Emergency Evacuation Study

Prepared for:
Montecito Fire Protection District

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LA-3285

FEHR PEERS

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1. Introduction

This emergency evacuation study offers a detailed look at considerations for evacuations in Montecito to help the Montecito Fire Protection District (MFPD) expand the community's preparedness to emergencies that require evacuation. This study is 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 study included four key components:

1. Community survey to understand current levels of community preparedness and evacuation readiness
2. Interviews with sheriff deputies and fire agency chief officers who have recent experience with executing an evacuation in order to inform opportunities for improvement based on these recent experiences
3. Review of after-action reports to identify similar trends and summarize opportunities for improvement based on recent evacuation events
4. Traffic operations modeling to identify locations where congestion accumulates on the roadway network and could potentially be managed through modifications to the roadway network, modifications to demand during the evacuation event, and/or modifications to communications and information dissemination during an evacuation event

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 MFPD 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 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, as well as and 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 MFPD better prepare for hazard-related events and associated evacuations, MFPD 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.

1.2 Background

While hazards of all kinds could require an evacuation, wildfires are a common hazard in California and can burn large areas of developed or undeveloped land in a short amount of time. They often begin as smaller fires caused by weather-related events such as lightning strikes or downed power lines during high winds or a seismic event. They can also be caused by intentional, careless, or accidental human behavior such as discarded smoking materials, vehicle fires, and even arson. During critical fire weather conditions of low humidity, high temperatures, 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. As shown in Figure 1 and Figure 2, the local fire history in Montecito demonstrates the wildfire risk that is present, particularly along the north, west, and eastern edges of the community.

Figure 1: Local Fire History (1960-1990)

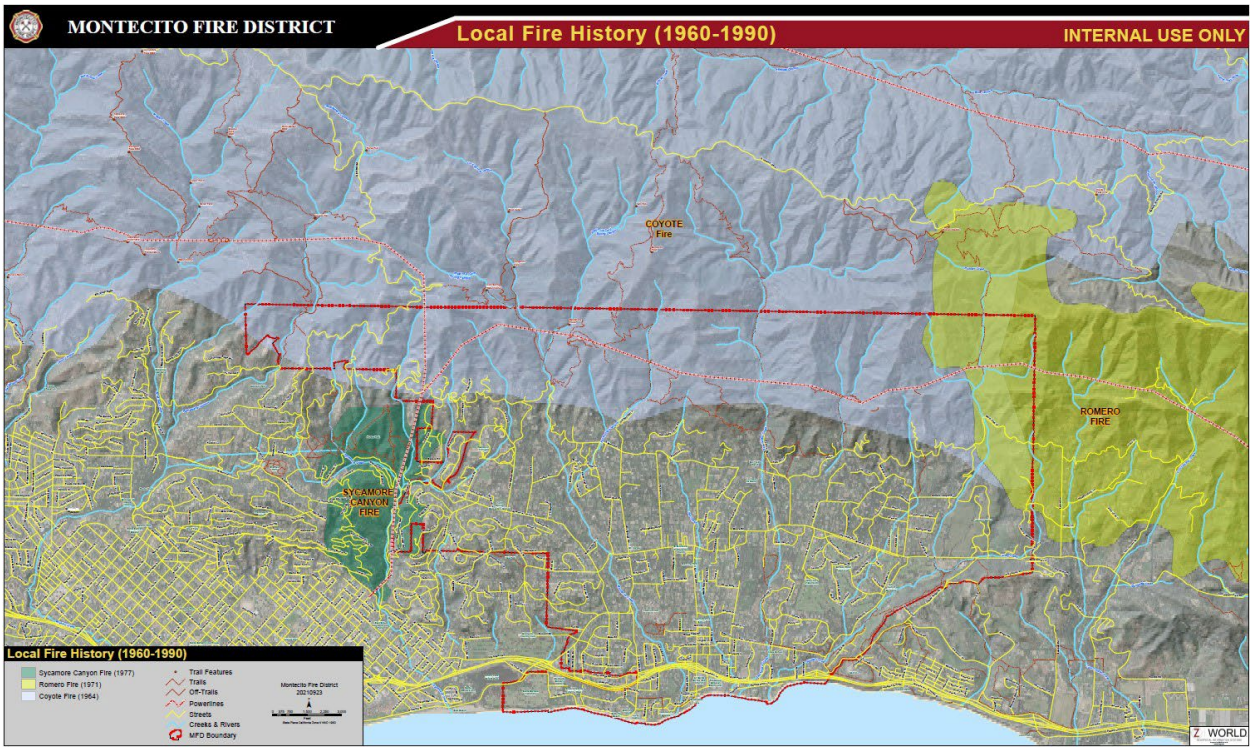
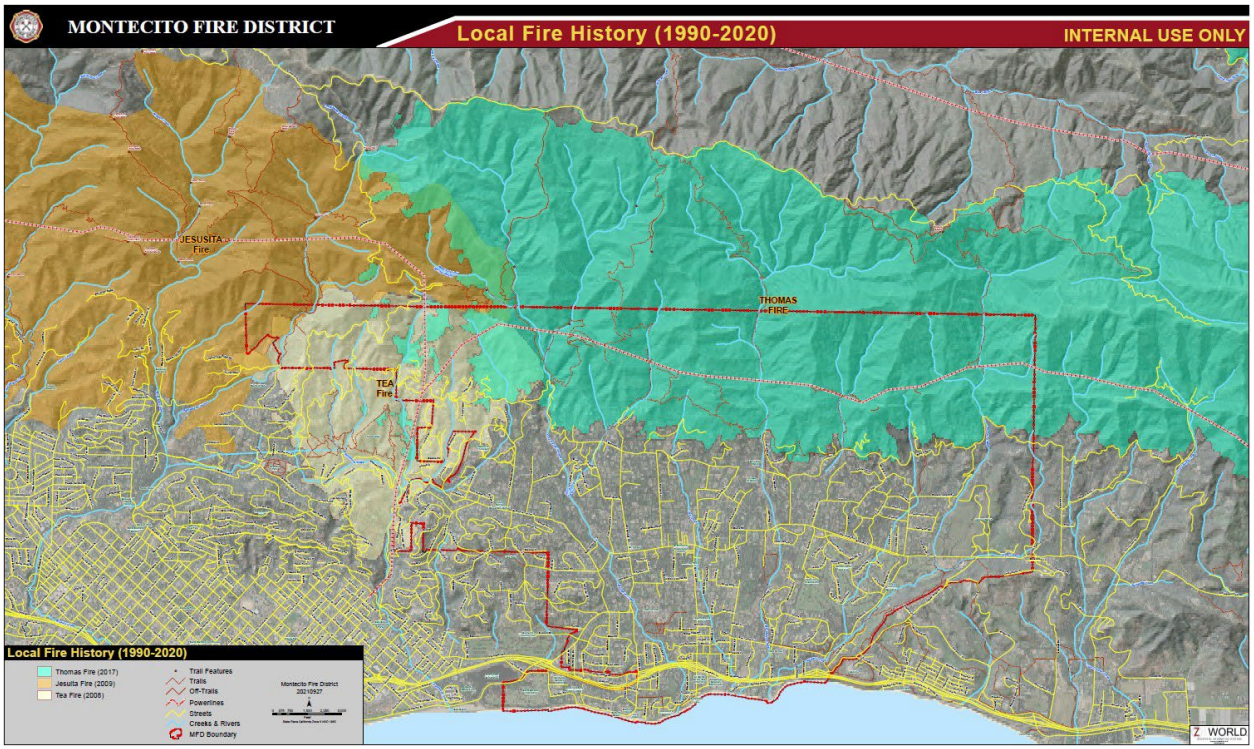


Figure 2: Local Fire History (1990-2020)



Typically, wildfires pose minimal threat to people and buildings in urban areas. However, in hillside areas of the community, the likelihood that wildfires will cause injuries, death, and/or property damage increases. Following and exacerbated by recent wildfires, debris flows can pose further risk to communities after fire risk has passed, as demonstrated in the 2017 Thomas Fire followed by the 2018 Montecito Debris Flow. As such, there is a need to understand how to effectively evacuate people from the hazard area to get them out of harm's way before and during a variety of emergency events.

In recent years, MFPD has invested substantial resources into understanding and responding to the risks associated with wildfires, debris flows, and other emergencies including through the development of the following maps, reports, and assessments:

- Montecito Community Wildfire Protection Plan (2016)
- A Defensible Community? A Retrospective Study of Montecito Fire Protection District's Wildland Fire Program during the 2017 Thomas Fire (2018)
- Montecito Community Wildfire Protection Plan Amendment (2019)
- Montecito Evacuation Plan (Updated 2021)

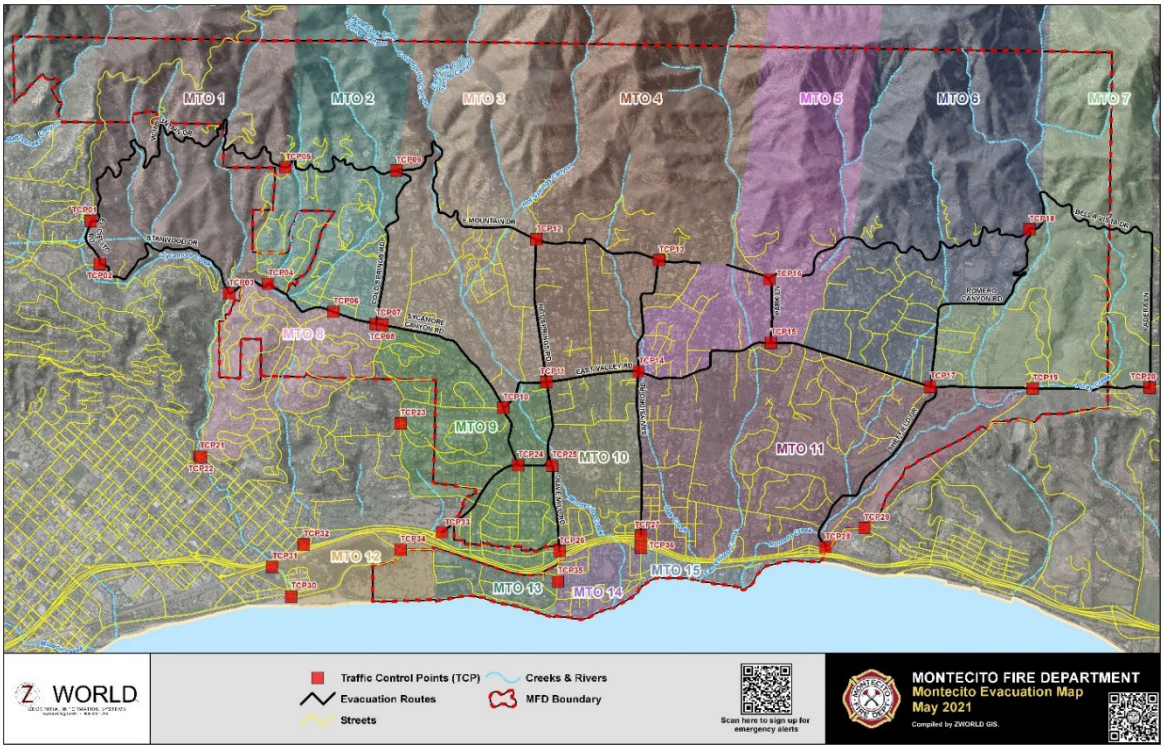
In addition, MFPD offers many programs to improve preparedness of the Montecito community and resilience to wildfire risks. These programs include:

- Ready! Set! Go! Program
- Home Hardening & Vent Retrofit Program

- Development inspection for remodels and new development
- Guidance on fire resistant landscaping
- Defensible Space Survey Program
- Neighborhood Chipping Program
- Wildfire Preparedness Community Meetings
- Weed Abatement Program
- Roadside fire hazard abatement
- Maintenance of fuel treatment network

This study builds upon these ongoing investments to focus on wildfire evacuation scenarios, utilizing existing resources, MFPD expert input, and newly collected/analyzed data to support the development of recommendations for improving the outcomes of evacuation events. Specific goals included development of recommendations around adjustments to MFPD's evacuation zones and traffic control points, as shown in Figure 3, MFPD Evacuation Plan.

Figure 3: Montecito Evacuation Map (2021)



The remainder of this report summarizes the following:

- Summary of Survey, Key Interviews, and After-Action Report Review Findings
- Traffic Operations Approach and Methodology
- Modeling Results
- Recommendations

2. Summary of After-Action Report Review, Community Survey, and Interview Findings

2.1 After-Action Report Review

The After-Action Report Review initiated the background research and data collection phase of work for the evacuation study. It includes a summary of the fire environment in Montecito and a description of lessons learned and recommendations gleaned from the review of key documents related to recent fires in California. The full analysis and findings can be found in Appendix A: After Action Report Memorandum. A synopsis of key findings are provided here.

After-action reports (AARs) are tools used to discuss an event, evaluate performance, and discuss strengths and weaknesses in response. In California, any city, county, or city and county that declares a local emergency for which the governor proclaims a state of emergency is required to complete an AAR. AARs can also be conducted by state agencies, the Federal Emergency Management Agency (FEMA), or third parties. The goal of an AAR is to identify areas that need to be addressed and learned from to improve response in future events. A total of 18 AARs were analyzed for this study, encompassing the past five years of catastrophic wildfires from across California. Below describes the lessons learned and findings for the community of Montecito.

Key findings from the review, organized by three overarching themes, are as follows:

- Public notification/information – communication, messaging, and information sharing was largely inconsistent across agencies and events
- Evacuation/sheltering – destination shelters were unprepared, and hotels often lacked capacity to shelter evacuees
- Recovery/re-entry – re-entry was inefficient and lacked consistent messaging and communication to the public

2.2 Community Survey

The community survey in support of this evacuation study was launched on July 24, 2021 and ended on August 27, 2021. In total, 141 people responded to the survey. Only responses from the 93108 zip code were included in the analysis, resulting in a final survey count of 113 responses. The full analysis and findings can be found in Appendix B: Public Survey Memorandum. A synopsis of key findings are provided here.

Key findings from the survey include:

- The main concerns during an evacuation were the road conditions impacting the ability to leave the area and how to return home after an evacuation.
- Respondents understood that when an evacuation warning is issued, they are to immediately begin preparing for an evacuation.
- Despite most respondents having been evacuated multiple times, respondents indicated high evacuation order compliance.
- Respondents were familiar with Ready! Set! Go! and it was the most common evacuation planning resource.
- Respondents were receptive to a community-wide evacuation plan and supportive of receiving additional evacuation planning resources.

2.3 Interviews

The consultant team conducted interviews with four fire chiefs and one sheriff deputy who all had experience with mass evacuation events from an initial attack, Incident Command perspective. They spanned a variety of jurisdictions and were selected in coordination with MFPD staff input. The interviewees were asked questions that addressed advanced planning efforts, public information and noticing, and post-evacuation/recovery themes. The full analysis and findings can be found in Appendix C: Evacuation Interview Results Memorandum. A synopsis of key findings are provided here.

Key findings from the interviews, for each of the three themes, include:

- Pre-planning efforts
    - Focus on coordination and developing trigger points for evacuation
    - Get residents engaged and keep them engaged throughout the year
    - Prepare residents so they are ready to respond and understand expectations
    - Develop and promote a campaign for alert registrations
- Public information and noticing
    - Establish standards for consistent and frequent messaging, including daily briefings so the public knows when to expect updates
    - Utilize pre-canned messaging as much as possible, with fill-in-the-blank style messages
    - Develop specific information for special needs, pet owners, and livestock
    - Include multi-lingual messaging and have interpreters/translators available during the event
- Post-evacuation and recovery
    - Develop a system for safely getting residents back home, including escorts and a pass system
    - Post photos and information so evacuees know the status of their property, easing concerns about damage and theft
    - Remind the public that re-entry does not mean the threat is completely gone

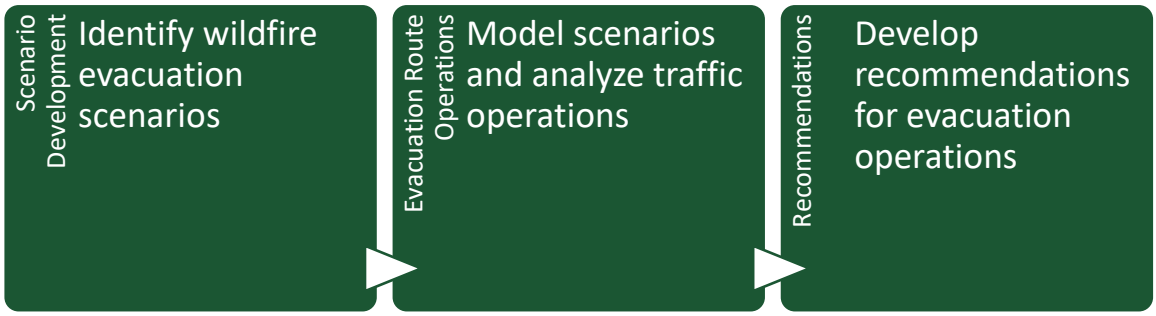
In addition, the following considerations were offered by the interviewees:

- Frequent evacuations or evacuation warnings can result in a populace that is desensitized and may not react in the desired way if evacuations occur too often.
- Continued public outreach is required to reach residents and provide them a clear understanding of their responsibility to help ensure their own personal safety.
- Expansion of a roadside vegetation clearance program is an important component of successful evacuations as it creates a safer passage by minimizing fire behavior that could temporarily block roadways and panic drivers.
- Additional mitigation measures should be incorporated into nighttime evacuations due to the increased complexity.
- Staging vehicles at key locations during weather conditions that would cause extreme wildfire behavior can maximize efficiency of executing an evacuation as it reduces the time needed for mobilization and evacuation orders.
- Private fire service personnel are increasingly working within the active fire zone, and coordination and communication with these personnel are not always adequate.
- Coordination with neighboring jurisdictions for issues including evacuation messaging, shelter, and traffic management can help minimize over-capacity shelters, traffic congestion, unsettled citizens, and impacts to multiple jurisdictions.

3. Traffic Operations Approach and Methodology

The approach illustrated in Figure 4 was adopted to study evacuation traffic conditions and identify improvements. There are an infinite amount of variations to wildfire emergency events and evacuation scenarios that can occur in the Montecito community. Given the geography and topography of Montecito, two of the likeliest scenarios were developed in coordination with MFPD staff and evaluated through this study. The following section explains each of the three stages of the traffic operations modeling approach in greater detail.

Figure 4: Emergency Evacuation Analysis Process



3.1 Scenario Development

After reviewing MFPD's Evacuation Plan and previous studies, we worked with MFPD to identify two wildfire evacuation scenarios. Each scenario specified the following parameters:

- **Description** – Definition of the wildfire scenario. Scenarios were based on previous studies conducted by MFPD and inputs from MFPD 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 time period is an important component of the study because it determines background traffic flows in the area that need to be considered in addition to evacuation traffic flows. For both scenarios, the peak afternoon period was selected to simulate a "worst-case" condition for background traffic.
- **Population, Households, and Employment** – Number of households and population in the evacuation area were identified. 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. Data from the 2020 Census and 2018 LODES data validated these totals and informed the disaggregation of transportation analysis zones (TAZs) into a greater level of detail.
- **Evacuation Trips** – Residents and employee's 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 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.

There is a wide range of potential wildfire scenarios that could cause the need for evacuation within Montecito. The two evacuation scenarios were developed with a goal of capturing variation in the different evacuation patterns and the resulting traffic congestion based on the geographic extent of the evacuating zones.

Table 1 summarizes the first evacuation scenario analyzed as part of this assessment. To reflect conditions that may occur during a wind-driven fire from the northwest, Scenario 1 has two phases of evacuation: Phase 1, an evacuation order issued for residents of zones 1, 2, and 3 to evacuate within 15 minutes, and Phase 2, an evacuation order issued for residents of zones 8 and 9 to evacuate within 90 minutes. This reflects possible pace of fire spread from evacuation zones 1, 2, and 3, which would be closer to the fire, to evacuation zones 8 and 9, which would be further from the fire. The zones included in each phase are shown in Figure 5.

Table 1: Summary of Evacuation Scenario 1

Parameters	Overall	Phase 1	Phase 2
Scenario Description	Phased evacuation of zones 1, 2, 3, 8, 9 during the peak afternoon period	Zones 1, 2, 3	Zones 8, 9
Time of Day	3:00-4:30pm	3:00-3:15pm	3:00-4:30pm
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		

Figure 5: Scenario 1 Evacuation Zones

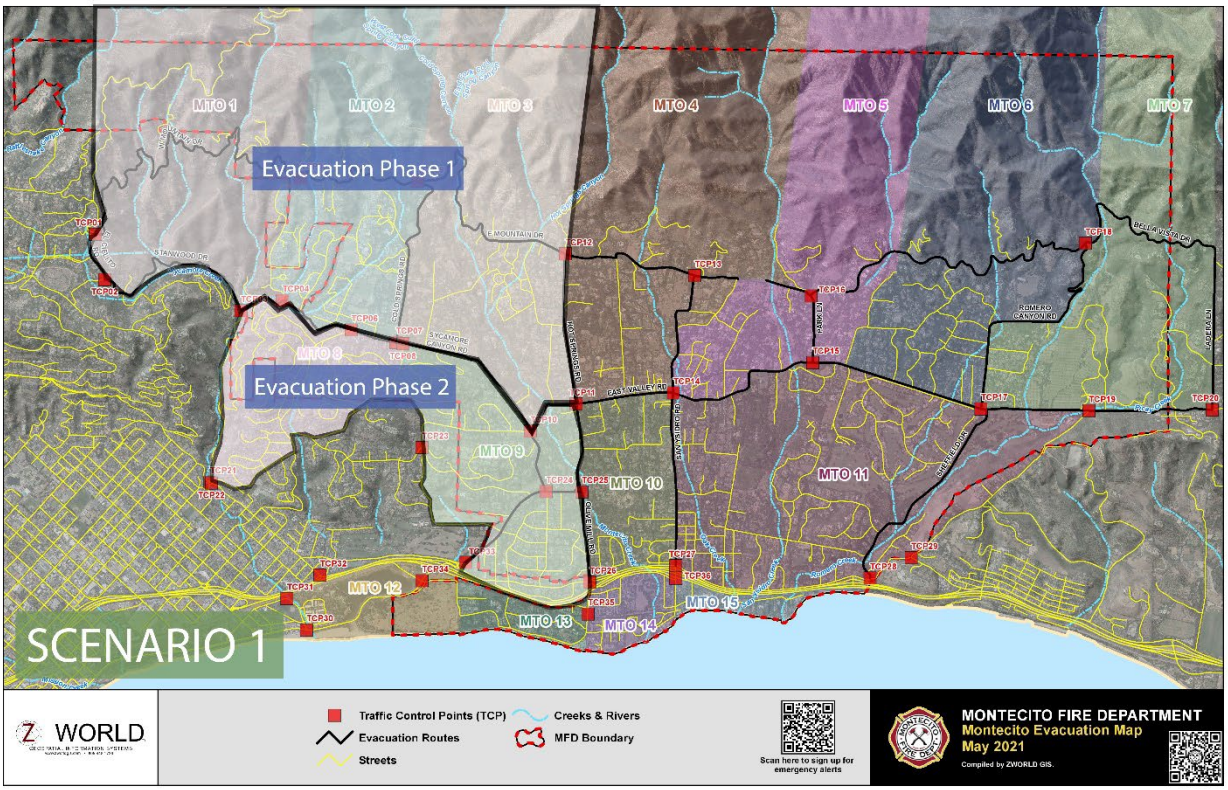


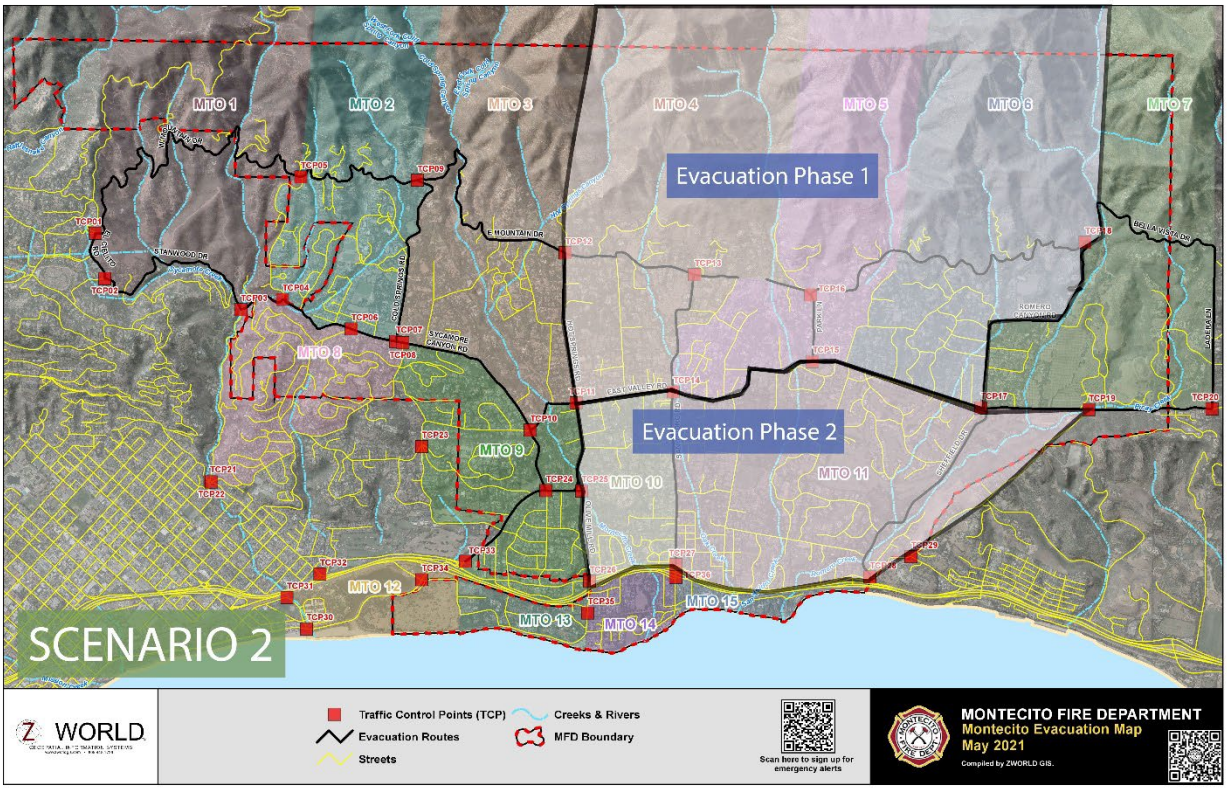
Table 2 summarizes the second evacuation scenario analyzed as part of this assessment. To reflect conditions that may occur during a fire from the northeast, Scenario 2 has two phases of evacuation: Phase 1, an evacuation order issued for residents of zones 4, 5, and 6 to evacuate within 15 minutes, and Phase 2, an evacuation order issued for residents of zones 10 and 11 to evacuate within 90 minutes. This reflects possible pace of fire spread from evacuation zones 4, 5, and 6, which would be closer to the fire, to evacuation zones 10 and 11, which would be further from the fire. The zones included in each phase are shown in Figure 6.

Table 2: Summary of Evacuation Scenario 2

Parameters	Overall	Phase 1	Phase 2
Scenario Description	Phased evacuation of zones 4, 5, 6, 10, and 11 during the peak afternoon period	Zones 4, 5, 6	Zones 10, 11
Time of Day	3:00-4:30pm	3:00-3:15pm	3:00-4:30pm
Population	4,316	1,794	2,522
Households	1,869	758	1,111

Parameters	Overall	Phase 1	Phase 2
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		

Figure 6: Scenario 2 Evacuation Zones



3.2 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 sub-area network representing the study area and the associated background trip tables
2. Estimating evacuation trips during the wildfire
3. Assigning trips (dynamically) to the sub-area network

The following sub-sections discuss each of these steps.

3.2.1 Preparing the Sub-Area Network and Associated Trip Tables

Supply and demand are two major aspects of any travel demand modeling exercise. In a travel demand model, the demand is usually derived from people having to perform some activity, for example going to work or evacuating during a wildfire. The resulting travel demand can be estimated from socio-economic data of the individuals whose travel constitutes such demand. The supply on the other hand is based on roadway capacity and travel speeds that determine how many vehicles can travel through a certain section of the roadway per unit of time. The total travel taking place during an evacuation period can be conceptualized as a sum of background travel, the kind that will happen irrespective of an evacuation, and the evacuation traffic that will enter the roads only because there has been an evacuation order creating the need to travel. In order to obtain the background travel, we first ran the SBCAG model with the most up-to-date socio-economic data for the Montecito community. Since the entire SBCAG area is too large to work with for the purposes of our analysis, we extracted a subset of the model area that represents the Montecito Fire Protection District and surrounding area including major gateways, such as freeway ramps and other roadways, that allow people to exit the area.

With this sub-area, we obtained the trip tables associated with the network that contain all the (vehicular) trips, by trip purpose (e.g. work) between each TAZ and the external gateways. The external gateways are not themselves destinations but serve as a proxy for trips leaving the study area.

Trip tables are a series of matrices that store trips between origin and destination pairs. A conventional travel demand model looks at travel aggregated in time periods. In the case of the SBCAG model these time periods are for the morning (6 am to 9 am), midday (9 am to 3 pm), afternoon (3 pm to 7 pm), and night-time (7 pm to 6 am). From an evacuation standpoint, these time periods are too large to develop an understanding of travel during an evacuation order lasting just a few hours with a large number of trips evacuating swiftly. Therefore, a 15-minute disaggregation of the trip tables was completed to allow for this greater granularity enabling traffic assignment in 15-minute intervals.

3.2.2 Subarea Model Calibration

The SBCAG model, as is typical in development of regional travel demand models, was calibrated and validated to the entirety of the SBCAG region, with parameters and assumptions about trip generation, roadway volumes, roadway capacity, and freeflow speed calibrated by and validated to empirical data from across the region. In order to ensure the subarea extraction of the SBCAG model reflected realistic conditions in Montecito, our team reviewed and modified the capacity and freeflow speed assumptions of the roadway network in Montecito, the roadway volume and trips within each TAZ, and ran a baseline "non-evacuation scenario" to compare to empirical data from across the subarea. Empirical data included

typical daily congestion patterns extracted from Google Maps, and 2019 average vehicle volume data by hour and as a daily average from Streetlight Data (location-based device data).

Through the process of model calibration, our team iterated through a series of baseline model runs, refining the parameters described above 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. Table 3 summarizes the model calibration results.

Table 3: Model Calibration Results

	One-Way (AB) Flow			One-Way (BA) Flow			All Direction Flow		
Time Period	**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*	*1,279*	***-11%***	*1,323*	*1,431*	***+8%***	*2,752*	*2,710*	***-2%***
3-4PM	*1,628*	*1,373*	***-16%***	*2,077*	*1,575*	***-24%***	*3,705*	*2,948*	***-20%***
4-5PM	*1,473*	*1,930*	***+31%***	*2,027*	*2,713*	***+34%***	*3,500*	*4,643*	***+33%***
2-5PM	4,530	4,581	**+1%**	5,427	5,719	**+5%**	9,957	10,300	**+3%**

[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.

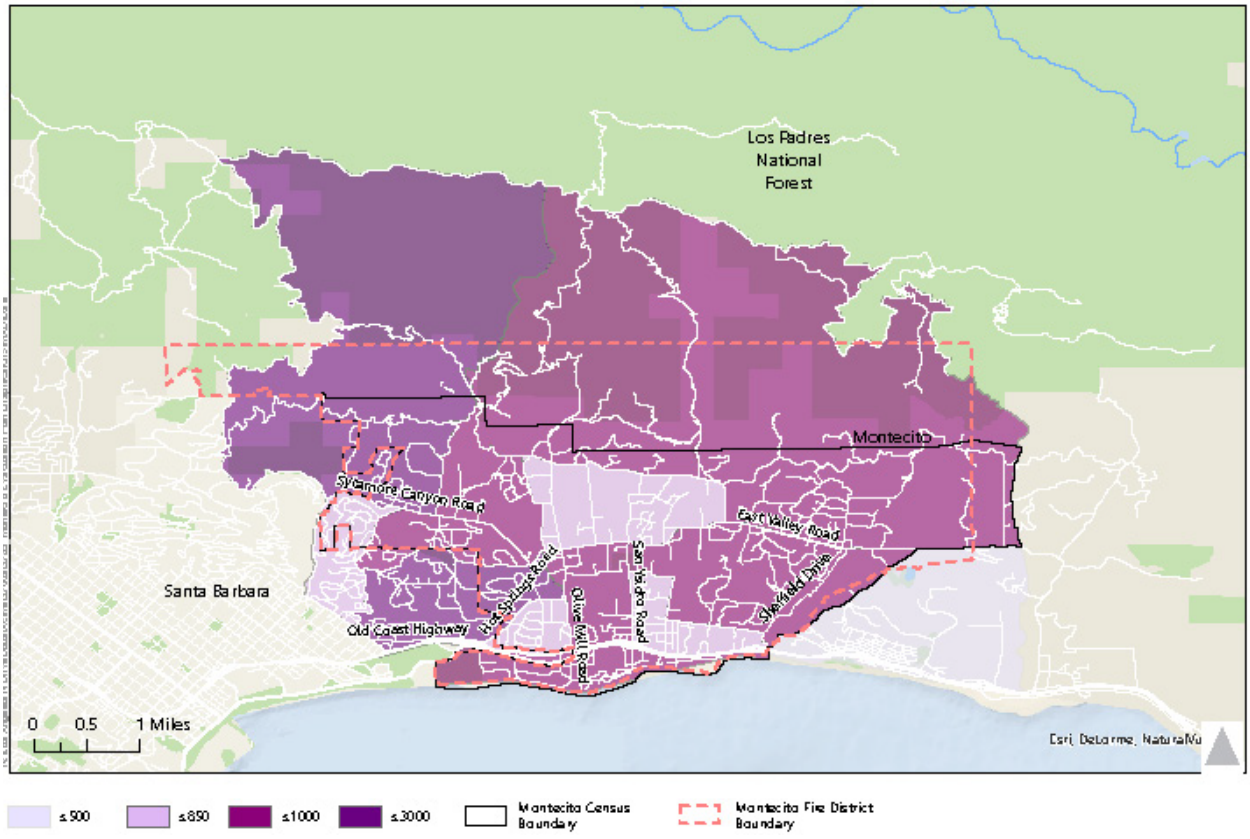
3.2.3 Estimate Trips During an Evacuation Event

In addition to the background traffic, traffic generated due to an evacuation, by residents, employees, and visitors of an evacuation area comprises the other portion of the total travel during an evacuation. In order to estimate the trips that would result during an evacuation, we need to determine the geographical extent of evacuation. TAZ geographies are used to represent neighborhoods and estimate the number of trips per household or trips per employee. The TAZ geography for Montecito as available from the SBCAG model was not detailed enough for the purpose of the evacuation evaluation and the boundaries did not exactly align with the evacuation zones as defined by MFPD. Therefore, some TAZs in Montecito were divided into smaller TAZs to better represent how trips leave the evacuation area and reflect the MFPD zones.

The number of vehicle trips generated by each household 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

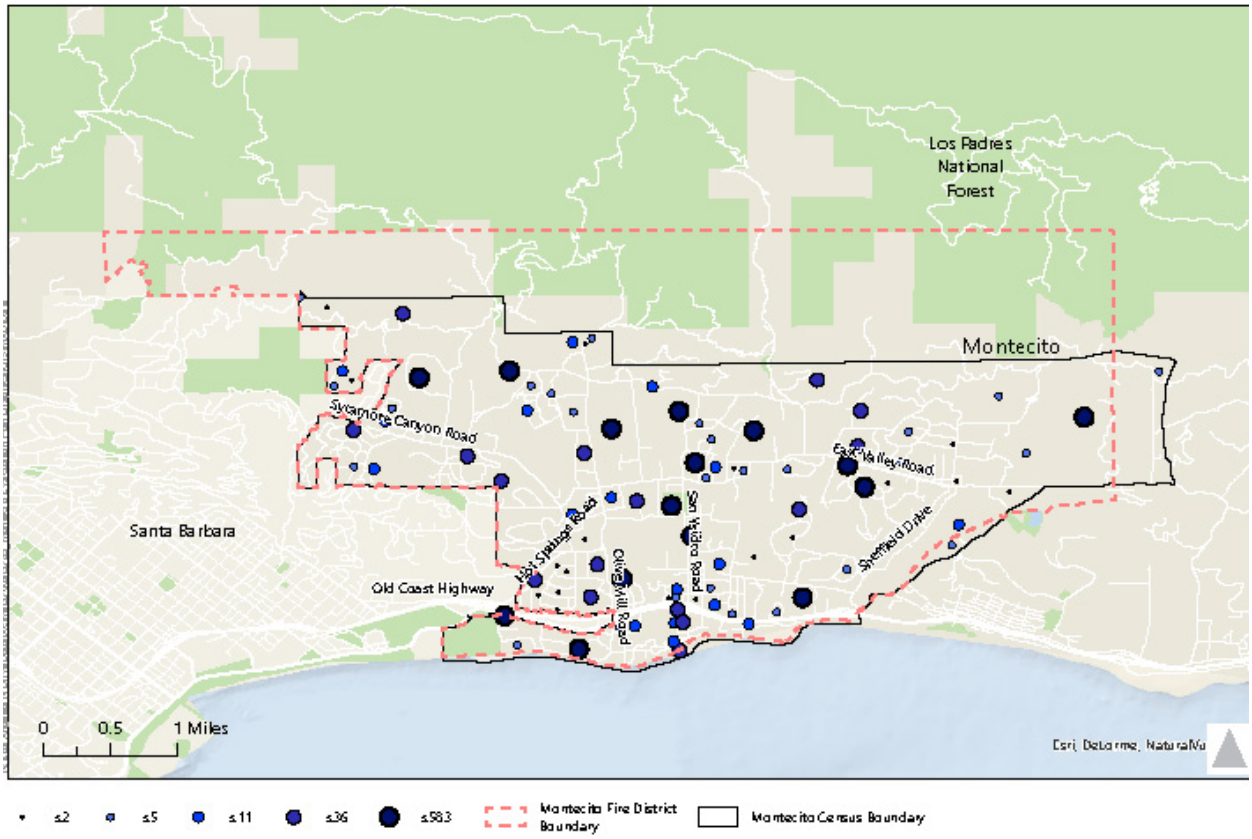
other factors that could affect the number of vehicles per household used during an evacuation event. The TAZs in Montecito were updated using 2020 Census data and 2018 LODES data (which describe the number and location of jobs within Montecito). These data are available at the census tract or block-group level. While TAZs typically line up well against census tracts, where needed, SED data were adjusted to account for differences in geographical boundaries. Plots showing population and employment distribution in the study area are shown in Figure 7 and Figure 8.

Figure 7: Population in Montecito Study Area (US Census, ACS 5-Year Estimates, 2019). Note: Population data are available at the block group level, which is similar but not identical to the MFD boundary and the Census Place boundary. Both boundaries are shown in Figure 7.



The households of each TAZ are classified by size and vehicle ownership so that the Evac+ tool can simulate the number of evacuation vehicle trips likely to be produced by each household in evacuating TAZs. Additionally, 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).

Figure 8: Jobs in Montecito Study Area (US Census. Longitudinal Employer-Household Dynamics [LEHD], 2018). Note: LEHD data are available at the Census Place boundary, which is similar but not identical to the MFD boundary. Both boundaries are shown in Figure 8.



For employees, each TAZ is assigned a vehicle mode share based on the mode share of all home-based work trips that the TAZ attracts. This estimate assumes that employment centers would provide evacuation assistance to employees without access to a vehicle. The employees in each TAZ are associated with parameters for home-based work (HBW) person-trip vehicle mode share and average vehicle occupancy so that the tool can simulate the number of evacuation vehicle trips likely to be produced by employees in the same TAZs. The overall employee vehicle mode share for Montecito is 97.5% and the average vehicle occupancy is 1.04.

The on-campus-living student population of Westmont College is included in the population total above but not in the households total, since the SBCAG model treats group quarters housing such as student dormitories differently from permanent resident housing. To account for evacuation trips from the college, we added a fixed 708 vehicle trips, which is equal to the number of parking spaces on campus, assuming 95% of parking spaces are utilized.

3.2.3.1 Vehicle Travel Demand

The dynamic traffic assignment model only reflects personal vehicle traffic. Due to the nature of this model, travel made by those in public transit, other shared modes (i.e., vanpool), or walking/biking are not

considered. The overall vehicle travel demand was based on the typical travel for each hour of daily activity until the evacuation notice was given. The travel demand for evacuation zones was separated from background traffic not associated with evacuation zones.

The activity and purpose of travel for evacuation traffic and background traffic vary by type and time of the event. In some cases, the trip destination also changes, especially for travel associated with evacuation zones. The description of evacuation and background travel activity is described below.

3.2.3.1.1 Evacuation Traffic

The evacuation travel demand consists of traffic generated by residents, employees, and students of evacuation zones. The number of residents, anticipated vehicle trips per household, and employees in the area were referenced to estimate the number of vehicles that would need to evacuate. For residential trips, the family unit is assumed to be together and the evacuation trip is made directly to the evacuation destination (i.e., shelter or external gateway). Similarly, employees in the evacuation zone may return home if their home is not in an evacuation zone or will travel to a shelter or out of the model area if their home is also in an evacuation zone.

3.2.3.1.2 Background Traffic

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 9 and Figure 10 show how evacuation trips over the entire sub-area network compare to non-evacuation or background traffic during the same (evacuation) period for each scenario. These graphs also show the comparison to trip volumes during the baseline (no evacuation) scenario.

Figure 9: Scenario 1 Comparison of Evacuation Trips to Non-Evacuation Trips by 15-Minute Time Segments

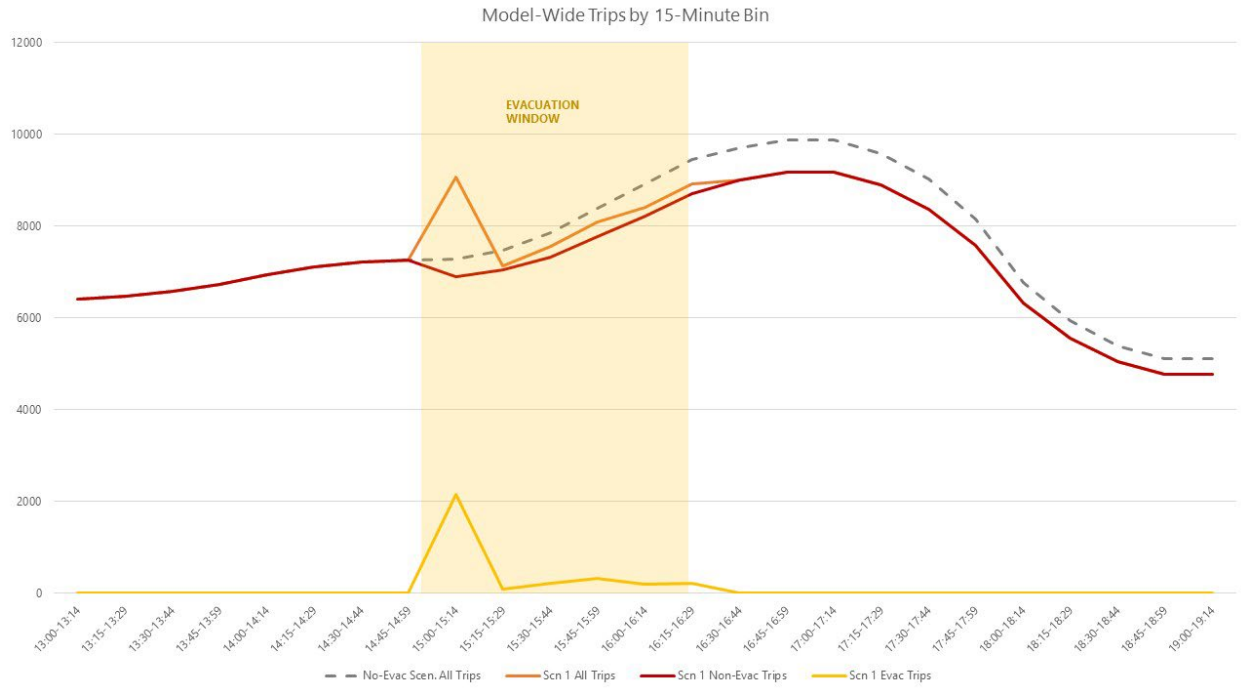
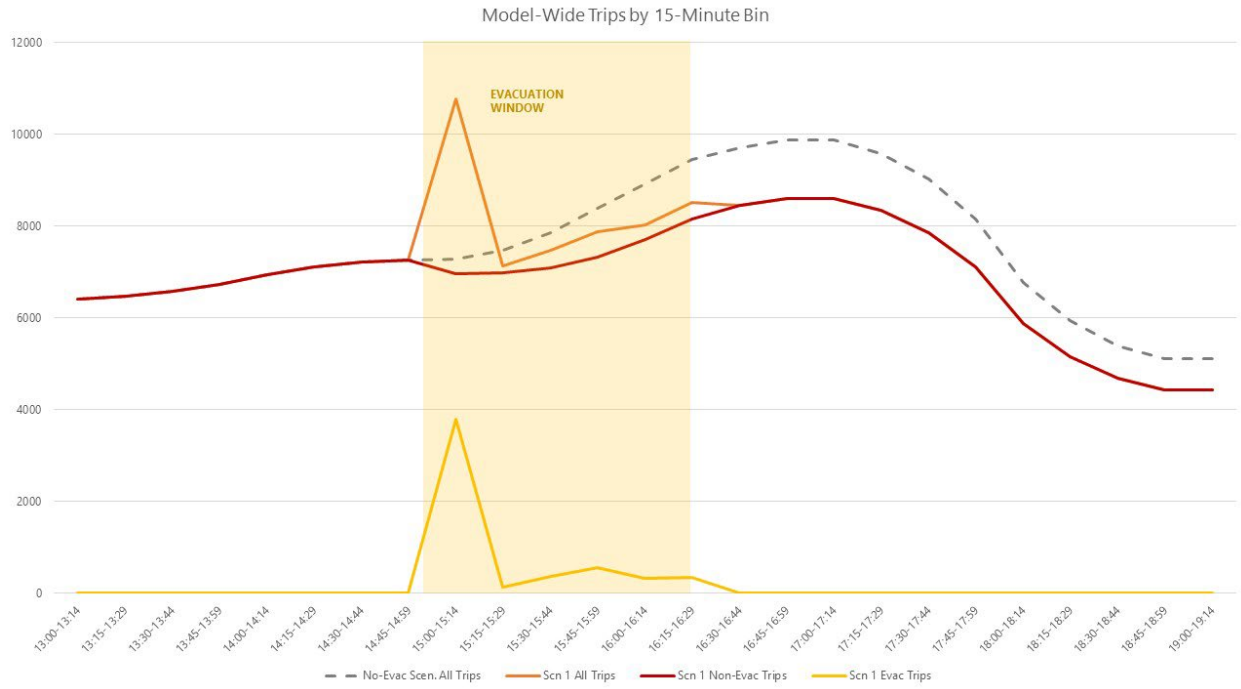


Figure 10: Scenario 2 Comparison of Evacuation Trips to Non-Evacuation Trips by 15-Minute Time Segments



3.2.3.2 Evacuation Departure Time

The departure time leaving the evacuation zones varies by the time and type of the event. For events where ample notice is given, less time is needed to prepare for the evacuation. On the other hand, when little notice of an event is given, the time required to prepare for an evacuation is typically longer as residents need to pack belongings, collect their animals, and conduct other coordination before beginning their evacuation trip. For both scenarios analyzed in this study, zones within both phases of the evacuation were simulated to depart immediately.

3.2.3.3 Evacuation Time Window

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 are shown in Table 4 and Table 5. 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. This is consistent with research on short-notice evacuation events as documented in the *Approach to Modeling Demand and Supply for a Short-Notice Evacuation* (Noh, Chiu, Zheng, Hickman, and Mirchandani, Transportation Research Record 2091) and the *Florida Statewide Hurricane Evacuation Model / TIME* presentation, although that distribution was for a much longer time period due to advanced warnings of hurricanes (Roberto Miguel, AICP, December 9, 2015). For the purposes of this simulation, therefore, this is the assumed distribution for Phase 2 in the EVAC+ model. In reality, however, emergency scenarios are often unpredictable, driver behavior can be disorderly, and evacuation events can be nonlinear.

Table 4: Evacuation Time Distribution Assumptions for Scenario 1

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%	2%

Table 5: Evacuation Time Distribution Assumptions for 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%	2%

The capacity assessment of the network also changes the time needed for an evacuation. For example, scenarios where a 2-hour time window is assumed for evacuation (generally representing the time from evacuation order to the time most people begin their trip to leave the area), the total time needed for evacuation can be longer due to time in congestion and total distance traveled into/out of the area. Evacuation orders that have shorter required departure times, for example Phase 1 of both evaluated scenarios in this study which require departure within 15 minutes of receiving the order, the roadway network would reach capacity faster than if the evacuation order had a longer departure window.

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.

3.2.3.4 Evacuation Destination

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 capacity of each use within the model area and the shelter opportunities represented at the gateways are used to determine the destination of evacuation trips. Based on consultation with the MFPD and knowledge of Montecito and its surrounding area, the share of trips ending in each evacuation destination were assumed as noted in Table 6. These parameters were kept the same across both scenarios.

Table 6: Share of Trips Ending in Different Evacuation Destinations

Description	Share of Trips	Details
Hotels (internal to sub-area)	8%	Based on a review of hotel capacity in the sub-area
Shelters & Stadiums (internal to sub-area)	0%	No shelters or stadiums in the sub-area

Description	Share of Trips	Details
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

3.2.4 Dynamically Assign Trips to the Sub-Area Transportation Network

The EVAC+ tool relies on the TAZs and existing roadway network details extracted from the SBCAG model. Where needed, as described in the Subarea Model Calibration section above, additional roadway details were added to the network to better reflect the possible routes people would take to evacuate. The 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 sub-area extracted network and new trip tables are then input into a Dynamic Traffic Assignment (DTA) model. A DTA model estimates traffic and levels of congestion on 15-minute intervals and, as link congestion builds (i.e., roads fill with cars), it dynamically reassigns traffic to less congested routes. 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.

4. 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 Dynamic Trip Assignment 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), while the width of the lines represents traffic volume.

The results of both scenarios capture the high levels of travel demand that occur 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 are described in the following sections.

4.1 Scenario 1, Phased Evacuation of Zones 1, 2, 3, 8, and 9

Due to the phased approach of this evacuation scenario, congestion caused by vehicles evacuating builds up quickly, within the first 15-30 minutes of the evacuation period as zones 1, 2, and 3 evacuate simultaneously. As shown in Figure 9, above, 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. However, as shown in Figure 11 and Figure 12, below, some locations experience more of an evacuation-related peak while other locations, due to background travel demands, are already experiencing congestion before the evacuation is called. For example, San Ysidro Road, Olive Mill Road and Hot Springs Road north of the US-101, and the US-101 itself are all experiencing congestion due to typical background traffic at the time of the evacuation. Note, the locations identified in the graphs in Figure 11 are identified with stars on the maps in Figure 12 through Figure 16.

Figure 12 through Figure 16 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. The period of greatest congestion across the local road network is present in the early stages of the evacuation, as the peak of the first phase uses local roads and arterials to exit the evacuating zones and travel towards the US-101 and other exit routes from Montecito. Due to congestion, vehicles are dynamically routed towards the City of Santa Barbara on Barker Pass Road and Sycamore Canyon Road as the quickest travel path instead of traveling on the more congested north-south roads in Montecito and avoiding congestion at the US-101 ramps. 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. 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.

Figure 11: Distribution of Evacuation Scenario 1 Trips at Selected Locations on the Roadway Network

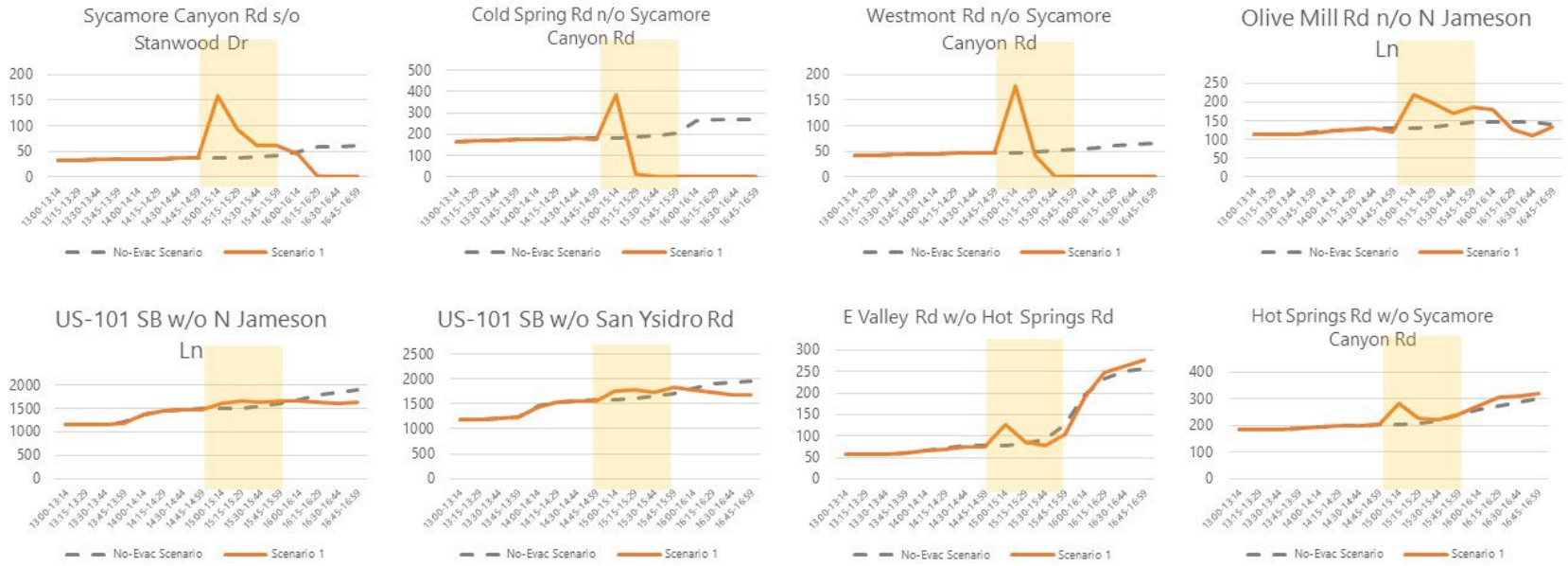


Figure 12: Scenario 1, Pre-Evacuation Period

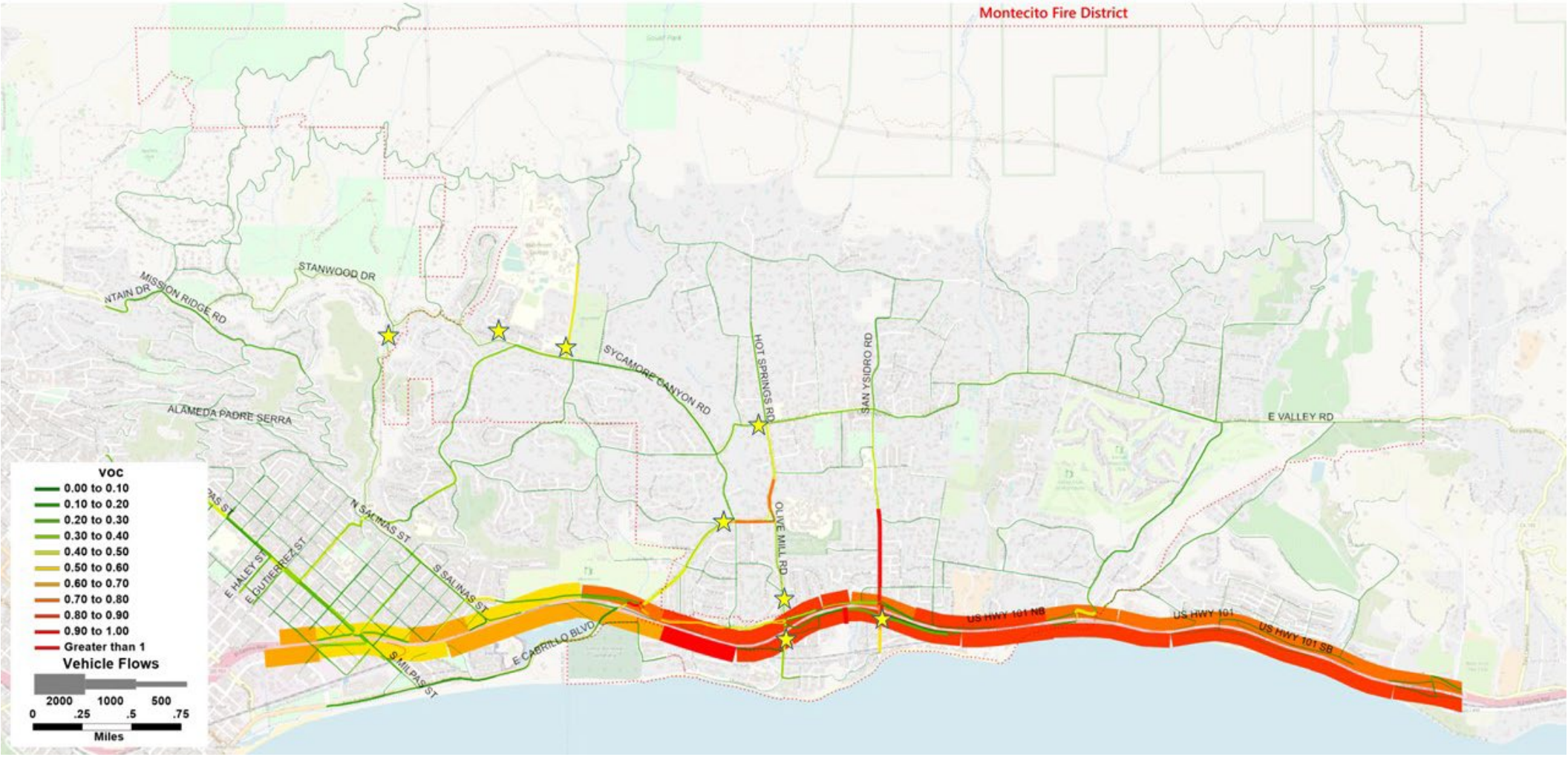


Figure 13: Scenario 1, Early Evacuation Period

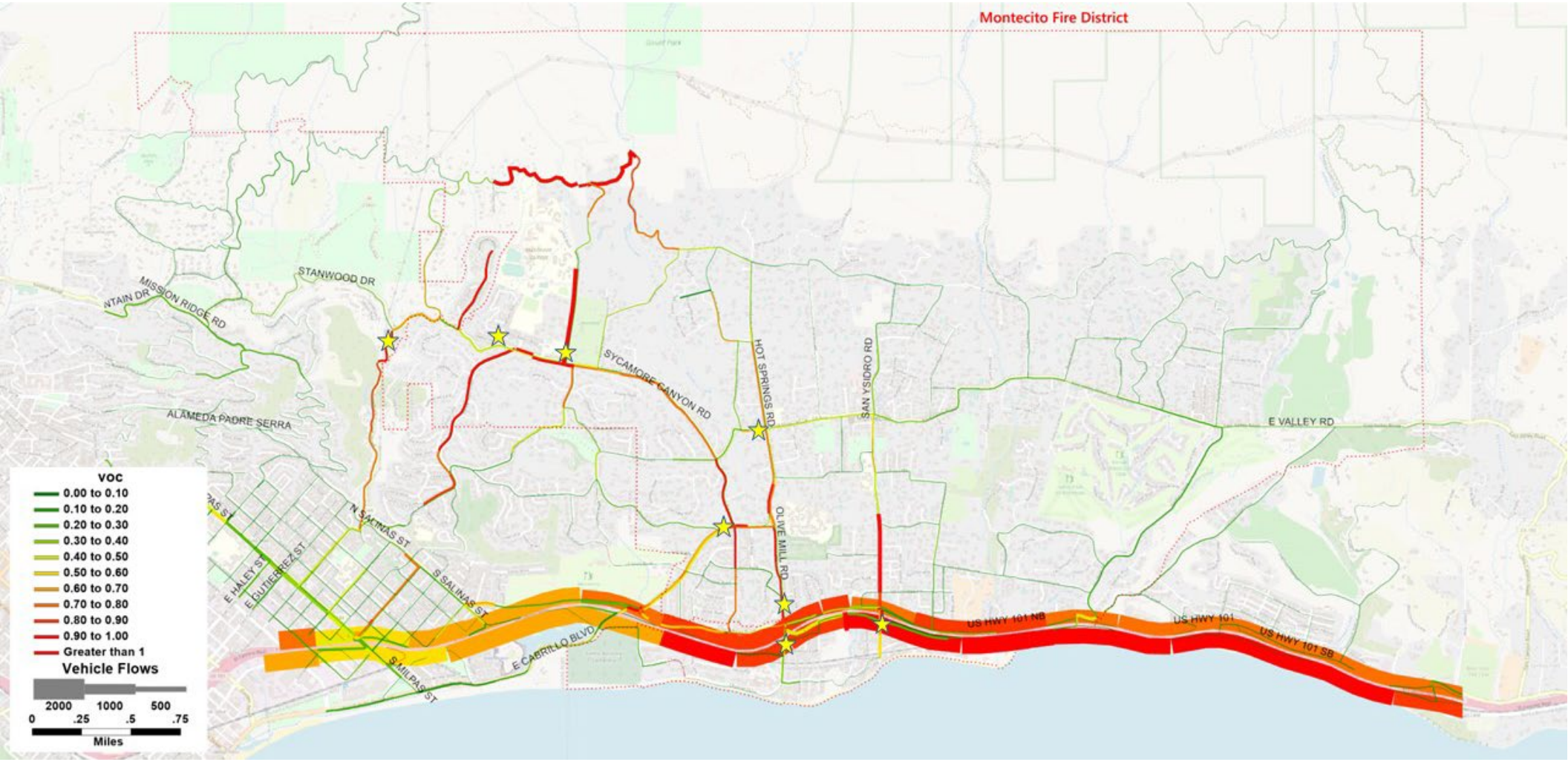


Figure 14: Scenario 1, Mid-Evacuation Period

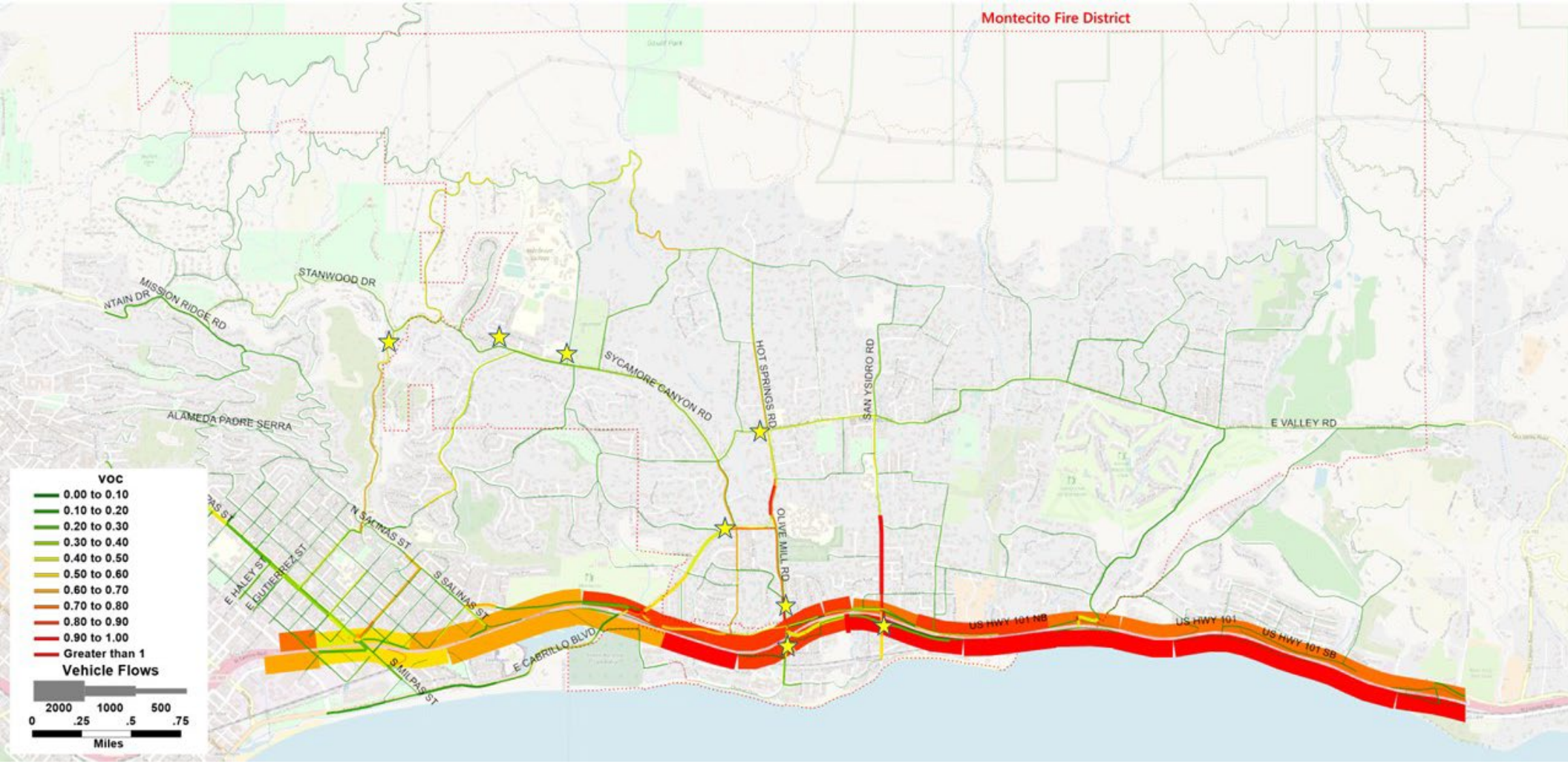


Figure 15: Scenario 1, Late Evacuation Period

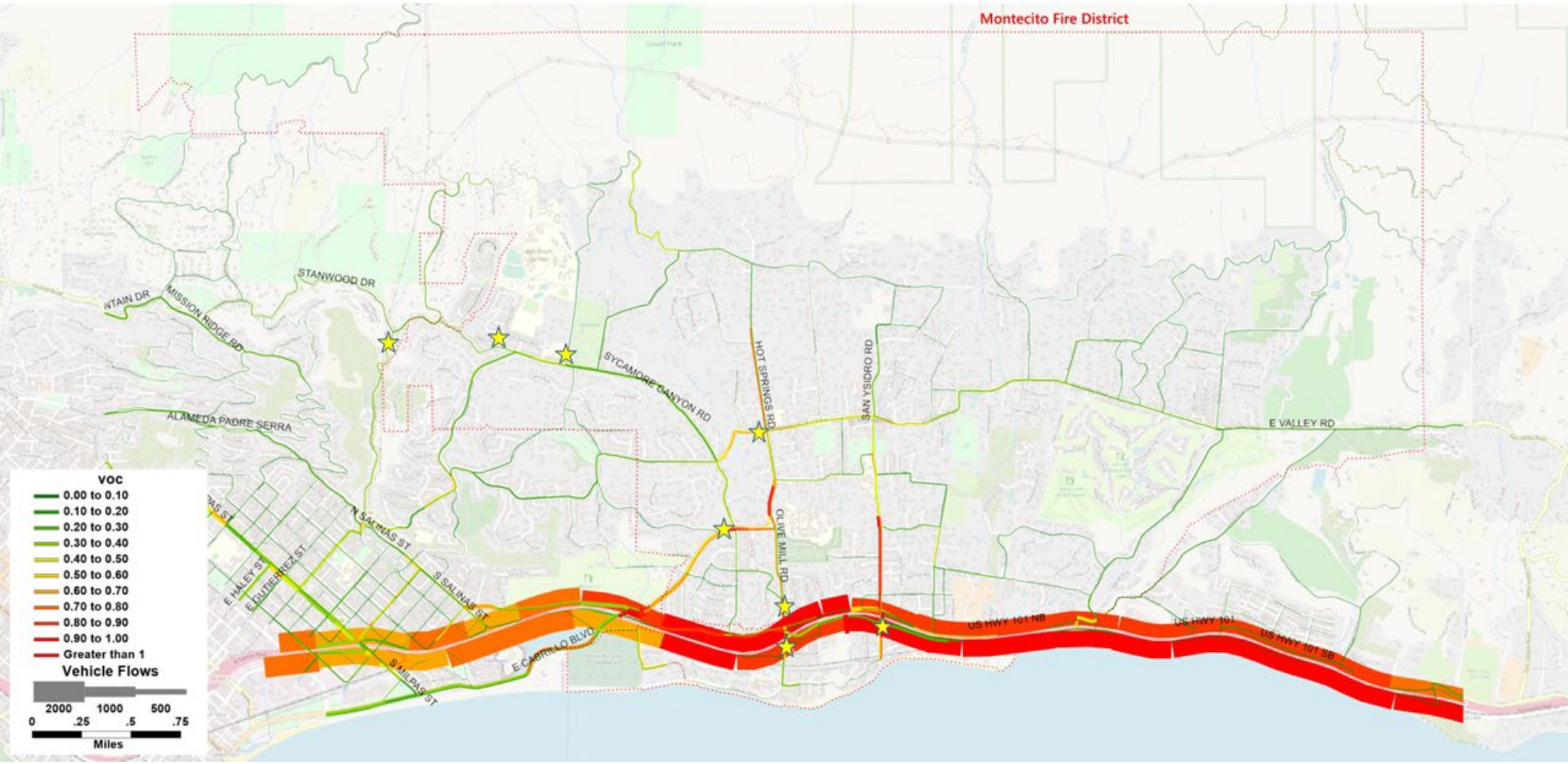
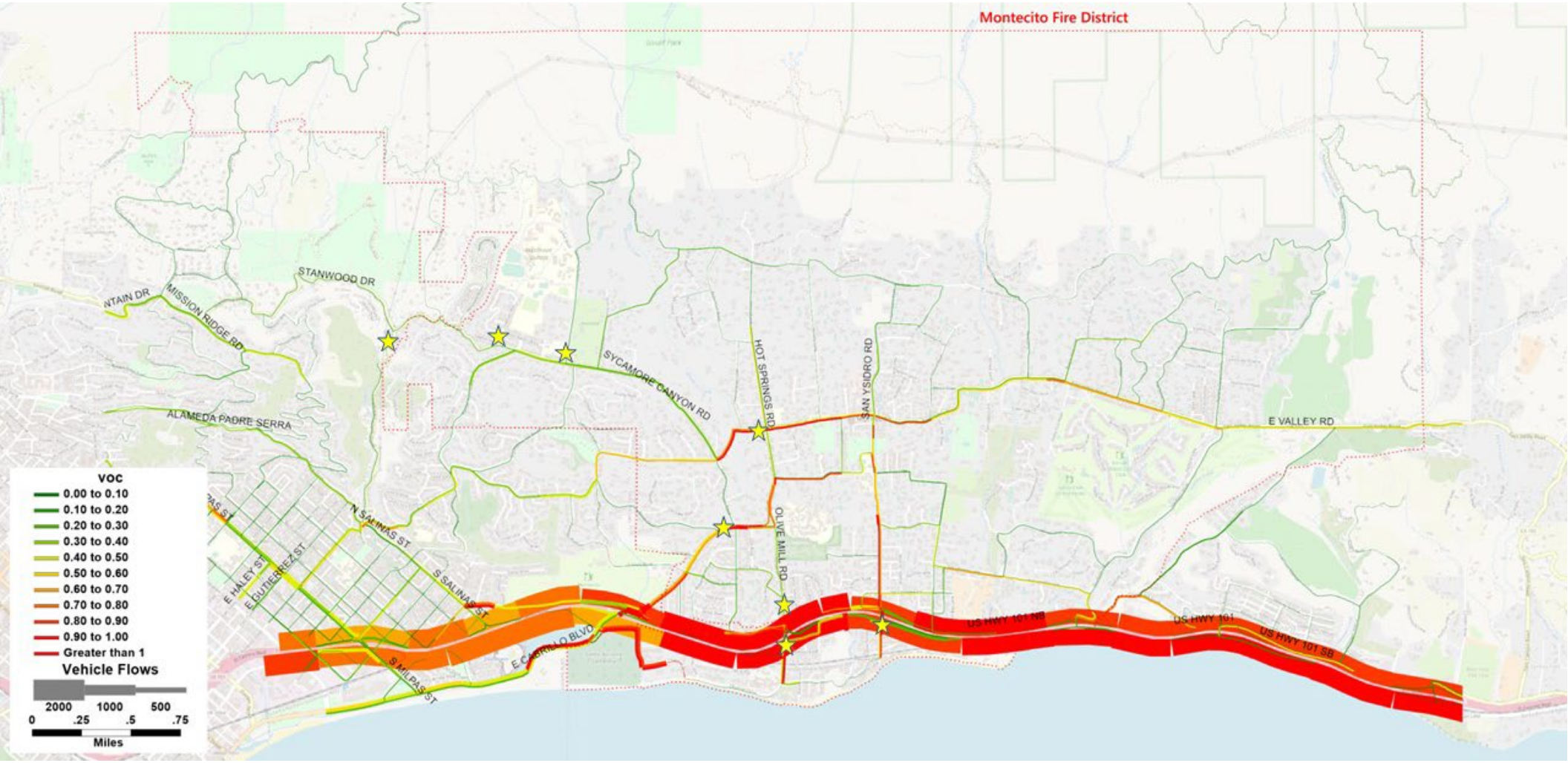


Figure 16: Scenario 1, Post-Evacuation Period



4.2 Scenario 2, Phased Evacuation of Zones 4, 5, 6, 10, and 11

Due to the phased approach of this evacuation scenario, 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 in Figure 10, above, 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. However, as shown in Figure 17 and Figure 18, below, some locations experience more of an evacuation-related peak while other locations, due to background travel demands, are already experiencing congestion before the evacuation is called. As in Scenario 1, San Ysidro Road, Olive Mill Road and Hot Springs Road north of the US-101 and the US-101 itself are experiencing congestion due to typical background traffic at the time of the evacuation. Note, the locations identified in the graphs in Figure 17 are identified with stars on the maps in Figure 18 through Figure 22.

Figure 18 through Figure 22 show the progression of congestion across the network before the evacuation begins, 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. Similar to Scenario 1, the period of greatest congestion across the local road network is present in the early stages of the evacuation, as the peak of the first phase uses local roads and arterials to exit the evacuating zones and travel towards the US-101 and other exit routes from Montecito. During the first 30 minutes of the evacuation period, most of the arterials on the east side of Montecito experience congestion. As the primary roadway providing access to evacuating vehicles, East Valley Road becomes increasing 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 faster paths through the local roadway network. Congestion also persists in the northeast part of Montecito along Bella Vista Drive.

During the course of the evacuation, the congestion on US-101 worsens and then subsides in the as a result of the evacuation on top of background traffic that grows between 3:00PM and 4:30PM. By the end of the evacuation period, congestion within the evacuating zones has cleared, with some new spots of congestion emerging along Cold Spring Road north of Sycamore Canyon Road, likely unrelated to the evacuation and more related to PM peak travel from Westmont College and other land uses north of Sycamore Canyon Rd.

Figure 17: Distribution of Evacuation Scenario 2 Trips at Selected Locations on the Roadway Network

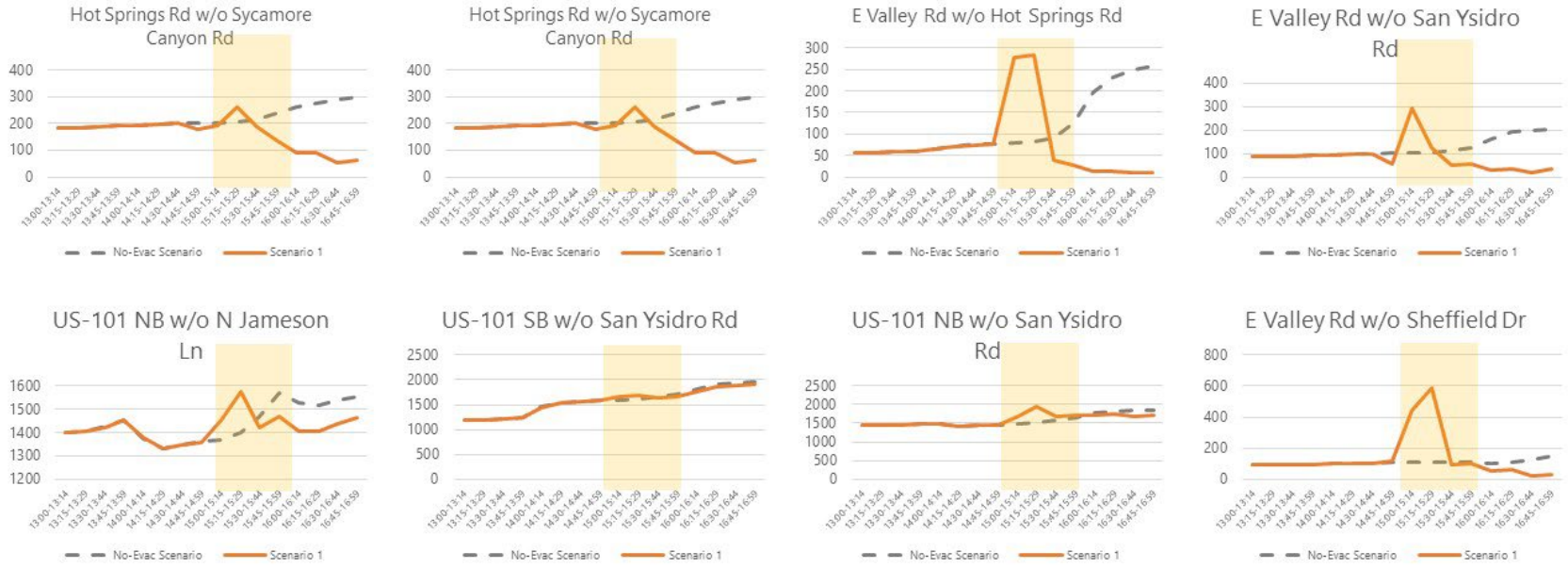


Figure 18: Scenario 2, Pre-Evacuation Period

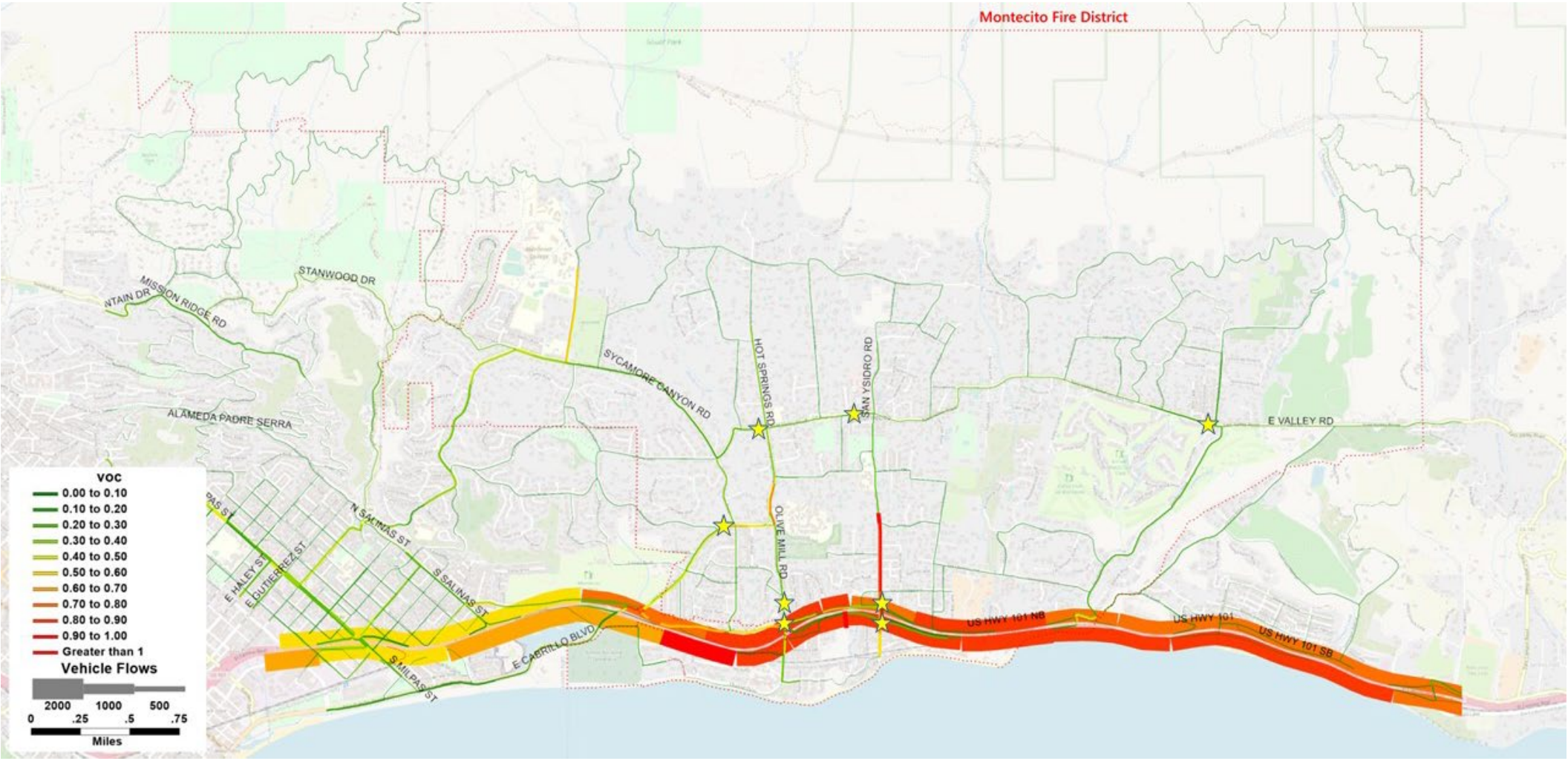


Figure 19: Scenario 2, Early Evacuation Period

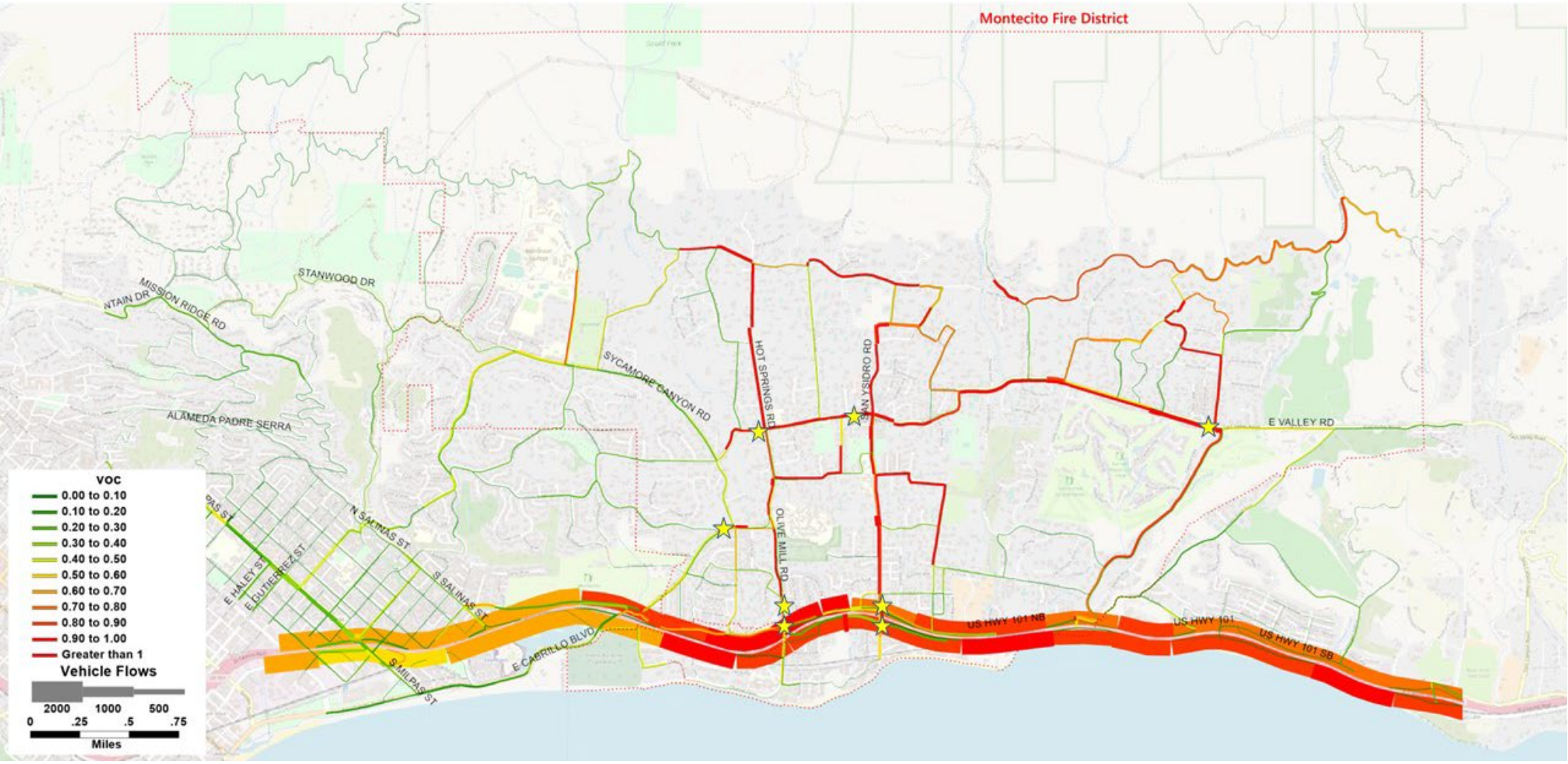


Figure 20: Scenario 2, Mid-Evacuation Period

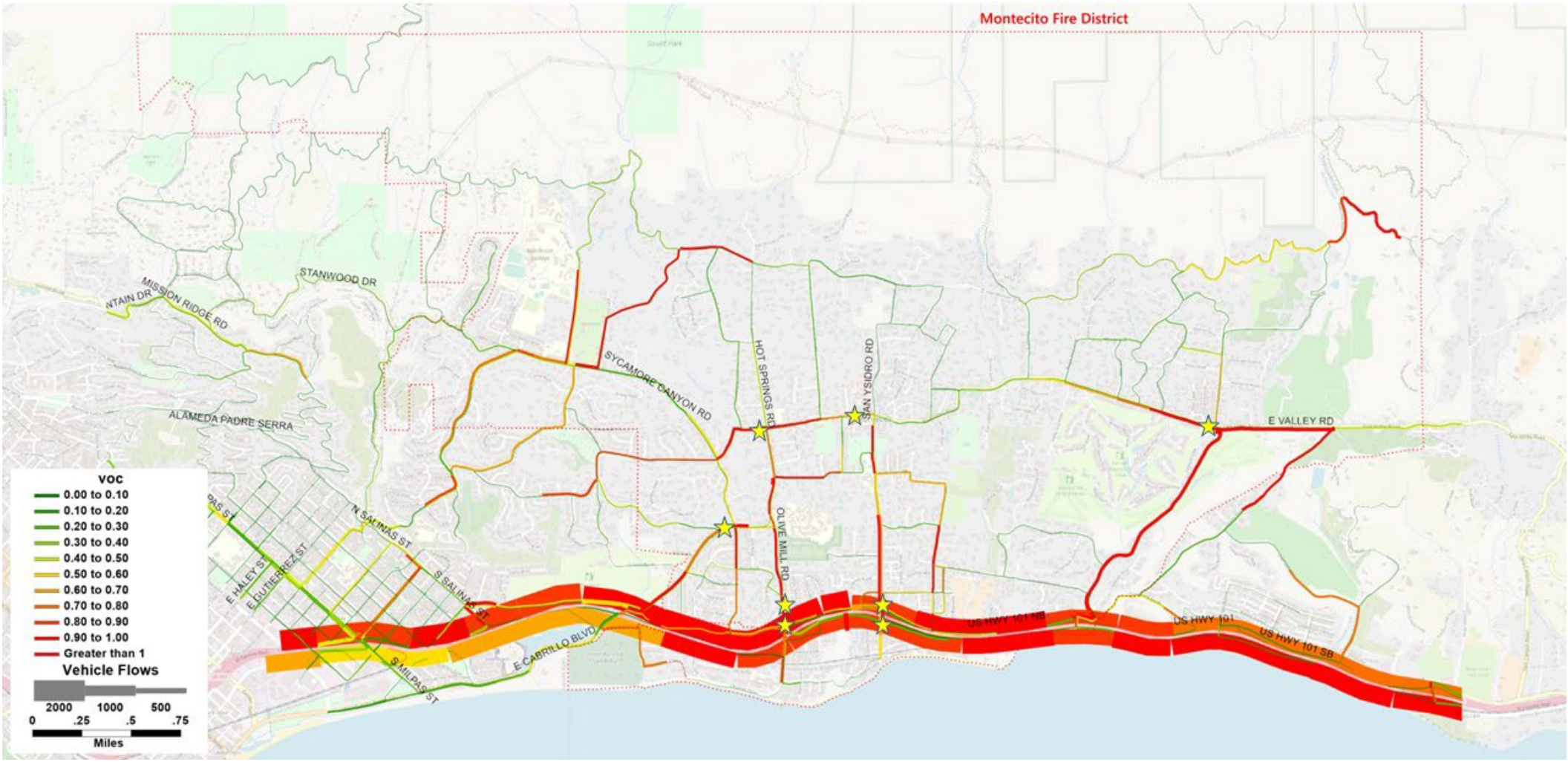


Figure 21: Scenario 2, Late Evacuation Period

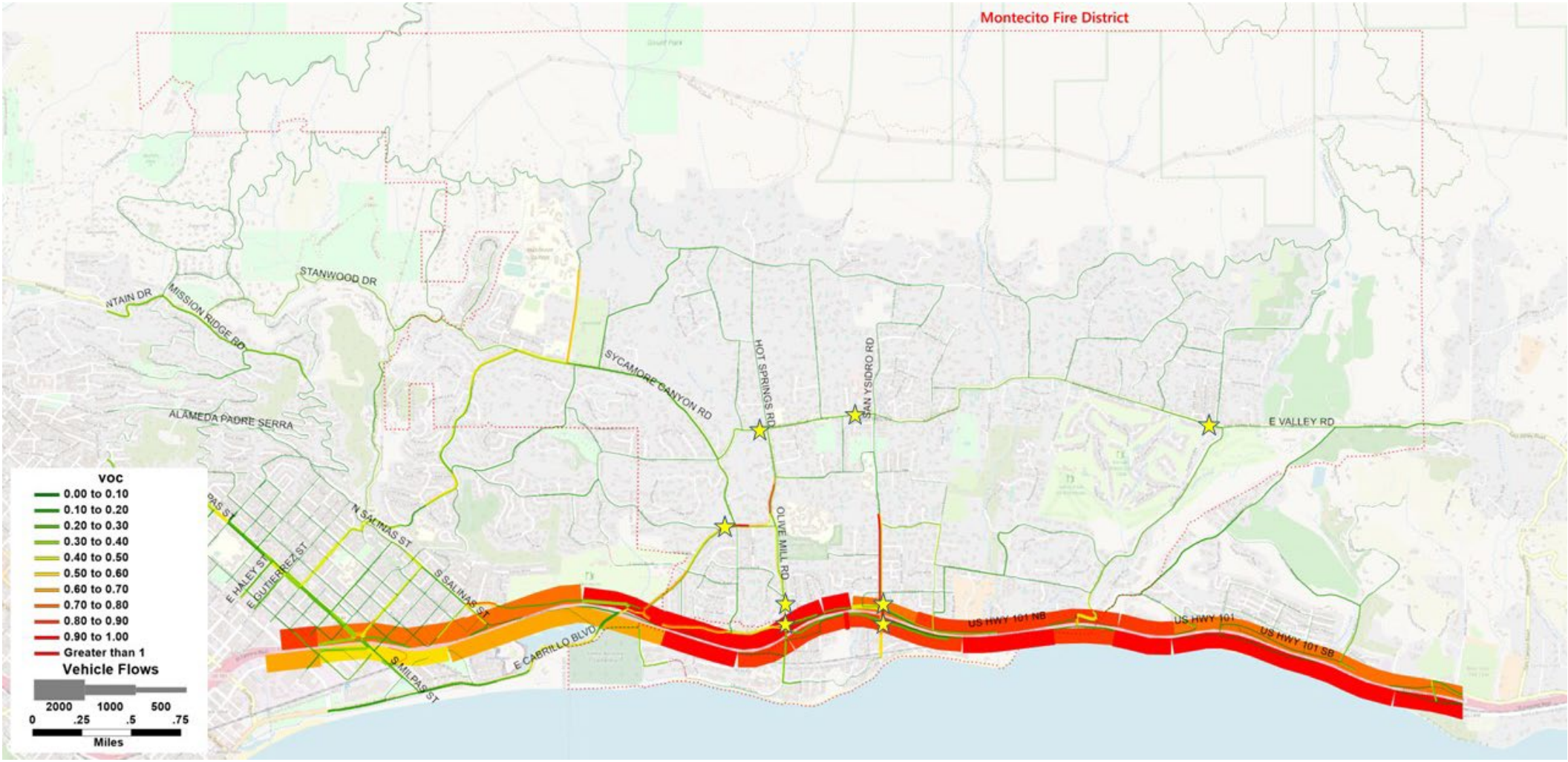
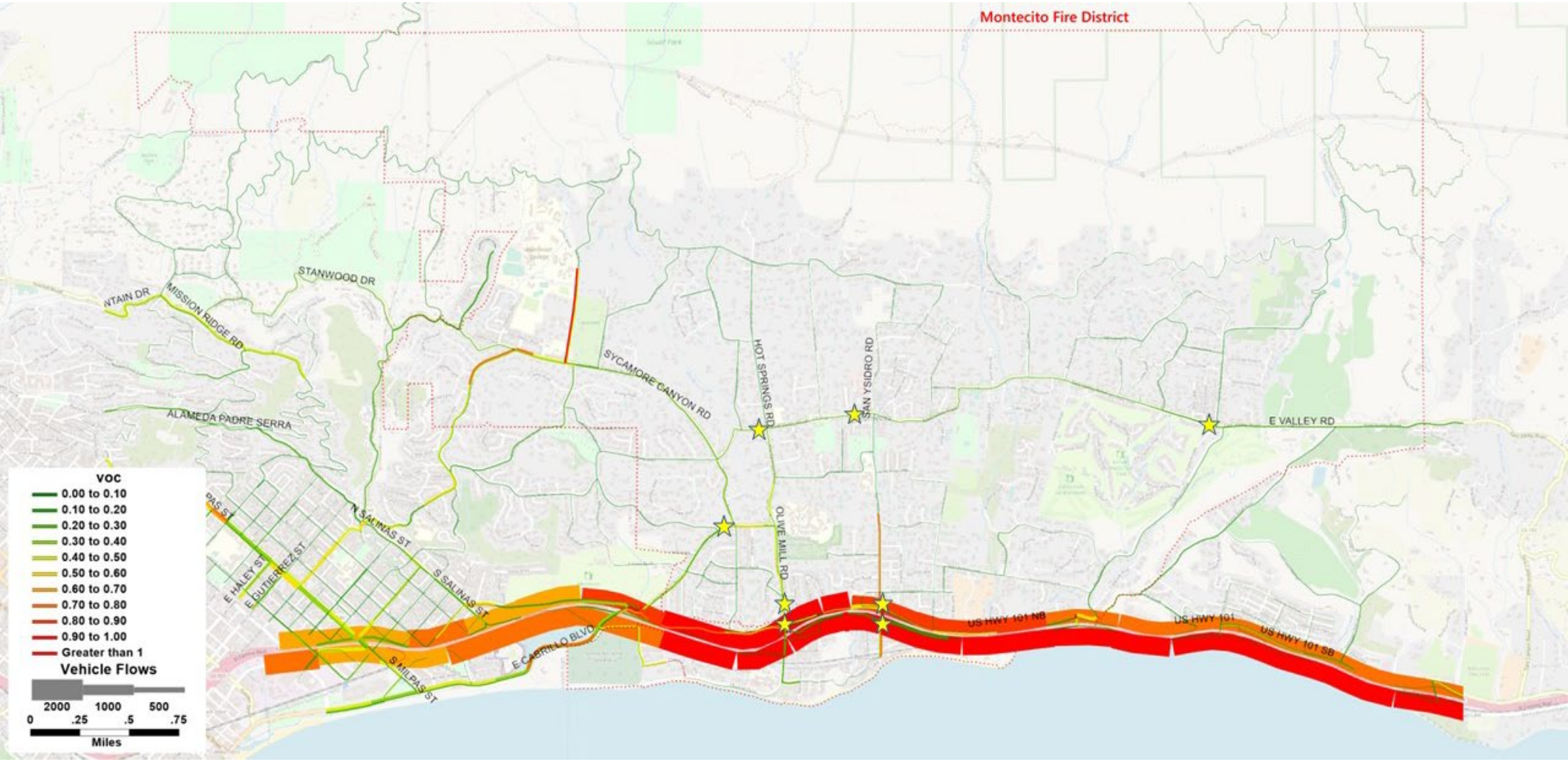


Figure 22: Scenario 2, Post-Evacuation Period



5. Recommendations

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. Despite these constraints and challenges, MFPD can build on existing local efforts and incorporate additional strategies that improve the efficiency of evacuation operations and create alternatives to full community evacuation.

The recommendations in this section are based on the results of the model as well as the community survey, AAR review, and interviews with fire and sheriff staff. They can be organized into the following categories, and are detailed further in this section below.

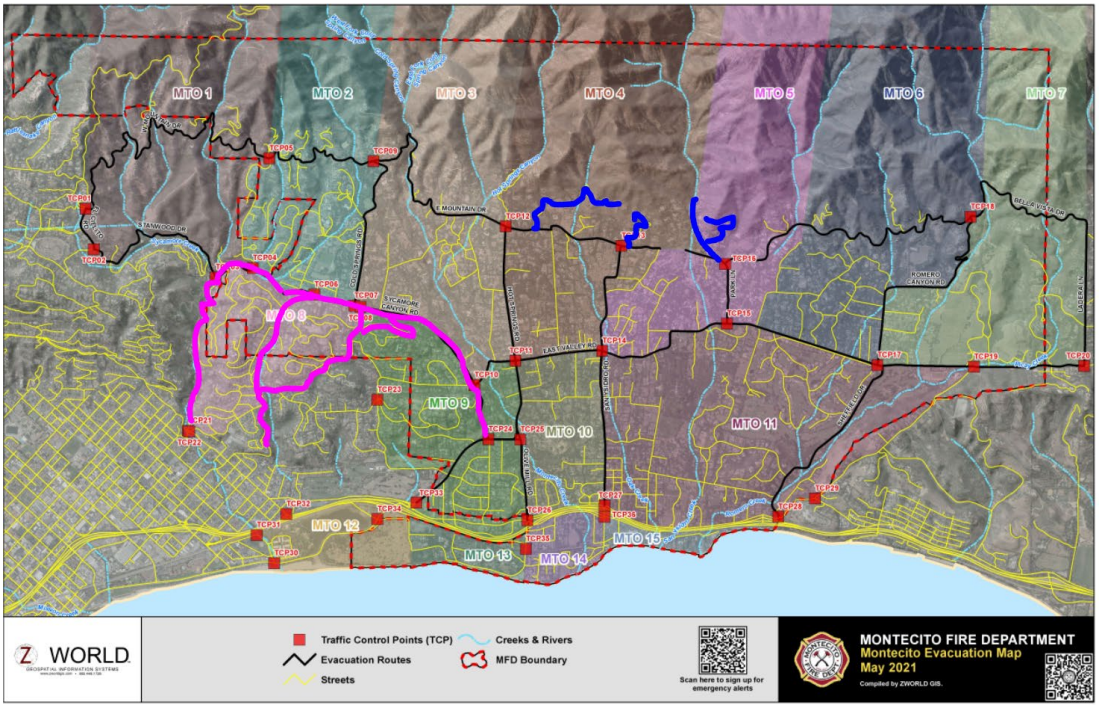
- Wildfire mitigation: strategies that greatly increase the likelihood that the roadway network is passable, enhance the resilience of the wildland-urban interface (WUI), and discourage fire spread
- Demand-side recommendations: strategies that influence when, how, and where people evacuate in an emergency
- Supply-side recommendations: strategies that influence the physical and operational roadway infrastructure that facilitate an emergency evacuation
- 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

5.1 Wildfire Mitigation

- Identify opportunities to expand fuel treatments to reduce fuel loads and minimize fire behavior along critical evacuation corridors. As shown in Figure 23 in blue, key roadways for deployment of additional fuel reduction efforts include:
    - Oak Creek Canyon Rd
    - Park Ln West
    - Park Hill Ln
    - High Drives off East Mountain Dr
- Expand or enhance fuel management to enclaves and vacant parcels along the following corridors, as shown in Figure 23 in purple:
    - Eucalyptus Hill Rd
    - Sycamore Canyon Rd

- Arcady Rd
- Barker Pass Rd

Figure 23: Areas for expanded or enhanced fuel management



- Seek opportunities to expand the existing fuel treatment network to increase the buffer between the urban environment and the wildlands to the north.
- Consider extending the fire code defensible space to 200 feet.
- Enhance prescribed herbivory within MFPD.

5.2 Demand-Side

- Deploy traffic management staff to intersections that are likely to have the greatest impact on traffic operations. In particular, intersections along SR-192 that are two-way stop controlled in the north/south direction may benefit from additional control to pause east/west traffic and allow southbound traffic to clear through. The key locations with this condition that are not already designated as traffic control points include:
    - Romero Canyon Road
    - Orchard Ave
    - Tabor Ln
    - Oak Grove Dr
    - Lilac Dr
    - Olive Rd

- Buena Vista Dr
- Moore Rd
- Live Oaks Rd
- El Bosque Rd
- Hodges Ln
- Santa Angela Ln
- Picacho Ln
- Parra Grande Ln
- Ashley Rd
- Stoddard Ln
- Barker Pass Rd
- Chelham Wy
- Westmont Rd
- Mountain Dr

While these roads have similar traffic control configurations, they do not serve equal numbers of households. In order to further prioritize the list of the above north/south roads, conduct additional traffic analysis to understand how many households and vehicle trips may pass through the intersection during an evacuation event. Note, this requires parcel-level data and may need to be verified/groundtruthed to understand how many of these homes are occupied year-round, by how many people, and whether they have additional household staff that may also be present during an evacuation event.

- Conduct additional modeling to understand the congestion impact of evacuating individual zones north of SR-192. This analysis tested two scenarios with simultaneous evacuation of multiple zones north of SR-192. It is possible that a more granular phased evacuation could reduce congestion on the roadway network. Additional "sensitivity testing" of individual zones would inform the level of phasing that would minimize congestion.
    - If additional testing warrants, consider splitting existing zones to narrower zones isolating the north/south roads that feed onto SR-192. For example, zone 2, zone 3, zone 5, and zone 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.
- Develop and communicate routing recommendations to evacuees to keep impacted US-101 ramps as clear as possible.
- Coordinate with Caltrans to manage upstream traffic during an evacuation event, designating lane 1 for through-traffic while keeping the outer-most lane(s) clear for evacuating vehicles getting on to US-101.

- Work with Santa Barbara County Planning and Development to understand development capacity associated with SB9 and incorporate evacuation review into ADU approval process.
- Explore opportunities to coordinate with property owners to validate whether site-specific conditions are conducive to sheltering-in-place, particularly for residents north of SR-192.
- Encourage residents to take only one or two vehicles (based on household size) to reduce the number of evacuating vehicles. Offer offsite parking facilities to safely store secondary vehicles in advance of an emergency event.
- Coordinate with Santa Barbara County Sheriff and California Highway Patrol to ensure parking maintains community member egress and emergency vehicle ingress at the following trailheads:
    - Cold Spring
    - Hot Springs
    - San Ysidro
    - Wineman
    - Buena Vista
    - Ferring
    - Romero Canyon

5.3 Supply-Side

- Work with Santa Barbara County Department of Public Works to identify hardscape/softscape improvements to roadways that can expand evacuation capacity without expanding daily capacity (removal of medians, soft shoulders, paved multi-use trails that can support traffic during an emergency, two-lane egress).
- Consider existing egress and access constraints in the adoption and implementation of the Montecito Fire Code.
- Consider conversion to roundabouts when intersections are upgraded, as roundabouts can process more vehicles than stop-controlled locations and do not require power like traffic signals.
- Install and utilize "No Parking on Red Flag Warning" days in the most high-risk areas of the community to enable full use of the right-of-way for evacuation and ingress of emergency vehicles.
- Continue to work with Santa Barbara County Department of Public Works on capital improvement projects that affect circulation within the District.
- Work with stakeholder group (Santa Barbara County Department of Public Works; Sheriffs) to prepare and test a catalogue of operations plans with sample cross-sections that would enable temporary conversion to two-lane egress on key roadways with modified traffic control points. Deployment of tested operations plans would depend on specific fire conditions including location, direction, windspeed, and pace of fire spread. Potential candidates for development of operations plans include:

- Sycamore Canyon Rd and/or Barker Pass Rd/Eucalyptus Hill Rd/Alameda Padre Serra south of SR-192
- Hot Springs Rd south of Mountain Dr
- Olive Mill Rd south of Hot Springs Rd
- Sheffield Dr and/or Ortega Ridge Rd south of SR-192
- Ortega Hill Rd and/or Greenwell Ave to eastbound Via Real & Padaro Ln

- Work with Caltrans to evaluate the local and regional effects of US-101 capacity expansion on the ability of Montecito to evacuate in an emergency. In addition, stay apprised of construction activity on US-101 and ramp closures that may impact evacuation routes.
- Pursue redundancy of critical transportation infrastructure to allow for continued access and movement in the event of an emergency, including vulnerabilities of traffic signals/traffic control centers, to reduce impact and response time for outages that may occur during emergency events (e.g., signals losing power due to high winds or active fire).
- Designate and publicize pedestrian evacuation routes particularly for household employees that may use transit to commute to homes in MFPD.
- Explore installation of tenth-mile markers along all evacuation routes to assist travelers and emergency responders with location, mainly when communications grids are down.

5.4 Education & Outreach

- Develop a Community Outreach Program that focuses on:
  - All hazards, with focus on key hazards during appropriate times of the year (i.e. debris flows after a fire, fire season, flood season, etc.).
  - Development/dissemination of materials that help property owners understand their responsibilities to manage individual and community risks.
  - Detailed information related to preparation, evacuation locations, property hardening and home hardening for shelter-in-place, and what to expect during an evacuation
- Evaluate the potential to establish a FireWise community for MFPD.
- Expand alert and readiness outreach to the community, especially when nearing the highest fire danger periods of the year.
- Expand community signage for fire risk ratings and indicators of high-risk conditions.
- Establish a redundant, diverse, and resilient public communications system that builds on existing communications tools and systems (such as the Wireless Emergency Alert, Nixle, and Everbridge) to ensure uninterrupted emergency communications such as through solar photovoltaic systems and battery storage, phone/text alerts, radio, sirens/loudspeaker, social media channels, and signage.
- Regularly re-evaluate and test all emergency communications channels.
- Consider community evacuation drills for residents so that they continue to grow in their awareness and preparedness for evacuation events.

- Work with Santa Barbara County Office of Emergency Management to promote Montecito community registry to accurately document where "Access & Functional Needs" populations are located, along with the location of other potentially vulnerable populations throughout the community, such as senior housing facilities and schools, and others without access to a personal vehicle (such as tourists).
- Coordinate with evacuation shelters and hotel destinations in neighboring communities to establish clarity on where residents should go, and ensure sufficient capacity exists to handle a surge of evacuees.
- Seek opportunities to provide evacuees with guidance on evacuation route conditions along with dynamic rerouting information to decrease travel times and reduce congestion on highly traveled roads (for example, GPS-routing systems).
    - Consider use of tech-enabled apps to communicate zones, routes, and destinations.
    - Monitor traffic using intelligent transportation system (ITS) technology to identify accidents and problem areas, determine the effectiveness of responses, and change responses as needed.
- During recovery/re-entry, focus on consistent and timely communications with residents, including consistent messaging of expectations through pre-evacuation communication with the community.

5.5 Capacity Building & Coordination

- Formalize/expand stakeholder working group(s) that focus on the following:
    - Local Evacuation (District, County Public Works, City of Santa Barbara)
    - Regional Evacuation (District, County Public Works, Caltrans, CHP)
    - Hazards Understanding/Abatement (District, County, Forest Service, CalFire)
- Sustain coordination/collaboration with Santa Barbara County Fire Safe Council.
- Conduct evacuation exercises with MFPD staff that focus on critical movements and capacities ensuring adequate movement to safety.

5.6 Additional Considerations

Facilitating evacuation of people who do not have access to a vehicle is not analyzed as part of this study. However, this is a critical consideration for emergency personnel to ensure that complete evacuation is provided. Further research into possible means of evacuating people who do not have access to a vehicle is recommended. Options for assisting with evacuation in such situations is included in the recommendations section of this report. This could include, but not be limited to, the following:

- Neighborhood "buddy" program to link people needing assistance with people willing to assist
- Coordination with local school district to provide school bus access or use of district vehicles to facilitate high-occupancy evacuation
- Partnership with Transportation Network Companies (TNCs, like Uber and Lyft) to provide reduced-rate access
- Increased coordination with emergency services personnel to assist with accessibility

6. Behavioral Considerations & Conclusion

The effectiveness of an evacuation is influenced by the planning and preparedness of both the agencies overseeing evacuation and the individuals involved in the evacuation itself. 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. Research has shown that the following components affect how people will behave during an evacuation:

- Hazard characteristics
- Level of individual preparedness
- Perceived level of personal risk
- Personal characteristics and family context
- Extent of social networks
- Receipt and timing of warning messages
- Level of belief that the event will occur[1]

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. Research conducted on the preparation, response, and recovery of bush fires in Australia[2] 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), 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[3]. Case study research about these considerations has shown that these dynamics can create tension between law enforcement

[1] 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.

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

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

personnel and residents. Law enforcement personnel expressed concern about residents who refused to leave, impeding their responsibility to protect members of the public, while some residents saw the requirement to evacuate as infringing upon their rights as US citizens[4].

When considering evacuation orders, public safety officials need to balance these considerations, allowing residents time to prepare to leave while minimizing 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.

Based on these factors and considerations, 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. For example, participation rates for much of the hurricane evacuation planning within Florida assumes between 35% and 80%, based on the size and severity of the potential hurricane[5].

This would indicate that many events would not include a 100% participation rate like that assumed in the above analyses. Therefore, while this assessment uses scenarios to capture the effects from evacuating all members of the affected area (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 after the evacuation order is issued – either shifting the entire evacuation curve or compressing that curve toward the end of the assumed evacuation event.

The assumption of 100% participation 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 reflecting the potential for the evacuation response curve to be compressed. Therefore, the results of this analysis represent the conditions which may cause more acute congestion impacts on the roadway network.

[4] Ibid.

[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

Appendix A: After Action Report Memorandum

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FINAL - AFTER ACTION REPORT MEMORANDUM

To:	Montecito Fire Protection District
From:	Dudek Fire Protection Planning Team – Mike Huff, principal
Subject:	After Action Report Review - Post-Event Evacuation Lessons Learned
Date:	January 25, 2022
cc:	
Attachment(s):	None

Evacuations during large, wind-driven wildfires have occurred in Montecito and because wildfire is a component of California landscapes, will occur again. As these types of fires increase across the state, mass evacuations are also increasing. It is this reality that was the nexus for assessing post-event evacuation lessons learned to improve the Montecito Evacuation Plan (Project) so that it will better serve and protect existing residents. The following memo provides a summary of the fire environment, after-action reports, lessons learned, and recommendations.

Note that this memorandum is a stand-alone document that may or may not be integrated into the overall project report. The intent of this memorandum is to help guide and inform the evacuation analysis so that recommendations provided in the final report adequately consider lessons learned by other fire agencies that have recently been involved with a significant wildfire emergency.

1 Fire Environment

1.1 California

Wildfires are a regular and natural occurrence in most of California. However, the number of acres burned annually has increased in recent years. In the last five years, California has faced catastrophic wildfires that took lives, destroyed communities, and temporarily displaced hundreds of thousands of Californians[1]. The 2020 fire season alone was considered among the most severe claiming 31 lives and consuming over 4 million acres[2]. Further, climate change has driven a combination of hotter and dryer years followed by years that are unusually wet, creating a build up of vegetation that provides more fuel for wildfires. Additionally, the incursion of human settlement into high fire-prone areas has resulted in more human-caused fires and greater threats to life and property. As the severity of fire season continues to increase, coupled with California's growing population, it is expected the number of people impacted by wildfires and evacuations will continue to grow.

[1] Governor's Office of Planning and Research. 2019. *Final Report of the Commission on Catastophic Wildfire Cost and Recovery.* Governor's Office of Planning and Research. https://opr.ca.gov/docs/20190618-Commission_on_Catastrophic_Wildfire_Report_FINAL_for_transmittal.pdf
[2] CAL FIRE. 2020. *2020 Fire Siege.* CAL FIRE. https://www.fire.ca.gov/media/hsviuuv3/cal-fire-2020-fire-siege.pdf

1.2 Montecito

Montecito is an unincorporated community in Santa Barbara County located between the Santa Ynez Mountains and the Pacific Ocean. The community borders the Los Padres National Forest, the City of Santa Barbara, and the unincorporated areas of Summerland and Carpinteria. The community is just under 10 sq. miles and hosts a population of over 8,600 people[3]. The climate in Montecito is characterized by warm summers and mild winters. However, as with much of California, the community periodically experiences significant downslope winds and warming events, referred to as "Sundowner Winds". Wind events such as these can promote the ignition and rapid spread of wildfires. Further, almost all the area in Montecito is classified as a Very High Fire Hazard Severity Zone by CAL FIRE[4]. Wildfires in the Montecito area have been directly related to human activity and predominately occur in the Santa Ynez Mountains. There have been a significant number of wildfires in the area and the largest recorded fire within the County was the 2017 Thomas Fire. The Thomas Fire not only destroyed homes but also resulted in the 1/9/2018 Debris Flow which the County considers the worst natural disaster in its history. Both natural disasters resulted in nearly back-to-back mass evacuation of residents from their homes.

2 After Action Reports

After Action Reports or After-Action Reviews (AAR) are tools used to discuss an event, evaluate performance, and discuss strengths and weaknesses in response. In California, any city, county, or city and county that declares a local emergency for which the governor proclaims a state of emergency is required to complete an AAR. AARs can also be conducted by state agencies, the Federal Emergency Management Agency (FEMA), or third parties. The goal of an AAR is to identify areas that need to be addressed and learned from to improve response in future events. A total of 18 AARs were analyzed from the past five years looking at catastrophic wildfires from across the state. Below described the lessons learned and recommendations for the community of Montecito.

Dudek evaluated 18 AARs to glean useful information and lessons learned that may be useful for Montecito's evacuation analysis. The 18 AARs reviewed were:

Jurisdiction	After Action Report Title
County of Santa Barbara	2017/2018 Thomas Fire and Debris Flow
City of Sonoma	October 2017 Fires
Butte County	2018 Camp Fire Response
Butte County District Attorney	2018 Camp Fire Investigation
CAL FIRE	2020 Fire Siege
Federal Emergency Management Agency	2018 Camp Fire

[3]United States Census Bureau. 2019. *QuickFacts Montecito CDP, California.* https://www.census.gov/quickfacts/fact/table/montecitocdpcalifornia/PST045219
[4] CAL FIRE. 2021. *FRAP Fire Hazard Severity Zone Viewer.* https://egis.fire.ca.gov/FHSZ/

National Park Service	2018 Carr Fire
Los Angeles County	2018 Woolsey Fire
Ventura County	2018 Hill and Woolsey Fires
Thousand Oaks	2018 Hill and Woolsey Fires
Sonoma County	2019 Kincade Fire
County of San Diego	2017 Lilac Fire
San Diego Foundation	2017 Lilac Fire
Los Angeles Fire Department, CAL FIRE, US Forest Service	2018 Mendocino Complex
City of Ventura	2017 Thomas Fire
City of Santa Rosa	2017 Tubbs and Nuns Fires
San Diego County	2020 Valley Fire
University of California - Berkeley	Review of Wildfire Evacuations 2017 to 2019

2.1 Lessons Learned

One of the most important features of an AAR is to identify lessons learned, both strengths and weaknesses, from the event. Below lists the lessons learned from various California wildfires that relate to public notification/information, evacuation/sheltering, and recovery/reentry that may be applicable to the Montecito community.

Public Notification/Information:

- Public communication was inconsistent, especially across multiple platforms and residents were unsure of which resources to use. Information that was disseminated in languages other than English was often very delayed or unavailable.

- Social media can be effective in quickly disseminating information to the public; however, over-reliance on these platforms (i.e. Twitter, Facebook) does not consider technological gaps amongst residents. Therefore, establishing redundancies in communication, such as text messages and/or daily press conferences, is important to spread information to all segments of the population. In addition to social media, daily press conferences for the public and media were considered an effective tool for providing guidance and instructions to community members.

- The call center and public information hotline were able to provide the public with information and increase situational awareness. However, the public needed better prior education on Ready! Set! Go!, alerting systems, and incident severity.

- Prior testing of alert and warning systems allowed for rapid dissemination of emergency messaging. However, limitations of the software resulted in having to initiate multiple alerts and warning campaigns to reach the full intended audience.

- The Partner Relay System allowed for effective communication about the fire to non-profits, houses of worship, and community leaders serving limited English residents.

- Concurrent power shut-off events and internet outages created additional hurdles for public information access. Further, there were inadequate low-tech backup systems.

Evacuation/Sheltering:

- People were more likely to evacuate under mandatory orders over warnings. Additionally, the use of fire modeling helped explain and justify evacuation orders and resulted in greater community compliance. One of the main reasons why people delayed or did not evacuate was the desire to protect their property or not wanting to leave their animals.

- Evacuation tended to occur several days after ignition and departure times were highly variable and dependent on the fire. Evacuations that occurred during the day experienced less panic and logistic issues than those that happened at night.

- There was not always a pre-established evacuation plan, pre-defined evacuations areas, procedures for evacuation communication, or management guidelines for evacuations and evacuees. When there was an evacuation plan, it was not intended to support the entire community evacuating at the same time. As a result, contraflow traffic operations were not effective for the evacuation of an entire community at once.

- Surrounding towns and communities were not prepared for the incoming flow of traffic or to receive evacuees.

- Mass care shelters were not prepared for the scope, duration, and dynamic nature of a catastrophic wildfire. However, shelters that were able to serve a larger variety of sheltering situations (i.e. individuals with animals, mobility issues, non-native speakers, etc.) were more successful.

- The sheltering plan did not adequately address sheltering needs for people with disabilities or functional needs (i.e. intellectual, psychiatric, medical, and physical support needs). Further, the County and Red Cross policies regarding criteria for sheltering differed.

Recovery/Reentry:

- Resources available for recovery and reentry were confusing and lacked formal and functional planning. Speed was prioritized over health and safety during repopulation. Housing conditions were not considered, and residents often returned home with no power.

- Repopulation information was distributed in a way that was inconsistent and conflicting. As a result, the public lacked awareness of the challenges and guidelines for repopulation.
- Establishing a recovery hotline and local assistance center allowed for a timely transition into the recovery period.

2.2 Recommendations for Montecito

AARs address recommendations for the agency to improve future disaster response. These recommendations can also be used as learning tools for other agencies that respond to similar incidents. Below describes recommendations derived from the reviewed AARs that relate to public notification/information, evacuation/sheltering, and recovery/repopulation and how they may apply to Montecito. The recommendations below were created based on the results from the AARs; some of the items below are already employed by Montecito Fire and/or other agencies within the County. Items in which Montecito Fire already practices should be revisited annual to capture the rapidly evolving standards and best practices of emergency planning.

Public Notification/Information

- Develop a robust public education plan that includes crisis communication, the use of social media for situational awareness, and low-tech communication resources, and identify trusted sources of information. Montecito should also consult with community groups serving limited English speakers and other groups that may have limited access to information on how to best develop situational awareness and distribute information.
- During the incident, public communication should be distributed quickly and consistently across all platforms and use ReadySBC.org as a centralized location for incident information. Content should be predeveloped in other languages to avoid delays and translators should be available during disaster response, such as via the public hotline.
- The Santa Barbara Operational Area should implement regularly scheduled testing and stress testing of the mass notification system to simulate real-world disaster scenarios. Further, Montecito should coordinate with the surrounding communities of City of Santa Barbara, Summerland, and Carpinteria to develop an emergency notification system protocol.

Evacuation/Sheltering

- To increase evacuation response Montecito should leverage evacuation orders and improve order communication. Orders should be at a minimum in English and Spanish and include supplementary information such as shelter locations, routes, safety tips, and reminders to help others.
- Montecito should educate residents on the risk of defending their homes and impacts on firefighting abilities as well as provide information on where to shelter with animals. Public education of Ready! Set! Go! Program and evacuation terminology should be increased. Additionally, residents should be made aware of the Santa Barbara Equine Assistance and Evac Team.

- The evacuation plan should be able to be scaled up or down depending on the event. The Montecito evacuation plan should prepare for evacuations to occur at any time of the day and be inclusive of debris flow terminology and decision making. The plan should include strategies for phased evacuations and simultaneous evacuations as well as consult with the City of Santa Barbara, Summerland, and Carpinteria to plan for increased flow of traffic and pre-identify locations to receive evacuees.

- Montecito should consult with their local Red Cross chapter to collaborate on sheltering policies as well as develop additional shelter management plans and guidelines that do not rely on the Red Cross. Additionally, a comprehensive inventory should be made of evacuation and shelter resources within the community and the greater Santa Barbara County. Sheltering policies should include resources and guidelines for people with disabilities or special needs.

Recovery/Repopulation

- Montecito should pre-develop reentry plans that include communication guidelines for reentry, reentry strategies, and protocols for utility infrastructure agencies. These plans should be consistently communicated to the public. The public education on reentry should also contain information on what to expect with returning to residences after an evacuation event.

- Recovery plans should be created pre-disaster, include considerations for recovery cost, debris management, prioritizations for health and safety, as well as include strategies for alleviating challenges associated with residence conditions. The repopulation strategies in the recovery plan should also be aligned with the evacuation plan.

- A recovery hotline and local assistance center should be established to quickly facilitate the transition to the recovery period and provide a centralized resource for the public.

Appendix B: Public Survey Memorandum

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FINAL - PUBLIC SURVEY MEMORANDUM

To:	Montecito Fire Protection District
From:	Dudek Fire Protection Planning Team – Michael Huff, Principal
Subject:	Survey Results
Date:	January 25, 2022

Montecito residents were surveyed to provide important public stakeholder input toward the Montecito Evacuation Plan (Project) so that it will better serve and protect existing residents. The objective of the survey was to establish an understanding of the population's evacuation knowledge and introduce community members to evacuation planning. The following memo provides a summary of the survey results.

1 Survey Results

The survey was launched on July 24, 2021 and ended on August 27, 2021. In total, the survey collected 141 responses. Only responses from the 93108 zip code were kept resulting in a final survey count of 113 responses.

1.1 Evacuation Population Characteristics

When asked about evacuation frequency, 93% of respondents had been evacuated from their homes at least one time. A total of 24% of resident respondents had been evacuated five or more times while only 7% had not previously been evacuated. The ability to return home was the primary concern for respondents regarding evacuation. This was closely followed by concerns regarding transportation and road conditions limiting evacuation ability and knowing where they should go.

1.2 Evacuation Response

In this section of the survey, the goal was to determine respondents' baseline response to evacuation warnings, evacuation orders, and shelter-in-place orders. We asked respondents to rate their knowledge on the difference in evacuation procedures on a scale of 1 to 10. Of the individuals who provided a response to this question, the average response was 7, indicating a perceived high level of evacuation knowledge. Approximately 66% of these individuals rated themselves 7 or higher; however, approximately 21% of respondents ranked themselves 5 or lower, as illustrated in Figure 1. When asked to describe their response to the issuance of an evacuation warning, over 86% of respondents indicated that their first step would be to immediately prepare for an evacuation. Whereas less than 10% said that they would delay preparations until more information, or an evacuation order was issued. Figure 2 illustrates the distribution of responses to an evacuation warning being issued. Respondents also displayed

a high evacuation willingness when asked to rate their likelihood of evacuating under an evacuation order. On a scale of 1 to 10, the average response was a 9; however, almost 20% of respondents rated themselves 6 or lower (Figure 3). When asked about their willingness to shelter-in-place; respondents also displayed a high willingness to shelter-in-place if required (Figure 4).

Figure 1. Distribution of Perceived Evacuation Knowledge

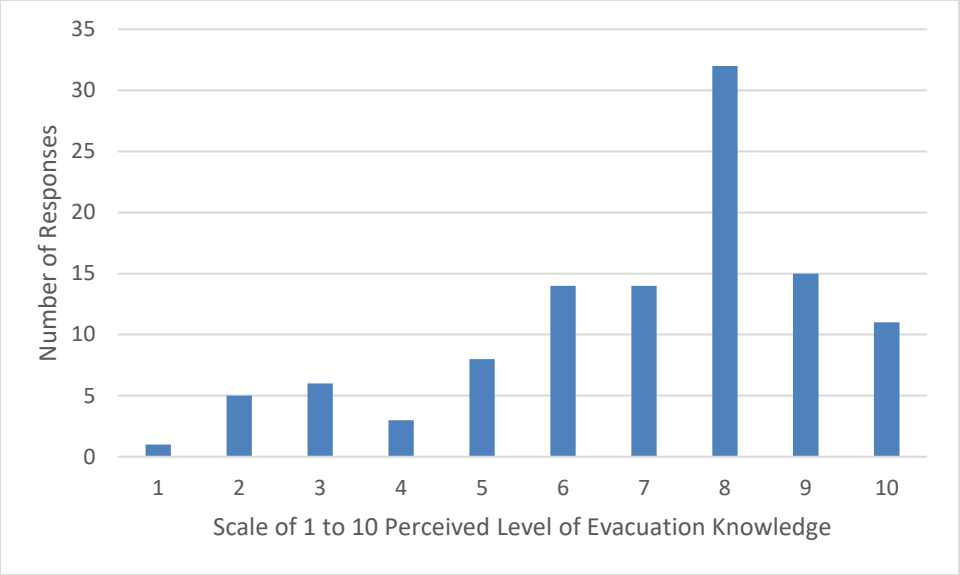


Figure 2. Distribution of Response to Evacuation Warning

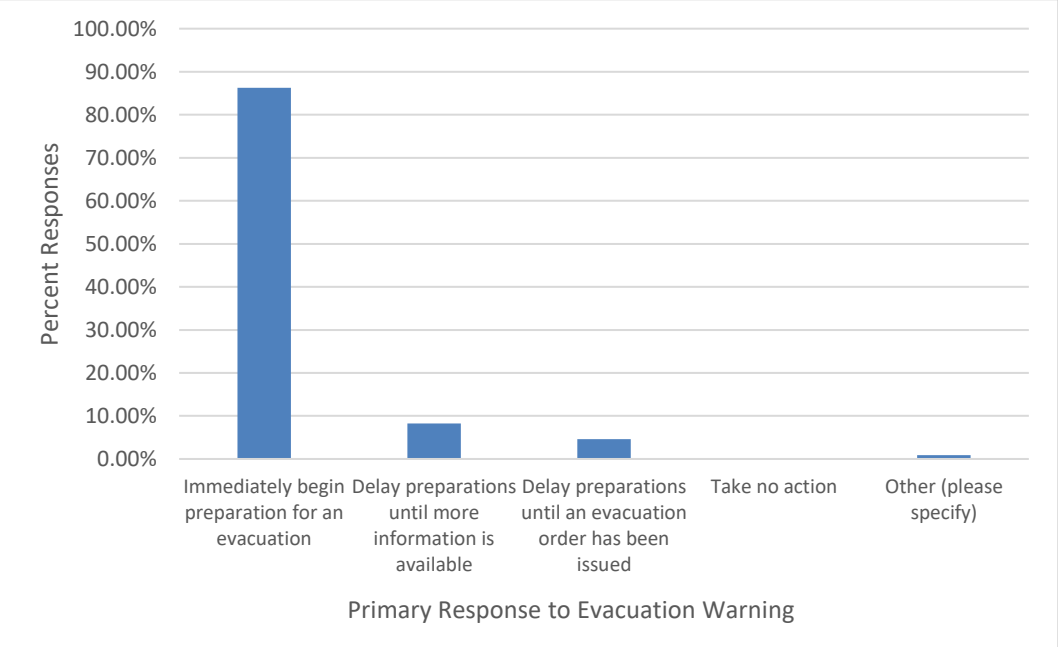


Figure 3. Distribution of Response to Evacuation Order

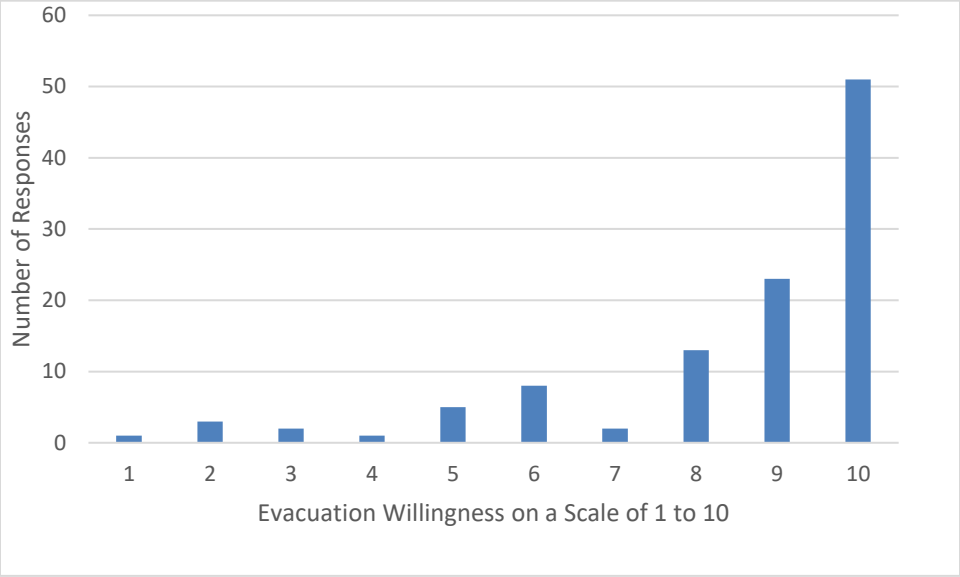
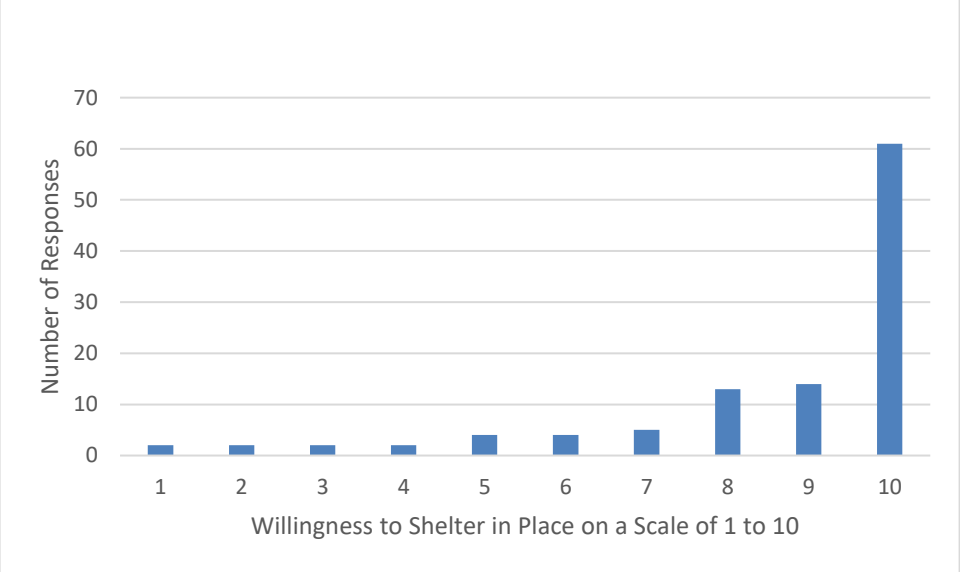


Figure 4. Distribution of Response to Shelter-In-Place Order



1.3 Evacuation Planning

The purpose of this section was to evaluate if respondents had an existing evacuation plan and introduce evacuation planning. Overall, respondents felt prepared for evacuations and over 78% had an existing evacuation plan that had been recently updated this year or within the last five years. Respondents who had an evacuation plan cited that their main resources for information were Ready! Set! Go!, Readysbc.org, the Montecito CWPP, and/or personal experience.

A total of 22% of respondents indicated that they did not have an evacuation plan in place and said that the main reason why was that they were unsure of how to plan for an evacuation. A of the 22% of respondents who did not have an evacuation plan 4% indicated that that they did not have an evacuation plan because they felt it was unnecessary.

When asked what would encourage them to prepare an evacuation plan, 38% of respondents chose bi-annual email reminders with links to resources and/or a virtual webinar focused on updating/preparing an evacuation plan. A total of 35% of respondents felt a bi-annual mailer with reminders to prepare or update an existing evacuation plan would be encouraging as well.

2 Concluding Comments, Questions, or Concerns

Additional concerns that were highlighted were road conditions during an event such as access restrictions, congestion, and ability to use the 101 highway. Respondents also expressed concerns regarding communication during an event and the ability to receive emergency information. Finally, the overall response to the survey was highly positive. Respondents felt that the survey was a positive tool and expressed gratitude for Montecito Fire's proactive approach to evacuation preparedness.

3 Important Findings

Results from the survey indicate that respondents from the Montecito community view themselves as personally prepared for evacuations and have a potentially high level of evacuation compliance. A surprising finding was that respondents also showed a high willingness to shelter-in-place. The top takeaways from the survey are:

1. The main concerns during an evacuation were the road conditions impacting the ability to leave the area and how to return home after an evacuation.
2. Respondents understood that when an evacuation warning is issued, they are to immediately begin preparing for an evacuation.
3. Despite the majority of respondents having been evacuated multiple times; respondents indicated high evacuation order compliance.
4. Respondents were familiar with Ready! Set! Go! and it was the most common evacuation planning resource.
5. Respondents were receptive to a community-wide evacuation plan and supportive of receiving additional evacuation planning resources.

The survey provides valuable input from the population for which the evacuation planning project is intended to protect and assist. It is recommended that the following findings are integrated into the evacuation plan scenario development and modeling, as feasible. Some of these items are already employed by MFD, but should be revisited annually to capture the rapidly evolving standards and best practices of emergency planning:

1. Development of comprehensive re-entry criteria and education for the community
2. Identify potential road hazards during an evacuation and develop mitigation measures
3. Create evacuation bi-annual reminders (mailers or email) and how-to webinars/videos on how to create and/or update an evacuation plan

4. Maintain evacuation education on types of evacuation procedures, Ready! Set! Go!, and personal evacuation plans

Appendix C: Evacuation Interview Results Memorandum

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FINAL - INTERVIEW RESULTS MEMORANDUM

To:	Montecito Fire Protection District
From:	Dudek Fire Protection Planning Team – Michael Huff, principal
Subject:	Evacuation Interviews
Date:	January 25, 2022
cc:	
Attachment(s):	None

The following summarizes the conversations between Dudek staff and senior-level fire and law enforcement professionals specific to their experience with mass evacuations. Interviewees included four fire chiefs (John Messina, John Dicochea, Chad Cook, and Sean Norman) and one sheriff deputy (Doug Jones), and were conducted to better understand mass evacuation from an Incident Command/boots on the ground perspective from various jurisdictions (as selected by Montecito Fire Department (MFD)) in order to prepare a more comprehensive evacuation analysis for the MFD. Interviews included questions that addressed advanced planning efforts, public information and noticing, and post-evacuation and recovery.

Note that this memorandum is a stand-alone document that may or may not be integrated into the overall project report. The intent of this memorandum is to help guide and inform the evacuation analysis so that recommendations provided in the final report adequately consider lessons learned by other fire agencies that have recently been involved with a significant wildfire emergency.

1 Interviews

Interviews were conducted with fire agency and law enforcement representatives that were selected by MFD. The five contacts interviewed were:

John Messina
Division Chief, Cal Fire Butte County, Butte County Fire Chief
Initial Attack IC on the Camp Fire
John.messina@fire.co.gov

Sean Norman
Battalion Chief, Cal Fire Butte County
Operations Section Chief Camp Fire
Sean.norman@fire.co.gov

Chad Cook
Assistant Chief, Ventura County Fire Department
Initial Attack IC on the Thomas, Woolsey and Maria fires
Chad.cook@ventura.gov

John Dicochea
Prevention Battalion Chief, Novato Fire
jdicochea@novatofire.org

Doug Jones
Deputy Sheriff, Santa Barbara County Sheriff's Department
Coordinator for Search and Rescue
DMJ2752@sbsheriff.org

1.1 Advanced Planning Efforts

The discussion around advanced planning efforts was focused on existing evacuation plans and how they supported or hindered decision-making during evacuation events and what efforts are currently being made to educate the public on existing evacuation plans/procedures. Several themes emerged during these discussions and are discussed in further detail below, including the importance of advance collaboration, community outreach and education, and community engagement.

1.1.1 Collaboration

All of the individuals that were interviewed agreed that advanced coordination internally within the jurisdiction and externally with surrounding jurisdictions was imperative. This point was underscored with the example of the Camp Fire in 2018, where downstream traffic issues almost 9 miles from the town caused many of the individuals to be stuck along the evacuation route as the fire approached. It was noted that despite the urgency of the situation, the IC had difficulty getting support from law enforcement in the jurisdiction where the traffic was originating. The following is a list of all recommendations related to collaboration:

- Pre-event coordination with law enforcement and other agencies within the jurisdiction
- Pre-event coordination with law enforcement and other agencies in surrounding jurisdictions
- Annual "all-hands" meeting at the start of fire season
- Advanced discussions to establish trigger points for evacuations
- Advanced discussions to establish standards for re-entry to include all stakeholders (i.e., public works, utilities, law enforcement, fire, etc.)

1.1.2 Community Outreach & Education

Investment in ongoing community outreach and education is essential to prepare communities for mass evacuation. As noted during the interviews, many individuals are moving from the city into the foothills as a result of the pandemic and have an expectation of a level of service that is not available in rural areas. Further, the public is often unaware of the objectives for fire and law enforcement agencies during a mass evacuation event, which

should be included as part of any effort to educate the public. The following is a list of recommendations specific to community outreach and education:

- Attend community events and provide resources for individual/family planning
- Establish a school program focused on situational awareness and family planning
- Campaign to encourage registration for local notification systems, including for those with special evacuation needs
- Education should include:
    - What to bring
    - Fire service capabilities
    - Understanding zones
    - Situational awareness
    - Personal responsibility
    - Responsibilities of different agencies
    - Expectations upon re-entry

1.1.3 Community Engagement

Beyond outreach and education, it was recommended that the fire department facilitate community engagement through programs such as CERT and establishing Firewise communities. The goal should be empowering the public to take personal responsibility, as well as training and organizing citizens to assist and support each other during an emergency, ideally freeing up fire fighters and law enforcement to focus on their primary objectives.

1.2 Public Information & Noticing

How information is disseminated to the public during a mass evacuation event can substantially help or hinder a mass evacuation effort. The following were recommendations for public noticing:

- Prepare fill-in the blank messages in advance
- Establish frequency and triggers for communication
- Utilize the best methods for communication: radio, television, Reverse 911, and expand to social media including Text, Twitter, FB Live
- Prepare messaging for special circumstances (i.e., pets, large animals)
- Multi-lingual messaging, including having interpreters and translators available during the event
- Establish a daily briefing, so the public knows when each day they can get an update on the event

1.3 Post Evacuation & Recovery

The post evacuation and recovery period of an event is no less stressful for responders and residents than the event itself. Residents are often anxious to return home and assess the damage to their homes and property. In order to repopulate an area; however, a number of decisions involving a variety of departments and agencies are required. Further, once the terms of repopulation have been negotiated, it is important to set the expectations of the public as they will not be returning to ideal conditions (i.e., no power, no internet, etc.). Lastly, these events also provide an opportunity for criminal activity, looting is a major concern during this stage of an evacuation and

increasing law enforcement presence is critical in reducing instances of looting. The following were recommendations for post evacuation and recovery:

- Escorts to help look for pets and medication
- Pass system to identify individuals who are working on the recovery efforts prior to communities being repopulated
- Team that can take photos for property owners
- Increased law enforcement presence to deter looters
- Educate the public on what to expect when returning home
- Remind the public re-entry does not mean the threat is completely gone

1.4 Additional Considerations & Recommendations

The following are additional considerations and recommendations that were identified during this series of interviews:

- Evacuation fatigue, complacency – frequent evacuations or evacuation warnings can result in a populace that is desensitized and may not react in the desired way if evacuations occur too often.
- Education on personal responsibility – continued public outreach is required to reach residents and provide for them a clear understanding of their responsibility to help ensure their personal safety.
- Roadside vegetation clearance program - this is an important component of successful evacuations as it creates a safer passage by minimizing fire behavior that could temporarily block roadways and panic drivers.
- Day vs. evening evacuations – there must be considerations provided when an evacuation occurs at night vs during the day. Nighttime evacuations are typically more difficult and include more frightened evacuees.
- Vehicle staging – staging vehicles at key locations during weather conditions that would facilitate wildfire spread is one important consideration for maximizing efficiency of executing an evacuation as it reduces the time needed for mobilization and evacuation orders.
- Zone Haven – this evacuation management and community support tool is widely praised for its abilities to train, prepare, and manage evacuations through an interactive system.

When asked about concerns for future mass evacuation events, there were two responses that were consistent among the individuals interviewed:

- Need for coordination with privatized fire service – private fire service personnel are increasingly working within the active fire zone and coordination and communication is not always adequate.
- Potential to exceed the ability of neighboring jurisdictions to house evacuees – when moving large numbers of people out of the jurisdiction, neighboring jurisdictions can quickly reach capacities, resulting in traffic congestion, unsettled citizens, and impacts to multiple jurisdictions.