Emergency Evacuation Study

Prepared for:
Montecito Fire Protection District

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FEHR PEERS

Table of Contents

List of Figures

List of Tables

1. Introduction

The emergency evacuation study completed in 2022 ("2022 analysis") for the Montecito Fire Protection District (Montecito Fire) offered a detailed look at considerations for evacuations in Montecito to help expand the community's preparedness to emergencies that require evacuation. It included a community survey to understand current levels of community preparedness and evacuation readiness, interviews with sheriff deputies and fire agency chief officers to inform opportunities for improvement related to evacuation orders, a review of after-action reports to identify similar trends and opportunities for improved evacuation, and traffic operations modeling to identify where congestion accumulates on the roadway network and how congestion can be managed through changes in physical infrastructure, evacuation orders, and communications and information dissemination. The study was intended to supplement the Community Wildfire Protection Plan and offer recommendations, based on spatial analysis and traffic simulation, that can be used to address vulnerabilities related to traffic operations and community evacuation response.

The 2022 analysis tested two scenarios with phased evacuation of zones north of SR-192. The report recommended studying a more granular phased evacuation to determine if it could reduce congestion on the roadway network. This study ("2023 analysis") uses a more granular phased evacuation with smaller draft evacuation zones to understand the changes to potential congestion impact of evacuating zones north of SR-192.

This report documents the 2023 analysis results along with a comparison between the 2022 analysis and 2023 analysis to understand the effect of using smaller evacuation zones and evacuating smaller areas during the first phase of an evacuation. The results, as described throughout this report, show that more granular evacuation zones allow for evacuation of fewer people which results in less congestion on the roadway network than the 2022 analysis.

1.1 Disclaimer

This document is intended to provide an assessment of roadway capacity during various potential evacuation scenarios. Please note that emergency evacuations 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 Montecito Fire 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 assumptions that are used for analysis purposes, nor does it guarantee that the findings are applicable to any or all situations.

Moreover, as emergency 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

also limited by the tools and data available, by the budgetary and time constraints in the scope of work, and by the current knowledge and state of the practice.

While this assessment is intended to help Montecito Fire better prepare for hazard-related events and associated evacuations, Montecito Fire should take care in planning and implementing any potential evacuation strategy. 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.

2. Traffic Operations Approach and Methodology

Given the geography and topography of Montecito, two of the likeliest evacuation scenarios were developed in coordination with Montecito Fire staff and evaluated for the 2022 analysis. To isolate the effects of the smaller draft evacuation zones, the parameters were kept the same for the 2023 analysis.

The evacuation scenarios analyzed specified the following parameters:

- **Description** – Definition of the wildfire scenario. Scenarios were based on previous studies conducted by Montecito Fire and inputs from Montecito Fire staff.
- **Location** – Definition of evacuation area based on the evacuation zones as they are currently established in the Evacuation Plan.
- **Evacuation Time Window** – The time period during which evacuation would occur. The peak afternoon period was selected to simulate a "worst-case" condition for background traffic for all scenarios.
- **Population, Households, and Employment** – Number of households and population in the evacuation area. The population and household data were obtained from the socio-economic data contained in the Santa Barbara County Association of Governments (SBCAG) Travel Demand Model, and are consistent with the 2022 analysis. Note, for both 2022 and 2023 analysis, Montecito Fire provided population estimates which were higher than reported in the SBCAG model or the US Census, possibly reflecting part-time or seasonal residents.
- **Evacuation Trips** – Residents and employees trips together make the total evacuation trips. For residents, a trip generation module used population, households, and the cross-classification between auto-ownership (number of vehicles) and household size to estimate the number of resident evacuation trips for each home zone (origin) and evacuation destination (like a shelter, a hotel, or a major arterial gateway exiting Montecito). For employees, auto mode share of employee trips attracted to each traffic analysis zone (TAZ) in the evacuation area was obtained from the travel demand model. This TAZ-specific mode share was used to estimate employee evacuation trips leaving the evacuation area.
- **Evacuation Destination and Trip Distribution** – The destination, direction and distribution of the evacuation trips that evacuating residents were assumed to be traveling based on the location of the fire and regional access to places where residents could shelter or leave the area.

The two scenarios developed for the 2022 analysis were replicated for the 2023 analysis by using smaller draft evacuation zones. Current zones (used for the 2022 analysis) are larger than the draft zones and therefore evacuate a larger number of people and vehicles. The purpose of creating new draft zones is to focus evacuation orders in areas closest to potential fire hazards and test the effects on congestion.

For both the 2022 and 2023 analysis, Scenario 1 evacuates parts of western Montecito and Scenario 2 evacuates parts of eastern Montecito. **Figure 1** shows the current evacuation zones used for the 2022 analysis and **Figure 2** shows the draft evacuation zones used for the 2023 analysis.

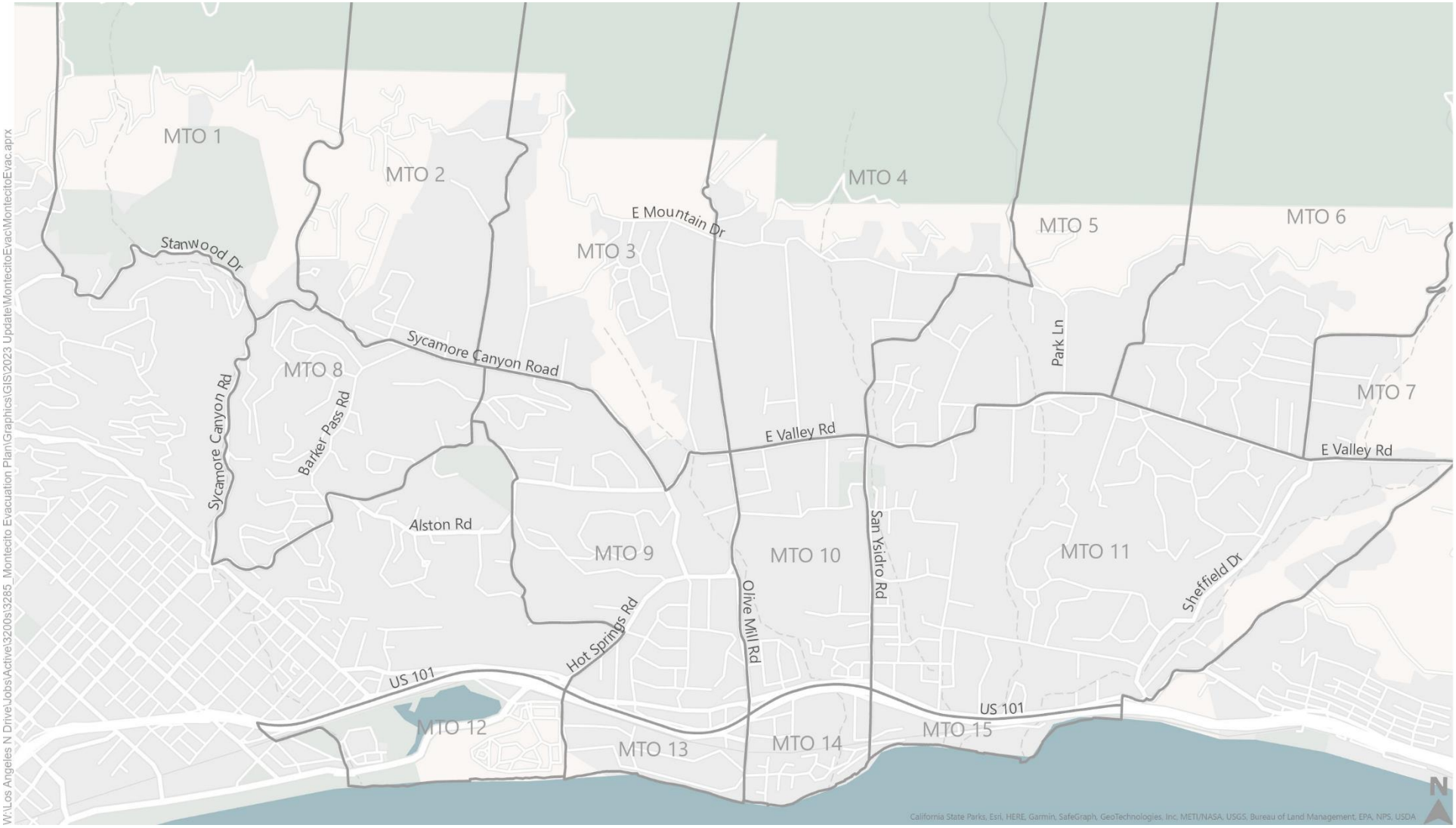


Figure 1

Current Evacuation Zones

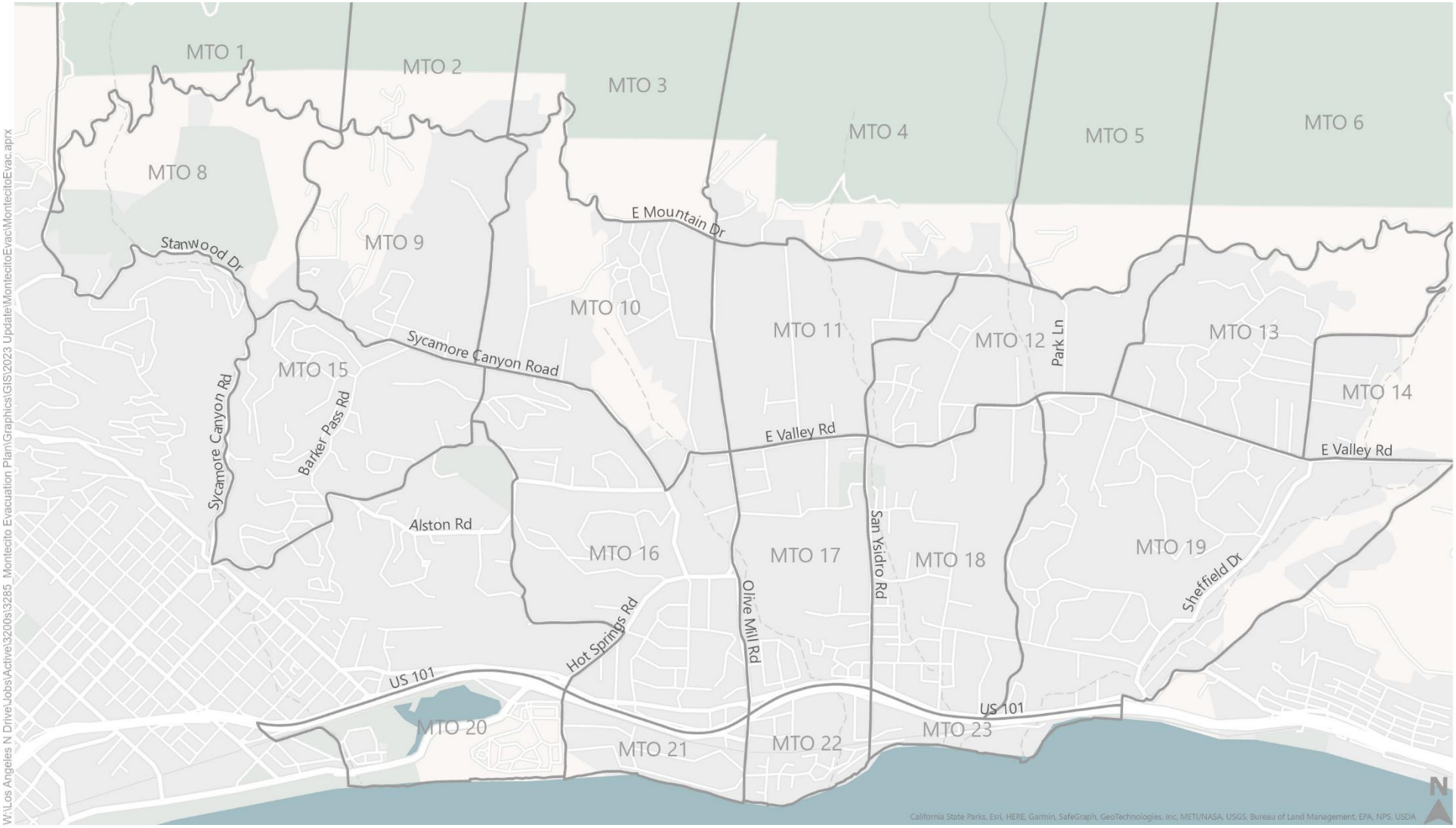


Figure 2

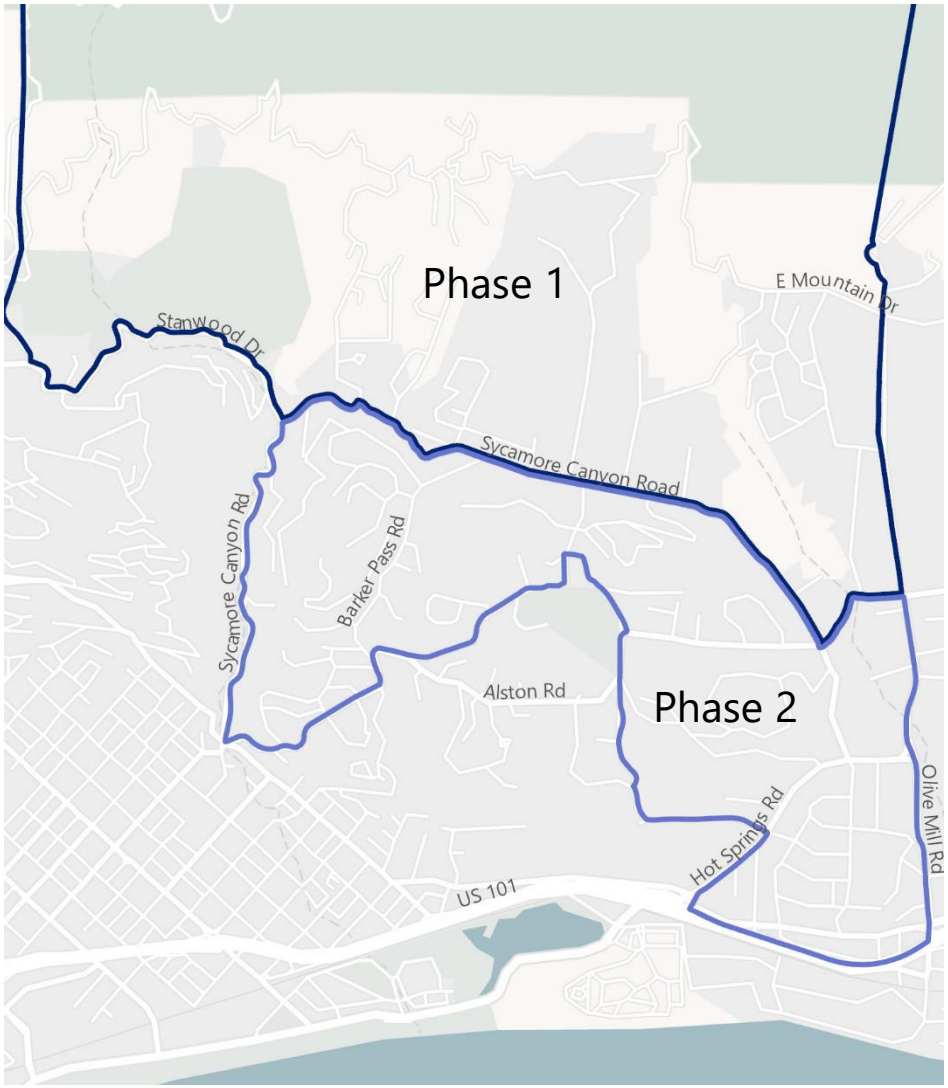
Draft Evacuation Zones

Table 1 summarizes the first evacuation scenario analyzed as part of this assessment and compares the parameters used in the 2022 analysis and 2023 analysis. To reflect conditions that may occur during a wind-driven fire from the northwest, Scenario 1 has two phases of evacuation. Phase 1 is an evacuation order issued for residents of zones 1, 2, 3, 8, 9, and 10 in the 2022 analysis and draft zones 1, 2, and 3 in the 2023 analysis to evacuate within 15 minutes. Phase 2 is an evacuation order issued for residents of zones 15 and 16 in the 2022 analysis and draft zones 8, 9, and 10 in the 2023 analysis to evacuate within 90 minutes. This reflects the possible pace of fire spread from the northernmost zones, which would be closer to the fire, to the southern evacuation zones, which would be further from the fire. The areas included in each evacuation phase for Scenario 1 for the 2022 analysis and 2023 analysis are shown in **Figure 3**.

Table 1: Summary of Evacuation Scenario 1

Parameters	2022 Analysis	2023 Analysis	Change
Scenario Description	Phased evacuation of zones 1, 2, 3, 8, 9, 10, 15, 16	Phased evacuation of draft zones 1, 2, 3, 8, 9, 10	Zone structure
Time of Day	3:00-4:30pm	3:00-4:30pm	None
Population	3,787	2,248	-1,539
Households	1,123	517	-606
Employees	569	522	-47
College Students	745	745	0
Evacuation Trips	3,200	2,085	**-1,115**
Trip Distribution	92% of trips were sent E/W beyond the model area: Of these, 40% east/US-101 Southbound, 60% west/US-101 Northbound 95% on US-101; 4% on SR-192; 1% by other arterials The remaining 8% of trips were kept internal to the model area: All of these sent towards Santa Barbara		

2022 Analysis



2023 Analysis

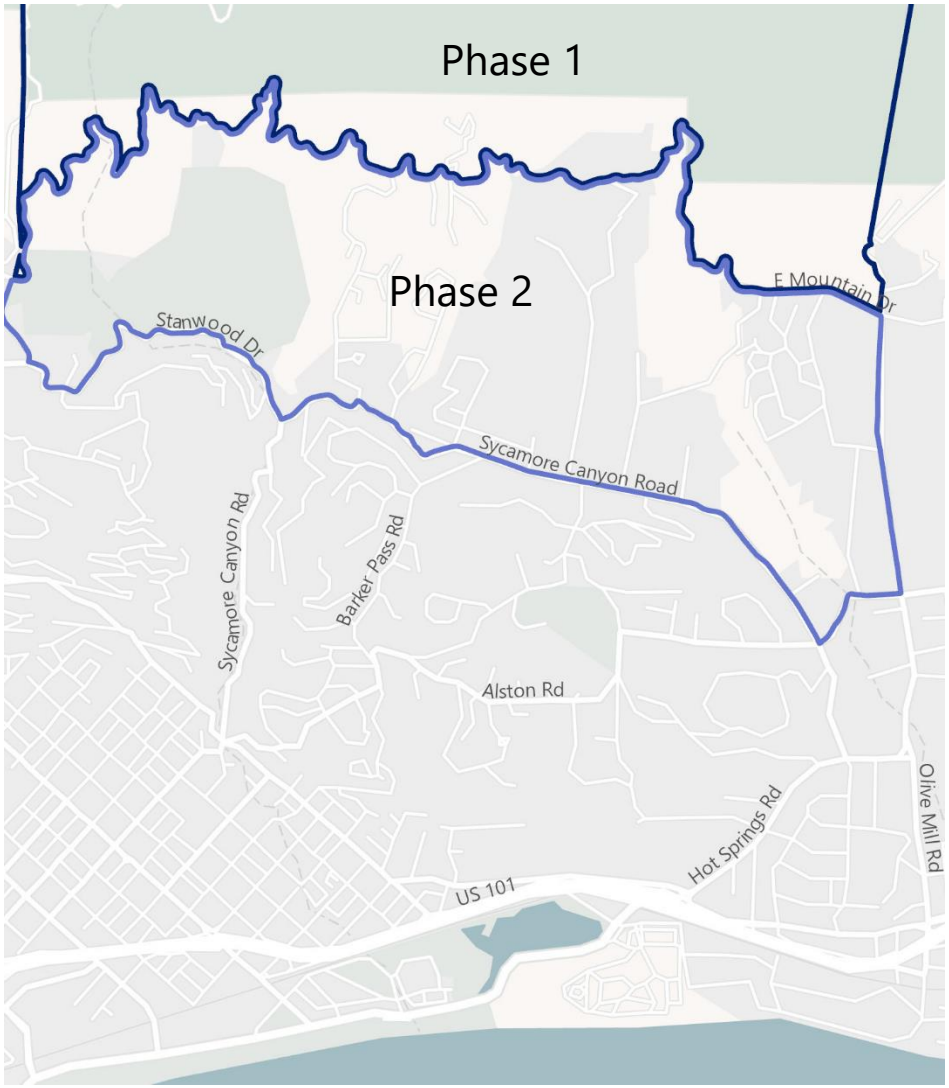


Figure 3

Scenario 1 Evacuation Zones

Table 2 summarizes the second evacuation scenario analyzed as part of this assessment. To reflect conditions that may occur during a fire from the northeast, Scenario 2 has two phases of evacuation. Phase 1 is an evacuation order issued for residents of zones 4, 5, 6, 11, 12, and 13 in the 2022 analysis and draft zones 4, 5, and 6 in the 2023 analysis to evacuate within 15 minutes. Phase 2 is an evacuation order issued for residents of zones 17, 18, and 19 in the 2022 analysis and draft zones 11, 12, and 13 in the 2023 analysis to evacuate within 90 minutes. This reflects the possible pace of fire spread from the northernmost zones, which would be closer to the fire, to the southern evacuation zones, which would be further from the fire. The areas included in each evacuation phase for Scenario 2 for the 2022 analysis and 2023 analysis are shown in **Figure 4**.

Table 2: Summary of Evacuation Scenario 2

Parameters	2022 Analysis	2023 Analysis	Change
Scenario Description	Phased evacuation of zones 4, 5, 6, 11, 12, 13, 17, 18, and 19	Phased evacuation of draft zones 4, 5, 6, 11, 12, and 13	Zone structure
Time of Day	3:00-4:30pm	3:00-4:30pm	None
Population	4,316	1,794	-2,522
Households	1,869	758	-1,111
Employees	2,643	1,504	-1,139
College Students	0	0	0
Evacuation Trips	5,547	2,703	**-2,844**
Trip Distribution	92% of trips were sent E/W beyond the model area: Of these, 40% east/US-101 Southbound, 60% west/US-101 Northbound 95% on US-101; 4% on SR-192; 1% by other arterials The remaining 8% of trips were kept internal to the model area: All of these sent towards Santa Barbara		

2022 Analysis

2023 Analysis

Figure 4

Scenario 2 Evacuation Zones

2.1 Evacuation Operations Analysis

The emergency evacuation operations analysis was conducted using the Fehr & Peers EVAC+ tool, which is a modeling workflow that extracts the study area from the SBCAG travel demand model to estimate vehicle demand and levels of congestion on 15-minute intervals during an evacuation window. The EVAC+ workflow can be broken down into three steps:

1. Preparing the subarea network representing the study area and the associated background trip tables
2. Estimating evacuation trips during the wildfire
3. Assigning trips (dynamically) to the subarea network

The 2023 analysis used the same subarea network and 15-minute disaggregated trip tables for the Montecito Fire Protection District as the 2022 analysis.

Minor modifications to the TAZ structure were made in the 2023 analysis to better represent how trips leave the evacuation area and how TAZs match and correspond to the smaller draft zones.

2.1.1 Subarea Model Calibration

For the 2022 analysis, in order to ensure the subarea extraction of the SBCAG model reflected realistic conditions in Montecito, our team reviewed and modified the capacity and free flow speed assumptions of the roadway network in Montecito and ran a baseline "non-evacuation scenario" to compare to empirical data from across the subarea. Through the process of model calibration for the 2022 analysis, our team iterated through a series of baseline model runs, refining the parameters until the model outputs came within 5% of the observed volumes across an average of 7 locations where empirical count data was available, for the time period during which the evacuation scenarios were to be analyzed.

Because slight modifications were made to the model network and allocation of model land uses to match TAZs with the smaller draft zones, one baseline "non-evacuation scenario" model run was completed to ensure model outputs came within 5% of the observed volumes between 2:00 and 5:00 pm at the 7 locations. **Table 3** summarizes the model calibration results for the 2023 study. These results are very similar to the calibration results of the 2022 study.

Table 3: 2023 Evacuation Study Model Calibration Results

Time Period	One-Way (AB) Flow			One-Way (BA) Flow			All Direction Flow		
	Observed Volumes[1]	Model Outputs[2]	% Difference	Observed Volumes[1]	Model Outputs[2]	% Difference	Observed Volumes[1]	Model Outputs[2]	% Difference
2-3PM	*1,429*	*1,348*	***-6%***	*1,323*	*1,521*	***+15%***	*2,752*	*2,869*	***+4%***
3-4PM	*1,628*	*1,451*	***-11%***	*2,077*	*1,664*	***-20%***	*3,705*	*3,115*	***-16%***
4-5PM	*1,473*	*1,898*	***+29%***	*2,027*	*2,605*	***+29%***	*3,500*	*4,503*	***+29%***
2-5PM	*4,530*	*4,697*	***+4%***	*5,427*	*5,790*	***+7%***	*9,957*	*10,487*	***+5%***

[1] Observed volumes reflect the sum of 7 locations where Streetlight Data (location-based device data) was gathered for an average weekday in 2019.
[2] Model outputs reflect the sum of the same 7 locations from the refined SBCAG Travel Demand Model.

2.1.2 Estimate Trips During an Evacuation Event

The number of vehicle trips generated by each household during an evacuation was informed by the existing land use and socio-economic data (SED) in each TAZ. The SED includes a variety of information based on census data, including persons per household, number of employees, auto-ownership information, population, and other factors that could affect the number of vehicles per household used during an evacuation event. The same TAZs used for the modeling in the 2022 analysis were used for the 2023 analysis. Only slight modifications to the SED data were made to account for changes between the current zones and draft zones.

The evacuation travel demand consists of traffic generated by residents, employees, and students within evacuation zones. Evacuation trip generation assumptions for households, employees, and students were held constant between the 2022 analysis and 2023 analysis.

Background traffic is associated with trips traveling to or from evacuation zones and is taken directly from the travel model for a typical day, then distributed over each hour of the day. Trips that do not end in evacuation zones go about their normal activity regardless of if the evacuation order has been given. Trips that end in the evacuation zone after the evacuation order is given do not travel and stay in the original zone. **Figure 5** and **Figure 6** show how evacuation trips over the entire subarea network compare to non-evacuation or background traffic during the same evacuation period for each scenario for the 2022 analysis and 2023 analysis. These graphs also show the comparison to trip volumes during the baseline (no evacuation) scenario.

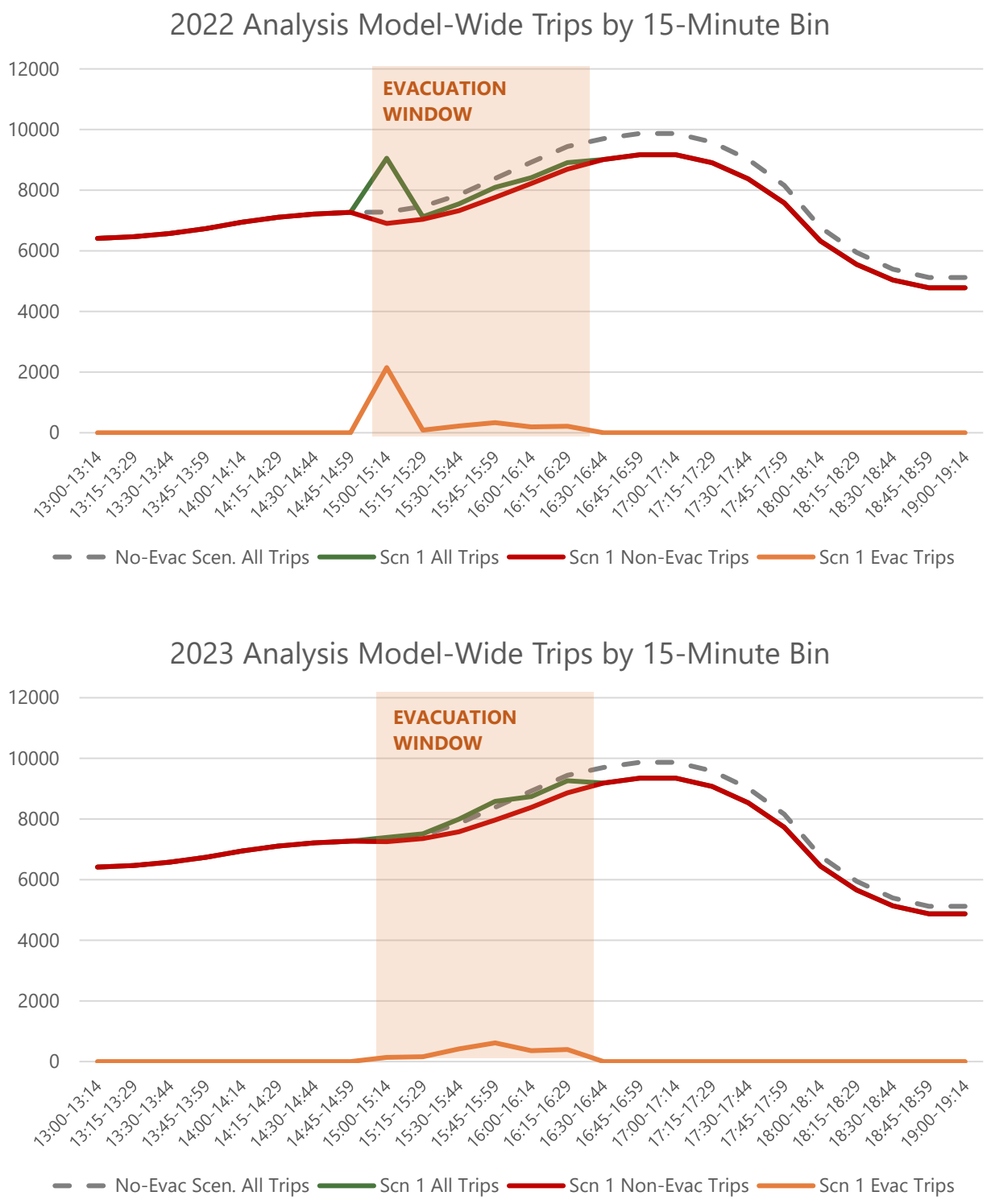


Figure 5

Scenario 1 Comparison of Evacuation Trips to Non-Evacuation Trips

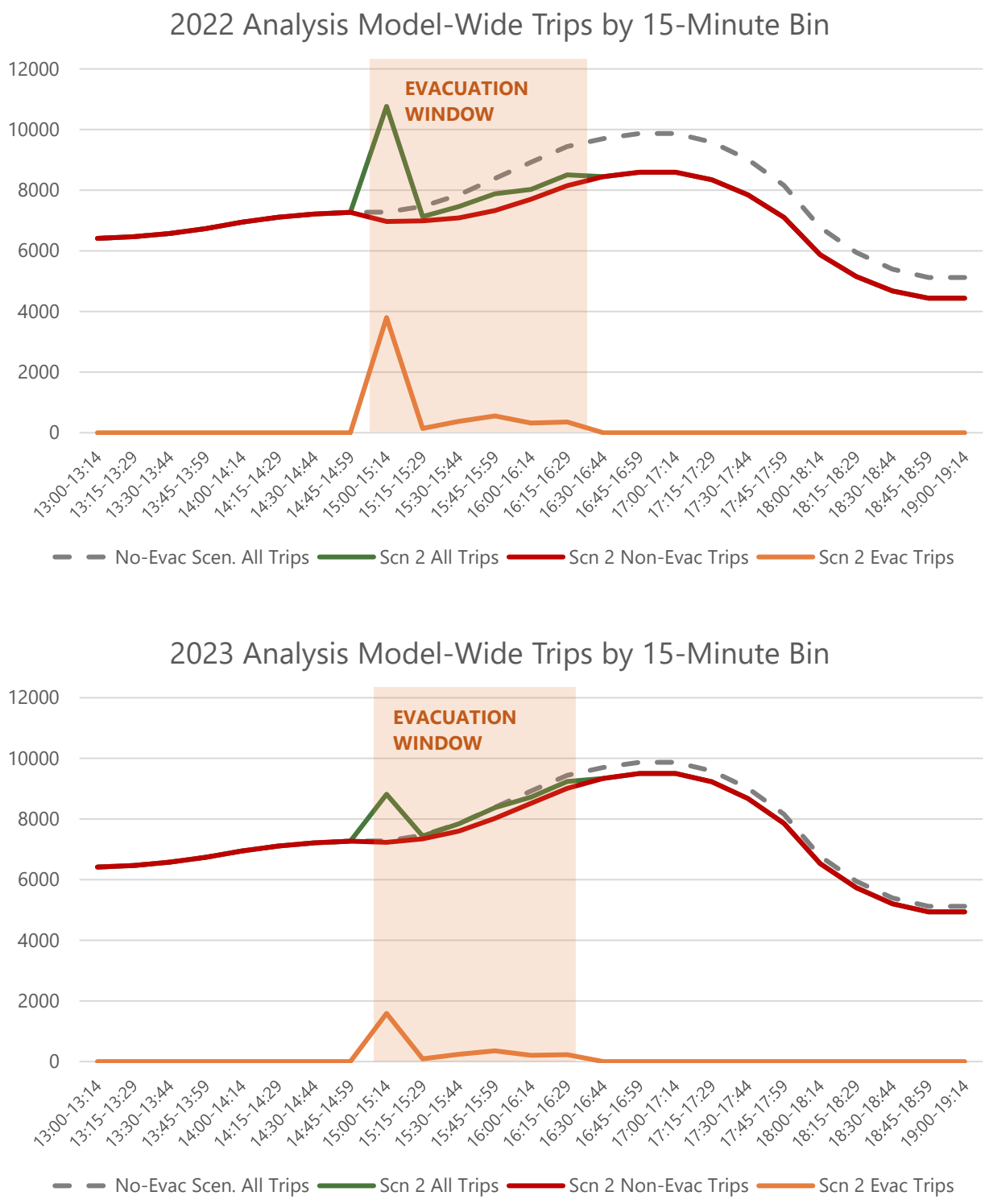


Figure 6

Scenario 2 Comparison of Evacuation Trips to Non-Evacuation Trips

The evacuation time window is the time between when the evacuation starts and how many minutes or hours the evacuation zones will require to be fully evacuated, based upon the evacuation order. The distribution across the evacuation time windows for the two evacuation scenarios is shown in **Table 4**. Both scenarios incorporate two phases of evacuation order – Phase 1 with a 15-minute departure order and Phase 2 with a 90-minute departure order. The distribution over the entire evacuation period reflects these differences in evacuation time window. For the second phase in each scenario, it is assumed that evacuees would vacate at a rate that resembles a bell curve from the time that the evacuation order is issued. The evacuation time distribution for both phases of both scenarios is the same in the 2023 analysis as it was in the 2022 analysis. In all cases, the evacuation order is assumed to be the moment that evacuees receive the order to depart. The analysis in this study does not account for the effects of early evacuation warnings, in which evacuees decide to depart early in anticipation of a potential order.

Table 4: Evacuation Time Distribution Assumptions for Scenario 1 and Scenario 2

Time Interval (PM)	Phase 1	Phase 2
3:00-3:14	100%	2%
3:15-3:29	0%	8%
3:30-3:44	0%	21%
3:45-3:59	0%	31%
4:00-4:14	0%	18%
4:15-4:30	0%	20%

Trips departing evacuation zones are allocated to shelters (i.e., hotels or large gathering spaces) or "model gateways" representing the destinations outside of the model area. The share of trips ending in each evacuation destination are noted in **Table 5**. These parameters were kept the same across both scenarios and are the same in both the 2022 analysis and 2023 analysis.

Table 5: Share of Trips Ending in Different Evacuation Destinations

Description	Share of Trips	Details
Hotels (internal to subarea)	8%	Based on a review of hotel capacity in the subarea
Shelters & Stadiums (internal to subarea)	0%	No shelters or stadiums in the subarea
East	36.8% (40% of external trips)	95% on US-101 Southbound 4% on SR-192 1% on other E/W arterials
West	55.2% (60% of external trips)	95% on US-101 Northbound 4% on SR-192 1% on other E/W arterials
North	0%	No trips evacuating to the North
South	0%	No trips evacuating to the South

The EVAC+ tool references trip tables for areas outside Montecito to form the "background" traffic estimates on the roadways not affected during an evacuation event. Areas affected by the evacuation event are then processed through the EVAC+ tool trip estimator to estimate the number and sequencing of trips that occur due to the event.

The subarea extracted network and new trip tables are then input into the SBCAG subarea model, which estimates traffic and levels of congestion on 15-minute intervals. This process helps identify congested locations on the network that should be considered during an evacuation event and alternative routes people may use due to congested conditions.

The typical daily operating conditions for both the number of travel lanes per direction and associated hourly capacity per lane reflect normal roadway conditions. 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. These conditions were used for both scenarios.

3. Modeling Results

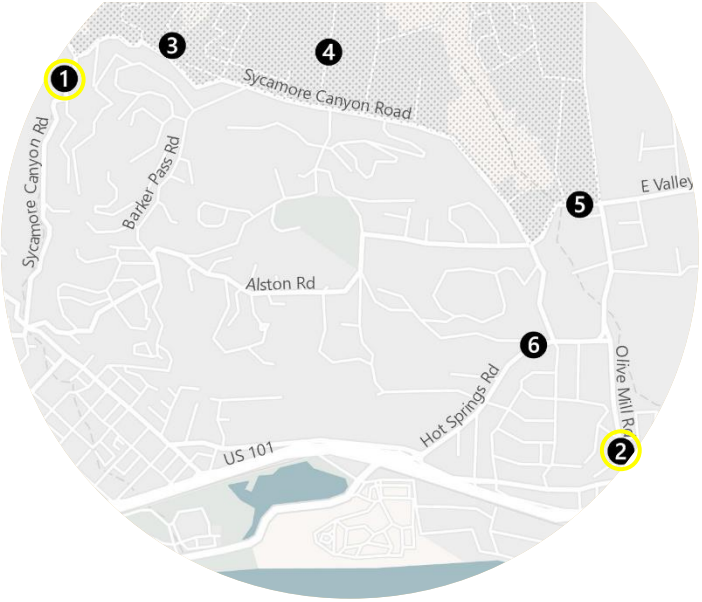
The EVAC+ tool, as described in the Approach and Methodology section, was used to estimate traffic conditions and operations during each of the evacuation scenarios. The volumes by time interval and the results of the tool output for each scenario are summarized below. The result plots are color-coded by Volume/Capacity ratio from green to red (green being free-flow traffic and red being heavily congested).

The results of both scenarios capture the high demand for travel that occurs on roadways within Montecito and along the US-101 freeway on a typical weekday afternoon. The two-lane, often narrow, roadways serving the Montecito community have limited capacity with most intersections controlled by stop signs. The limited roadway capacities can result in periods of high congestion due to local travel demands, such as school pick-up/drop-off periods when vehicles queuing impedes travel flows. The results of each scenario and a comparison between the 2022 and 2023 analyses are described in the following sections.

Scenario 1 assumes the phased evacuation of zones 1, 2, 3, 8, 9, 10, 15, and 16 in 2022. In the 2023 analysis, Scenario 1 assumed the phased evacuation of draft zones 1, 2, 3, 8, 9, and 10. Scenario 1 results for both analyses are shown on **Figure 7**.

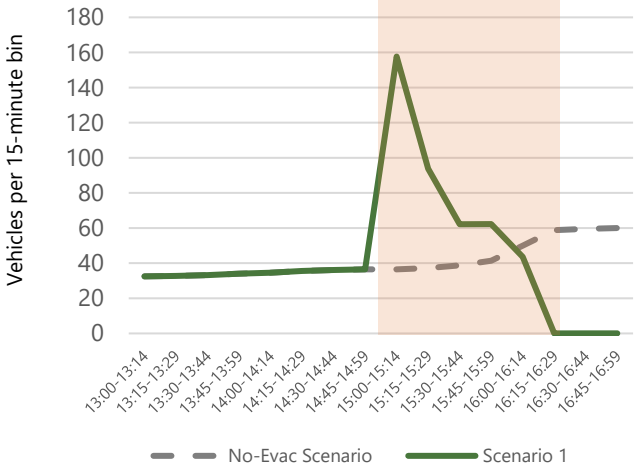
Scenario 2 assumes the phased evacuation of zones 4, 5, 6, 11, 12, 13, 17, 18, and 19 in 2022. In the 2023 analysis, Scenario 1 assumed the phased evacuation of draft zones 4, 5, 6, 11, 12, and 13. Scenario 2 results for both analyses are shown on **Figure 13**.

Figure 7A: Scenario 1, Phased Evacuation of Western Montecito

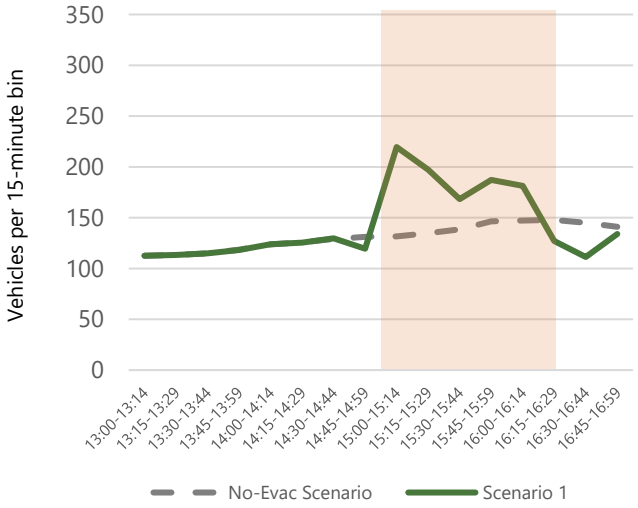


2022 Analysis

1 Sycamore Canyon Rd s/o Stanwood Dr

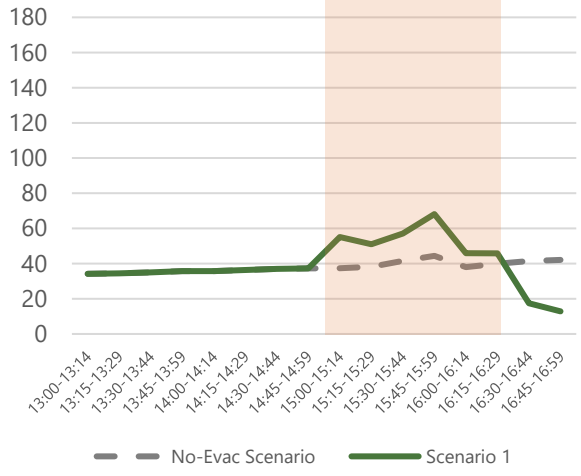


2 Olive Mill Rd n/o N Jameson Ln

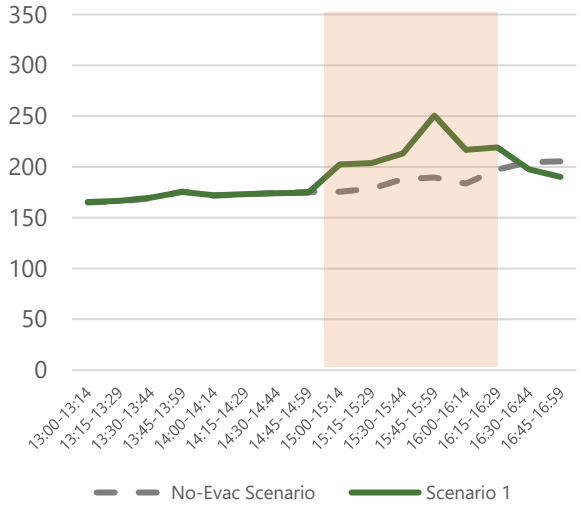


2023 Analysis

Sycamore Canyon Rd s/o Stanwood Dr



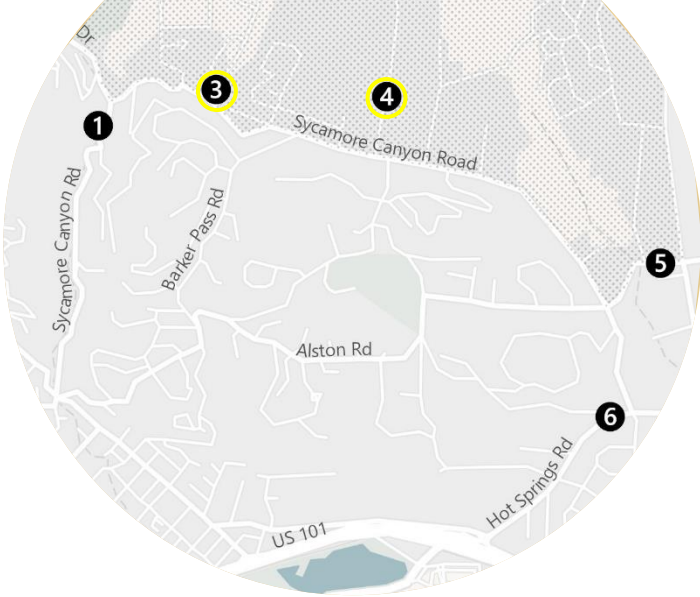
Olive Mill Rd n/o N Jameson Ln



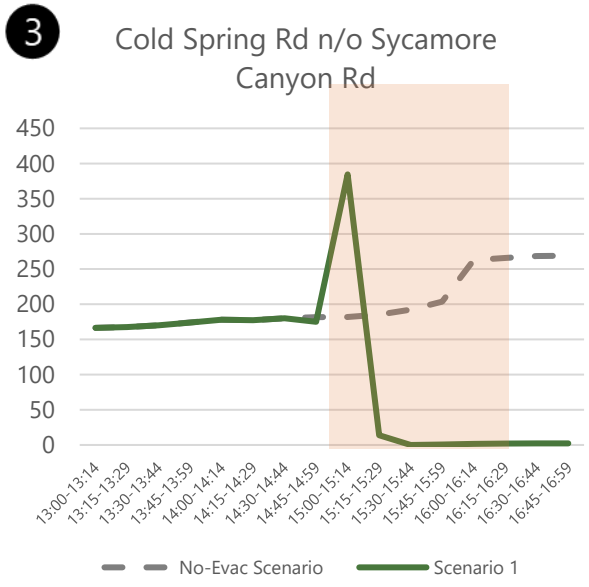
Due to the phased approach of Scenario 1, congestion caused by vehicles evacuating builds up quickly, within the first 15-30 minutes of the evacuation period as the first zones evacuate simultaneously and use local roads and arterials to exit the evacuating zones and travel towards the US-101 and other exit routes from Montecito. As shown earlier, within the first 30 minutes of the evacuation, the number of vehicles evacuating comprises nearly 25% of the total number of vehicles in the subarea model.

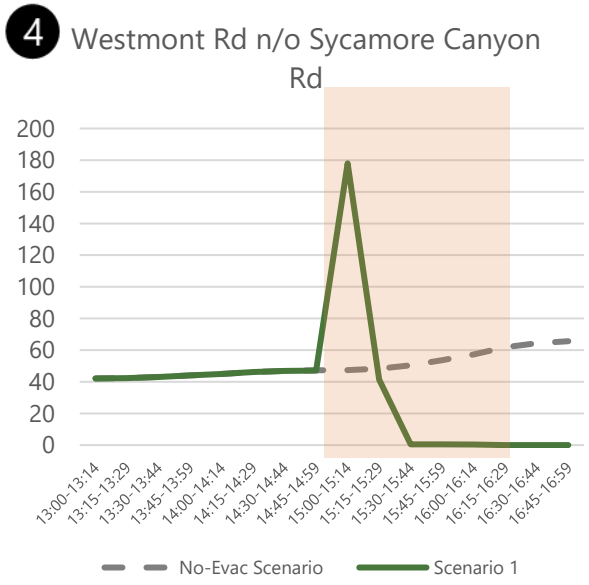
The 2023 analysis evacuated fewer zones in the first period resulting in a smaller peak in evacuation traffic but a longer period of higher-than-normal traffic at most analyzed road segments. As some vehicles are routed towards the City of Santa Barbara, the quickest travel paths, including Barker Pass Road and Sycamore Canyon Road, better absorb the evacuation traffic in the 2023 analysis since Phase 1 evacuates a smaller area.

Figure 7B: Scenario 1, Phased Evacuation of Western Montecito

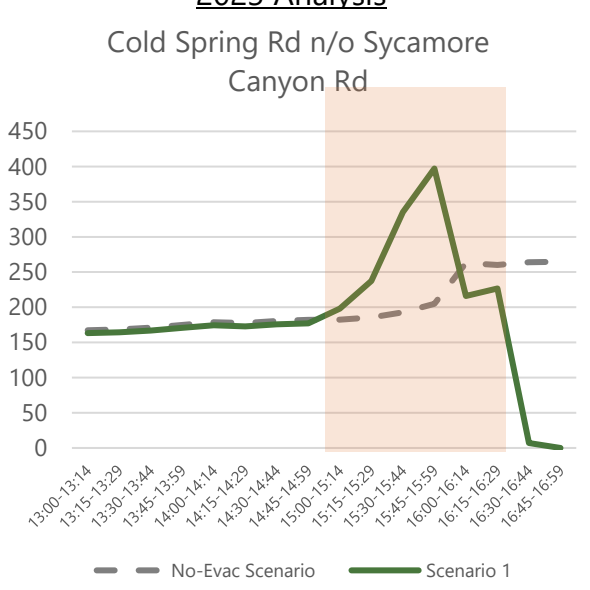


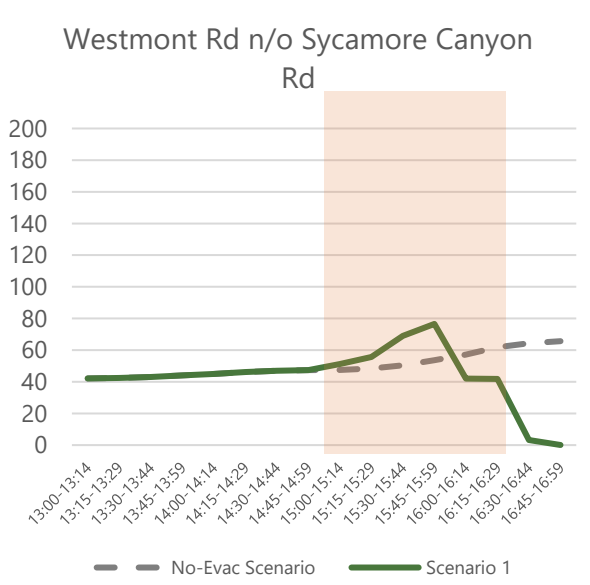
2022 Analysis





2023 Analysis



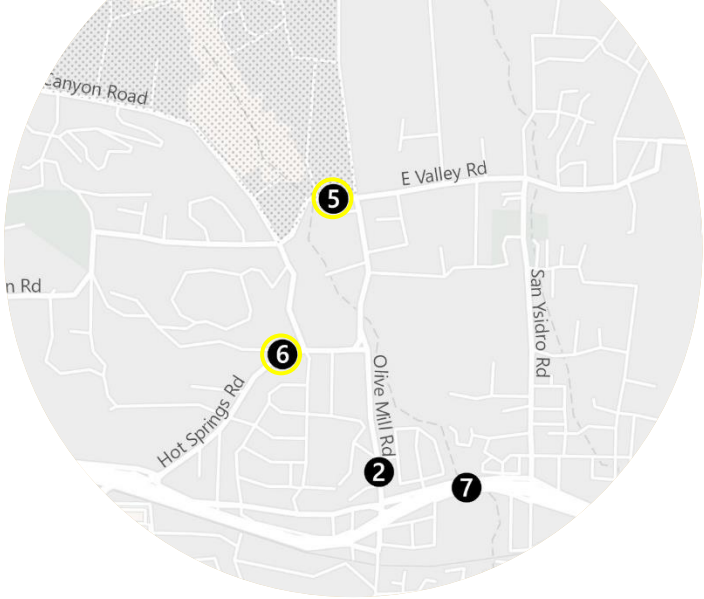


Some locations were not analyzed with empirical count data, but were shown to serve significant evacuation demand. For example, Barker Pass Road serves traffic that would otherwise use Sycamore Canyon Road or Olive Mill Road.

In general, study locations closer to the evacuation zones experience more of an evacuation-related peak than other locations. Cold Springs Road and Westmont Road experience larger peaks than other study locations, especially since they serve traffic evacuating from Westmont College.

A longer evacuation period for smaller evacuation areas, as studied in the 2023 analysis, results in less congestion at these locations and more gradual loading of evacuation trips onto the roadway network.

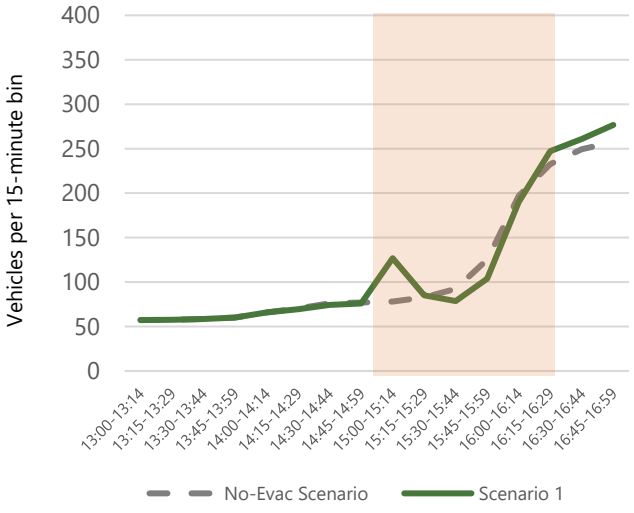
Figure 7C: Scenario 1, Phased Evacuation of Western Montecito



2022 Analysis

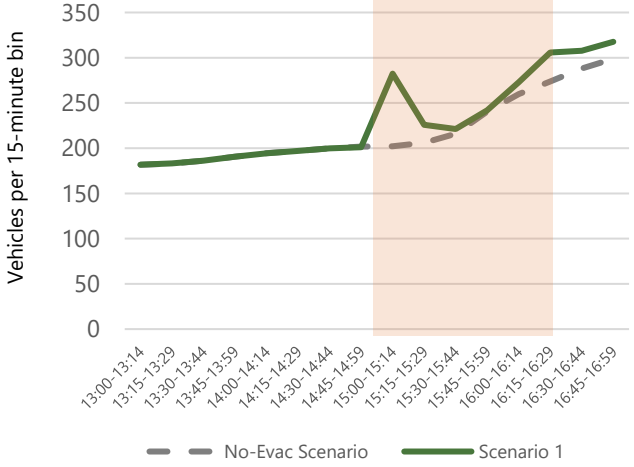
5

E Valley Rd w/o Hot Springs Rd



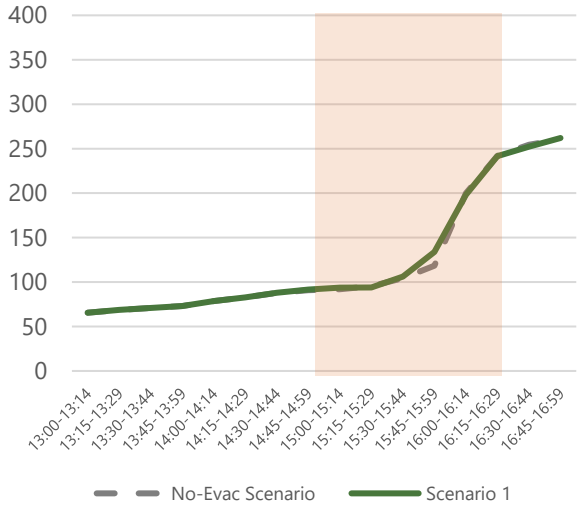
6

Hot Springs Rd w/o Sycamore Canyon Rd

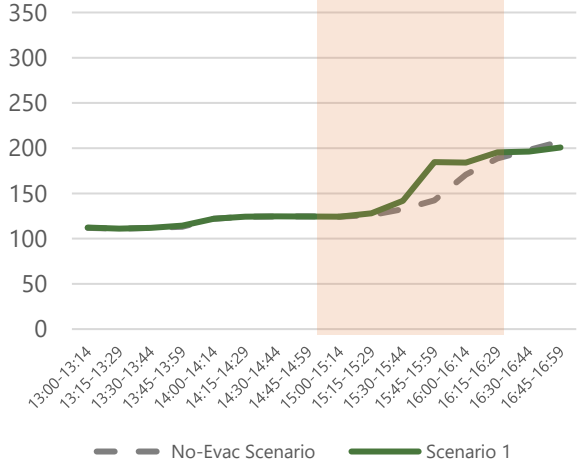


2023 Analysis

E Valley Rd w/o Hot Springs Rd



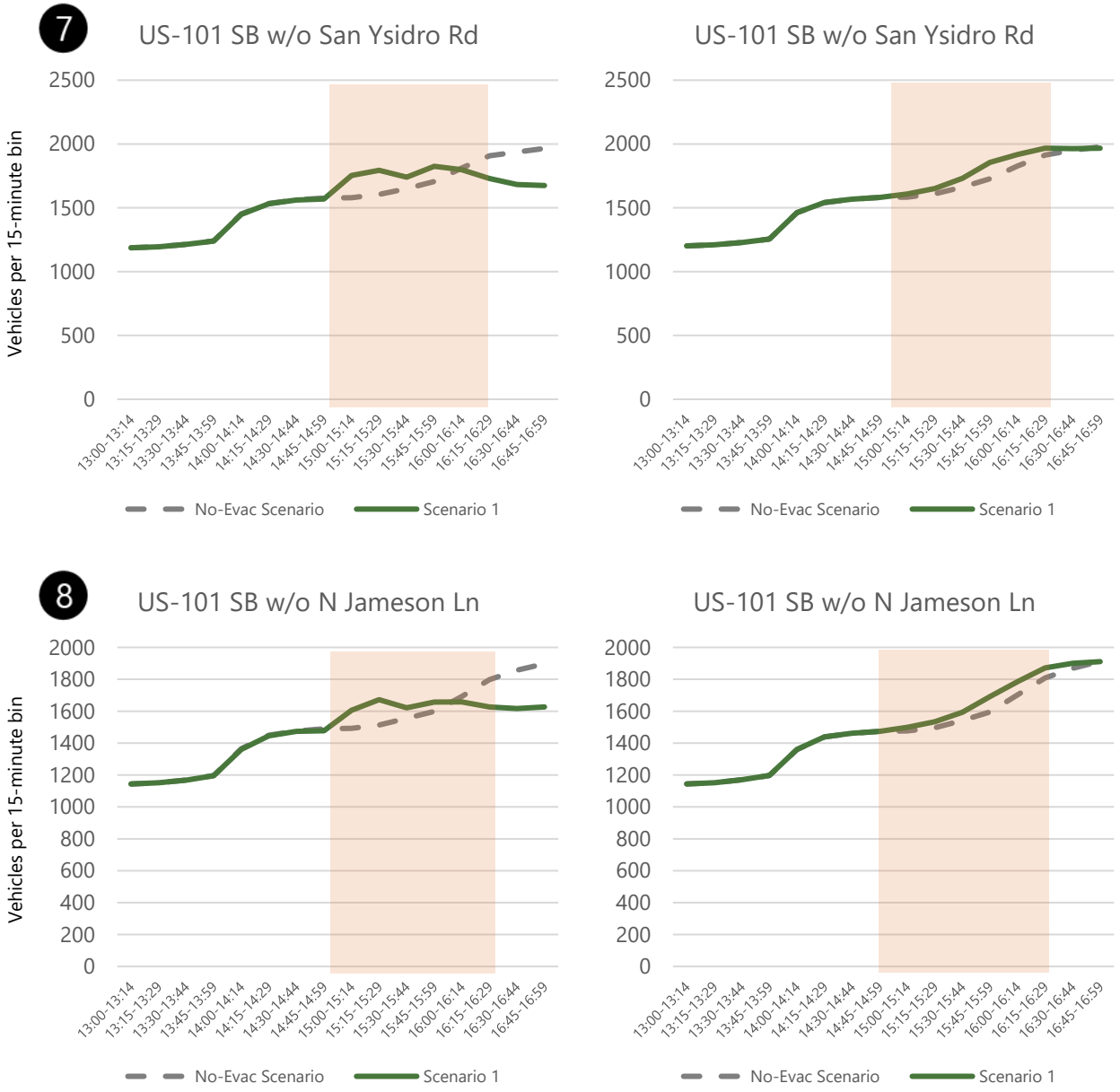
Hot Springs Rd w/o Sycamore Canyon Rd

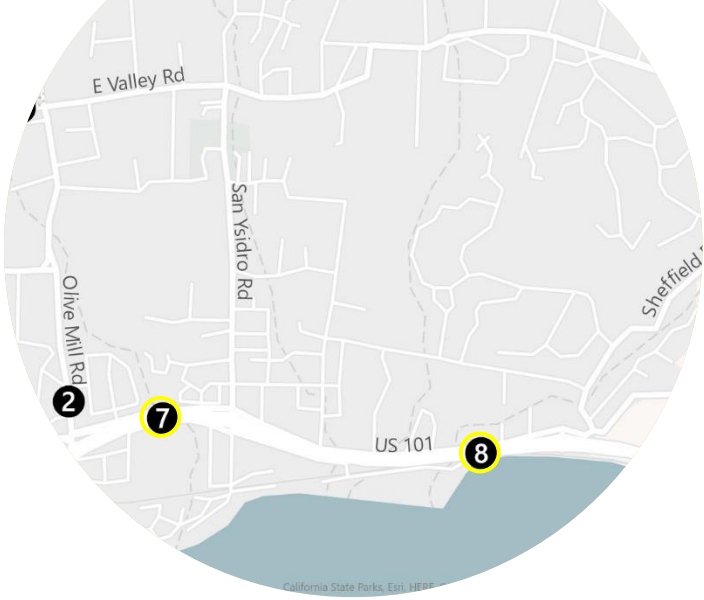


Due to background travel demands, many study locations are already experiencing congestion before the evacuation begins. For example, San Ysidro Road, Olive Mill Road, and Hot Springs Road north of the US-101, and the US-101 itself all experience congestion due to typical background traffic at the time of the evacuation. On East Valley Road, typical background traffic more than doubles over the course of the evacuation period.

By the end of the evacuation period, congestion within the evacuating zones persists, especially near the US-101 ramps, on Hot Springs Road, San Ysidro Road, and East Valley Road. However, this is less pronounced in the 2023 analysis.

Figure 7D: Scenario 1, Phased Evacuation of Western Montecito





As the evacuation period progresses and the congestion on the network peaks and subsides, the 2022 analysis showed vehicles diverting from US-101 to parallel routes in or adjacent to the evacuation area because they became less congested post-evacuation. The 2023 analysis adds evacuation trips to the network more gradually, particularly from Westmont College, better utilizing roadway capacity and resulting in less diversion.

During the course of the evacuation, the congestion on US-101 worsens as a result of the evacuation on top of background traffic that grows between 3:00PM and 4:30PM.

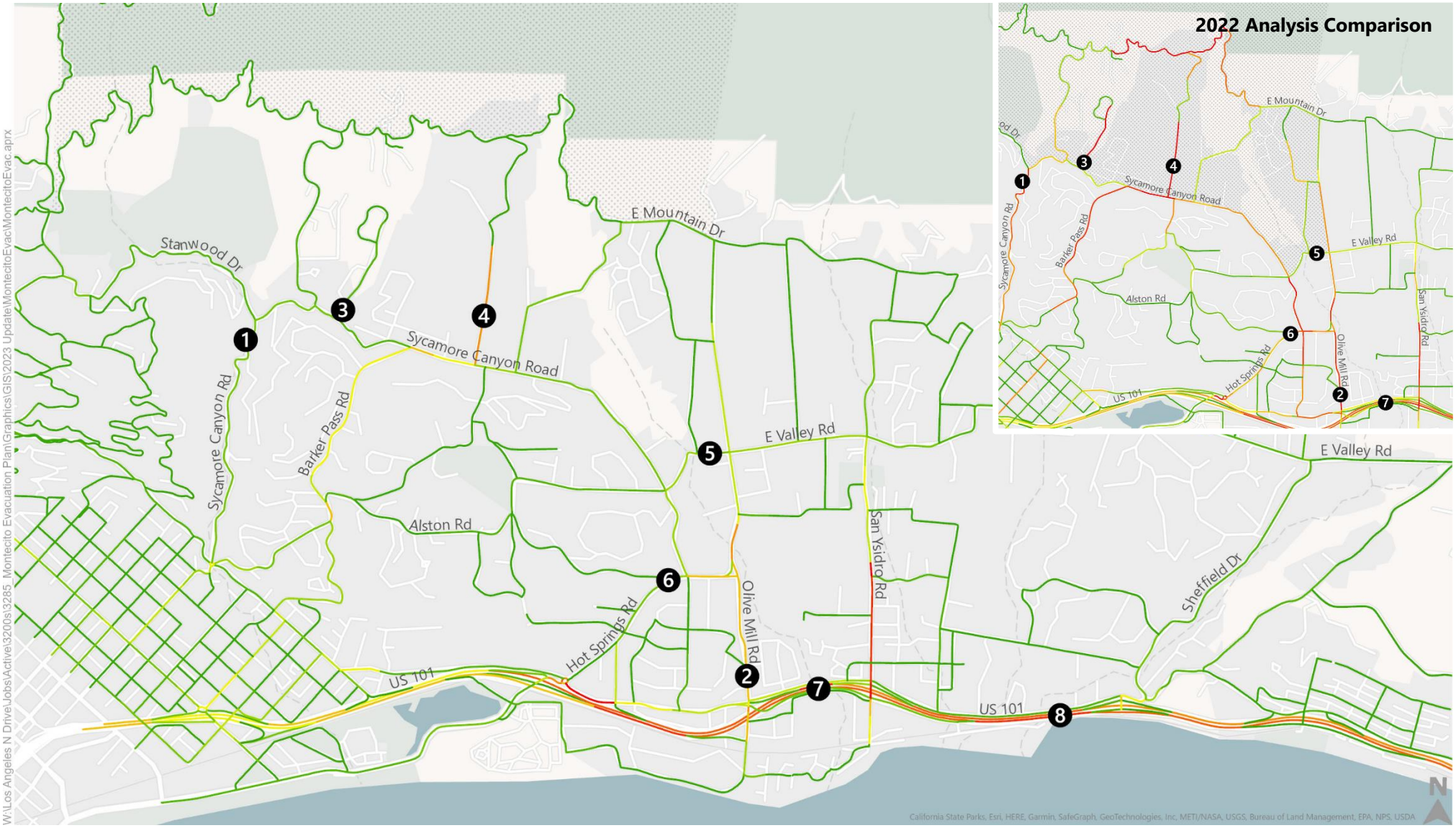
Figure 8 through **Figure 12** show the progression of congestion across the network before the evacuation, during the early, mid, and late stages of the evacuation period, and after the evacuation period concludes.

Volume/Capacity:

0.0 - 0.10 | 0.11 - 0.20 | 0.21 - 0.30 | 0.31 - 0.40 | 0.41 - 0.50 | 0.51 - 0.60 | 0.61 - 0.70 | 0.71 - 0.80 | 0.81 - 0.90 | 0.91 - 1.00 | > 1.00

Figure 8

Scenario 1, Pre-Evacuation Period

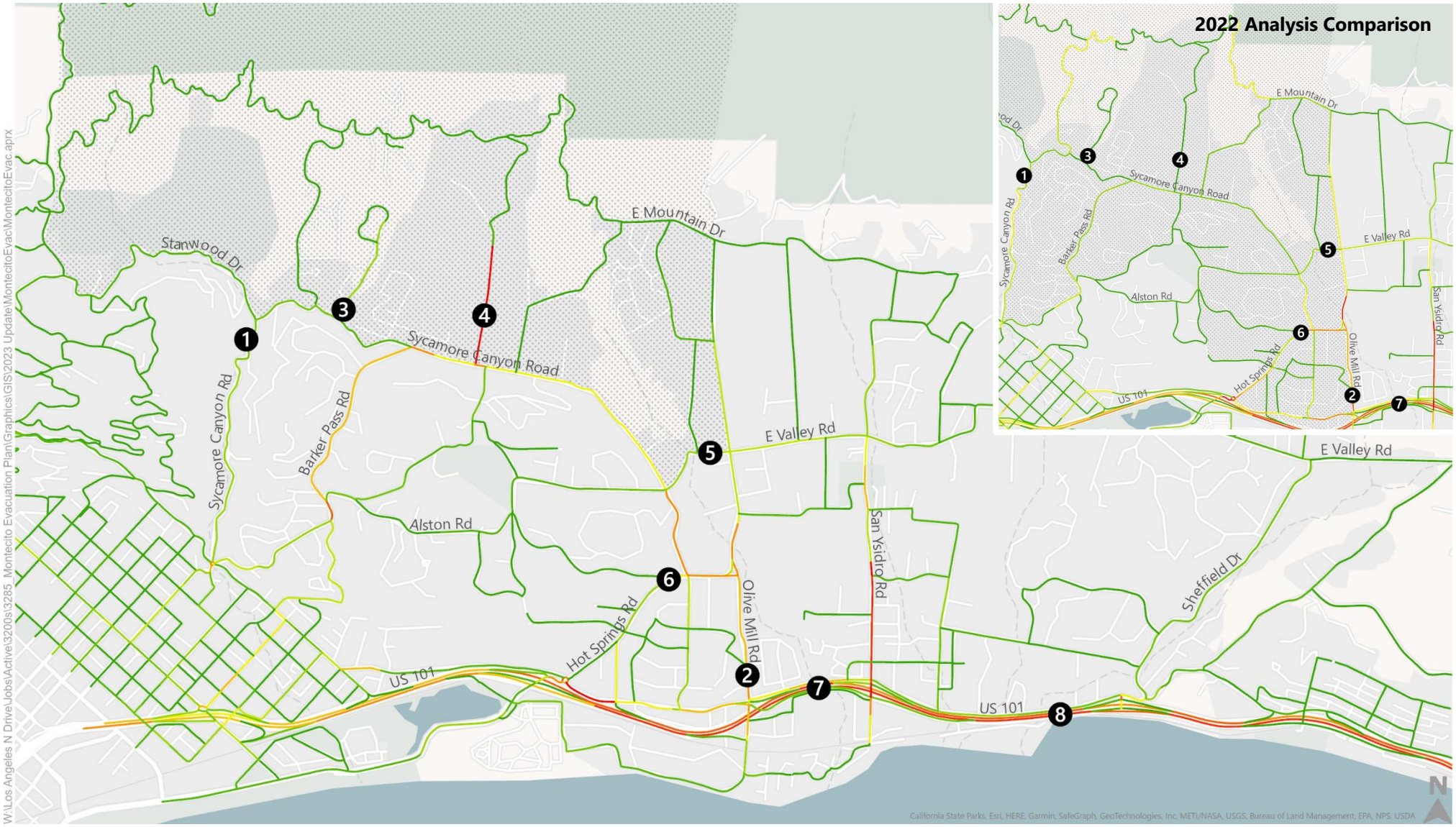


Volume/Capacity:

0.0 - 0.10 | 0.11 - 0.20 | 0.21 - 0.30 | 0.31 - 0.40 | 0.41 - 0.50 | 0.51 - 0.60 | 0.61 - 0.70 | 0.71 - 0.80 | 0.81 - 0.90 | 0.91 - 1.00 | > 1.00

Figure 9

Scenario 1, Early Evacuation Period



Volume/Capacity:

0.0 - 0.10 | 0.11 - 0.20 | 0.21 - 0.30 | 0.31 - 0.40 | 0.41 - 0.50 | 0.51 - 0.60 | 0.61 - 0.70 | 0.71 - 0.80 | 0.81 - 0.90 | 0.91 - 1.00 | > 1.00

Figure 10

Scenario 1, Mid-Evacuation Period

Volume/Capacity:

0.0 - 0.10 | 0.11 - 0.20 | 0.21 - 0.30 | 0.31 - 0.40 | 0.41 - 0.50 | 0.51 - 0.60 | 0.61 - 0.70 | 0.71 - 0.80 | 0.81 - 0.90 | 0.91 - 1.00 | > 1.00

Figure 11

Scenario 1, Late Evacuation Period

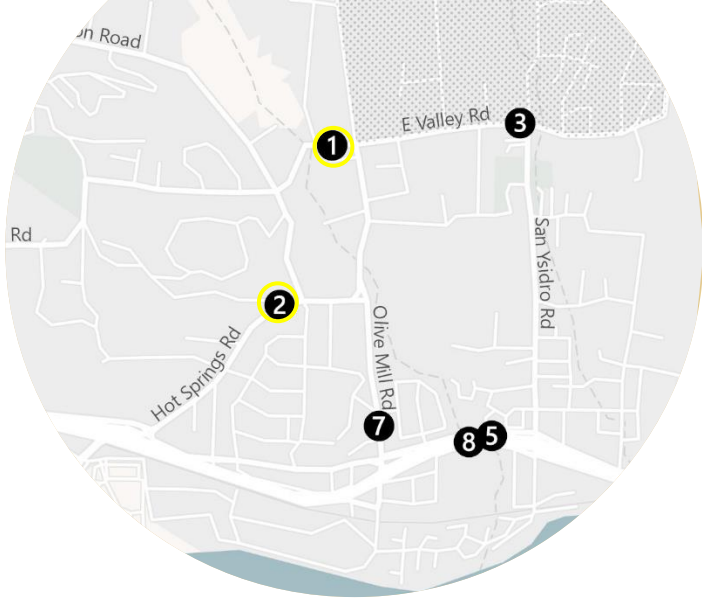
Volume/Capacity:

0.0 - 0.10 | 0.11 - 0.20 | 0.21 - 0.30 | 0.31 - 0.40 | 0.41 - 0.50 | 0.51 - 0.60 | 0.61 - 0.70 | 0.71 - 0.80 | 0.81 - 0.90 | 0.91 - 1.00 | > 1.00

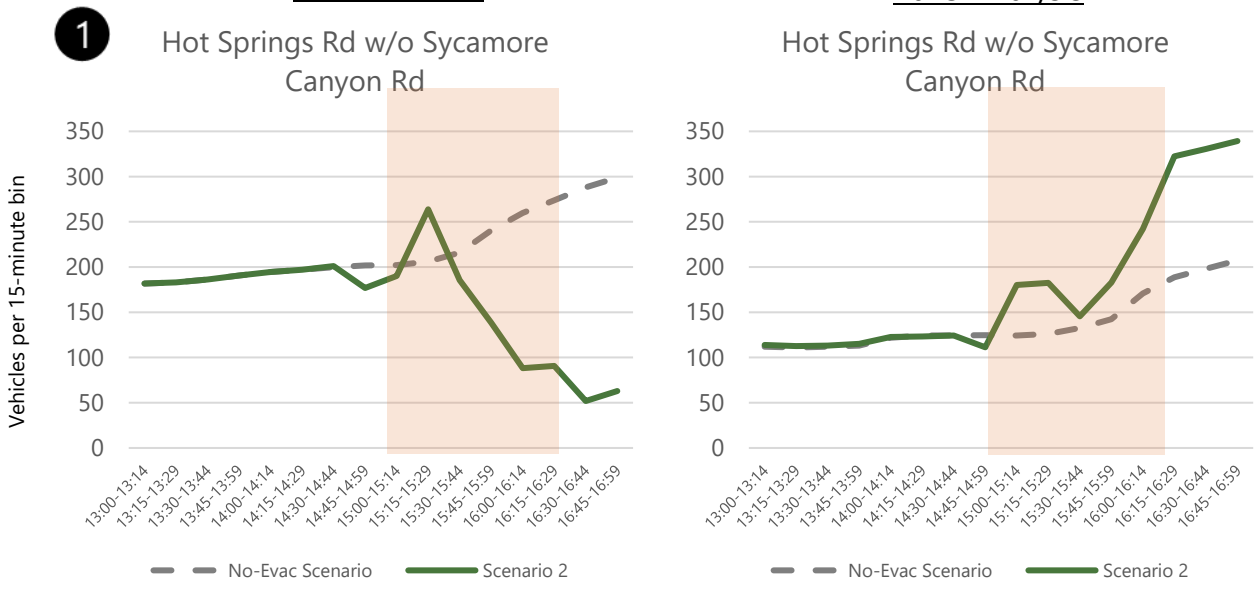
Figure 12

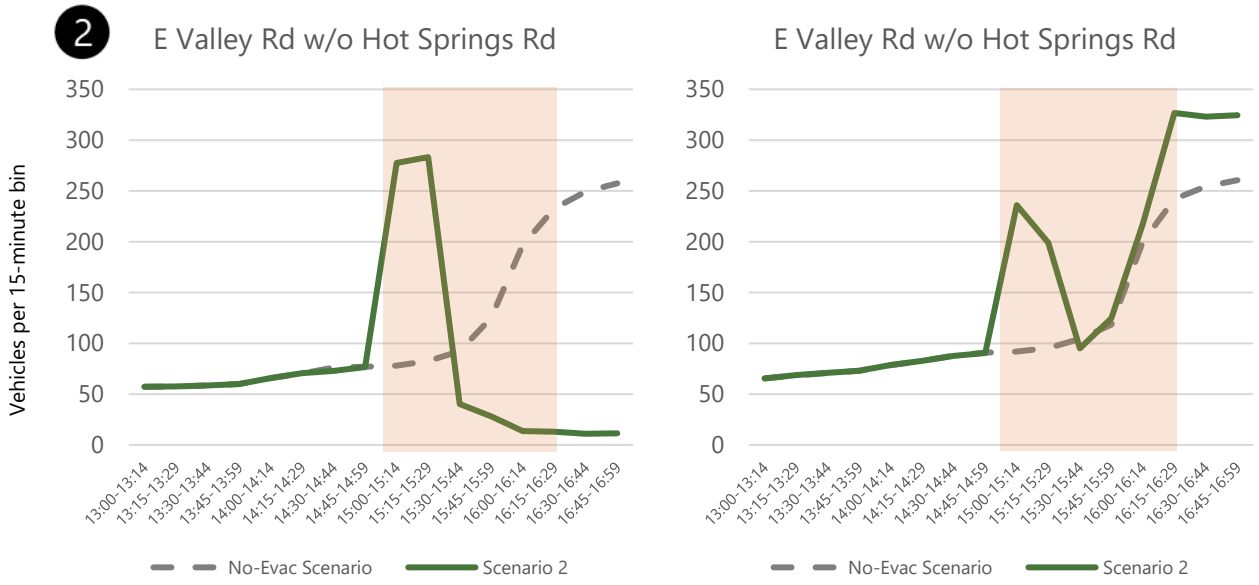
Scenario 1, Post-Evacuation Period

Figure 13A Scenario 2, Phased Evacuation of Eastern Montecito



2022 Analysis





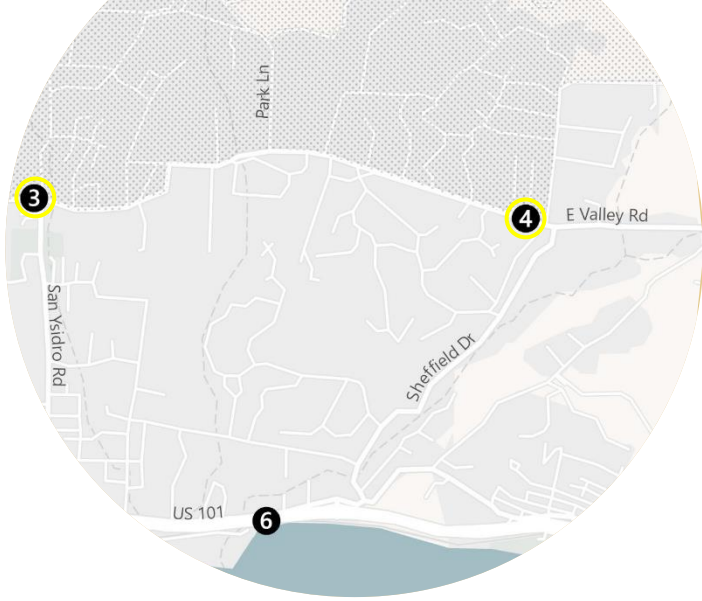
2023 Analysis

Due to the phased approach of Scenario 2, congestion caused by vehicles evacuating builds up quickly, within the first 15-30 minutes of the evacuation period as zones 4, 5, and 6 evacuate simultaneously. As shown earlier, within the first 30 minutes of the evacuation, the number of vehicles evacuating comprises over one-third of the total number of vehicles in the subarea model.

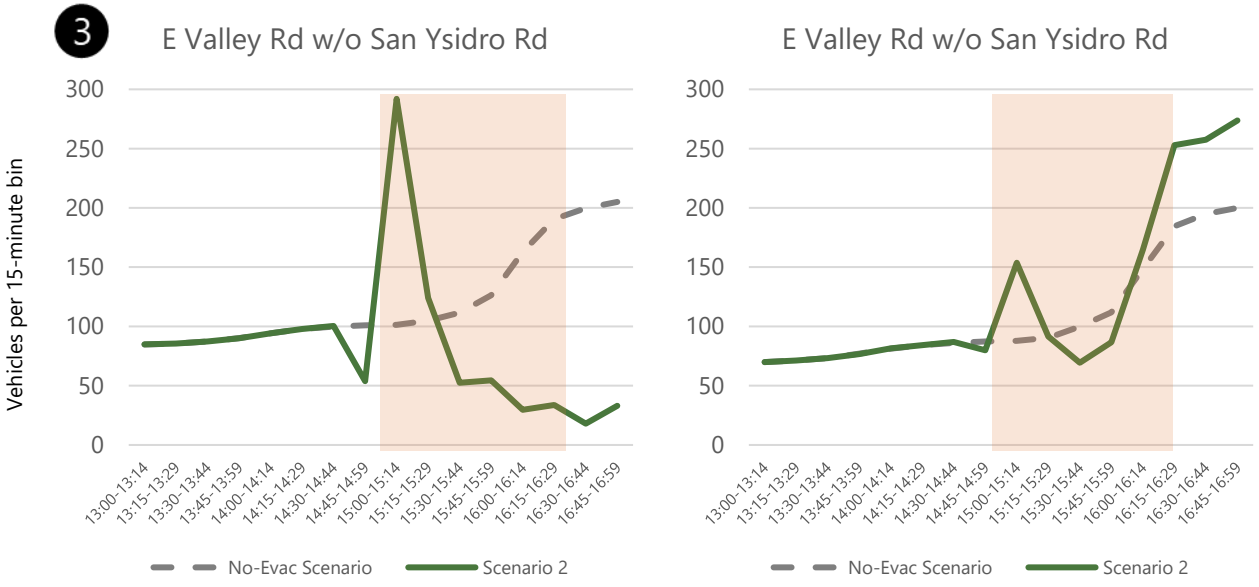
Under scenario 2, evacuation zones represent the eastern portions of Montecito, causing Hot Springs Road, East Valley Road, and other main corridors serving the area to experience large peaks in traffic as phase 1 evacuees use local roads and arterials to exit the evacuating zones and travel towards the US-101 and other exit routes from Montecito.

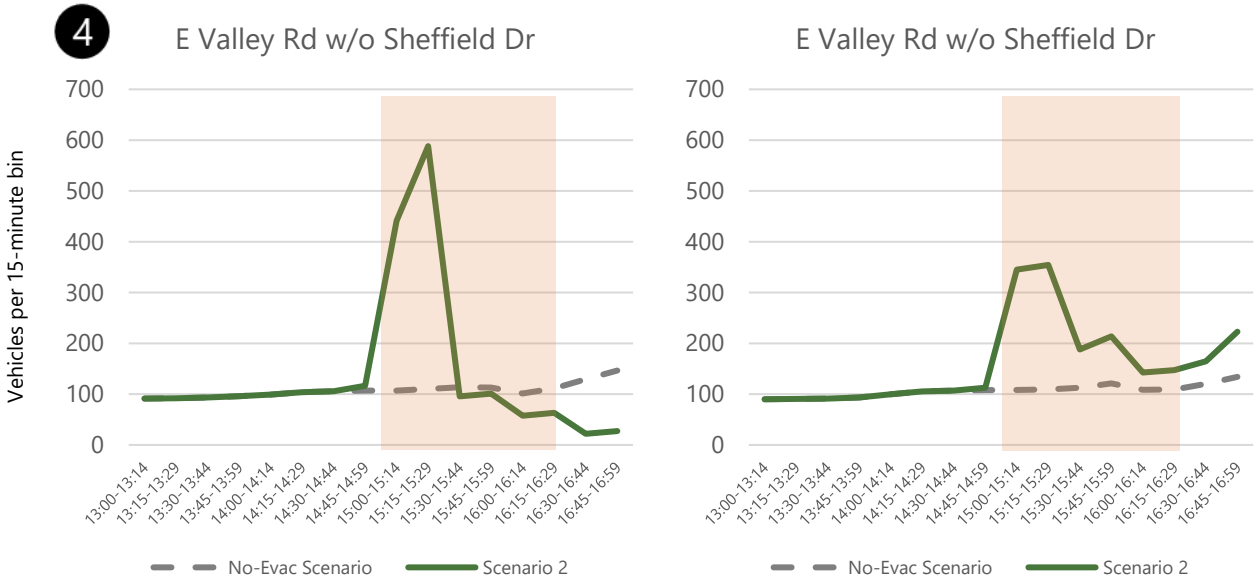
Like scenario 1, the 2023 analysis shows a smaller peak in phase 1 with fewer total evacuation trips.

Figure 13B Scenario 2, Phased Evacuation of Eastern Montecito



2022 Analysis



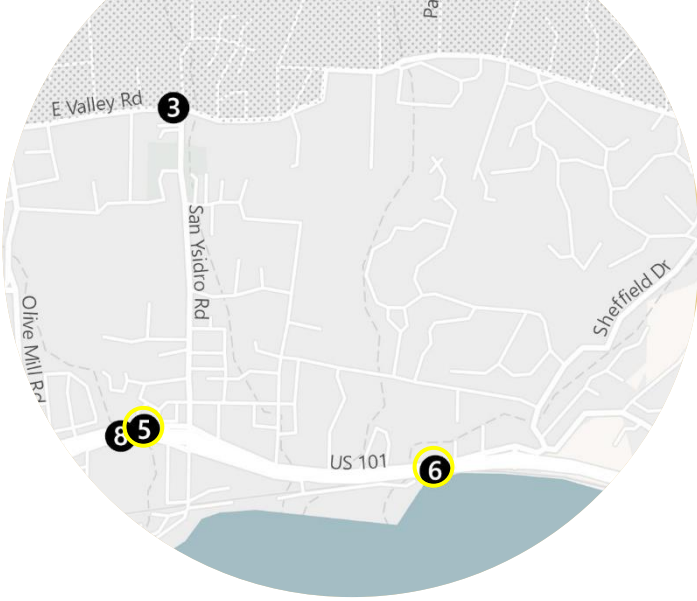


2023 Analysis

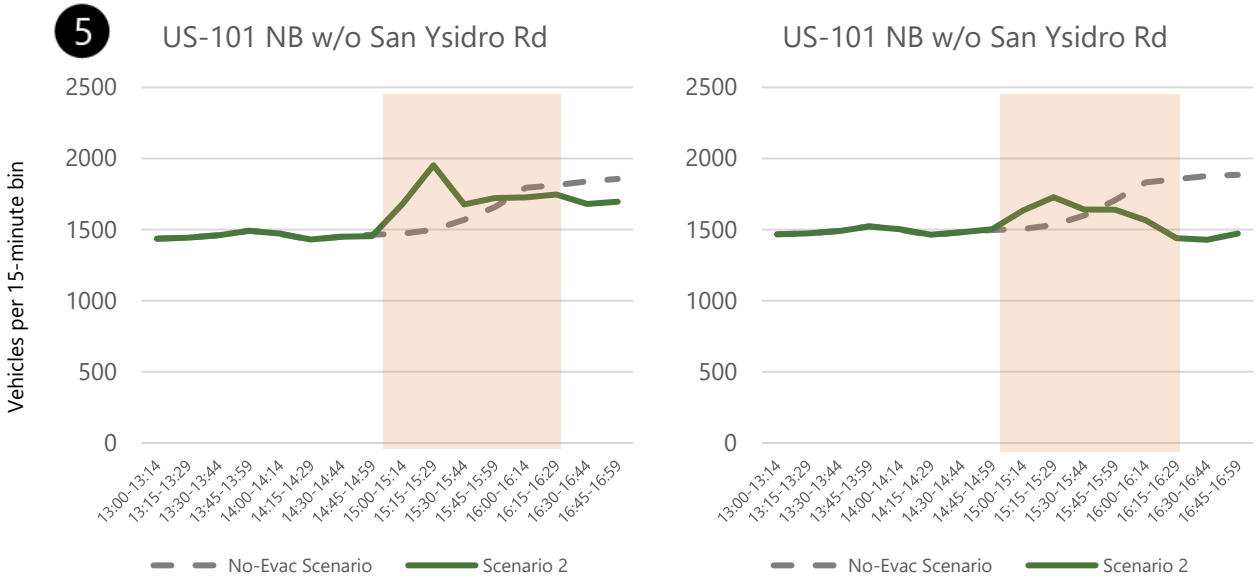
East Valley Road becomes increasingly congested as vehicles use the corridor to travel eastbound and leave the Montecito area or access the north-south roads in Montecito to reach the US-101 freeway. By the middle of the evacuation period, the congestion migrates westward towards the City of Santa Barbara as the US-101 ramps become heavily congested and vehicles are routed to other paths on the local roadway network. Congestion also persists in the northeast part of Montecito along Bella Vista Drive.

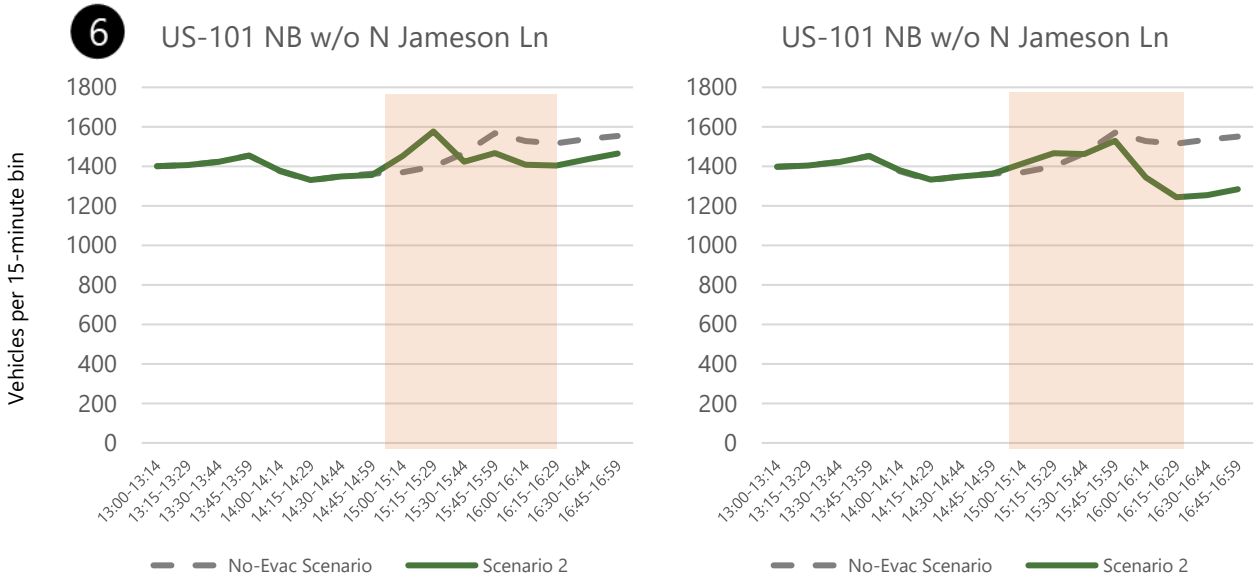
These primary corridors show smaller peaks in the 2023 analysis since smaller areas are evacuated in Phase 1 compared to the 2022 analysis. This more gradual loading of vehicles onto the roadway network prevents severe peaks in congestion in the 2023 analysis.

Figure 13C Scenario 2, Phased Evacuation of Eastern Montecito



2022 Analysis



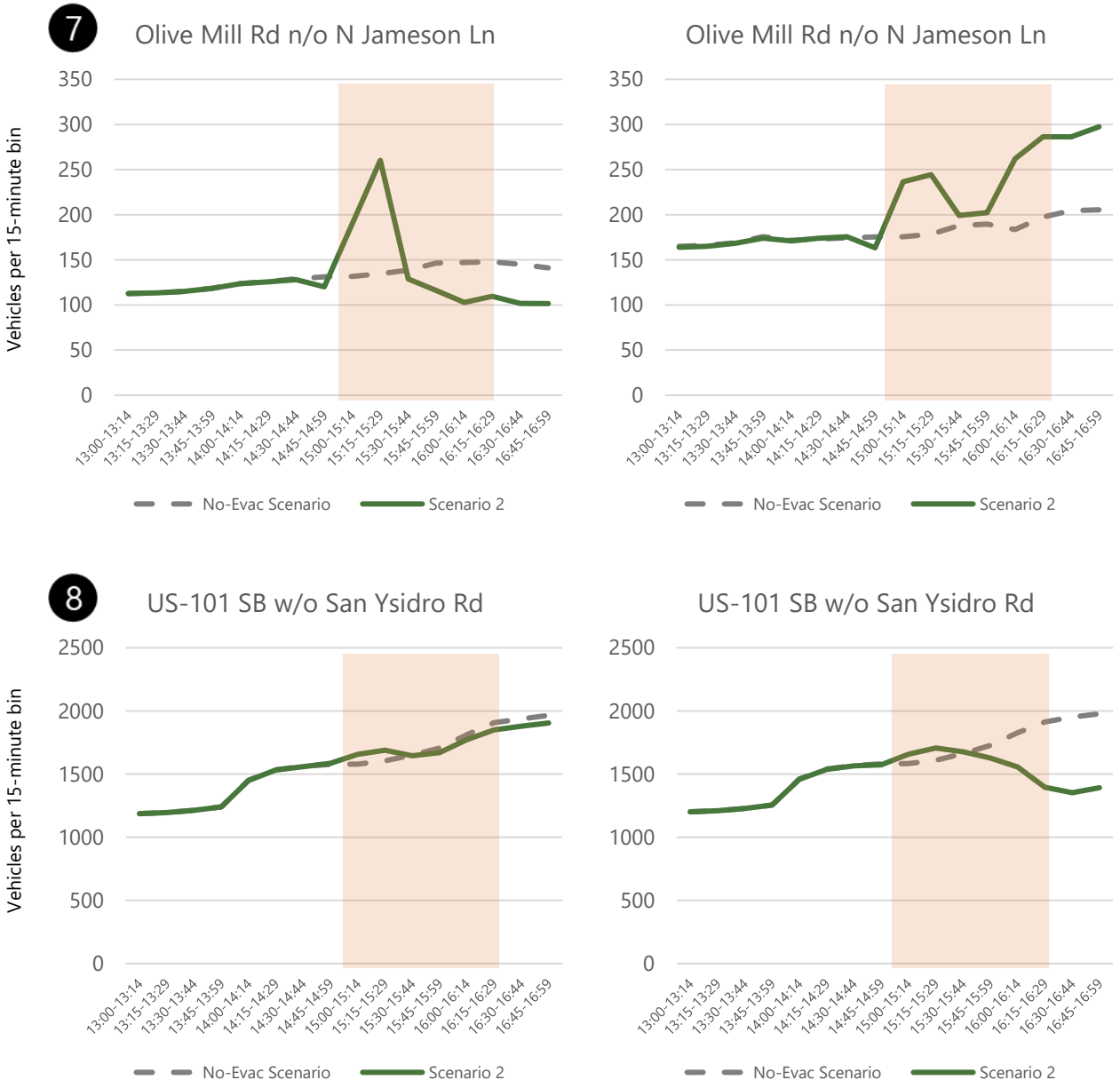


2023 Analysis

Due to background travel demands, many study locations already experience congestion before the evacuation begins. For example, US-101 experiences congestion due to typical background traffic at the time of the evacuation.

In the 2023 analysis, there is a rebound in traffic post-evacuation on some facilities and a decrease in traffic post-evacuation on US-101. Because fewer residents are evacuated in the 2023 analysis compared to the 2022 analysis, the model shows these residents and through-travelers from US-101 traveling as usual, along parallel facilities such as East Valley Road because they become less congested after northern neighborhoods are fully evacuated. This underscores the need for ongoing traffic management after an evacuation concludes.

Figure 13D Scenario 2, Phased Evacuation of Eastern Montecito



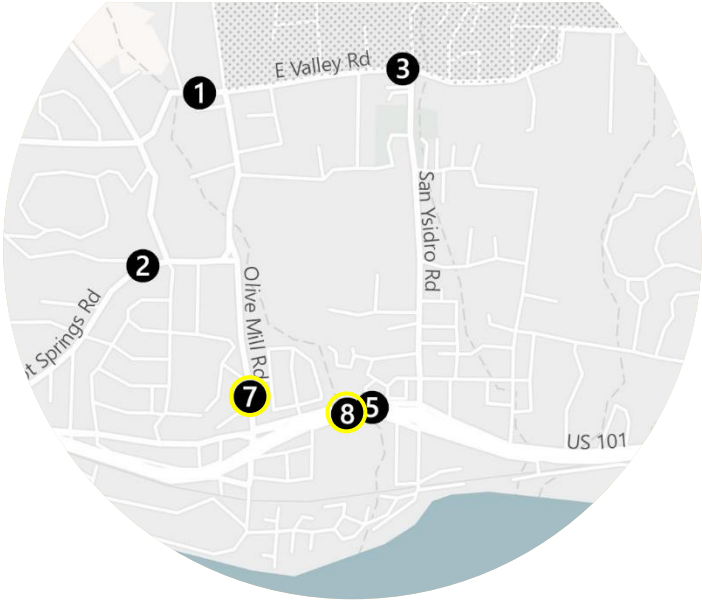
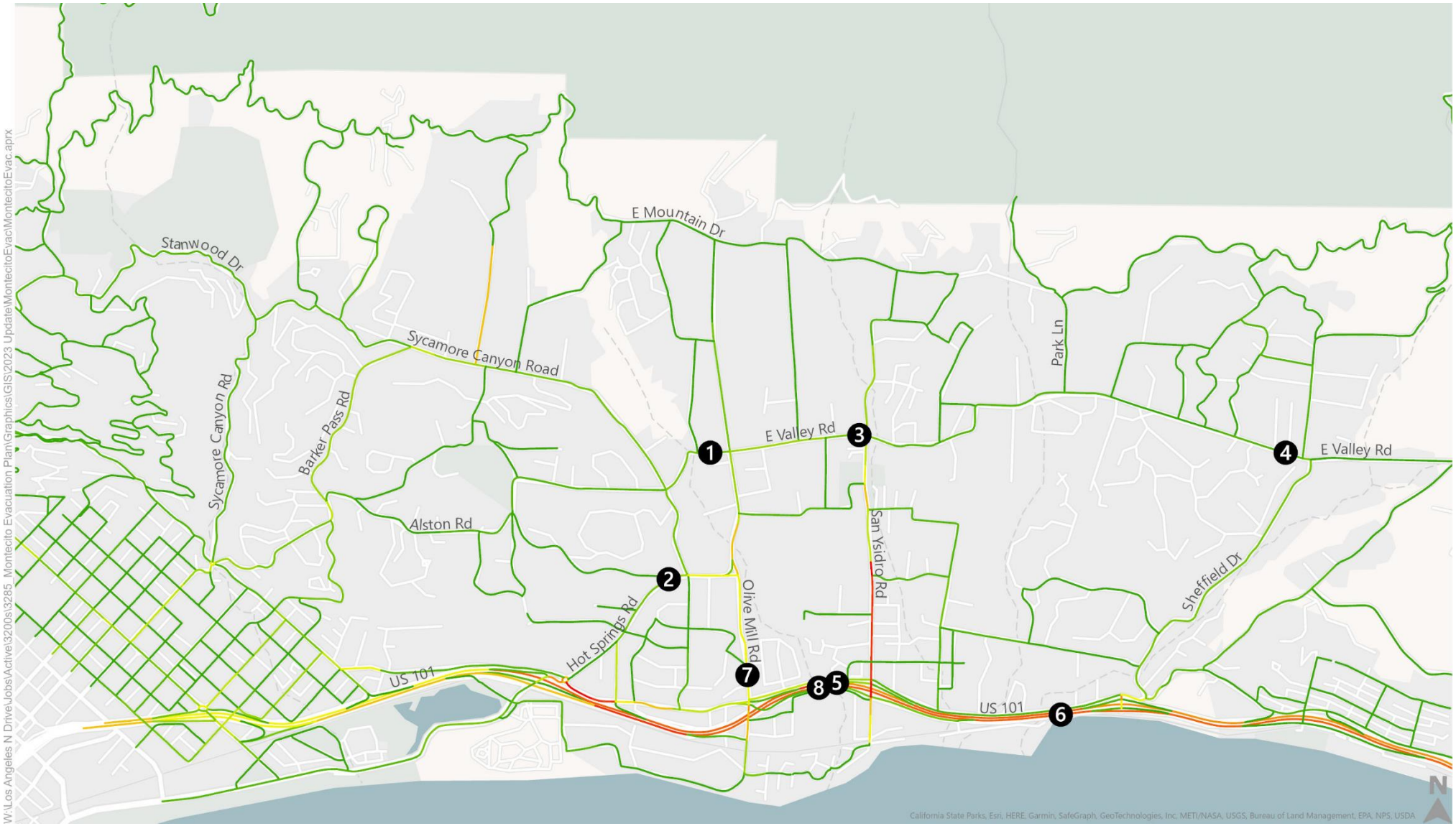


Figure 14 through **Figure 18** show the progression of congestion across the network before the evacuation, during the early, mid, and late stages of the evacuation period, and after the evacuation period concludes.

As the evacuation period progresses, the congestion on the network peaks and subsides.



Volume/Capacity:

0.0 - 0.10 | 0.11 - 0.20 | 0.21 - 0.30 | 0.31 - 0.40 | 0.41 - 0.50 | 0.51 - 0.60 | 0.61 - 0.70 | 0.71 - 0.80 | 0.81 - 0.90 | 0.91 - 1.00 | > 1.00

Figure 14

Scenario 2, Pre-Evacuation Period

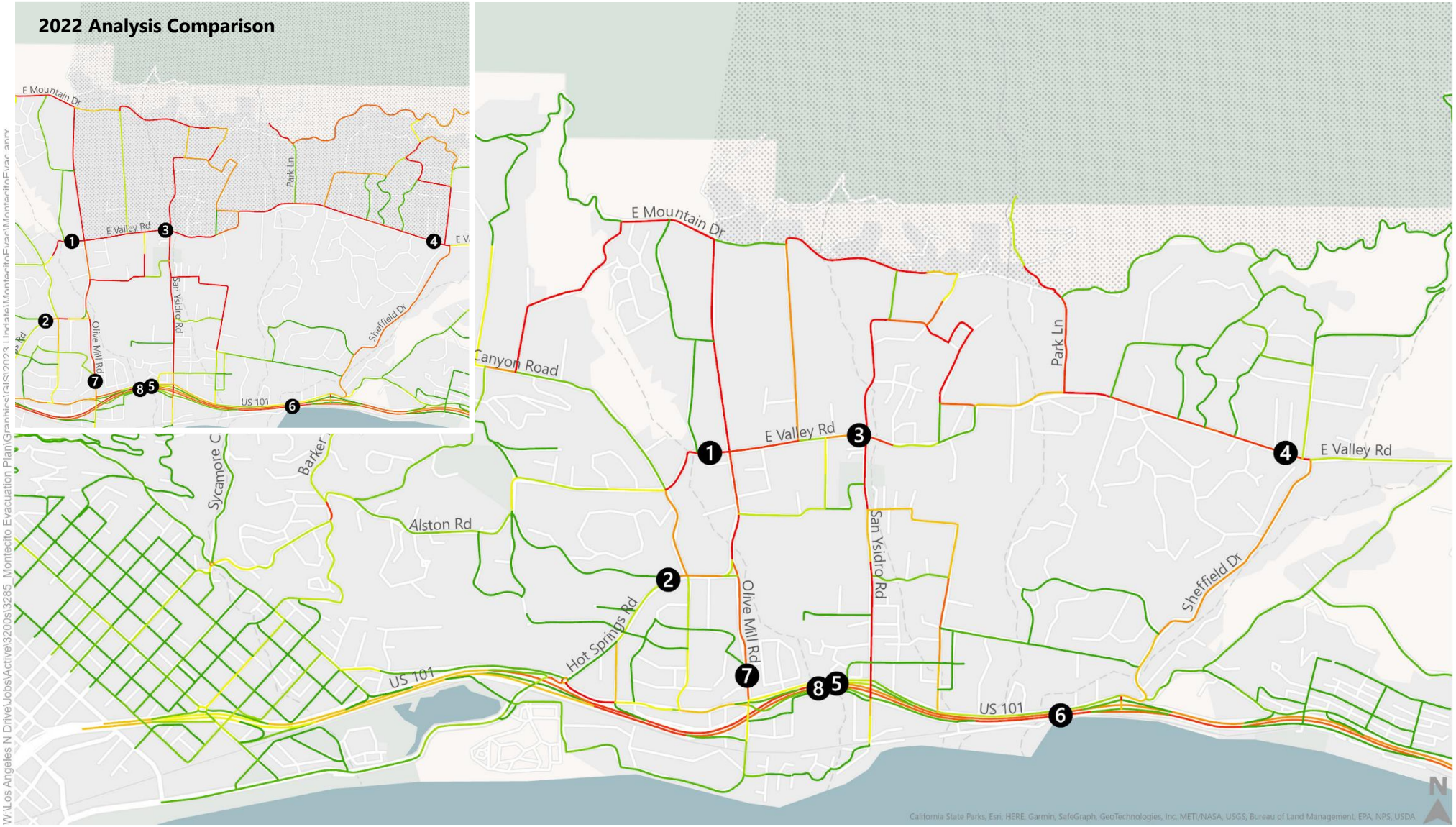
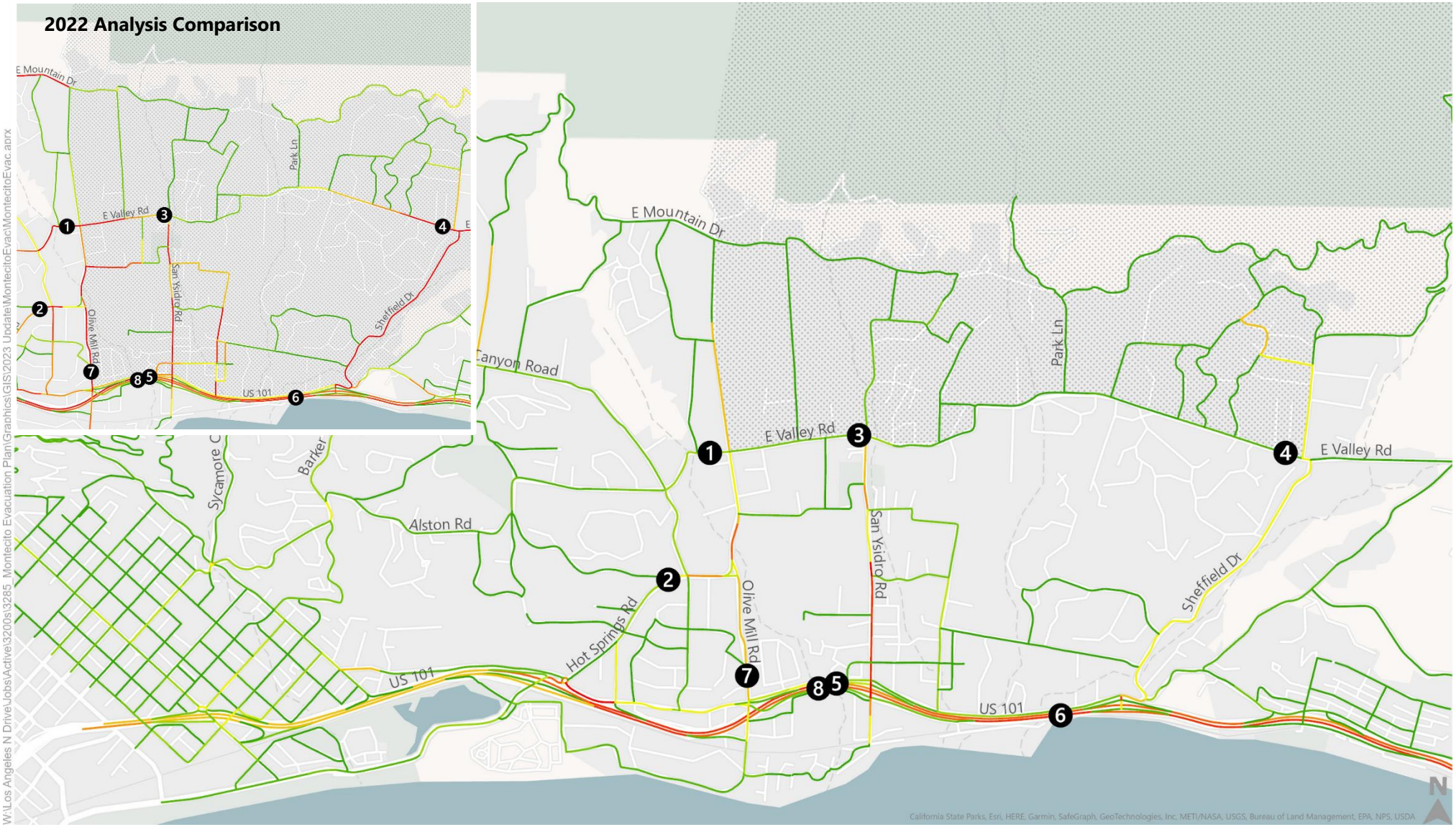


Figure 15

Scenario 2, Early Evacuation Period



Volume/Capacity:

0.0 - 0.10 | 0.11 - 0.20 | 0.21 - 0.30 | 0.31 - 0.40 | 0.41 - 0.50 | 0.51 - 0.60 | 0.61 - 0.70 | 0.71 - 0.80 | 0.81 - 0.90 | 0.91 - 1.00 | > 1.00

Figure 16

Scenario 2, Mid-Evacuation Period

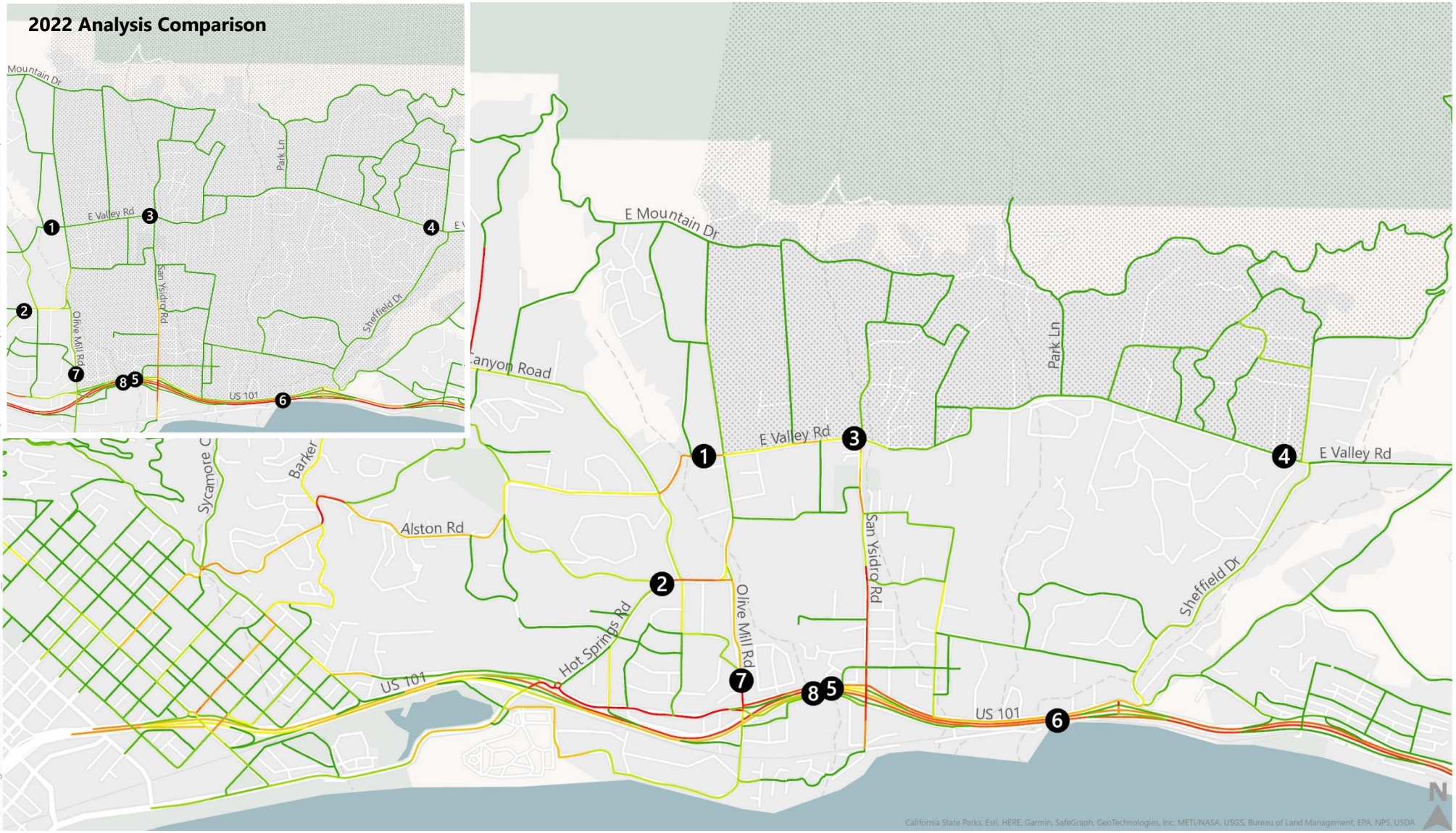
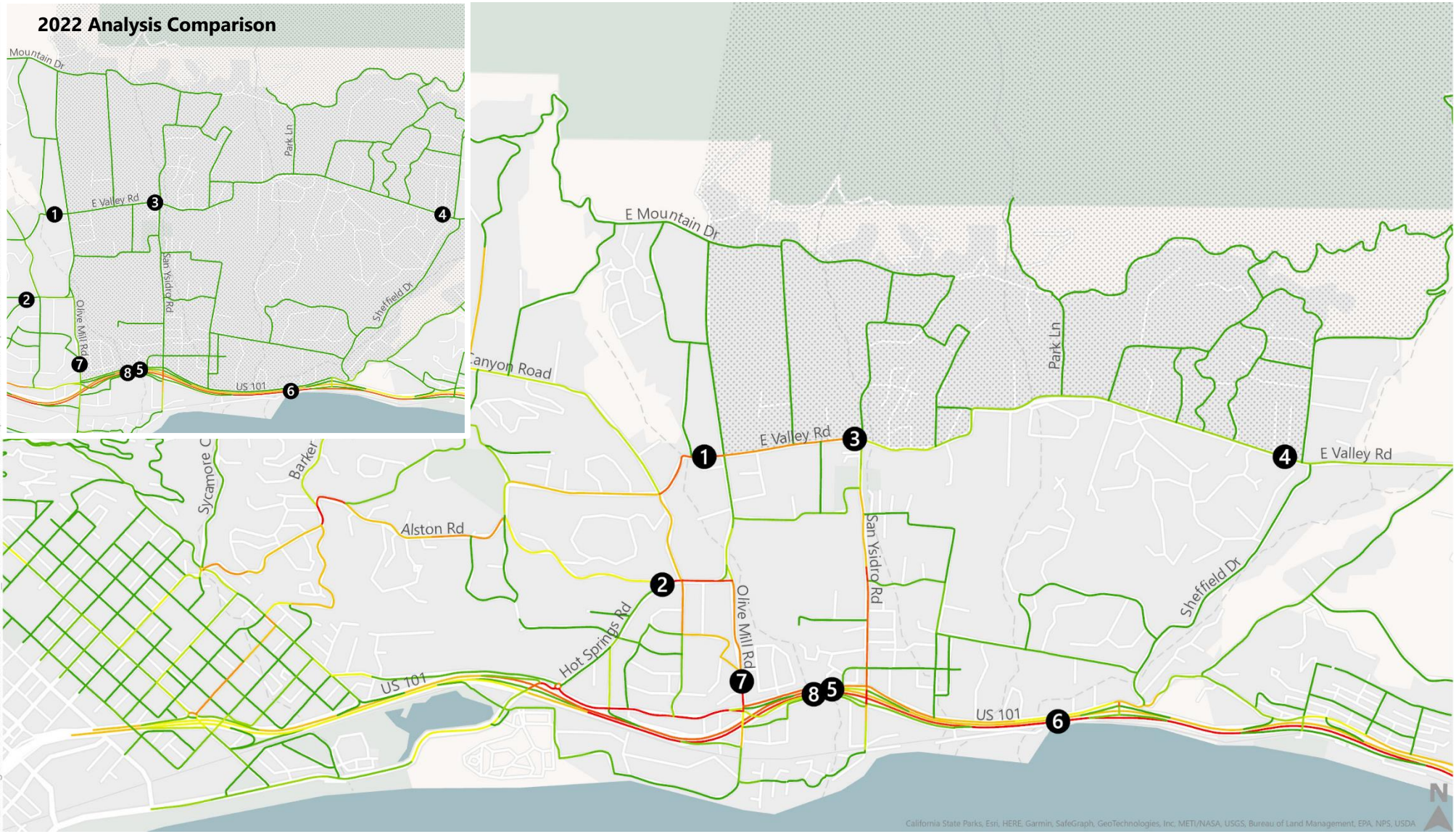


Figure 17

Scenario 2, Late Evacuation Period



Volume/Capacity:

0.0 - 0.10 | 0.11 - 0.20 | 0.21 - 0.30 | 0.31 - 0.40 | 0.41 - 0.50 | 0.51 - 0.60 | 0.61 - 0.70 | 0.71 - 0.80 | 0.81 - 0.90 | 0.91 - 1.00 | > 1.00

Figure 18

Scenario 2, Post-Evacuation Period

4. Conclusions

Given topographic and roadway network constraints, Montecito has limited options to manage evacuation demand during an emergency scenario. The two emergency evacuation scenarios analyzed as part of this assessment highlight the significance of US-101 as a key evacuation route as well as a key regional thoroughfare. The differences between the 2022 analysis and 2023 analysis highlight the changes in evacuation traffic resulting from evacuation of smaller zones and fewer residents, students, and employees. Based on this 2023 analysis, the deployment of smaller zones, as drafted and tested here, would be expected to reduce the congestion that accumulates on the roadway network during an evacuation.

The 2022 analysis offered recommendations for Montecito Fire to consider, building on existing local efforts with additional strategies that improve the efficiency of evacuation operations and create alternatives to full community evacuation. Recommendations were based on the results of the model as well as the community survey, after-action report review, and interviews with fire and sheriff staff and were categorized as follows:

- Wildfire mitigation: strategies that greatly increase the likelihood that the roadway network is passable, enhance the resilience of the wildland-urban interface (WUI), and discourage fire spread.
- Demand-side recommendations: strategies that influence when, how, and where people evacuate in an emergency.
- Supply-side recommendations: strategies that influence the physical and operational roadway infrastructure that facilitate an emergency evacuation. These recommendations included expanding evacuation capacity without expanding daily capacity through hardscape and softscape improvements, roundabout conversions, cross-section designs to enable two-lane egress on key roadways during evacuations, building redundancy of critical infrastructure, and designating pedestrian evacuation routes.
- External education and outreach: strategies that inform how information is shared and received in an emergency.
- Capacity building and coordination: strategies that increase the power of limited human resources through improvements to internal and external processes.

The 2022 analysis tested two scenarios with simultaneous evacuation of multiple zones north of SR-192. The 2023 analysis tested a demand-side recommendation, using a more granular phased evacuation to understand the congestion impact of evacuating smaller zones north of SR-192. The results, as analyzed above, show that more granular evacuation zones allow for evacuation of smaller areas which can reduce congestion on the roadway network.

For example, existing zones 2, 3, 5, and 6 have multiple north/south roads within one zone that each serve sizeable individual communities, which would all evacuate simultaneously onto SR-192 even if only one

zone were evacuated at a time. Peaks in evacuation traffic are smaller with the more granular approach tested for the 2023 analysis, resulting in a smoother evacuation for areas most threatened by fire.

The assumption of 100% community compliance to an evacuation order within a relatively short evacuation window (one- to two-hours) provides a conservative estimate for the purposes of this assessment, representing a participation rate beyond that which may occur during an evacuation event and a compressed evacuation response curve. Therefore, the results of this analysis represent assumptions and conditions which may cause more acute congestion impacts on the roadway network. While this assessment uses scenarios to capture the effects from evacuating all members of the affected area, it is possible that some residents may not evacuate or, if they take a "Wait and See" approach, they may evacuate much later after the evacuation order is issued – either shifting the entire evacuation curve or extending the duration of the evacuation response curve.