, such as widening sidewalks, narrowing travel lanes, creating medians, restriping to allow diagonal parking, and planting trees.	Planning & Community Environment Department	S	\$\$\$

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Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$\$/\$\$\$)
<b>2. Land Use Element</b>				
L4.5.1	Revise zoning and other regulations as needed to encourage the preservation of space to accommodate small businesses, start-ups and other services.	Planning & Community Environment Department	M	\$\$
L4.5.2	Program L4.5.2 Consider planning, regulatory, or other incentives to encourage property owners to include smaller office spaces in their buildings to serve small businesses, non-profit organizations, and independent professionals.	Planning & Community Environment Department	M	\$
L4.6.1	Explore increasing hotel FAR from 2.0 to 3.0 in the University Avenue/Downtown area and 2.5 in areas outside of Downtown.	Planning & Community Environment Department	M	\$\$
L4.8.1	Prepare a Coordinated Area Plan for Downtown.	Planning & Community Environment Department	S	\$\$\$
L4.8.2	Study the feasibility of converting parts of University Avenue to a pedestrian zone.	Planning & Community Environment Department	S	\$\$
L4.9.1	While preserving adequate parking to meet demand, identify strategies to reuse surface parking lots.	Planning & Community Environment Department	R	\$
L4.9.2	Explore adding additional Floor Area Ratio (FAR) for retail at Stanford Shopping Center.	Planning & Community Environment Department	M	\$

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Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$/\$/\$)
<b>2. Land Use Element</b>				
L4.10.1	Prepare a coordinated area plan for the North Ventura area and surrounding California Avenue area. The plan should describe a vision for the future of the North Ventura area as a walkable neighborhood with multi-family housing, ground floor retail, a public park, creek improvements, and an interconnected street grid. It should guide the development of the California Avenue area as a well-designed mixed use district with diverse land uses and a network of pedestrian-oriented streets.	Planning & Community Environment Department	S	\$\$\$
L4.10.2	Create regulations for the California Avenue area that encourage the retention or rehabilitation of smaller buildings to provide spaces for existing retail, particularly local, small businesses.	Planning & Community Environment Department	S	\$\$
L4.16.1	Maintain distinct neighborhood shopping areas that are attractive, accessible and convenient to nearby residents.	Planning & Community Environment Department	R	\$
<b>Goal L-5: High quality employment districts, each with their own distinctive character and each contributing to the character of the city as a whole.</b>				
L5.1.1	Explore with Stanford University various development options for adding to the Stanford Research Park a diverse mix of uses, including residential, commercial hotel, conference center, commercial space for small businesses and start-ups, retail, transit hub, and other community-supporting services that are compatible with the existing uses, to create a vibrant innovation-oriented community.	Planning & Community Environment Department	S	\$\$
<b>Goal L-6: Well-designed buildings that create coherent development patterns and enhance city streets and public spaces.</b>				
L6.1.1	Promote awards programs and other forms of public recognition for projects of architectural merit that contribute positively to the community.	Planning & Community Environment Department	L	\$

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<b>2. Land Use Element</b>				
L6.3.1	Develop guidelines for bird-friendly building design that minimizes hazards for birds and reduces the potential for collisions.	Planning & Community Environment Department	M	\$\$
L6.6.1	Modify design standards for mixed use projects to promote a pedestrian-friendly relationship to the street, including elements such as screened parking or underground parking, street-facing windows and entries, and porches, windows, bays and balconies along public ways, and landscaping, and trees along the street. Avoid blank or solid walls at street level.	Planning & Community Environment Department	S	\$
L6.7.1	Implement architectural standards to assure they effectively address land use transitions.	Planning & Community Environment Department	R	\$
<b>Goal L-7: Conservation and preservation of Palo Alto's historic buildings, sites, and districts.</b>				
L7.1.1	Update and maintain the City's Historic Resource Inventory to include historic resources that are eligible for local, State, or federal listing. Historic resources may consist of a single building or structure or a district.	Planning & Community Environment Department	S	\$
L7.1.2	Reassess the Historic Preservation Ordinance to ensure its effectiveness in the maintenance and preservation of historic resources, particularly in the University Avenue/Downtown area.	Planning & Community Environment Department	S	\$
L7.8.1	Promote and expand available incentives for the retention and rehabilitation of buildings with historic merit in all zones and revise existing zoning and permit regulations to minimize constraints to adaptive reuse.	Planning & Community Environment Department	M	\$
L7.8.2	Create incentives to encourage salvage and reuse of discarded historic building materials.	Planning & Community Environment Department	L	\$

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<b>2. Land Use Element</b>				
L7.8.3	Seek additional innovative ways to apply current codes and ordinances to older buildings. Use the State Historical Building Code for designated historic buildings.	Planning & Community Environment Department	R	\$
L7.12.1	Review parking exceptions for historic buildings in the Zoning Code to determine if there is an effective balance between historic preservation and meeting parking needs.	Planning & Community Environment Department	L	\$
<b>Goal L-8: Attractive and safe civic and cultural facilities provided in all neighborhoods and maintained and used in ways that foster and enrich public life.</b>				
<b>Goal L-9: Attractive, inviting public spaces and streets that enhance the image and character of the city.</b>				
L9.1.1	Evaluate existing zoning code setback requirements to ensure they are appropriate for scenic routes.	Planning & Community Environment Department	L	\$
L9.3.1	Review standards for streets and signage and update as needed to foster natural, tree-lined streets with a minimum of signage.	Planning & Community Environment Department	M	\$
L9.6.1	Analyze existing neighborhoods and determine where publicly accessible shared, outdoor gathering spaces are below the citywide standard. Create new public spaces, including public squares, parks and informal gathering spaces in these neighborhoods.	Planning & Community Environment Department	M	\$\$\$
L9.7.1	Develop a strategy to enhance gateway sites with special landscaping, art, public spaces and/or public buildings. Emphasize the creek bridges and riparian settings at the entrances to the City over Adobe Creek and San Francisquito Creek.	Planning & Community Environment Department	R	\$

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<b>2. Land Use Element</b>				
L9.8.1	Establish incentives to encourage native trees and low water use plantings in new development throughout the city.	Planning & Community Environment Department	M	\$
L9.10.1	Continue the citywide undergrounding of utility wires. Minimize the impacts of undergrounding on street tree root systems and planting areas.	City of Palo Alto Utilities	R	\$\$\$
L9.10.2	Encourage the use of compact and well-designed utility elements, such as transformers, switching devices, backflow preventers and telecommunications infrastructure. Place these elements in locations that will minimize their visual intrusion.	City of Palo Alto Utilities	R	\$
L9.11.1	Implement the findings of the City's Infrastructure Blue Ribbon Committee and its emphasis for rebuilding our civic spaces.	Department of Public Works	IP	\$\$\$
L9.11.2	Identify City-owned properties where combinations of wireless facilities can be co-located, assuming appropriate lease agreements are in place.	City of Palo Alto Utilities	M	\$
L9.12.1	Coordinate with regional utility providers on activities that would impact their infrastructure and right-of-way.	City of Palo Alto Utilities	R	\$
<b>Goal L-10: Maintain an economically viable local airport with minimal environmental impacts.</b>				
L10.1.1	Relocate the terminal building away from the Runway 31 clear zone and closer to the hangars, allowing for construction of a replacement terminal.	Department of Public Works	L	\$\$\$
L10.1.2	Update the Airport Layout Plan in accordance with Federal Aviation Administration requirements, as needed, while ensuring conformance with the Baylands Master Plan to the maximum extent feasible.	Department of Public Works	M	\$\$\$
L10.1.3	Identify and pursue funding to address maintenance, safety and security improvements needed at PAO.	Department of Public Works	R	\$
L10.3.1	Establish and implement a system for processing, tracking and reporting noise complaints regarding local airport operations on an annual basis,	Department of Public Works	S	\$\$

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<b>2. Land Use Element</b>				
L10.3.2	Work with the airport to pursue opportunities to enhance the open space and habitat value of the airport. These include: <ul style="list-style-type: none"> <li>▪ Maintaining native grasses;</li> <li>▪ Reconstructing levees to protect the airport from sea level rise while enhancing public access and habitat conservation; and</li> <li>▪ Evaluating the introduction of burrowing owl habitat. This program is subject to federal wildlife hazard requirements and guidelines for airports.</li> </ul>	Community Services Department	R	\$\$
L10.4.1	Continue to provide a bicycle/pedestrian path adjacent to Embarcadero Road, consistent with the Baylands Master Plan and open space character of the baylands subject to federal and State airport regulations.	Planning & Community Environment Department	R	\$

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<b>3. Transportation Element</b>				
<b>Goal T-1: Create a sustainable transportation system, complemented by a mix of land uses, that emphasizes walking, bicycling, use of public transportation, and other methods to reduce greenhouse gas emissions and the use of single occupancy motor vehicles.</b>				
T1.2.1	Create a long-term education program to change the travel habits of residents, visitors, shoppers, and workers by informing them about transportation alternatives, incentives, and impacts. Work with the PAUSD and with other public and private interests, such as the Chamber of Commerce and Commuter Wallet partners, to develop and implement this program.	Planning & Community Environment Department	R	\$
T1.2.2	Advocate for improved connectivity to transit to serve workers who live in the South Bay and work in Palo Alto.	Planning & Community Environment Department	R	\$
T1.2.3	Formalize TDM requirements by ordinance and require new developments above a certain size threshold to prepare and implement a TDM plan to meet specific performance standards. Require regular monitoring/reporting and provide for enforcement with meaningful penalties for non-compliance. The ordinance should also: <ul style="list-style-type: none"> <li>▪ Establish a list of effective TDM measures that include transit promotion, prepaid transit passes, commuter checks, car sharing, carpooling, parking cash-out, bicycle lockers and showers, shuttles to Caltrain, requiring TMA membership and education and outreach to support the use of these modes.</li> <li>▪ Allow property owners to achieve reductions by contributing to citywide or employment district shuttles or other proven transportation programs that are not directly under the property owner's control.</li> <li>▪ Provide a system for incorporating alternative measures as new ideas for TDM are developed.</li> <li>▪ Establish a mechanism to monitor the success of TDM measures and track the cumulative reduction of peak hour motor vehicle trips. TDM measures should at a minimum achieve the following reduction in peak hour motor vehicle trips, with a focus on single-occupant vehicle trips. Reductions should be based on the rates included in the Institute of Transportation Engineers' Trip Generation Manual for the appropriate land use category and size:</li> </ul>	Planning & Community Environment Department	S	\$

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<b>3. Transportation Element</b>				
	<ul style="list-style-type: none"> <li>• 45 percent reduction in the Downtown district</li> <li>• 35 percent reduction in the California Avenue area</li> <li>• 30 percent reduction in the Stanford Research Park</li> <li>• 30 percent reduction in the El Camino Real Corridor</li> <li>• 20 percent reduction in other areas of the city</li> <li>▪ Require new development projects to pay a Transportation Impact Fee for all those peak-hour motor vehicle trips that cannot be reduced via TDM measures. Fees collected would be used for capital improvements aimed at reducing vehicle trips and traffic congestion.</li> <li>▪ Ensure a stable, sustained funding source to support implementation of TDM measures.</li> </ul>			
T1.2.4	Evaluate the performance of pilot programs implemented by the Palo Alto Transportation Management Association and pursue expansion from Downtown to California Avenue and other areas of the city when appropriate.	Planning & Community Environment Department	IP	\$
T1.2.5	Site City facilities near high-capacity transit and revise existing regulations, policies, and programs to encourage telecommuting, satellite office concepts, and work-at-home options.	Planning & Community Environment Department	R	\$
T1.2.6	Pursue full participation of Palo Alto employers in the TMA.	Planning & Community Environment Department	R	\$\$
T1.3.1	Develop an electric vehicle promotion program that identifies policy and technical issues, barriers and opportunities to the expansion of electric vehicles.	Office of Sustainability	M	\$\$
T1.3.2	Use low-emission vehicles for the Palo Alto Free Shuttle and work with transit providers, including SamTrans and VTA, to encourage the adoption of electric, fuel cell or other zero emission vehicles. Also work with private bus and shuttle providers, delivery companies, and ride services.	Planning & Community Environment Department	M	\$\$\$

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<b>3. Transportation Element</b>				
T1.4.1	Update the Zoning Code to ensure compatibility with the electric vehicle infrastructure requirements.	Planning & Community Environment Department	S	\$
T1.4.2	Periodically review requirements for electric and plug-in vehicle infrastructure in new construction. Consider and periodically review requirements for electric and plug-in infrastructure for remodels. Consider costs to the City, including identifying payment options.	Office of Sustainability	R	\$
T1.6.1	Collaborate with transit providers, including Caltrain, bus operators and rideshare companies, to develop first/last mile connection strategies that boost the use of transit and shuttle service for local errands and commuting.	Planning & Community Environment Department	S	\$
T1.6.2	Continue to work with Caltrain, Amtrak, and public bus operators to expand bicycle storage on public transit vehicles and at transit hubs during both peak and off-peak hours.	Planning & Community Environment Department	IP	\$
T1.11.1	Collaborate with Stanford University, VTA, Caltrain and other agencies to pursue improvements to the Palo Alto Transit Center area aimed at enhancing pedestrian experience and improving circulation and access for all modes, including direct access to El Camino Real for transit vehicles.	Planning & Community Environment Department	IP	\$\$\$
T1.11.2	In collaboration with Caltrain and Stanford Research Park, pursue expansion of service to the California Avenue Caltrain Station and creation of an enhanced transit center at the Station, including connections to VTA bus service, the Palo Alto Free Shuttle, the Marguerite, and other private shuttles serving the Research Park.	Planning & Community Environment Department	M	\$\$\$
T1.12.1	Strongly recommend that VTA maintain existing service and coverage levels in Palo Alto.	Planning & Community Environment Department	IP	\$

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<b>3. Transportation Element</b>				
T1.12.2	Work with VTA to expand VTA express bus service routes to serve the Stanford Research Park, California Avenue, Stanford University, and Downtown.	Planning & Community Environment Department	S	\$\$
T1.12.3	Work with VTA to study the feasibility of, and if warranted provide, traffic signal prioritization for buses at Palo Alto intersections, focusing first on regional transit routes. Also, advocate for bus service improvements on El Camino Real such as queue jump lanes and curbside platforms.	Planning & Community Environment Department	S	\$\$
T1.13.1	Investigate a pilot program to subsidize a taxi, rideshare, or transit program for Palo Altans to get to/from downtown, including offering education and incentives to encourage users.	Planning & Community Environment Department	M	\$
T1.14.1	Evaluate the shuttle system in collaboration with community members, people with special needs, and PAUSD to: <ul style="list-style-type: none"> <li>▪ Evaluate current routes and ridership;</li> <li>▪ Identify potential service improvements, including new or modified routes; expanded schedules that accommodate daytime, evening, and weekend demand; facilitating transit connections, and improvements to the safety and appearance of shuttle stops;</li> <li>▪ Explore partnerships with other services that could complement and supplement the Palo Alto Shuttle;</li> <li>▪ Develop clear and engaging materials to explain and promote shuttle use with the purpose of reducing barriers to use; and</li> <li>▪ Establish a schedule for regular evaluation and reporting to optimize shuttle system use and effectiveness.</li> </ul>	Planning & Community Environment Department	IP	\$\$\$
T1.16.1	Continue regular surveys of bicycle use across the city, by collecting bicycle counts on important and potential bicycle corridors.	Planning & Community Environment Department	IP	\$\$

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<b>3. Transportation Element</b>				
T1.16.2	Consider marketing strategies such as a recurring Palo Alto Open Streets program of events, potentially in coordination with local business groups, which would include street closures and programming.	Planning & Community Environment Department	M	\$
T1.16.3	Encourage private schools to develop Walk and Roll Maps as part of Transportation Demand Management strategies to reduce vehicle trips.	Planning & Community Environment Department	IP	\$
T1.16.4	Participate in local and regional encouragement events such as Palo Alto Walks and Rolls, Bike to Work Day, and Bike Palo Alto! that encourages a culture of bicycling and walking as alternatives to single occupant vehicle trips.	Planning & Community Environment Department	M	\$
T1.19.1	Adjust the street evaluation criteria of the City's Pavement Management Program to ensure that areas of the road used by bicyclists are maintained at the same standards as, or at standards higher than, areas used by motor vehicles. Include bicycle and e-bike detection in intersection upgrades.	Department of Public Works	M	\$
T1.19.2	Prioritize investments for enhanced pedestrian access and bicycle use within Palo Alto and to/from surrounding communities, including by incorporating improvements from related City plans, for example the 2012 <i>Bicycle + Pedestrian Transportation Plan</i> and the Parks, Trails & Open Space Master Plan, as amended, into the Capital Improvements Program.	Department of Public Works	IP	\$\$\$
T1.19.3	Increase the number of east-west pedestrian and bicycle crossings across Alma Street and the Caltrain corridor, particularly south of Oregon Expressway.	Department of Public Works	L	\$\$\$
T1.19.4	Encourage the use of bike sharing, and the provision of required infrastructure throughout Palo Alto, especially at transit stations and stops, job centers, community centers, and other destinations.	Planning & Community Environment Department	IP	\$

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<b>3. Transportation Element</b>				
T1.19.5	Improve amenities such as seating, lighting, bicycle parking, street trees, public art, and interpretive stations along bicycle and pedestrian paths and in City parks to encourage walking and cycling and enhance the feeling of safety.	Planning & Community Environment Department & Department of Public Works	IP	\$\$\$
T1.22.1	Collect, analyze and report transportation data through surveys and other methods on a regular basis. Track progress on build-out of the 2012 <i>Bicycle + Pedestrian Transportation Plan</i> network.	Planning & Community Environment Department	R	\$\$
T1.25.1	As part of the effort to reduce traffic congestion, regularly evaluate the City's current Transportation Impact Fee and modify as needed to implement transportation infrastructure improvements. Modifications to the impact fee program should be structured in keeping with the City's desire to require new development to reduce peak hour motor vehicle trips to the extent feasible through TDM plans and by contributions to the provision of transit services, shuttles, carpool/ rideshare incentives, and similar programs.	Planning & Community Environment Department	IP	\$
T1.26.1	In collaboration with regional agencies and neighboring jurisdictions, identify and pursue funding for rail corridor improvements and grade separation.	Planning & Community Environment Department	S	\$
<b>Goal T-2: Decrease delay, congestion, and vehicle miles travelled with a priority on our worst intersections and our peak commute times, including school traffic.</b>				
T2.1.1	Implement computerized traffic management systems to improve traffic flow when feasible.	Planning & Community Environment Department	IP	\$\$\$
T2.1.2	Implement a program to monitor, coordinate, and optimize traffic signal timing a minimum of every two years along arterial and residential arterial streets.	Planning & Community Environment Department	IP	\$\$

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<b>3. Transportation Element</b>				
T2.2.1	Work in partnership with the Palo Alto TMA and Stanford University to aggregate data and realize measurable reductions in single-occupant vehicle commuting to and from Downtown and in the Stanford Research Park.	Planning & Community Environment Department	IP	\$
T2.3.1	When adopting new CEQA significance thresholds for VMT for compliance with SB 743 (2013), adopt standards for vehicular LOS analysis for use in evaluating the consistency of a proposed project with the Comprehensive Plan, and also explore desired standards for MMLOS, which includes motor vehicle LOS, at signalized intersections.	Planning & Community Environment Department	S	\$\$
T2.4.1	Revise protocols for reviewing office, commercial, and multi-family residential development proposals to evaluate multimodal level of service and identify gaps in the low stress bicycle and pedestrian network.	Planning & Community Environment Department	S	\$
<b>Goal T-3: Maintain an efficient roadway network for all users.</b>				
T3.5.1	Continue to use best practices in roadway design that are consistent with complete streets principles and the Urban Forest Master Plan, focusing on bicycle and pedestrian safety and multi-modal uses. Consider opportunities to incorporate best practices from the National Association of City Transportation Officials guidelines for urban streets and bikeways, tailored to the Palo Alto context.	Department of Public Works	S	\$\$
T3.5.2	Establish procedures for considering the effects of street design on emergency vehicle response time.	Department of Public Works & Palo Alto Police Department & Palo Alto Fire Department	R	\$

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<b>3. Transportation Element</b>				
T3.10.1	Support increased public transit, traffic management and parking solutions to ensure safe, convenient access to and from the Stanford Shopping Center/ Medical Center area.	Planning & Community Environment Department	R	\$
T3.10.2	Implement and monitor Development Agreement traffic mitigations at Stanford Medical Center.	Planning & Community Environment Department	IP	\$
T3.10.3	Provide safe, convenient pedestrian, bicycle, and transit connections between the Stanford Shopping Center/Medical Center areas and housing along the Sand Hill Road/Quarry Road corridors to Palo Alto Transit Center, Downtown Palo Alto, and other primary destinations.	Planning & Community Environment Department	R	\$\$\$
T3.10.4	Pursue extension of Quarry Road for transit, pedestrians and bicyclists to access the Palo Alto Transit Center from El Camino Real. Also study the feasibility of another pedestrian and bicycle underpass of Caltrain at Everett Street.	Planning & Community Environment Department	M	\$\$
T3.15.1	Undertake studies and outreach necessary to advance grade separation of Caltrain to become a "shovel ready" project and strongly advocate for adequate State, regional, and federal funding for design and construction of railroad grade separations.	Planning & Community Environment Department	S	\$\$\$
T3.15.2	Conduct a study to evaluate the implications of grade separation on bicycle and pedestrian circulation.	Planning & Community Environment Department	S	\$\$
T3.17.1	Complete a Palo Alto Avenue crossing study to identify potential near-term safety and accessibility improvements.	Planning & Community Environment Department	S	\$\$

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<b>3. Transportation Element</b>				
T3.17.2	Work with Caltrain to ensure that the rail tracks are safe and secure with adequate fencing and barriers.	Planning & Community Environment Department	S	\$
<b>Goal T-4: Protect local streets that contribute to neighborhood character and provide a range of local transportation options.</b>				
T4.2.1	Periodically evaluate residential areas for traffic impacts and use the results of that evaluation to prioritize traffic calming measures.	Planning & Community Environment Department	IP	\$\$
T4.4.1	Use landscaping and other improvements to establish clear "gateways" at the points where the Oregon Expressway, University Avenue and Embarcadero Road transition from freeways to neighborhoods.	Department of Public Works	L	\$\$\$
<b>Goal T-5: Encourage attractive, convenient, efficient and innovative parking solutions for all users.</b>				
T5.1.1	Evaluate the need to update parking standards in the municipal code, based on local conditions, different users' needs and baseline parking need. Allow the use of parking lifts for Office/R&D and multifamily housing as appropriate.	Planning & Community Environment Department	S	\$
T5.1.2	Consider reducing parking requirements for retail and restaurant uses as a way to encourage new businesses and the use of alternative modes.	Planning & Community Environment Department	M	\$
T5.1.3	Work with stakeholders in each commercial center and employment district to monitor conditions and determine the appropriate timing for revisions to parking requirements.	Planning & Community Environment Department	M	\$
T5.1.4	Study the feasibility of unbundled parking for office, commercial, and multi-family residential developments (including senior housing developments) that are well-served by transit and demonstrated walking and biking connections.	Planning & Community Environment Department	S	\$

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<b>3. Transportation Element</b>				
T5.1.5	Consider reducing parking requirements for multi-family uses as a way to encourage new multi-family housing and the use of alternative modes, where reduction in parking would not impact the neighborhood.	Planning & Community Environment Department	S	\$
T5.2.1	Use technology to help identify parking availability and make it easy to pay any parking fees.	Planning & Community Environment Department	S	\$\$\$
T5.2.2	Study and implement pricing strategies for public parking in commercial districts, taking into consideration both employee parking demand and the needs of retailers and customers. Use pricing to encourage short term parking on street, long term parking in parking garages, and the use of alternative modes of transportation	Planning & Community Environment Department	IP	\$\$
T5.2.3	Implement Council-adopted recommendations from the parking management study for the Downtown area, which address the feasibility of removing color-coded parking zones, and dynamic pricing and management policies to prioritize short-term parking spaces closest to the commercial core for customers, garage parking for employees, and neighborhood parking for residents.	Planning & Community Environment Department	S	\$\$\$
T5.4.1	Explore incentives to encourage privately initiated shared parking among individual property owners when developments have excess parking that can be available for other businesses to use.	Planning & Community Environment Department	S	\$
T5.8.1	Study the feasibility of retrofitting City-owned surface parking lots to implement best management practices for stormwater management and urban heat island mitigation, including green infrastructure, permeable pavement and reflective surfaces.	Department of Public Works	S	\$\$
T5.8.2	Identify incentives to encourage the retrofit of privately owned surface parking areas to incorporate best management practices for stormwater management and urban heat island mitigation as well as incentives for the provision of publicly accessible bicycle parking in privately owned lots.	Planning & Community Environment Department	S	\$

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<b>3. Transportation Element</b>				
T5.8.3	Update City requirements regarding trees and other landscaping that capture and filter stormwater within surface parking lots to take advantage of new technology.	Planning & Community Environment Department	R	\$
T5.11.1	Coordinate with neighborhood groups and local businesses and other stakeholders to evaluate the need for a residential parking permit program in areas without existing programs.	Planning & Community Environment Department	S	\$\$
T5.12.1	Work with employers, merchants, schools, and community service providers, to identify ways to provide more bicycle parking, including e-bike parking with charging stations, near existing shops, services and places of employment.	Planning & Community Environment Department	R	\$
T5.12.2	Install secure electronic bike lockers such as the BikeLink system, at high theft locations, including transit stations and parking garages.	Planning & Community Environment Department	M	\$\$
T5.12.3	Assess the need to provide additional bicycle parking in City-owned parking lots and rights-of-way.	Planning & Community Environment Department	M	\$\$
<b>Goal T-6: Provide a safe environment for motorists, pedestrians, and bicyclists on Palo Alto streets.</b>				
T6.1.1	Follow the principles of the safe routes to schools program to implement traffic safety measures that focus on Safe Routes to work, shopping, downtown, community services, parks, and schools, including all designated school commute corridors.	Planning & Community Environment Department	R	\$\$
T6.1.2	Develop, distribute and aggressively promote maps and apps showing safe routes to work, shopping, community services, parks and schools within Palo Alto in collaboration with stakeholders, including PAUSD, major employers, TMAs, local businesses and community organizations.	Planning & Community Environment Department	IP	\$\$

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<b>3. Transportation Element</b>				
T6.1.3	Address pedestrian safety along Alma Street between Embarcadero Road and Lytton Street.	Planning & Community Environment Department	S	\$\$
T6.1.4	Address pedestrian safety on shared-use paths through the use of signs, pavement markings, and outreach to users, encouraging them to be safe and courteous.	Planning & Community Environment Department	R	\$
T6.2.1	Regularly collect severity and location data on roadway collisions for all modes of travel, including fatalities and severe injuries, and use this data to make roadway design decisions. In collaboration with Santa Clara County, develop an up-to-date, public database for this information.	Planning & Community Environment Department	R	\$\$
T6.4.1	Consider the Adopted School Commute Corridors Network and adopted "Walk and Roll" maps when reviewing development applications and making land use and transportation planning decisions. Incorporate these requirements into City code when feasible.	Planning & Community Environment Department	R	\$
T6.4.2	Establish standards and procedures for maintaining safe bicycling routes, including signage for warnings and detours during construction projects.	Planning & Community Environment Department	IP	\$
T6.4.3	In collaboration with PAUSD, provide adult crossing guards at school crossings that meet established warrants.	Planning & Community Environment Department	S	\$\$
T6.6.1	Periodically evaluate safety on roadways and at intersections and enhance conditions through the use of signal technology and physical changes. Consider the construction of traffic circles for improved intersection safety.	Planning & Community Environment Department	R	\$\$\$

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<b>3. Transportation Element</b>				
T6.6.2	Continue to provide educational programs for children and adults, in partnership with community-based educational organizations, to promote the safe walking and safe use of bicycles, including the City-sponsored bicycle education programs in the public schools and the bicycle traffic school program for juveniles.	Planning & Community Environment Department	R	\$\$
T6.6.3	Work with PAUSD and employers to promote roadway safety for all users, including motorized alternatives to cars and bikes such as mopeds and e-bikes, through educational programs for children and adults.	Planning & Community Environment Department	R	\$\$
T6.6.4	Complete a mobility and safety study for downtown Palo Alto, looking at ways to improve circulation and safety for all modes.	Planning & Community Environment Department	M	\$\$
T6.6.5	Identify and construct safety improvements for pedestrian underpasses, including on Embarcadero Road.	Planning & Community Environment Department	L	\$\$\$
T6.6.6	Improve pedestrian crossings by creating protected areas and better pedestrian and traffic visibility. Use a toolbox including bulb outs, small curb radii, high visibility crosswalks, and landscaping.	Planning & Community Environment Department	R	\$\$\$
T6.6.7	Establish a program to educate residents to keep sidewalks clear of parked cars, especially on narrow local streets in neighborhoods with rolled curbs. Survey for compliance annually.	Planning & Community Environment Department	M	\$\$
T6.7.1	Evaluate the performance of safety improvements and identify methods to encourage alternative transportation modes.	Planning & Community Environment Department	R	\$

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<b>3. Transportation Element</b>				
<b>Goal T-7: Provide mobility options that allow people who are transit dependent to reach their destinations.</b>				
T7.1.1	Expand transportation opportunities for transit-dependent riders by supporting discounts for taxi fares, rideshare services, and transit, by coordinating transit systems to be shared by multiple senior housing developments, and by maintaining a database of volunteer drivers, and other transit options.	Planning & Community Environment Department	M	\$\$
T7.1.2	Coordinate with social service agencies and transit agencies to fill gaps in existing transportation routes and services accessible to transit-dependent riders no matter their means and design new bus routes that enable them to access those services.	Planning & Community Environment Department	R	\$\$\$ <u>1</u>
T7.1.3	Pursue expanded evening and night time bus service to enhance mobility for all users during off-peak times.	Planning & Community Environment Department	R	\$
<b>Goal T-8: Influence the shape and implementation of regional transportation policies and technologies to reduce traffic congestion and greenhouse gas emissions.</b>				
T8.1.1	Continue to participate in regional efforts to develop technological solutions that make alternatives to the automobile more convenient.	Planning & Community Environment Department	R	\$
T8.3.1	Advocate for provision of a new southbound entrance ramp to Highway 101 from San Antonio Road, in conjunction with the closure of the southbound Charleston Road on-ramp at the Rengstorff Avenue interchange in Mountain View.	Planning & Community Environment Department	S	\$
T8.7.1	Work with regional transportation providers to improve connections between Palo Alto and the San Francisco International Airport and Norman Y. Mineta San Jose International Airport.	Planning & Community Environment Department	R	\$

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<b>3. Transportation Element</b>				
T8.8.1	Identify and improve bicycle connections to/from neighboring communities in Santa Clara and San Mateo counties to support local trips that cross city boundaries. Also advocate for reducing barriers to bicycling and walking at freeway interchanges, expressway intersections, and railroad grad crossings.	Planning & Community Environment Department	IP	\$\$\$

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<b>4. Natural Environment</b>				
<b>Goal N-1: Protect, conserve and enhance Palo Alto’s citywide system of open space, including connected and accessible natural and urban habitats, ecosystems, and natural resources, providing a source of public health, natural beauty and enjoyment for Palo Alto residents.</b>				
N1.1.1	Develop Comprehensive Resource Conservation Plans for the Pearson Arastradero Preserve, Esther Clark Preserve, and Foothills Park to steward the protection of local ecosystems.	Community Services Department	S-M	\$\$\$
N1.1.2	Promote and support ecosystem protection and environmental education programs in Palo Alto and neighboring school districts.	Community Services Department	S	\$
N1.3.1	Work to maintain Williamson Act agricultural preserve contracts within the City.	Planning & Community Environment Department	S	\$
N1.3.2	Provide information and support programs that encourage residents to enhance their private yards with native plant species and low impact landscaping.	Planning & Community Environment Department	R	\$\$
N1.4.1	Periodically review California Environmental Quality Act (CEQA) thresholds of significance regarding special status species to identify changes in listed species recommended by professionally recognized scientific experts.	Planning & Community Environment Department	R	\$
N1.4.2	Explore the feasibility of expanding the use of overlay tools such as the Site and Design (D) Review Combining District or similar development review and restriction tools to protect special-status species and their habitats from development.	Planning & Community Environment Department	M	\$\$
N1.4.3	Assess opportunities to expand habitats of special –status species within publicly-owned open spaces.	Community Services Department	R	\$\$
N1.5.1	Maintain the value of local wetlands as habitats by ensuring adequate flow from the Bay and minimizing effluent.	Community Services Department	R	\$

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<b>4. Natural Environment</b>				
N1.6.1	Continue to coordinate City review, particularly by Planning, Public Works and Community Services Departments, of projects that might impact the City's foothills and hillside areas.	Planning & Community Environment Department	R	\$\$
N1.7.1	Examine and improve existing management practices, including the provision of access to open space for City vehicles and equipment, to ensure that natural resources are protected.	Community Services Department	R	\$\$
N1.7.2	Protect wildlife in public open space areas by improving litter collection, restricting the use of non-recyclable plastics, prohibiting the feeding of wild, feral and stray animals in open space, and enforcing dog leash laws.	Community Services Department	R	\$
N1.7.3	Provide information about responsible behavior in environmentally-sensitive areas through signage, pamphlets and documents on the City's website.	Community Services Department	R	\$
N1.7.4	Review and map existing easements and maintenance roads for potential trails and trail connections.	Community Services Department	S	\$\$
N1.10.1	Use City funds and seek additional sources of funding, including State and federal programs, to finance open space acquisition, maintenance or conservation.	Community Services Department	R	\$
N1.10.2	Create mechanisms to monitor, assess and respond quickly to land acquisition opportunities that would expand or connect the City's system of parks and open spaces, and establish a long-term funding strategy for acquisition that would enable the City to move quickly when opportunities arise.	Community Services Department	S	\$\$\$
<b>Goal N-2: A thriving urban forest that provides public health, ecological, economic, and aesthetic benefits for Palo Alto.</b>				
N2.1.1	Explore ways to prevent and ameliorate damage to trees and tree roots by above and below ground infrastructure and buildings.	Department of Public Works	R	\$
N2.2.1	Periodically update the UFMP and Tree Protection Ordinance to ensure policies and regulations remain relevant set leading standards for tree health practices.	Department of Public Works	R	\$\$

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<b>4. Natural Environment</b>				
N2.4.1	Promote landscape design that optimizes soil volume, porosity, structure and health, as well the location, shape and configuration of soil beds.	Planning & Community Environment Department	M	\$
N2.7.1	Maintain and irrigate healthy trees in parks, open space, parking lots, and City rights-of-way, while identifying and replacing unhealthy trees in those areas.	Department of Public Works	S	\$\$
N2.7.2	Continue to invest in the care, irrigation and monitoring of street trees during drought conditions.	Department of Public Works	R	\$\$
N2.7.3	Actively pursue funding for tree planting to increase canopy cover significantly across the city, avoid a net loss of canopy at the neighborhood level, and attain canopy size targets in parks, open space, parking lots, and City rights-of-way.	Department of Public Works	R	\$
N2.9.1	Increase awareness, severity and enforcement of penalties for tree damage.	Department of Public Works	M	\$
N2.9.2	Develop a program for using the City's Urban Forestry Fund to replace trees lost to public improvement and infrastructure projects, with replanting occurring onsite or as close to the original site as is ecologically appropriate.	Department of Public Works	M	\$\$
N2.10.1	Continue to require replacement of trees, including street trees lost to new development.	Planning & Community Environment Department	R	\$
N2.10.2	As part of the update of the Tree and Landscape Technical Manual, consider expanding tree protections to include additional mature trees and provide criteria for making site-specific determinations of trees that should be protected.	Planning & Community Environment Department	S	\$
N2.10.3	Consider revisions to the appeals process to increase transparency regarding tree removals and expanded opportunities for community members to appeal the removal of trees.	Planning & Community Environment Department	L	\$\$
N2.11.1	Develop a transparent and publicly accessible street tree removal and replacement schedule.	Department of Public Works	M	\$

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<b>4. Natural Environment</b>				
N2.11.2	Develop a program to replace unhealthy public trees over time.	Department of Public Works	M	\$\$
N2.12.1	Explore ways to leverage the fact that Palo Alto's urban forest alleviates climate change by capturing and storing carbon dioxide.	Department of Public Works	M	\$
N2.13.1	Work with local nonprofits to establish one or more tree planting programs that are consistent with the UFMP, and rely on locally native, resilient species. Review existing tree planting guidelines to ensure they achieve these objectives.	Department of Public Works	S	\$\$
N2.13.2	Provide on-going education for City staff, residents, and developers regarding landscape, maintenance, and irrigation practices that protect the urban forest and wildlife species.	Department of Public Works	R	\$
N2.13.3	Involve tree owners in tree maintenance programs.	Planning & Community Environment Department	R	\$
N2.13.4	Cooperate with the Palo Alto Unified School District, Stanford University, Caltrain, Caltrans, Pacific Gas & Electric, and other public and private entities to ensure that their tree planting, tree removal, and maintenance practices are consistent with City guidelines.	Department of Public Works	R	\$
<b>Goal N-3: Conservation of both natural and channelized creeks and riparian areas as open space amenities, natural habitat areas, and elements of community design.</b>				
N3.3.1	Update the Stream Corridor Protection Ordinance to explore 150 feet as the desired stream setback along natural creeks in open space and rural areas west of Foothill Expressway. This 150-foot setback would prohibit the siting of buildings and other structures, impervious surfaces, outdoor activity areas and ornamental landscaped areas within 150 feet of the top of a creek bank. Allow passive or intermittent outdoor activities and pedestrian, equestrian and bicycle pathways along natural creeks where there are adequate setbacks to protect the natural riparian environment. Within the setback area, provide a border of native riparian vegetation at least 30 feet along the creek bank.	Planning & Community Environment Department	S	\$\$
The update to the Stream Protection Ordinance should establish:				

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<b>4. Natural Environment</b>				
	<ul style="list-style-type: none"> <li>Design recommendations for development or redevelopment of sites within the setback, consistent with basic creek habitat objectives and significant net improvements in the condition of the creek.</li> <li>Conditions under which single-family property and existing development are exempt from the 150-foot setback</li> <li>Appropriate setbacks and creek conservation measures for undeveloped parcels.</li> </ul>			
N3.3.2	Examine the development regulations of the Stream Corridor Protection Ordinance, with stakeholder involvement to establish appropriate setback requirements that reflect the varying natural and channelized conditions along creeks east of Foothill Expressway. Ensure that opportunities to provide an enhanced riparian setback along urban creeks as properties are redeveloped or improved are included in this evaluation.	Planning & Community Environment Department	S	\$\$
N3.3.3	<p>For all creeks, update the Stream Corridor Protection Ordinance to minimize impacts on wildlife by:</p> <ul style="list-style-type: none"> <li>Limiting the development of recreational trails to one side of natural riparian corridors.</li> <li>Requiring careful design of lighting surrounding natural riparian corridors to maximize the distance between nighttime lighting and riparian corridors and direct lighting away from the riparian corridor.</li> </ul>	Planning & Community Environment Department	S	\$\$
N3.4.1	Develop a community creek stewardship program to promote existing creek clean-up days, organize new events, and increase appreciation of riparian corridors.	Department of Public Works	M	\$\$
N3.6.1	Review and update the Grading Ordinance to ensure that it adequately protects creeks from the erosion and sedimentation impacts of grading.	Department of Public Works	M	\$\$
N3.8.1	Work with the SCVWD to develop a maintenance, restoration and enhancement improvement program that preserves flood protection while preserving riparian habitat, and identifies specific stretches of corridor to be restored or daylighted, standards to be achieved, and sources of funding. Include provisions for tree and vegetation planting to enhance natural habitat	Department of Public Works	M	\$\$

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<b>4. Natural Environment</b>				
	and shade cover.			
N3.8.2	Participate cooperatively in the JPA to achieve increased flood protection, habitat preservation, enhancement and improved recreational opportunities along San Francisquito Creek.	Department of Public Works	IP	\$
<b>Goal N-4: Water resources and infrastructure that are managed to sustain plant and animal life, support urban activities, and protect public health and safety.</b>				
N4.2.1	Educate customers on efficient water use (indoor and outdoor), tree care, and landscaping options.	Department of Public Works	R	\$
N4.5.1	Study the supply and quality of local groundwater aquifers to better understand their utility as natural water storage.	City of Palo Alto Utilities	L	\$
N4.5.2	Work with local public agencies to educate residents regarding the public health, fire, and overall quality of life risks associated with long-term drought.	City of Palo Alto Utilities	R	\$
N4.6.1	Encourage residents to use rain barrels or other rainwater reuse systems.	City of Palo Alto Utilities	S	\$
N4.7.1	Support and participate in the work of the SCVWD to prepare a high-quality groundwater management plan that will address groundwater supply and quality, including, as appropriate: <ul style="list-style-type: none"> <li>▪ An understanding of subsurface hydrology.</li> <li>▪ Strategies to reduce depletion.</li> <li>▪ Opportunities to recharge groundwater, including through use of recycled water and extracted groundwater.</li> <li>▪ Methods to ensure that uncontaminated, toxin-free groundwater is used in a manner that benefits the community, for example in irrigation of parks, street cleaning, and dust suppression.</li> <li>▪ An approach to metering extracted groundwater.</li> </ul>	Department of Public Works	S	\$
N4.7.2	Support the SCVWD and the Regional Water Quality Control Board (RWQCB) to implement their mandate to protect groundwater from the adverse impacts of urban uses.	Department of Public Works	S	\$

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<b>4. Natural Environment</b>				
N4.7.3	Work with the SCVWD and RWQCB to identify and map key groundwater recharge and stormwater management areas for use in land use planning and permitting and the protection of groundwater resources.	Department of Public Works	IP	\$
N4.8.1	Research and promote new construction techniques and recharge strategies developed to reduce subsurface and surface water impacts and comply with City dewatering policies.	Department of Public Works	IP	\$
N4.8.2	Explore appropriate ways to monitor all excavations and other projects to ensure that dewatering does not result in recharge into the aquifer where needed.	Department of Public Works	S	\$
N4.10.1	Monitor and implement practices for reducing water pollution. Examples include state-of-the-art best management practices (BMPs), land use planning approaches, and construction of modern stormwater management facilities.	Department of Public Works	R	\$\$\$
N4.10.2	Continue public education programs on water quality issues, including BMPs for residents, businesses, contractors, and City employees.	Department of Public Works	R	\$
N4.10.3	Implement swift and rigorous spill response, cleanup, and follow-up investigation procedures to reduce the impacts of toxic spills on the city's creeks and San Francisco Bay.	Department of Public Works	R	\$\$
N4.10.4	Increase monitoring and enforcement of existing prohibitions on materials and practices known to impact local water quality, such as use of copper, in the design and construction industries.	Department of Public Works	R	\$
N4.11.1	Evaluate neighborhoods where parking controls may hinder street sweeping and recommend any changes that are needed.	Department of Public Works	M	\$
N4.12.1	Implement the City's Integrated Pest Management Policy with periodic assessments of pesticide use and use of BMPs to reduce pesticide applications and toxicity, and maximize non-chemical control.	Department of Public Works	R	\$
N4.12.2	Revise the City's Tree and Landscape Technical Manual to include stronger requirements for least-toxic practices in the landscape permitting process.	Department of Public Works	S	\$
N4.12.3	Promote the value of toxin-free landscape management, and educate residents about the impacts of common fertilizers, herbicides, insecticides and pesticides on local water quality.	Department of Public Works	R	\$

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<b>4. Natural Environment</b>				
N4.13.1	Promote the use of permeable paving materials or other design solutions that allow for natural percolation and site drainage through a Storm Water Rebate Program and other incentives.	Department of Public Works	S	\$
N4.13.2	Develop and implement a green stormwater infrastructure plan with the goal to treat and infiltrate stormwater.	Department of Public Works	S	\$\$\$
N4.13.3	Mitigate flooding through improved surface permeability or paved areas, and stormwater capture and storage.	Department of Public Works	S	\$\$
N4.14.1	Establish a standardized process for evaluating the impacts of development on the storm drainage system, including point source discharge, base flow and peak flow.	Department of Public Works	S	\$
N4.14.2	Complete improvements to the storm drainage system consistent with the priorities outlined in the City's Storm Drainage Master Plan, as amended.	Department of Public Works	IP	\$\$\$
N4.15.1	Work with commercial and industrial dischargers to identify and implement pollution prevention measures and BMPs to eliminate or reduce the discharge of metals and other pollutants of concern.	Department of Public Works	R	\$\$
N4.15.2	Encourage commercial dischargers to consistently go beyond minimum requirements of the Clean Bay Business Program.	Department of Public Works	R	\$
N4.16.1	Implement approved recommendations based on the Long-Term Facilities Plan prepared for the RWQCP.	City of Palo Alto Utilities	IP	\$\$\$
N4.16.2	Develop a plan to address ongoing operations of the RWQCP taking potential sea level rise and growth in surrounding communities into account.	City of Palo Alto Utilities	M	\$\$\$
N4.17.1	Evaluate the expansion of existing recycled water infrastructure to serve a larger area. Develop a plan to install "purple pipe" when streets are opened for other infrastructure work.	City of Palo Alto Utilities	M	\$\$
N4.17.2	Evaluate the possibility of using recycled water as an emergency water supply.	City of Palo Alto Utilities	L	\$
N4.17.3	Investigate ways to reuse non-traditional water sources including recycled, gray, black and stormwater.	City of Palo Alto Utilities	R	\$

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<b>4. Natural Environment</b>				
<b>Goal N-5: Clean, healthful air for Palo Alto and the San Francisco Bay Area.</b>				
N5.1.1	Provide City input on significant proposals for air quality legislation and state implementation plans.	Planning & Community Environment Department	R	\$
N5.1.2	Implement BAAQMD recommended standards for the design of buildings near heavily traveled roads, in order to minimize exposure to auto-related emissions.	Planning & Community Environment Department	S	\$
N5.1.3	Explore adopting new standards that target the reduction of very fine particulate matter (PM2.5), which is associated with increased impacts on health.	Planning & Community Environment Department	S	\$
N5.2.1	Promote understanding of the impacts of extended idling on air quality, for residents, auto-dependent businesses, and schools.	Planning & Community Environment Department	M	\$
N5.2.2	Consider adopting and enforcing penalties for drivers that idle for longer than 3-5 minutes.	Planning & Community Environment Department	M	\$
N5.3.1	Cooperatively work with Santa Clara County and the BAAQMD to ensure that mining and industrial operations mitigate environmental and health impacts.	Planning & Community Environment Department	R	\$
N5.3.2	Monitor particulate emissions at local California Air Resources Board monitoring stations and make the information easily available to citizens.	Planning & Community Environment Department	R	\$

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<b>4. Natural Environment</b>				
N5.3.3	Promote understanding of the health impacts of particulate emissions and provide information to residents and businesses about steps they can take to reduce particulate emissions, such as reducing or eliminating wood burning or using low emission alternatives to wood-burning stoves and fireplaces.	Planning & Community Environment Department	R	\$
N5.3.4	Explore feasible and cost-effective opportunities to reduce concrete and asphalt use by the City, in parks and other public projects.	Department of Public Works	R	\$
<b>Goal N-6: An environment that minimizes the adverse impacts of noise.</b>				
N6.3.1	Continue working to reduce noise impacts created by events and activities taking place in communities adjoining Palo Alto.	Planning & Community Environment Department	R	\$
N6.3.2	Evaluate the feasibility of adopting noise criteria in the purchase of new City vehicles and equipment.	Department of Public Works	M	\$
N6.3.3	Update the Noise Ordinance, as needed, to provide for clear interpretation of the regulations, to review the effectiveness of existing standards, and to ensure that regulations address contemporary issues.	Planning & Community Environment Department	S	\$
N6.7.1	Update noise impact review procedures in the Noise Ordinance and the Zoning Code to address appropriate requirements for analysis and thresholds for impacts on residential land uses and publicly-owned conservation land.	Planning & Community Environment Department	S	\$
N6.10.1	Evaluate changes to the Noise Ordinance to further reduce the impacts of noise from leaf blowers and residential power equipment.	Planning & Community Environment Department	M	\$
N6.11.1	For larger development projects that demand intensive construction periods and/or use equipment that could create vibration impacts, such as the Stanford University Medical Center or major grade separation projects, require a vibration impact analysis, as well as formal, ongoing monitoring and reporting of noise levels throughout the entire construction process pertinent to industry standards.	Planning & Community Environment Department	S	\$\$

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<b>4. Natural Environment</b>				
	The monitoring plan should identify hours of operation and could include information on the monitoring locations, durations and regularity, the instrumentation to be used and appropriate noise control measures to ensure compliance with the noise ordinance.			
N6.12.1	Continue working to reduce noise associated with operations of the Palo Alto Airport. Also, ensure compliance with the land use compatibility standards for community noise environments, shown in <a href="#">Table N-1</a> , by prohibiting incompatible land use development within the 60 dBA CNEL noise contours of the airport.	Department of Public Works	R	\$\$
N6.12.2	Participate in appropriate public forums and engage with other governmental agencies and representatives to ensure that activities at airports in the region do not negatively affect noise levels in Palo Alto.	Department of Public Works	IP	\$
N6.13.1	Encourage the Peninsula Corridors Joint Powers Board to pursue technologies and grade separations that would reduce or eliminate the need for train horns/whistles in communities served by rail service.	Planning & Community Environment Department	IP	\$
N6.13.2	Evaluate changing at-grade rail crossings so that they qualify as Quiet Zones based on Federal Railroad Administration (FRA) rules and guidelines in order to mitigate the effects of train horn noise without adversely affecting safety at railroad crossings.	Planning & Community Environment Department	S	\$\$\$
N6.13.3	Participate in future environmental review of the California High-Speed Rail (HSR) Project, planned to utilize existing Caltrain track through Palo Alto, to ensure that it adheres to noise and vibration mitigation measures.	Planning & Community Environment Department	S	\$\$
<b>Goal N-7: A clean, efficient energy supply that makes use of cost-effective renewable resources.</b>				
N7.1.1	Meet customer electricity needs with least total cost resources after careful assessment of environmental cost and benefits.	City of Palo Alto Utilities	R	\$
N7.2.1	Promote the adoption of cost-effective, renewable energy technologies from diverse renewable fuel sources by all customers.	City of Palo Alto Utilities	S	\$
N7.2.2	Assess the feasibility of using life cycle analysis and total cost of ownership analysis for public and private projects, funded by the project proponent, in	City of Palo Alto Utilities	M	\$\$

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<b>4. Natural Environment</b>				
	order to minimize the consumption of energy, the production of greenhouse gases, including GHG emissions of construction materials and demolition and costs over the life of the project.			
N7.4.1	Continue timely incorporation of State and federal energy efficiency standards and policies in relevant City codes, regulations and procedures, and higher local efficiency standards that are cost-effective.	Planning & Community Environment Department	R	\$
N7.4.2	Implement cost effective energy efficiency programs for all customers, including low income customers.	City of Palo Alto Utilities	R	\$
N7.4.3	Incorporate cost-effective energy conservation measures into construction, maintenance, and City operation and procurement practices.	City of Palo Alto Utilities	R	\$\$
N7.4.4	Implement gas and electric rate structures that encourage efficient use of resources while meeting State law requirements that rates be based on the cost of service.	City of Palo Alto Utilities	M	\$
N7.4.5	Continue to provide public education programs addressing energy conservation and efficiency.	City of Palo Alto Utilities	R	\$
N7.5.1	Monitor professional and medically-sound research and studies on light-emitting diodes (LEDs).	City of Palo Alto Utilities	M	\$
N7.6.1	Explore changes to building and zoning codes to incorporate solar energy, energy storage and other energy efficiency measures into major development projects, including City-owned projects.	Planning & Community Environment Department	S	\$
N7.6.2	Promote use of the top floors of new and existing structured automobile garages for installation of photovoltaic panels and green roofs.	Planning & Community Environment Department	S	\$
N7.6.3	Promote solar energy in individual private projects.	Planning & Community Environment Department	R	\$

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<b>4. Natural Environment</b>				
N7.7.1	Evaluate the potential for a cost-effective plan for transitioning to a completely carbon-neutral natural gas supply.	City of Palo Alto Utilities	S	\$
N7.7.2	Explore the transition of existing buildings from gas to electric or solar water and space heating.	City of Palo Alto Utilities	S	\$\$
N7.8.1	Evaluate energy efficient approaches for the treatment and reuse of organic waste that maximize resource recovery and reduce greenhouse gas generation at the RWQCP located in Palo Alto and the Palo Alto Landfill.	City of Palo Alto Utilities	M	\$
<b>Goal N-8: Actively support regional efforts to reduce our contribution to climate change while adapting to the effects of climate change on land uses and city services.</b>				
N8.1.1	Participate in cooperative planning with regional and local public agencies, including on the Sustainable Communities Strategy, on issues related to climate change, such as greenhouse gas reduction, water supply reliability, sea level rise, fire protection services, emergency medical services, and emergency response planning.	Planning & Community Environment Department	R	\$
N8.1.2	Pursue or exceed State goals of achieving zero net carbon for residential buildings by 2020 and commercial buildings by 2030, without compromising the urban forest.	Office of Sustainability	S	\$
N8.2.1	Periodically update the S/CAP consistent with the update schedule in the approved S/CAP; this update shall include an updated greenhouse gas inventory and updated short, medium, and long-term emissions reduction goals.	Office of Sustainability Services	M	\$\$
N8.3.1	Protect the Municipal Services Center, Utility Control Center, and RWQCP from the impacts of sea level rise.	City of Palo Alto Utilities	M	\$\$\$
N8.4.1	Prepare response strategies that address sea level rise, increased flooding, landslides, soil erosion, storm events and other events related to climate change. Include strategies to respond to the impacts of sea level rise on Palo Alto's levee system.	Planning & Community Environment Department	S	\$\$\$

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<b>5. Safety Element</b>				
<b>Goal S-1: A safe community that is aware of risks and prepared for emergencies.</b>				
S1.1.1	Expand public education programs that help and encourage each household in the City to be prepared to be self-sufficient, with enough stored water and food to support the entire household for at least one week after a major earthquake, flood, terrorism event, pandemic or other major disaster.	Office of Emergency Services	S	\$
S1.1.2	Continue to implement and fund the Emergency Services Volunteer program.	Office of Emergency Services	S	\$
S1.1.3	Conduct emergency hazard drills with key stakeholder organizations across the community to improve preparedness for known threats and hazards.	Office of Emergency Services	R	\$\$
S1.1.4	Support an annual community public safety fair to educate and engage the public on preparedness and offer the opportunity to buy emergency disaster supplies for home and vehicle.	Office of Emergency Services	R	\$\$
S1.1.5	Encourage local businesses and other organizations to have disaster preparedness, communication, mitigation and recovery plans in place.	Office of Emergency Services	R	\$
S1.2.1	Develop accessible, attractive marketing materials to promote involvement in community crime safety programs.	Office of Emergency Services	R	\$
S1.3.1	Explore the use of urban design principles to increase safety and prevent crime in Palo Alto.	Planning & Community Environment Department	S	\$
S1.3.2	Support programs such as the Department of Housing and Urban Development's Good Neighbor Next Door, which incentivizes home purchase for first responders with discounts.	Planning & Community Environment Department	R	\$
S1.4.1	Make data available to maintain an accurate, up to date, and complete real-time local crime mapping function to promote neighborhood safety.	Police Department	M	\$\$

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<b>5. Safety Element</b>				
S1.5.1	Promote neighborhood security by providing crime prevention information and training to residents, and continuing to fund resident involvement in neighborhood safety programs such as “Know Your Neighbor” grants and Block Preparedness Coordinators.	Police Department	R	\$
S1.5.2	Collaborate with the Palo Alto Unified School District (PAUSD), other school districts in the city, private schools, businesses, non-profits, and local faith-based organizations provide community safety education.	Police Department	R	\$
S1.5.3	Encourage the PAUSD to develop secure school facilities and collaborate with Emergency Services Volunteers on disaster preparedness activities; emergency disaster planning, exercises and drills; and disaster recovery.	Office of Emergency Services	R	\$
S1.5.4	Continue to support and encourage participation in Police Department programs to introduce youth to the importance and benefits of local law enforcement.	Police Department	R	\$
S1.6.1	Enhance public safety department training for evolving challenges, such as small- to large-scale human threats, interacting with individuals with mental illness, and non-lethal alternatives.	Police Department	R	\$
S1.6.2	Support the PAPD in implementing and maintaining approved technologies for data gathering, surveillance, and recording interactions with the public. Incorporate best practices in use policies with special consideration in ensuring the programs protect the public’s privacy rights and civil liberties, in accordance with current legislation. Ensure transparency by communicating new equipment implementation, usage, privacy considerations, and retention of data.	Police Department	S	\$\$
S1.6.3	Communicate transparently with the community regarding adoption of new PAPD equipment and/or tactics while balancing the need for operational security.	Police Department	S	\$
S1.7.1	Regularly monitor and review the level of public safety staffing and satellite police station locations required for efficient local service delivery.	Police Department	R	\$
S1.7.2	Design the new Public Safety building to meet essential service standards, the needs of the public safety departments and be resilient against known threats and hazards.	Department of Public Works	S	\$\$\$

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<b>5. Safety Element</b>				
S1.7.3	Provide community notifications in the event of emergency using the best available methods and explore new technologies for emergency public information and warnings.	Office of Emergency Services	R	\$\$
S1.8.1	Update Palo Alto's 2001 Terrorism Response Plan.	Office of Emergency Services	S	\$\$
S1.9.1	Develop an Infrastructure Master Plan that projects the future needs of streets, underground utilities, and all City assets and plans for the incorporation of new technology that improves efficiency and effectiveness.	Department of Public Works	S	\$\$\$
S1.10.1	Regularly update and make publicly available the City of Palo Alto Emergency Operations Plan (EOP).	Office of Emergency Services	R	\$\$\$
S1.10.2	Participate in local and regional planning efforts to mitigate, prepare for, respond to, and recover from emergencies.	Office of Emergency Services	R	\$
S1.10.3	Implement the mitigation strategies and guidelines provided by the LHMP, including those that address evolving hazards resulting from climate change.	Office of Emergency Services	R	\$\$
S1.12.1	Encourage multiagency coordination in case of incidents that cross disciplinary or jurisdictional boundaries or coordination that involves complex incident management scenarios.	Office of Emergency Services	R	\$
S1.12.2	Explore the establishment of mutually-beneficial cooperative agreements between Palo Alto's police and fire departments and those of neighboring cities.	Police Department, Fire Department	M	\$
S1.13.1	Identify solutions to add an additional power line to Palo Alto to ensure redundancy.	City of Palo Alto Utilities	S	\$\$
S1.13.2	Explore incentives to adopt emerging, residential off-grid capabilities and technologies, including back-up power sources vital in the event of natural disasters or other threats.	City of Palo Alto Utilities	M	\$

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<b>5. Safety Element</b>				
S1.13.3	Continue citywide efforts to underground utility wires to limit injury, loss of life, and damage to property in the event of human-made or natural disasters.	City of Palo Alto Utilities	R	\$\$\$
S1.13.4	Enhance the safety of City-owned natural gas pipeline operations. Work with customers, public safety officials, and industry leaders to ensure the safe delivery of natural gas throughout the service area. Provide safety information to all residents on City-owned natural gas distribution pipelines.	City of Palo Alto Utilities	R	\$\$
S1.13.5	Provide off-grid and/or backup power sources for critical City facilities to ensure uninterrupted power during emergencies and disasters.	City of Palo Alto Utilities	R	\$\$
<b>Goal S-2: Protection of life, ecosystems and property from natural hazards and disasters, including earthquake, landslide, flooding, and fire.</b>				
S2.5.1	Periodically review and update the City's Seismic Hazard Ordinance.	Development Services Department	IP	\$
S2.5.2	Continue to provide incentives for seismic retrofits of structures throughout the city, particularly those building types that would affect the most people in the event of an earthquake.	Planning & Community Environment Department	S	\$
S2.6.1	Encourage efforts by individual neighborhood or block-level groups to pool resources for seismic retrofits.	Planning & Community Environment Department	M	\$
S2.6.2	Continue to use a seismic bonus and a TDR Ordinance for seismic retrofits for eligible structures in the Commercial Downtown (CD) zone.	Planning & Community Environment Department	R	\$
S2.6.3	Evaluate the TDR Ordinance so that transferred development rights may be used for residential development on the receiver sites.	Planning & Community Environment Department	R	\$

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<b>5. Safety Element</b>				
S2.6.4	Study the possibility of revising the transfer of development rights program to encourage seismic retrofits.	Planning & Community Environment Department	M	\$
S2.6.5	Explore the use of Community Development Block Grants, Palo Alto Housing Funds and other sources of funding to support owners of lower income and senior housing to retrofit seismically-unsafe construction.	Planning & Community Environment Department	S	\$
S2.7.1	As part of the construction permitting process for proposed new and redeveloped buildings in areas of identified hazard shown on <u>MapS-2</u> , structures that would affect the most people in a seismic event require submittal to the City of a geotechnical/seismic report that identifies specific risks and appropriate mitigation measures.	Development Services Department	S	\$
S2.7.2	Review and update, as appropriate, City code requirements for excavation, grading, filling and construction to ensure that they conform to currently accepted and adopted State standards.	Department of Public Works	M	\$
S2.7.3	Utilize the results of Palo Alto's Seismic Hazards Identification Program and inventory of potentially seismically vulnerable building types to establish priorities and consider incentives to encourage structural retrofits.	Planning & Community Environment Department	S	\$
S2.8.1	Implement flood mitigation requirements of FEMA in Special Flood Hazard Areas as illustrated on the Flood Insurance Rate Maps.	Department of Public Works	R	\$\$\$
S2.8.2	Continue participating in FEMA's Community Rating System to reduce flood insurance for local residents and businesses and strive to improve Palo Alto's rating in order to lower the cost of flood insurance.	Department of Public Works	R	\$
S2.8.3	Collaborate with the San Francisquito Creek Joint Powers Authority and the Santa Clara Valley Water District on environmentally-sensitive efforts to stabilize, restore, maintain and provide one percent (100-year) flood protection adjacent to San Francisquito Creek.	Department of Public Works	IP	\$\$\$

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<b>5. Safety Element</b>				
S2.8.4	Work with East Palo Alto, Santa Clara Valley Water District and San Francisquito Creek Joint Powers Authority on efforts to increase the flows within the San Francisquito Creek possible solutions include replacing the City-owned Newell Road Bridge and District-owned Pope Chaucer Street Bridge.	Department of Public Works	S	\$\$\$
S2.10.1	Keep basement restrictions up to date with changing flood hazard zones.	Planning & Community Environment Department	S	\$
S2.11.1	Review development standards applicable in areas susceptible to flooding from sea level rise, including east of Highway 101, West Bayshore and East Meadow Circle, the area east of San Antonio Road and north of East Charleston, and implement shoreline development regulations to ensure that new development is protected from potential impacts of flooding resulting from sea level rise and significant storm events. Regulations should be consistent with the Baylands Master Plan, as amended, and may include new shoreline setback requirements, limits on lot line adjustments to avoid the creation of vulnerable shoreline lots, and/or triggers for relocation or removal of existing structures based on changing site conditions and other factors.	Planning & Community Environment Department	S	\$\$
S2.11.2	Study appropriate restrictions on underground construction in areas outside of flood zones, as shown on Map S-5, to accommodate expected higher groundwater levels due to sea level rise and minimize consequent flooding of underground construction.	Planning & Community Environment Department	S	\$
S2.12.1	Work cooperatively with the Santa Clara Valley Water District and the San Francisquito Creek Joint Powers Authority to provide flood protection from high tide events on San Francisco Bay, taking into account the impacts of future sea level rise, to provide one percent (100-year) flood protection from tidal flooding, while being sensitive to preserving and protecting the natural environment.	Department of Public Works	R	\$\$\$
S2.12.2	Work with regional, State, and federal agencies to develop additional strategies to adapt to flood hazards to existing or new development and infrastructure, including support for environmentally sensitive levees.	Department of Public Works	R	\$

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<b>5. Safety Element</b>				
S2.13.1	Regularly review and update the Fire Department's operations, training facilities and programs to ensure consistency with current standards and Best Management Practices.	Fire Department	R	\$
S2.13.2	Explore technological tools, such as cameras or remote sensors, to identify smoke or fires and initiate response as quickly as possible.	Fire Department	S	\$\$
S2.14.1	Regularly review and fund updates to the Palo Alto Foothills Fire Management Plan to ensure consistency with current standards and Best Management Practices.	Fire Department	M	\$\$
S2.14.2	Implement the Foothills Fire Management Plan to balance conservation of natural resources with reduction of fire hazards especially in open space areas.	Fire Department	R	\$\$\$
S2.14.3	Minimize fire hazards by maintaining low density zoning in wildland fire hazard areas.	Planning & Community Environment Department	R	\$
S2.14.4	Work collaboratively with other jurisdictions and agencies to reduce wildfire hazards in and around Palo Alto, with an emphasis on effective vegetation management and mutual aid agreements.	Fire Department	R	\$
S2.14.5	Consider implementation of CAL FIRE recommended programs in educating and involving the local community to diminish potential loss caused by wildfire and identify prevention measures to reduce those risks.	Fire Department	S	\$\$
S2.15.1	Evaluate measures for optimal service delivery to improve efficiency; develop automatic or mutual aid agreements with other jurisdictions, including Stanford, to improve efficiencies.	Fire Department	M	\$\$
S2.15.2	Upgrade fire stations so that all remain fully functional following earthquakes.	Fire Department	IP	\$\$\$
S2.15.3	Periodically update the Fire Department Standards of Cover document.	Fire Department	S	\$
S2.16.1	Provide public education on fire safety, including wildland and structural fire prevention, evacuation routes and guidelines for clearance of landscaping and other hazards around structures.	Fire Department	R	\$

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<b>5. Safety Element</b>				
<b>Goal S-3: An environment free of the damaging effects of human-caused threats and hazardous materials.</b>				
S3.1.1	Continue City permitting procedures for commercial and industrial storage, use, and handling of hazardous materials and regulate the commercial use of hazardous materials that may present a risk of off-site health or safety effects.	Fire Department	IP	\$
S3.1.2	Minimize the risks of biohazards in Palo Alto, including Level 4 biohazards, by continuing to review and update, as necessary, local regulations regarding use, handling and disposal.	Fire Department	S	\$
S3.1.3	Strengthen development review requirements and construction standards for projects on sites with groundwater contamination.	Development Services Department	S	\$
S3.1.4	Establish protocols to monitor the movement of hazardous materials on Palo Alto roadways and respond effectively to spills via established truck and construction routes.	Fire Department	M	\$
S3.1.5	Work with non-profit organizations to provide information to the public regarding pesticides and other commonly used hazardous materials, environmentally preferable alternatives, and safe recycling and disposal practices to all user groups.	Fire Department	R	\$
S3.1.6	Continue providing regular household hazardous waste collection events at the Palo Alto Regional Water Quality Control Plant and strive to make these programs more convenient and accessible to residents.	Department of Public Works	R	\$
S3.1.7	Continue to allow small quantity generators to dispose of hazardous waste at cost.	Department of Public Works	R	\$
S3.1.8	Continue to educate residents on the proper disposal of pharmaceutical and household hazardous waste. Encourage proper disposal of medications through pharmacies or drug take-back programs rather than flushing.	Department of Public Works	R	\$
S3.6.1	Work with the freight industry to monitor the contents of freight trains intersecting Palo Alto for potentially hazardous materials, and to establish accountability for accidents and spills.	Office of Emergency Services	R	\$

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<b>5. Safety Element</b>				
S3.6.2	Work with Caltrain and the PAUSD, to educate students and the public on the dangers of rail trespass and the benefits of suicide support services available in Palo Alto.	Community Services Department	R	\$
S3.8.1	Encourage residential and commercial food waste reduction through incentives, educational outreach and programs.	Department of Public Works	R	\$
S3.8.2	To the extent allowed by law, use refuse rate structures that incentivize waste reduction.	Department of Public Works	R	\$
S3.8.3	Continue to work with CalRecycle and the Department of Toxic Substances Control to develop and promote long-term solid waste management, such as environmentally responsible recycling programs, composting of food waste and other organics, and citywide electronics and digital hardware recycling efforts.	Department of Public Works	IP	\$
S3.9.1	Periodically review and update the adopted Construction and Debris program.	Department of Public Works	R	\$
S3.9.2	Educate Palo Alto residents and developers about available incentives to use environmentally friendly deconstruction activities to minimize our carbon footprint, and to save natural resources, as well as space in our landfills.	Development Services Department	R	\$
S3.10.1	Support efforts to enforce extended producer responsibility for solid waste to reduce waste produced from manufacturing, shipping, packaging and the entire life-cycle of the product.	Office of Sustainability Services	R	\$
S3.12.1	Complete an inventory of the City's digital infrastructure to locate vulnerabilities and gaps in system redundancies and develop recommendations for improved cybersecurity.	City of Palo Alto Utilities	S	\$\$
S3.12.2	Establish criteria for the installation of high security telecommunications technology in new local government projects.	City of Palo Alto Utilities	M	\$
S3.12.3	Establish a wi-fi network that will be available to public safety responders and Emergency Service Volunteers in the event of power interruption during an emergency or disaster.	City of Palo Alto Utilities	S	\$\$

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<b>6. Community Services &amp; Facilities Element</b>				
<b>Goal C-1: Deliver community services effectively and efficiently.</b>				
C1.1.1	Based on identified needs, continue to provide and expand the provision of multilingual literature, program information and educational displays at public community facilities and parks.	Community Services Department	R	\$
C1.1.2	Establish a cross-cultural outreach program to engage residents of all ages, cultural, social and linguistic backgrounds in educational, recreational and cultural activities offered throughout the City of Palo Alto.	Community Services Department	M	\$
C1.2.1	Periodically review public information, outreach and community relations activities to evaluate effectiveness.	Community Services Department	R	\$
C1.2.2	Explore a City solution to help residents and others to resolve questions and concerns and navigate the City's community services and facilities.	Community Services Department	M	\$
C1.2.3	Identify barriers to participation in City programming and facilities across gender, age, socioeconomic and ethnic groups and sexual identity and orientation, as well as mental and physical abilities, and adopt strategies to remove barriers to participation.	Community Services Department	S	\$
C1.2.4	Based on identified needs, expand program offerings to underserved groups.	Community Services Department	R	\$\$\$
C1.3.1	Develop and implement a plan to collect and analyze data on demographics, use of community service facilities and needs of the community as related to parks, open spaces, recreation, arts and culture.	Community Services Department	M	\$
C1.6.1	Establish a program to facilitate continuing corporate support for community services through contributions of funds, time, materials and expertise.	Community Services Department	M	\$
C1.12.1	In cooperation with public and private businesses, non-profit organizations, and PAUSD, develop a service program that will coordinate the efforts of agencies providing services to families and youth in Palo Alto.	Community Services Department	R	\$

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<b>6. Community Services &amp; Facilities Element</b>				
C1.13.1	Determine the potential for City shared use of PAUSD facilities for weekend, summer and evening use for community uses such as child care, libraries, recreational facilities, community meeting space, education, language education, health care, culture and computer resources.	Community Services Department	M	\$
C1.15.1	Support and promote the provision of comprehensive child care services in Palo Alto by public and private providers, including employers.	Community Services Department	S	\$
C1.15.2	Utilize the Early Care and Education Committee to develop and update the Child Care Master Plan, and to connect providers and professionals working with families with young children, explore challenges and opportunities to programs and services for young children, and support early education programs in the community in their efforts to enhance quality.	Community Services Department	S	\$
C.1.15.3	Collaborate with Palo Alto Community Child Care (PACCC) to identify, develop, and promote high quality early learning environments to serve all families in our community.	Community Services Department	M	\$
C1.15.4	Explore opportunities to provide access to childcare for families of City employees.	Community Services Department	L	\$
C1.16.1	Identify funding sources for expanded outreach and increased involvement to support youth and teen leadership programs and events.	Community Services Department	M	\$
C1.16.2	Leverage available funding to pursue support of teen mental, physical, social and emotional health programs.	Community Services Department	R	\$
C1.17.1	Optimize participation in such programs by increasing the number of locations where the programs are provided and by supporting transportation options to these locations.	Community Services Department	S	\$
C.1.17.2	Develop programs and activities for teens that strengthen leadership skills, encourage a culture of community service, inclusiveness, tolerance and acceptance of others.	Community Services Department	R	\$

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<b>6. Community Services &amp; Facilities Element</b>				
C1.17.3	Promote a diverse range of interests and vocations among programs offered to children, youth and teens.	Community Services Department	M	\$
C1.18.1	Develop a program to engage the talents and skills that seniors possess that would provide volunteer opportunities throughout the City.	Community Services Department	R	\$
C1.18.2	Support, promote, and publicize the provision of comprehensive senior services in coordination with senior service providers. Comprehensive services include addressing senior nutrition, mental health and transportation.	Community Services Department	R	\$
C1.18.3	Establish a support program for caregivers of seniors and people with disabilities by partnering with private, nonprofit, faith-based and public community service organizations.	Community Services Department	M	\$
C1.20.1	Partner with agencies for support and improved access so that all can participate as appropriate in Palo Alto recreational programs.	Community Services Department	R	\$
C1.22.1	Increase awareness about caring and compassion for the unhoused and those who suffer from mental and/or physical conditions through educational programming in partnership with community and business organizations throughout the region.	Community Services Department	R	\$
C1.22.2	Work with Santa Clara and San Mateo Counties, the State of California, the federal government, non-profit agencies, business and other organizations to define roles and responsibilities in the comprehensive provision of permanent supportive housing and temporary shelter, food, clothing and transportation for those in need.	Planning & Community Environment Department	R	\$
<b>Goal C-2: Demonstrate a commitment to excellence and high quality service to the public among City of Palo Alto officials and employees.</b>				
C2.2.1	Establish performance review criteria for City employees that consider the quality of service provided.	Human Resources Department	M	\$

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Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$/\$/\$)
<b>6. Community Services &amp; Facilities Element</b>				
C2.2.2	Periodically perform evaluations of City service delivery and develop strategies for continuous improvement. Use metrics and make information publicly available.	Community Services Department	R	\$\$
C3.2.1	Develop a proactive Asset Management Program for infrastructure requirements and costs.	Administrative Services Department	M	\$\$
<b>Goal C-3: Recognize the intrinsic value and everyday importance of our parks and community centers, libraries, civic buildings and cultural assets by investing in their maintenance and improvement.</b>				
C3.3.1	Periodically evaluate how parks and recreational facilities are being used and develop strategies for improving their use overall.	Community Services Department	IP	\$
C3.3.2	Study and recommend methods of private and public financing for improved park maintenance, rehabilitation, and construction of facilities, including those used for arts and culture.	Community Services Department	S	\$
C3.3.3	Estimate the costs of retrofitting all park facilities with water efficient appliances, fixtures and irrigation systems and develop an implementation schedule to phase-in use of non-potable water conservations measures where and when feasible.	City of Palo Alto Utilities & Community Services Department	M	\$\$
C3.3.4	Periodically assess the need to adjust parkland dedication or fees in lieu thereof to ensure they remain proportional to real estate values in Palo Alto.	Planning & Community Environment Department	R	\$
<b>Goal C-4: Plan for a future in which our parks, open spaces, libraries, public art, and community facilities thrive and adapt to the growth and change of Palo Alto.</b>				
C4.1.1	Explore opportunities to dedicate City-owned land as parkland to protect and preserve its community-serving purpose into the future.	Community Services Department	S	\$\$\$
C4.1.2	Encourage dedication of new land for parks through regulations and incentives for new development and programs to solicit bequests of land within the city.	Community Services Department	M	\$\$

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Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$/\$/\$)
<b>6. Community Services &amp; Facilities Element</b>				
C4.1.3	Pursue opportunities to create linear parks over the Caltrain tracks in the event the tracks are moved below grade.	Community Services Department	L	\$\$\$
C4.1.4	Explore ways to dedicate a portion of in-lieu fees towards acquisition of parkland, not just improvements.	Community Services Department	M	\$
C4.5.1	Use Cubberley Community Center as a critical and vital part of the City's service delivery system while also planning for its future.	Community Services Department	IP	\$\$
<b>Goal C-5: Sustain the health, well-being, recreation, and safety of residents and visitors, and improve the quality, quantity, and affordability of social services for all community members, including children, youth, teens, seniors, the unhoused, and people with disabilities.</b>				
C5.1.1	Allocate resources to create and support initiatives to increase the health and well-being of the public.	Community Services Department	R	\$
C5.1.2	Establish a community-sourced online clearinghouse of information and activities related to health promotion in the community.	Community Services Department	M	\$
C5.6.1	Incorporate health and well-being topics, including arts and culture, into existing events and programs at City-owned park and recreation facilities.	Community Services Department	R	\$
C5.6.2	Work with schools and community organizations to provide programs that educate residents, workers and visitors on health and well-being topics.	Community Services Department	R	\$\$
C5.9.1	Identify existing and potential indoor and outdoor locations for community gardens and farmers markets at City-owned or leased facilities and spaces.	Community Services Department	M	\$

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Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$/\$/\$)
<b>7. Business &amp; Economics Element</b>				
<b>Goal B-1: Businesses in Palo Alto that contribute to economic vitality, enhance the city's physical environment, promote municipal revenues and provide needed local services.</b>				
B.1.1	Implement and periodically amend an Economic Development Policy to guide business development in the City.	Office of Economic Development	R	\$
<b>Goal B-3: Careful management of City revenues and expenditures so that the fiscal health of the City is ensured and services are delivered efficiently and equitably.</b>				
B3.2.1	Continue to refine tools, such as the Business Registry, as data sources on existing businesses, including the type of business, number of employees, size, location, and other metrics to track the diversity of Palo Alto businesses.	Development Services Department/ Office of Economic Development	IP	\$\$
<b>Goal B-4: The stimulation of diverse commercial, retail and professional service business opportunities through supportive business policies and a culture of innovation.</b>				
B4.2.1	Revise zoning and other regulations as needed to encourage the preservation of space to accommodate small businesses, start-ups and other services.	Planning & Community Environment Department	M	\$\$
B4.2.2	Consider planning, regulatory, or other incentives to encourage property owners to include smaller office spaces in their buildings to serve small businesses, non-profit organizations, and independent professionals.	Planning & Community Environment Department	M	\$
B4.6.1	Work with local merchants to encourage Palo Alto residents, workers, and visitors to buy in Palo Alto.	Office of Economic Development	R	\$\$
B4.6.2	Study the overall viability of ground-floor retail requirements in preserving retail space and creating an active street environment, including the types of locations where such requirements are most effective.	Office of Economic Development	M	\$\$

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<b>7. Business &amp; Economics Element</b>				
B4.6.3	Maintain distinct neighborhood shopping areas that are attractive, accessible, and convenient to nearby residents.	Planning & Community Environment Department	R	\$
<b>Goal B-5: City regulations and operating procedures that provide certainty, predictability and flexibility and help businesses adapt to changing market conditions.</b>				
B5.1.1	Regularly evaluate ways to improve coordination of the City's environmental review, permitting, and inspection processes.	Planning & Community Environment Department	R	\$
B5.1.2	Improve design guidelines to reduce ambiguity and more clearly articulate compatibility principles to the business community and to the public.	Planning & Community Environment Department	M	\$\$
B5.1.3	Simplify the design review process for small-scale changes to previously approved site plans and buildings.	Planning & Community Environment Department	M	\$\$
B5.1.4	Revise zoning and other regulations as needed to encourage the revitalization of aging retail structures and areas. Encourage the preservation of space to accommodate small, independent retail businesses and professional services.	Planning & Community Environment Department	R	\$\$
<b>Goal B-6: Attractive, vibrant retail centers, each with a mix of uses and a distinctive character.</b>				
B6.1.1	Actively work with Downtown businesses, professional associations and the Palo Alto Chamber of Commerce to retain successful retail businesses that contribute to the City's goals for Downtown.	Office of Economic Development	R	\$\$

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Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$/\$/\$)
<b>7. Business &amp; Economics Element</b>				
<b>Goal B-7: Thriving business employment districts at Stanford Research Park, Stanford Medical Center, East Bayshore/San Antonio Road Area and Bayshore Corridor that complement the City's business and neighborhood centers.</b>				
B7.2.1	Review policies and regulations guiding development at Stanford Research Park and revise them as needed to allow improved responsiveness to changing market conditions.	Planning & Community Environment Department	M	\$\$
B7.2.2	Study the feasibility of a "transfer of development rights" (TDR) program and other measures that would provide greater development flexibility within Stanford Research Park without creating significant adverse traffic impacts or increasing the allowable floor area.	Planning & Community Environment Department	M	\$\$

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Program #	Program Text	Lead Department or Agency	Priority (\$/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$/\$/\$)
<b>8. Governance Element</b>				
<b>Goal G-1: Effective opportunities for public participation in local government.</b>				
G1.1.1	Consider making data available at a transactional level on the Open Data Portal.			
G1.2.1	Continue to hold regular, Town Hall-style meetings in neighborhoods.	City Council	R	\$\$
G1.2.2	Periodically review the suite of engagement options used to solicit citizen input and expertise on policy issues.	City Manager	R	\$ - \$\$\$
G1.2.3	Continue to rely on neighborhood organizations, the City website, local media, online technologies and other communication platforms to keep residents informed of current issues and to encourage citizen engagement.	City Manager	R	\$
G1.2.4	Provide access to communications technologies at City facilities, including public libraries and City Hall, and explore innovative locations for communication.	City Manager	R	\$\$
G1.2.5	Continue to release City Council staff reports to the public up to 10 days prior to Council hearings to increase public awareness of City decision-making.	City Clerk	R	\$
<b>Goal G-2: Informed and involved civic, cultural, environmental, social service and neighborhood organizations and residents.</b>				
G2.2.1	Continue to offer the use of City facilities to non-profit civic, environmental, cultural, neighborhood and social service organizations for meetings and events at discounted or complimentary rates and via sponsorship programs.	City Manager	R	\$
<b>Goal G-4: Active involvement of local citizens as volunteers.</b>				
G4.1.1	Continue and expand volunteer opportunities and the community's awareness of public and nonprofit organizations serving the City.	All Departments	R	\$
G4.1.2	Publicly recognize the efforts of individuals, groups, and businesses that provide volunteer services within the City.	City Manager	R	\$
G4.1.3	Coordinate with the Palo Alto Unified School District to develop classroom-based leadership, governance and civic participation programs.	City Manager	M	\$\$
G4.1.4	Support the transition from school-based volunteering to civic participation via outreach to parent volunteers and student leaders.	City Manager	M	\$

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Program #	Program Text	Lead Department or Agency	Priority (S/M/L/IP/R) <sup>a</sup>	Anticipated Level of Effort (\$/\$\$/\$\$\$)
<b>8. Governance Element</b>				
G4.1.5	Coordinate with the real estate community to develop a welcome package for new residents, containing City resources, information and ways to contribute to livability.	City Manager	M	\$\$
<b>Goal G-6: More clearly defined procedures, standards, and expectations for development review.</b>				
G6.2.1	Provide clear information across multiple communications platforms to guide citizens and businesses through the City review and approval process.	Planning and Community Environment	R	\$
G6.2.2	Continue and expand customer-oriented process improvement efforts.	All Departments	R	\$\$
G6.2.3	Use the pre-screening process to obtain early feedback from the City Council and the community regarding ordinance changes intended to facilitate specific development proposals.	Planning and Community Environment	R	\$

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# PALO ALTO RAIL CORRIDOR STUDY

The Report of the Task Force



Approved by City of Palo Alto City Council  
January 22, 2013

Figure 4.1: Framework of Crossings & Connectivity

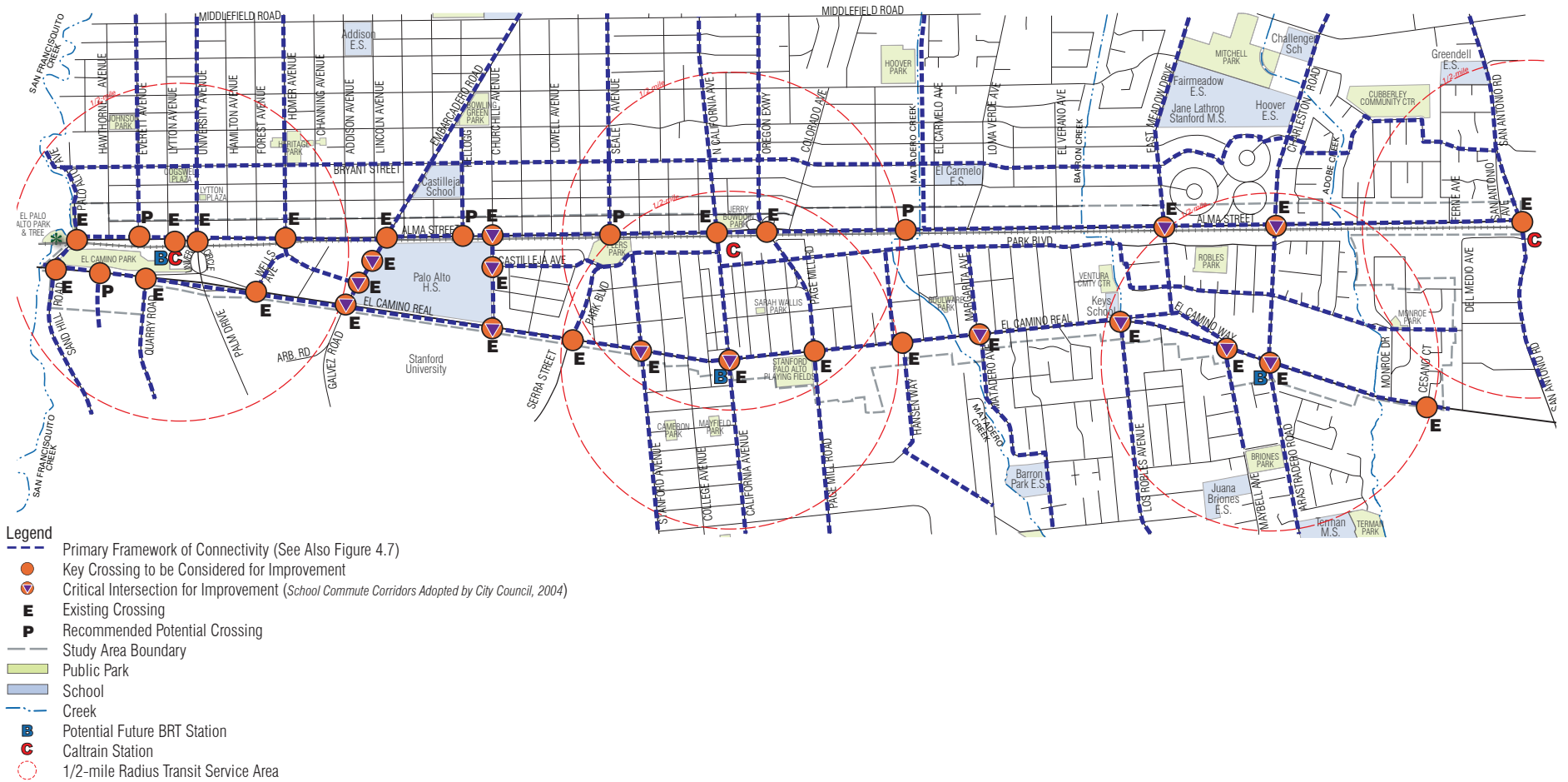


Figure 4.3: Priority Rail Crossing Locations



**Additional Crossing Study Zone**  
See Note #3 below

- Legend**
- Priority Safety Crossing Improvement Area (Existing Grade Crossings)
  - Vehicular, Bicycle & Pedestrian Crossing
  - Bicycle & Pedestrian Crossing
  - Additional Crossings Study Area, See Note #3
  - ▼ Critical Intersection for Improvement (School Commute Corridors Adopted by City Council, 2004)
  - #** Intersection Reference Numbers (See Table 4.1)
  - E** Existing Crossing (See dot color for type)
  - P** Potential Crossing (See dot color for type)
  - - - Study Area Boundary
  - Public Park
  - School
  - Creek
  - B Potential Future BRT Station
  - C Caltrain Station
  - 1/2-mile Radius Transit Service Area

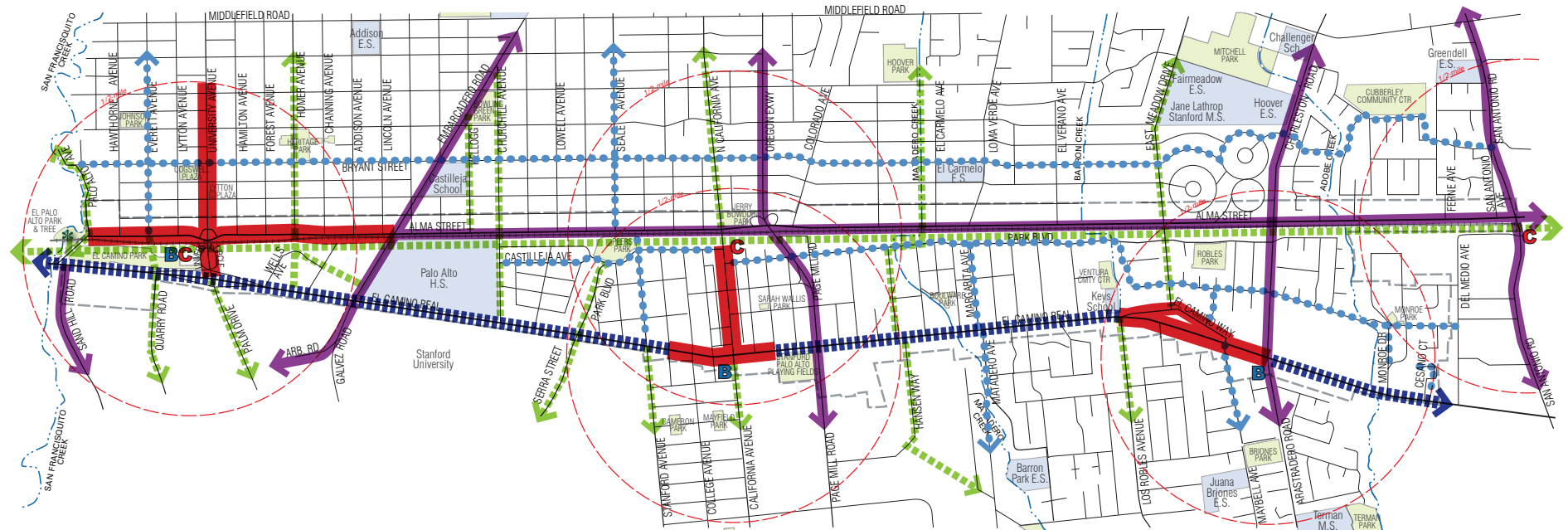
**NOTES:**

1. Some crossings shown exist but need improvement. The colored dots indicate the preferred type of crossing.
2. See Table 4.1 for a comparative overview of the Below-Grade Open Trench and Two-Track At-Grade configurations related to the numbered locations shown here.
3. It is desirable to have a balanced approach along the entire rail corridor for east-west connections. However, land use (existing homes) and discontinuous streets create considerable difficulty in identifying additional crossings in the south. Further studies are recommended to explore additional connectivity opportunities across the rail lines in south Palo Alto.
4. Distances shown are approximate and have been rounded.





Figure 4.7: Layered Street Framework



- Legend**
- Major Vehicular Street
  - Primary Multi-Modal Transportation Corridor
  - Main Street in the Mixed-Use Centers
  - Inter-neighborhood Pedestrian/Bicycle Connector
  - Bicycle Boulevard
  - Local Streets
  - Study Area Boundary
  - Public Park
  - School
  - Creek
  - B Potential Future BRT Station
  - C Caltrain Station
  - 1/2-mile Radius Transit Service Area



For purposes of this study, roadways and streets have been described using terms that differ from the Comprehensive Plan to allow for a discussion about the character of the streets, the function they play in the community and the multi-modal aspects of certain corridors.

**PALO ALTO'S COMPREHENSIVE PLAN'S ROADWAY HIERARCHY (for reference only)**

**Freeway:** Major roadway with controlled access; devoted exclusively to traffic movement, mainly of a through or regional nature. (ex. 101, 280)

**Expressway:** Major roadway with limited access to adjacent properties; devoted almost exclusively to traffic movement, mainly serving through-traffic. (ex. Oregon Expy)

**Arterial:** Major roadway mainly serving through-traffic; takes traffic to and from expressways and freeways; provides access to adjacent properties. (ex. Alma Street, El Camino Real, Sand Hill Road, San Antonio Road)

**Residential Arterial:** Major roadway mainly serving through-traffic; takes traffic to and from expressways and freeways; provides access to adjacent properties, most of which are residential properties located on both sides of the roadway with direct frontages and driveways on that roadway. (ex. Embarcadero Road east of Alma, East Charleston Road, Arastradero Road)

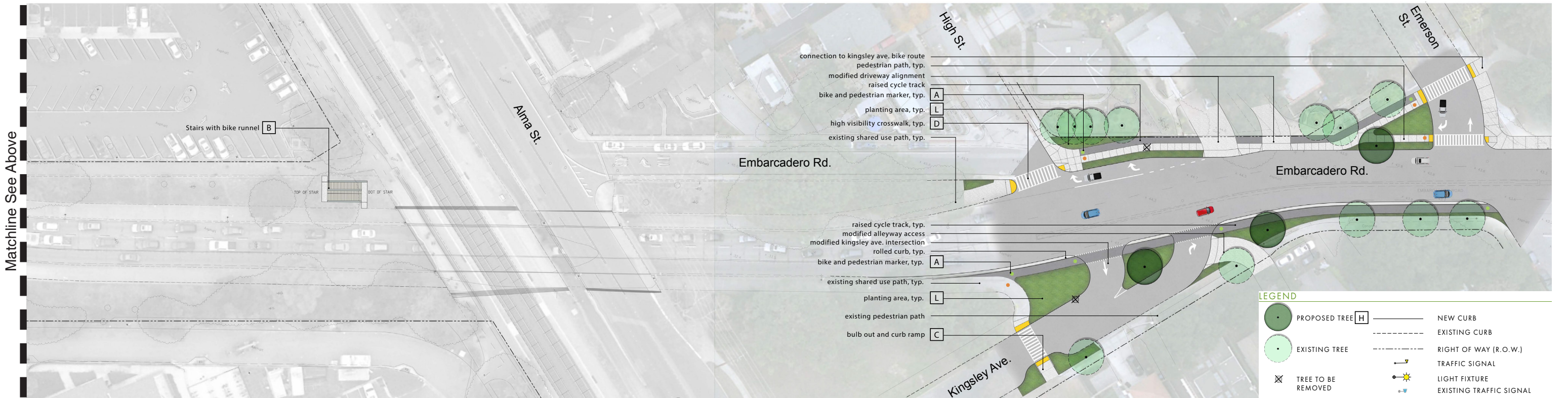
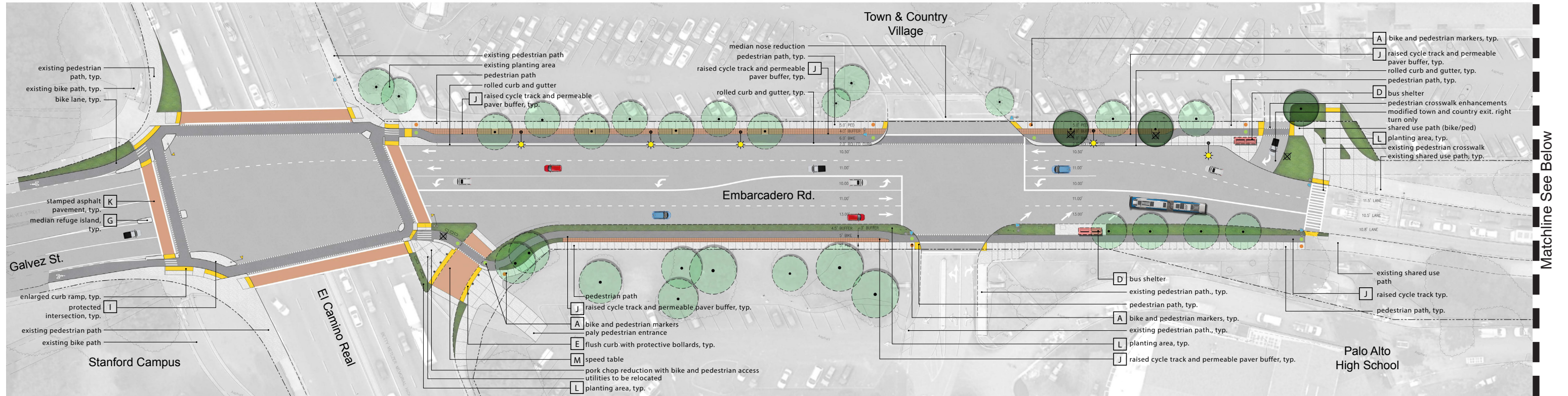
**Collector:** Roadway that collects and distributes local traffic to and from arterial streets, and provides access to adjacent properties. (ex. East Meadow Drive, California Avenue, El Camino Way)

**Local:** Minor roadway that provides access to adjacent properties only.



# EMBARCADERO ROAD & EL CAMINO REAL CORRIDOR & INTERSECTION IMPROVEMENTS

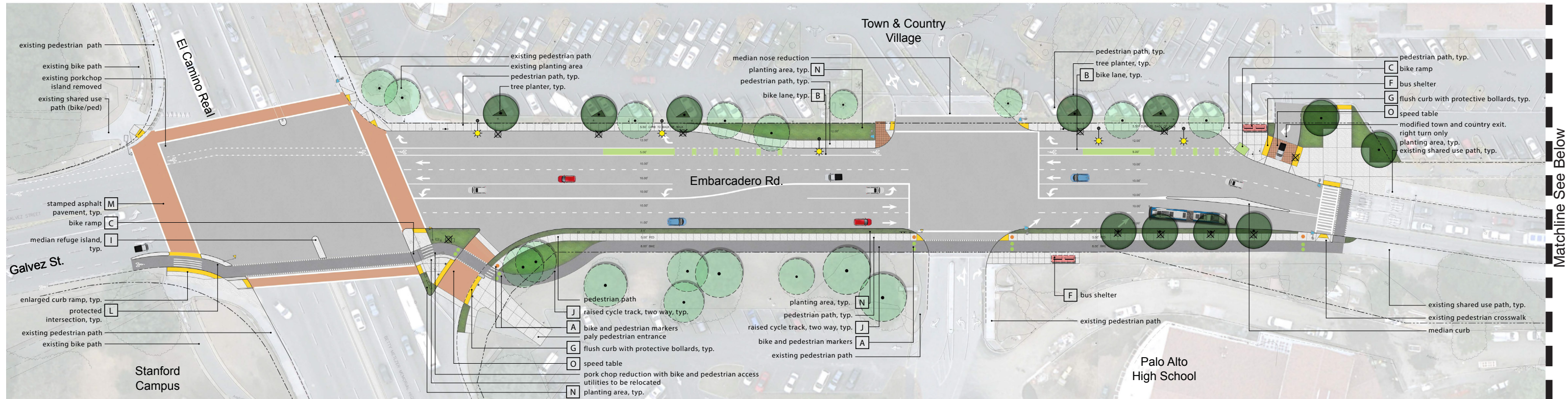
AUGUST 10, 2016  
City of Palo Alto



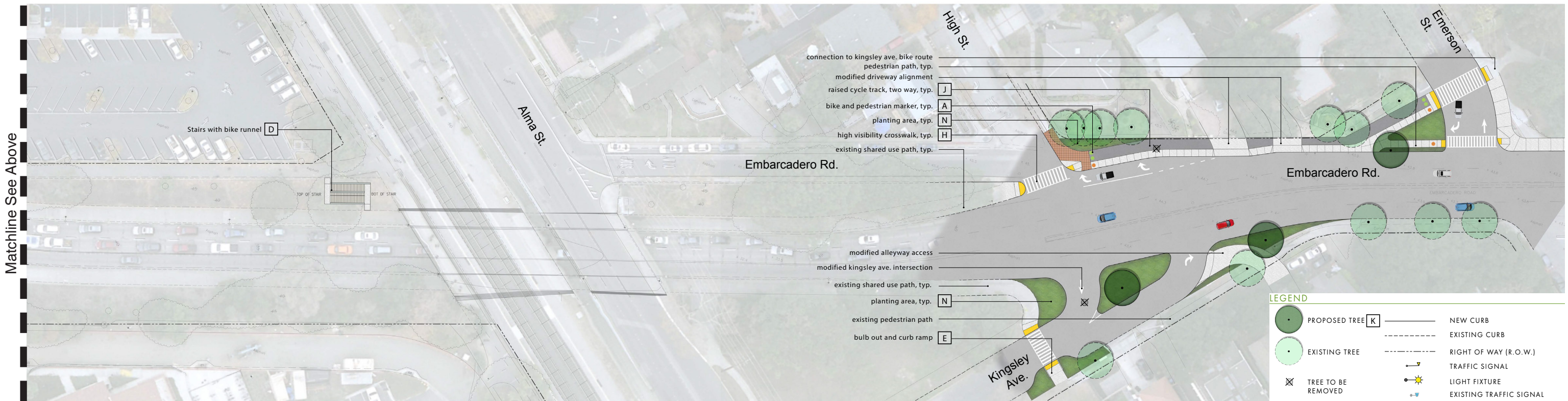
**LEGEND**

- PROPOSED TREE
- EXISTING TREE
- TREE TO BE REMOVED
- NEW CURB
- EXISTING CURB
- RIGHT OF WAY (R.O.W.)
- TRAFFIC SIGNAL
- LIGHT FIXTURE
- EXISTING TRAFFIC SIGNAL





Matchline See Below



Matchline See Above

