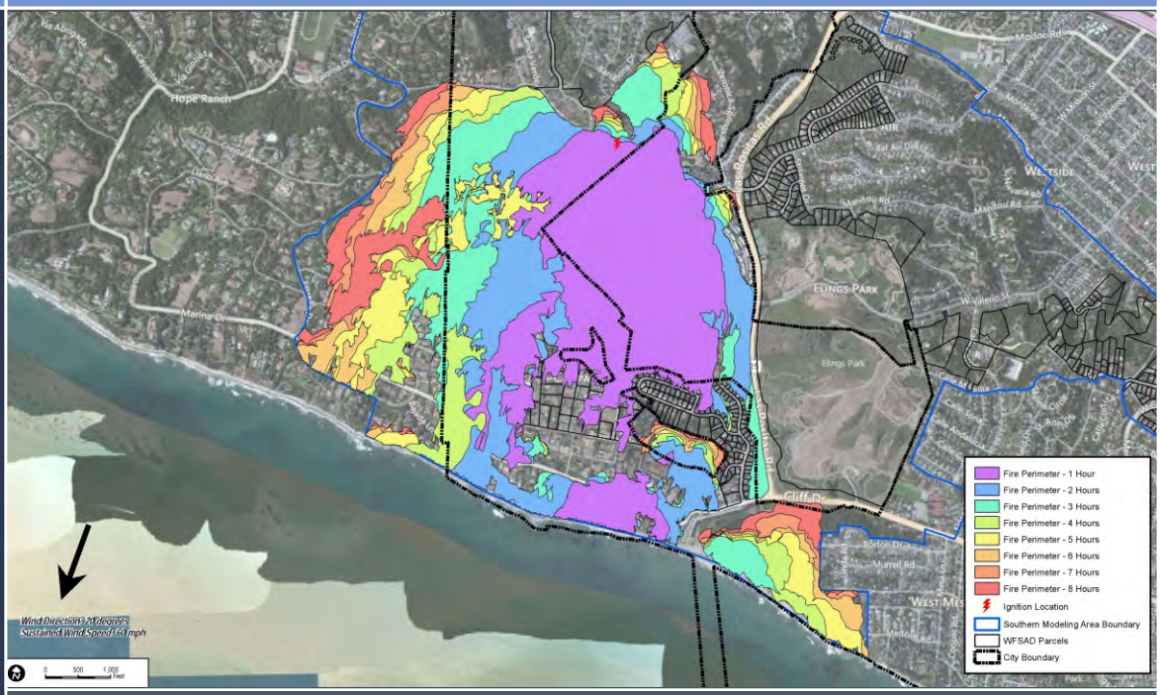
Wildland Fire Evacuation Procedures Analysis



JULY 2014

SUBCONSULTANTS:

Fehr & Peers
600 Wilshire Boulevard, Suite 1050
Los Angeles, CA 90017
Contact: John Muggridge

Hunt Research Corp.
PO Box 291
Solvang, CA 93464
Contact: Jim Hunt

Viking Research
2650 Latigo Drive
Solvang, CA 93464
Contact: Don Oaks

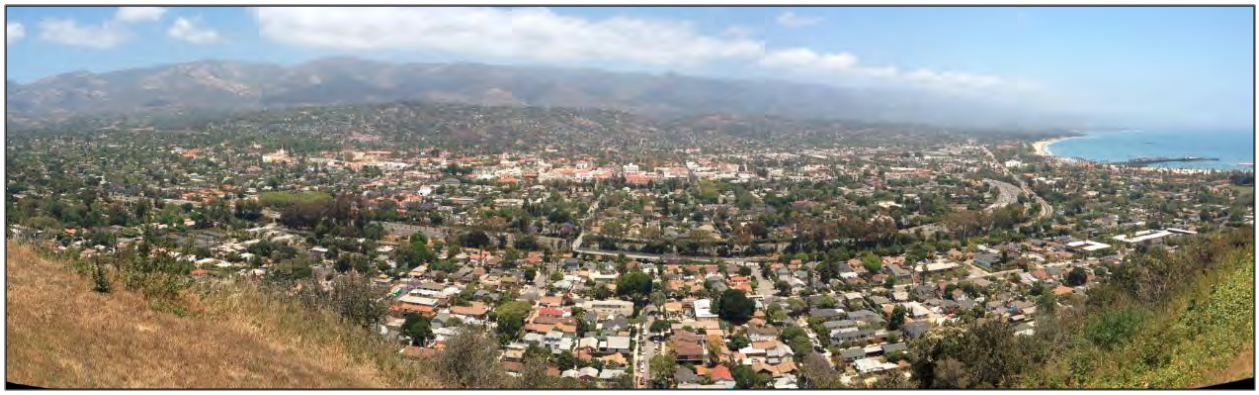
PREPARED FOR:

City of Santa Barbara
Fire Department
925 Chapala Street
Santa Barbara, CA 93101

PREPARED BY:

DUDEK
605 Third Street
Encinitas, CA 92024

WILDLAND FIRE EVACUATION PROCEDURES ANALYSIS
for
City of Santa Barbara, California



Prepared for:

City of Santa Barbara Fire Department
925 Chapala Street
Santa Barbara, California 93101

Prepared by:

DUDEK
621 Chapala Street
Santa Barbara, California 93101
Contact: Michael Huff

JULY 2014

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TABLE OF CONTENTS

Section **Page No.**

EXECUTIVE SUMMARY **1**

1 BACKGROUND **13**

2 FIRE HISTORY AND FIRE ENVIRONMENT **15**

3 PROJECT SCOPE **17**
3.1 Methods 18
3.1.1 Law Enforcement Agency Information Interviews 18
3.1.2 Literature Searches 18
3.1.3 Fire Behavior Modeling 19
3.1.4 Traffic Modeling 20

4 FINDINGS **33**
4.1 Findings: Evacuation Procedures and Population Types 33
4.1.1 Special Population Considerations (Non-City Residents and Shadow Evacuees) 36
4.2 Findings: Social Aspects of Wildfire Evacuation 38
4.3 Findings: FARSITE Fire Spread Modeling 38
4.4 Findings: Traffic Modeling 40

5 INTEGRATION OF WILDLAND FIRE EVACUATION PROCEDURES ANALYSIS DISCIPLINES **57**
5.1 Existing Wildland Fire Evacuation Procedures Evaluation 57

6 RECOMMENDATIONS **59**
6.1 Maintain Existing Pre-Plan Evacuation Block Maps and Prepare Scenario Based Sub-Block Phone Tree Lists 59
6.2 Coordination and Cooperation among Stakeholders Charged with Evacuation Responsibilities 60
6.3 Community Planning and Safety Zones 61
6.3.1 Community Planning Role 61
6.3.2 Planner Facilitate Identification and Enhancements to Potential Safety Zones 61
6.3.3 Planners Facilitate Permitting 62
6.3.4 Existing Potential Safety Zones 62
6.4 Traffic Flow/Road Recommendations 62
6.4.1 General Recommendations 62

TABLE OF CONTENTS (CONTINUED)

Section **Page No.**

6.4.2 Specific Recommendations for Selected Evacuation Corridors 66
6.4.3 Increased Roadway Evacuation Capacity: Recommendations for Traffic Flow Improvements in Hillside Communities Surrounding the City of Santa Barbara 69
6.4.4 Other Considerations 71
6.5 Law Enforcement 72
6.6 Civilian Evacuation Contingency 75
6.7 Safety Zones 76
6.7.1 Wildfire Scenario Potential Safety Zones 78
6.7.2 Escape Routes 81
6.7.3 Other Potential Safety Zones in the Foothill or Extreme Fire Hazard Severity Zones 82
6.7.4 Temporary Firefighter Refuge Areas 85
6.8 Santa Barbara Fire Department and Local Fire Agencies 87
6.8.1 City Wildfire Pre-Plan Completion 87
6.8.2 Joint Agency Training 87
6.8.3 Evacuation Simulations 87
6.8.4 FARSITE Scenario Modeling 88
6.8.5 Joint Agency Training 88
6.8.6 Reverse 911 Testing 88
6.8.7 Develop Evacuation Contingency Plans 88
6.8.8 Evacuation Scenario Training 88
6.8.9 Evacuation Pre-Plans in Engines 88
6.8.10 Evacuation/Shelter in Place Flow Chart 88
6.8.11 Reverse 911 Custom Message Training 89
6.8.12 Recommendation Implementation Coordination 89
6.8.13 Grant Funding for Recommendation Implementation 89
6.8.14 Fire/Law Agency Cross-Training 89
6.8.15 CAFS Equipped Engines 89
6.9 Wildfire Scenario Evacuation Decision Points 89
6.10 Prepare for Reentry/Recovery 99
6.11 Implement Technological Advances 100
6.12 Evacuation of Special Populations 101
6.13 Animal Evacuations 103

TABLE OF CONTENTS (CONTINUED)

Section **Page No.**

6.14 Public Outreach 103
6.15 Options Analyzed and Considered Not Implementable 103

7 CONCLUSION 105

8 LIMITATIONS 107

9 REFERENCES 109

APPENDICES

A Current Santa Barbara Evacuation Blocks
B Santa Barbara Regional Fire History
C FARSITE Modeling Analysis
D Social Aspects of Evacuation Planning
E Evacuation Time Frame Chart

FIGURES

1 Aerial Exhibit 11
2 FARSITE Modeling Areas 21
3 Existing Street Network Classification 23
4 Santa Barbara Population Density 25
5 Santa Barbara Land Use 27
6 Selected Evacuation Routes 31
7 FARSITE Model Results for Lauro Canyon 41
8 FARSITE Model Results for Santa Barbara Bowl 43
9 FARSITE Model Results for Campanil Hill 45
10 Estimated Evacuation Travel Speeds 49
11 Santa Barbara Travel Times to Nearest Evacuation Routes 51
12 Estimated Travel Time from Parcels to Core Downtown Area 53
13 Evacuation Road Improvement Locations 73
14 Wildlife Scenario Potential Safety Zones and Escape Routes 79
15 Other Potential Safety Zones 83

TABLE OF CONTENTS (CONTINUED)

Page No.

TABLES

ES-1 Summary of Santa Barbara Wildland Fire Evacuation Procedures Analysis Recommendations 2
1 General Evacuation Traffic Flow Improvement Tool Kit 63
2 Specific Santa Barbara Evacuation Flow Improvement Recommendations 70
3 Evacuation Considerations for Wildfire Scenario 1- Lauro Canyon 93
4 Evacuation Considerations for Evacuation Scenario 2 – Santa Barbara Bowl 95
5 Evacuation Considerations for Evacuation Scenario 3 – Campanil Hill. 98

EXECUTIVE SUMMARY

The City of Santa Barbara encompasses a large wildland urban interface (WUI), and must plan for fires within these areas (Figure 1). The WUI includes terrain, vegetation, and climate that may facilitate fire ignition and spread. The City and surrounding Santa Barbara County have experienced numerous wildfires, especially within the Los Padres National Forest and the south-facing slopes of the Santa Ynez Mountains, the foothills of which are within portions of the City's WUI and Foothill and Extreme Fire Hazard Zones. During the long list of wildfires that have burned near or within the City's borders over recorded history, including the recent 2008 Tea Fire and the 2009 Jesusita Fire, numerous people have been successfully evacuated from higher to lower risk areas. Despite the number of fires and the severity of the largest fires, there have been surprisingly minimal reports of citizen deaths and injuries. Considering the large number of people successfully evacuated and the constraints that face the City's road network, evacuations from wildfires under the existing wildfire evacuation procedures has proven to be reliable and at minimum, adequate. However, there are numerous wildfire scenarios that have not been realized as of the time of this report. This Wildland Fire Evacuation Procedures Analysis (WEPA) was commissioned to evaluate three of these scenarios as well as perform an overall evaluation of the evacuation procedures and recommend improvements that would guide the City toward greater preparedness and improved firefighter safety and evacuation efficiency. To that end, this WEPA evaluates the current protocols and provides informed opinions regarding the overall validity of these protocols as well as recommendations aimed at improving the evacuation process.

Evacuation from emergency situations has been researched for decades and in the context of many environmental hazards, but not as extensively for wildfire (Cova et al. 2011). Many of the research projects are overly complicated or overly theoretical to apply to a specific area. Several facets of evacuation have been examined, with human behavior and traffic engineering modeling often looked at independently. These evacuation components are being looked at more often together for more realistic prediction and planning purposes. This WEPA also links fire behavior utilizing sophisticated modeling, which when combined with social behavior and traffic modeling outputs, results in a multi-discipline approach to establishing evacuation decision triggers and a tool kit of pre, during, and post fire measures that will improve wildfire evacuations in Santa Barbara.

Recommendations Summary

Table ES-1 provides a summary of recommendations that are the result of the analysis presented in this Wildland Fire Evacuation Procedures Analysis. Recommendations are further discussed throughout this document, but specifically in Section 6.0.

The purpose of this document is to put forward recommendations for review and future determination of priorities, additional analysis needs, and implementation. Local officials must determine which recommendations to pursue and on what timeframe they will be implemented. There are likely to be divergent views on what recommendations should be a priority between City and County decision makers. City of Santa Barbara officials must determine which recommendations can be implemented within Santa Barbara's jurisdiction. Consideration for adjacent jurisdictions and their evacuation plans should be a component of the decision making progress.

Table ES-1
Summary of Santa Barbara Wildland Fire Evacuation Procedures Analysis Recommendations

Recommendation	Report Section	Description
1	6.1	**Existing Evacuation Blocks** 1 - Maintain Existing Evacuation Blocks. 2 - Prepare scenario based sub-block phone tree lists to evacuate most vulnerable properties immediately and the remainder of the block as dictated by fire behavior. 3 - Evacuation Blocks should be updated as necessary based on post-fire studies, actual evacuation events, changing populations, or technological advances.
2	6.2	**Coordination and Cooperation** 6.2.1 - Improve coordination/cooperation among agencies. 6.2.2 - Ensure evacuation planning is coordinated between Law/Fire. 6.2.3- Law Enforcement officers are not properly trained or equipped with safety equipment necessary to carry out their critical function so providing that equipment and knowledge will be important to future evacuations.
3	6.3	**Community Planning and Safety Zones** 6.3.1 - Community Planning plays a critical role in provisions for firefighter safety zones. 6.3.2 - City Planning Department work with the Santa Barbara Fire Department (SBFD) to facilitate improvements to areas that could meet the definition of a safety zone with certain enhancements. 6.3.3 - Planners work with Fire Department to look at permitting enhancements, possible funding for enhancements through project development fire mitigation fees, and direct projects to consider safety zones in design. 6.3.4 Recommend the following Safety Zones – 1. Cater Water Treatment Facility 2. First Baptist Church at 949 Veronica Springs Road 3. Ellings Park 4. Arroyo Burro Beach 5. Sheffield Reservoir 6. Westmont College 7. Mount Calvary Monastery 8. Northern terminus of Cieneguitas Road 9. Others as identified during SBFD scenario modeling

Table ES-1
Summary of Santa Barbara Wildland Fire Evacuation Procedures Analysis Recommendations

Recommendation	Report Section	Description
4	6.4.1	**Traffic Flow Road Recommendations** – General Recommendations 6.4.1.1 - Control Intersections – may require additional law enforcement agencies/personnel to increase success. 6.4.1.2 - Utilize Roadblocks and Barricades – less effective than officer at intersections, but can be used as last resort. 6.4.1.3 - Electronic Signage – may be useful in Santa Barbara Foothill and Extreme area evacuations because of the large number of visitors who may not be familiar with the roadway. 6.4.1.4 - Where opportunity exists, look at the feasibility of Lane Expansions. 6.4.1.5 - Contraflow – providing additional evacuation lanes would increase the number of cars that can be moved out of vulnerable areas, but must be implemented with caution and controls.
5	6.4.2	**Traffic Flow/Road Recommendations –Selected Evacuation Corridors** 6.4.2.1 - Congested Corridor Recommendations 1. Upper State Street Corridor – up to five new traffic control points recommended. 2. Las Positas Corridor – emergency signal timing at Veronica Springs. Road, extension of existing private roads and vegetation clearance, such as: extension of Campanil Drive to Las Positas and Senda Verde community and Campanil Drive. Vegetation clearance along roadways where needed requires more detailed analysis. 3. Mission Street/Valerio Street Corridor – left turn restrictions during evacuation along Mission north of 101 4. Cabrillo and Castillo Street Corridors – emergency signal timing for the corridors 4 signals would provide improved evacuation traffic flow. 5. Milpas Street Corridor – based on lack of pre-planned traffic control points, area should be considered for deployment of traffic control officers during emergency where evacuation from the area requires flowing Milpas traffic.
6	6.4.3	**Traffic Flow/Road Recommendations – Develop New or Alternative Access Routes** Where feasible, look at potential extension of private roadways and/or vegetation clearance to improve secondary alternative egress. For example, an extension of Holly Road to connect to San Roque Road, if feasible, may be beneficial for fire protection planning and may improve the evacuation travel time for the Upper Mission Canyon area and relieve the evacuation traffic congestion on Mission Canyon Road approaching the City. This recommendation may have limited application in much of Santa Barbara due to terrain which makes road extensions infeasible. Further evaluation would be needed.
7	6.4.3	**Traffic Flow/Road Recommendations - Increase Roadway Evacuation Capacity** Look at feasibility of implementing strategies that include provision of additional lanes through restriping parking zones to allow additional clearance for emergency vehicles, turnout zones, or trailer truck access, applying lane reversal or using roadway shoulders or vegetation removal. Potential locations for the suggested enhancements include:: a. Sycamore Canyon Road/Hot Springs Road: Removal of vegetation on the roadway shoulders and provision of a southbound right-turn lane from Sycamore Canyon Road to Hot Spring Road would facilitate the evacuation of traffic exiting the Sycamore Canyon Road neighborhood.

Table ES-1
Summary of Santa Barbara Wildland Fire Evacuation Procedures Analysis Recommendations

Recommendation	Report Section	Description
		b. Sycamore Canyon Road /Barker Pass Road: Improve the east and south legs of the intersection to allow drivable shoulders and provide available right-of-way for emergency vehicular evacuation. c. Foothill Road between San Marcos Pass Road (SR 154) and Sycamore Canyon Road: This road serves several neighborhoods to the north side of the City, and potential heavy evacuation traffic levels on Foothill Road may force drivers to delay making left turns out of their neighborhoods. Removal of vegetation on the roadway shoulders would allow drivers exiting the residential neighborhoods to merge with the traffic faster on Foothill Road. d. Foothill Road and Mission Canyon Road/Tornoe Road intersection: Improve the east and south legs of the intersection to allow drivable shoulders and provide available right-of-way for emergency vehicular evacuation. Roadway shoulder improvements should be considered on Mission Canyon Road, where feasible, to provide a turn-out zone allowing emergency vehicles to pass general traffic. This intersection is located on a Caltrans facility and would require collaboration between the County and Caltrans and may require removal of existing encroachments in County and Caltrans right-of-way. e. Los Olivos Street between Mountain Drive and Alameda Padre Serra: Improve this segment of Los Olivos Street in the southbound direction between both intersections to allow drivable shoulders and bike/pedestrian paths to be used for cars in an emergency with the aid of traffic control. This segment would require collaboration between the County and City and may require alteration of existing pedestrian paths and walls, including potentially historic resources. f. Mission Canyon Road (south) and Las Encinas Road: Roadway shoulder improvements could be considered on Mission Canyon Road, where feasible, to provide a turn-out zone for emergency vehicles to pass general traffic. The portion of Las Encinas Road near Mission Canyon Road would require collaboration between the County and City. g. Foothill Road and Ontare Road intersection: Improve the south leg of the intersection to allow drivable shoulders and available right-of-way to be used for cars in an emergency with aid of traffic control. h. Foothill Road and Morada Lane: Improve the north leg of the intersection with the removal of vegetation to allow an additional left-turn lane. i. Mountain Drive: A number of trees on West Mountain Drive hang fairly low over the road and may cause issues for fire engines. Regular vegetation clearance trimming is recommended. j. Las Canoas Road: Regular vegetation clearance trimming is recommended. This could also help along the narrow sections of Las Canoas where there are several tight turn radii. Since the road usually only has room for two cars at any one time, these tight turn radii may slow down traffic in an evacuation. k. Stanwood Drive: Fire engines navigating the tight turns on Stanwood Drive would also benefit from a wider roadway that could be achieved with regular vegetation removal.

Table ES-1
Summary of Santa Barbara Wildland Fire Evacuation Procedures Analysis Recommendations

Recommendation	Report Section	Description
8	6.4.3	**Traffic Flow/Road Recommendations - Traffic Control Changes During Evacuation** a. Roundabout at the intersection of Alameda Padre Serra, Sycamore Canyon Road (SR 144), Salinas Street, Montecito Street, and Yanonali Street: These five streets serve fairly large Eastside and Riviera communities, as well as the Cleveland Elementary School. Deployment of law enforcement/traffic control personnel could be used to prioritize certain approaches during a fire evacuation. This could ease the traffic bottleneck where the streets meet. b. Las Canoas Road, Gibraltar Road and Mountain Drive: This intersection is located on a main thoroughfare for many hillside residents north of the Sheffield Reservoir and is likely to become a traffic bottleneck during a fire evacuation. Reversing the northbound lane on Gibraltar (between the Las Canoas Road intersection and the El Cielito Road intersection) to provide a temporary second southbound lane during the evacuation period (with a traffic control point) should be considered. c. Position law enforcement at designated traffic control points to facilitate outbound traffic flow from the Mission Canyon area approaching the City of Santa Barbara. The locations to be considered include: • Foothill Road at Alamar Avenue • Foothill Road at Mission Canyon Road (north) • Foothill Road at Mission Canyon Road (south)/Tornoe Road • Mission Canyon Road (north) at Tunnel Road • Mission Canyon Road (north) at Las Canoas Road • Mission Canyon Road (north) at Santa Barbara Botanical Garden Driveway • Mission Canyon Road (south) at Santa Barbara Natural History Museum driveway • just south of Las Encinas Road • Mission Canyon Road (south) at Mountain Drive • Los Olivos Road at Alameda Padre Serra • E. Los Olivos Street and Laguna Street • State Street, Las Positas Road/San Roque Road intersection
9	6.5	**Law Enforcement** Additional officers may be required in large evacuation events to control intersections. Training, protective clothing, equipment and resources are required for law enforcement officers who are responsible for controlling intersections.
10	6.6	**Civilian Evacuation Contingency Planning** Contingency planning for civilian safety when evacuation is not possible – develop checklists/matrix for civilian evacuation contingency planning.
11	6.7.1	**Safety Zones - Wildfire Scenario Potential Safety Zones** • Scenario 1 - Lauro Canyon: Cater Water Treatment Facility. This facility is located within the Lauro Canyon Evacuation Block and provides a large, reduced fuel or non-fuel landscape. It provides more than 4 times setback from off-site fuels in all directions. On-site fuels include an earth and grass covered storage reservoir. This

Table ES-1
Summary of Santa Barbara Wildland Fire Evacuation Procedures Analysis Recommendations

Recommendation	Report Section	Description
		area is maintained and represents very low ignition potential and low flame lengths and fire intensity should it ignite. For this area to be considered a Safety Zone, access would need to be available to firefighters during a fire event, including from non-Santa Barbara County fire departments. • Scenario 2 - Santa Barbara Bowl. There were no adequate safety zones identified in the immediate vicinity of the Santa Barbara Bowl fire scenario. The Santa Barbara Middle School and the primary parking lot for the Santa Barbara Bowl include features that are consistent with a safety zone, but do not include enough setback area from native fuels to meet the standard definition of four times the flame lengths. Further, the middle school is in the path of the wind-driven fire, even though the wind is low in the scenario. The nearest safety zone would be within the Santa Barbara High School grounds, roughly 4/10 of a mile south of the fire origin in this scenario. • Scenario 3 - Campanil Hill. The immediate area within the Campanil Hill fire scenario does not include any identifiable firefighter Safety Zones. To the north of the area, the First Baptist Church at 949 Veronica Springs Road includes a large, paved parking lot with modified fuels in most directions. The parking lot could serve as a pre-planned safety zone. The eucalyptus trees located in the eastern portion of the project may require thinning and crown lifting on an annual basis to minimize likelihood of ignition. In the southern portion of this area, • Ellings Park may also provide firefighter safety zones. Ball fields in the northern portion of the park provide adequate setback from adjacent fuels, but may not support fire engine access. Firefighters on foot could use this area as a safety zone. • Arroyo Burro Beach appears to meet the requirements for a safety zone, providing 4 times the projected flame length, but including a limited area which could accommodate a strike team (up to 5 engines). No additional safety zones were observed. Additional study is recommended regarding these potential safety zones at a finer detail than this report's scope of work would enable.
12	6.7.2	**Safety Zones - Recommended Escape Routes (Roadways only)** • Scenario 1 Lauro Canyon: Cater Water Treatment Facility has been identified as a potential safety zone. Firefighters retreating from increased fire behavior from this scenario's ignition point would follow San Roque Road southward out of the Lauro Canyon, past the reservoir, and into the facility. Firefighters from the south would take San Roque Road northward to the facility. As a secondary access from the south, Laurel Canyon Road would provide access to the facility, but is gated at its intersection with San Roque Road. Fuel modification and tree crown clearance along this road, especially in the northern sections is recommended for improving escape route conditions. In addition, any of the urban areas to the south could be accessed as TRAs. • Scenario 2: Santa Barbara Bowl. There were no adequate safety zones identified in the immediate vicinity of the Santa Barbara Bowl fire scenario. However Escape Routes to potential TRAs would include: leaving the Santa Barbara Bowl area, possibly on Lowena Drive and heading southwesterly along E. Anapamu St. If firefighters are north, east, or west of the fire, they may take one of any number of roadways into urban areas as TRAs.

Table ES-1
Summary of Santa Barbara Wildland Fire Evacuation Procedures Analysis Recommendations

Recommendation	Report Section	Description
		• Scenario 3: Campanil Hill. Escape routes to the identified potential safety zones are primarily along Las Positas Road. In addition, there are numerous residential streets that would lead away from the active fire area to areas that can be utilized as TRAs. Escape routes that are public roadways are maintained in good condition with adequate fuel modification. Additional study regarding these escape routes is warranted at a finer detail level than possible with this report's scope of work.
13	6.7.3	**Safety Zones - Other Potential Safety Zones in the Foothill or Extreme Fire Hazard Severity Zones** The following locations include potential safety zones that with enhancements, could be available to firefighters as safety zones. 1. Sheffield Reservoir – although semi-removed from the wildland, this location is a large, low fuel property that is within the wildland urban intermix and close enough that it could serve as a functioning safety zone. Enhancements would include: either a dedicated emergency access road to a paved parking/staging area or verification that existing road on site would support fire apparatus. Would need ongoing vegetation management and removal of some plants on site. 2. Westmont College – although in neighboring Montecito, City of Santa Barbara firefighters may be working in this area during a wildfire. This site includes areas along an unnamed road to the east of the sports fields. There are currently pull-outs and parking areas that could accommodate fire engines. Enhancements could include creation of an emergency engine parking area within the existing parking lot that is capable of supporting a fire engine, but functions as part of the landscape as it would be used very rarely. 3. The existing Mount Calvary Monastery site, at its widest point along Mount Calvary Road, includes a wide setback that could accommodate engines and provide up to four times flame length set back. Steep slopes to the east and west could be burned off prior to entering the safety zone ahead of wildfire. Additional enhancements could be provided by installing 100 to 200 feet of fuel modification in all directions. Northern terminus of Cieneguitas Road – the area is just north of the City boundary, but is currently in a low fuel, disturbed condition and could be, depending on ownership, funding, and environmental review, provided a safety zone with a dirt/gravel cleared area and mowed/maintained landscape surrounding it. It provides a safe escape to potential TRAs should the safety zone be compromised. These enhancements would require more intensive and purposeful planning efforts and may not be feasible.
14	6.7.4	**Enhanced Temporary Firefighter Refuge Areas** In addition to typical Temporary Refuge Areas (TRAs), this WEPA recommends enhanced TRAs as a pre-planned effort to provide contingency evacuation options when evacuation is considered too dangerous.
15	6.8	**Santa Barbara Fire Department** 6.8.1 –Complete City Wildfire Pre-Plans consistent with SB County Pre-Plans and share information with surrounding agencies. 6.8.2 - Conduct joint, scenario-based, real-time field training exercises with all local fire and

Table ES-1
Summary of Santa Barbara Wildland Fire Evacuation Procedures Analysis Recommendations

Recommendation	Report Section	Description
		law enforcement agencies. 6.8.3 - Test the evacuation plan periodically in real time simulations using the public in actual movement, including support systems such as Reverse 911. Activate the EOC and any department level Operating Centers to be sure they are coordinated and work correctly. 6.8.4 - Conduct additional FARSITE wildfire scenario modeling exercises throughout the City's fire hazard areas to help refine pre-plans, establish immediate evacuation zones, as educational tools for public awareness, and to establish decision points, as appropriate. 6.8.5 - Conduct joint scenario-based field training exercises with all local responding Fire and law Enforcement Agencies. Exercises should include actual movement of apparatus, establishment of ICP, communications, mobilization of law enforcement etc. Some of these exercises should also include the residents from time to time. The best way to test a system to be sure it will work is by ongoing exercises. 6.8.6 - Test the Reverse 911 and other community notification systems on a regular basis. Preface any announcements with "this is a test only." 6.8.7 - Develop evacuation contingency plans including the utilization of buildings designed to provide safe refuge as an alternate to evacuation. Develop a decision flow chart to evaluate evacuation contingencies. 6.8.8 - Training and familiarity with evacuation plans, vulnerable areas, live training on in-field decision making regarding temporary refuge areas vs. evacuation to safety 6.8.9 - Provide Pre-Plans in engines with iPad or similar device provided to each crew (hard copy and electronic) – focus on BC levels, but available to all. 6.8.10 - Develop Shelter in Place/Evacuation decision flow chart for use by the Incident Command team. 6.8.11 - Work with County dispatchers so they are trained in how to activate, focus and put a customized message on the system in pre-planned zones based on fire scenario modeling conducted herein by SBFD over time. 6.8.12 - Evaluate the recommendations provided in this WEPA and implement them in a coordinated fashion with other fire and law enforcement agencies. 6.8.13 - Seek grant funding for implementing roadway improvements and to support acquisition of equipment and technological recommendations detailed in this WEPA. 6.8.14 - Consider cross-training a member of the police department and a member of the fire department to focus on updating evacuation information, providing training, and coordinating communications between agencies pre- and post-fires. 6.8.15 - Evaluate cost-benefit of specialized Compressed Air Foam System equipped engines for pre-treating structures or other refuge areas for the possibilities when evacuation is not possible.
16	6.9	**Evacuation Decision Points** Consider recommended evacuation decision points discussed in Section 6.9 for the City-selected three wildfire scenarios.. Continue to refine decision points for these and new scenarios with use of provided information.

Table ES-1
Summary of Santa Barbara Wildland Fire Evacuation Procedures Analysis Recommendations

Recommendation	Report Section	Description
17	6.10	**Citizen Re-entry and Recovery** Develop a citizen re-entry and recovery plan.
18	6.11	**Technological Advancements** Implement technological advances in all aspects of early fire detection, traffic planning and road improvements, evacuation, and contingency sheltering as they develop.
19	6.12	**Special Needs Populations** The City of Santa Barbara is a member of the Coalition through the Office of Emergency Services Division of the Fire Department. Therefore, any evacuations of Access and Functional Needs and Disabilities (AFN/D) population that include the City of Santa Barbara Fire Department, prior to and during evacuations, is coordinated with the County Office of Emergency Management and the County Public Health Department's Emergency Medical Services Division.
20	6.13	**Animal Evacuation** Develop and coordinate with local animal evacuation organizations to ensure small and large pets/livestock are addressed.
21	6.14	**Public Outreach** Public Outreach focused on evacuation block areas that is consistent and year-round helps create an informed population that leads to fewer issues during actual evacuation events.

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FIGURE 1

Regional Location

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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1 BACKGROUND

In 2004 the City of Santa Barbara adopted the City Wildland Fire Plan (Plan) (http://www.santabarbaraca.gov/gov/depts/fire/fireplan.asp). The Plan characterizes the City's wildland fire hazard and risk, provides a framework for seeking funding, coordinates work efforts, prioritizes work areas, and identifies Policies and Actions to mitigate the impact of wildfire to the City. The Plan also includes basic evacuation procedures that identify public evacuation blocks and routes, fire resource ingress/egress routes, and traffic control points to facilitate evacuations. Presented evacuation information is an abbreviated summary of a joint agency effort to preplan for large emergencies. As previously described, this evacuation plan appears to have worked during recent fires, although the level to which the evacuations occurred according to the plan is not known. For example, it is not known if County agencies involved in the wildfire Incident Command enacted the City's plan, a plan that was similar to the City's or a separate plan. In any event, it is unlikely that the City will be acting alone for any wildland fire evacuation as the most vulnerable areas include County and City jurisdiction and the County Fire will have a leading role in wildland firefighting and command.

As the City is aware, evacuation during a wildfire is not necessarily directed by the fire department, except in specific areas where fire personnel may enact evacuations on-scene. The Santa Barbara County Sheriff's Department, Santa Barbara Police Department (SBPD), and other cooperating law enforcement agencies have primary responsibility for evacuations. These agencies work closely within the Unified Incident Command System with the County Office of Emergency Services, and responding fire department personnel who assess fire behavior and spread, which should ultimately guide evacuation decisions. To that end, the City Fire, Police, and Public Works Departments have worked with a County Pre-Fire Mitigation Task Force to address wildland fire evacuation planning for Santa Barbara. In addition to these Santa Barbara departments, the task force also included Montecito Fire Protection District, Carpinteria/Summerland Fire Department, California Highway Patrol, California Department of Transportation, and various homeowners associations throughout the Santa Barbara area. The work completed by this task force is the development of an evacuation preplan (Santa Barbara I-Zone Major Incident Preplan 2004 which is only available at the City in hard copy) that outlines Fire Department response routes, probable public evacuation routes, traffic control points, and staging areas. The interagency plan is supposed to be used by law enforcement, fire, and public works agencies during a wildfire evacuation. It can and should be used by agencies as a public education tool, although it does not appear that this has been the case given there is no widespread dissemination of the plan. It is our understanding that the I-Zone Major Incident Preplan is not complete at the time of this report, but provides narrative and map locations for some of the high-priority foothill areas.

The evacuation preplan separates the high fire hazard areas throughout the Santa Barbara front country into evacuation areas or "evacuation blocks" (Appendix A). Development of the evacuation blocks was determined by landforms, primarily major canyons and road systems. A total of 26 blocks were identified within the City. For each evacuation block, a template and a map of the area were developed. The block templates outline the traffic closure points, fire response routes, fire resources that would respond to a fire based on first, second, and third alarm, probable evacuation routes, incident command posts to facilitate management of the fire, fire staging areas for fire equipment, collection points (evacuation centers) for civilians and animals, and any additional risk that exist with an evacuation block. These block maps provide a wealth of information that should remain as the primary evacuation pre-plan.

Within each evacuation block the road systems were evaluated to determine the best routes for fire response equipment and "probable" evacuation routes for relocating people to lower hazard areas. In addition, the Santa Barbara I-Zone Major Incident Preplan identified traffic closure points, Incident Command Posts, Fire Staging Areas, and Collection Points based on their ability to adequately handle emergency response resources. *The document is in draft format as of this date. Areas within the Extreme Foothill and Foothill Zone have been completed and maps are being completed. The areas within the Coastal and Interior Coastal Zone still need to be developed.* The results of this Wildland Fire Evacuation Procedures Analysis (WEPA) are intended to inform the completion of these areas so that the I-Zone document can be considered final.

It is important to note that every evacuation scenario will include some level of unique challenges, constraints, and fluid conditions that require interpretation, fast decision making, and alternatives. For example, one roadway incident that results in blockage of evacuating vehicles may require short-term or long-term changes to the evacuation process. In a worst-cast situation, where evacuees are evacuating late, and fire encroachment is imminent, this can have grave ramifications. This hypothetical scenario highlights the importance of continuing to train responding agencies, model various scenarios, educate the public, and take a very conservative approach to evacuation decision timelines as well as providing contingency plans. Equally as important, the evacuation procedures should be regularly updated, as they were in 2010 following lessons learned from the 2008 Tea Fire and the 2009 Jesusita Fire. The authors of this WEPA recommend that occasional updates are provided, especially following lessons learned from actual incidents, as new technologies become available that would aid in the evacuation process, and as changing landscapes and development patterns occur within and adjacent the City that may impact how evacuation is accomplished.

The following sections provide a summary of this project's scope, the City's desired outcome, methods used, analysis results, and recommendations for improving the current evacuation procedures.

2 FIRE HISTORY AND FIRE ENVIRONMENT

Fire history is an important component of evacuation planning. Fire history information can provide an understanding of fire frequency, fire type and behavior, most vulnerable community areas, and significant ignition sources, amongst others. Appendix B – Fire History Exhibit presents a fire history map for the City of Santa Barbara area. As presented in the exhibit, there have been numerous fires recorded by fire agencies in the area, primarily associated with the Santa Ynez Mountain foothills. Fire history data was obtained via the California Department of Forestry and Fire Protection (CAL FIRE) Fire and Resource Assessment Program (FRAP) database (CAL FIRE 2013). Significant fires include:

- September 1932 – Matilija Fire – 220,000 acres
- September 1955 – Refugio Fire – 85,000 acres
- September 1964 – Coyote Fire – 64,000 acres
- June 1966 – Wellman Fire – 94,000 acres
- July 1977 – Unnamed – 805 acres
- July 1985 – Wheeler Fire – 118,000 acres
- June 1990 – Painted Cave Fire – 4,900 acres
- July 2007 – Zaca Fire – 225,000 acres
- July 2008 – Gap Fire – 9,443 acres
- November 2008 – Tea Fire – 1,946 acres
- May 2009 – Jesusita Fire – 8,733 acres

Large fires have historically occurred in June or later with the exception of the Jesusita fire that occurred in May. It is unclear if there is a potential shifting or extension of the fire season to earlier fire weather occurrence or if the May fire is more of an exception. Nevertheless, it provides additional evidence that May does include occasional weather conditions that can facilitate large, uncontrollable wildfires in the Santa Barbara area and that fire weather needs to be considered in evacuation planning, which should prepare people for evacuation any time of year. Santa Barbara includes climatic and topographic conditions that facilitate fire spread. The seasonal vegetation drying, high winds associated with Sundowner wind events, and steep terrain all combine to influence the potential fire risk and recurrence of wildfires.

Interestingly, most vegetation fires ignited within the City occur in the more urban areas rather than in the foothill areas (City of Santa Barbara 2004). However, ignitions in the foothill areas

have the potential to spread throughout large expanses of wildland fuels and cause more widespread landscape damage than would a vegetation ignition in an urban setting.

Fire History, climate, and topography are three important components of evacuation planning and help define why pre-planning for these recurring events is critical for reducing risk by streamlining agency cooperation, improving agency and public fire evacuation awareness and readiness, and implementing measures that will directly improve the ability to protect people during large wildfires.

3 PROJECT SCOPE

The City of Santa Barbara Fire Department's scope of work for this project focuses on analysis of current wildland fire evacuation procedures and development of recommendations for improving the evacuation process and the capability of the existing roadways, providing for firefighter ingress and safety zones (note that the City has identified in the scope of work that firefighter safety zones be identified. Authors of this WEPA report want to clarify that these areas would not be appropriate for civilians who are not equipped or prepared for the conditions that may exist in these areas), as possible, and understanding how human behavior may impact successful evacuations. The City's scope of work included technical and engineering services to support fire behavior and traffic modeling and development of recommendations for improving evacuation efficiency and effectiveness. The current wildland fire evacuation procedures were evaluated and recommendations to improve evacuation based on fire behavior modeling, transportation engineering/traffic modeling, and human behavioral response have been completed. Further, this WEPA has included evaluation of the Santa Barbara Fire Department's (SBFD) wildfire evacuation procedures, development of evacuation decision points, identification of specific roads in critical locations that do not meet Fire Department Access Standards and development of feasible mitigations and/or appropriate tools that can increase evacuation flow and reduce fire risk. In addition, we have identified potential firefighter safety zones and escape routes in the City's high fire hazard areas and developed appropriate tools and improvements to incorporate into the City's land development process to help ensure that firefighter protections are considered and that evacuation is facilitated.

Among the tasks completed by the project team are:

1. Reviewed existing evacuation planning documents

   Neighborhood: (Mission Canyon Community Plan (MCCP), Santa Barbara Botanic Garden Fire Protection Plan, various research papers including those by Cova et al.).

   City: (Wildland Fire Evacuation Plan 2004, I-Zone Major Incident Evacuation PrePlan, traffic data, road data, speed limit data, vegetation data, topographic data, weather data)

   County: (County OES Multi-Jurisdiction Hazard Mitigation Plan, County Ready, Set, "Go!" policy, Santa Barbara County Community Wildfire Protection Plan

   State: (CAL FIRE Evacuation Tips**,** CAL FIRE Pre-Fire Attack Plans**)**

   Federal: (Unified Command System, Federal Emergency Management Agency (FEMA) evacuation information, United States Forest Service (USFS) Red Zone Actions)

2. Interviewed City Fire, Police, and Sheriff Personnel regarding current evacuation protocols, perceived strengths and weaknesses, checklists, and readiness
3. Developed landscape files and ran FARSITE fire behavior modeling of three scenarios.
4. Developed and ran traffic models
5. Conducted research on human behavior during emergency situations
6. Analyzed potential firefighter safety zones and escape routes
7. Conducted transportation engineering evaluation of existing evacuation procedures impacts on evacuation movement during an event
8. Developed evacuation options based on potential fire behavior and fire movement
9. Developed evacuation Trigger Points/Decision Points
10. Developed various Emergency Checklists, and an Evacuation Component Time Frame estimate
11. Developed feasible mitigations and appropriate tools to facilitate and improve wildfire evacuation and incorporate into City Community Development process
12. Developed options to improve existing evacuation plans
13. Coordinated with stakeholders from SBFD, SBDPW, to develop potentially feasible recommendations

3.1 Methods

3.1.1 Law Enforcement Agency Information Interviews

A member of the project team met with law enforcement agencies including Santa Barbara Police and the Santa Barbara Sheriff's Office, and discussed their current protocols and practices during wildfire evacuations. Topics discussed included: communication protocols, level of involvement in evacuations, agency procedures, available protective equipment, procedural checklists, training, and cooperation and coordination with fire and other law enforcement agencies.

3.1.2 Literature Searches

Literature searches were conducted regarding each aspect of the evacuation procedures scope of work. Literature searches regarding wildfire and fire evacuations, human behavior during evacuations was conducted in support of how the public's reactions may affect the successful movement of people and what effect those reactions have on recommendations to improve the existing procedures. Literature searches on Unified Command and the Incident Command system

were conducted and included application of project team members' (Hunt Research) experience with the system and changes that improve real-time function. Literature searches and review of applications of GIS fire behavior modeling were conducted and serve to provide precedent for applying sophisticated FARSITE modeling outputs to overall evacuation pre-planning. The outcomes of this WEPA have been informed by some of the literature reviewed during this project phase.

3.1.3 Fire Behavior Modeling

In support of this project, Dudek utilized the FARSITE fire behavior modeling software package to analyze three different fire scenarios within the fire behavior modeling area. The fire behavior modeling area included two distinct areas within and adjacent to the City, each of which encompass the City's Wildland Fire Suppression Assessment District (WFSAD) parcels plus adjacent areas outside of City limits. The Northern Modeling Area is located generally north of Foothill Road up to the ridge of the Santa Ynez Mountains and the Southern Modeling Area is located in the southwest portion of the City, south of Highway 101 and generally north of Cliff Drive (Figure 2). The three different wildfire modeling scenarios included:

1. Scenario 1: a simulation of conditions during the Jesusita Fire; considered a "worst-case" (sundowner) event; ignition located at the north end of San Roque Road.
2. Scenario 2: a simulation of a slope-driven fire with moderate, on-shore winds; ignition located near the Santa Barbara Bowl, north of Lowena Drive.
3. Scenario 3: a simulation of high fire conditions (97th percentile weather) in the Campanil Hills area (coastal wildland area); ignition located to the east of Senda Verde within an undeveloped wildland area.

Appendix C provides a discussion of the inputs, results, and assumptions made during the FARSITE modeling efforts conducted for the project.

The FARSITE software package is a publicly available resource available through the nonprofit research and educational organization Systems for Environmental Management (SEM 2008). This organization is focused on fire-related research and is partnered with the USFS, and well as numerous other national land management agencies. The FARSITE software package is a more robust analysis tool than FlamMap, allowing for an analysis of fire spread over time, rather than a static representation of wildfire characteristics. The software simulates the growth of a fire front by using wave propagation principles over a heterogeneous surface. As with FlamMap, the software requires a minimum of five input variables, including elevation, slope, aspect, fuel model, and canopy cover. Wind and weather data are also critical components to FARSITE

modeling efforts. FARSITE modeling is also conducted utilizing a GIS-based interface with outputs generated in GIS-compatible shapefile and raster formats.

3.1.4 Traffic Modeling

Fehr & Peers conducted an initial assessment of the potential wildland fire evacuation traffic conditions for the City of Santa Barbara and its bordering neighborhoods in order to provide recommendations and improve the City of Santa Barbara Fire Department's Wildfire Evacuation Procedures. Fehr & Peers previously worked on the City's General Plan Circulation Element update in 2011 and the results of that study inform the analysis and results of this focused evacuation plan traffic study.

3.1.4.1 Analysis

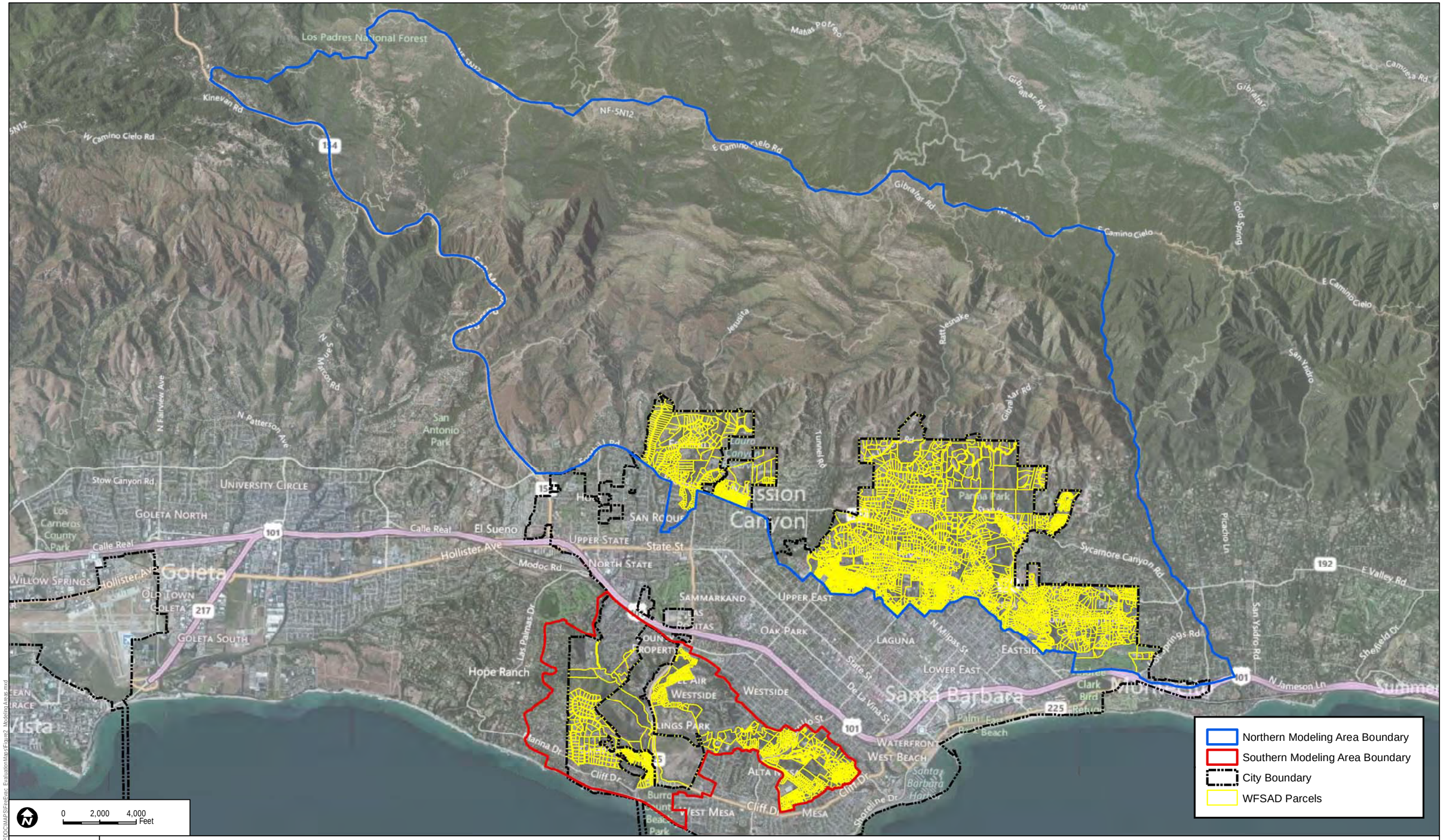
Identify Existing Evacuation Traffic Operational Deficiencies and Issues

Previous studies obtained and reviewed included:

- Existing Zoning Map (August 2012)
- City of Santa Barbara Circulation Element (2011)
- Final Program EIR Wildland Fire Plan (February 2004)
- Evacuation Map Evacuation Routes and designated traffic control points (2004 and 2010)
- City of Santa Barbara Fire Department Wildland Fire Plan (January 2004)
- Mission Canyon Community Plan Update Revised Draft EIR (February 2013)

Based on the available GIS data from the City and the most recent US Census data, the following documents/data were reviewed:

- Existing street network and functional classification (Figure 3)
- Population density (Figure 4) and land use data (Figure 5)
- Fire hazard assessment map from the previous Fire Protection Plan documents.



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SOURCE: City of Santa Barbara; Santa Barbara County; Bing

FIGURE 2

FARSITE Modeling Areas

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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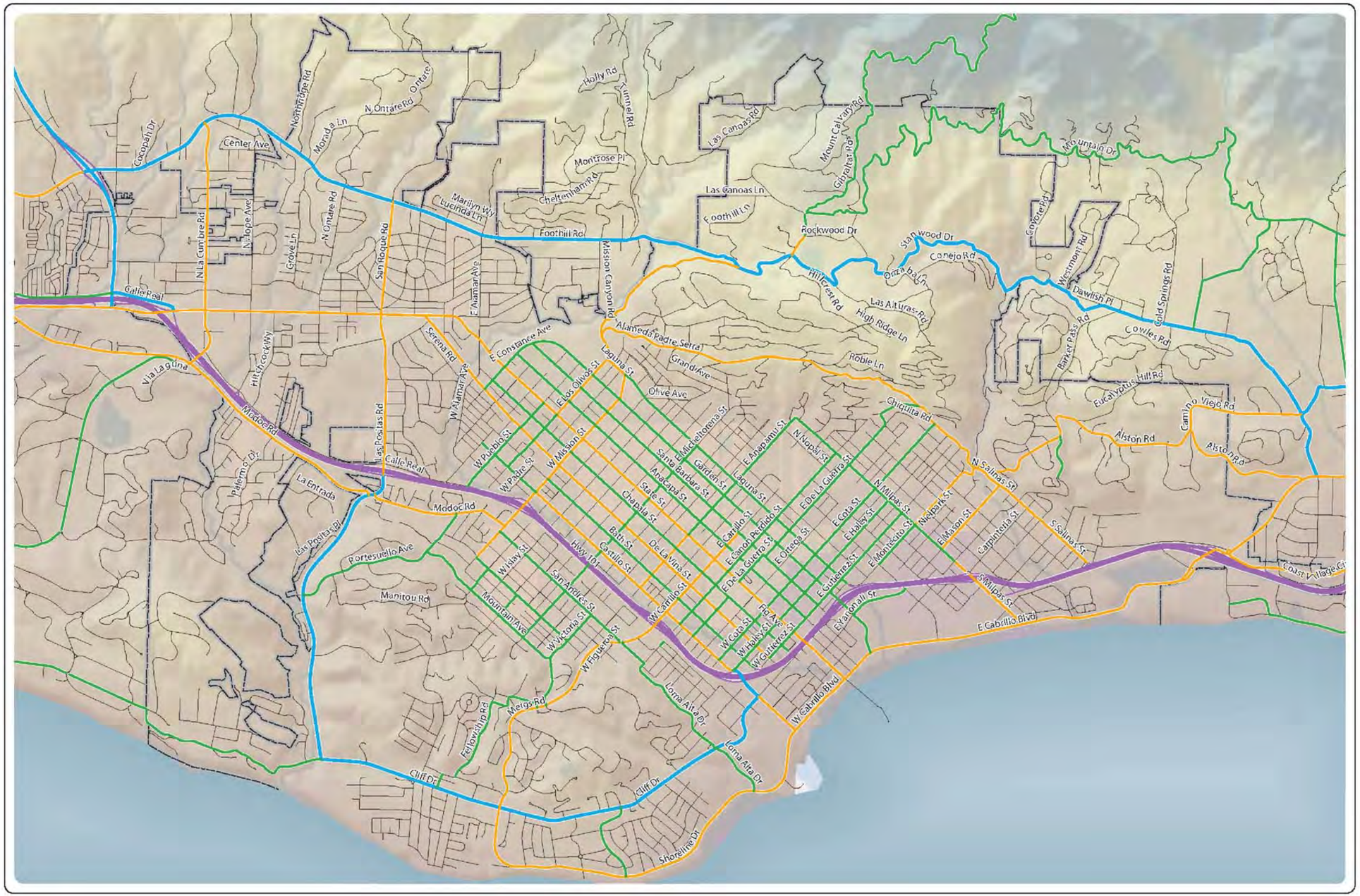

SOURCE: Fehr & Peers 2013

FIGURE 3

Existing Street Network Classification

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SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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Population Density
High
Low

Not to Scale

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SOURCE: Fehr & Peers 2013

FIGURE 4

Santa Barbara Population Density

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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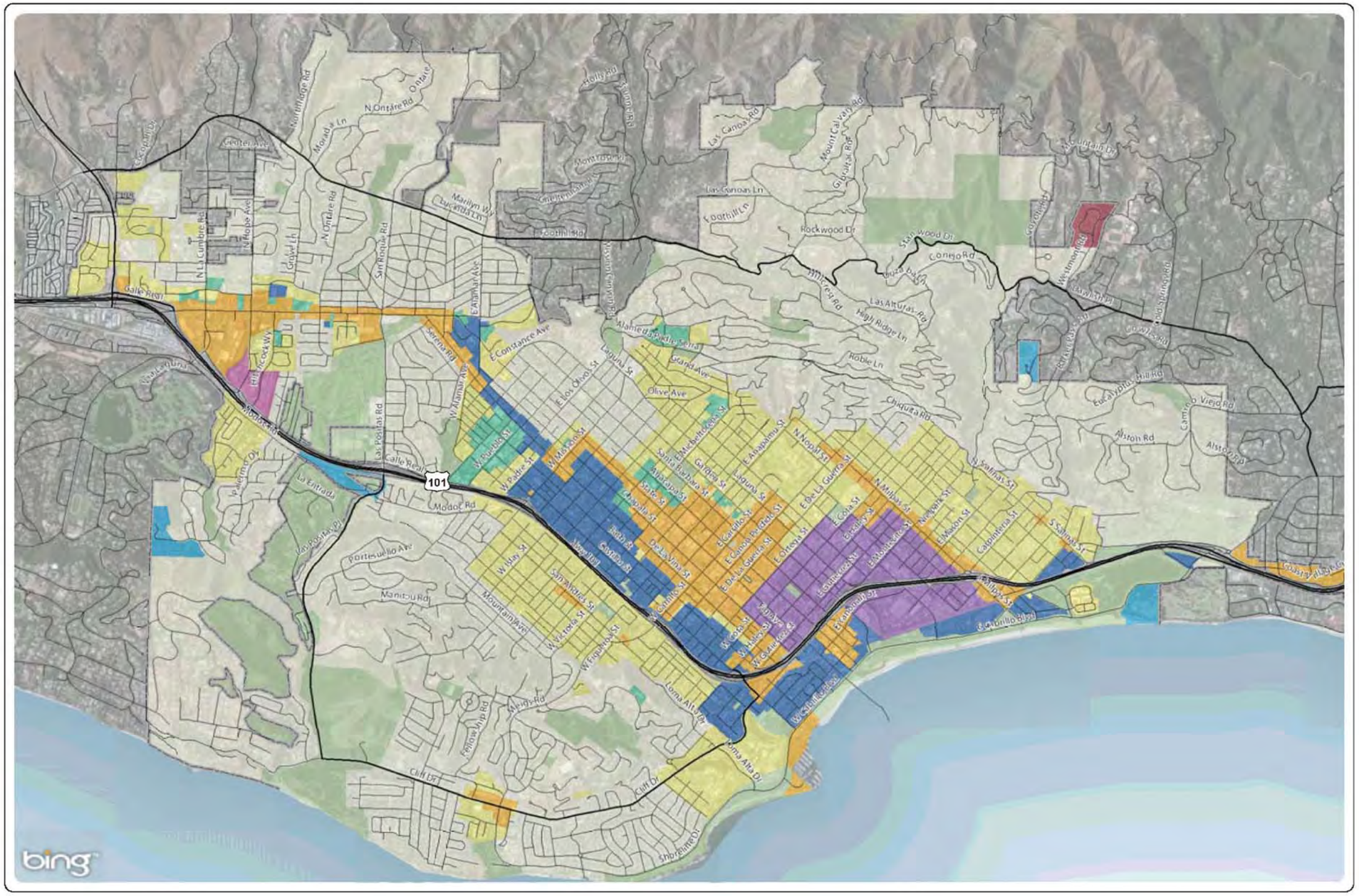

Land Use Zoning

- Single Family Residential
- Multi-Family Residential
- Commercial
- Medical/Office
- Manufacturing
- Hotel/Mixed Used
- Parks/Open Space
- PUD
- Planned Development Zone
- Specific Plan Zone 5
- Santa Barbara City Limits

N
Not to Scale

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SOURCE: Fehr & Peers 2013

FIGURE 5

Santa Barbara Land Use

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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Estimate Roadway Segments Evacuation Travel Speed

In order to further identify the possible bottlenecks and assess and prioritize the existing evacuation route corridors in and around the City of Santa Barbara, available GIS data was used to evaluate the travel time estimates along the designated evacuation routes. As part of the update to the Mission Canyon Community Plan (MCCP), Fehr & Peers addressed ongoing and new traffic circulation and fire safety issues for the MCCP plan area. During the MCCP study, GPS travel speed surveys were conducted for the key evacuation routes that connect the Upper Mission Canyon road and the City of Santa Barbara (such as Foothill Road and Mission Canyon Road). A micro-scale VISSIM traffic model was developed for the MCCP area and the north portion of the City of Santa Barbara neighborhoods to identify bottlenecks and choke points during the evacuation process under existing conditions and with future buildout of the MCCP conditions. Given that the roadway characteristics in surrounding hillside communities are similar to the roadways analyzed in the Mission Canyon Community area, the typical travel speeds from the MCCP traffic operational analysis (micro-simulation model) were extrapolated to inform the assumptions for this WEPA. For urban corridors in the City of Santa Barbara, travel speed estimates were developed based on review of the existing travel speed data in the validated City of Santa Barbara travel demand model developed for the *Plan Santa Barbara EIR*. The City's travel model (TransCAD model) contains the roadway length, width, free flow speed and travel speed during the congested commute peak periods. All available travel speed data were combined into one layer using ArcGIS. In addition, the contour maps from the US Census data were reviewed and a slope and curvature analysis (which is the ratio of the elevation or curvature difference over a segment length) was conducted in ArcGIS. The terrain categories were then defined (flat, moderate, severe, etc.) for every street in the City of Santa Barbara and the surrounding communities. Based on roadway grade changes and curvature, further adjustments were made to the initial travel speed estimates for each segment, as needed and agreed to by City of Santa Barbara.

Adjust Travel Speed Data to Account for Traffic Control Points and Intersection Delay

Network Analyst is an extension that works inside ArcGIS Desktop and provides network-based spatial analysis. It enables users to dynamically model realistic network conditions, including roadway segment speed limits and intersection delay. In order to supplement and refine the available data, a delay was included at intersections based on a number of sources, including the City's Plan Santa Barbara traffic study (based on average vehicle delay data reported in the traffic study), known evacuation control check points identified by the City, and observed information for other stop-controlled intersections. It should be noted that the traffic control scenarios may vary depending on the timing and location of a fire, the weather conditions, the

traffic control equipment (barriers) and particularly staff resources that could be rapidly deployed by the County, Caltrans and the City of Santa Barbara.

Develop Evacuation Travel Time from Key Neighborhood Areas to Nearest Evacuation Routes and to the City Center

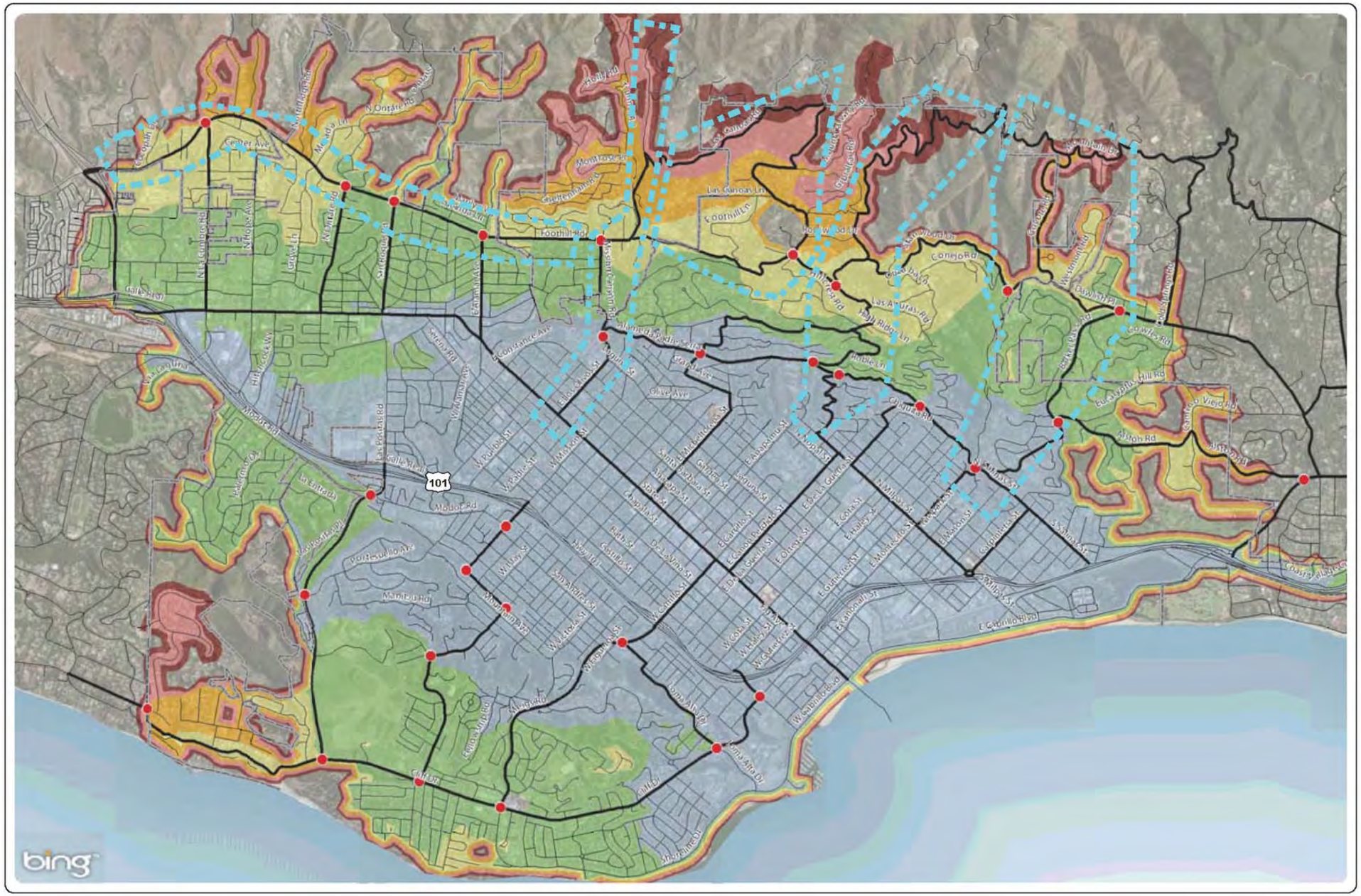
Based on the travel speed data, ArcGIS was used to conduct a shortest path analysis to estimate the travel time between various origin-destination pairs (e.g., from residential neighborhoods in Upper Mission Canyon Road to Downtown Santa Barbara).

Select Five Evacuation Corridors

Based on the initial assessment of evacuation traffic travel time and understanding of the fire hazard history in the area, the project team (including SBFD and SB Public Works) selected the top five evacuation corridors for further analysis, as illustrated in Figure 6. The five corridors within the Foothill and Extreme areas are all located north of the City of Santa Barbara and provide critical access to the hillside residential communities based on the previous fire history in the WEPA area, as listed below (from west to east):

1. Foothill Road between SR 154 (San Marcos Pass Road) and Alamar Avenue and the designated north/south evacuation routes such as N. La Cumbre Road, N. Ontario Road and San Roque Road
2. Foothill Road between Alamar Avenue and Mission Canyon Road, and the designated north/south evacuation routes of Mission Canyon Road, Alamar Avenue and Tunnel Road
3. Foothill Road between Mission Canyon Road and Foothill Lane, and Alameda Padre Serra
4. Mountain Drive, Rockwood Drive, Las Canoas Road, Stanwood Drive, El Cielito Road, Salinas Street in the Eastside communities
5. SR 144 Sycamore Canyon Road, Baker Pass Road and Alameda Padre SerraHuman

Discussion of the Results and recommendations from the traffic modeling study are provided in the following section.



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SOURCE: Fehr & Peers 2013

FIGURE 6

Top Five Evacuation Corridors

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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4 FINDINGS

4.1 Findings: Evacuation Procedures and Population Types

Wildfires in Santa Barbara County, like most of southern California, automatically result in an analysis of evacuations. Santa Barbara City has prepared a basic Wildland Fire Evacuation Plan in cooperation with government agencies, community groups, and citizens that provides guidance for wildfire pre-planning. Evacuations typically occur by geographic zones or evacuation blocks. The initial response team may request evacuations and for fires burning under conditions that make containment difficult, a Unified Command (Incident Command) is established and larger scale evacuations are analyzed. The real-time and predicted fire behavior and spread patterns, in conjunction with road capacities, are at the heart of evacuation considerations, driving the determination at which point evacuations throughout the wildland urban interface areas would occur and typically utilizing conservative thresholds. Allowance for adequate evacuation time is a key factor in determining the relocation timeframe so that the roads do not become congested. Hence, this WEPA aims to provide an estimated calculated evacuation time estimate for informing evacuation decisions. It is estimated that the minimum amount of time needed to move populations from the high priority evacuation corridors to safer areas (downtown core area) may require in excess of 45 minutes travel time after notification to evacuate is given. Based on additional allowances for the time needed to detect and report a fire, for fire response and on-site intelligence, for Reverse 911 and in the field patrol cars announcing evacuations, and for notifying special needs citizens, may require 60 or more minutes. Lastly, the time required for evacuees to gather personal items and small pets and/or livestock may require 45 minutes or more. Therefore, at minimum, it may require 105 minutes or more to evacuate the high vulnerability areas, and that assumes that traffic is kept flowing and grid-lock is avoided. Wolshon and Marchive (2007) simulated traffic flow conditions in the wildland urban interface (WUI) under a range of evacuation notice lead times and housing densities. To safely evacuate more people, they recommended that emergency managers (1) provide more lead time to evacuees and (2) control traffic levels during evacuations so that fewer vehicles are trying to exit at the same time.

Resident receptiveness to evacuation information, and their ability to process and carry out given direction, plays a significant role in the successful movement of a large number of people in multiple vehicles from one area to another. Logistics associated with large scale evacuations are complex and require significant pre-planning so that phased evacuations are possible and completed in a safe manner. Following this approach, large numbers of people have been successfully evacuated throughout California and within the Santa Barbara area during recent, large wildfire events. However, there are anticipated scenarios that could result in constrained evacuation in terms of available time and or available evacuation routes and increased hazard,

with the most difficult situation to plan for being that of a late evacuation (or a fire that blocks the egress route and prevents movement away from danger).

Wildfire emergency response procedures will vary depending on the type of wildfire and the available time in which decision makers (Incident Command, SBFD, Santa Barbara County Fire Department (SBCFD), SBPD, Santa Barbara County Sheriff's Office (SBCSO), and/or County Office of Emergency Management) can assess the situation and determine the best course of action. Based on the community, it's road network, and the related fire environment, the primary type of evacuation envisioned is an orderly, pre-planned evacuation process where people are evacuated from the higher hazard areas (evacuation blocks) to more urban areas further from the encroaching wildfire (likely in urban areas of Santa Barbara and surrounding communities) well before fire threatens. This type of evacuation must include a conservative approach to evacuating the most vulnerable areas, i.e., when ignitions occur and weather is such that fires may spread rapidly, evacuations should be triggered on a conservative threshold that includes time allowances for unforeseen, but possible, events that would slow the evacuation process.

Evacuation is considered by many to offer the highest level of life protection to the public, but it can result in evacuees being placed in harm's way if the time available for evacuation is insufficient (Cova et al. 2011). An example of this type of evacuation which is highly undesirable from a public safety perspective, is an evacuation that occurs when fire ignites close to vulnerable communities. This type of situation is inherently dangerous because there is generally a higher threat to persons who are in a vehicle on a road when fire is burning in the immediate area. Conditions may become so poor, that the vehicle drives off the road or crashes into another vehicle, and flames and heat overcome the occupants. This scenario occurred in San Diego County during the 2003 Cedar Fire. Even though hundreds of thousands of people were successfully evacuated, a late evacuation on Wildcat Canyon Road resulted in multiple fatalities where people were killed in their vehicles. A vehicle offers little shelter from a wildfire if the vehicle is situated near burning vegetation or catches fire itself. This type of evacuation must be considered a very undesirable situation by law and fire officials in all but the rarest situations where late evacuation may be safer than seeking temporary refuge in a structure (such as when there are no nearby structures, the structure(s) is/are already on fire, or when there is no other form of refuge).

The third potential type of evacuation is a hybrid of the first two. In cases where evacuation is in process and changing conditions result in a situation that is considered unsafe to continue evacuation, it may be advisable to direct evacuees to pre-planned temporary refuge locations, including their own home if it is ignition resistant and defensible. As with the second type of evacuation discussed above, this situation is considered highly undesirable, but the City's

evacuation pre-planning must consider these potential scenarios and prepare decision makers at the IC level and at the field level for enacting an alternate to evacuation when conditions dictate.

In any of the three evacuation scenarios identified above, it is a common first reaction to assume that moving large numbers of people to safety will be difficult. There are many factors that may affect successful outcomes and one of the largest concerns is that of public reaction. How the public reacts to dangerous, urgent, and potentially life-threatening situations has considerable impact on pre-planning for wildfire emergencies. Indications from past fires and related evacuations, in Santa Barbara and throughout Southern California, which have experienced increasingly more frequent and larger fires, are that evacuations are largely successful, even with a generally unprepared populace. It then stands to reason that an informed and prepared populace would minimize the potential evacuation issues and related risk to levels considered acceptable from a community perspective.

Research indicates that wildland fire evacuation procedures are typically the same as those for other emergency disasters: 1) notification, 2) timing, 3) evacuation of pets and livestock, 4) ingress and egress, 5) immobile populations, 6) people who refuse to leave or delay leaving (Carroll and Cohn 2007) and 7) re-entry/recovery. All things considered, the issue of determining optimal evacuation paths out of an area at risk is modeled as a network flow problem in GIS. The objective of the network flow evacuation problem for the City of Santa Barbara is to route the population from various land uses and population densities in the northern portion of the City to a set of safer zones to the south, likely within the urban core or southeast or southwest along the coastal areas, in the least amount of time, without exceeding the capacity constraints of the system.

The vulnerable populations are linked by streets that indicate the allowed direction of flow of people or vehicles during the emergency evacuation. The streets have characteristic attributes including capacity (i.e., maximum flow that the streets will flow), geometric characteristics, and travel time (which depends on the flow and geometric characteristics of a particular street). For Santa Barbara, as for most WUI communities, the links (streets) are the limiting factor. Santa Barbara includes many narrow, winding roads in the foothills areas. These roads are often tree-lined, adjacent wildland fuels, and include the risk of “over-the-side” vehicle accidents. In addition to the limiting roadway attributes in Santa Barbara, there is a high population that would need to be evacuated on these roads that further complicates the situation.

4.1.1 Special Population Considerations (Non-City Residents and Shadow Evacuees)

In addition to the relatively straight forward appearing process of safely moving people from the north to the south, there are other population components that impact the process. For example, non-Santa Barbara City residents (e.g., County, Montecito, Goleta residents) and "shadow evacuations" may affect Santa Barbara wildfire evacuations, especially if there is an attempt to control evacuation traffic numbers by phasing the evacuation from most vulnerable to least within the evacuation zone(s). It is possible that both neighboring city and shadow evacuees, those who are evacuating before receiving the official evacuation notice and those evacuating even though they are not in a vulnerable area, may have an effect on the efficiency of the evacuation procedures. If the roadways would be beyond capacity during evacuations of planned areas, additional evacuees who are not supposed to be evacuating can bring traffic to a halt. Therefore it is recommended that a conservative estimate of the total number of potential non-Santa Barbara residents and shadow evacuees is considered when making evacuation assumptions and built into the calculation of time required to move people out of harm's way.

During certain types of evacuations that impact a large area and population, traffic in Santa Barbara will be impacted by evacuating residents form Montecito and potentially from Goleta. These impacts would not be expected during any of the three wildland fire scenarios modeled in this WEPA, but a large, wind-driven fire event that originated north/northeast of the City in the foothills or mountains and spread across the foothills from east to west, or from west to east, could force Montecito or Goleta foothill residents to evacuate into Santa Barbara via roads including 1) Sycamore/192/Foothill Road and any north-south trending road from that road including Baker Pass Road, Sycamore Canyon Road, Mission Canyon Road, Los Olivos, Hope Road, W. Ontare Road, or others into Santa Barbara and onto roads being utilized to move Santa Barbara residents out of harm's way, 2) impact from Goleta would be expected to be lower than from Montecito, but both could result in increased traffic merging onto Highway 1 (such as at N. Patterson Avenue, S. Turnpike Road, or Carpenteria St), causing backups that impact Santa Barbara evacuation of foothill areas where the goal is to move people/cars from north to south. The population of residents north of Highway 192 in Montecito is substantial enough that it could complicate Santa Barbara City evacuations or in turn, may be impacted by Santa Barbara City evacuations. Therefore, coordination between agencies will be essential when large scale evacuations occur to account for neighboring City traffic flows.

This WEPA has estimated an additional 25–50% or more of the evacuating number of vehicles may be on the road during a wildfire evacuation. For example, Sorensen and Vogt 2006 indicate that shadow evacuation was well documented for Hurricane Floyd and averaged 26% in low risk zones. Further, Mitchel et al. (2005, 2007) studied a chorine release caused by a train derailment

and noted that the shadow evacuation in an area 1–2 miles from the release was 59%. In fact, it is thought that spontaneous evacuation occurs in most evacuation events. A varying percentage of people leave areas when a threatening event (hurricane, tornado, wildfire, tsunami, etc.) seems imminent, often well before officials order or recommend evacuation.

At the opposite end of the spectrum, in most evacuations, there is a percentage of people within evacuation areas that choose not to participate in the evacuation or have no awareness of the event and its significance. Other reasons for not evacuating may include that evacuation orders were not received, practiced and prepped citizens feel prepared for sheltering in place, traffic congestion prevented evacuation, pets and/or livestock care, and the emergency is too close and/or moving too fast, amongst others. This WEPA anticipates the number of people in the vulnerable areas who refuse to evacuate or are unaware of an evacuation will be minimal, less than 5%. This is based on the general fire awareness levels in the foothill areas of Santa Barbara that have been formed by the high fire frequency in the area. Therefore, this portion of the population is not expected to significantly decrease the number of vehicles on the road or impact the general flow of traffic, unless firefighters or law enforcement personnel are attempting to reach these individuals to assist, notify, or have direct contact for purposes of convincing them to evacuate. This could negatively impact evacuation efforts by limiting options for opening up flow southward (contraflow) on the northbound lane.

Further, a segment of the population is considered to have special needs for evacuation notifications and/or when actual evacuations are designated. Special needs components of the population may include people without transportation, the mobility impaired, those who cannot afford evacuations, the elderly, those who are a sole care provider, those with work obligations, those with hearing or visual impairments, children, and similar people who may not be able to evacuate even if they want to. These population components are likely dispersed throughout the evacuation area within residences, facilities, schools, and other institutions. It is important for the emergency service agencies to know where the special needs persons are so they can be considered during the pre-planning stage and extra time calculated into the evacuation process. The higher wildfire vulnerable areas of Santa Barbara are not expected to include a particularly large special needs population. However, the United States Census Bureau (2005) indicates that roughly 19% of the non-institutionalized population includes a disability of some sort. This percentage is considered higher nationally than in the vulnerable areas of Santa Barbara, but if based on this percentage, the total number of people who may need assistance evacuating is roughly 1,000 people, assuming 5,000 persons in the affected area. Special needs population data is maintained by the County OES due to privacy and Health Insurance Portability and Accountability Act requirements.

4.2 Findings: Social Aspects of Wildfire Evacuation

Orderly movement of people is the result of planning, training, education, and awareness, all of which are promoted in Santa Barbara County/City. Evacuation has been the standard term used for emergency movement of people and implies imminent or threatening danger. The term in this WEPA, and under the "Ready, Set, Go!" concept, indicates that there is a perceived threat to persons and movement out of the area is necessary, but will occur according to a pre-planned and practiced protocol, reducing the potential for panic. Even with an uneducated/prepared populace, direction provided to the populace in a confident manner, by anyone, not necessarily from a uniformed officer, has been shown to result in acceptance and abiding by persons who are unfamiliar with the threat or the area (numerous research articles on evacuation).

Citizen reactions may vary during an evacuation event, although several studies indicate that orderly movement during wildfire and other emergencies is not typically unmanageable. Evacuation can be made even less problematic through diligent public education and emergency personnel training and familiarity. Social science research literature indicates that reactions to warnings follow certain behavior patterns that are defined by people's perceptions (Aguirre 1994, Drabek 1991, Fitzpatrick and Mileti 1994, Gordon 2006, Collins 2004) and are not unpredictable. In summary, warnings received from credible sources by people who are aware (or have been made aware) of the potential risk, have the effect of an orderly decision process that typically results in successful evacuation. This success is heightened when evacuations are practiced (Quarentelli and Dynes 1977; Lindell and Perry 2004) as is recommended within the City of Santa Barbara for both the populations in higher hazard areas and for fire and law enforcement personnel. Further, in all but the rarest circumstances, evacuees will be receiving information from credible sources during a Santa Barbara wildfire evacuation. Further, it would be anticipated that law enforcement and/or fire personnel would be on site to help direct traffic and would be viewed by evacuees as knowledgeable and credible. The importance of training these personnel cannot be understated and annual education and training regarding fire safety and evacuation events will be essential for successful future evacuations.

Appendix D, presents a summary of research (FEMA 2013 and by Sorensen and Vogt (2006)) supporting the notion that the public generally does not significantly impact successful evacuations.

4.3 Findings: FARSITE Fire Spread Modeling

Three different output files were generated from the FARSITE models, representing one run for each Scenario. The output files are a GIS shapefile representing fire perimeter boundaries at 1-hour intervals for the duration of the FARSITE run (8 hours).

As noted, Wildfire Scenario 1, which included an ignition within Lauro Canyon, results in a relatively fast fire spread within the first hour, spreading roughly 1.25 miles to the south, driven by the sustained 60 mph winds and low 8% relative humidity (Figure 7). Fire spread to the east and west is largely contained within the Lauro Canyon evacuation block for the first hour. Subsequent hours of burning include much slower spread to the east and west as the fire bumps up against urban areas. The model indicates that the fire spread stops when it reaches urban areas, which may not be the case as there may be widespread, but spotty structure and/or landscape fires which are not captured in a FARSITE modeling analysis.

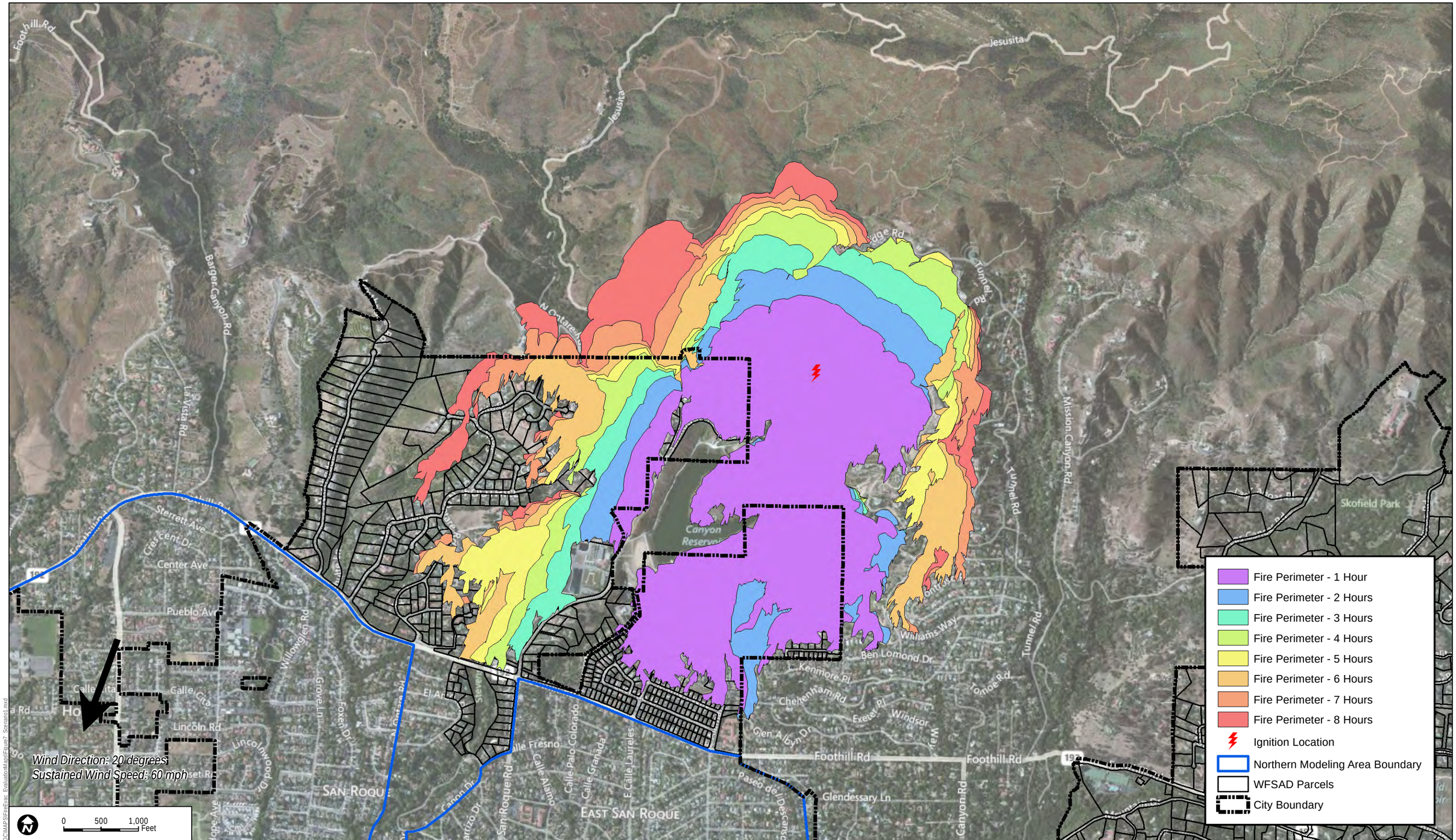
Wildfire Scenario 2, which depicts an ignition off of Lowena Drive in the Lower Riviera community near the Santa Barbara Bowl, indicates that under the typical weather conditions, including average relative humidity and low, 6 mph on-shore winds, the majority of the open space fuels will be consumed within four hours (Figure 8). Within hour one, the fire is projected to spread roughly 0.25 mile from Lowena Drive in the south, northward to Alameda Padre Serra, eastward to Newton Road, and westward up the western canyon wall. Fire spread in subsequent hours is eastward and westward, consuming available fuels within the open space and into some of the adjacent neighborhoods, generally following vegetated corridors. Structure ignitions are not captured in the FARSITE modeling analysis, but would be possible, but less likely due to the lack of significant winds and fuels that are not as dry and ready to burn in this scenario.

Wildfire Scenario 3 depicts an ignition south of Barcelona Drive in an open area that includes large expanses of naturally vegetated opens space including Ellings Park and Arroyo Burro Beach County Park to the southwest of the ignition, open space to the west of Las Positas Road and connected vegetated slopes and corridors to the north and west including Hidden Valley Park. This ignition includes extreme fire weather with 8% relative humidity and high sustained winds of 60 mph. Within the first hour, fire spread is projected to have burned over one mile through the open space areas to the south where it bumps up against urban neighborhoods, including Vista Del Mar and neighborhoods to the west. FARSITE projects spot fires may burn the coastal bluffs (Figure 9) within hour one. Hours two and three include continued spread among available fuels primarily to the west, where it burns through the City boundary, while spread to the east is limited to Las Positas Road, remaining out of Elings Park, primarily due to the wind and the fuel break presented by Las Positas Road, although it is realistic to anticipate that the flashy fuels within Elings Park could easily ignite from embers. Spread into Arroyo Burro Beach County Park occurs during hour 3, presumably from spotting and hours 4 through 8 include continued spread through the available fuels in the park as well as perimeter growth throughout the neighborhoods to the west of the City boundary, but remaining east of Estrella Drive.

It should be noted that the modeling results presented herein depict values based on inputs to the FARSITE software. While the FARSITE model allows for a temporal analysis of fire spread, the inclusion of constant wind speed and direction data in the model were used to represent specific weather scenarios, and do not account for real-world changes in wind speed or direction that may be realized during an actual fire event. Further, current research indicates that FARSITE analyses tend to over-predict fire spread rates (Finney 1998). The FARSITE modeling effort did calculate spotting from surface fires, thus spread rates resulting from FARSITE models are based on the progression of the flaming front of the fire plus spotting ahead of the fire front. Changes in wind, weather, or pockets of different fuel types are not accounted for in this analysis. Fuel models were derived from classifications of remotely sensed data, coupled with cursory field evaluations. Model results should be used as a basis for planning only, as actual fire behavior for a given location will be affected by many factors, including variable weather patterns over time, small-scale topographic variations, or changing vegetation patterns.

4.4 Findings: Traffic Modeling

Evaluation of the various data available for conducting traffic modeling required review of various data sources and resulted in a good overall picture of the evacuation opportunities and constraints in Santa Barbara, especially for the top five evacuation corridors that were the focus of this analysis. Congestion on roads can lead to longer travel times, especially from the evacuation corridors evaluated. Temporarily moving people out of these areas is the primary focus of evacuations because they are the population at highest risk. Therefore, there are a number of issues that need to be addressed. The northern part of the City of Santa Barbara is in the designated WUI area, where residential development and the transportation network is within and adjacent to highly flammable vegetation (Extreme and Foothill Zones). While the roads in this area are generally adequate to serve everyday commuter traffic, the need for efficient and safe evacuation routes/procedures during a fire is a concern for many in the City and especially for those residents in the surrounding communities north of Foothill Road (State Route 192) in Santa Barbara County, such as the Mission Canyon Communities. Further, several of the City's arterials that provide primary access to the upper Mission Canyon neighborhoods have been identified as wildland fire evacuation routes. The evacuation traffic from adjacent areas could also use the same routes as residents of the Mission Canyon Community. For example, Foothill Road and Mission Canyon Road may carry traffic from Las Canoas Road. Similarly, Mountain Drive, Alameda Padre Serra and North Los Olivos Road may serve traffic from adjacent City of Santa Barbara and Eastside neighborhoods.



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SOURCE: City of Santa Barbara; Santa Barbara County; Bing

FIGURE 7

FARSITE Model Results for Lauro Canyon

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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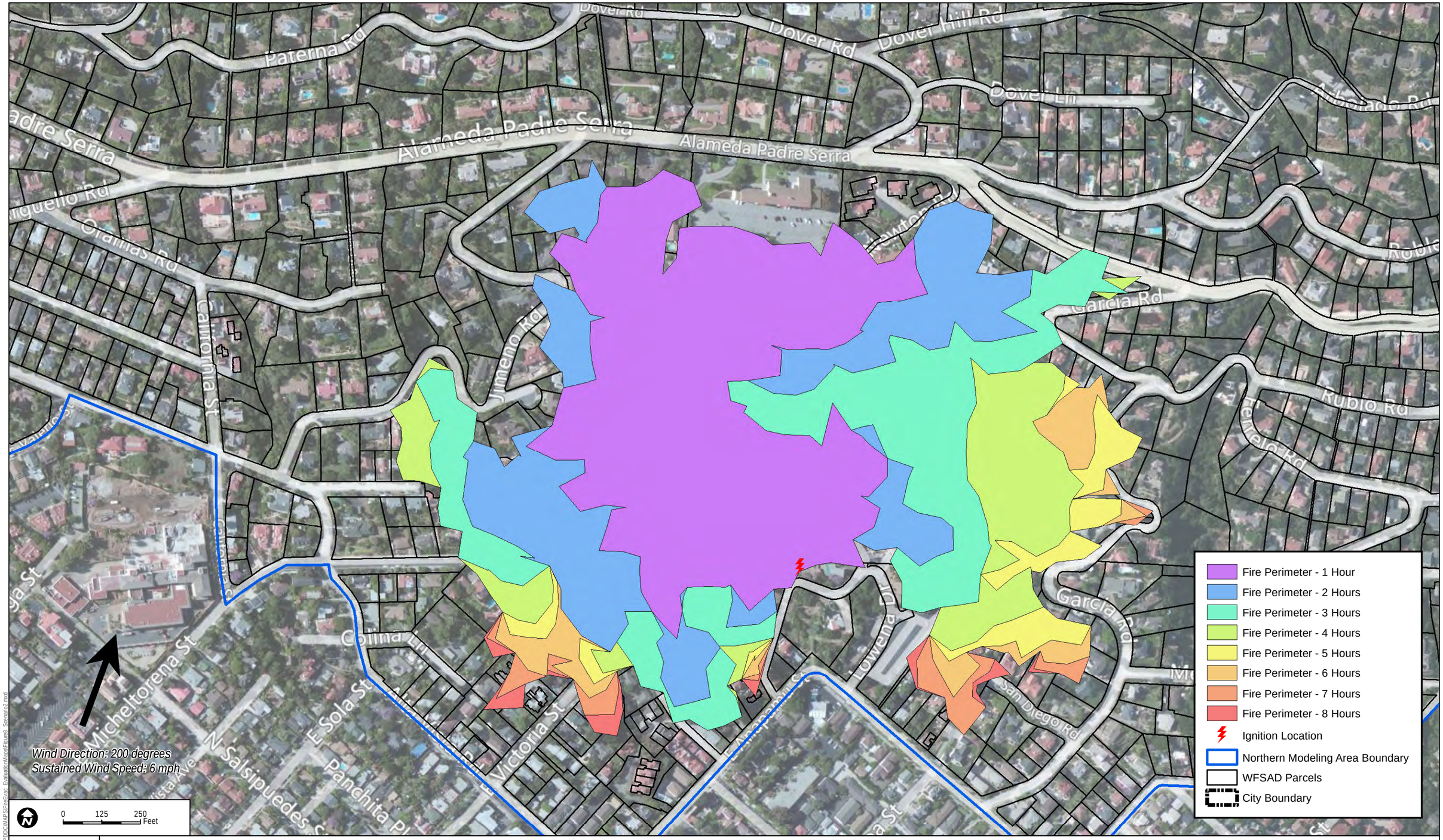

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SOURCE: City of Santa Barbara; Santa Barbara County; Bing

FIGURE 8

FARSITE Model Results for Santa Barbara Bowl

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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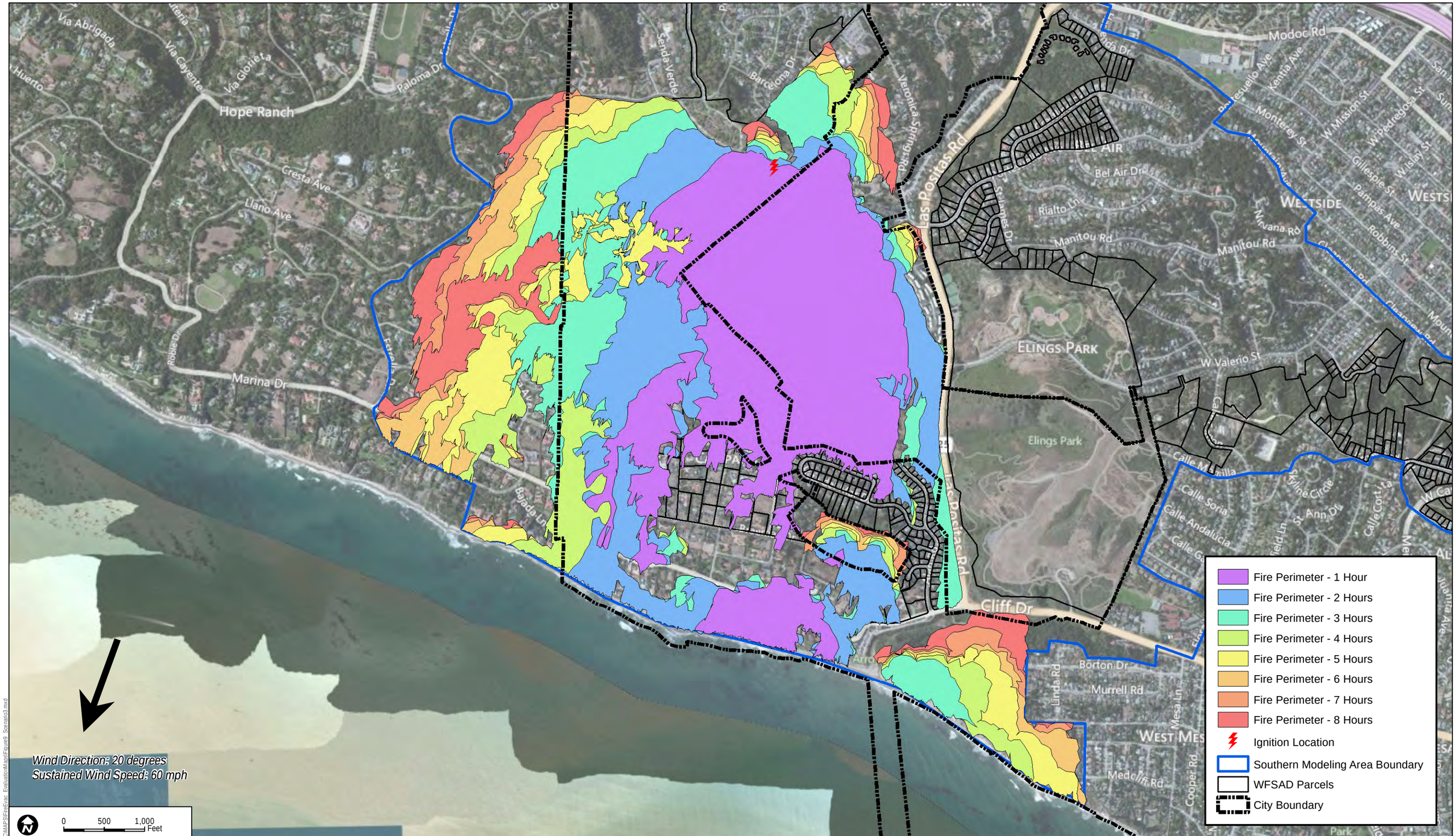

SOURCE: City of Santa Barbara; Santa Barbara County; Bing

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FIGURE 9

FARSITE Model Results for Campinelli Hill

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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While there is no GIS database available that provides right-of-way information for every roadway segment in the project area, Fehr & Peers' understanding, based on review of previous studies and field observations, is that many of the existing residential roads and collectors north of the City of Santa Barbara do not connect. Most of the access roads to the residential homes are public roadways with short private driveways. These public roads are usually narrow roads with short curve radii. These roads do not always conform to current fire code requirements and fire access standards (24 feet [two 12 foot travel lanes] unobstructed paved roadway). The key evacuation routes in those areas are generally narrow and do not have paved shoulders, curbs, gutters, or sidewalks. The average roadway width varies from 20–30 feet for two-way travel. The posted speed limit is generally 20–25 miles per hour (mph) for the residential collectors, with advised speeds of 15 mph for many locations with limited visibility due to horizontal curves or grade changes. The key roadways have fog line striping and portions are designated No Parking zones, but the residential streets generally allow on-street parking, which can often only allow one car to pass at a time, resulting in a difficult situation for fire engines during emergencies or fire evacuations. Many of those residential homes and tourist venues, such as the Santa Barbara Botanic Garden and Santa Barbara Natural History Museum, cannot provide multiple access points to evacuation routes designated by the City and the County.

Given the aforementioned parameters and potential congestion relating to evacuation traffic, the possible delay at each traffic control checkpoint and key bottlenecks may be on the order of five minutes or more for each motorist/vehicle. Figure 10 illustrates the estimated evacuation travel speed data for the City of Santa Barbara. Many of the roadways in the hillside communities north of Foothill Road have roadway segments where the average travel speeds are less than 10 mph. In the City, the residential streets generally operate at 10 to 20 mph during the congested peak hours. The collectors and arterials that may carry the majority of the evacuation traffic operate between approximately 20–0 mph. Depending on the congestion levels and the time of day, some parts of the 101 Freeway mainly between Carrillo Street and Salinas Road may operate at speeds less than 50 mph.

Figure 11 illustrates the travel speed from each parcel in the City to the nearest designated evacuation routes. This figure reveals that the estimated travel time from any parcel in Downtown Santa Barbara to the nearest evacuation route is approximately five minutes or less. In hillside areas such as the adjacent Mission Canyon Heights and Las Canoas communities within the top five evacuation corridors, the time to travel from residential areas to the closet key evacuation routes may be up to 10 minutes or more.

Recent fire history suggests that the majority of the evacuation traffic will be exiting the hillside areas toward the City of Santa Barbara or the coastal area for shelter or refuge. This would, of course, vary in the event of a fire burning from the ocean towards the foothills. Figure 12

provides the estimated travel time from each parcel to the core downtown Santa Barbara. In a fire evacuation scenario similar to the Tea Fire (2008) or Jesusita Fire (2009), under existing conditions and during a typical weekday afternoon, the evacuation outbound travel time from the Upper Mission Canyon Area to Downtown (e.g., City Hall) may be at least 40 minutes or more.

This travel time estimate does not account for the worst-case maximum usage of the Santa Barbara Botanic Garden or Natural History Museum. If large events were assumed at these facilities, the travel time would be expected to be greater than 45 minutes. However, each of these facilities voluntarily and by condition, employ fire safety protocols and restrictions on the number of events and the size of events during especially high fire hazard days. Similarly, these facilities are required to include shuttles for larger events, limiting the number of vehicles that would impact traffic during an evacuation. They also include the last-resort capability of temporarily sheltering in any of the site's newer buildings on site if determined safer than evacuating. These restrictions and requirements are expected to have a significant positive impact on the potential for a large fire coinciding with a "worst-case" population condition.

As briefly discussed previously, the 45 minute timeframe is for moving vehicles out of the most vulnerable portions of the City. This timeframe assumes "wheels rolling", actual travel time. Additional time that must be considered in the evacuation process includes time for:

1. Fire detection and reporting (up to 10 minutes)
2. Dispatch and fire response (up to 10 minutes)
3. Evacuation decision (10 minutes or more)
4. Message to dispatch (5 minutes)
5. Evacuation message dissemination (up to 45 minutes)
6. Residents to gather personal items, pets, livestock (if able) and begin evacuation travel (45 minutes)
7. Contingency time to allow for shadow evacuees, special needs population, unforeseen congestion or blockages (30 minutes)

Total minimum time that may be needed for a large-scale evacuation from the detection of a fire until the last person is out of harm's way is 90–120 minutes, with variation on the size of the evacuation and the minutes required for each step. Appendix E illustrates an evacuation time frame estimate. Smaller scale evacuations (particular evacuation blocks, streets or neighborhoods) would be expected to require less time, proportionately to the population being evacuated.

SOURCE: Fehr & Peers 2013

FIGURE 10

Santa Barbara Travel Speed Data

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SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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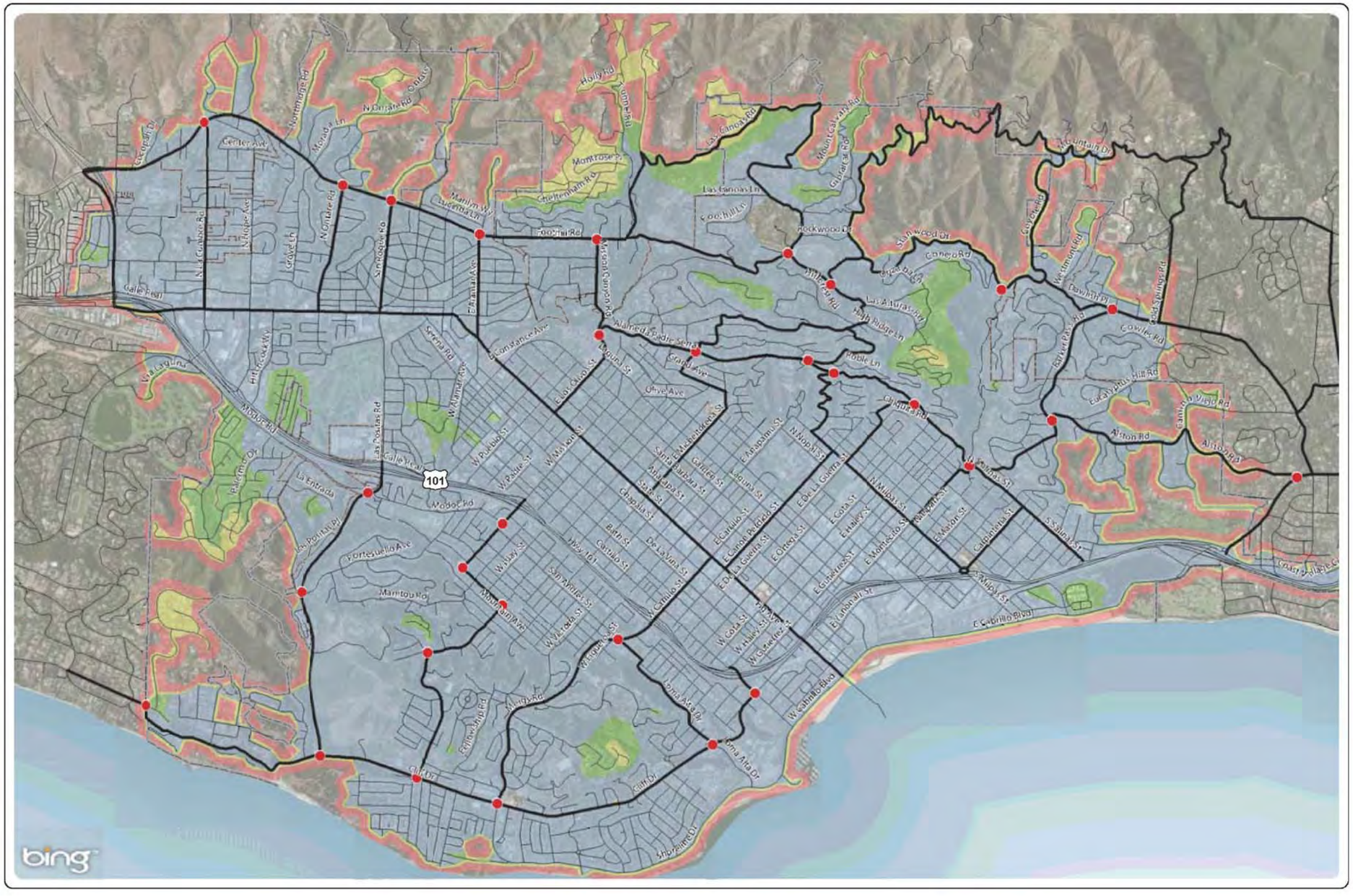

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SOURCE: Fehr & Peers 2013

FIGURE 11

Santa Barbara Travel Times to Nearest Evacuation Routes

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

NOTE: Evacuation scenario times are calculated after a 45 minute reverse 911 calls are completed.

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SOURCE: Fehr & Peers 2013

FIGURE 12

Estimated Travel Time from Parcels to Core Downtown Area

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

NOTE: Evacuation scenario times are calculated after a 45 minute reverse 911 calls are completed.

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Because actual circumstances during a fire can be fluid and somewhat unpredictable, estimates of travel time and other parameters are based on conditions during recent events. These estimated travel times were based on evacuation assumptions. Actual conditions may or may not be consistent with the estimates. However, a conservative approach has been employed. The travel time estimate is intended to be used to identify and prioritize the evacuation corridors for City staff to choose from and/or combine when responding to fire evacuation scenarios. These would depend on the timing and location of a fire, the weather conditions, and the traffic control equipment and staff resources that could be provided jointly by the County, Caltrans and the City of Santa Barbara.

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5 INTEGRATION OF WILDLAND FIRE EVACUATION PROCEDURES ANALYSIS DISCIPLINES

Evacuation planning that focuses only on fire behavior/spread modeling results in a reasonable estimate of how long it may take for fire to spread from a preselected ignition point to vulnerable areas of the City, suggesting a reasonable estimate of how much time would be available to enact an evacuation. Similarly, evacuation planning focused only on traffic modeling for the City's high fire hazard areas results in a reasonable estimate of the amount of time it will take to move the existing residents from vulnerable areas to evacuation points within the City of Santa Barbara. In terms of preparing an evacuation plan that has a goal of resulting in successful evacuations of the effected populations during a wildfire, it is very useful to know both the amount of time needed to evacuate and the amount of time available to evacuate. To that end, the modeling conducted for this project was not completed in a vacuum or without consideration of real-life events in Santa Barbara's recent past. Informed City data guided the traffic modeling, adjusting speeds and loading based on actual evacuation results from previous wildfire evacuations. Similarly, fire spread modeling was guided by fire spread and behavior from previous wildfires in the area as well as incorporating expected urban landscape fire spread predictions. Results were corroborated so that the fire spread models provide realistic patterns and timeframes.

Factors that may influence the time needed for evacuation are more controllable than factors that may influence fire spread rates. One important factor is how the public reacts to the emergency. Public behavior in an emergency, as the research indicates, tends to be reasonably predictable. There are however, unpredictable facets of social behavior that are difficult or impossible to anticipate and equally as difficult to pre-mitigate. Therefore, this WEPA has conducted independent traffic and fire spread analysis and then built into the analysis a fire evacuation, social behavior based, buffer time period. The social aspects of fire evacuation appear to be predominantly that an informed public that is familiar with the threat, understands their options, has been a part of the planning process, and is routinely refreshed on the issue, will have fewer issues during an evacuation, resulting in higher probabilities for successful evacuations.

5.1 Existing Wildland Fire Evacuation Procedures Evaluation

The current wildland fire evacuation procedures have worked well for the City as evidenced by the successful evacuation s that have occurred over the last two decades. However, there are fire scenarios that have not been realized and that may stress the ability of the evacuation procedures to be implemented quickly enough and/or to move people to safer areas when extreme weather conditions exist. The existing procedures utilize standard protocols to determine when evacuations would be necessary, which evacuation blocks or areas may be affected, which pre-planned intersection control points will be manned, and how fire behavior and spread would trigger additional evacuations.

Our analysis of the existing evacuation plan considers the basics of Evacuation block delineation, evacuation roadways, emergency vehicle ingress ways, and control points to be positioned in nearly optimal locations, with a few exceptions described in Section 6.0 – Recommendations. Given the City's and surrounding community road network and the constraints that limit road widths, connections, alternative ingress/egress ways, populations, and options for improving the existing condition, there are not many feasible improvement options available. However, we have identified some general and specific options that if implemented, would result in incremental to significant improvements in the ability to evacuate people from vulnerable areas to less vulnerable areas faster than currently possible. Evacuation speed and efficiency become increasingly important as fires ignite closer to urban areas.

Currently, there are no pre-planned trigger points for most of the wildfire scenarios that include ignition near urban areas. Distant wildfires that move into the City from the north typically allow enough time to evacuate people out of the Foothill and Extreme Fire Hazard Zones. Triggers, or decision points for evacuations are relatively easy in these cases and provide significant buffer time for traffic issues, special needs citizens, animal evacuations, etc. Based on the information reviewed for preparation of this WEPA, what appears to be missing from the current protocols is a workable pre-plan for managing evacuations when wildfires ignite close to urban areas, especially during extreme weather conditions.

The scenarios considered in this WEPA provide insight into how quickly wildfires in specific areas selected by the SBFD can encroach upon existing communities. In all three cases, but especially the scenarios that include extreme fire weather, the projected time to evacuate residents is longer than time available before the fire is threatening the community. This realization indicates that pre-planned evacuation decision points will include an immediate evacuation of the most vulnerable neighborhoods within threatened evacuation blocks followed by a secondary, and possibly a tertiary decision point that would trigger evacuation of successively larger areas, depending on fire behavior, but likely to be necessary when wind-driven fire occurs. Further, it emphasizes the need for robust fuel management programs for private property owners, roadside fuel modification improvements, structural hardening of older structures, and citizen evacuation readiness, especially during Red Flag Warning Conditions.

Enhancing the current evacuation capabilities for Santa Barbara residents in high fire hazard areas is a primary goal of this WEPA. This goal will be reached through various improvements to the current evacuation procedures that facilitate the movement of people, provide for a prepared public directed by informed officials and include a practiced pre-plan involving all agencies and organizations that are critical components of the evacuation system, as discussed in the following section.

6 RECOMMENDATIONS

The following recommendations are based on analysis of the fire environment, the road network, fire behavior modeling, traffic modeling, the existing evacuation planning procedures, anticipated public response, fire department input, and available evacuation plans and data.

6.1 Maintain Existing Pre-Plan Evacuation Block Maps and Prepare Scenario Based Sub-Block Phone Tree Lists

The I Zone Major Incident Preplan separates the high fire hazard areas throughout the Santa Barbara front country and in the southwestern portion of Santa Barbra into evacuation areas or "evacuation blocks" (Appendix A). Development of the evacuation blocks included an exhaustive effort and a comprehensive approach. A total of 26 blocks were identified within the City. The evacuation blocks appear to be based on a variety of features including watersheds, terrain including ridgelines, population areas, significant landscape transitions including roadways, vegetation, and others. These features combine to create "firesheds", which can be defined as areas that tend to burn as part of a continuous block of fuels due to landscape similarities. There were no recommended edits to these blocks based on the scope of this analysis.

For each evacuation block, a template and a map of the area was developed. The block templates outline:

- traffic closure points
- fire response routes
- fire resources that would respond to a fire based on first, second, and third alarm
- probable evacuation routes
- incident command posts to facilitate management of the fire
- fire staging areas for fire equipment
- collection points (evacuation centers) for civilians and animals
- any additional risk that exist with an evacuation block.

These block maps provide a wealth of information that should remain as the primary evacuation pre-plan. It is our understanding that the SBFD is in the process of completing individual pre-plans for the City's jurisdiction that will be consistent with Santa Barbara County Fire Department Pre-plan maps. This WEPA recommends that those pre-plan sheets are completed as early as possible and shared with neighboring agencies. This material should be made available in each fire station, fire engine, command vehicle.

Edits to the evacuation blocks, such as combining blocks or further separating blocks into new blocks is not considered necessary at this time. The evacuation block can be considered the "fireshed" at risk and evacuation notices can be tailored within the individual blocks, as discussed further in Section 6.10 so that evacuations of specific neighborhoods can be achieved without evacuating an entire evacuation block, depending on the fire behavior at the time.

1. Therefore, this plan does not propose editing the evacuation blocks, but leaves open the possibility that evacuation blocks may require adjustments in the future based on post-fire studies.
2. We recommend that scenario based sub-block level phone tree lists are prepared so that the most vulnerable properties can be contacted immediately with successively larger areas evacuated as fire behavior dictates. Currently, the Reverse 911 zones include wide swaths that include more vulnerable properties to the north and less vulnerable (generally) to the south. Sub block phone tree lists would provide the ability to focus evacuations where they are needed most while reducing the roadway traffic associated with evacuating residents who may not need to leave their homes.
3. We also recommend occasional updates are provided, especially following lessons learned from actual incidents, as new technologies become available that would aid in the evacuation process, and as changing landscapes and development patterns occur within and adjacent the City that may impact how evacuation is accomplished.

The recommendations that follow seek to enhance and augment this existing pre-plan, not replace it. Therefore, the plan will need to be updated to reflect any of the recommendations that are adopted and implemented.

6.2 Coordination and Cooperation among Stakeholders Charged with Evacuation Responsibilities

There are numerous federal, state, and local, agencies, organizations and other entities involved in the evacuation decision making process, actual evacuation, and post-emergency period. These stakeholders must be part of the ongoing coordination efforts and outreach. The more educated and informed each of these organizations is regarding Santa Barbara wildfire evacuation pre-planning, the higher the probability that evacuations will occur with minimal issues.

- 6.2.1 Improve coordination/cooperation among agencies. Better coordination amongst agencies is an important component of successful implementation of evacuation plans. This report notes various agencies and their evacuation planning protocols that are not shared beyond their own agency.

- 6.2.2 Ensure evacuation planning is coordinated between Law/Fire. Law enforcement plays a critical role in carrying out evacuations, controlling intersections and the flow of traffic. They currently have only minimal exposure to evacuation planning efforts of other agencies.
- 6.2.3 Law Enforcement officers are not properly trained or equipped with safety equipment necessary to carry out their critical function. Equipping officers with protective gear, real-time video communication technology, and an understanding of the regional evacuation perspective will be important to future evacuations, as discussed further in Sections 6.5 and 6.11.

6.3 Community Planning and Safety Zones

Most of the City is built out and the new development that may occur in the higher fire hazard areas is limited. As such, it is difficult for future development and the funding that it provides to have a significant effect on the evacuation process on a wide-scale basis through the land planning process. However, development that does occur, including re-development of existing properties, should include consideration of evacuation impacts, firefighter response, staging, and roadway mitigation.

6.3.1 Community Planning Role

Community planning can and should be a part of the solution to identifying and enhancing pre-planned firefighter safety zones. This WEPA, in section 6.8, discusses results of our analysis of potential safety zones within the WUI areas of Santa Barbara. There are not many areas that meet the strict definition of a safety zone. Further, the type of fires fought at the WUI do not lend themselves well to typical safety zones. In urban settings, wildland fires may transition to urban/structure conflagrations. Finding large, clear, low fuel areas that provide adequate setback from encroaching flames is nearly impossible due to a variety of factors, with land values and development pressures leading the list. However, safety zones in urban areas may give way to Temporary Refuge Areas, which are typically abundant, as discussed further in Section 6.8.

6.3.2 Planner Facilitate Identification and Enhancements to Potential Safety Zones

Community planners can assist safety zone enhancements or creation by knowing where they exist, what enhancements would result in potential areas being listed as useable areas, and how those enhancements can be funded through various ways, including new development projects.

6.3.3 Planners Facilitate Permitting

Another important component of safety zone establishment that planners will play a lead role in pertains to permitting the on-the-ground enhancements which may include ground disturbances such as grading and vegetation removal.

6.3.4 Existing Potential Safety Zones

The following list of potential safety zones could be enhanced to provide firefighters pre-planned areas of refuge during wildfire events. These areas are discussed in more detail in Section 6.8.

1. Cater Water Treatment Facility
2. First Baptist Church at 949 Veronica Springs Road
3. Ellings Park
4. Arroyo Burro Beach
5. Sheffield Reservoir
6. Westmont College
7. Mount Calvary Monastery
8. Northern terminus of Cieneguitas Road
9. Others as identified during SBFD scenario modeling

6.4 Traffic Flow/Road Recommendations

6.4.1 General Recommendations

The following general recommendations are adapted from FEMA (2013) for application in Santa Barbara. Specific recommendations for selected Santa Barbara evacuation corridors are provided following these general descriptions of traffic flow facilitating measures.

The recommendations presented in Table 1 are provided as a tool kit of options available to Santa Barbara and focus on improving the existing evacuation planning process. Each recommendation is discussed in more detail below the table.

Table 1
General Evacuation Traffic Flow Improvement Tool Kit

Number	Recommendation	Estimated Importance to Santa Barbara Evacuations 1 = low, 10 = high
1	Control the Intersections	10
2	Roadblocks and Barricades	5
3	Electronic Signage	5
4	Lane Expansion	3
5	Contraflow	5

6.4.1.1 Control the Intersections

Experience with evacuations and input from law enforcement personnel experienced with conducting wildfire evacuations indicates that a key factor for maintaining traffic movement out of evacuation areas is "controlling the intersections". This includes intersections far south of the evacuation corridor areas and evacuation blocks, possibly including the primary intersections north of downtown, downtown areas, streets south of and in some cases, the on-ramps to Highway 101. Typically, available law enforcement personnel may be a limiting factor on how well the intersections are controlled. It is estimated that only 4–5 intersections may be controlled during a fire event due to a lack of available law enforcement personnel.

Intersections must be controlled by law enforcement personnel early, while they are still open (personal communication with Santa Barbara Police Department 2014) . Once an intersection becomes gridlocked, it is almost impossible to re-open traffic flow (public hearing presentation by Orange County Sheriff's Department 2013). Therefore, intersections along the north-south bound N. Ontare road, San Roque Road, Alamar Avenue, Mission Canyon Road, Sycamore Canyon Road, and Barker Pass Road, along with adjacent southbound roads in Montecito (Olive Mill Road and San Ysidro Road) are critical to keep open and flowing traffic southward. Keeping these roads flowing will enable law enforcement to direct traffic onto these roads off of the major east-west evacuation roads, including east-west bound Sycamore Canyon Road and east-west bound Foothill Road.

The goal is to command the intersections along these major evacuation roads travel to the south at each intersection, opening the east-west roads for evacuees from the north, where they too would be allowed to go westward until the next intersection, where they too would be directed south. Depending on the scope of the fire, available police, highway patrol, and County Sheriff's office are projected to have the ability to effectively manage the intersections within critical portions of town that are under evacuation orders. In the three scenarios evaluated as part of this

WEPA, There are between 4 (Scenarios 1 and 2) and 8 (Scenario 3) intersections that require control. Scenario 3 may tax the available officers, so should be a focus of future planning efforts so that additional traffic control resources can be deployed in the Campanil area during a large fire event.

6.4.1.2 Roadblocks and barricades

A variety of methods are used to stop or divert traffic. Roadblocks and barriers include a number of different technologies:

- Tape barriers
- Portable signs
- Cones
- Barrels
- DOT Type II rail barricades: must be at least 3 feet high with two rails 2 feet in length.
- DOT Type III rail barricades: must be at least 5 feet high and have three rails that are at least 3 feet long.
- Concrete or water-filled barricades (manual)
- Automated vehicle barricades
- Manual swinging gate barricades

These devices can be set in place without staffing or staffed (labor and time intensive) by traffic guides or law enforcement personnel (traffic control). In general, un-staffed and removable barricades are not very effective as drivers can circumvent them rather easily. The importance of maintaining intersections flowing traffic will supersede the possibility of using these types of barricades during most Santa Barbara block evacuations.

6.4.1.3 Electronic Signage

Electronic signage networks are LED (light emitting diodes), LCD (liquid crystal displays), or plasma screen-based display solutions that are utilized in airports, borders, ports, highways, and other public areas to inform people during emergency or disaster events. Such signs can be permanent or portable (labor and time intensive). They have been incorporated into Amber alert systems in many locations. They also can be used to advise motorist to take alternative routes or alert them to traffic problems, such as during a wildfire evacuation. This technology may have application in Santa Barbara and could be used at intersections where officer coverage is not

available. The high population areas and facilities that may include large events would be appropriate locations for this type of traffic assistance. Signs can be programmed to indicate to visitors where the nearest evacuation route is or provide other information important for successful evacuation.

6.4.1.4 Lane Expansion

Lane expansion involves using road shoulders to increase the vehicle capacity of evacuation routes. It is only feasible when unobstructed shoulders are available and the shoulders are not needed for emergency vehicles, which is a rare instance in Santa Barbara. If re-merging due to a bridge or shoulder constriction is necessary, lane expansion is not a good option because the re-merging will further slow the evacuation. Furthermore, options for moving stalled vehicles out of the shoulder need to be available. This option will not be useful on most of the roadways in the evacuation corridors of Santa Barbara due to a lack of significant shoulder, steep drop offs, narrow roads and lanes, and the practice of many property owners to place rocks and vegetation in front of their properties in order to prevent parking, etc.

6.4.1.5 Contraflow

Contraflow or lane reversal involves directing traffic to use lanes coming toward the source of a hazard to move people away from the hazard. Such a strategy can be used to eliminate bottlenecks in communities with road geometries that prevent efficient evacuations or to facilitate the flow of traffic out of major urban areas. Among the considerations in planning emergency contraflow are whether sufficient traffic control officers are available, potential negative impact on responding fire apparatus, access management, merging, exiting, access to fuel and supplies, safety concerns, labor requirements, and cost.

Contraflow configurations need to be carefully planned based on a number of factors such as the location of the potential hazard, the geometry of the road structure, origin of evacuees, the destination of the evacuees, and ingress and egress points. When implementing the strategy on an ad-hoc fashion, many problems may occur including massive congestion. One major lesson learned from implementing these events is that terminating the contraflow needs to be carefully planned to avoid creating choke points. In addition, access by first responders is negatively affected. Lane reversal would not appear to be of widespread application in Santa Barbara. Many of the roadways only have room for two lanes and the lane reversal will have greater negative effect on fire equipment access than the value of the extra vehicles egressing. The access from south to north will never rise to the level of emergency egress, so developing sufficient room to use three lanes should focus on two southbound lanes and one inbound.

6.4.2 Specific Recommendations for Selected Evacuation Corridors

Based on the evaluation of the data presented above, discussions with the project team, including the City of Santa Barbara Fire Department and Traffic Services Department, and capitalizing on specific recommendations from in depth analysis provided in the County of Santa Barbara's MCCP study (Fehr & Peers conducted traffic analysis for that project) beyond the analysis included in this scope, the following improvements and strategies for emergency evacuation are recommended.

In order to improve the current fire evacuation procedures, more dynamic traffic monitoring and better signal and signage technology should be leveraged to provide a flexible evacuation framework for vehicular traffic. For critical traffic control locations where fire history has been severe, more effective measures should be considered, such as implementing curbside parking restrictions or spot widening. Real-time traffic monitoring and an improved emergency communication protocol between various jurisdictions (County, City and Caltrans) are essential.

The following recommended improvements have been based on a set of assumptions and our understanding of the fire history in the area and may or may not necessarily represent actual evacuation situations.

6.4.2.1 City of Santa Barbara Congested Corridor Recommendations

Fehr & Peers reviewed the historical traffic data and future traffic forecasts in the Plan Santa Barbara EIR and identified six key congested arterial corridors within the City. These corridors are considered to have both existing and future traffic hot spots during the traffic commute peak periods, and have the potential to impact fire evacuation traffic flow. The six corridors are (from northwest to southeast):

1. Upper State Street Corridor from La Cumbre to San Roque Road/Las Positas Roads
2. Las Positas Corridor from Modoc Road to Adams Elementary School
3. Mission Street Corridor from San Andres to State Street
4. Carrillo Street Corridor from San Andres to De La Vina and Castillo Street Corridor from Haley and Montecito
5. Milpas Street Corridor from Montecito Street to the US 101 Interchange

All the aforementioned corridors are currently considered Wildland Emergency Evacuation Routes in the City's plan.

Upper State Street Corridor

The Upper State Street corridor is the closest to the high fire hazard hillside residential communities. The entire State Street, within the City limits, is part of the Wildland Emergency Evacuation Route system. This corridor is heavily utilized between the US 101 Interchange and San Roque Road/Las Positas Road during the midday and afternoon peak periods due to high traffic volumes, multiple driveways and closely spaced traffic signals. The City's current evacuation procedures plan does not include any traffic control points on Upper State Street. However, Upper State Street collects the traffic exiting the hillside communities on La Cumbre Road, Hope Avenue and San Roque Road. Upper State Street currently has two travel lanes in each direction plus a center two-way left-turn lane. The deployment of law enforcement/traffic control personnel on Upper State Street would help manage the southbound traffic converging onto Upper State Street during an evacuation associated with either Wildfire Scenarios 1–2 described in this WEPA. It is recommended that new traffic control points be considered at the following locations, depending on the type of incident and fire behavior and the availability of trained law enforcement officers:

- Upper State Street and La Cumbre Road
- Upper State Street and Hope Avenue
- Upper State Street and Ontare Road
- Upper State Street and San Roque Road/Las Positas Road
- Upper State Street and Alamar Avenue

The traffic traversing Upper State Street west of US 154 Highway and east of San Roque Road could be diverted away from Upper State Street onto parallel corridors to the south, such as Calle Real Road, Las Palmas Drive, and Modoc Road. This type of traffic control plan would help provide evacuation traffic capacity on Upper State Street if required.

Las Positas Corridor

The Las Positas corridor (also known as the State Route 225) is congested during the afternoon peak period in the vicinity of the US 101 Interchange. In addition, the Las Positas corridor is one of the evacuation routes for the Hidden Valley Park and Las Positas Valley communities as well as from the Lauro Canyon area, so improvements of traffic flow on this road would have a positive effect on Wildfire Scenarios 1 and 3 of this WEPA. The corridor currently has three traffic control points:

- Las Positas Road and Modoc Road

- Las Positas Road and Veronica Sprints Road
- Las Positas Road and Cliff Drive

Las Positas corridor has two through travel lanes in each direction north of Modoc Road but narrows down to one lane in each direction south of Modoc Road. There is also a lack of parallel north/south routes for evacuation purposes. Due to the limited right-of-way on Las Positas Road and the existing bike lane, restriping or widening to provide additional roadway capacity is not feasible.

The extension of private roadways and/or vegetation clearance in the corridor will offer additional evacuation alternatives. For example, the extension of Campanil Drive to Las Positas Road and a new connector between the Senda Verde community and Campanil Drive, if feasible, would be beneficial for fire protection planning and may improve evacuation travel times for the Hidden Valley Park neighborhoods. This may also help relieve the evacuation traffic congestion on Veronica Springs Road and Las Positas Road.

Mission Street/Valerio Street Corridor

The Mission Street Corridor connects the City's upper east neighborhoods to the westside communities south of the 101 Freeway. In the upper east neighborhood, Mission Street Corridor from San Andres to State Street is congested during both morning and afternoon peak periods due to heavy traffic volumes and limited left-turn pockets. The land uses and lack of available right-of-way on Mission Street limit options for adding turn lanes. South of the 101 Freeway, Mission Street turns into Valerio Street and ultimately connects to Cliff Drive. Mission Street, Valerio Street and Calle Canyon Road have all been identified as Wildland Emergency Evacuation Routes and would affect evacuations from Wildfire Scenario 3 of this WEPA. The streets include five traffic control points:

- Mission Street and Modoc Road
- Mission Street and Monterey Street
- Mission Street and Valerio Street
- Valerio Street and Calle Canyon Road
- Calle Canyon Road and Cliff Drive

When additional evacuation traffic capacity is needed along Mission Street north of US 101, temporary no left-turn signs or left-turn restrictions can be implemented at selected locations to prioritize the traffic flow on Mission Street.

Carrillo and Castillo Street Corridors

The Carrillo and Castillo Street corridors are major gateways to the old town Santa Barbara. Another adjacent parallel north/south collector is Loma Alta Drive (just west of Castillo Street). These corridors are often congested, especially when Santa Barbara City College and other local schools are in session, and due to weekend beach traffic. There are four traffic control points in these corridors:

- Carrillo Street and San Andres Street
- Carrillo Street and Cliff Drive
- Loma Alta Drive and Cliff Drive
- Castillo Street and Montecito Street

Based on a review of the City's fire hazard assessment map, this area is considered as "Low" to "Moderate" fire hazard. Due to limited right-of-way, widening or restriping of these corridors is not considered feasible. Therefore, at a minimum, development of emergency signal timing plans for the four intersections could be programmed into the City's traffic signal system and activated during a fire. The emergency plan would result in a split signal phase, allowing additional green time for evacuating traffic on certain approaches. This corridor affects primarily Wildfire Scenario 3 of this WEPA.

Milpas Street Corridor

The Milpas Street corridor provides two lanes in each direction with a center turn lane. The street provides a primary evacuation corridor serving the north side and the east side of the City of Santa Barbara, including the Wildfire Scenario 2 of this WEPA. It connects to Montecito Street, which then forms a roundabout with Salinas Street, Sycamore Canyon Road, Alameda Padre Serra and Baker Pass Road. Currently, there are no traffic control points in this corridor to relieve any congestion that may occur due to evacuation. Traffic control officers can be deployed if the need arises.

6.4.3 Increased Roadway Evacuation Capacity: Recommendations for Traffic Flow Improvements in Hillside Communities Surrounding the City of Santa Barbara

The following recommendations listed in Table 2 focus on Hillside Communities that surround the northern portion of the City of Santa Barbara. This recommendation suggests these options are implementable, but will require additional City analysis to determine the feasibility of implementing these strategies. Among them are provisions for additional lanes through restriping

parking zones to allow additional clearance for emergency vehicles, turnout zones, or trailer truck access, applying lane reversal or using roadway shoulders and vegetation removal. Potential locations for the suggested enhancements The are illustrated in Figure 13 and more detail provided in the discussion that follows.

Table 2
Specific Santa Barbara Evacuation Flow Improvement Recommendations

Number	Recommendation
1	**Develop New or Alternative Access Routes.** Where feasible, look at potential extension of private roadways and/or vegetation clearance to improve secondary alternative egress. For example, an extension of Holly Road to connect to San Roque Road, if feasible, may be beneficial for fire protection planning and may improve the evacuation travel time for the Upper Mission Canyon area and relieve the evacuation traffic congestion on Mission Canyon Road approaching the City. This recommendation may have limited application in much of Santa Barbara due to terrain which makes road extensions infeasible. Further evaluation would be needed.
2	**Increase roadway evacuation capacity:** Possible strategies include provision of additional lanes through restriping parking zones to allow additional clearance for emergency vehicles, turnout zones, or trailer truck access, applying lane reversal or using roadway shoulders or vegetation removal. Potential locations for the suggested enhancements include: a. Sycamore Canyon Road/Hot Springs Road: Removal of vegetation on the roadway shoulders and provision of a southbound right-turn lane from Sycamore Canyon Road to Hot Spring Road would facilitate the evacuation of traffic exiting the Sycamore Canyon Road neighborhood. b. Sycamore Canyon Road /Barker Pass Road: Improve the east and south legs of the intersection to allow drivable shoulders and provide available right-of-way for emergency vehicular evacuation. c. Foothill Road between San Marcos Pass Road (SR 154) and Sycamore Canyon Road: This road serves several neighborhoods to the north side of the City, and potential heavy evacuation traffic levels on Foothill Road may force drivers to delay making left turns out of their neighborhoods. Removal of vegetation on the roadway shoulders would allow drivers exiting the residential neighborhoods to merge with the traffic faster on Foothill Road. d. Foothill Road and Mission Canyon Road/Tornoe Road intersection: Improve the east and south legs of the intersection to allow drivable shoulders and provide available right-of-way for emergency vehicular evacuation. Roadway shoulder improvements should be considered on Mission Canyon Road, where feasible, to provide a turn-out zone allowing emergency vehicles to pass general traffic. This intersection is located on a Caltrans facility and would require collaboration between the County and Caltrans and may require removal of existing encroachments in County and Caltrans right-of-way. e. Los Olivos Street between Mountain Drive and Alameda Padre Serra: Improve this segment of Los Olivos Street in the southbound direction between both intersections to allow drivable shoulders and bike/pedestrian paths to be used for cars in an emergency with the aid of traffic control. This segment would require collaboration between the County and City and may require alteration of existing pedestrian paths and walls, including potentially historic resources. f. Mission Canyon Road (south) and Las Encinas Road: Roadway shoulder improvements could be considered on Mission Canyon Road, where feasible, to provide a turn-out zone for emergency vehicles to pass general traffic. The portion of Las Encinas Road near Mission Canyon Road would require collaboration between the County and City. g. Foothill Road and Ontare Road intersection: Improve the south leg of the intersection to allow drivable shoulders and available right-of-way to be used for cars in an emergency with aid of traffic control. h. Foothill Road and Morada Lane: Improve the north leg of the intersection with the removal of vegetation to allow an additional left-turn lane. i. Mountain Drive: A number of trees on West Mountain Drive hang fairly low over the road and may cause issues for fire engines. Regular vegetation clearance trimming is recommended.

Table 2
Specific Santa Barbara Evacuation Flow Improvement Recommendations

Number	Recommendation
	j. Las Canoas Road: Regular vegetation clearance trimming is recommended. This could also help along the narrow sections of Las Canoas where there are several tight turn radii. Since the road usually only has room for two cars at any one time, these tight turn radii may slow down traffic in an evacuation. k. Stanwood Drive: Fire engines navigating the tight turns on Stanwood Drive would also benefit from a wider roadway that could be achieved with regular vegetation removal.
3	**Traffic Control Changes During Evacuation** a. Roundabout at the intersection of Alameda Padre Serra, Sycamore Canyon Road (SR 144), Salinas Street, Montecito Street, and Yanonali Street: These five streets serve fairly large Eastside and Riviera communities and as well as the Cleveland Elementary School. Deployment of law enforcement/traffic control personnel could be used to prioritize certain approaches during a fire evacuation. This could ease the traffic bottleneck where the streets meet. b. Las Canoas Road, Gibraltar Road and Mountain Drive: This intersection is located on a main thoroughfare for many hillside residents north of the Sheffield Reservoir and is likely to become a traffic bottleneck during a fire evacuation. Reversing the northbound lane on Gibraltar (north of this intersection to El Cielito Road) to provide a temporary second southbound lane during the evacuation period (with a traffic control point) should be considered. Fire department access on Gibraltor north of El Cielito Road can be accessed off of El Cielito Road. c. Position law enforcement at designated traffic control points to facilitate outbound traffic flow from the Mission Canyon area approaching the City of Santa Barbara. The locations to be considered include: • Foothill Road at Alamar Avenue • Foothill Road at Mission Canyon Road (north) • Foothill Road at Mission Canyon Road (south)/Tornoe Road • Mission Canyon Road (north) at Tunnel Road • Mission Canyon Road (north) at Las Canoas Road • Mission Canyon Road (north) at Santa Barbara Botanical Garden Driveway • Mission Canyon Road (south) at Santa Barbara Natural History Museum driveway • just south of Las Encinas Road • Mission Canyon Road (south) at Mountain Drive • Los Olivos Road at Alameda Padre Serra • E. Los Olivos Street and Laguna Street • State Street, Las Positas Road/San Roque Road intersection

6.4.4 Other Considerations

Depending on the intensity and location of a fire, the number of vehicles that could be allowed to enter the project area could change significantly. With limited roadway capacity, the traffic control deployment would focus on maximizing system-wide performance and facilitating both the inbound and outbound traffic demand flow at the key bottlenecks. However, vehicles exiting the area should be granted priority to relieve congestion in the Upper Mission Canyon area, Mission Canyon Heights, the adjacent Upper Las Canoas neighborhoods and Riviera communities to the east and the East San Roque communities to the west.

Real-time communication between these traffic control stations would facilitate the continuous outbound flow along the City's and County's designated evacuation routes, but also allow limited inbound movement to help residents evacuate from their homes.

Implementation of the various options of aforementioned recommendations would require coordination of the State, County and City law enforcement team and the Office of Emergency Services, Caltrans, and both County and City Public Works and Traffic Divisions.

6.5 Law Enforcement

Law enforcement agencies are a very important component of successful evacuations. Although firefighting personnel may make evacuation decisions in the field during a fire fight, the overall evacuation process is controlled by law enforcement. Therefore, it is critical that law enforcement agencies have a pre-plan, be well-integrated into the decision making process and Incident Command, and be equipped to execute the plan. Indications are that communication between the various agencies that would be coordinating during a wildfire evacuation in Santa Barbara may be less than ideal and that individual law enforcement personnel are ill-equipped to carry out evacuations in wildfire areas. For instance, Santa Barbara Police Department do not have pre-planned intersection control points even though they are available in the City's evacuation plan. Recommendations to improve this situation include:

1. **Cooperation and Officer Augmentation for large events** – The number of officers who may be available for controlling intersections during an evacuation may be limited to as many as four, which would not generally suffice for successful evacuations if a large area is included. Ideally, Santa Barbara police, Highway Patrol, and County Sheriff's office as well as neighboring agencies coordinate to provide assistance during evacuations so that intersections can be controlled in a pre-planned, practiced manner.
2. **Training** – on-going training and education for carrying out the pre-plan
   - Peace Officer Standards and Training (POST) is needed at a statewide level to train law enforcement personnel to work in wildfire hazard areas.
   - Incident Command System training.
   - Investigate the possibility of cross training selected individuals from Santa Barbara City fire and police using the model developed by Santa Barbara County where paramedics from the fire department were provided training in special weapons and tactics (SWAT), and deputies were given training in fire/medical response so they functioned on a different level when unique situations developed and the combined skills were needed. This situation lends itself to that resolution.

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SOURCE: Fehr & Peers 2013

FIGURE 13

Evacuation Road Improvement Locations

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

NOTE: Evacuation scenario times are calculated after a 45 minute reverse 911 calls are completed.

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3. **Protective clothing** – wildfire evacuations may require personnel to be in hostile conditions including heavy smoke, flying embers, poor visibility, and generally dangerous conditions. Clothing that should be provided to every law enforcement officer who will be working within the wildland fire evacuation areas includes:
   - Fire retardant clothing (Nomex or similar) to minimize ember burn-through
   - Goggles to prevent eye injuries
   - Appropriate respirator/smoke masks, etc.
   - Hard hats
   - Gloves
4. **Equipment**
   - Fire extinguishers
   - Hardened, specialized vehicles (possibly one or two vehicles equipped with clothing and tools that could be distributed to individual officers)
   - Portable video Cameras so they can remotely send intelligence during fire event (and others). One example is the Watchguard system.
   - Radios providing the ability for Police Department (PD)/Sheriff to communicate with County Highway Patrol (CHP) directly
   - City provided cell phones for police officers
   - First Aid Kits
   - Emergency food and water
5. **Resources**
   - Standardized Incident Command information with PD, Fire Department, sheriff
   - Emergency checklists
   - Mapping
   - Hand-off packet from IC to law enforcement branch director with response bag in each police car

6.6 Civilian Evacuation Contingency

As of this document's preparation, no community in California has implemented an official civilian shelter in place option during a wildland fire. Even the communities in Rancho Santa Fe, California which are designed and touted as shelter in place communities, were evacuated during the 2007 Witch Creek Fire. This is not to say that people have not successfully sheltered in place

during wildfire, where there are numerous examples of people sheltering in their homes, in hardened structures, in community buildings (Westmont College, Barona Casino, etc.), in swimming pools, and in cleared or ignition resistant landscape open air areas. The preference will likely always be early evacuation following the "Ready, Set, Go!" model, but there exists the potential for unforeseen civilian evacuation issues, and having a contingency plan will provide direction in these situations that may result in saved lives. Potential problems the City may face during wildfires include:

- Fires that prevent safe passage along planned evacuation routes
- Inadequate time to safely evacuate
- Fire evacuations during rush hour traffic or when large events are occurring
- Blocked traffic due to accidents or fallen tree(s) or power pole(s)
- The need to move individuals who are unable to evacuate
- Shadow evacuees affecting traffic movement
- Inefficient or inadequate planning
- A poorly informed public.

This WEPA recommends that a concerted pre-planning effort focus on evacuation contingency planning for civilian populations when it is considered safer to temporary seek a safer refuge than evacuation. Further, it is recommended that contingency checklists/matrices are developed for civilian evacuation contingency planning.

6.7 Safety Zones

The International Fire Service Training Association (IFTSA; Fundamentals of Wildland Fire Fighting, 3rd Edition) defines Safety Zones as areas mostly devoid of fuel, which are large enough to assure that flames and/or dangerous levels of radiant heat will not reach the personnel occupying them. Areas of bare ground, burned over areas, paved areas, and bodies of water can all be used as safety zones. The size of the area needed for a safety zone is determined by fuel types, its location on slopes and its relation to topographic features (chutes and saddles) as well as observed fire behavior. Safety zones should never be located in topographic saddles, chutes or gullies. High winds, steep slopes or heavy fuel loads may increase the area needed for a Safety Zone.

The National Wildland Fire Coordinating Groups (NWFCG), Glossary of Wildland Fire Terminology provides the following definitions for Safety Zone and Escape routes

Safety Zone. An area cleared of flammable materials used for escape in the event the line is outflanked or in case a spot fire causes fuels outside the control line to render the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuelbreaks; they are greatly enlarged areas which can be used with relative safety by firefighters and their equipment in the event of blowup in the vicinity.

According to NWFCG, Safety Zone(s):

- Must be survivable without a fire shelter
- Can include moving back into a clean burn
- May take advantage of natural features (rock areas, water, meadows)
- Can include Constructed sites (clear-cuts, roads, helispots)
- Are scouted for size and hazards
- Consider the topographic location (larger if upslope)
- Should be larger if downwind
- Should not include heavy fuels
- May need to be adjusted based on site specific fire behavior

The definition for a safety zone includes provisions for separation distance between the firefighter and the flames of at least four times the maximum continuous flame height. Distance separation is the radius from the center of the safety zone to the nearest fuels. For example, considering average 50 foot tall flame lengths that may be possible in the scenarios examined in this plan, then a 200 foot separation would be required, and more if there were any site-specific features that would result in more aggressive fire behavior. In order to provide 200 feet in all directions, a minimum 3 acres is considered necessary for a safety zone to be considered appropriate for one 3 person engine crew during an extreme weather fire. Some areas within the Jesusita Fire included observed flame lengths in some areas of 100 feet or more. This would equate to a safety zone that was 400 feet in all directions, or a minimum 12 acres, all but eliminating the presence of pre-planned safety zones that meet the strict definition.

Safety Zones are developed during the incident planning process. In terms of pre-planning safety zones, potential safety zones can be identified as part of the planning process, although during the fire, the identified safety zones may not be feasible due to distance, location, fire behavior, etc. Typically, safety zones are identified and/or constructed nearby the firefighting activities of crews so that they may have ready access if sudden weather change or unusual fire behavior places them

at risk. Throughout the foothill or extreme fire hazard areas, there are few opportunities for Safety Zones that meet the strict definition. Among the considerations for effective safety zones are to:

- Take advantage of heat barriers such as lee side of ridges, large rocks, or solid structures.
- When possible, burn out safety zones prior to arrival of fire front.
- Avoid locations that are upslope or downwind from the fire; chimneys, saddles, or narrow canyons; and steep uphill escape routes.

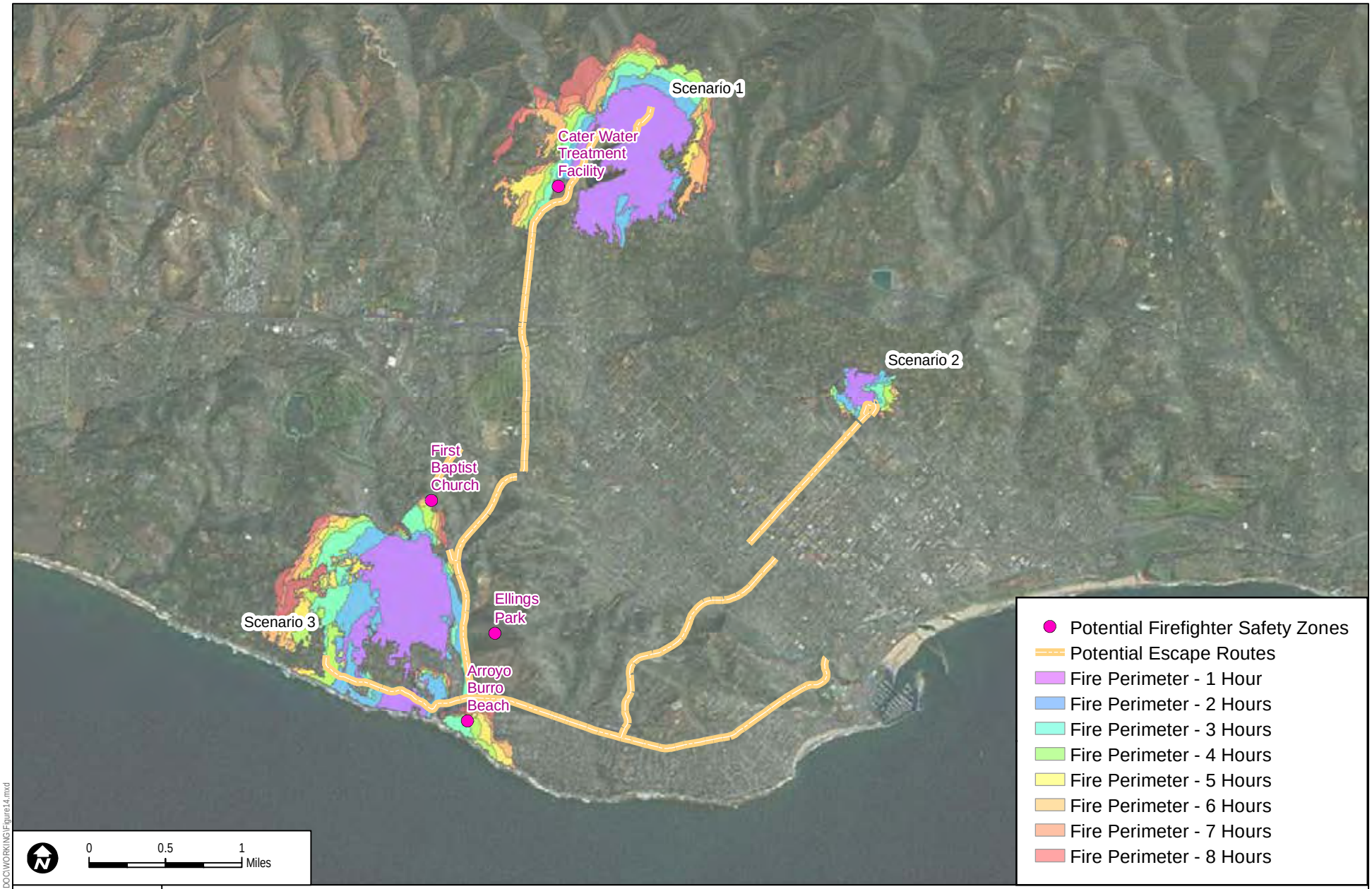
The third bullet eliminates some of the potential safety zones from consideration. For example, the St. Mary's Seminary could be modified to result in consideration as a safety zone based solely on the vegetation in the immediate vicinity, but occurs in an area that will likely be downwind from advancing fire, is located in steep terrain, with several fire chutes, and fuels that are too close and is modeled to result in flame lengths that would exceed the setback distance available. The site could, however, serve as a Temporary Refuge Area, as defined in Section 6.8.3.

6.7.1 Wildfire Scenario Potential Safety Zones

Scenario 1 Lauro Canyon: Cater Water Treatment Facility (Figure 14). This facility is located within the Lauro Canyon Evacuation Block and provides a large, reduced fuel or non-fuel landscape. It provides more than 4 times setback from off-site fuels in all directions. On-site fuels include an earth and grass covered storage reservoir. This area is maintained and represents very low ignition potential and low flame lengths and fire intensity should it ignite. For this area to be considered a Safety Zone, access would need to be available to firefighters during a fire event, including from non-Santa Barbara County fire departments.

Scenario 2: Santa Barbara Bowl. There were no adequate safety zones identified in the immediate vicinity of the Santa Barbara Bowl fire scenario. The Santa Barbara Middle School and the primary parking lot for the Santa Barbara Bowl include features that are consistent with a safety zone, but do not include enough setback area from native fuels to meet the standard definition of four times the flame lengths. Further, the middle school is in the path of the wind-driven fire, even though the wind is low in the scenario. The nearest safety zone would be within the Santa Barbara High School grounds, roughly 4/10 of a mile south of the fire origin in this scenario.

Scenario 3: Campanil Hill. The immediate area within the Campanil Hill fire scenario does not include any identifiable firefighter Safety Zones. To the north of the area, the First Baptist Church at 949 Veronica Springs Road includes a large, paved parking lot with modified fuels in most directions. The parking lot could serve as a pre-planned safety zone (Figure 14). The eucalyptus trees located in the eastern portion of the project may require thinning and crown lifting on an annual basis to minimize likelihood of ignition. In the southern portion of this area,



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SOURCE: ESRI 2014, City of Santa Barbara, Fehr & Peers 2014

FIGURE 14

Wildlife Scenario Potential Safety Zones and Escape Routes

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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Ellings Park may also provide firefighter safety zones. Ball fields in the northern portion of the park provide adequate setback from adjacent fuels, but may not support fire engine access. Firefighters on foot could use this area as a safety zone.

Arroyo Burro Beach appears to meet the requirements for a safety zone, providing 4 times the projected flame length, but including a limited area which could accommodate a strike team (up to 5 engines). No additional safety zones were observed.

6.7.2 Escape Routes

NWFCG defines a safety zone Escape Route as:

> **Escape Route**. A preplanned and understood route firefighters take to move to a safety zone or other low-risk area. When escape routes deviate from a defined physical path, they should be clearly marked (flagged).

Escape routes would typically be identified on-scene. Pre-planning the escape routes, like the safety zones, can occur well before a fire occurs, but the routes may be altered by actual conditions during the fire fight.

Wildfire Scenario Recommended Safety Zone Escape Routes (Roadways Only)

Scenario 1 Lauro Canyon: Cater Water Treatment Facility has been identified as a potential safety zone. The Escape Routes are presented in Figure 14. Firefighters retreating from increased fire behavior from this scenario's ignition point would follow San Roque Road southward out of the Lauro Canyon, past the reservoir, and into the facility. Firefighters from the south would take San Roque Road northward to the facility. As a secondary access from the south, Laurel Canyon Road would provide access to the facility, but is gated at its intersection with San Roque Road. Fuel modification and tree crown clearance along this road, especially in the northern sections is recommended for improving escape route conditions. In addition, any of the urban areas to the south could be accessed as Temporary Refuge Area(s)(TRA).

Scenario 2: Santa Barbara Bowl. There were no adequate safety zones identified in the immediate vicinity of the Santa Barbara Bowl fire scenario. However Escape Routes to potential TRAs would include: leaving the Santa Barbara Bowl area, possibly on Lowena Drive and heading southwesterly along E. Anapamu St. If firefighters are north, east, or west of the fire, they may take one of any number of roadways into urban areas as TRAs (Figure 14).

Scenario 3: Campanil Hill. Escape routes to the identified potential safety zones are presented in Figure 14. In addition, there are numerous residential streets that would lead away from the active fire area to areas that can be utilized as TRAs.

Escape routes that are public roadways are maintained in good condition with adequate fuel modification.

These escape routes likely require additional focused study to determine their potential for being unavailable to firefighters during a wildland fire event where evacuation has been mandated. This level of detail, including field verification could not be provided in this scope of work.

6.7.3 Other Potential Safety Zones in the Foothill or Extreme Fire Hazard Severity Zones

The following locations include potential safety zones that with enhancements, could be available to firefighters as safety zones.

1. Sheffield Reservoir – although semi-removed from the wildland (Figure 15), this location is a large, low fuel property that is within the wildland urban intermix and close enough that it could serve as a functioning safety zone. Enhancements would include: either a dedicated emergency access road to a paved parking/staging area or verification that existing road on site would support fire apparatus. Would need ongoing vegetation management and removal of some plants on site.
2. Westmont College – although in neighboring Montecito, City of Santa Barbara firefighters may be working in this area during a wildfire. This site includes areas along an unnamed road to the east of the sports fields. There are currently pull-outs and parking areas that could accommodate fire engines. Enhancements could include creation of an emergency engine parking area within the existing parking lot illustrated in Figure 15 that is capable of supporting a fire engine, but functions as part of the landscape as it would be used very rarely.
3. The existing Mount Calvary Monastery site, at its widest point along Mount Calvary Road (Figure 15), includes a wide setback that could accommodate engines and provide up to four times flame length set back. Steep slopes to the east and west could be burned off prior to entering the safety zone ahead of wildfire. Additional enhancements could be provided by installing 100–200 feet of fuel modification in all directions,
4. Northern terminus of Cieneguitas Road – the area is just north of the City boundary, but is currently in a low fuel, disturbed condition (Figure 15) and could be, depending on ownership, funding, and environmental review, provided a safety zone with a dirt/gravel cleared area and mowed/maintained landscape surrounding it. It provides a safe escape to potential TRAs should the safety zone be compromised. These enhancements would require more intensive and purposeful planning efforts and may not be feasible.

DUDEK

SOURCE: ESRI 2014

FIGURE 15

Other Potential Safety Zones

7823-01

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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These potential safety zones likely require additional focused study to determine their potential for being unavailable to firefighters during a wildland fire event where conditions require firefighters to retreat. This level of detail, including field verification could not be provided under this project's scope of work.

6.7.4 Temporary Firefighter Refuge Areas

Firescope California defines a contingency plan when it is not possible to retreat to a safety zone. This contingency includes establishment of TRA(s), which are defined as:

> *A preplanned area where firefighters can immediately take refuge for temporary shelter and short-term relief without using a fire shelter in the event that emergency egress to an established Safety Zone is compromised.*

Examples of a TRA may include lee side of structure, inside of structure, large lawn or parking area, cab of apparatus. Differences between a TRA and a Safety Zone is that TRA's are closer to the immediate firefighting area, are considered a contingency to being able to get to a Safety Zone, do not include a requirement for a large area set back four times the flame lengths of adjacent fuels, and cannot be feasibly pre-planned until firefighters arrive on-scene and size up the situation.

Firescope appropriately notes that although Safety Zones and viable Escape Routes shall always be identified in the WUI environment, they may not be immediately available should the fire behavior increase unexpectedly. Often a TRA is more accessible in the WUI environment. A TRA will provide temporary shelter and short-term relief from an approaching fire without the use of a fire shelter and allow the responders to develop an alternate plan to safely survive the increase in fire behavior.

TRAs are pre-planned areas (planned shortly after firefighters arrive on scene) where firefighters may take refuge and temporary shelter for short-term thermal relief, without using a fire shelter in the event that escape routes to an established safety zone are compromised. The major difference between a TRA and a safety zone is that a TRA requires another planned tactical action, i.e., TRAs cannot be considered the final action, but must include self-defense and a move out of the area when the fire threat subsides. A TRA should be available and identified on site at a defended structure. TRAs are NOT a substitute for a Safety Zone. TRA pre-planning is difficult, at best because they are very site and fire behavior specific. For the three scenarios analyzed in this report, which are all very near the WUI and include many opportunities for retreat from wildland fuel areas, TRAs would likely include navigating into any of the urban neighborhoods where fuels are reduced, irrigated, and maintained, and structures represent lower ignition risk then wildland fuels.

Enhanced TRAs, recommended by the authors of this report, would be a pre-planned partnership (as opposed to identified in the field during a firefight). The partnership would include establishment of enhanced TRAs on properties that are provided regular maintenance (both structure(s) and landscape) and can be relied upon as temporary safer areas when fire behavior requires a change in the strategy and contingency sheltering of firefighters, and in a worst-case condition, sheltering evacuating citizens. This approach would be consistent with Firescope California (2013) which indicates that firefighter must determine if a safe evacuation is appropriate and if not, to identify safe refuge for those who cannot be evacuated, including civilians.

It is recommended that these enhanced TRAs would include consideration of:

- Sized appropriately to expected size of sheltering population
- Behave Plus used to influence size and setback of TRA and fuel modification areas
- Construction ignition resistance if using building or leeward side
- Engine access from primary roadways
- Generally meet codes for fire access
- Water supply

A very good example of an enhanced TRA occurred on the Westmont College campus during the 2008 Tea Fire. Some 800 students were successfully sheltered in place in the campus gymnasium while fire burned within 10 feet of the structure. A TRA allows responders to develop an alternate plan to safely survive and/or assist civilian survival of an adverse change in fire behavior (CAL FIRE 2013). An Enhanced TRA could be an important part of the pre-plan as an evacuation contingency.

Because there is the possibility that evacuation of some populations in vulnerable fire hazard areas could be compromised during a fast-moving, wind driven fire, this report recommends that it is superior to have pre-planned, properly constructed and protected buildings to shelter citizens and firefighters in than simply relying on ad-hoc TRAs. To that end, it is recommended that strategic partnerships with owners of protected facilities (meet Chapter 7A of CBC, maintained fuel modification sufficient for adjacent fuels, etc.), homes and other structures within the most at risk areas (e.g., Mission Canyon, Lauro Canyon, Rattlesnake Canyon, etc.) be arranged as part of the pre-fire planning efforts. Details of this type of arrangement would need to be formalized, but could include SBFD assistance to these selected properties for safety evaluations and maintenance of the landscape defensible space as well as ensuring that the ignition resistance features of these structures are functioning as intended. These properties could be strategically

located (as properties that meet safety criteria are identified) within the vulnerable areas and considered a component of the "Ready, Set, Go!" model by providing a broader level of "readiness" should the ability to execute an early evacuation be negated by the fire, road congestion, or other unforeseen issues. These properties would be considered a last-resort safety net during wildfire with the primary focus being on early evacuation.

6.8 Santa Barbara Fire Department and Local Fire Agencies

The Santa Barbara area agencies and cooperators described earlier in this analysis are dependent upon each other for successful evacuation associated with a WUI event. That interdependence relies on trust and that trust comes from teamwork; communicating, pre-planning and training together, so as to develop a shared confidence. Since fire does not conform to jurisdictional boundaries, there will be numerous agencies involved in any large wildfire. For example, the Sycamore Fire in 1977 involved four local jurisdictions directly impacted and dozens of fire departments responding personnel and equipment. This can result in poor communications, confusion as to who is in charge, who is ordering equipment, allocation of available resources, and a general lack of coordination. All involved agencies use the Incident Command System to manage fires. This system provides the common language and protocols that facilitate this effort, including the recognition that several agencies may share responsibility under a Unified Command. This Unified Command may be viewed as a committee approach that resolves issues reflecting interests of the respective impacted jurisdictions as a group but recognizes a single spokesperson and that spokesperson is the Incident Commander.

Recommendations

6.8.1 City Wildfire Pre-Plan Completion

Complete City Wildfire Pre-Plans consistent with SB County Pre-Plans and share information with surrounding agencies

6.8.2 Joint Agency Training.

Conduct joint, scenario-based, real-time field training exercises with all local fire and law enforcement agencies.

6.8.3 Evacuation Simulations

Test the evacuation plan periodically in real time simulations using the public in actual movement, including support systems such as Reverse 911. Activate the EOC and any department level Operating Centers to be sure they are coordinated and work correctly

6.8.4 FARSITE Scenario Modeling

Conduct additional FARSITE wildfire scenario modeling exercises throughout the City's fire hazard areas to help refine pre-plans, establish immediate evacuation zones, as educational tools for public awareness, and to establish decision points, as appropriate.

6.8.5 Joint Agency Training

Conduct joint scenario-based field training exercises with all local responding Fire and law Enforcement Agencies. Exercises should include actual movement of apparatus, establishment of Incident Command Post, communications, mobilization of law enforcement etc. Some of these exercises should also include the residents from time to time. The best way to test a system to be sure it will work is by ongoing exercises.

6.8.6 Reverse 911 Testing

Test the Reverse 911 and other community notification systems on a regular basis. Preface any announcements with "this is a test only."

6.8.7 Develop Evacuation Contingency Plans

Develop evacuation contingency plans including the utilization of buildings designed to provide safe refuge as an alternate to evacuation. Develop a decision flow chart to evaluate evacuation contingencies.

6.8.8 Evacuation Scenario Training

Training and familiarity with evacuation plans, vulnerable areas, live training on in-field decision making regarding temporary refuge areas vs. evacuation to safety

6.8.9 Evacuation Pre-Plans in Engines

Provide Pre-Plans in engines with iPad or similar device provided to each crew (hard copy and electronic) – focus on BC levels, but available to all.

6.8.10 Evacuation/Shelter in Place Flow Chart

Develop Shelter in Place/Evacuation decision flow chart for use by the Incident Command team.

6.8.11 Reverse 911 Custom Message Training

Work with County dispatchers so they are trained in how to activate, focus and put a customized message on the Reverse 911 system in pre-planned zones based on fire scenario modeling conducted herein by SBFD over time.

6.8.12 Recommendation Implementation Coordination

Evaluate the recommendations provided in this WEPA and implement them in a coordinated fashion with other fire and law enforcement agencies

6.8.13 Grant Funding for Recommendation Implementation

Seek grant funding for implementing roadway improvements and to support acquisition of equipment and technological recommendations detailed in this WEPA.

6.8.14 Fire/Law Agency Cross-Training

Consider cross-training a member of the police department and a member of the fire department to focus on updating evacuation information, providing training, and coordinating communications between agencies pre- and post-fires

6.8.15 CAFS Equipped Engines

Evaluate cost-benefit of specialized Compressed Air Foam System equipped engines for pre-treating structures or other refuge areas for the possibilities when evacuation is not possible

6.9 Wildfire Scenario Evacuation Decision Points

Emergency responders face many decisions during a wildfire and providing safety for citizens is among the top priorities. Six important questions arise when formulating evacuation orders: where is the fire now?, where is the fire going?, when will it get there? who is at risk?, how long will it take to evacuate?, and how much time is available? These questions are often addressed together using a concept called an evacuation trigger or decision point. A decision point is an agreed upon landmark that denotes the decision to evacuate affected areas if a fire advances across the landmark. Features on the ground including roads, ridgelines, and water bodies make good decision points. Decision points are generally determined on-the-fly at the time of an event, but comprehensive emergency plans may identify candidate landmarks in advance. In cases when there is not enough time to set decision points in front of an advancing wildfire, evacuation orders may be issued immediately upon assessing the situation. However, establishing pre-

planned decision points is expected to assist decision makers by providing perspective on where a fire is in relation to known landmarks that would result in an evacuation and what the parameters of that evacuation are likely to entail.

The scenarios considered for this WEPA generally do not fit neatly into the decision point model. For example, each of the scenarios includes an ignition close to urban areas and with urban land uses on all or most sides of the vegetated area burning. Based on fire spread rates and anticipated evacuation time requirements, the decision points for these scenarios often overlap such that they do not function, as there's less time available before the fire may encroach upon citizens than there is time needed to evacuate. Therefore, the decision point to evacuate would be considered immediately, or as soon as possible given the need to respond to the fire, determine the severity, call for the evacuation notification, prepare the message and finally notify evacuation block residents. It may be worthwhile to consider any ignition during extreme fire weather (Red Flag Warning conditions or similar) as an automatic evacuation for segments of the Evacuation Blocks, as described below. Additionally, decision points for other areas where fire commonly occurs and moves into the community should be developed with the use of FARSITE or FlamMap models and comparisons with past fire spread. For example, fire originating in the Los Padres National Forest under worst case weather conditions can be modeled to consider how long it may take to threaten City neighborhoods. Then, knowing that a conservative estimate for an orderly evacuation may be two hours, an appropriate trigger point can be established, including additional buffer time, to order evacuations by Evacuation Block. These types of scenarios are more easily fit into the decision point model. Whereas, the constraints associated with fitting scenarios where fire ignites within a short distance from urban areas include: the desire to not evacuate people late, as that is when people have historically been killed; the time necessary to deliver evacuation messages; the desire to meter traffic out of neighborhoods following "intersection control" by law enforcement personnel; the effect of shadow evacuees and the special needs population: and unforeseen issues that must be provided buffer time. It is the opinion of the authors of this WEPA, that unless sufficient time is available to conduct an orderly evacuation that is well before a fire encroaches on an area, then contingency plans must be made that may include partial population evacuations and partial temporary refuge, or other options that are developed specifically for each vulnerable neighborhood.

Evacuation Decision Points or Trigger Points for wildland fires should be based on the information discussed below. What differentiates the Wildfire Scenarios evaluated herein from wildland fires is that they are in urban areas. If scenarios included fires in mountain areas outside of the City to the North, then trigger points of 2 hours or more could perhaps be used in some cases. Examples may be the area from Paradise Road to Camuesa or the Santa Ynez River, or East Camino Cielo Road. Actual lead time is subject to actual fire behavior including rate of spread. Wind Driven fire in heavy shrubs (SH-7) with 60 MPH winds, could have a rate of

spread of 10 MPH. Spotting will be occurring 3–5 miles ahead of the fire and would likely be the cause of ignitions in urban areas.

This WEPA recommends that the City adopt extreme fire weather and typical weather decision points which are based on historical fire progression, FARSITE or FlamMap fire behavior modeling, and incorporate traffic modeling timeframes. The landscape files created during this WEPA will be useful for SBFD future exercises and focused decision point establishment. The following discussions describe the three wildfire scenarios evaluated in this WEPA and related evacuation decision point recommendations.

As this section indicates below, the most conservative approach is to use the criteria that any significant and sustained ignition in any of the City Wildfire Scenarios evaluated herein during a Red Flag Warning event is a trigger point to activate an Evacuation of specific streets and an Evacuation Warning for areas that could be evacuated via reverse 911 and other in place methods. The Evacuation Warning alerts community members in a defined area of a potential threat to life and property from a fire. Then, if the fire cannot be controlled by the first alarm units and is burning more than two homes or roughly one-acre of wildland fuels, an Evacuation order is given. This is based on an immediate threat to life and property from the fire.

If there is not time to safely evacuate based on the lead time needed, then the residents need to be advised to stay secured inside an enhanced TRA.

In the event of a fire with winds off ocean (summer fire) spread will not be as rapid so more time can elapse prior to notifications unless fire is slope or fuel driven.

Possible checklist items; fire in City in identified scenario areas:

- Any significant ignition and sustained wildland fire on a piece of property during a red flag warning; Implement an “Evacuation Warning” (reverse 911, etc.).
- Fire burning more than 2 homes or 1 acre and first alarm units are unable to control it (for example flame lengths over 10 feet); Initiate evacuation order via Reverse 911.
- If it is unsafe to evacuate, instruct residents to stay secured in an enhanced temporary refuge area (home with ignition resistant construction and defensible space).
- Fire in back country north of City; or perhaps east of City; monitor location and fire behavior and weather. When fire is estimated to be within 2 hours of City, implement evacuation order in the appropriate areas. For example; 2 hours from Camino Cielo Road, Paradise to Camuesa area or Santa Ynez river. (Mike; this would be subject to your measurements).

Wildfire Scenario #1 – Ignition northeast of Lauro Canyon Reservoir

This scenario considered extreme weather conditions and an ignition within Lauro Canyon, near the end of San Roque Road. As indicated by FARSITE modeling, the largest spread is projected to occur within the first hour. Homes along San Roque Road, Marilyn Way, Ariba Way, Holly Road and Palomino Road are expected to be the first threatened and would need to be evacuated as quickly as possible. Structures to the east and west of N. Ontare Road would be encroached upon within the second to third hour. According to the modeling, neighborhoods to the north of Foothill Road would be encroached upon from the third hour through the eighth hour (limits of scope). Fire spread to the east is somewhat limited by urban landscapes and wind alignments, resulting in fire remaining west of Tunnel Road even after eight hours. However, evacuation notices should be expected to occur based on fire behavior and containment success. The high priority evacuation blocks of Lauro Canyon, Mission Canyon, San Roque, Northridge, and Stevens should be notified of potential evacuation so that citizens can be prepared. Notifications should announce that traffic will not be allowed to enter these areas. These evacuation blocks could be phased to enable Lauro Canyon, San Roque and Mission Canyon to evacuate, then followed by the remaining blocks. Additional evacuation blocks may be evacuated if there is a wind shift.

Traffic modeling indicates that it would take a relatively short time to move the evacuation block's southerly residents to evacuation routes (ranging from 3 to 5 minutes) while it may take up to 10 minutes for residents along Holly Road and Palomino Road to reach an evacuation roadway, and up to 45 minutes to reach downtown Santa Barbara. Based on these timeframes, and considering the time it is estimated to take for the fire to be spotted and reported, fire response to occur, evacuation notifications provided, persons preparing to leave, and finally reaching an evacuation road and exiting the area, may require up to 2 hours. However, the affected residents within the Lauro Canyon, and parts of Mission Canyon and San Roque evacuation blocks may not have that much time to evacuate. Therefore, the evacuation of these areas would need to include a faster notification process and a faster evacuation from the area although there are many constraints to achieving these goals and it is not likely that significant time can be cut from the process. These changes would enable the evacuation time to be less than one hour to the evacuation roadways and out of the immediate fire area. Minimizing time required for each of the evacuation steps will need to include training and public education on a frequent basis.

Establishing one decision trigger for this scenario is not appropriate. There would need to be a series of decision triggers. As mentioned, evacuation blocks within which the fire is burning and those immediately adjacent and down-wind should be evacuated in a logical succession that enables residents of the most exposed areas (northern stretches) to evacuate first. The decision trigger should be automatic for these areas, no matter what evacuation blocks in the foothills are burning or adjacent to an active fire. Decision triggers for the remaining adjacent evacuation blocks would be determined based on wind direction and overall fire behavior. Any wildfire burning during extreme fire weather

will result in consideration of evacuation of all evacuation blocks that are downwind. Once the immediate areas are evacuated, then successive evacuation blocks that are down-wind, in the path of the fire should be evacuated in small enough successive groupings (from nearest to furthest from the fire) to avoid overloading the roadways. Similarly, in a conservative approach, the evacuation blocks up-wind should be on high alert and the decision to evacuate these blocks be made upon any shift in the wind or fire behavior or additional fire starts that may impact them.

Although not modeled for this scenario, a fire on a typical summer day (low wind and normal humidity) would likely not result in numerous Evacuation Block evacuations. Under this scenario, the decision trigger to evacuate a block may be associated with fire spread to the north or east with immediate evacuation of the neighborhoods directly west of the area to Tunnel Road. Additional evacuation triggers, possibly including the entire Mission Canyon Evacuation Block may occur if fire burned through the eastern ridgeline of Lauro Canyon under these conditions.

Table 3 provides a summary of Scenario 1 evacuation considerations.

Table 3
Evacuation Considerations for Wildfire Scenario 1- Lauro Canyon

Lauro Canyon Wildfire Ignition – Extreme Weather Conditions	
Ignition Location	Northeast of Lauro Canyon Reservoir (Figure 7)
City Evacuation Block	Lauro Canyon
Neighboring City Evacuation Blocks	West – San Roque East – Mission Canyon Southwest – Stevens Southeast – Mission Park North - None
Primary Land Cover	Lauro Canyon Evacuation Block includes wildland fuels, grass and shrub mix, reservoir, rural residential Neighboring Evacuation Blocks include similar wildland urban intermix of fuels and structures. Residential unit density increases to the south. Vegetated canyon (Steven's Park) may facilitate fire spread to the south due to fuels and wind alignment. Oak dominated canyon south of Foothill Road (Mission Park Evac Block) may facilitate fire spread under extreme weather conditions.
Fire Spread Results	1st hour is most significant with fire spreading south to community north of Foothill Road and east into Mission Canyon Evac Block. Successive hours include incremental fire spread to the north, south and west. Expect patchy ignitions and spread throughout urban landscapes north of Foothill Road and potentially south of Foothill Road. Structure ignitions may occur from ember penetration. Structural conflagration possible due to winds/embers.
Downwind Potential Susceptibility to Fire Spread	Moderate to High in Stevens Evacuation Block; Moderate within Mission Park Evac Block; urban neighborhoods have varying spread potential – patchy and reduced
Consequences of Fire	Burns into neighboring evacuation blocks. Impacts rural residential areas and open space

Table 3
Evacuation Considerations for Wildfire Scenario 1- Lauro Canyon

Lauro Canyon Wildfire Ignition – Extreme Weather Conditions	
Escape	throughout these blocks. Impacts more dense urban areas to the south. Keep fire out of Steven's Evacuation Block and fire corridor within.
Potential Safety Zones	Lauro Canyon Water Facility (Figure 14)
Firefighter Route(s) to Safety Zones	Figure 14
Evacuation Recommendations	
Existing Evacuation Route	Foothill Avenue (east-west) E. Alamar Avenue (north-south) N. Ontare (north-south) Mission Canyon (north-south)
Existing Fire Response Ingress	Foothill Avenue (east-west) San Roque Road (north-south) Mission Canyon (north-south) E. Alamar Avenue (short stretch north-south)
Existing Traffic Control Points	1. Foothill and San Roque Road 2. N. Ontare and Foothill Road 3. E. Alamar and Foothill Road
Proposed Traffic Improvements	1. Optimized Traffic Control at E. Alamar and _Calle Noguera road. 2. Others south of this area as described in Section 6.4.
Evacuation Trigger Points	Red Flag Warning Conditions – Evacuation Trigger: With confirmation by first engine at scene, reverse 911 Mandatory Evacuation Notice for all structures along San Roque Road, Marilyn Way, Ariba Way, Holly Road and Palomino Road in Lauro Canyon Evacuation Block (based roughly on whether 2 or more homes are ignited or one acre or more of land) Evacuation Warning provided for larger area within Evacuation Block and neighboring blocks. Depending on fire spread and behavior, Mission Canyon, and San Roque Evacuation Blocks may need to be evacuated at same time or within the first 2 to 3 hours. As possible, evacuate northerly stretches of these evacuation blocks first.

Wildfire Scenario #2 – Ignition in the Lower Riviera Open Space – Santa Barbara Bowl Area

This scenario involves an ignition off of Lowena Drive on a typical summer day. Winds are a low 6 mph and relative humidity is 37% or higher. The fire spread rate is slower than would be on a high wind day, but still spreads throughout the majority of the westerly open space canyon within the first hour, then spreads to the east aggressively during the next three hours into the Santa Barbara Bowl area. Fire spread following the 4th hour slows considerably as the fire runs out of available fuels, but may continue to spread in the urban areas as both vulnerable structures (older construction) and unmaintained landscapes or landscape components ignite in a patchy

manner. The easterly fire perimeter after 8 hours is contained to the west of Garcia Road and the westerly perimeter burns through the vegetated canyon south of Jimeno Road and just east of the dead end roads Grand Avenue and Micheltorena Street.

Based on the FARSITE and traffic modeling results the decision to evacuate the area surrounding the vegetated open space would need to be made quickly. Under summer weather conditions, absent high winds and low humidity, it is not likely that a complete Lower Riviera Evacuation Block evacuation would need to occur. The decision point for ignitions within this open space area, including the Santa Barbara Bowl, under these conditions, could include a partial evacuation block evacuation, focusing on structures south of Alameda Padre Serra, east of California Street, north of Alta Vista Road and E. Figueroa Street and west of Garcia Road. This evacuation area would limit the number of evacuees on the roadways, provide multiple directions of travel for the various evacuation neighborhoods, and therefore not impact fire apparatus access.

This particular scenario, like that in Scenario 1, does not lend itself well to decision point demarcation. The decision point for evacuation in this scenario is: as soon as a fire is detected within any portion of the open space area. The evacuation would be particularly for the relatively compact area identified above. Although not modeled for this scenario, extreme weather conditions would be expected to alter the evacuation area, potentially extending the evacuation area to the south and west, and possibly requiring the use of contingency plans due to the fast movement of a wind driven fire in the urban island represented by the open space.

Table 4 provides a summary of Scenario 2 Evacuation Considerations.

Table 4
Evacuation Considerations for Evacuation Scenario 2 – Santa Barbara Bowl

Santa Barbara Bowl Wildfire Ignition – Typical Summer Weather Conditions	
Ignition Location	Lower Riviera Open Space (Figure 8)
City Evacuation Block	Lower Riviera Evacuation Block
Neighboring City Evacuation Blocks	West – Mission Park East – County Bowl North – Upper Riviera South – None
Primary Land Cover	Lower Riviera = chaparral, shrub/tree Neighboring Evacuation Blocks include similar wildland urban intermix of fuels and structures. Residential unit density increases in all directions. Urban landscapes Series of north-south trending vegetated canyons aligned with typical Sundowner winds may facilitate fire spread.

Table 4
Evacuation Considerations for Evacuation Scenario 2 – Santa Barbara Bowl

Santa Barbara Bowl Wildfire Ignition – Typical Summer Weather Conditions	
Fire Spread Results	1st hour is most significant with fire spreading nearly to Alameda Avenue in the north. Hours 2 and 3 result in fire spread easterly and westerly to the urban interface. Successive hours include incremental fire spread to the north, east and west within areas designated as unmaintained vegetation. Expect patchy ignitions and spread throughout urban landscapes toward California Street to the west, Ferrelo Road to the east, Anacapa to the south, and Alameda Padre Serra to the north. Structure ignitions less likely than under windy conditions.
Downwind Potential Susceptibility to Fire Spread	Low in surrounding Evacuation Blocks; urban neighborhoods have varying spread potential – patchy and reduced; spotting is expected to be negligible.
Consequences of Fire Escape	Burns into neighboring evacuation blocks. Impacts urban areas with potential for structure fires/loss The "wildland" area is completely surrounded by urban neighborhoods. Fire must be contained to open space within the Lower Riviera Evacuation Block.
Potential Safety Zones	No safety zones identified; TRAs occur in neighborhoods to the south, east, and west
Firefighter Route(s) to Safety Zones	N/A; urban streets throughout the Lower Riviera Evac Block (outside the wildand fuel area), and in surrounding evacuation blocks provide access to TRAs
Evacuation Recommendations	
Existing Evacuation Routes	Foothill Avenue (east-west) Jimeno Road/Alta Vista Road on east-side (north-south) to E. Sola St Garcia Road on west-side (north-south) to Anapamu St eastward and south on E. Canon Perdido St.
Primary Fire Response Ingress	E. Sola Street to Alta Vista road/Jimeno Road (north-south) E. Anapamu Street (north-south) Milpas Street (east-west) Alameda Pedra Serra (east-west)
Existing Traffic Control Points	1. Alameda Padre Serra and Bonita Way 2. Alameda Padre Serra and Arbolado Road 3. Alameda Padre Serra and Garcia Road
Proposed Traffic Improvements	1. Road closure at Alameda Padre Serra and Jimeno Road 2. Other traffic flow improvements to the north, south, east and west described in Section 6.4.
Evacuation Trigger Point	Typical Summer Weather – Evacuation Trigger: With confirmation by first engine at scene of one acre or more burning (or two homes), Reverse 911 Mandatory Evacuation Notice for all structures south of Alameda Padre Serra, east of California Street, north of Alta Vista Road and E. Figueroa Street and west of Garcia Road. Evacuation Warning for larger area within Evacuation Block and neighboring evacuation blocks of Mission Park, County Bowl, portions of Upper Riviera, and successively wider evacuation area would be appropriate if weather conditions changed.

Wildfire Scenario #3 – Ignition in the Campanil Hill Area

This scenario considers an ignition north of Campanil Hill at the edge of a large open space, naturally vegetated polygon, within the Las Positas Evacuation block, between the Hidden Valley and Ellings Park Evacuation Blocks. One large residence occurs within the middle of the

open space areas while the perimeter of the area is surrounded by residential development and urban land uses. The ignition assumes 97th percentile winds and humidity (60 mph sustained winds and 8% relative humidity). Ignitions under these conditions will be fast moving with significant spotting. The large residence on the top of Campanil Hill includes significant fuel modification and appears to be ignition resistant, so could be considered a TRA. Evacuation of this residence immediately upon fire detection and response should be considered, unless the fire is moving too rapidly and would create an unsafe condition. In that case, a temporary refuge area (either in the structure or in the large hardscape area could be elected).

Under wind driven fire pushing to the south, the fire travels nearly 1.25 miles to the coastal bluffs. Fire spread is fast and spot fires occur in front of the flame front. The fastest spread occurs during the first hour, with the second hour including spread both east to Las Positas Road and west to nearly the City boundary. Additional southerly fire spread occurs during hour two burning the remainder of the coastal bluffs south of Campanil Hill. The third hour includes southeasterly burning, likely due to spotting within Arroyo Burro Beach Park and beyond the City/County line to the west. Hour three also includes burning to the north of the ignition point. Hours 4 through 8 result in incremental fire spread in heavily vegetated areas adjacent to urban land uses to the west, in open space Arroy Burro Beach Park to the east of Barcelona Drive/south of Veronica Springs Road in the north and to the south of Senda Verde in the northwest.

Based on the FARSITE and traffic modeling results and under extreme fire weather conditions, the evacuation decision point again, would need to be in the fire's incipient stages. The first decision point would be whether there is time to evacuate the large residence on Campanil Hill or whether fire conditions require a temporary refuge. The owner/resident at this location should be prepared (through self-guided awareness and SBFD outreach) to temporarily refuge during a wildfire in this area. Roughly the same time that decision is being made, areas within the Las Positas Evacuation Block, especially areas to the south of the open space, particularly Vista Del Mar Drive, Braemar Drive, Sea Cliff Drive, and Cliff Drive as well as neighborhoods to the west to the City line from Cliff Drive in the south to Monte Drive in the north should be evacuated. The priority areas would be to the south and southwest/west of the Campanil open space area. The remaining areas, as far west as Estrella Drive (County) can be evacuated following the first wave of vehicles out of the area.

This fire scenario, like the other two, is in a relatively compact area and doesn't fit into a neat decision point model. Ignitions within the open space fuels, depending on weather/wind conditions, will need to be evaluated in terms of where are they spreading, and how quickly. This will impact the initial evacuation notifications as it could be concentrated in the north/northwest under on-shore flows, or to the south, southwest, southeast under varying wind conditions. There will be a relatively short timeframe for initial evacuations to occur, so the public in areas

surrounding this open space will need special emphasis on their own readiness and ability to evacuate quickly.

Table 5 provides a summary of Scenario 3 Evacuation Considerations.

Table 5
Evacuation Considerations for Evacuation Scenario 3 – Campanil Hill.

Summary: Campanil Hill Wildfire Ignition Scenario	
Ignition Location	North of Campanil Hill (Figure 9)
City Evacuation Block	Las Positas Evacuation Block
Neighboring City Evacuation Blocks	West – None (City of Goleta) East – Ellings Park North – Hidden Valley South – None (coastal residential)
Primary Land Cover	Las Positas Evac Block – open space: annual grassland with scattered coastal sage scrub; developed: large parcel, semi-rural residential Neighboring Evacuation Blocks include similar wildland urban intermix of fuels and structures. Ellings Park Evac Block mostly annual grasses, steep slopes. Hidden Valley includes treed corridors and shrub/tree canopy covered slopes Residential unit density increases in all directions. Urban landscapes Continuous vegetation corridor from Highway 1 to the coast and aligns with Sundowner events
Fire Spread Results	1st hour is most significant with fire spreading to the coast (1.25 miles). Successive hours include significant fire spread to the east, while western landscapes will slow the fire spread in that direction, but could result in structure fires and spread into Ellings Park Evacuation Block is likely due to the presence of large open space of flashy fuels.
Downwind Potential Susceptibility to Fire Spread	Downwind potential for ignitions, spotting is high throughout the Las Positas Evac Block naturally vegetated areas. Structures are primarily of newer construction and should be relatively ignition resistant. However; structure fires are likely and under worst case conditions, could become a conflagration.
Consequences of Fire Escape	Burns into neighboring evacuation blocks. Impacts urban areas with potential for structure fires/loss The "wildland" area is completely surrounded by urban neighborhoods of both semi-rural and rural. Fire must be contained to open space within the Las Positas and Ellings Park Evacuation Blocks.
Potential Safety Zones	Potential Safety Zone at the First Baptist Church on Veronica Springs Road (with enhancements); potential at Arroyo Burro Beach. TRAs occur in neighborhoods to the south, east, and west and at large structure at the terminus of Campanil Drive.
Firefighter Route(s) to Safety Zones	Las Positas Road north to Veronica Springs Road to First Baptist Church Las Positas Road south to Cliff Drive west to Arroyo Burro Beach
Evacuation Recommendations	
Existing Evacuation Routes	None Indicated on Current City Evacuation Plan Las Positas Road (south) to Cliff Drive (east) Las Positas Road (south) to Cliff Drive (west) to Marina Drive (west and north) if suitable advanced notice Garcia Road on west-side (north-south) to Anapamu St eastward and south on E. Canon Perdido St.
Primary Fire Response Ingress	None Indicated on Current City Evacuation Plan Las Positas Road (south)

Table 5
Evacuation Considerations for Evacuation Scenario 3 – Campanil Hill.

Summary: Campanil Hill Wildfire Ignition Scenario	
	W. Carillo Street (south) to Cliff Drive (west)
Existing Traffic Control Points	1. Cliff Drive at Marina Drive 2. Cliff Drive at Marina Drive, Las Positas Drive Flora Vista Dr, and Meigs Rd. 3. Flora Vista/Valerio Street at Calle Cannon and Mountain Avenue 4. Mountain Avenue at W. Mission Street/W. Mission St at San Andres
Proposed Traffic Improvements	1. None identified by Traffic engineers. 2. Other traffic flow improvements north and east of this location described in Section 6.4. 3. Ahead of evacuation, control key traffic intersections (will depend on fire behavior, but general moving traffic to the east and north)
Evacuation Trigger Point	Extreme Fire Weather – Evacuation Trigger: With confirmation by first engine at scene of one or more acre burning (or two homes), Reverse 911 Mandatory Evacuation Notice for all structures within the Las Positas Evacuation Block, especially areas to the south of the open space, particularly Vista Del Mar Drive, Braemar Drive, Sea Cliff Drive, and Cliff Drive as well as neighborhoods to the west to the City line from Cliff Drive in the south to Monte Drive in the north (Figure 14) Successively wider evacuation area would be appropriate within surrounding evacuation blocks (Eling Park, Hidden Valley) if weather conditions changed.

6.10 Prepare for Reentry/Recovery

Planning for reentry/recovery has been an issue realized following numerous wildfires in California and elsewhere. This component of emergency planning is often not addressed in response plans. It is not widely known, but managing traffic during reentry can be more problematic than during the evacuation.

It is recommended that a Citizen Re-entry and Recovery Plan is prepared for the City of Santa Barbara. This plan should include law enforcement agency input. Law enforcement personnel must be engaged and involved in the reentry process to prevent unnecessary hardships for evacuees returning to their homes. Planning for reentry must include a similar attention to details as the evacuation process and for dealing with people who should not be allowed into the area, i.e., looters, and a morbid and/or curious public. Phasing reentry such that traffic is minimized is one element of this process. Providing informed personnel in affected neighborhoods to help homeowners deal with stresses of property damage or other fire effects will also have longer term benefits by making people feel that the process worked from start to finish and that they will be likely to evacuate the next time they are told to do so.

6.11 Implement Technological Advances

There are key facets of fire behavior modeling evacuation planning that utilize sophisticated landscape based models. These models rely on certain inputs and assumptions that may not accurately reflect the situation during a wildfire as the results are only as good as the inputs and decision during a wildfire rely on real-time fire activities. For example, traffic modeling can provide a picture of how traffic will move through various streets/roads and intersections, but is limited by inputs and assumptions. During an evacuation, there are many variables that may not follow the model's algorithm and may therefore, result in longer travel times, unforeseen congestion, or road blockages, amongst others. Similarly, fire behavior modeling currently has some limitations in terms of spotting, fuel pockets, and changing wind conditions. The result may be unexpected shifts in fire spread rate and direction and reduced time available for evacuation ahead of the fire. Further, establishment of decision triggers provides a general landmark indicator that evacuation of vulnerable areas should be initiated, but it may be difficult to determine when the decision point has been triggered.

Because of these limitations, it is recommended that the City continue to monitor developing technologies in traffic and fire behavior modeling, real-time data capabilities, situation awareness technologies, early fire detection and tracking methods, personal and neighborhood sheltering options, and other technologies that may improve the accuracy of predicting wildfire spread and monitoring its progression toward vulnerable areas, and moving people from vulnerable areas to safe zones.

To improve the real-time situation analysis capabilities as well as provide a fast detection and response to wildfires, there are various technologies that are available or are being researched and tested. These programs/technologies are important for evacuation planning because early detection and real-time information play a major role on successful evacuations as well as alternative protections, if necessary. Technologies and programs that the SBFD should stay abreast of and or consider instituting include:

- Stay on top of the notification avenues available to an evolving population: where do people get info in an emergency – Reverse 911, website, twitter, Facebook, television, radio, patrol car PA, sirens, etc.
- Fire watch – there are good volunteer fire watch programs that could be emulated in Santa Barbara City/County that can provide early detection of wildfires as well as act as a deterrence to would-be arsonists. Fire watch volunteers are trained, provided basic communication equipment, and are typically deployed during Red Flag Warning conditions

to key lookout areas where wildland fires must be hit hard and fast to minimize potential spread. These programs include various costs, but have a high benefit to cost ratio.

- Remote Web Cameras – in addition to volunteer programs, remote Web Cameras can be placed in key areas and fitted with thermal imaging capabilities and run on solar power. These systems are useful because they can be monitored by volunteers from their homes as most volunteers are not comfortable being in the field at night. Remote Web Cameras or similar fire detection systems can provide 24/7 coverage of concentrated areas where fire starts could have significant impacts.
- Developing technologies utilizing remote sensors and automatic warning – various products are being developed that may be available in the near future and would assist the fire agencies in Santa Barbara County with early fire detection. These systems are based on radio-frequency identification (RFID) technology and are pre-planted in the field in "fire sheds" (compare to water sheds). These systems include sensors that when burned, send important information to fire officials including location and temperature. The time it takes between receipt of the first sensor's information and the second, third and so on (which are placed at intervals) provides the fire spread rate and direction.
- Drone use during wildfires to feed intelligence to IC – more and more agencies are acquiring drone technology to assist with reconnaissance, information gathering, real-time video monitoring, and birds-eye views of situations. This technology is a useful tool for evacuation planning as it can help determine real-time traffic issues and help direct resources where most needed.

There are many other technologies that are being developed and may have applications within Santa Barbara for assisting the fire agencies in their wildfire fighting activities and in the evacuation process. Following these developments or better yet, becoming partners with some of the companies, universities, and other entities that are developing these technologies is recommended.

6.12 Evacuation of Special Populations

Vogt (1990 and 1991) defines special populations as those groups of people who, because of their special situations or needs, require different planning strategies from those of the general population. Special needs populations include those in institutions or special facilities, those with disabilities in homes, those who need care, children, and others who cannot provide for their own evacuation if necessitated. The special needs population is concentrated in facilities, but is also widespread in terms of facility locations and those who live in residences. Special needs populations in Santa Barbara include the hearing or visually impaired, foreign speaking, transients such as visitors/tourists passing through the area, temporary visitors such as day workers, and the non-ambulatory confined to residences either temporarily or permanently.

Because of the tourist attractions in the northern portion of the City and just outside the City's boundaries, this segment of the population is anticipated to have the capacity to impact successful evacuations. Tourists and temporary visitors may not have knowledge of the areas fire hazard, they may not know how to react in a fire emergency, and they may not understand what they are being told to do. Conversely, this segment of the population would typically be easier to evacuate quickly as they have no possession or pets that they would need to prepare. They can get in their cars and be directed south and west out of the area.

The reasons why special needs populations may fail to respond to warnings to take protective actions is that they may require special transportation while others require different types of warnings or technologies to receive a warning. Some groups must rely on care-givers (such as schools and day-care centers) to hear the warning and respond. Populations of nursing homes or assisted-care facilities may combine various aspects related to mobility and mental competence that makes evacuation the last resort in protective action planning. Lack of mobility may not be voluntary as in the case of detention facilities where continued constraints must be imposed during the evacuation process.

Most schools have plans to evacuate children in event of a community emergency. Two planning strategies most frequently used by schools include:

- Early dismissal, in which children are returned to their homes. Children who cannot return are sheltered at the school.
- Relocation of the school populations to a pre-designated shelter by bus.

Recommendations

Due to privacy concerns and Federal Laws, there is currently no registries for populations with Access and Functional Needs and Disabilities (AFN/D) who live independently within the City and County of Santa Barbara. However, the County Public Health Department does have a database of Skilled Nursing Facilities, Board and Care Homes, Hospitals and other licensed medical facilities. The County Public Health Department facilitates a Disaster Healthcare Coalition that includes all licensed medical facilities throughout the County; including the City of Santa Barbara. The City of Santa Barbara is a member of the Coalition through the Office of Emergency Services Division of the Fire Department. Therefore, any evacuations of AFN/D population that include the City of Santa Barbara Fire Department, prior to and during evacuations, is coordinated with the County Office of Emergency Management and the County Public Health Department's Emergency Medical Services Division.

- Prepare law enforcement personnel to manage visitors/tourists/transient populations that may not understand instructions

6.13 Animal Evacuations

Animal evacuations present a host of challenges that may affect the overall successful movement of people and their possessions out of harm's way. For example, livestock owners do not always have the means to load and trailer their livestock from the danger zone. Further, most wildfire evacuation relief shelters or commercial lodging facilities do not allow people to bring in pets or other animals. Sorensen and Vogt (2006) indicate that an issue receiving increasing attention is what evacuees do with pets or other animals such as livestock when they leave their homes and whether having pets or animals impacts their decision to evacuate. The results indicate that most people take their small pets with them while anywhere from 11–50% or more take their livestock with them.

Recommendations:

- Develop a strong outreach program for pet and livestock owners so they understand their responsibilities and that they will not be allowed re-entry once evacuated.
- Develop a registration for owners of animals who cannot evacuate them without assistance so that volunteer organizations, such as Equine Assistance, can provide resources

6.14 Public Outreach

Because of the varied nature of hazard interpretations, knowledge about protective actions, and understanding of the warning processes, it is important to provide public information and education about hazards before they occur in order to prepare residents for future events and minimize surprises during a hazard warning. Pre-event public education specifically focused on the evacuation block areas should be thought of as a part of larger emergency management education efforts and is best accomplished in coordination with multiple partners. There are numerous methods to inform the public including media, internet, mail, door hangers, flyers, and informational pieces in utility mailings, amongst others.

6.15 Options Analyzed and Considered Not Implementable

Throughout the course of this analysis, potential evacuation related options for implementation in Santa Barbara were evaluated for their usefulness in solving existing evacuation issues and they were evaluated for their ability to be implemented in Santa Barbara. Some of the options were considered inappropriate for Santa Barbara based on one or more factors including roadway constraints, negative ramifications for areas adjacent to the potential recommendation area, funding, terrain, or others.

The following brief list provides summaries of two options that were analyzed, but were considered to be difficult or impossible to implement at the time of this report's preparation.

1. **Optimized Signal Timing**

   Signal timing can effectively relieve congestion and facilitate evacuations. However, it is not always possible to implement a special pre-configured traffic signal timing plan without negatively affecting other movements. For planned events, signal timing optimization can work because traffic planners know where people are coming from, where they are going to (path of travel) and what time the event will happen. Wildfire is a very different situation due to the fluid nature of how a wildfire event unfolds. It would not be possible to predict when a fire would occur. It may be possible to predict where fires will occur, as part of scenario modeling, but pre-programming traffic signals would include too many unknowns and could result in elevated risk and is therefore, not recommended in Santa Barbara.

2. **Permanent Evacuation Route Signing**

   Evacuation routes are often marked with permanent signs that guide people toward the best or nearest evacuation route. These are particularly useful is areas with large transient or tourist populations, like Santa Barbara. However, results of the analysis conducted as part of this WEPA preparation indicate that permanent evacuation signage works for some types of disaster situations, but because fire is very fluid across a landscape and may start spot fires well away from the active fire area, permanent fire evacuation route signage is not recommended in Santa Barbara.

7 CONCLUSION

This WEPA has evaluated three City-selected fire scenarios and the wildfire evacuation capabilities of the City's existing evacuation plan. Each of these evaluations included use of sophisticated, GIS based models. The results of these efforts formed the basis for establishing evacuation decision points, where the rate of fire spread was compared to the worst-case elapsed timed to move people from vulnerable areas to safer areas, a contingency time allotment added for a safety buffer, and a physical landmark established in GIS.

Since the fire behavior and traffic modeling analysis are not the only factors affecting successful evacuations in Santa Barbara, additional analysis focused on researching social behavior during emergency evacuations, supporting special needs populations, providing public education and outreach, establishing firefighter safety zones and temporary refuge areas, providing for contingency plans for firefighters, and developing recommendations to facilitate traffic flow, reduce wildfire threat, increase likelihood of early fire detection, and improve law enforcement capabilities and preparedness.

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8 LIMITATIONS

The recommendations provided in this WEPA have been developed based on wildfire and evacuation standards and are specifically intended for implementation in the City of Santa Barbara, with appropriate co- implementation by neighboring fire and law enforcement agencies. This WEPA tiers off of the City's "Ready, Set, Go!" model, adopted by the State of California and many fire agencies statewide. The goal is to raise agency and citizen awareness of potential evacuation issues and get a majority of the public "Ready" by taking a proactive stance on preparedness, training drills, and visitor education, and evacuation planning efforts. The City and its populace will be "Set" by closely monitoring the situation whenever fire weather occurs and/or when wildland fire occurs within the Santa Barbara area, and elevating pre-planned protocol activities and situation awareness. Lastly, officials will implement the plan and mandate that populations "Go" by executing the pre-planned evacuation procedures in a conservative manner, i.e., evacuation will occur based on conservative decision points, as proposed in this WEPA or when directed by fire and law enforcement personnel, whichever is more conservative. The preferred alternative will always be early evacuation. However, there may be instances when evacuation is not possible, is not considered safe, or is not an option based on changing conditions. For example, should a fire occur within a WUI area and make evacuation to the south too dangerous, a contingency plan for residents must be pre-planned, practiced and efficiently carried out. This contingency would include moving people to pre-designated temporary refuge areas until it is safe to evacuate.

Ultimately, it is the intent of this WEPA to guide the implementation of City evacuation procedure recommendations such that the process of evacuating people from vulnerable areas is facilitated in an efficient manner according to a pre-defined, practiced evacuation protocol as well as providing a contingency option of temporarily sheltering, if evacuation is too dangerous.

During extreme fire weather conditions, there are no guarantees that a given structure will not burn or that evacuations will be successful all of the time. Wildfires may occur in the area that could damage property or harm persons. However, successful implementation of the recommendations outlined in this WEPA will provide for an informed populace, especially in the most vulnerable areas, pre-planned and practiced fire and law enforcement personnel, and informed evacuation officials.

This WEPA does not provide a guarantee that all persons will be safe at all times because of the recommendations proposed. There are many variables that may influence overall safety. This WEPA provides recommendations for implementation of standard evacuation protocols, customized roadway improvements, and public outreach, which should result in reduced wildfire related risk and hazard. Even then, fire can compromise the procedures through various, unpredictable ways. The

goal is to reduce the likelihood that the system is compromised through implementation of the elements of this WEPA and regular occurring program maintenance and updates.

It is recommended that the evacuation process is carried out with a conservative approach to fire safety. This approach must include maintaining the landscape and infrastructural components according to the appropriate standards and embracing a "Ready, Set, Go!" stance on evacuation. Accordingly, evacuation of the vulnerable wildfire areas should occur according to the pre-established evacuation decision points, or as soon as they receive notice to evacuate, which may vary depending on many environmental and other factors, whichever is more conservative. Fire is a dynamic and somewhat unpredictable occurrence and it is important for anyone living at the wildland-urban interface to educate themselves on practices that will improve safety.

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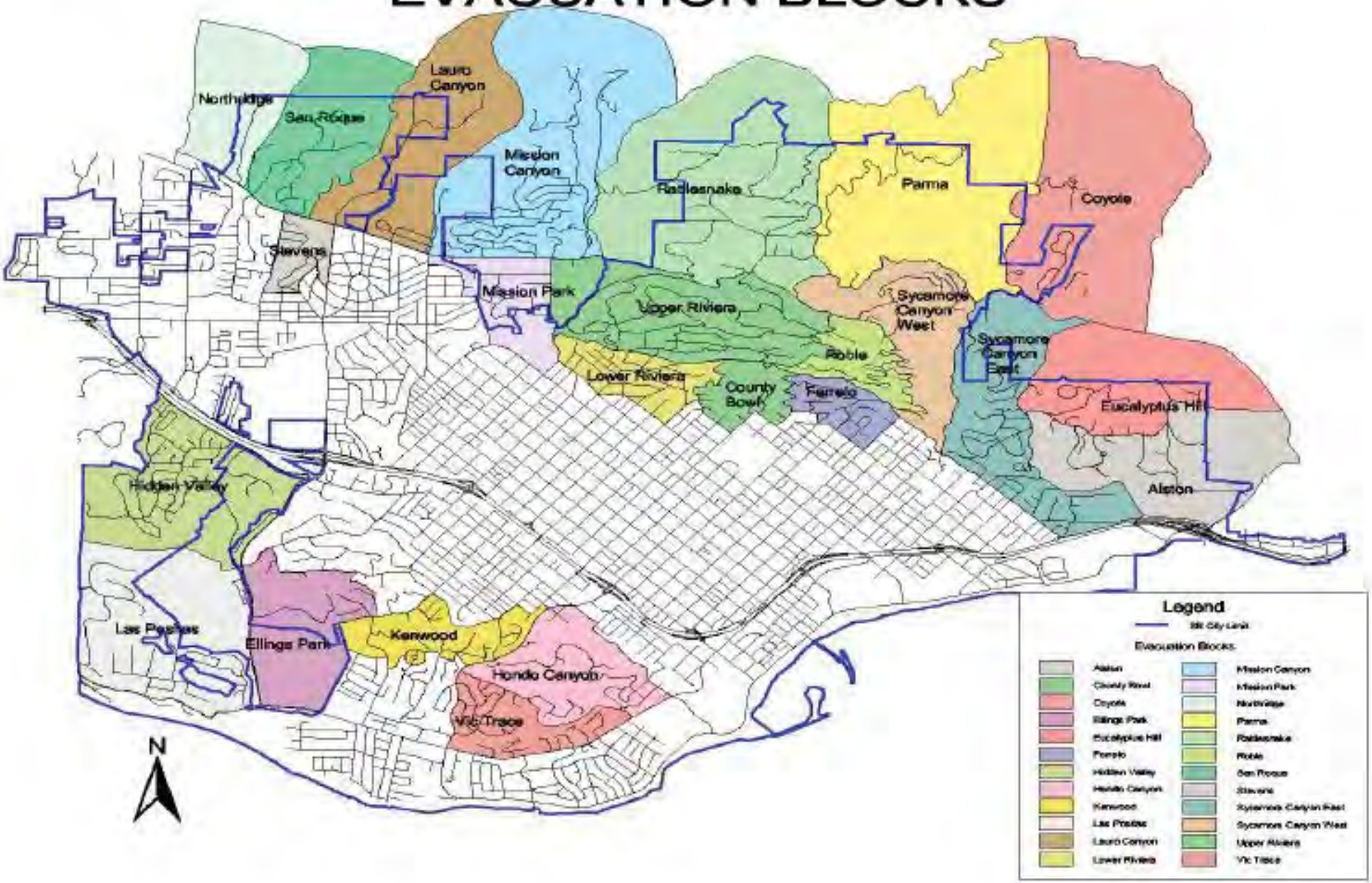
APPENDIX A

Current Santa Barbara Evacuation Blocks

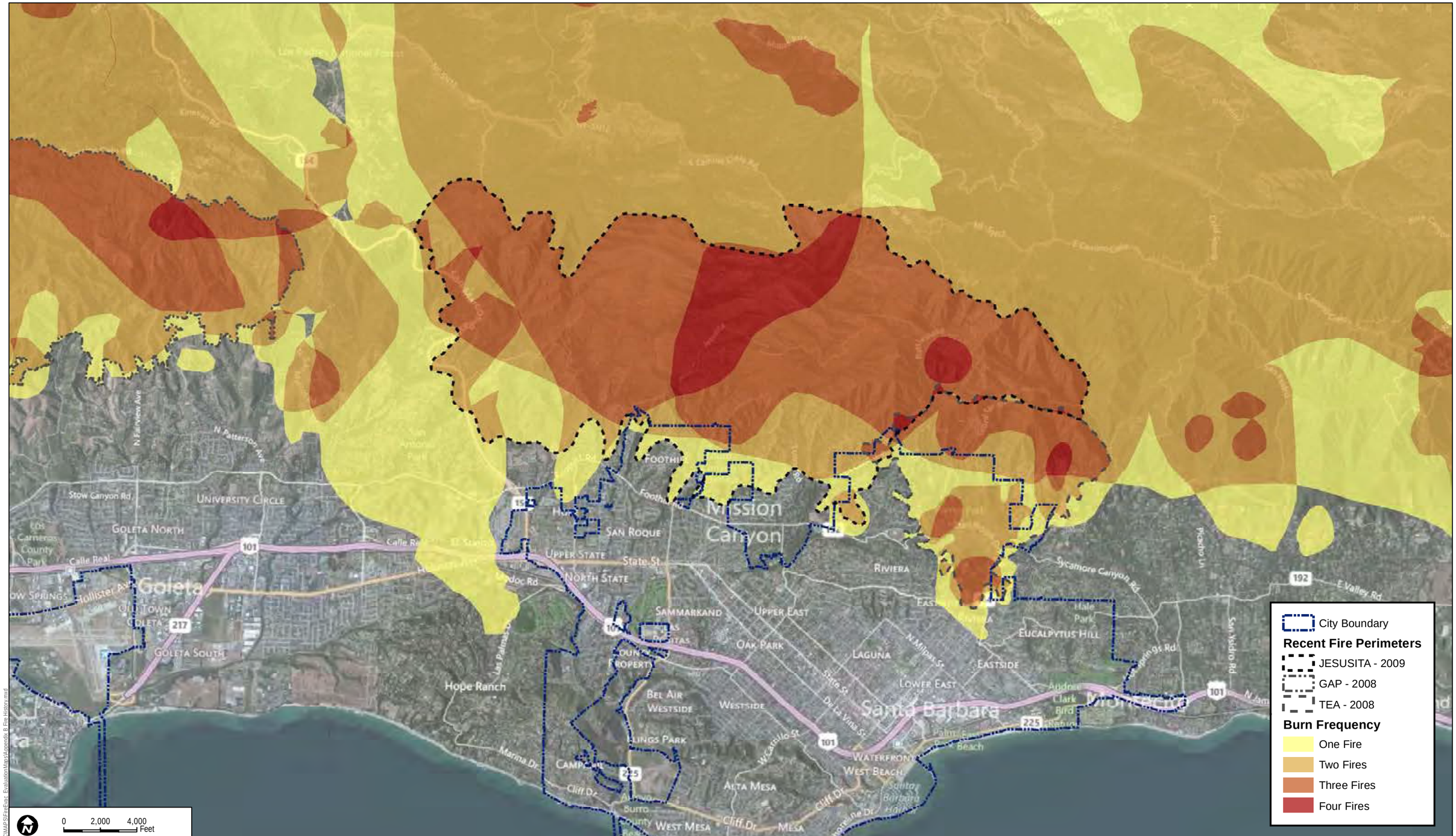
Figure 24

EVACUATION PREPLANNING
EVACUATION BLOCKS



APPENDIX B

Santa Barbara Regional Fire History



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7823-01

SOURCE: City of Santa Barbara; Santa Barbara County; Cal Fire 202; Bing

Appendix B

Fire History Exhibit

SANTA BARBARA WILDLAND FIRE EVACUATION PROCEDURES EVALUATION

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APPENDIX C

FARSITE Modeling Analysis

Appendix C
FARSITE Modeling Inputs

For the purposes of this analysis, two distinct fire behavior modeling areas were determined that encompasses a total of approximately 22,700 acres (approximately 20,200 acres in the Northern Modeling Area and approximately 2,500 acres in the Southern Modeling Area). The Northern Modeling Area is roughly bounded by the ridge of Santa Ynez Mountains to north; Montecito Creek/Cold Spring Canyon to the east; Highway 154 to the west; and Foothill Road/WFSAD parcels to the south. The Southern Modeling Area is roughly bounded by Hope Ranch Road to the west, Highway 101/Mountain Avenue/W. Carillo Street to the north, Loma Alta Drive to the east, and Cliff Drive/Pacific Ocean to the south (Figure 2).

The FARSITE software package requires a minimum of five separate input files including elevation, slope, aspect, fuel model, and canopy cover. Each of these files was created as a raster GIS file using ArcGIS 10.1 software, exported as an ASCII grid file, then utilized in creating a FARSITE (Finney 1998) Landscape file (.lcp) that served as the base for all FARSITE runs. Based on available data sets, the resolution of each grid file and associated ASCII file that was used in the FARSITE models described herein is 3 meters (9.8 feet). In addition to the Landscape file, wind and weather data are incorporated into the model inputs. The output files for each of the modeling runs are a series of fire perimeter boundaries, segmented into 1-hour intervals.

The following provides a more detailed description of the input variables used in processing the FARSITE models. In addition, data sources are cited and any assumptions made during the modeling process are described.

Wind and Weather

In order to utilize weather and fuel moisture variables for the fire behavior modeling area, data from the Montecito Remote Automated Weather Station (RAWS) was analyzed. Utilization of RAWS data is necessary for fire behavior modeling as it includes data for fuel moisture, temperature, relative humidity, and wind speed. The Montecito RAWS is located approximately 4 miles to the east of the Northern Modeling Area and approximately 7 miles to the northeast of the Southern Modeling Area. The following summarizes the location and available data ranges for the Montecito RAWS:

Latitude: 34.46139

Longitude: -119.64889

Elevation: 1,619 feet

Data years: 1996 to 2012

Wind and weather data are a required component to fire behavior modeling efforts. The Montecito RAWS data was processed with the FireFamily Plus v. 4.0.2 (FireFamily Plus 2007) software package to determine summer (50th percentile) and fall (97th percentile) weather

conditions to be incorporated into modeling efforts. The analysis period for weather data analysis was May 1–November 30.

Fuel moisture information was incorporated into the Fuel Moisture file used as an input in FARSITE. In addition, temperature and relative humidity information was incorporated into a Weather data file to be used during FARSITE runs. Different wind direction and wind speed values were also utilized for each of the FARSITE runs to model scenarios for 50th percentile and 97th percentile weather conditions. As FARSITE incorporates a temporal component to the fire spread model, a detailed wind input file was necessary to incorporate wind direction, as well as sustained wind speeds over the entire analysis period. For the purposes of this analysis, worst-case fire weather scenarios (97th percentile) were assumed and wind directions were aligned with canyon alignments and held constant for the entire analysis period. For 50th percentile weather scenarios, wind directions were aligned with on-shore flows. Table 1 presents the wind and weather data inputs used for each modeling scenario.

Table 1
Fire Behavior Weather and Fuel Moisture Inputs

Model Variable	Scenario 1: Northern Modeling Area, 97th Percentile Weather	Scenario 2: Northern Modeling Area, 50th Percentile Weather	Scenario 3: Southern Modeling Area, 97th Percentile Weather
1 h fuel moisture	2%	6%	2%
10 h fuel moisture	3%	8%	3%
100 h fuel moisture	5%	12%	5%
Live herbaceous moisture	30%	60%	30%
Live woody moisture	66%	97%	66%
Low temperature	77˚ F	58˚ F	77˚ F
High temperature	96˚ F	78˚ F	96˚ F
Low relative humidity	8%	37%	8%
High relative humidity	26%	74%	26%
20-ft. wind speed (mph)	60 mph	6 mph	60 mph
Wind direction	Offshore, 20˚	Onshore, 200˚	Offshore, 20˚

Elevation

Elevation data were derived from a 3 meter resolution Interferometric Synthetic Aperture Radar (IfSAR) measurement for coastal Southern California, acquired from the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center and projected in the NAD 1983, California State Plane, Zone 5 coordinate system, with units in feet. Elevation values throughout the Northern Modeling Area range from 6 to 4,002 feet above mean sea level (AMSL) and those for the Southern Modeling Area range from 0 (sea level) to 626 feet AMSL. This data were utilized to create an elevation grid file, using units of feet above mean sea level. The elevation

data are a necessary input file for FlamMap runs and are necessary for adiabatic (i.e., a process that happens without loss or gain of heat) adjustment of temperature and humidity and for conversion of fire spread between horizontal and slope distances (Finney 2004).

Slope

Using ArcGIS Spatial Analyst tools, a slope grid file was generated from the elevation grid file described above. Slope measurements utilized values in degrees of inclination from horizontal. Slope values throughout the Northern Modeling Area range from 0% (flat) to 460% (78 degrees) and those for the Southern Modeling Area range from 0% (flat) to 400% (76 degrees). The slope input file is necessary for computing slope effects on fire spread and solar radiance.

Aspect

Using ArcGIS Spatial Analyst tools, an aspect grid file was generated from the elevation grid file described above. The aspect values utilized were azimuth degrees. Aspect values are important in determining the solar exposure of grid cells.

Fuel Model

Development of the fuel model data set used in the FARSITE modeling effort for the project involved the use of publicly available vegetation coverage data plus an image classification procedure for more urbanized areas. The initial step involved retrieving USFS Pacific Southwest Region (R5) Vegetation Inventory GIS data[1] for the modeling area. The delineation of the vegetation in the R5 USFS data set was developed from pan sharpened 5 meter 2003 SPOT imagery. The wildlife habitat relationships type (WHRTYPE) attribute[2] in the USFS R5 data set was then used as the basis for fuel model classifications, with the exception of areas classified as Urban (WHRTYPE = URB). Due to the intermix of vegetation, roads, structures, and other non-fuel land cover types in the areas classified as urban, a separate image classification analysis was completed for these areas.

Using the Image Classification tools within ArcGIS, a Maximum Likelihood Classification procedure was completed for urban areas using 2005 National Agriculture Imagery Program (NAIP) imagery[3] reclassified to a resolution of 3 meters. The 2005 NAIP imagery was selected for the image classification procedure as it did not include recent burn scars from the 2008 Tea Fire or 2009 Jesusita Fire which would have resulted in misclassification of burned areas, the majority of which have grown back to chaparral cover. Thirty nine training samples were drawn within each of the modeling areas (North and South) and assigned cover type classifications, which were then used in the Maximum Likelihood Classification process to classify each pixel in

[1] http://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347188
[2] http://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=fsbdev3_048103
[3] http://www.dfg.ca.gov/biogeodata/gis/map_services.asp

the image. The resulting classification file was then merged with the USFS R5 vegetation cover file to create a complete vegetation/land cover file for the modeling areas.

In addition, an analysis of non-vegetated areas was conducted to identify portions of the modeling area that were non-fuel (e.g., rock outcrops, roads, pools, parking lots). To complete this analysis, an analysis of the Normalized Difference Vegetation Index (NDVI) data set from the 2005 NAIP imagery data set[4] was completed. Specifically, using Image 3 of the 2005 NDVI data set, non-vegetated areas with a pixel value of 3 were isolated and classified in a new GIS grid file as non-fuel land cover. The resulting non-fuel land cover grid file was then merged with the previously created vegetation/land cover file, with identified non-fuel areas superseding previous vegetation classifications.

Finally, structure location GIS data available from Santa Barbara County was used to augment the vegetation/land cover data set. Building footprints within the modeling areas were converted to a GIS grid file and classified as non-fuel. The resulting building grid file was then merged with the previously created vegetation/land cover file, with building locations classified as non-fuel superseding previous vegetation classifications. While structures will burn, there is currently no fuel model which has been developed for this purpose.

Following GIS data processing and vegetation/land cover file generation, the resulting land cover types were reclassified into fuel models. Fuel model classification was based on vegetation mapping data and the results from cursory field evaluations. Table 2 outlines the vegetation/land cover types and associated fuel models used for the FARSITE modeling areas.

Table 2
FARSITE Modeling Areas Vegetation and Fuel Types

Vegetation/Land Cover	Source	Fuel Model Assignment	Acreage within Northern Modeling Area	Acreage within Southern Modeling Area
Annual Grass (AGS)	USFS R5	1	585.4	168.8
Barren (BAR)	USFS R5	1	40.7	39.7
Coastal Oak Woodland (COW)	USFS R5	TU1	1,830.8	12.7
Chamise-Redshank Chaparral (CRC)	USFS R5	SH7	117.4	0.0
Cropland (CRP)	USFS R5	GR1	653.0	0.0
Coastal Scrub (CSC)	USFS R5	SCAL18	316.7	335.2
Deciduous Orchard (DOR)	USFS R5	1	58.9	6.4
Eucalyptus (EUC)	USFS R5	TU1	10.1	0.0
Lacustrine (LAC)	USFS R5	1	21.5	0.7
Mixed Chaparral (MCH)	USFS R5	SH7	10,672.7	13.3
Montane Hardwood (MHW)	USFS R5	TU1	13.9	0.0
Pasture (PAS)	USFS R5	1	0.0	13.9

[4] http://www.dfg.ca.gov/biogeodata/gis/map_services.asp

Table 2
FARSITE Modeling Areas Vegetation and Fuel Types

Vegetation/Land Cover	Source	Fuel Model Assignment	Acreage within Northern Modeling Area	Acreage within Southern Modeling Area
Sierran Mixed Conifer (SMC)	USFS R5	9	11.1	0.0
Valley Oak Woodland (VOW)	USFS R5	1	35.6	0.0
Valley Foothill Riparian (VRI)	USFS R5	8	654.2	60.4
Grassland (Urban)	Image Classification	GR1	302.3	187.4
Scrub (Urban)	Image Classification	GS2	1,323.7	535.9
Turf (Urban)	Image Classification	GR1	0.0	125.2
Woodland (Urban)	Image Classification	TU1	1,119.8	282.0
Non-Fuel (Urban)	Image Classification	0	363.1	160.5
Non-Fuel	NDVI Classification	0	1,984.9	359.3
Buildings	Building Footprint Classification	0	99.9	204.3
		Total	**20,215.8**	**2,505.6**

Canopy Cover

Canopy cover is measured as the horizontal fraction of the ground that is covered directly overhead by tree canopy. Crown closure refers to the ecological condition of relative tree crown density. Stands can be said to be "closed" to recruitment of canopy trees but still only have 40% or 50% canopy cover. Coverage units can be categories (0–4) or percentage values (0%–100%).

Canopy cover for both modeling areas was compiled from two distinct data sets: 1) tree canopy cover data for the City of Santa Barbara, and 2) vegetation type classifications for non-City areas. City tree canopy data was assigned a canopy coverage value of 4 while all woodland areas outside of City limits were assigned a canopy coverage value of 3 (to account for gaps between individual tree canopies). The two files were merged in a GIS and converted to grid format to provide the required canopy cover data layer for the modeling runs.

Other FARSITE Model Inputs

The FARSITE software package also requires additional settings to initiate model runs. The following outlines the settings used for the three FARSITE runs completed in support of this project:

1. The 'Time Step' used for all runs was 60 minutes (1 hour).
2. The 'Perimeter Resolution' for all runs was 10 meters.
3. The duration for all runs was maximized at 8 hours.

4. Crown fires were enabled and the 'Enable Spot Fire Growth' ignition frequency input variable was set at 5% and the ignition delay was set at 2 minutes for all model runs. Spotting in FARSITE is simulated only from torching trees from passive and active crown fires and is intended to compute the maximum spotting distance from a given point on a fire front if torching occurs.

The fire spread modeling results for the modeled scenarios were analyzed by the project team and incorporated into the resulting recommendations. This type of modeling is sophisticated and provides useful guiding information, but was not the lone basis for any of the recommendations provided herein. Fire behavior modeling is not an exact science and fire may burn in unpredictable ways.

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APPENDIX D

Social Aspects of Evacuation Planning

Appendix D
Social Aspects of Evacuation Planning

The following analysis is quoted/summarized from the FEMA training documents (2013) with Santa Barbara Wildland Fire Evacuation Analysis team inclusions presented absent italics:

Conventional wisdom holds that victims typically respond to disasters with shock, passivity, or panic (Drabek 1997; Perry 1983). However, social scientific studies have repeatedly demonstrated that none of these responses represents the reaction of the majority of disaster victims (Quarantelli 1954; Quarantelli & Dynes 1972; Wenger, Faupel & James 1980; Goltz, Russell & Bourque 1992; Johnson, Feinberg & Johnston 1994). Indeed, most people do not develop shock reactions, panic flight occurs only rarely, and people tend to act in what they believe is their best interest, given their limited understanding of the situation. Most people respond constructively to environmental threats by seeking information and progressing through a reasonably logical sequence of steps in determining how to cope with a threatening event. Moreover, behavior in the emergency response phase is generally prosocial as well as rational. When they seek assistance, victims are more likely to contact informal sources such as friends, relatives, and local groups rather than governmental agencies or even such quasi-official sources as the Red Cross. The picture that emerges of disaster victims is one of responsible activism, self-reliance, community support, and adaptation to the situation as best they understand it, using whatever resources are available.

The myths of irrational and antisocial behavior in disaster are not just erroneous; they can hamper the effectiveness of emergency planning by misdirecting the allocation of resources and the dissemination of information (Tierney et al. 2001). For example, expectations of panic often become the justification for giving the public incomplete information about an environmental threat or withholding it altogether. This response to the myth of panic is particularly troubling because people have been shown repeatedly to be more reluctant to comply with recommended protective actions when they are provided with vague or incomplete information in warning messages. The misconception that accurate information will cause panic sometimes leads officials to release information that actually decreases the likelihood of compliance. Consequently, an important part of the emergency planning process involves review not only of physical or biological science literature on the hazards to which a community is exposed, but also of the behavioral science literature describing the response patterns of affected populations. The behavioral record is very clear with respect to three commonly held beliefs about disaster victims' reactions—disaster shock, panic flight, and socially integrative responses, discussed below:

4.2.1.1 Disaster Shock

Following disasters, there have been documented reports of a condition characterized by a state of shock associated with docility, disoriented thinking, and sometimes a general insensitivity to cues in the immediate environment. Menninger (1952) reported on transient "apathy, confusion and disbelief" among some flood victims. Particularly in the literature of clinical and community

psychology, there have been many studies identifying cases where disaster shock symptoms have appeared. Melick's (1985) review of studies conducted between 1943 and 1983 yielded three important conclusions. First, disaster shock appears most frequently in sudden onset, low forewarning events involving widespread physical destruction, traumatic injuries, or death (Fritz & Marks,1954; Murphy 1984; Melick 1985). Wildfires are typically not sudden, often times including multiple hours or days before they effect urban areas. *Second, when the symptoms do appear, a relatively small proportion of the disaster stricken population is affected. In one of the classic studies of the phenomenon, Fritz and Marks (1954) found 14% of their random sample showed evidence of the early symptoms associated with the disaster shock. Most of those who report any symptoms of disaster shock report only mild ones.*

For the most part, people presenting disaster shock symptoms seem to be able to develop functional coping mechanisms for these disorders with minimal (if any) intervention by mental health professionals (Gist, Lubin & Redburn 1999). What is important for emergency managers to understand is that such short-term stress reactions do not interfere with disaster victims' abilities to act responsibly on their own or to follow instructions from emergency response officials. Isolated cases of immobilizing shock are reported among some people in some disasters, but such reactions are very rare and certainly cannot be described as typical of the population as a whole (Wert 1979). In summary, disaster shock is a topic of significant theoretical interest to disaster researchers and of practical relevance to mental health professionals, but ***emergency managers should be aware that this reaction occurs so infrequently that it will not impede emergency response and disaster recovery operations****.*

4.2.1.2 Panic

Perhaps the most stubborn myth about human response to disasters is the idea that panic is a major problem in emergency management. In general, "panic can be defined as an acute fear reaction marked by a loss of self-control which is followed by nonsocial and nonrational flight behavior" (Quarantelli 1954, p. 272, emphasis added). Although such panic flight is a staple of horror books and movies, it is a rare response to natural or technological disasters. It is important to also emphasize that the experience of fear is not the same as panic. People's fear of disaster impacts motivates them to take actions that will avoid those impacts. Thus, it is an overwhelming level of fear—panic—that causes people to take actions that are either nonrational (e.g., moving into areas of greater danger) or nonsocial (e.g., deliberately impeding others' self-protective actions).

Indeed, even when disaster victims are successful in avoiding death, observers often interpret any attempt to flee the hazard as evidence of panic. Yet, in light of Quarantelli's definition of panic, it is difficult to see why anyone would assume that it is anything other than rational to want to put distance between oneself and a life-threatening event such as a fire, or to move quickly to leave the vicinity of crumbling buildings in an earthquake or terrorist bombing. In

such cases, those affected are assessing a threat in the environment and coping with it (and their fear as well) by taking an immediate protective action. If unguided or not directed appropriately, they may move into an area of higher danger during a wildfire.

Of course, some examples of panic flight cannot be explained away as observer errors. While it is indeed very rare, panic flight does occur under certain circumstances. In research dating back to the early 1950s, analysis of situations in which panic flight took place indicates several conditions must occur, probably simultaneously, in order to evoke mass panic flight (Fritz 1957; Quarantelli 1981b; Drabek 1986). These are: (1) a perception of immediate and extreme danger; (2) the existence of a limited number of escape routes; (3) a perception that the escape routes are closing, necessitating immediate escape; and (4) a lack of communication about the situation. It is important to recognize that these conditions are defined in terms of an individual's perceptions or beliefs; thus, the conditions are based on what those at risk believe to be true at the time, not upon what others know after the fact. It is also important to note the distinction between the occurrence of an event and the potential for dangerous consequences resulting from that event. **These findings indicate that with clear and concise information describing the situation and the options, that pre-planned evacuation or last-resort temporary sheltering in a hardened and protected structure for a short duration will be safer than attempting to flee in front of a nearby, aggressive wildfire, that residents will be able to process the information and weigh the risk appropriately**.

In summary, panic has sometimes been documented in response to both natural and technological disasters, but it is not a common reaction to any type of disaster. When panic flight is observed, it seems to involve a relatively small proportion of the people exposed to the threat and does not usually persist for any period of time. Emergency managers should know that panic does not always materialize even in cases where conditions support its emergence.

4.2.1.3 Socially Integrative Responses

One of the most common misconceptions is that there is an undifferentiated "public" when, in fact, there are many population segments that differ in their hazard knowledge, roles, and available resources. In particular, emergency managers must distinguish among residents, transients/visitors*, and special facility populations because these population segments differ in their willingness and ability to evacuate (Drabek 1996; Urbanik 2000).* The City of Santa Barbara includes all three population types. *Residents are those who live or work in the risk area, whereas transients*/visitors *consist primarily of those who stay in hotels/motels— although day visitors can be a significant concern in rapid onset disasters. However, day visitors are unlikely to be a problem for Wildfires and other hazards with forewarning because they are likely to leave very early,* not being tied to a residence, possessions, or pets. *Special facilities include schools, hospitals, nursing homes, and jails. Special facility populations typically must be*

analyzed separately because their patterns of warning and evacuation are very different from those of residents and transients (Urbanik 2000).

4.2.1.4 Warnings

It is commonly assumed that authorities are the first to warn risk area citizens and also that authorities provide almost all the information about a disaster. However, as indicated by the Protective Action Decision Model, people also rely substantially on the news media, peers, and environmental cues to determine if disaster impact is likely to affect them. People also observe the behavior of others (peers evacuating) to assess the need for protective actions such as evacuation. They also seek to confirm warnings, regardless of the initial warning source, to verify the information they have received, and to work out the logistics of response (mode of transportation, route of travel, shelter destination). Indeed, in a major disaster, the volume of calls into and within the impact area can overload the available telephone circuits.

Whether people receive a warning and when they receive one has been the subject of substantial research over the past five decades (Lindell & Perry 2004). Warning sources differ in their accessibility and these differences can vary by community. Technological advances, including Reverse 911 the internet, e-mail, social media, websites, Twitter, Facebook and personal cell phones, have provided a new and effective means for warning large quantities of people in a short time frame.

In part, the extent to which any source provides the first warning—and the rate at which the entire population is warned—depends on the communication channels each source uses. Lindell and Perry (1992) summarized the available warning mechanisms as face-to-face, route alert (loudspeaker broadcast from a moving vehicle), siren, commercial radio and television, tone alert radio (which only broadcasts a warning within the home after receiving a special tone from the National Weather Service), telephones, and newspapers. These warning mechanisms differ with respect to their precision of dissemination, penetration of normal activities, message specificity, susceptibility to message distortion, rate of dissemination over time, receiver requirements, sender requirements, and feedback (verification of receipt). Sources using channels that have more rapid dissemination rates (including Reverse 911) *will produce steeper warning curves*, resulting in a larger number of people alerted within the critical initial time period that aids in providing the early evacuation that is the basis of the "Ready, Set, Go!" evacuation basis in Santa Barbara.

4.2.1.5 Personal Risk Assessment and Response

Consistent with common assumptions, people do rely on authorities for information about what protective actions to take and when to take them. However, they also rely on the news media, peers, environmental cues, and their own preexisting beliefs about appropriate protective actions. Drabek's (1996) research suggests transients are warned at a faster rate than residents and also prepare to evacuate more rapidly than residents, but there are no quantitative data on

the size of this difference. Consequently, Lindell et al. (2002a) derived warning and preparation time distributions for this population segment from their data on residents. It is crucial for emergency managers to understand that people confronted by a disaster tend to respond in ways that seem logical to them given their limited information about the situation and the constraints that limit their options.

The second basic principle is that people generally experience fear—not debilitating shock or panic. Fear is a normal human reaction to extreme environmental conditions that arises when people expect that they or their loved ones are personally threatened by forces that are high in certainty ("it definitely will happen"), severity ("it will be very bad"), immediacy ("it will be very soon"), and duration ("the effects will last a long time"). Fear rarely is so overwhelming that it prevents people from responding, but does impair people's ability to effectively reason through complex, unfamiliar problems. Fear is especially high when people lack information about the personal consequences of hazard exposure. This situation is considered less of an issue in Santa Barbara due to the frequency of wildfires and the recent history of the dangers along with public outreach efforts. This situation should be further addressed through a robust education and training campaign that is a coordinated effort including the City Fire Department, law enforcement, Santa Barbara County Fire and County OES as well as other local law enforcement agencies so that information disseminated and people disseminating that information will provide an official, informed voice during wildfire events that people will feel comfortable responding to in a rational manner.

It is important for emergency managers to address people's concerns directly. This is done most effectively through a strategy of information dissemination. Emergency managers should not try to give people a university education on the topic. Instead, they should provide clear, direct, and relevant information about the hazard agent and its potential personal consequences. In addition, people should also be told what the authorities are doing to provide protection from the threat and what sources they can contact for additional information. Contrary to popular fiction, the path to fear reduction is through providing—not withholding— information (Quarantelli & Dynes 1985).

The third basic principle is that people take action when they think they are at risk. The initial response to a threatening situation might be to seek additional information, but those who ultimately conclude they are at risk will take protective action. It is therefore important that official warning messages include recommended protective actions. If authorities do not provide recommended actions, people will take action anyway—implementing the most appropriate actions they know (or hear about from other sources such as the news media and peers) with whatever resources are available to them.

In summary, a message not accompanied by guidance for protective action fails to provide opportunities to reduce fear. In providing protective action recommendations, it might also be necessary to briefly explain why the action will be effective. Tell people why quarantine at home

will reduce their exposure to smallpox, or why climbing a canyon wall will provide better protection from a flash flood better than driving their cars out of the canyon, or why taking potassium iodide will reduce radiation exposure damage. Such information accomplishes two important functions. First, it gives people a rationale for complying with official instructions; and second, it discourages people from inventing other apparently reasonable alternative actions that might or might not ultimately be protective.

The fourth basic principle is that some of those at risk will comply with authorities' recommendations, but their compliance is rarely automatic. The level of compliance is contingent upon a variety of other factors; it varies by information source, message content, and receiver characteristics as well as situational characteristics such as threat familiarity and apparent urgency for response (usually lead time until impact). In cases such as seasonal floods, where risk area residents are likely to be very familiar with the threat and its environmental cues, compliance with protective action recommendations from authorities is likely to be lower than with less familiar threats such as toxic chemicals. When those at risk are familiar with threat agents, they are more comfortable in their own ability to understand the danger, when and where it will materialize, and what should be done about it. Consequently their personal assessment of the situation might cause them to reject official recommendations, or at least thoroughly examine the basis for of such recommendations. **Therefore, public education and outreach needs to be consistent and factual regarding the City's wildfire threat. Vulnerable populations/areas should be the focus of the effort and seek to raise the population's awareness level and understanding such that their decision making process is heavily influenced in a direction that is consistent with the City's evacuation pre-planning.** Santa Barbara is positioned at the fore-front for planning for such an event. The next logical step for the City to take is actively promoting an understanding in the general public of the distinction between relocation and evacuation so that the better informed population would make even better decisions with respect to "going early". A side benefit would be a recognition of the relatively simple and inexpensive actions that could be taken by many individual property owners to improve survivability if temporary refuge was necessary. Another possible outcome would be analyzing the existing public (and private) buildings to see which ones might legitimately be utilized for refuge with minor improvements.

Where threat familiarity is low, for example with some hazardous materials or at the initial eruptive activities of long quiet volcanoes, there is little or no personal experience or knowledge of the threat. In such cases, people are more likely to accept (in the response period) the assessment of authorities. Also, people tend to comply more readily when the warning claims that impact is imminent or the threat is visible, simply because there is no time for reflection. This is a research-based conclusion from the disaster literature, not wishful thinking by emergency managers (Lindell & Perry 1992). According to Dynes's (1983) emergent human resources model, emergency managers should assume that many risk area residents have disaster-relevant competencies, just as local emergency response organizations do. In addition,

emergency managers should also rely on existing patterns of social and task behavior rather than expect them to learn new ones. Finally, emergency managers should also utilize existing authority structures and communications channels (Dynes 1994). In particular, they need to understand what percentage of the population can perform different emergency response actions and what are the resources (communications devices, information, and vehicles/equipment) needed to respond effectively. Accordingly, emergency managers need to avoid stereotyping all persons as being identical. Instead they must recognize the differences among persons. Moreover, emergency managers must avoid the error of assumed self-typicality; they must recognize that many persons are not self-reliant who have reliable cars, can (and will) evacuate when they are advised to do so, and have credit cards to pay for their evacuation expenses.

Santa Barbara evacuation pre-planning should focus on providing residents and visitors, especially in vulnerable areas, with important fire safety information so that if one of the typical, most likely scenarios occurs or even if the worst case scenario were to occur, citizens would have at least a baseline understanding of their responsibilities to ensure their safety and how the City will assist in that process. *In times of extreme stress, people look to government for guidance. When the agent of destruction is unfamiliar or intangible, or when the consequences appear overwhelming, people's expectations of protection and help are especially pronounced. Particularly during the response phase, people appear to carefully comply with directions from police and fire personnel and sometimes other uniformed personnel.*

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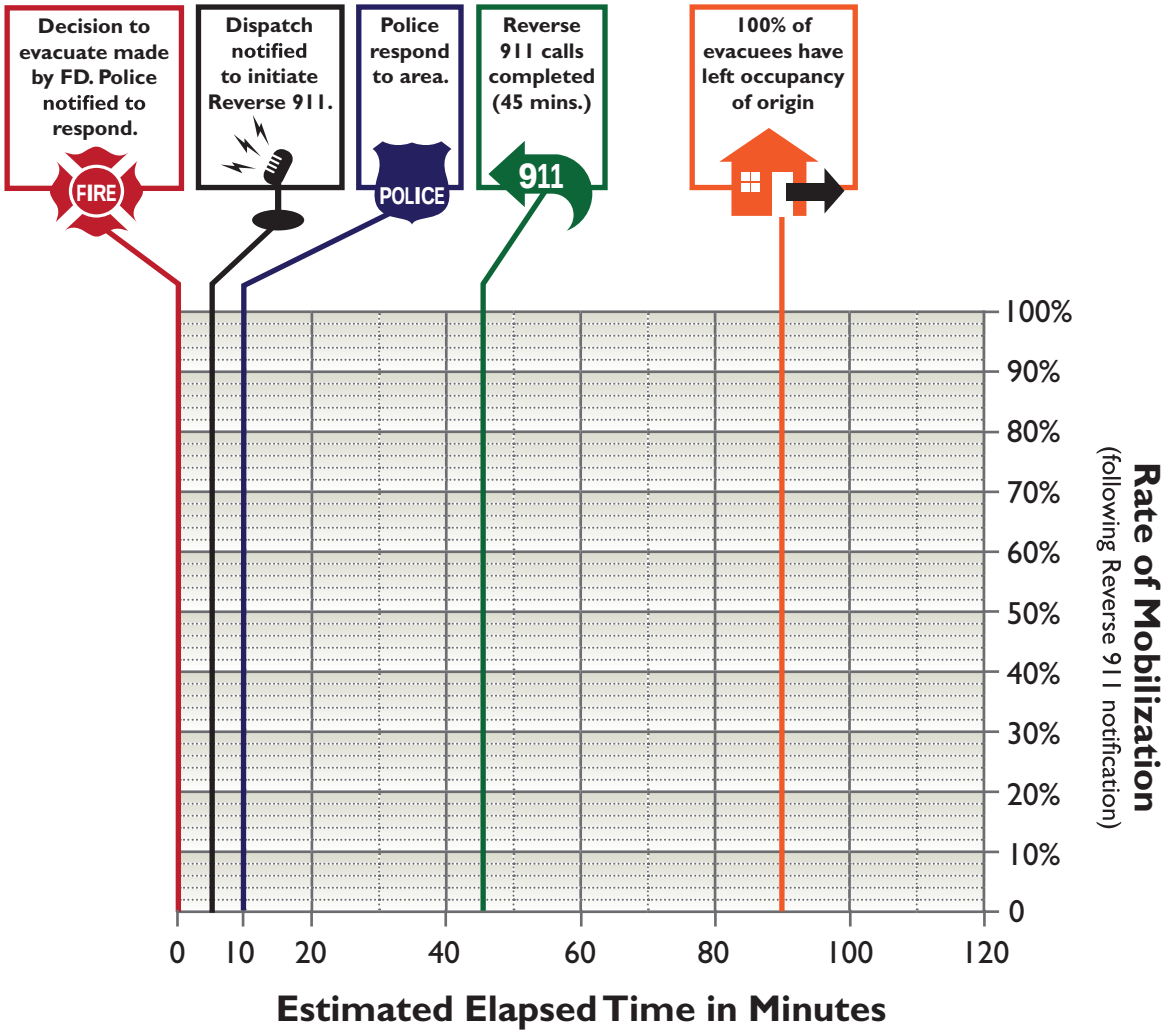
APPENDIX E

Evacuation Time Frame Chart

EVACUATION COMPONENT TIME FRAME ESTIMATES



Estimated elapsed time from decision to evacuate by Fire Department to completion = 90 minutes (approx. 1 1/2 hours). Takes estimated time of up to 45 minutes after notification until all have left occupancy of origin.