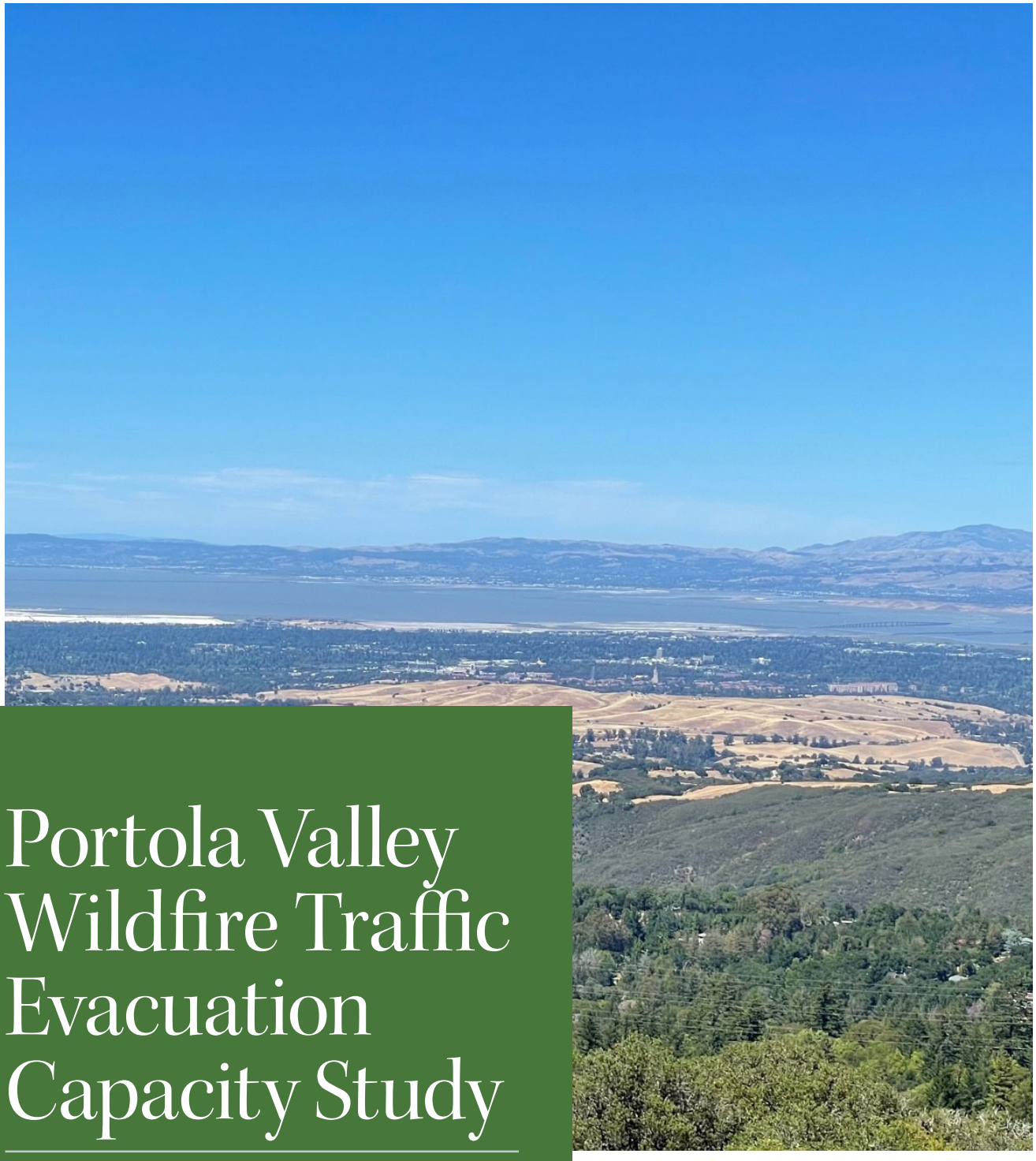

# Portola Valley Wildfire Traffic Evacuation Capacity Study

SUBMISSION: OCTOBER 2022

PREPARED FOR: TOWN OF PORTOLA VALLEY

# Portola Valley Wildfire Traffic Evacuation Capacity Study

Prepared for:
Town of Portola Valley

10.14.2022

SF21-1185

FEHR PEERS

In partnership with

Parisi
TRANSPORTATION CONSULTING

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# Executive Summary

There are a variety of events that could require an evacuation of parts of the Town of Portola Valley. These events could be caused or fueled by nature, including wildfires, floods, geological or seismic events; while others can be caused by human initiated events such as utility failures, infrastructure failures or other factors (such as airplane crashes or vehicular crashes). With climate change increasing drought conditions and weather events throughout the state, it is prudent to review the capacity of the evacuation system (e.g. capacity of the evacuation roadways) to assist with planning for these events. Additionally, recent events like the Camp Fire in Paradise, California, reinforce the notion to better prepare for rapid evacuations during these types of events.

This study provides a detailed look at the evacuation system and focuses on estimating the time needed to evacuate. The results are intended to provide information to help inform the on-going update of the Portola Valley Safety Element in addition to meeting the legislative requirements associated with Assembly Bills 747 and 1409.

This study was informed through a series of presentations at four meetings with the Town Emergency Preparedness Committee (EPC) and Wildfire Preparedness Committee (WPC), meetings with an interagency working group, meetings with Town staff, and meetings with study co-chairs Dale Pfau and Rob Younge from the EPC. Community input on study methodology, evacuation time estimates, and evacuation strategies was provided at four calendared EPC and WPC monthly meetings between January and August. Three meetings were held with an interagency working group established for this study that included Town staff, study co-chairs from the EPC, San Mateo County Department of Emergency Management (SMC DEM), Woodside Fire Protection District (WFPD), and San Mateo County Sheriff representatives. Consultation with Zonehaven and SMC DEM staff occurred to review and coordinate inputs for the existing evacuation platform managed by SMC DEM staff and the analysis conducted for this study. Coordination calls with the consultant team preparing the Town Safety Element Update occurred throughout the process.

## Study Purpose

The intent of this study is not to estimate disaster behavior nor is it to evaluate every disaster that is possible in the Town; rather it is to help the Town understand the amount of time potentially needed under "stress test" scenarios for a wildfire evacuation, understand the most vulnerable areas where evacuations would occur (e.g. those with the least amount of redundant access and those areas furthest from evacuation gateways), and look for strategies to improve emergency egress during these events.

## Evacuation Scenarios

The study evaluates three evacuation scenarios as summarized below in **Table E-1**.

**Table E-1: Full Town Evacuation Scenarios**

| Criteria | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|
| **Description** | All Evacuation Routes Open | North Evacuation Routes Open | South Evacuation Routes Open |
| **Major Routes Available** | Portola Road-Woodside Road<br>Whisky Hill Road<br>Sand Hill Road<br>Alpine Road<br>Arastradero Road | Portola Road-Woodside Road<br>Whisky Hill Road<br>Sand Hill Road | Alpine Road<br>Arastradero Road |
| **Major Routes Not Available** | None | Alpine Road<br>Arastradero Road | Portola Road-Woodside Road<br>Whisky Hill Road<br>Sand Hill Road |

*Source: Fehr & Peers, 2022.*

## Vulnerable Area Assessment – SB 99 Evaluation

Portola Valley has a total of seven constrained parcel groups (CPG) that are in areas prone to seismic, flood, wildfire, and landslide hazards. These CPGs all have single ingress/egress access routes and were identified based on the number of parcels accessing the identified constrained route. **Figure 4** identifies the locations of these 7 CPGs, which include a total of 589 individual parcels that may be affected by evacuations due to limited ingress/egress conditions during a hazard event. Constrained Parcel Group 6 in the northwest portion of the Town is located within a Very High Fire Hazard Severity Zone (VHFHSZ) within a Local Responsibility Area (LRA). There are 170 parcels located in this constrained parcel group that access Portola Road via Santa Maria Avenue, Wayside Road, and Hayfields Road. To further constrain this area, all access points to these neighborhoods are located along the San Andreas Fault, which increases the vulnerability to those roadway connections.

## Evacuation Time Assessment - AB 747 Assessment

AB 747 requires the evaluation of the capacity of the evacuation network under a range of emergency scenarios. However, when looking at the capacity of the system, one must also consider the length of time available for an evacuation which is directly dependent on the amount of lead time available to plan for the evacuation. With ample notice, roadway capacity typically does not become an issue during an evacuation except for minor locations of congestion. However, during short-notice evacuations, like that experienced during the Camp Fire in Paradise, California, a short evacuation window was required, and the capacity of the evacuation system became an issue.

This study provides evacuation time estimate (ETE) ranges and average evacuation times for three population groups (residents, employees, and equestrian trailers) for the three study scenarios based on a 6:00 am evacuation notice. The evacuation time estimate ranges are provided for two evacuation level scenarios (90 and 100 percent) and two road network capacity scenarios (normal roadway conditions and 40% reduced roadway capacity). **Table E-2** provides a summary of the ETE duration ranges for residents. Additional details on evacuation time estimates are presented in Section 3.2.

**Table E-2: Evacuation Time Estimate Ranges for Residents**

| Evacuation Level | Scenario 1 (All Evacuation Routes Open) | Scenario 2 (North Evacuation Routes Open) | Scenario 3 (South Evacuation Routes Open) |
|---|---|---|---|
| **90% of residents evacuated within:** | 1 hr, 15 min – 1 hr, 30 min | 2 hr, 45 min – 3 hr, 45 min | 2 hr – 2 hr, 45 min |
| **100% of residents evacuated within:** | 3 hr, 15 min | 3 hr, 30 min – 4 hr, 45 min | 3 hr, 15 min – 3 hr, 30 min |

*Notes:*
*6:00 am evacuation notice.*
*First time in range is ETE for baseline road capacity scenario.*
*Second time in range is ETE for 40% below baseline road capacity scenario.*

*Source: Fehr & Peers, 2022.*

# Observations

Below summarizes the general observations for the evacuation assessments, constrained parcel groups, and remote households.

## Evacuation Time Assessments

Scenario 2 (north routes only) has the highest overall Evacuation Time Estimates as travel distances from most residential areas to I-280 via Sand Hill Road are much longer than the distance to I-280 via Alpine Road. Off-ramp volume and corresponding background traffic are also higher at the I-280/Sand Hill Road interchange when compared to the I-280/Alpine Road interchange.

Alpine Road is the most direct evacuation route to I-280 for most Portola Valley residents and would experience the heaviest volumes during a major evacuation, particularly between Westridge Drive and I-280. The stop-controlled intersections on Alpine Road at the I-280 interchange as well as at La Cuesta Drive and La Mesa Drive in Ladera are critical locations for traffic control during a major evacuation. Webb Ranch, which is the largest of the stables in the area in terms of horses boarded, has a single driveway on Alpine Road where equestrian trailers would evacuate in the heavily used segment between Ladera and I-280.

As noted above, Scenario 2 (north routes only) has the highest overall Evacuation Time Estimates. In addition to the fact that travel distances from most residential areas to I-280 via Sand Hill Road are much longer than the distance to I-280 via Alpine Road, traveling through Woodside via either Woodside Road or Whisky Hill Road is more circuitous than remaining on Sand Hill Road. Use of Woodside Road or Whisky Hill Road by greater levels of evacuation traffic would require a coordinated traffic management plan through these areas.

Westridge Drive is a major collector that would carry among the heaviest volume of evacuation traffic aside from Alpine Road, Sand Hill Road, and Portola Road. The stop-controlled intersections of Westridge Drive/Alpine Road and Westridge Drive/Portola Road are critical locations for traffic control during a major evacuation.

### Constrained Parcel Groups

Constrained Parcel Group 6 in the northwest portion of the Town is located within a Very High Fire Hazard Severity Zone (VHFHSZ) within a Local Responsibility Area (LRA). There are 170 parcels located in this constrained parcel group that access Portola Road via Santa Maria Avenue, Wayside Road, and Hayfields Road. To further constrain this area, all access points to these neighborhoods are located along the San Andreas Fault, which increases the vulnerability to those roadway connections.

### Remote Households

Households along the upper portions of Alpine Road and Los Trancos Road are located the farthest from I-280. With only one evacuation route, these households would experience the longest evacuation times.

## Strategies to Reduce Evacuation Time Estimates

The following provides a summary of potential supply-side (i.e., road network) strategies, demand-side strategies, and communication strategies that may reduce evacuation time estimates.

### Supply-Side Strategies to Reduce Evacuation Time Estimates

The following are potential supply-side strategies that would either provide additional traffic management support for an evacuation or would increase the capacity of evacuation routes. **Figure 13** illustrates traffic management strategies that are also summarized below.

**Traffic Management Strategies**

- Provided supplemental evacuation management for Constrained Parcels Group 6 such as providing early evacuation warning notices when other zones in Portola Valley and surrounding areas in the Sant Cruz Mountains, Woodside and Los Altos Hills receive evacuation warnings. Constrained Parcels Group 6 is primarily located in Zonehaven Zone PV-E001. Provisions for early evacuation warning notices could also be considered for areas that have the longest evacuation trips such as Zonehaven Zones PV-E007 (Upper Los Trancos) and PV-E012 (Upper Alpine).
- Coordinate with County DEM staff to designate evacuation traffic control locations on Alpine Road at Webb Ranch Driveway, Portola Road at Santa Maria Avenue, and Westridge Drive at both intersections with Cervantes Road.

**Alpine Road Shoulder Evacuation Lane Concept**

Alpine Road is the most direct route for most residents to I-280 and is therefore the most desirable evacuation route. Simulations indicate the highest volumes occur in the segment between Westridge Drive and I-280. The portion of Alpine Road in Ladera, between La Mesa Drive and La Cuesta Drive, has

three travel lanes with one through lane in each direction and a center left turn lane. The remaining portion of Alpine Road between Westridge Drive and I-280 is a two-lane section with one through lane in each direction. A preliminary engineering review of this segment indicates the potential to widen the paved section of Alpine Road to allow for two outbound lanes during an evacuation. **Figure 14** illustrates a concept for widening the existing outbound shoulder from approximately four feet to 11 feet to provide a dual-use shoulder in the outbound direction that would provide a wider protected bike lane during normal conditions and a second outbound evacuation lane when needed.

**Other Road Network Strategies**

The following are other road network strategies that would either provide new evacuation routes, improved connectivity for areas with limited egress, and/or enhance existing streets to reduce evacuation times.

- Engage with Stanford University to explore evacuation route opportunities
- Increase connectivity within areas with evacuation constraints through the use of easements, and emergency access roadways, if the addition of new roadways or roadway extensions are deemed infeasible by the Town.
- Future roadway design, especially in areas that have less accessibility and on key evacuation routes, should consider evacuation capacity and design treatments such as painted medians (instead of raised medians) that could assist in creating reversible lanes and facilitate additional capacity in an evacuation event scenario.
- Consider new local revenue measure(s) to assist in funding the mitigation and enhancement of the circulation network to alleviate evacuation constraints. The revenues could assist in delivering redundant infrastructure that would assist in evacuation events.

## Demand-Side Strategies to Reduce Evacuation Time Estimates

The following are potential demand-side strategies that would reduce the number of vehicles evacuating. The first strategy would involve a pledge by households to evacuate with only a single vehicle. The evacuation analysis assumes 1.91 vehicles per household are involved in an evacuation.

- 1 car per household evacuation pledge
    - For households that must have second vehicles, an alternative could involve early off-site placement of a second car when advance warnings of a wildfire or other hazard requiring evacuation are available.
- Identify local shelter locations and plan/implement shelter facilities.

Identifying local shelter locations can serve both as a demand-side strategy to reduce evacuation trips and to provide redundancy in the evacuation system for situations where an evacuation may prove infeasible and shelter-in-place becomes a primary option.

### Information-Side Strategies to Reduce Evacuation Time Estimates

The following are potential information-side strategies that would support evacuation notifications, monitoring, and management.

- Explore and deploy wildfire early detection systems (i.e., wildfire video surveillance cameras, drones, etc.).
- Deploy clear evacuation wayfinding, signs and barriers to direct evacuation traffic.
- Investigate improvements to communication systems to provide for "hardening" during wildfires.
- Targeted communication systems and early/mandatory evacuation notice during all events for Constrained Parcel Groups (Zonehaven Zones 1, 7, and 12).
- Plan and install vehicle monitoring devices and variable message signs both to monitor evacuation progress and to provide notification to motorists along the road of any changes in evacuation routes or plans due to a change in the wildfire or incidents.

## Potential Future/Ongoing Activities

The Town of Portola Valley collaborated with the San Mateo County Department of Emergency Management (SMC DEM) to create a Working Group of interagency partners in spring 2022 to develop detailed Evacuation Plans. Section 5 presents a list of potential future/ongoing activities for the Working Group and/or the Town Emergency Preparedness Committee (EPC).

# 1. Introduction

This initial traffic capacity assessment of wildfire evacuation for the Town of Portola Valley coincides with an update of the General Plan Safety Element. This study was conducted in coordination with the Town Emergency Preparedness Committee (EPC), where input from community members was provided and incorporated into the study process. Interagency collaboration was facilitated through a Working Group of Town Staff, Town EPC co-chairs, County Department of Emergency Management (DEM), Woodside Fire District, and County Sheriff officials.

This traffic capacity study is intended to inform ongoing emergency evacuation preparedness efforts including implementation of the Zonehaven evacuation notification platform in San Mateo County as well as an ongoing coordinated effort recently launched by members of the interagency Working Group described above to develop an overall, interagency evacuation plan for Portola Valley, including local schools and the Sequoias retirement community. San Mateo County also released a Public Review Draft of an updated Multijurisdictional Local Hazard Mitigation Plan (LHMP) in August 2021.

## 1.1 Study Purpose

The following is a summary of the purpose of this Evacuation Study.

- Identify major evacuation routes and shelter locations,
- To inform the development of traffic mitigation strategies, conduct traffic simulations of wildfire evacuation scenarios,
- Identify evacuation time estimates (ETE) and bottlenecks on major evacuation routes based on the simulations,
- Identify strategies/projects to improve performance of the road network during evacuations, and
- Identify potential future/ongoing efforts for a detailed Evacuation Plan that may be undertaken.

This assessment is consistent with requirements outlined in Assembly Bill (AB) 747 and AB 1409 that require local agencies to evaluate the capacity of their evacuation routes and identify shelter locations.

A separate analysis was prepared for the Safety Element that includes a residential street accessibility analysis that identified constrained groups of parcels in hazard areas with limited egress routes as required by Senate Bill (SB) 99.

## 1.2 Study Context

This document is intended to provide an assessment of roadway capacity and time needed to evacuate under the described evacuation scenarios. Please note that wildfire evacuation can occur due to any number of events. Additionally, any emergency movement is unpredictable because it has an element of individual behavior related to personal risk assessment for each hazard event as the associated evacuation instructions are provided. As such, this assessment is intended to provide the Town with a broad

understanding of the capacity of the transportation system during an evacuation scenario; it does not provide a guarantee that evacuations will follow modeling that is used for analysis purposes, nor does it guarantee that the findings are applicable to any or all situations.

Moreover, as wildfire evacuation assessment is an emerging field, there is no established standard methodology. Fehr & Peers has adopted existing methodologies in transportation planning that, in our knowledge and experience, we believe are the most appropriate. Nevertheless, such methodologies are necessarily also limited by the tools and data available and the budgetary and time constraints in the scope of work, and by current knowledge and state of the practice.

While this assessment should help the Town better prepare for hazard related events and associated evacuations, the Town should take care in planning and implementing any potential evacuation scenario. Fehr & Peers cannot and does not guarantee the efficacy of any of the information used from this assessment as such would be beyond our professional duty and capability.

## 1.3 Wildfire Hazard

The most common natural hazard in California is a wildfire. These fires can burn large areas of undeveloped or natural land in a short amount of time. They often begin as smaller fires caused by weather related events such as lightning strikes and arcing or downed power lines during high winds or a seismic event. They are also caused by intentional, careless, or accidental human behavior such as unattended campfires, discarded smoking materials, vehicle fires, and even arson. During critical fire weather conditions of low humidity, high heat, and sustained winds, small fires may rapidly expand in size. The recent trend toward more prolonged periods of drought increases the likelihood of a wildfire occurring.

Typically, wildfires pose minimal threat to people and buildings in urban areas. However, in more suburban and rural areas where there is human encroachment into natural areas or where large portions of land are designated as conservation or preservation areas, the likelihood that wildfires will cause injuries, death, and/or property damage increases. As such, there is a need to effectively evacuate people from the hazard area to get them out of harm's way before and during a wildfire event.

Portola Valley's geographical location and proximity to the Santa Cruz Mountains creates a wildland-urban interface (WUI). The Federal Emergency Management Agency (FEMA) defines the wildland-urban interface as a transition zone between human development and unoccupied land with naturally occurring vegetation. "It is the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels."[1] Having a wildland-urban interface increases a community's risk of and susceptibility to wildfires. The presence of wildland-urban interface, coupled with the steepness and direction of topography, vegetation, and the potential for "Diablo" winds, increase the opportunity for wildfires to ignite, grow, and spread in the Town.

[1] FEMA. (2021). US Fire Administration. *What is the WUI?*

Historic fires in areas surrounding Portola Valley include the 2020 CZU Lightning Complex fires to the southwest (San Mateo-Santa Cruz unit fire that covered 86,500 acres), the 2017 Skeggs fire to the northwest (50-acre fire at Skyline Road and Skeggs Point), and a 1962 fire in the Skylonda area to the north (1,300 acres).

## 1.4 Legislative Requirements

Recent state legislation requires additional review of evacuation routes when specific elements within the General Plan or other emergency planning documents (such as a Hazard Mitigation Plan) are completed or updated by a local agency. The legislative requirements described below are specific to the analysis of evacuation routes and identification of evacuation shelters:

- ***AB 747 (2019) -*** Requires that the safety element be reviewed and updated to identify evacuation routes and their capacity, safety, and viability under a range of emergency scenarios. This is a requirement for all safety elements or updates to hazard mitigation plans completed after January of 2022.
- ***AB 1409 (2021) –*** Requires that the safety element also identify evacuation locations.

## 1.5 Evacuation Assessment Approach

As described above, wildfire evacuation can occur due to any number of scenarios. Early discussions with community members and interagency partners involved discussions of many different options. In the end, it was determined that the most useful analysis of evacuation time estimates (ETE's) for the major evacuation routes would involve conducting a "stress test" based on a full Town-wide evacuation.

The following is a summary of the key parameters for the "stress test" evacuation assessment. It should be noted that the combination of these parameters is unlikely to occur, but the stress test approach bounds the problem.

- Study analyzes major evacuation routes on Alpine, Portola, and Sand Hill Roads
- Evacuation order at 6:00 am when all residents assumed to be at home
- Full evacuation - 100% of Town/Immediate Surrounding residents (no shelter in place assumed)
- All homes are occupied
- Evacuation vehicle demand includes residents, employees, and equestrian trailers
- 85% of residents are assumed to begin their trip by 7:00 am
- Sheriff/CHP traffic control at key intersections begins at 6:30 am
- Traffic control officers prohibit inbound trips other than emergency vehicles
- No contraflow operations (only single outbound lane on routes)

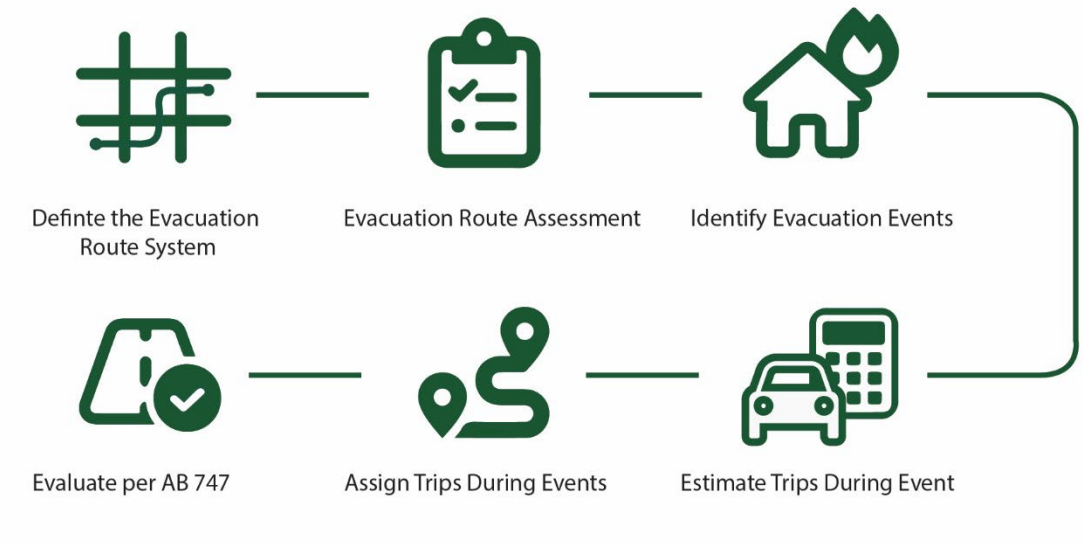
## 1.6 Report Organization

The remainder of this report summarizes the following:

- Approach and Methodology
- Emergency Evacuation Assessment
- Observations and Behavioral Considerations
- Potential Future/Ongoing Activities

# 2. Approach and Methodology

This analysis is focused on the identification of Evacuation Time Estimates (ETE'S) for a wildfire evacuation event. The following flow chart illustrates the steps in the process.




## 2.1 Define Evacuation Routes

This section describes major evacuation routes for the Town of Portola Valley and surrounding unincorporated areas. Evacuation routes are used to transport evacuees using their own vehicle and transit dependent evacuees to temporary shelter. Routes that provide the most direct path to exit the community with the least exposure to risk will be used by evacuees. The identification of major evacuation routes was done in consideration of the location of critical facilities (i.e., safety and security, health and medical, and communications) as well as residential, employment, and recreational uses. **Figure 1** shows the Town's zoning and parcels, which illustrate where most of the residential units are located relative to the transportation network.

The current Portola Valley General Plan Safety Element provides the following policies related to major evacuation routes.

- "Interstate 280 and the arterial roads identified in the circulation element of this general plan are designated as "evacuation routes" that be utilized in the event of an emergency."
- "The town recognizes the need to have roads of adequate capacity for use in times of emergency. The town has adopted specific standards for road design, including standards for road width, grade and alignment that it finds to be appropriate for the movement of emergency equipment."
- "The town recognizes the necessity of having emergency evacuation routes unimpeded by structures near the traveled way, by narrow bridges, by low overhead signs or by trees that would

> block the passage of vehicles in time of emergencies. It is therefore town policy to maintain emergency "evacuation routes" in usable condition. The town has adopted zoning regulations that set forth minimum setbacks for buildings from roads."

The following streets are identified as arterial roads in the current General Plan Circulation Element: Alpine Road, Portola Road, Skyline Boulevard, Sand Hill Road, Junipero Serra Boulevard, Old La Honda Road, Whisky Hill Road, Arastradero Road, and Page Mill Road.

Major collectors identified in the Circulation Element include: Westridge Drive, Alpine Road from Portola Road to Willowbrook Road, and Los Trancos Road from Alpine Road to Los Trancos Woods.

The above arterial and collector streets were identified as draft evacuation routes as a starting point for engaging Town staff in discussions about defining emergency evacuation routes. Collaborative discussions with interagency working group partners and community members refined the preferred evacuation routes. **Figure 2** shows the Town's major evacuation routes, which are the primary routes assessed as part of the analysis. The Evacuation Routes identified are:

- Alpine Road
- Arastradero Road
- Los Trancos Road
- Page Mill Road
- Portola Road
- Sand Hill Road
- Westridge Drive
- Whisky Hill Road
- Woodside Road

The County Department of Emergency Management staff identified Canada College as an evacuation shelter that will be utilized during an emergency evacuation event for Portola Valley. Evacuees are asked to check in at the Canada shelter to confirm they have successfully evacuated.

## 2.2 Constrained Local Routes and Parcel Groups

As noted earlier, a separate analysis was conducted for the Safety Element to identify constrained local routes and parcel groups as required by Senate Bill (SB) 99. This section provides a summary of that assessment to provide additional context for the evacuation assessment. It should be noted that these roadways are local residential streets and not major evacuation routes.

Of the Town's 52.88 miles of roadways, approximately 40% (21.16 miles) are identified as constrained roadways (**Figure 3**), which includes cul-de-sacs and roadways with a single connection to the rest of the roadway network. The analysis focuses on the number of ingress/egress points for roadways and does not

identify other roadway constraints like width and grade. Analyzing these conditions is beyond the requirements identified in SB99.

Based on the analysis, Portola Valley has a total of seven constrained parcel groups (CPG) that are in areas prone to seismic, flood, wildfire, and landslide hazards. These CPGs all have single ingress/egress access routes and were identified based on the number of parcels accessing the identified constrained route. **Figure 4** identifies the locations of these 7 CPGs, which include a total of 589 individual parcels that may be affected by evacuations due to limited ingress/egress conditions during a hazard event. Constrained Parcel Group 6 in the northwest portion of the Town is located within a Very High Fire Hazard Severity Zone (VHFHSZ) within a Local Responsibility Area (LRA). There are 170 parcels located in this constrained parcel group that access Portola Road via Santa Maria Avenue, Wayside Road, and Hayfields Road. To further constrain this area, all access points to these neighborhoods are located along the San Andreas Fault, which increases the vulnerability to those roadway connections.

## 2.3 Evacuation Route Assessment

AB 747 requires that the capacity of the evacuation system be assessed. That can be completed in different ways, from identifying the hourly theoretical capacity of individual roads in the network to simulation of the Town's evacuation routes to assesses how long it will take for evacuations to occur and identify congested locations.

For this assessment, a robust assessment of the evacuation system within the Town was completed, this assessment involved application of PTV Visum, a macroscopic model, to assess traffic conditions on the major evacuation routes.

### 2.3.1 Identify Evacuation Scenarios

There are a wide range of potential events that could cause the need for evacuation within the Town. Many of these events are described and classified in Chapter 1; however, to test the evacuation network, a set number of evacuation events were defined for the technical assessment. All three evacuation scenarios assume a full Town evacuation order issued at 6:00 am.

**Table 1** describes the three study evacuation scenarios based on varying levels of network availability.

- Scenario 1 assumes all evacuation routes are open and available, while Scenarios 2 and 3 are based on partial availability of the evacuation routes.
- Scenario 2 assumes that a wildfire to the south makes Alpine Road and Arastradero Road unavailable for evacuation and assigns trips only to evacuation routes to the north including Sand Hill Road, Portola Road/Woodside Road, and Whisky Hill Road.
- Scenario 3 assumes that a wildfire to the north makes Sand Hill Road, Portola Road/Woodside Road, and Whisky Hill Road unavailable for evacuation and assigns trips only to evacuation routes to the south including Alpine Road and Arastradero Road.

**Figures 5, 6, and 7** illustrate available evacuation routes for each of the scenarios.

**Table 2: Full Town Evacuation Scenarios**

| Criteria | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|
| **Description** | All Routes Open | North Routes Open | South Routes Open |
| **Major Routes Available** | Portola Road-Woodside Road<br>Whisky Hill Road<br>Sand Hill Road<br>Alpine Road<br>Arastradero Road | Portola Road-Woodside Road<br>Whisky Hill Road<br>Sand Hill Road | Alpine Road<br>Arastradero Road |
| **Major Routes Not Available** | None | Alpine Road<br>Arastradero Road | Portola Road-Woodside Road<br>Whisky Hill Road<br>Sand Hill Road |

*Source: Fehr & Peers, 2021.*

### 2.3.2 Estimate Trips During an Evacuation Event

The number of evacuation vehicle trips assigned to the roadway network are a combination of trips generated by residential households, employee trips (including those from the Sequoias retirement community), and equestrian trailer trips. These trips include those generated by uses in the Town as well as surrounding unincorporated areas including the Ladera, Upper Los Trancos, Farm Road, Old La Honda, and Old Alpine areas.

Trips generated by residential households was informed by the most recent available data from the US Census Bureau and the California Department of Finance. This includes data on population, the number of households, persons per household, and vehicles per household. This data was cross-referenced with data in the Zonehaven platform for the platform's designated evacuation zones within and surrounding the Town. The household data was then used to estimate evacuation vehicle trips based on the number of households, persons per household, auto-ownership information, population, and other factors that could affect the number of vehicles per household used during an evacuation event.

The existing households in Portola Valley and surrounding unincorporated areas are forecast to generate a total of about 4,760 evacuation trips including about 3,160 trips from Portola Valley households and 1,600 from surrounding unincorporated households. This yields about 1.91 evacuation vehicle trips per household.

For context, the 1.91 trips per household rate is higher than those applied in the following evacuation study or identified through the noted surveys of recent fire evacuees.

- Ashland, OR Evacuation Study – 1.43
- Santa Rosa Post-Fire Survey – 1.75
- UC Berkeley Study of 2017-19 Fires – 1.89

The Sequoias retirement community has approximately 140 employees and 310 residents. It is estimated that up to 108 employees, a combination of the overlapping overnight and day shifts, could be at the facility at 6:00 am for an early morning evacuation.

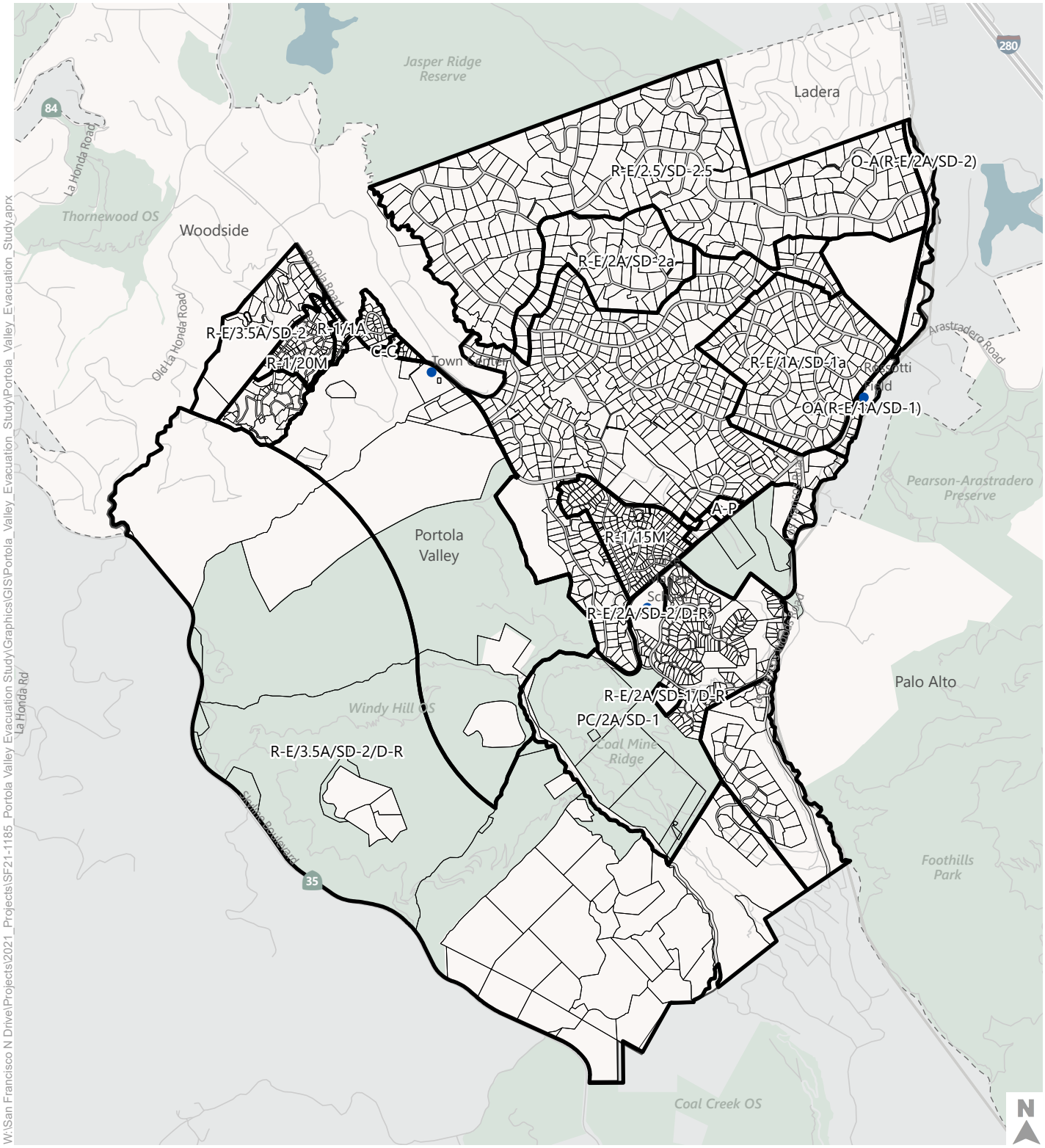
The San Mateo County travel model estimates that there are about 1,440 total employees in the Town of Portola Valley and surrounding areas on a typical weekday. For reference, the Ashland OR Evacuation Study forecast that 10 percent of total townwide employees would be working and involved in an overnight/early morning evacuation. To provide a conservative assessment, it is forecast that 20 percent of total townwide employees plus the 108 Sequoia employees would be involved in the evacuation. This yields 396 employee vehicle trips, assuming one outbound trip per employee, for a 6:00 am evacuation. This represents about 25 percent of the daily employee total.

**Table 2** shows the estimated number of horses and trailers in Portola Valley and the surrounding community based on surveys of stables, community members, and the San Mateo County Large Animal Evacuation Group. Based on the surveys, a total of 100 trailer trips are forecast during a town wide evacuation. This is equivalent to about 300 standard vehicle trips.

### Table 2: Equestrian Trailer Trip Demand Data

| FACILITY | HORSES | TRAILERS | NOTES |
|---|---|---|---|
| **Home-Based** | 80 | 25 | 5-4 horse, 8-3 horse, 12-2 horse |
| **Isola Stables/Glen Oaks** | 60 | 3 | 3-6 horse trailers |
| **Alpine Rock Ranch** | 10 | 5 | 5-2 horse trailers |
| **Webb Ranch** | 300 | 50 | |
| **Millennium Farm** | 40 | 2 | 1-2 horse, 1-6 horse |
| **Spring Down** | 53 | 3 | 1-5 horse, 2-2 horse |
| **SMC Large Animal Evacuation Group** | | 1-4 | 45 min. travel time, 45-60 min. to load a barn, 2-2.5 hours total time |

*Sources: Rob Younge, Fehr & Peers, 2022.*



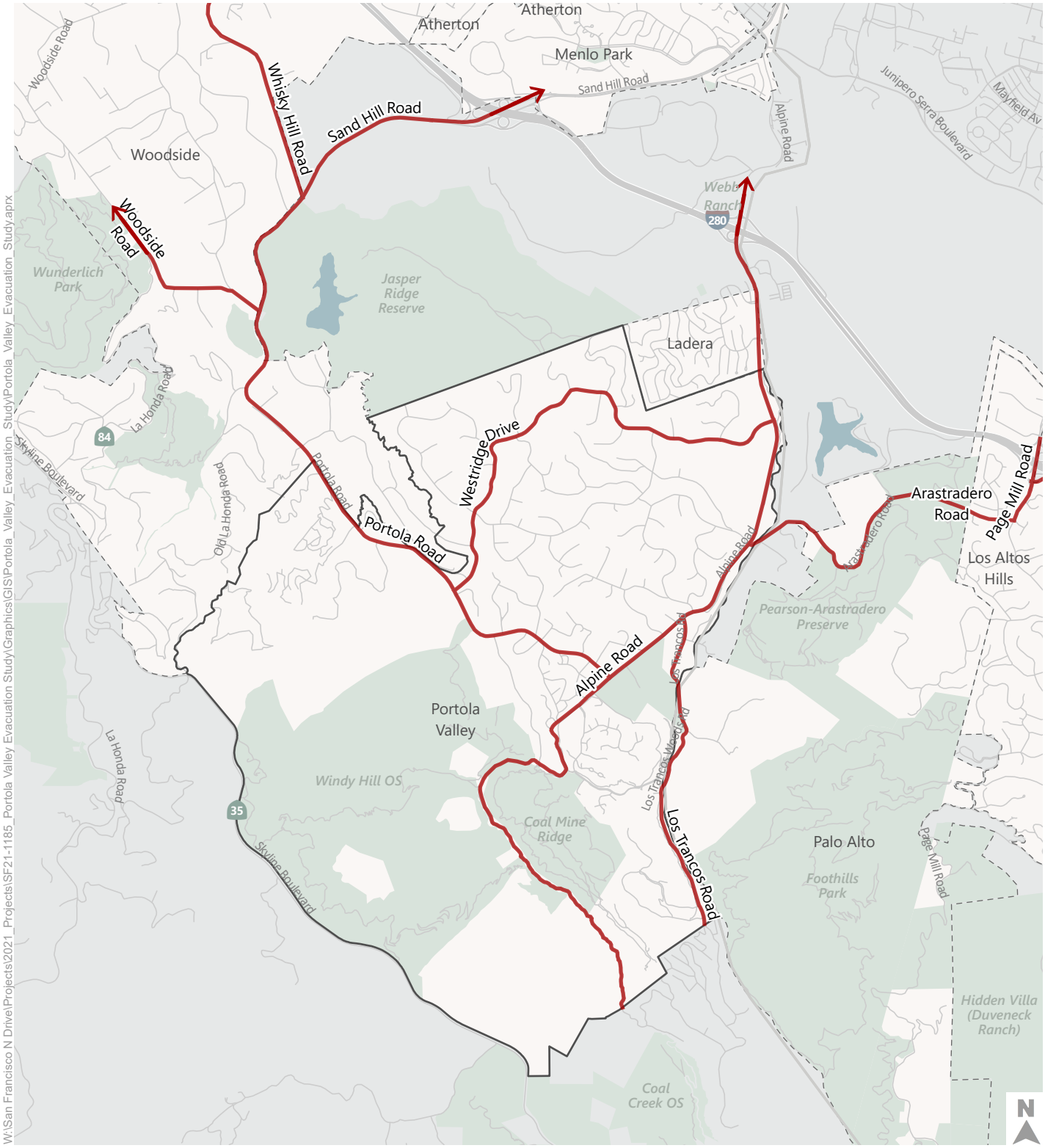

Parcels

Zoning

Open Space Preserve

Figure 1

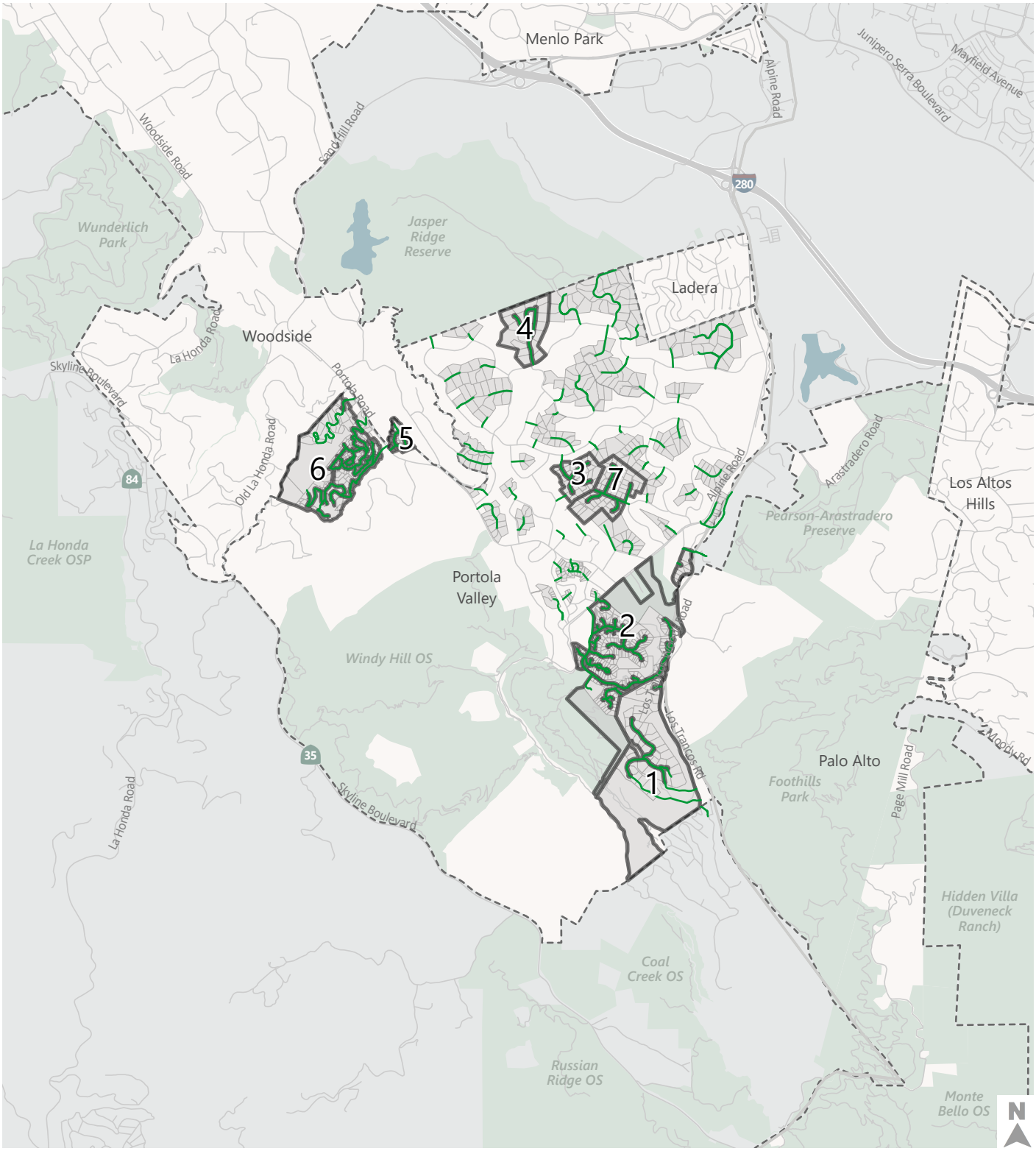
# Portola Valley Zoning and Parcels




Portola Valley Evacuation Routes

Figure 2

# Portola Valley Evacuation Routes

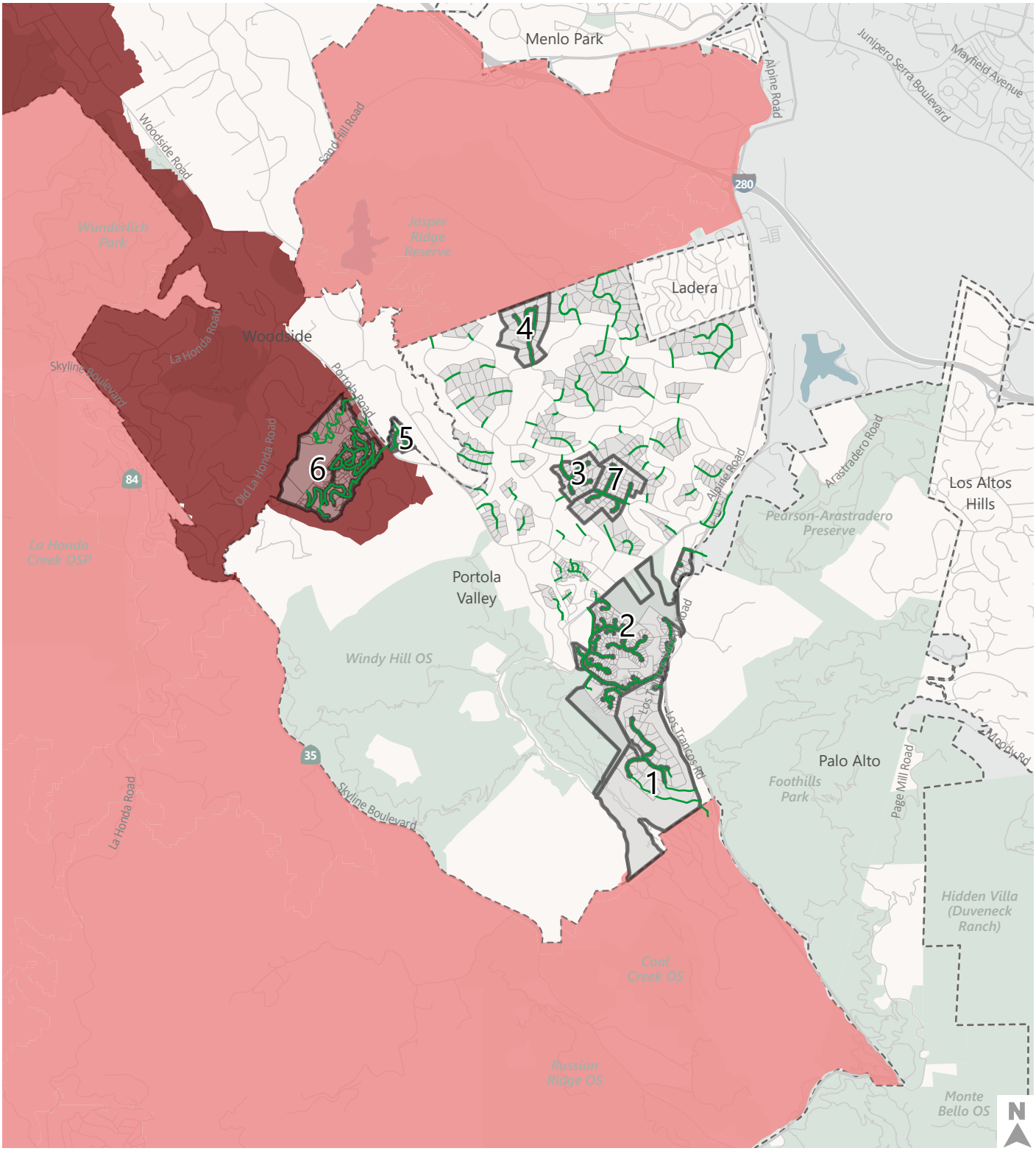



Constrained Streets  Constrained Parcel Groups

Single Access Parcels

Figure 3

## Constrained Parcel Groups and Streets

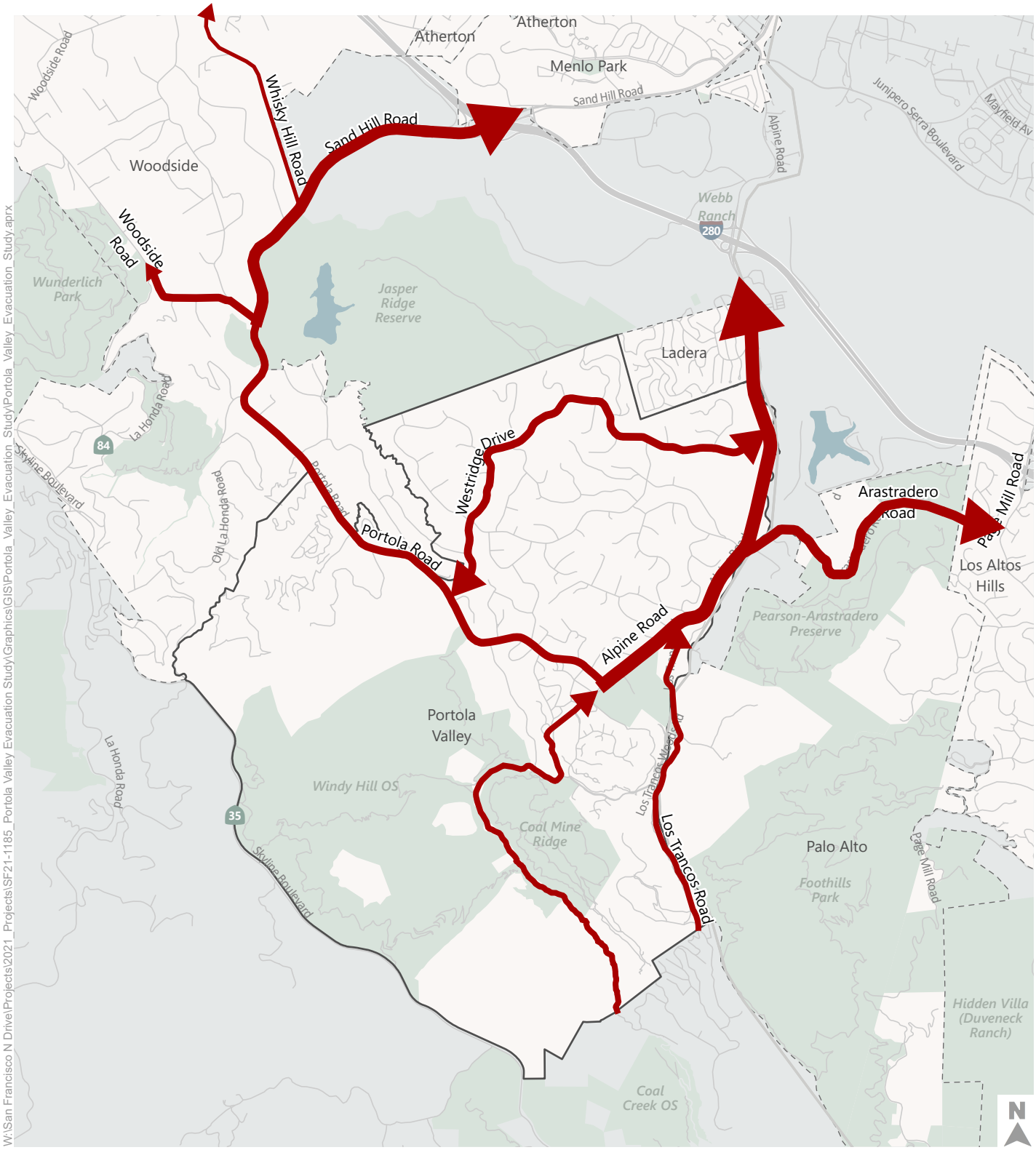



Constrained Streets
Single Access Parcels
Constrained Parcel Groups
Fire (LRA)
Fire (SRA)

**Town of Portola Valley is within a Seismic hazard area*

Figure 4

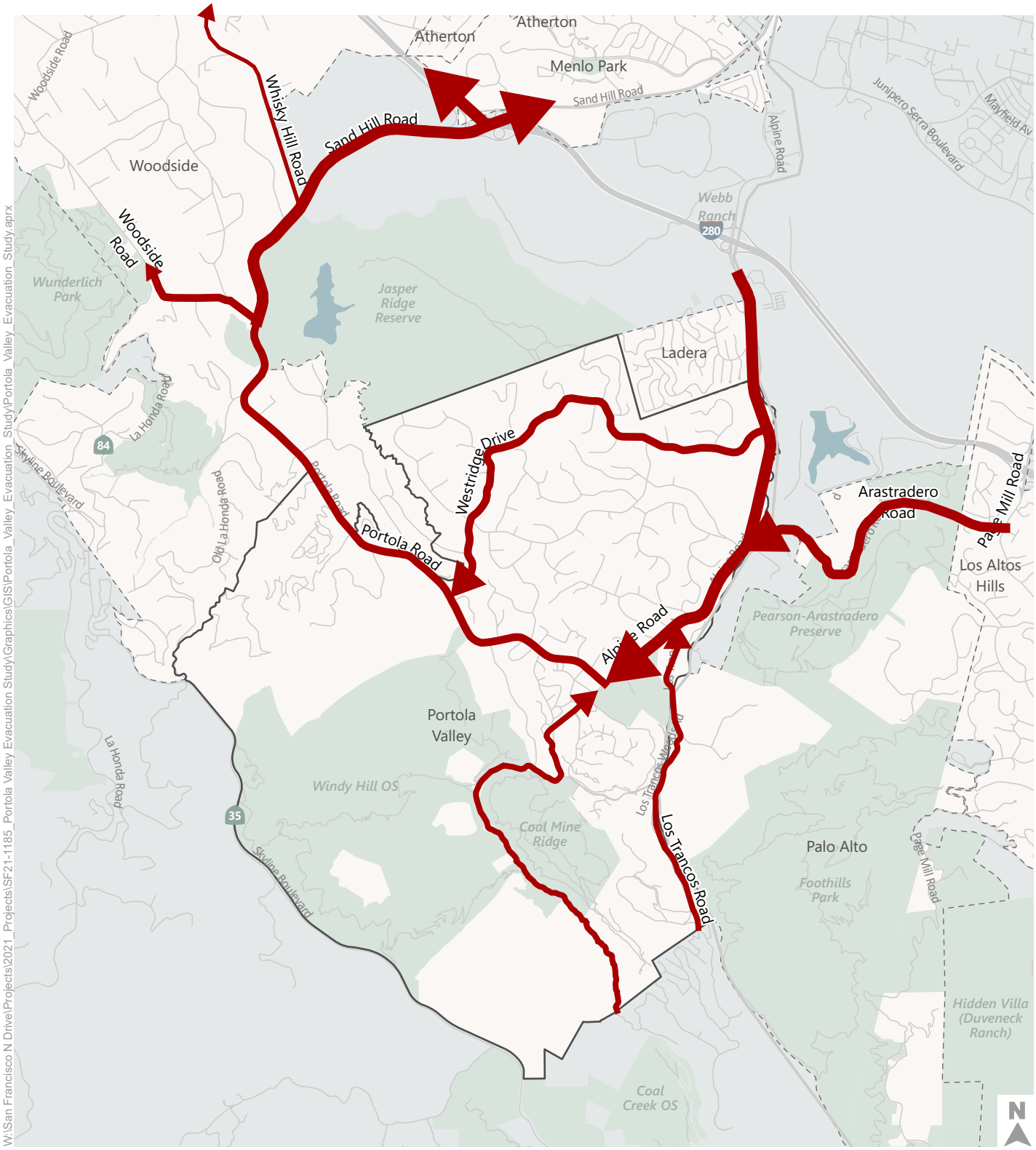
## Constrained Parcel Groups within Fire Hazardous Area(s) and Served by a Constrained Street




Portola Valley Evacuation Routes

Figure 5

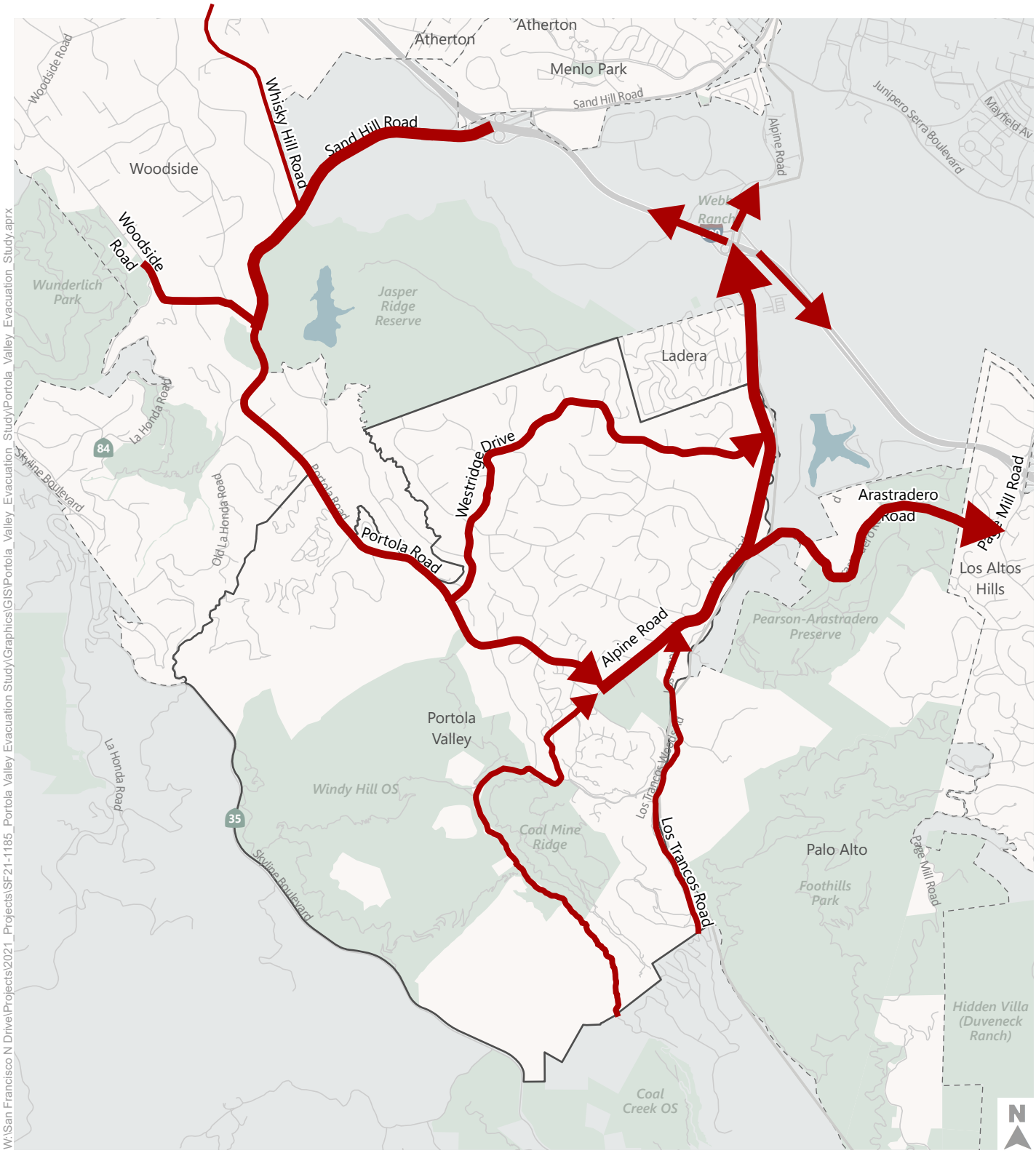
# Portola Valley Evacuation Scenario 1




Portola Valley Evacuation Routes

Figure 6

# Portola Valley Evacuation Scenario 2




Portola Valley Evacuation Routes

Figure 7

## Portola Valley Evacuation Scenario 3

### 2.3.3 Trip Assignment

The total household, employee, and equestrian trailer evacuation trips are disaggregated into 17 different geographically designated evacuation zones in the Zonehaven platform. Trips are linked from each of these zones to intersections along the major evacuation routes. Once on the major evacuation routes, the trips are assigned to evacuation routes based on the best route to I-280 where each trip is considered to be fully evacuated.

Trips were assigned using the PTV Visum macroscopic model. The model relies on the Zonehaven zones, trip tables between origin zones and destination gateways, and the existing roadway network extracted from the San Mateo travel model and compared to other sources including the Zonehaven platform network and field observations.

PTV Visum estimates traffic and levels of congestion on 15-minute intervals and, as link congestion builds (roads fill with cars), it dynamically reassigns traffic to less congested routes if available. This is a dynamic approach to estimating trip assignment and identifying congested locations on the network.

### 2.3.4 Additional Consideration

The trips assigned to the transportation system are estimated based on household and employer demographics and are useful to assist with the amount of time needed during an evacuation event.

This evacuation assessment includes trips generated by the Sequoias retirement community including both employee evacuation and trips to evacuate residents. A critical consideration for emergency personnel is to address individual residents who either do not have access to a vehicle or can't drive to ensure that compete evacuation is provided. Further research into strategies for evacuating people who do not have access to a vehicle is recommended. Options for assisting with evacuation in such situations could include, but not be limited to, the following:

- Neighborhood "buddy" program to link people needing assistance with people willing to assist
- Coordination with SamTrans to provide transit assistance
- Coordination with local school districts to provide school bus access
- Partnership with Transportation Network Companies (TNCs, like Uber and Lyft)
- Increased coordination with emergency services personnel to assist with accessibility

# 3. Emergency Evacuation Assessment

The PTV Visum model was utilized to evaluate the estimated travel time for five evacuation scenarios. The model uses inputs from the travel demand model for a typical day and modifies the travel demand and transportation network to represent the evacuation condition. After determining the evacuation travel demand and associated transportation network, a dynamic traffic assignment with 15-minute intervals is performed to reflect congestion and departure time to estimate travel time. Note that this model does not include estimating the time people need to prepare for the evacuation.

As previously shown in **Table 1**, the following evacuation scenarios that are also shown in **Figures 5 through 7** are evaluated in this assessment.

| Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|
| All Routes Open | North Routes Open | South Routes Open |

## 3.1 Travel Demand and Activity Estimation

The travel demand considers the number of people and automobiles used by those evacuating as well as background vehicle traffic.

### 3.1.1 Vehicle Travel Demand

The macroscopic model only reflects vehicle traffic. Due to the nature of this model, travel made by other modes are not considered. The travel demand for evacuation zones was separated from background traffic not associated with evacuation zones.

### 3.1.2 Evacuation Traffic

The evacuation traffic consists of traffic generated by residents, employees, and equestrian trailers generated from the evacuation zones. The number of residents, anticipated vehicle trips per household, and employees in the area werereferenced to estimate the number of vehicles that would need to evacuate.

### 3.1.3 Background Traffic

For "background" traffic, it was assumed that traffic control offices located at the perimeter gateways including I-280 would prohibit inbound trips into Portola Valley and surrounding areas given the scale of the town wide evacuation identified for the study scenarios. "Background" traffic is therefore comprised of existing trips on I-280 based on Caltrans PEMS

count data and historic ramp counts. Through trips on I-280 were not affected by the assignment. All trips that exit I-280 at local interchanges (i.e., Alpine Road, Sand Hill Road) that under normal conditions would travel to the west were reallocated to travel to the east.

### 3.1.4 Evacuation Departure Time

The departure time for trips leaving evacuation zones varies by the time and type of the event. For events where ample notice is given or the family unit is already together, less time is needed to prepare for the evacuation. On the other hand, where little notice of an event or when the family unit is not together, the time required to prepare for an evacuation is typically longer as residents need to pack belongings, collect their animals, and conduct other business before beginning an evacuation trip.

With different evacuation starting times, the impact of the evacuation trips on the roadway conditions will be different. For example, evacuation occurring at nighttime when all household members are at home with no visitors will be different from evacuations occurring when all or part of household members have made their regular trips from or to the evacuation TAZs.

For the evacuation scenarios evaluated in this study, the starting time for all evacuations was set at 6:00 am. Return trips are not included in this round of analysis because these types of trips are assumed to be negligible due to the evacuation beginning at 6:00 am. This represents a compressed evacuation scenario for testing the roadway network as virtually all residents are at home (maximizing demand on the roadway system).

The departure distribution across the evacuation time window for the three evacuation scenarios is shown in **Table 2**. The table shows the percent of the population that begins their evacuation trips, by 15-minute intervals, starting at 6:00 am. The trip allocation ranges are separately provided for trips by employees, residents, and equestrian trailers. The table builds on research conducted for the *City of Ashland Evacuation Time Estimate Study* (April 2021) which identified evacuation curves for employees and residents based on surveys. Employees have the steepest departure curve as they do not have to pack items or coordinate evacuations with others. All employees would begin their evacuation trips within one hour, fifteen minutes of the evacuation notice. Based on comments provided at EPC presentations, the evacuation curve applied for residents in Portola Valley assumed residents would evacuate more quickly than Ashland residents (i.e., 85 percent of Portola Valley residents would begin their trip in the first 60 minutes vs 65 percent of Ashland residents). The evacuation curves for equestrian trailers was the flattest, given the length of time it takes for evacuees to get to stables and load trailers. About 20 percent of equestrian trailer trips would start within one hour and about 80 percent within two hours of the notice.

### 3.1.5 Evacuation Destinations

Trips departing evacuation zones are allocated first to the closest evacuation route and then assigned along the routes to gateways including I-280 and evacuation routes that connect east of

I-280. A limited number of evacuation trips, made from parcels along Old La Honda Road, were assigned to Skyline Boulevard.

**Table 3: Percent of Population Beginning Evacuation Trip after Evacuation Notice**

| Time Interval (AM) | Employees | Residents | Equestrian Trailers |
|---|---|---|---|
| 6:00-6:14 | 45% | 8% | 0% |
| 6:15-6:29 | 82% | 48% | 1% |
| 6:30-6:44 | 93% | 75% | 8% |
| 6:45-6:59 | 96% | 85% | 23% |
| 7:00-7:14 | 100% | 92% | 43% |
| 7:15-7:29 | -- | 95% | 60% |
| 7:30-7:44 | -- | 96% | 73% |
| 7:45-7:59 | -- | 97% | 81% |
| 8:00-8:14 | -- | 98% | 86% |
| 8:15-8:29 | -- | 99% | 90% |
| 8:30-8:44 | -- | 99.5% | 94% |
| 8:45-8:59 | -- | 100% | 96% |
| 9:00-9:14 | -- | -- | 97% |
| 9:15-9:29 | -- | -- | 98% |
| 9:30-9:44 | -- | -- | 99% |
| 9:45-9:59 | -- | -- | 100% |

*Sources: City of Ashland Evacuation Time Estimate Study, April 2021; Fehr & Peers, 2022.*

### 3.1.6 Transportation Network

Depending on the event, the traffic assignment can have a change in the accessibility and capacity of the roadway over the duration of the event. This may be due to debris, flooding, or other hazards that change throughout the model evaluation period. It is presumed that the intersection control will be implemented through a combination of existing stop sign control and human direction. Beyond the individual roadway and location details that may vary over time, thereare two fundamentally different operating conditions that the model can evaluate, as described below, Normal Roadway Conditions and Reduced Operational Capacity.

The typical daily operating conditions for the number of travel lanes per direction are assumed in the simulation, allowing first responders to use inbound lanes to access the evacuation area. The simulation

does not allow for contra-flow operations where the opposite direction of evacuation traffic is used for evacuation traffic.

#### *3.1.6.1 Normal Roadway Conditions (Baseline Road Capacity)*

The typical daily operating conditions for both the number of travel lanes per direction and associated hourly capacity per lane are applied for the baseline road capacity scenario. The capacity analysis conducted for the baseline scenario is based on road segment capacity and intersection capacity as defined in the Highway Capacity Manual (HCM) without adjustments. This condition allows for the opposite direction of evacuation traffic to be used for emergency responders to access the evacuation area and for background traffic to operate normally. This capacity approach is similar to the ones applied for the City of Ashland Evacuation Time Estimate Study (April 2021) and the Rancho Cucamonga Evacuation Assessment (October 2021), two of the most comprehensive recent evacuation assessments in the western US.

#### *3.1.6.2 Reduced Operational Capacity*

There is little research on how people drive in wildfire smoke and how changes in driver behavior during a wildfire evacuation affect roadway capacity. For this evacuation assessment, a reduced operational capacity 40 percent below baseline road capacity levels is applied. The 40 percent reduction level is based on professional judgment of the consultant team and a process where the reduced capacity level was applied and peak hour volumes on segments of evacuation routes were reviewed.

### 3.1.7 Vehicle Accessibility

Vehicle accessibility was reviewed to identify the number of households in the area that would potentially have issues during an evacuation event due to limited mobility options. Since the San Mateo travel model does not provide granular information regarding driver's license holders in a household, we used data from the model for zero vehicle households to provide an indication of residents who have vehicle accessibility challenges. The San Mateo model indicates that 31 households in the three model zones that surround the Town of Portola Valley are zero vehicle households. Census data (ACS 2019) indicates that there are 51 households in Portola Vallely with no vehicles available. It is presumed that most of these households are those located in the Sequoias retirement community.

Zero vehicle households would likely require outside assistance for evacuation. Although outside the scope of this assessment, the Town may want to consider a program that identifies zero vehicle households and provides a mechanism for evacuation for these households via private transport providers, first responders, public transit and/or neighborhood programs.

Employees who access their places of employment via transit or active transportation modes may also have vehicle accessibility challenges during an evacuation. As with the above scenario for zero vehicle households, the Town may want to consider working with employers to develop evacuation assistance strategies for employees without access to avehicle.

Finally, it was assumed that some households with more than two vehicles likely would not be able to utilize all vehicles during an evacuation event (e.g., homes with three or four vehicles but with only two licensed drivers).

## 3.2 Evacuation Scenario Testing

The results of the macroscopic trip assignment by time interval, using PTV Visum, are shown in the following pages for the three evacuation scenarios.

Evacuation time estimates (ETE's) are provided for each scenario for two network capacity levels and two evacuation levels as summarized below.

Evacuation Capacity Levels

- Baseline road capacity
- 40 percent below baseline road capacity

Evacuation Levels

- 90 percent of population evacuated
- 100 percent of population evacuated

For the purpose of the evacuation time assessment, population groups are considered to be evacuated when they have either accessed gateways to the north or south on I-280 or traveled east of I-280. The evacuation time estimate ranges provided are thus when 90 or 100 percent of all evacuees in each population group would clear the evacuation area and routes. The evacuation times include time spent traveling on major evacuation routes such as Alpine Road, Portola Road, and Westridge Road as well as the time vehicles would wait while in queues on local connecting streets to access the evacuation routes.

Average evacuation times are also provided for residents, based on the start time of the resident evacuation trip by 15-minute interval, for each scenario. The average evacuation times shown in the tables and histograms are average times of evacuees from all zones. Residents living closer to I-280 would experience shorter evacuation times and residents living farther from I-280 would experience longer evacuation times.

The evacuation time estimates are based on existing lane configurations in place throughout the evacuation and no change to provide contraflow lane operations. The evacuation assessment is based on no major traffic incidents that would impede egress in the study area.

### 3.2.1 Scenario 1 (All Routes Open) Evacuation Time Estimates

**Table 3** shows a range of evacuation durations by population group for Scenario 1 where all routes are open. With reduced capacity levels, 90 percent of employees would be evacuated within one hour, 90 percent of residents within 90 minutes, and 90 percent of equestrian trailers within 2 hours and 30 minutes. Full evacuation times with reduced capacity levels are about 90 minutes longer for each group, in part due to the fact that the evacuation start times for the last five percent of evacuees in these population groups significantly lags the assumed start times of most others.

**Table 3: Scenario 1 Evacuation Time Estimates**

| POPULATION GROUP | 90% EVACUATED WITHIN | 100% EVACUATED WITHIN |
|---|---|---|
| **Residents** | 1 hr, 15 min – 1 hr, 30 min | 3 hr, 15 min |
| **Employees** | 45 min – 1 hr | 1 hr, 45 min – 2 hr, 30 min |
| **Equestrian Trailers** | 2 hr, 30 min | 4 hr, 15 min |

*Notes:*
*The above times are the estimated duration of time. starting with a 6:00 am evacuation notice. after which 90 and 100 percent of the three population groups are evacuated.*
*First time in range is ETE for baseline road capacity scenario.*
*Second time in range is ETE for 40% below baseline road capacity scenario.*

*Source: Fehr & Peers, 2022.*

To provide additional detail on the evacuation characteristics for Scenario 1, the average evacuation travel times for residents was extracted from the model by 15-minute time interval. The average evacuation travel times are identified for the baseline road capacity and reduced road capacity levels. It should be noted that these are the average of all evacuation times and that residents located closer to I-280 would experience lower travel times while residents located farther away would experience higher travel times.

**Table 4** shows the average evacuation travel times for Scenario 1. Average evacuation times under reduced road capacity levels range from about 35 to 45 minutes for resident trips that start in the 6:30 to 7:45 am window when times are at their greatest for Scenario 1.

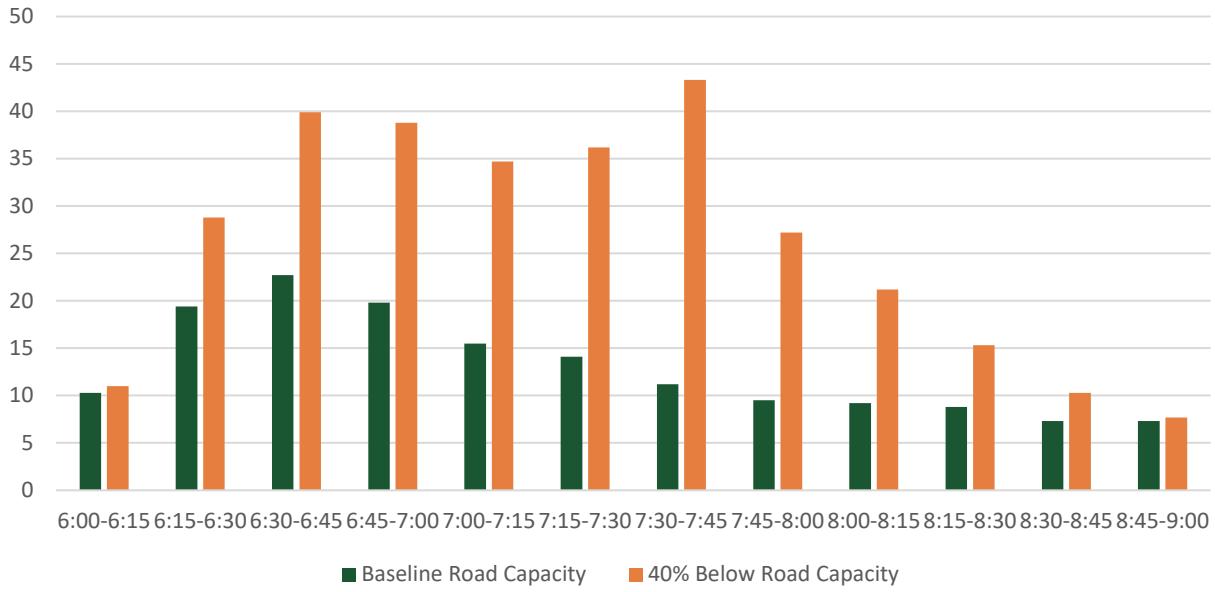
**Table 4: Scenario 1: Average Resident Evacuation Travel Time (Minutes) by Time Interval**

| TIME INTERVAL RESIDENT TRIP STARTED | AVERAGE EVACUATION TIME [BASELINE ROAD CAPACITY] | AVERAGE EVACUATION TIME [40 PERCENT BELOW BASELINE ROAD CAPACITY] |
|---|---|---|
| 6:00-6:14 | 10.3 | 11.0 |
| 6:15-6:29 | 19.4 | 28.8 |
| 6:30-6:44 | 22.7 | 39.8 |
| 6:45-6:59 | 19.8 | 38.5 |
| 7:00-7:14 | 15.5 | 34.7 |
| 7:15-7:29 | 14.1 | 36.2 |
| 7:30-7:44 | 11.2 | 43.3 |
| 7:45-7:59 | 9.5 | 27.2 |
| 8:00-8:14 | 9.2 | 21.1 |
| 8:15-8:29 | 8.8 | 15.3 |
| 8:30-8:44 | 7.3 | 10.3 |
| 8:45-8:59 | 7.3 | 7.7 |

*Notes:*
*6:00 am evacuation notice.*
*Source: Fehr & Peers, 2022.*

The above average evacuation travel times by time interval for Scenario 1 are illustrated in the histogram on Figure 8 below. As noted, the evacuation travel times shown in Table 4 and Figure 8 are averages of evacuation times from zones throughout the study area. Residents living closer to I-280 would experience shorter evacuation times and residents living farther from I-280 would experience longer evacuation times. The longest individual evacuation time for a resident living farthest from I-280 under the Scenario 1 study parameters would be about one hour under baseline road capacity conditions and 90 minutes under reduced capacity conditions.

Figure 8: Scenario 1 (all routes open)
Average Evacuation Travel Time (Minutes)



### 3.2.2 Scenario 2 (North Routes Open) Evacuation Time Estimates

**Table 5** shows a range of evacuation durations by population group for Scenario 2 where only the north routes are open. With reduced capacity levels, 90 percent of employees would be evacuated within two hours, 90 percent of residents within three hours and 45 minutes, and 90 percent of equestrian trailers within three hours and thirty minutes. Full evacuation times with reduced capacity levels are about 60 to 90 minutes longer for each group, in part due to the fact that the evacuation start times for the last five percent of evacuees in these population groups significantly lags the assumed start times of most others.

Scenario 2 has the highest average evacuation times of the three study scenarios, with the elapsed evacuation time for all residents shown in Table 5 below, based on a 6:00 am evacuation notice, ranging from three and a half hours to four hours and forty-five minutes. Under these Scenario 2 conditions, the total evacuation times would be reduced if the Incident Commander, who makes the ultimate decision on evacuation strategy, approves contraflow operations (i.e., converting both lanes to one-way outbound traffic) on segments of Portola Road and Sand Hill Road between Westridge Drive and I-280. For reference, this happened for the Camp Fire in Paradise where the main egress route Skyway was converted to one-way traffic two hours after the evacuation order. The total evacuation time for the Camp Fire, where an estimated 52,000 people were evacuated, was seven hours.

**Table 5: Scenario 2 Evacuation Time Estimates**

| POPULATION GROUP | 90% EVACUATED BY | 100% EVACUATED BY |
|---|---|---|
| **Residents** | 2 hr, 45 min – 3 hr, 45 min | 3 hr, 30 min – 4 hr, 45 min |
| **Employees** | 1 hr, 30 min – 2 hr | 3 hr, 30 min – 4 hr, 30 min |
| **Equestrian Trailers** | 3 hr – 3 hr, 30 min | 4 hr, 15 min – 4 hr, 45 min |

*Notes:*
*The above times are the estimated duration of time. starting with a 6:00 am evacuation notice. after which 90 and 100 percent of the three population groups are evacuated..*
*First time in range is ETE for baseline road capacity scenario.*
*Second time in range is ETE for 40% below baseline road capacity scenario.*

*Source: Fehr & Peers, 2022.*

To provide additional detail on the evacuation characteristics for Scenario 2, the average evacuation travel times for residents was extracted from the model by 15-minute time interval. The average evacuation travel times are identified for the baseline road capacity and reduced road capacity levels. It should be noted that these are the average of all evacuation times and that residents located closer to I-280 would experience lower travel times while residents located farther away would experience higher travel times.

**Table 6** shows the average evacuation travel times for Scenario 2. Average evacuation times under reduced road capacity levels range from about 100 to 135 minutes for resident trips that start in the 6:30 to 8:00 am window when times are at their greatest for Scenario 2.

**Table 6: Scenario 2: Average Resident Evacuation Travel Time (Minutes) by Time Interval**

| TIME INTERVAL RESIDENT TRIP STARTED | AVERAGE EVACUATION TIME [BASELINE ROAD CAPACITY] | AVERAGE EVACUATION TIME [40 PERCENT BELOW BASELINE ROAD CAPACITY] |
|---|---|---|
| 6:00-6:14 | 17.1 | 23.0 |
| 6:15-6:29 | 61.9 | 98.9 |
| 6:30-6:44 | 78.6 | 116.7 |
| 6:45-6:59 | 76.0 | 114.6 |
| 7:00-7:14 | 66.7 | 104.2 |
| 7:15-7:29 | 72.4 | 121.5 |
| 7:30-7:44 | 67.2 | 134.3 |
| 7:45-7:59 | 54.6 | 121.4 |
| 8:00-8:14 | 42.6 | 96.1 |
| 8:15-8:29 | 33.9 | 96.3 |
| 8:30-8:44 | 34.3 | 102.3 |
| 8:45-8:59 | 29.3 | 87.3 |

*Notes:*
*6:00 am evacuation notice.*
*Source: Fehr & Peers, 2022.*

The above average evacuation travel times by time interval for Scenario 2 are illustrated in the histogram on Figure 9 below. As noted, the evacuation travel times shown in Table 6 and Figure 9 are averages of evacuation times from zones throughout the study area. Residents living closer to I-280 would experience shorter evacuation times and residents living farther from I-280 would experience longer evacuation times. The longest individual evacuation time for a resident living farthest from I-280 under the Scenario 2 study parameters would be about three hours under baseline road capacity conditions and four hours under reduced capacity conditions.

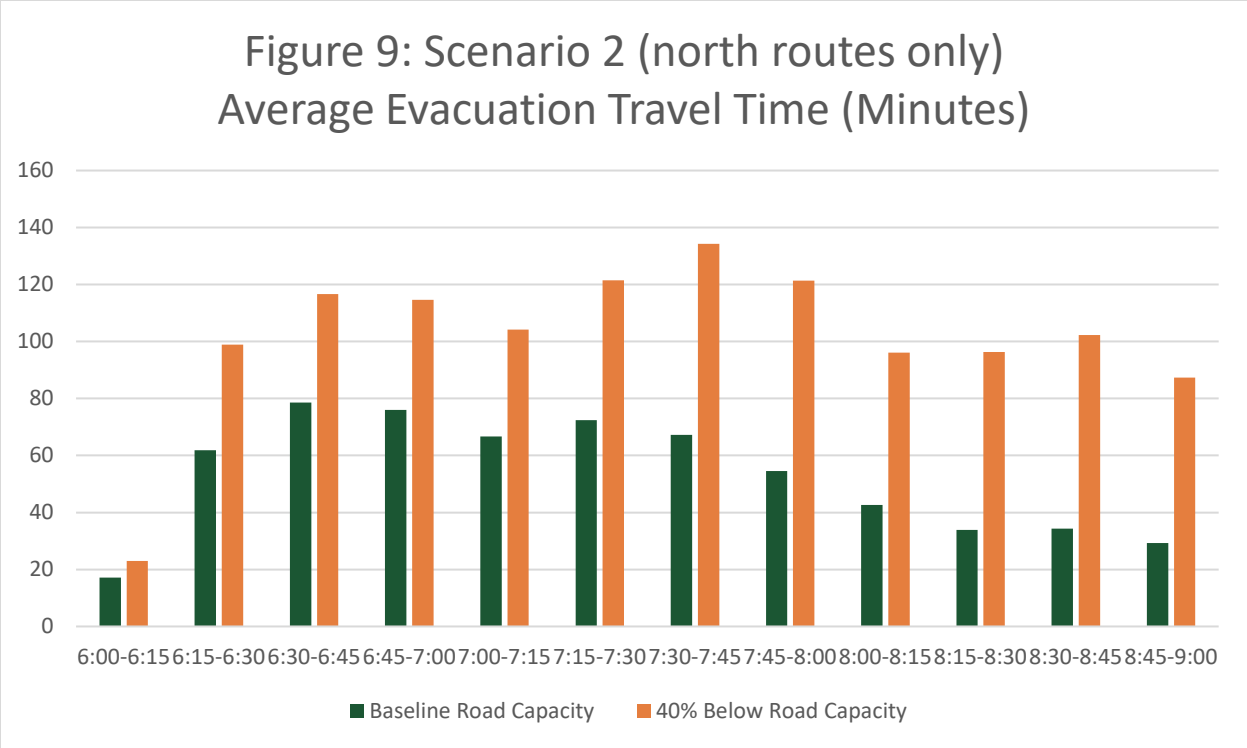


Figure 9: Scenario 2 (north routes only)
Average Evacuation Travel Time (Minutes)
160
140
120
100
80
60
40
20
0
6:00-6:15
6:15-6:30
6:30-6:45
6:45-7:00
7:00-7:15
7:15-7:30
7:30-7:45
7:45-8:00
8:00-8:15
8:15-8:30
8:30-8:45
8:45-9:00
Baseline Road Capacity
40% Below Road Capacity

### 3.2.3 Scenario 3 (South Routes Open) Evacuation Time Estimates

**Table 7** shows a range of evacuation durations by population group for Scenario 3 where only the north routes are open. With reduced capacity levels, 90 percent of employees would be evacuated within one hour and 45 minutes, 90 percent of residents within two hours and 45 minutes, and 90 percent of equestrian trailers within three hours. Full evacuation times with reduced capacity levels are up to 75 minutes longer for each group, in part due to the fact that the evacuation start times for the last five percent of evacuees in these population groups significantly lags the assumed start times of most others.

**Table 7: Scenario 3 Evacuation Time Estimates**

| POPULATION GROUP | 90% EVACUATED WITHIN | 100% EVACUATED WITHIN |
|---|---|---|
| **Residents** | 2 hr – 2 hr, 45 min | 3 hr, 15 min – 3 hr, 30 min |
| **Employees** | 1 hr, 15 min – 1 hr, 45 min | 2 hr, 45 min – 3 hr, 30 min |
| **Equestrian Trailers** | 2 hr, 30 min - 3 hr | 4 hr, 15 min |

*Notes:*
*The above times are the estimated duration of time. starting with a 6:00 am evacuation notice. after which 90 and 100 percent of the three population groups are evacuated.*
*First time in range is ETE for baseline road capacity scenario.*
*Second time in range is ETE for 40% below baseline road capacity scenario.*

*Source: Fehr & Peers, 2022.*

To provide additional detail on the evacuation characteristics for Scenario 3, the average evacuation travel times for residents was extracted from the model by 15-minute time interval. The average evacuation travel times are identified for the baseline road capacity and reduced road capacity levels. It should be noted that these are the average of all evacuation times and that residents located closer to I-280 would experience lower travel times while residents located farther away would experience higher travel times.

**Table 8** shows the average evacuation travel times for Scenario 3. Average evacuation times under reduced road capacity levels range from about 80 to 85 minutes for resident trips that start in the 6:30 to 7:45 am window when times are at their greatest for Scenario 3.

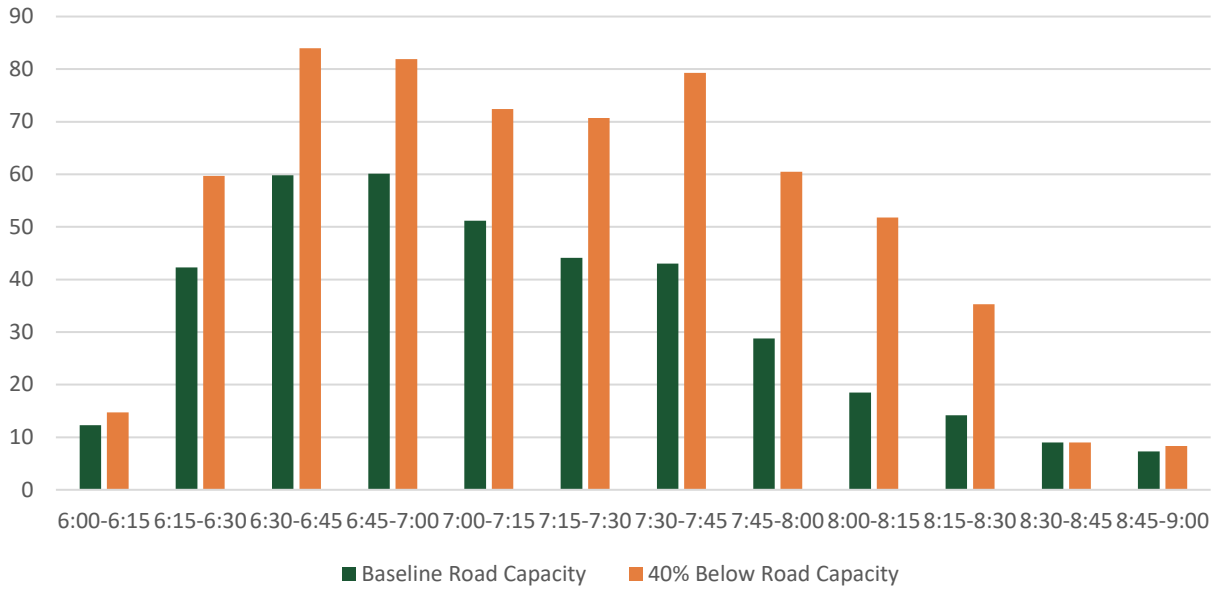
**Table 8: Scenario 3: Average Resident Evacuation Travel Time (Minutes) by Time Interval**

| TIME INTERVAL RESIDENT TRIP STARTED | AVERAGE EVACUATION TIME [BASELINE ROAD CAPACITY] | AVERAGE EVACUATION TIME [40 PERCENT BELOW BASELINE ROAD CAPACITY] |
|---|---|---|
| 6:00-6:14 | 12.3 | 14.7 |
| 6:15-6:29 | 42.3 | 59.7 |
| 6:30-6:44 | 59.8 | 84.0 |
| 6:45-6:59 | 60.1 | 81.9 |
| 7:00-7:14 | 51.2 | 72.4 |
| 7:15-7:29 | 44.1 | 70.7 |
| 7:30-7:44 | 43.0 | 79.3 |
| 7:45-7:59 | 28.8 | 60.5 |
| 8:00-8:14 | 18.5 | 51.8 |
| 8:15-8:29 | 14.2 | 35.3 |
| 8:30-8:44 | 9.0 | 9.0 |
| 8:45-8:59 | 7.3 | 8.3 |

*Notes:*
*6:00 am evacuation notice.*
*Source: Fehr & Peers, 2022.*

The above average evacuation travel times by time interval for Scenario 3 are illustrated in the histogram on Figure 10 on the following page. As noted, the evacuation travel times shown in Table 8 and Figure 10 are averages of evacuation times from zones throughout the study area. Residents living closer to I-280 would experience shorter evacuation times and residents living farther from I-280 would experience longer evacuation times. The longest individual evacuation time for a resident living farthest from I-280 under the Scenario 3 study parameters would be about two hours and 15 minutes under baseline road capacity conditions and three hours under reduced capacity conditions.

Figure 10: Scenario 3 (south routes only)
Average Evacuation Travel Time (Minutes)



# 4. Evacuation Assessment Observations and Behavioral Considerations

**Chapter 3** summarized the results of the evacuation assessment for Portola Valley and provided a review of the capacity assessment consistent with AB 747. This chapter provides a high-level overview of those assessments along with observations, recommendations, and other considerations associated with evacuations within the Town.

## 4.1 General Observations

Below summarizes the general observations for evacuation assessments, constrained parcel groups, and remote parcels.

### 4.1.1 Evacuation Time Assessments

Scenario 2 (north routes only) has the highest overall Evacuation Time Estimates, as travel distances from most residential areas to I-280 via Sand Hill Road are much longer than the distance to I-280 via Alpine Road. Off-ramp volume and corresponding background traffic are also higher at the I-280/Sand Hill Road interchange when compared to the I-280/Alpine Road interchange.

Alpine Road is the most direct evacuation route to I-280 for most Portola Valley residents and would experience the heaviest volumes during a major evacuation, particularly between Westridge Drive and I-280. The stop-controlled intersections on Alpine Road at the I-280 interchange as well as at La Cuesta Drive and La Mesa Drive in Ladera are critical locations for traffic control during a major evacuation. Webb Ranch, which is the largest of the stables in the area in terms of horses boarded, has a single driveway on Alpine Road where equestrian trailers would evacuate in the heavily used segment between Ladera and I-280.

As noted above, Scenario 2 (north routes only) has the highest overall Evacuation Time Estimates. In addition to the fact that travel distances from most residential areas to I-280 via Sand Hill Road are much longer than the distance to I-280 via Alpine Road, traveling through Woodside via either Woodside Road or Whisky Hill Road is more circuitous than remaining on Sand Hill Road. Use of Woodside Road or Whisky Hill Road by greater levels of evacuation traffic would require a coordinated traffic management plan through these areas.

Westridge Drive is a major collector that would carry among the heaviest volume of evacuation traffic aside from Alpine Road, Sand Hill Road, and Portola Road. The stop-controlled intersections of Westridge Drive/Alpine Road and Westridge Drive/Portola Road are critical locations for traffic control during a major evacuation.

### 4.1.2 Evacuation Time Risks

Several residents providing comments during the EPC meetings asked about risks that could affect evacuation times. The evacuation time assessment includes a reduced capacity analysis that addresses potential effects on capacity and driver behavior that may occur due to reduced visibility and related factors. Potential evacuation risks that may affect major evacuation routes such as Alpine Road or Portola Road include the following.

- Vehicle accident(s)
- Abandoned or stalled vehicle(s)
- Downed trees
- Downed power lines
- Earthquake fissures

### 4.1.3 Constrained Parcel Groups

Constrained Parcel Group 6 in the northwest portion of the Town is located within a Very High Fire Hazard Severity Zone (VHFHSZ) within a Local Responsibility Area (LRA). There are 170 parcels located in this constrained parcel group that access Portola Road via Santa Maria Avenue, Wayside Road, and Hayfields Road. To further constrain this area, all access points to these neighborhoods are located along the San Andreas Fault, which increases the vulnerability to those roadway connections.

### 4.1.4 Remote Households

Households along the upper portions of Alpine Road and Los Trancos Road are located the farthest from I-280. With only one evacuation route, these households would experience the longest evacuation times.

## 4.2 Strategies to Reduce Evacuation Time Estimates

The following section provides a description of potential supply-side (i.e., road network) strategies, demand-side strategies, and communication strategies that may reduce evacuation time estimates.

### 4.2.1 Supply-Side Strategies to Reduce Evacuation Time Estimates

The following are potential supply-side strategies that would either provide additional traffic management support for an evacuation or would increase the capacity of evacuation routes. **Figure 11** illustrates traffic management strategies.

- Provided supplemental evacuation management for Constrained Parcels Area 6 such as providing early evacuation warning notices when other zones in Portola Valley and surrounding areas in the Sant Cruz Mountains, Woodside and Los Altos Hills receive evacuation warnings. Constrained Parcels Area 6 is primarily located in Zonehaven Zone PV-E001. Provisions for early evacuation warning notices could also be considered for areas that have the longest evacuation trips such as Zonehaven Zones PV-E007 (Upper Los Trancos) and PV-E012 (Upper Alpine).

- Coordinate with County DEM staff to designate evacuation traffic control locations on Alpine Road at Webb Ranch Driveway, Portola Road at Santa Maria Avenue, and Westridge Drive at both intersections with Cervantes Road.

**Alpine Road Shoulder Evacuation Lane Concept**

Alpine Road is the most direct route for most residents to I-280 and is therefore the most desirable evacuation route. Simulations indicate the highest volumes occur in the segment between Westridge Drive and I-280. The portion of Alpine Road in Ladera, between La Mesa Drive and La Cuesta Drive, has three travel lanes with one through lane in each direction and a center left turn lane. The remaining portion of Alpine Road between Westridge Drive and I-280 is a two-lane section with one through lane in each direction. A preliminary engineering review of this segment indicates the potential to widen the paved section of Alpine Road to allow for two outbound lanes during an evacuation. **Figure 12** illustrates a concept for widening the existing outbound shoulder from approximately four feet to 11 feet to provide a dual-use shoulder in the outbound direction that would provide a wider protected bike lane during normal conditions and a second outbound evacuation lane when needed. The shoulder evacuation lane, in conjunction with CHP traffic control at the I-280/Alpine Road interchange, is estimated to reduce evacuation times for Scenario 3 (south routes only) by 25 to 30 percent.

If phasing is needed, it is recommended that the segment from I-280 to La Cuesta Drive be constructed initially. Based on initial review, this segment appears to be the easiest to construct. Completing this segment would also allow for an outbound lane for Ladera residents, when combined with the existing two-way left turn lane between La Mesa Drive and La Cuesta Drive, that would be separate from the existing through lane that would be used by Portola Valley and surrounding area evacuees.

An alternative to constructing the dual-use shoulder evacuation lane would be to construct a continuous striped median between Westridge Drive and I-280. This striped median (i.e., a two-way left turn lane through Ladera) would be used as a second outbound lane during evacuations. It could also be used as a left turn pocket for access to the Webb Ranch driveway between La Cuesta Drive and I-280.

**Other Road Network Strategies**

The following are other road network strategies that would either provide new evacuation routes, improved connectivity for areas with limited egress, and/or enhance existing streets to reduce evacuation times:

- Engage with Stanford University to explore evacuation route opportunities.
- Increase connectivity within areas with evacuation constraints through the use of easements, and emergency access roadways if the addition of new roadways or roadway extensions are deemed infeasible by the Town.
- Future roadway design, especially in areas that have less accessibility and on key evacuation routes, should consider evacuation capacity and consider design treatments such as painted

medians (instead of raised medians) that could assist in creating reversible lanes and facilitate additional capacity in an evacuation event scenario.

- Consider new local revenue measure(s) to assist in funding the mitigation and enhancement of the circulation network to alleviate evacuation constraints. The revenues could assist in delivering redundant infrastructure that would assist in evacuation events.

Community members requested information on wildfire considerations for two roundabouts that are being considered for implementation in Ladera at the intersections of Alpine Road/La Mesa Drive and Alpine Road/La Cuesta Drive. Roundabouts may present evacuation challenges along major evacuation routes for the following reasons:

- Roundabouts are designed for a maximum speed of 18 miles per hour through the intersection with vertical elements (including a raised center island) designed to prevent higher speeds.
- Right-of-way at the two intersections is relatively constrained for roundabouts. To accommodate larger vehicles such as aerial fire trucks and horse trailers, roundabouts would need a diameter of 100 feet or more. Installing a roundabout with a smaller diameter at intersections such as these with constrained right-of-way would mean that larger vehicles may have to drive over the raised center island to maneuver through the roundabout.
- The vertical elements of roundabouts (center island and splitter islands on approaches) could present challenges to motorists when visibility is obscured during an evacuation.
- Installation of roundabouts at these intersections would likely lock in a single outbound evacuation lane and preclude the construction of a second outbound lane on Alpine Road from Westridge Drive to I-280.

### 4.2.2 Demand-Side Strategies to Reduce Evacuation Time Estimates

The following are potential demand-side strategies that would reduce the number of evacuation vehicles. The first strategy would involve a pledge by households to evacuate with only a single vehicle. The evacuation analysis assumes 1.91 vehicles per household are involved in an evacuation.

- 1 car per household evacuation pledge
    - For households that must have second vehicles, an alternative could involve early off-site placement of a second car when advance warnings of a wildfire or other hazard requiring evacuation are available.
- Identify local shelter locations and plan/implement shelter facilities.

Identifying local shelter locations can serve both as a demand-side strategy to reduce evacuation trips and to provide redundancy in the evacuation system for situations where an evacuation may prove infeasible and shelter-in-place becomes a primary option.

### 4.2.3 Information-Side Strategies to Reduce Evacuation Time Estimates

The following are potential information-side strategies that would support evacuation notifications, monitoring, and management.

- Explore and deploy wildfire early detection systems (i.e., wildfire video surveillance cameras, drones, etc.).
- Deploy clear evacuation wayfinding, signs, and barriers to direct evacuation traffic.
- Investigate improvements to communication systems to provide for "hardening" during wildfires.
- Targeted communication systems and early/mandatory evacuation notice during all events for Constrained Parcel Groups (Zonehaven Zones 1, 7, and 12).
- Plan and install vehicle monitoring devices and variable message signs both to monitor evacuation progress and to provide notification to motorists along the road of any changes in evacuation routes or plans due to a change in the wildfire or incidents.

## 4.3 Additional Behavioral Considerations

Planning for evacuation should also consider factors beyond what the theoretical roadway capacity analyses show above. The effectiveness of these evacuations also relies on a combination of both the planning and preparedness conducted by the agencies overseeing evacuation and the individuals involved in the evacuation itself. For evacuations to be effective there are a variety of factors that have to be effectively navigated. These often include the following components that define the new situation and affect the development of new behaviors:

- Warning message confirmation
- The level of perceived personal risk
- Personal characteristics and family context
- Hazard characteristics
- Level of preparedness
- Extent of social networks
- Level of belief that the event will occur[2].

Based on of these components, the outcomes and effectiveness of evacuation efforts can be highly variable based on the type of event and the various factors that affect each resident's decision making.

Much of the research in the psychology of evacuation suggests that the decisions made by potentially affected property owners are based on the ability of individuals to mitigate the effects of disasters, which is determined by the amount of warning they have and the relative severity of the potential event.

[2] TIERNEY, K.J., M.K. LINDELL, AND R.W. PERRY. 2001. Facing the unexpected: Disaster preparedness and response in the United States. Joseph Henry Press, Washington, DC. 306 p.

Research conducted on the preparation, response, and recovery of bush fires in Australia[3] have concluded that there are typically eight responses to an evacuation situation, which include:


For those that do not comply with evacuation orders the motivation may be rooted in a desire to protect valued assets (property, pets, livestock), the potential evacuee may be less prepared to evacuate (psychologically or logistically), or they may believe the threat is remote and not deserving of action.[5]

Based on these responses it is entirely possible that the real-world responses to an evacuation situation may vary significantly compared to the analysis completed in this assessment. Much of the research and modeling indicates that 100% participation in an evacuation event is not likely. So, while this assessment uses scenarios to capture the effects from all members of the area of potential effect (which is prudent in modeling evacuations), it is likely that some residents may not evacuate or, if they take a "Wait and See" approach, they may evacuate much later in the evacuation order – either shifting the entire evacuation curve or compressing that curve toward the end of the assumed evacuation event. That is why the analyses presented above use a relatively short (one- to two-hour evacuation time period) to reflect the potential for these evacuation curves to be compressed.

When considering evacuation orders, public safety officials need to balance allowing residents time to prepare to leave with the dangers of delaying evacuation. Delaying the evacuation could mean that some evacuation routes would become unavailable, that traffic jams may result, and that evacuees would impede access by firefighting personnel. A concern for law enforcement personnel was how to manage residents who refused to leave–mostly because they wanted to defend their properties or protect them from looters. What law enforcement officers saw as discharging their responsibilities to protect members of the public, some residents saw as infringing their rights as US citizens[4].

Participation rates for much of the hurricane evacuation planning within Florida assumes between 65% and 80%, based on the size and severity of the potential hurricane[5]. This would indicate that many events will not include a 100% participation rate like that assumed in the above analysis. Again, the assumption

[3] Reinholdt S., Rhodes A. and Scillio M. (1999a) Stay or go: understanding community responses to emergencies. Burwood, Country Fire Authority.

[4] Jim McLennan et al. 2018. Should We Leave Now?: Behavioral Factors in Evacuation Under Wildfire Threat. Fire Technology, 55, 487-516

[5] XUWEI CHEN, JOHN W. MEAKER and F. BENJAMIN ZHAN. Agent-Based Modeling and Analysis of Hurricane Evacuation Procedures for the Florida Keys. Texas Center for Geographic Information Science (TxGISci), Department of Geography, Texas State University, 601 University Dr. San Marcos, TX 78666, USA

of 100% participation does provide another layer of conservative estimates to this assessment – in that the evacuation times noted above represent a participation rate beyond that which may occur during an evacuation event.

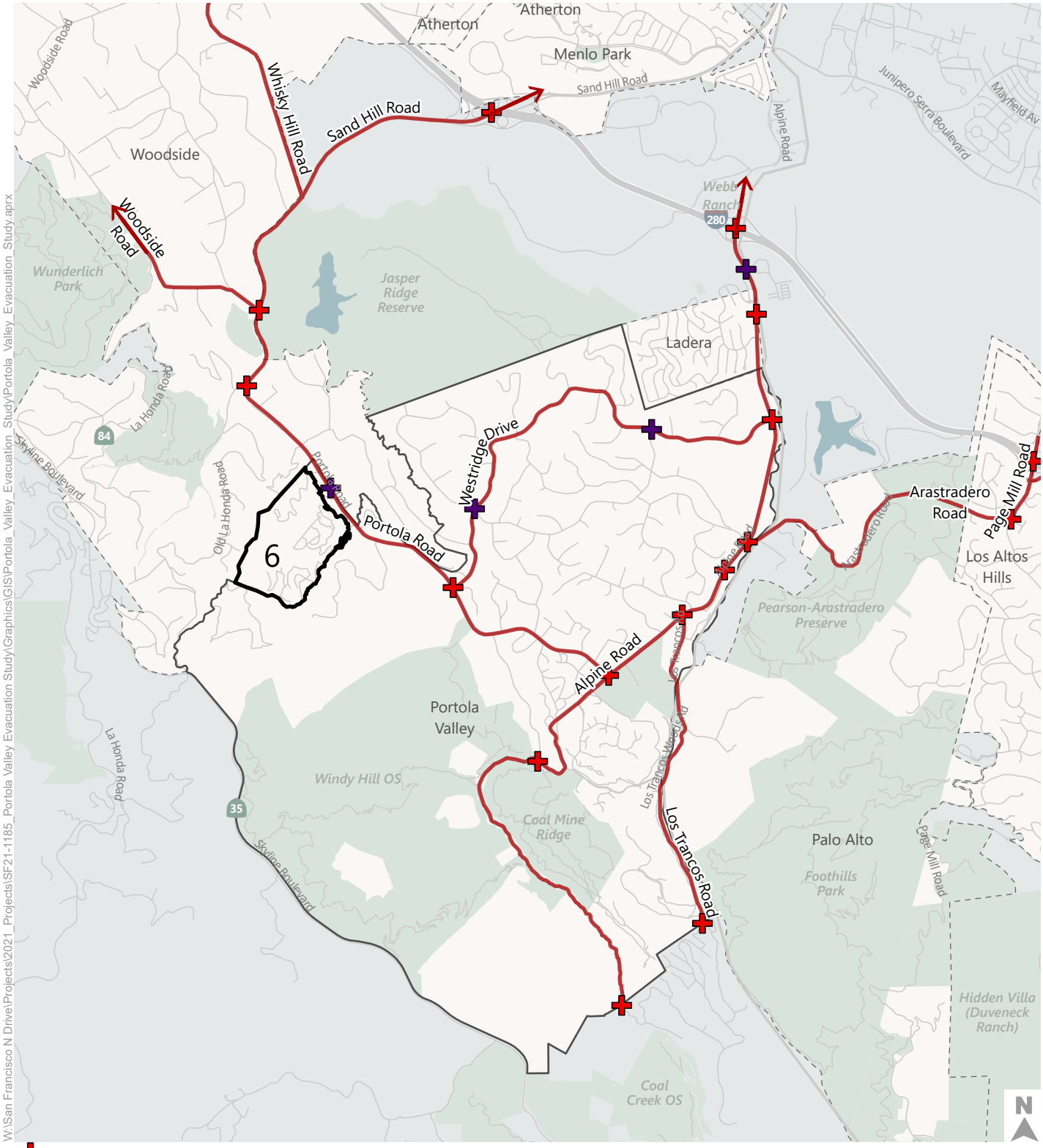



Figure 11

# Portola Valley Traffic Control Strategies

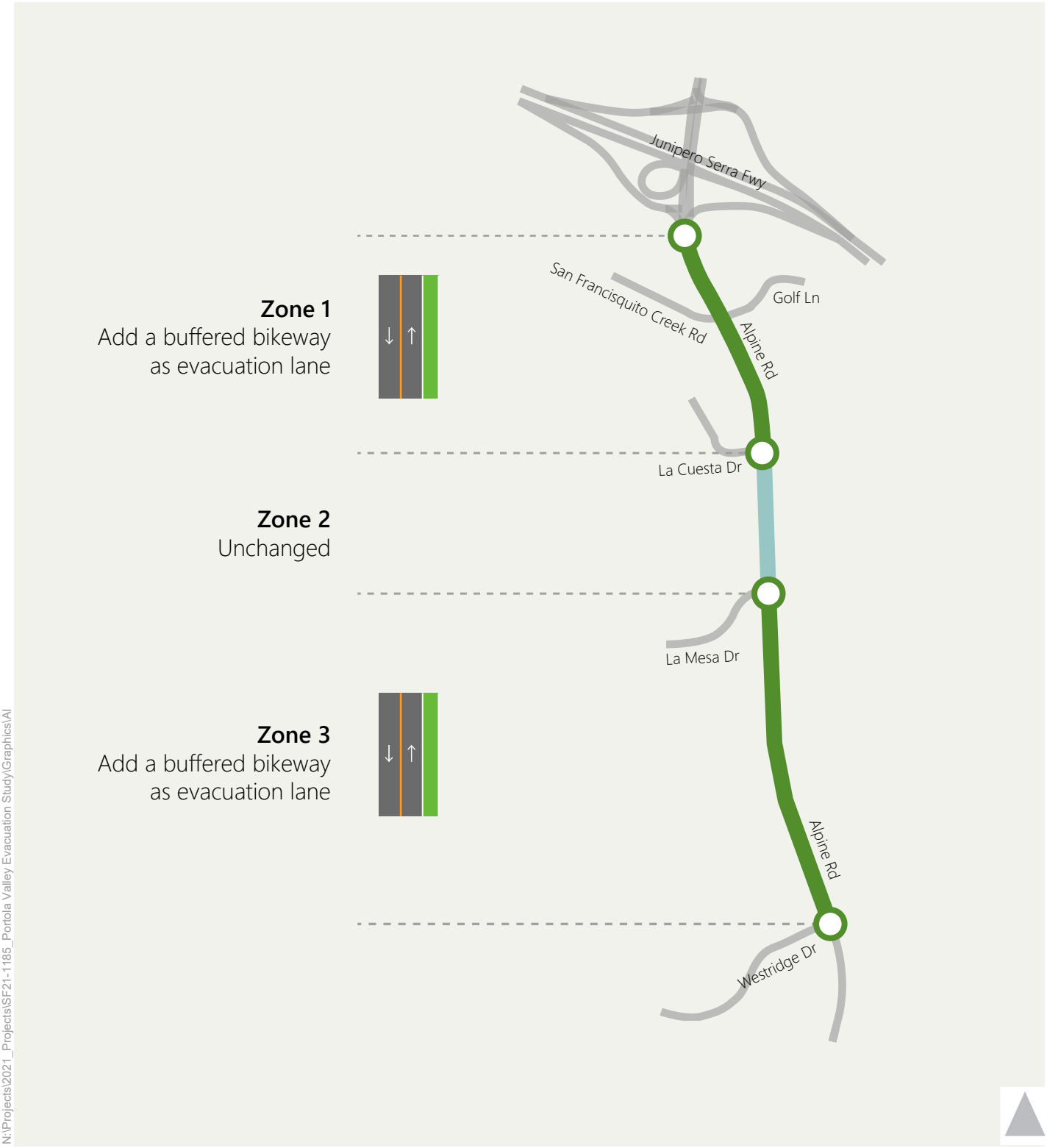



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Figure 12

Alpine Road Shoulder Evacuation Lane Concept

# 5. Potential Future/Ongoing Activities

The Town of Portola Valley collaborated with the San Mateo County Department of Emergency Management (SMC DEM) to create a Working Group of interagency partners in spring 2022 to develop detailed Evacuation Plans. The working group includes representatives from SMC DEM, Woodside Fire Protection District, San Mateo County Sheriff, the Town Manager, the evacuation subcommittee of the Emergency Preparedness Committee, all schools in Portola Valley, and The Sequoias. The working group is being hosted by SMC DEM staff and is responsible for preparing a written evacuation plan that will define the authority and responsibilities for actions to be taken during an active evacuation of Portola Valley.

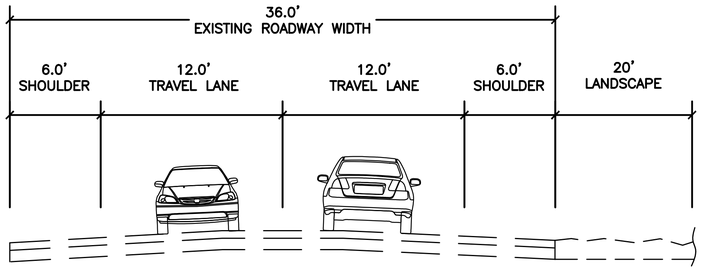
The following are potential future/ongoing efforts for the Working Group and/or the Town Emergency Preparedness Committee (EPC).

- Establish Evacuation Responsibilities
- Integrate Evacuation Plans for Schools & Sequoias
- Coordinate with SamTrans on availability and travel time for buses as needed for evacuation
- Explore early evacuation notifications for Constrained Parcels Area 6 (Highlands area including parcels along Santa Maria Avenue, Wayside Road and Hayfields Road), upper Los Trancos and Upper Alpine areas, and Ladera community
- Local Traffic Management Strategies including additional intersection traffic control locations as described in Section 4 (Portola Road at Highlands area egress intersections, Westridge Drive at Cervantes Road (2 intersections), and Alpine Road at Webb Ranch driveway)
- Identification of vehicle crash emergency clearance crews
- Investigate potential for qualified local residents to support traffic control activities at local intersections for situations where police resources are not available.
- Create a multi-agency working group to identify and implement fuel break, vegetation management, large tree, and/or utility pole mitigation strategies along major evacuation routes. Initial focus areas identified through this process include the segment of Alpine Road from Ladera to I-280 where utility poles and large trees are located as well as segments of Portola Road where large trees are located in close proximity to the travel lanes.
- Evacuation strategies for local stables and horse owners
- Local Street Accessibility Improvements (Access to Constrained Parcel Groups per Safety Element analysis, Narrow Streets)
- Local Evacuation Shelters/Centers for conditions where shelter-in-place is appropriate
- Daytime Employee Evacuation (how to notify, manage evacuation of household/yard/construction workers)
- Improved Communication Systems
- Supplemental Traffic Assessments

- Multi-agency Evacuation Assessment and Plan with Woodside and Los Altos Hills
- Evacuation Education Programs

# ATTACHMENT A

# ALPINE ROAD
# SHOULDER EVACUATION LANE
# CONCEPTS

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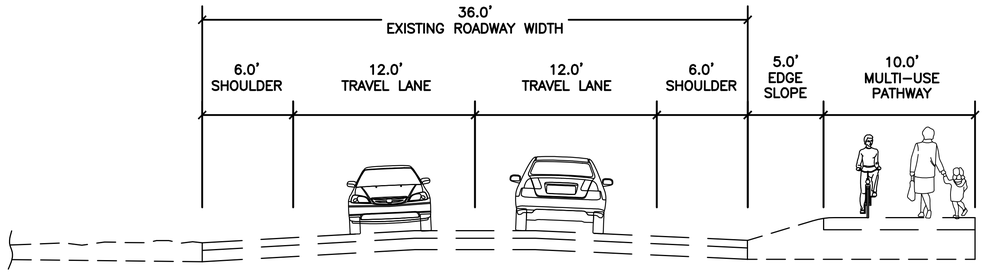
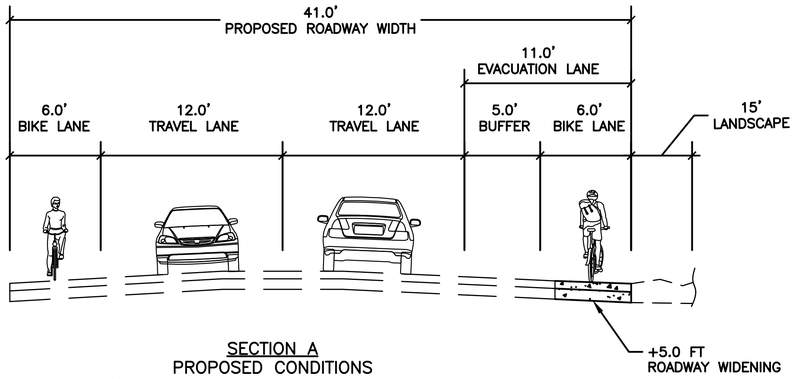
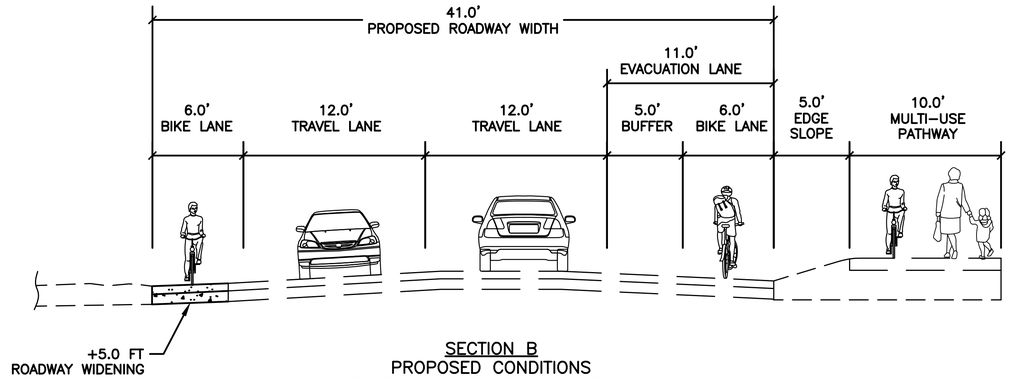
WESTRIDGE DRIVE TO PORTOLA VALLEY TOWN LIMIT
1380 LF




SECTION B
EXISTING CONDITIONS
PORTOLA VALLEY TOWN LIMIT TO
LADERA COMMUNITY CHURCH DRIVEWAY
300 LF




SECTION A
PROPOSED CONDITIONS
WESTRIDGE DRIVE TO PORTOLLA VALLEY TOWN LIMIT
1380 LF




SECTION B
PROPOSED CONDITIONS
PORTOLA VALLEY TOWN LIMIT TO
LADERA COMMUNITY CHURCH DRIVEWAY
300 LF

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# TOWN OF PORTOLA VALLEY
## LOCATION
## ALPINE ROAD AND ARASTRADERO ROAD

| REVISIONS | |
|---|---|
| 5 | |
| 4 | |
| 3 | |
| 2 | |
| 1 | |
| NO. | DESCRIPTION |

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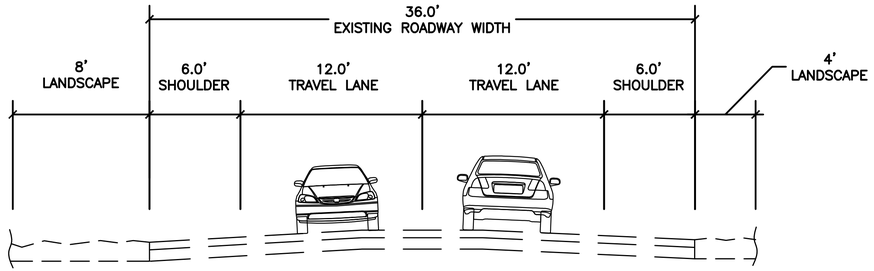
SHEET NO. 1 OF 9




SECTION C
EXISTING CONDITIONS
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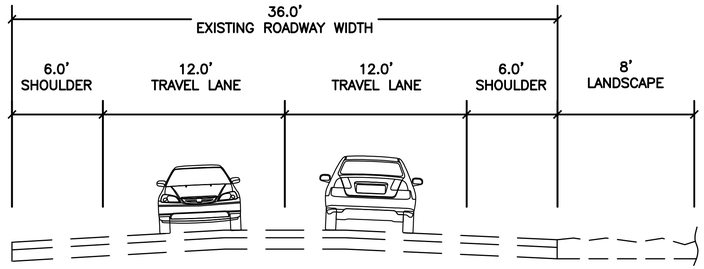


SECTION D
EXISTING CONDITIONS
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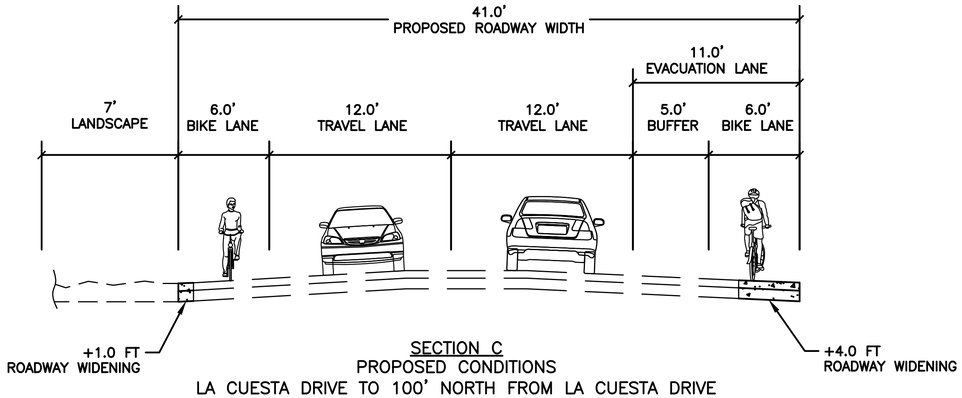
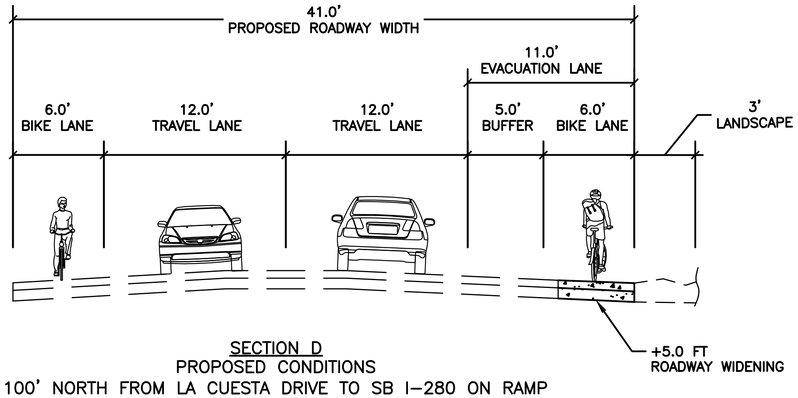
1150 LF




SECTION C
PROPOSED CONDITIONS
LA CUESTA DRIVE TO 100' NORTH FROM LA CUESTA DRIVE
100 LF




SECTION D
PROPOSED CONDITIONS
100' NORTH FROM LA CUESTA DRIVE TO SB I-280 ON RAMP
1150 LF

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**TOWN OF PORTOLA VALLEY**

**LOCATION**

**ALPINE ROAD AND ARASTRADERO ROAD**

| REVISIONS | |
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DATE 04/25/2022 | SCALE

PTC PROJECT NO. 22012

DRAWING **X-2**

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# TOWN OF PORTOLA VALLEY
## LOCATION
## ALPINE ROAD AND ARASTRADERO ROAD

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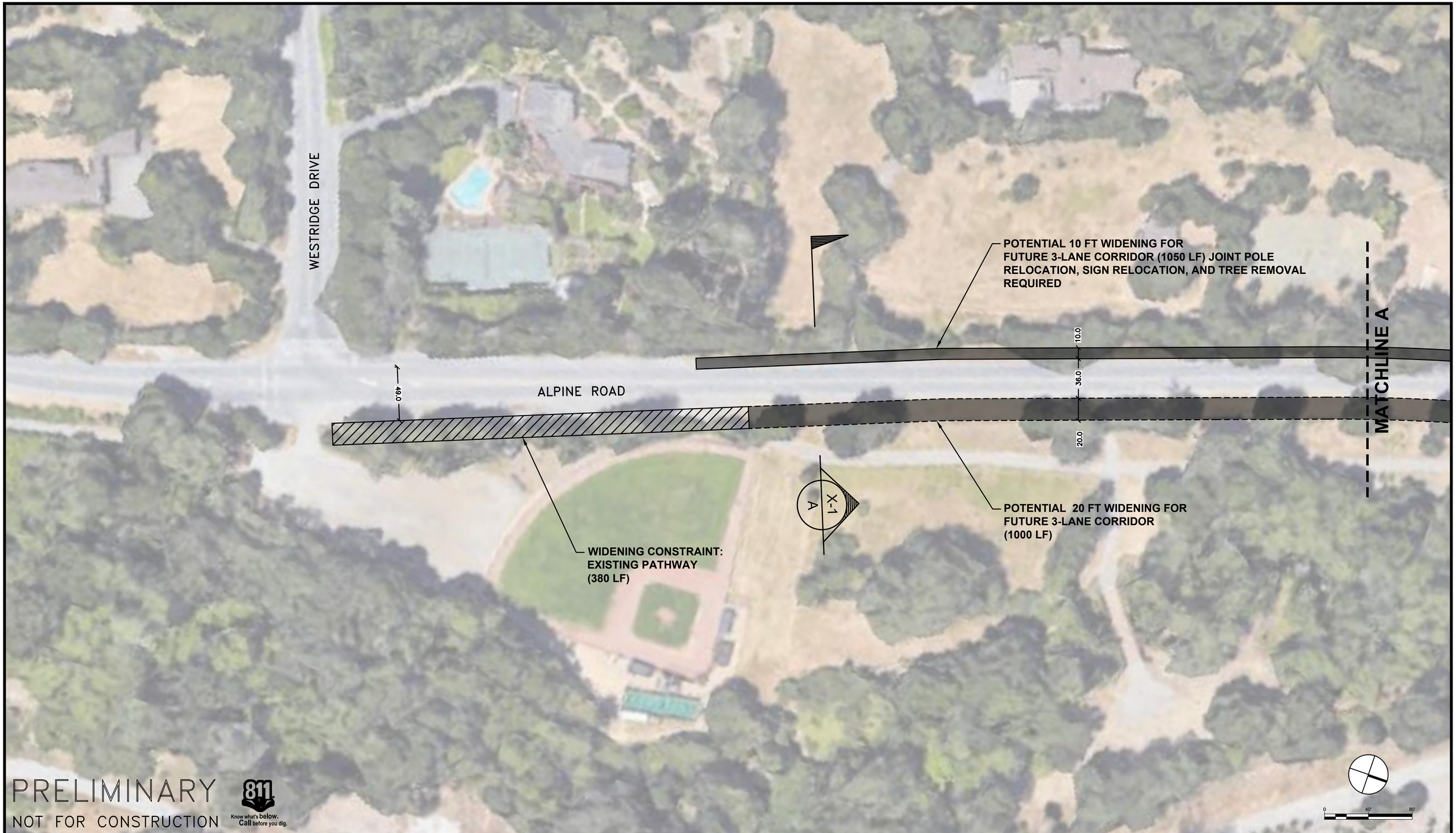


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| AG | DP |

# TOWN OF PORTOLA VALLEY

## LOCATION

## ALPINE ROAD FROM WESTRIGDE DRIVE TO 280 ON-RAMP

| REVISIONS | |
|---|---|
| 5 | |
| 4 | |
| 3 | |
| 2 | |
| 1 | |
| NO. | DESCRIPTION |

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|---|---|
| DATE | 04/25/2022 |
| SCALE | 1" = 40' |
| PTC PROJECT NO. | 22012 |
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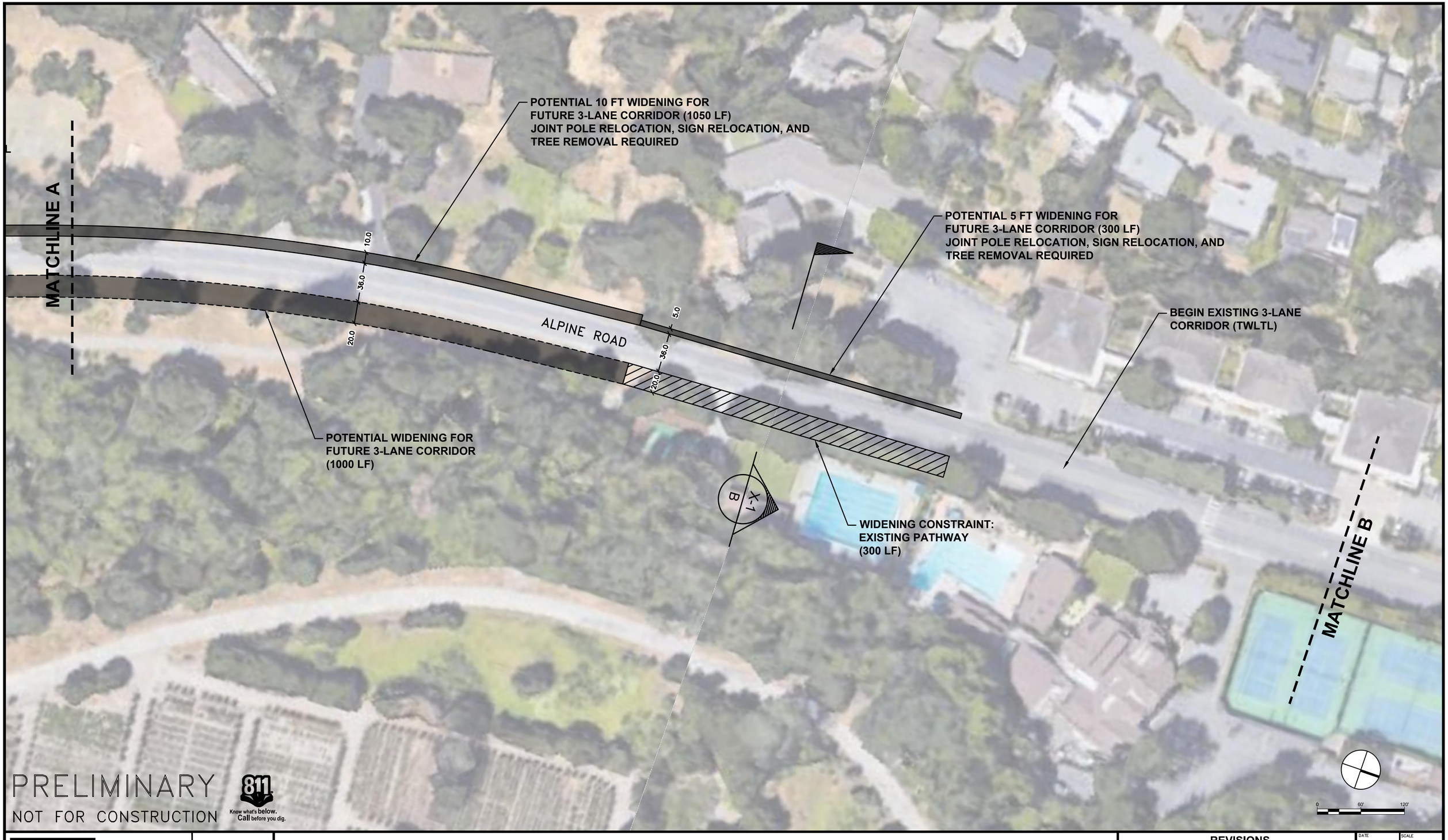


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| AG | DP |

**TOWN OF PORTOLA VALLEY**

**LOCATION**

**ALPINE ROAD FROM WESTRIGDE DRIVE TO 280 ON-RAMP**

| REVISIONS | |
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| 04/25/2022 | 1" = 40' |

PTC PROJECT NO. 22012

DRAWING L-3

SHEET NO. 5 OF 9


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**TOWN OF PORTOLA VALLEY**

**LOCATION**

**ALPINE ROAD FROM WESTRIGDE DRIVE TO 280 ON-RAMP**

| REVISIONS | |
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| NO. | DESCRIPTION |

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| SCALE | 1" = 40' |
| PTC PROJECT NO. | 22012 |
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| SHEET NO. | 6 OF 9 |


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# TOWN OF PORTOLA VALLEY

## LOCATION

## ALPINE ROAD FROM WESTRIGDE DRIVE TO 280 ON-RAMP

| REVISIONS | |
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| 5 | |
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| NO. | DESCRIPTION |

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|---|---|
| DATE | 04/25/2022 |
| SCALE | 1" = 40' |
| PTC PROJECT NO. | 22012 |
| DRAWING | L-5 |
| SHEET NO. | 7 OF 9 |


PRELIMINARY

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| AG | DP |

# TOWN OF PORTOLA VALLEY

## LOCATION

## ALPINE ROAD FROM WESTRIGDE DRIVE TO 280 ON-RAMP

| REVISIONS | |
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| NO. | DESCRIPTION |

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|---|---|
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| SCALE | 1" = 40' |
| PTC PROJECT NO. | 22012 |
| DRAWING | L-6 |
| SHEET NO. | 8 OF 9 |


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| AG | DP |

# TOWN OF PORTOLA VALLEY

## LOCATION

## ALPINE ROAD FROM WESTRIGDE DRIVE TO 280 ON-RAMP

| REVISIONS | |
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| 4 | |
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| NO. | DESCRIPTION |

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|---|---|
| DATE: 04/25/2022 | SCALE: 1" = 40' |
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| SHEET NO.: 9 OF 9 | |