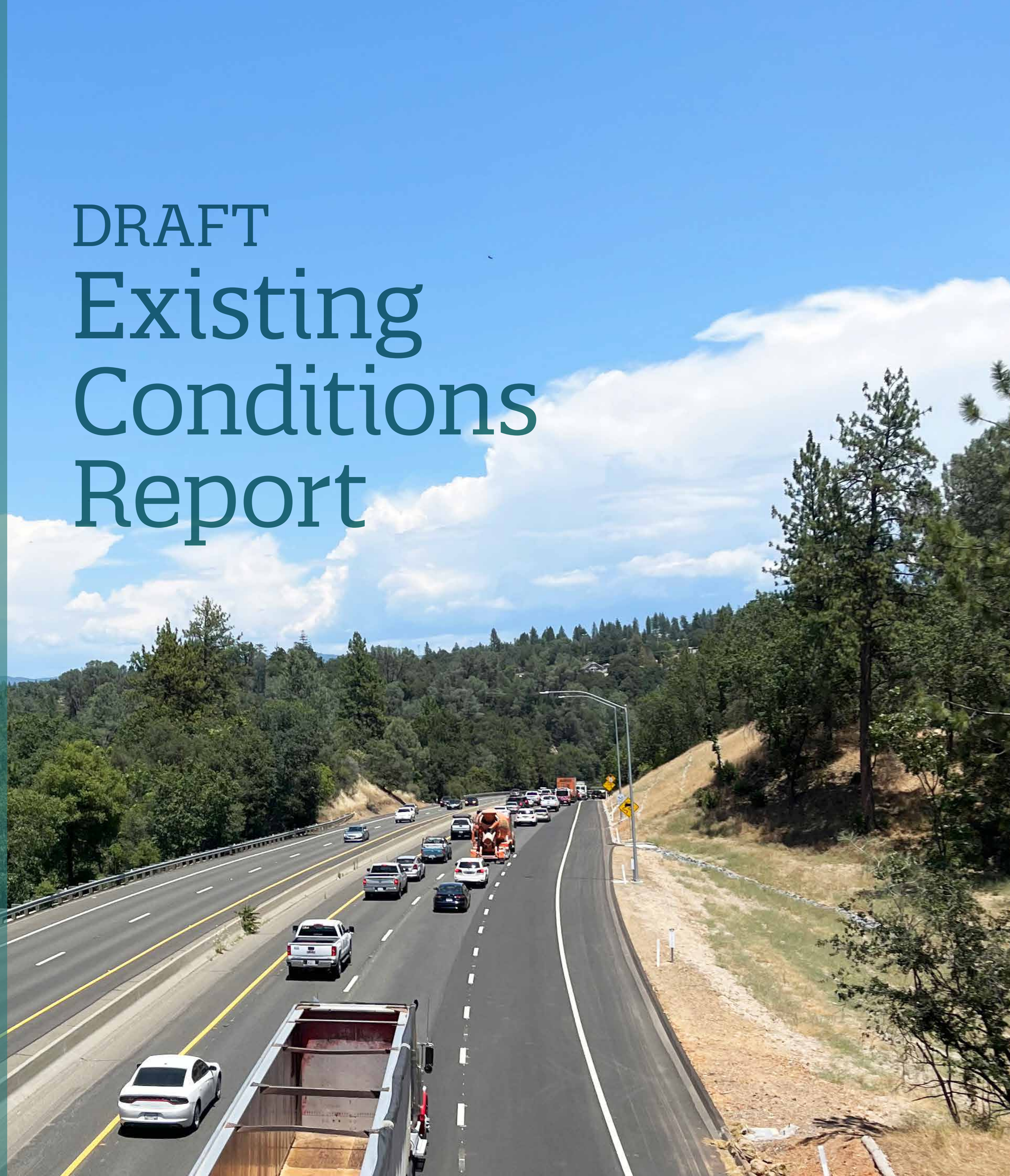
Greater Placerville

WILDFIRE EVACUATION PREPAREDNESS STUDY

Envisioning a Fire Adaptive Community

DRAFT Existing Conditions Report



EL DORADO COUNTY TRANSPORTATION COMMISSION

MARCH 2023
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Acknowledgments

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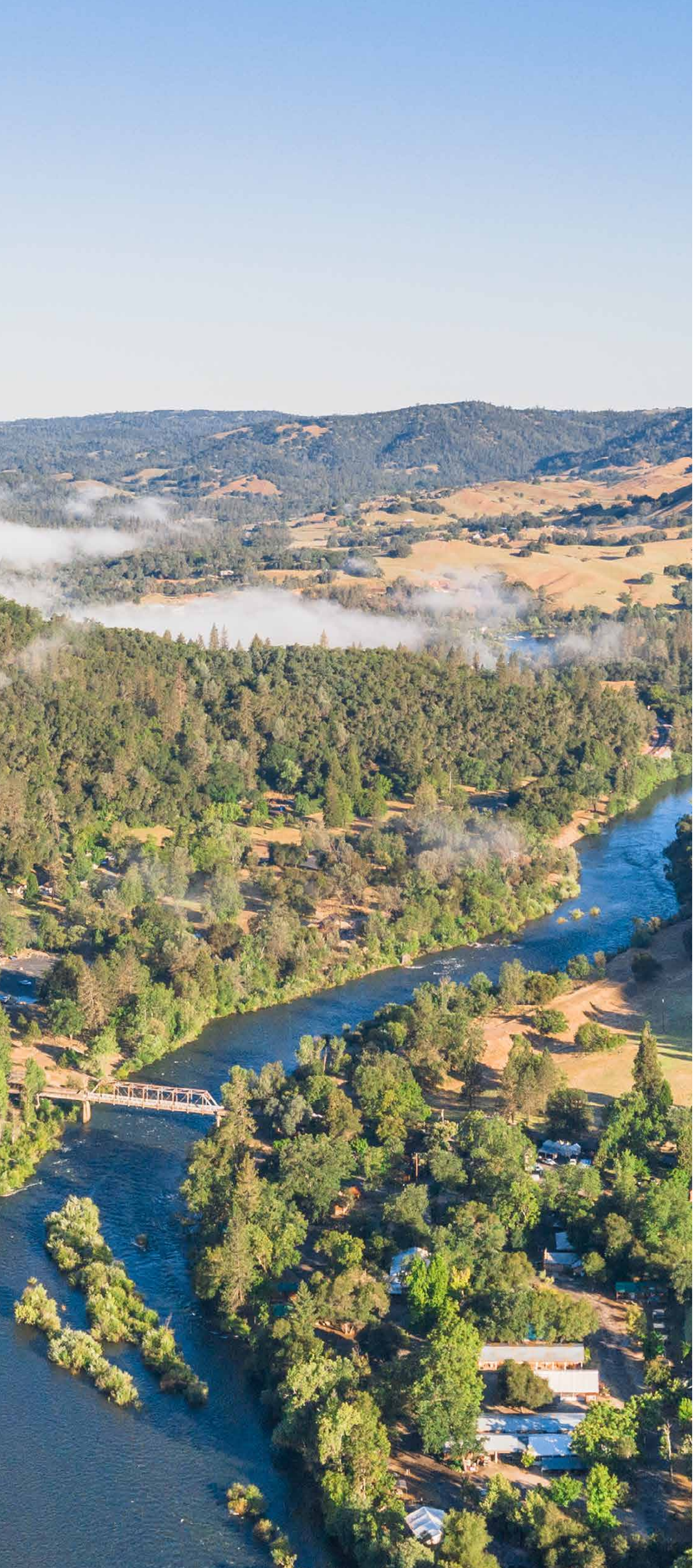


Introduction

THIS REPORT DOCUMENTS THE EXISTING CONDITIONS WITHIN THE PLACERVILLE PROJECT STUDY AREA (PPSA), AND IS THE FIRST PIECE OF THE GREATER PLACERVILLE WILDFIRE EVACUATION PREPAREDNESS PLAN. THE PURPOSE OF THE GREATER PLACERVILLE WILDFIRE EVACUATION PREPAREDNESS PLAN IS TO PROVIDE A GUIDE THAT ALLOWS PLACERVILLE AND EL DORADO COUNTY TO REACT QUICKLY, AND BE PREPARED FOR, FUTURE DESTRUCTIVE WILDFIRE EVENTS WHICH ARE EXPECTED TO OCCUR GIVEN THE SIZE AND FREQUENCY OF WILDFIRES IN CALIFORNIA IN RECENT YEARS.

This existing conditions report provides a baseline which will be used to support subsequent analysis and understand how future improvements can be expected to impact the community. The report includes the following subsections:

- Physical Geography, Terrain, Climate, and Wildfire Hazard
- Demographics and High-Hazard Communities
- Transportation Network
- Utility Network
  - Communication Network
  - Water Network
- Policies and Plan Review

This report is a resource for agencies, including the City of Placerville, El Dorado County, California Department of Forestry and Fire Protection (CAL FIRE), California Department of Transportation, United States Forest Service, Pacific Gas and Electric Company (PG&E), El Dorado Irrigation District, and the public.

Study Area Definition

The study area is in El Dorado County approximately 40 miles northeast from the Sacramento metropolitan area. The Placerville Project Study Area (PPSA) is located on the western slope of the foothills of the Sierra Nevada mountain range and bisected by US 50 from east to west and CA 49 from north to south. Figure 1 shows the project study area.

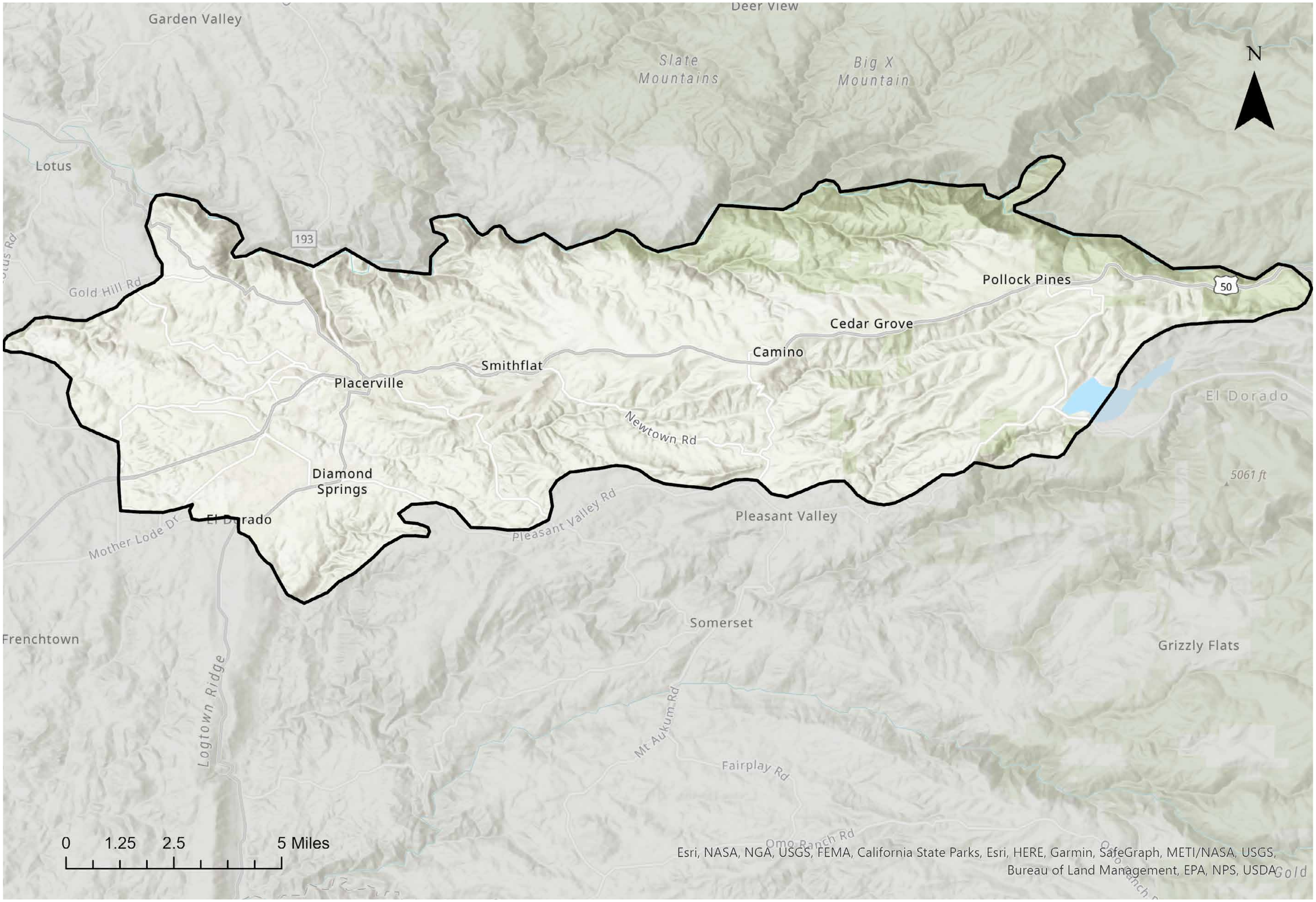
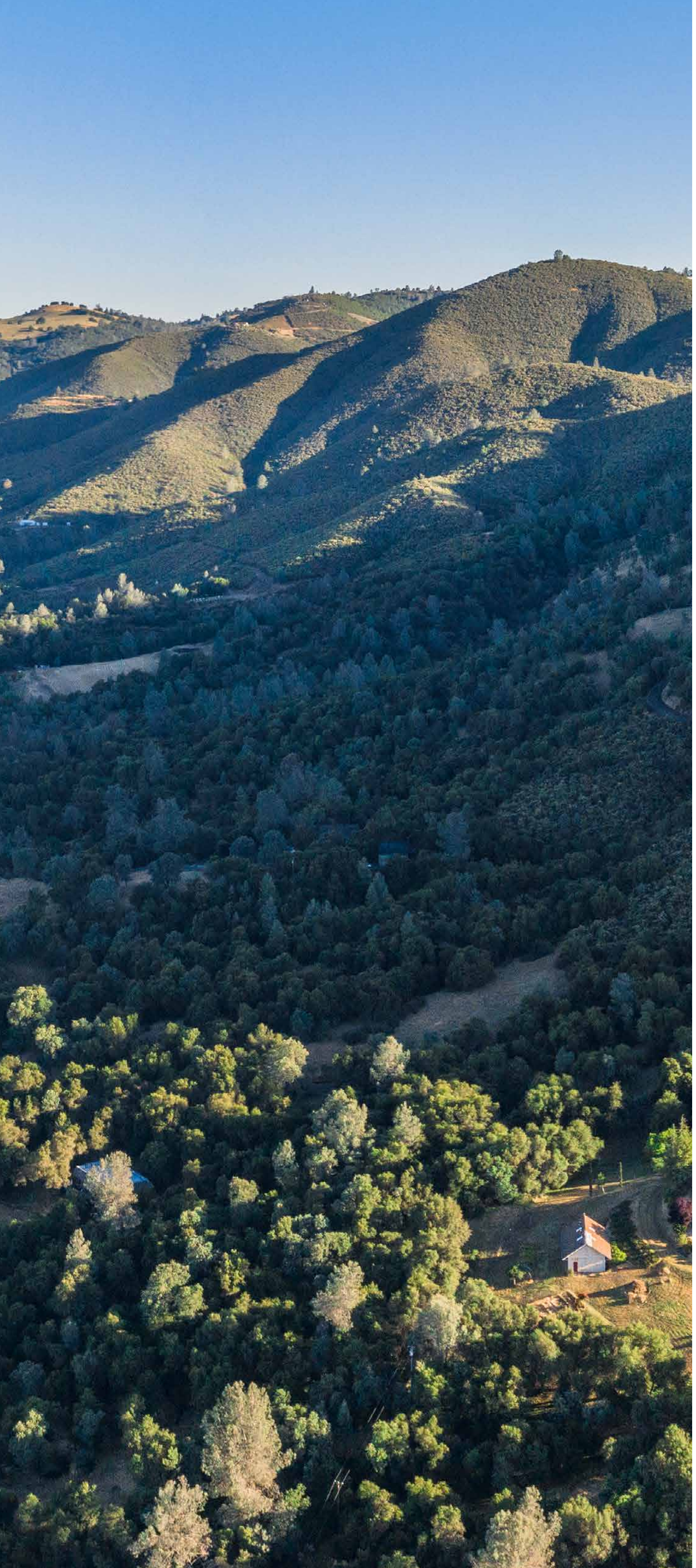


FIGURE 1. STUDY AREA



Physical Geography, Terrain, Climate, & Wildfire Hazard

THE PHYSICAL GEOGRAPHY, TERRAIN, AND CLIMATE ARE ALL CRITICAL ELEMENTS THAT INFLUENCE THE WILDFIRE HAZARD WITHIN THE GREATER PLACERVILLE REGION. THIS SECTION SERVES AS AN EXECUTIVE SUMMARY OF THE GREATER PLACERVILLE WILDFIRE EXISTING CONDITIONS REPORT PREPARED BY WILDFIRE SPECIALISTS, TSS CONSULTANTS, INC. THE FULL REPORT CAN BE FOUND IN THE APPENDIX.

The goal of the existing condition wildfire assessment is to provide information on the wildfire hazard current conditions in the Placerville Project Study Area (PPSA) that can be used at a regional planning level to enable the development of projects and policies that facilitate wildfire evacuation preparedness. The results of the wildfire assessment existing conditions analysis provide the initial stage of information gathering that future multi-stage planning efforts can build off to create more detailed specific-area focused analyses and generate information that would be needed to support tactical-level efforts to reduce wildfire hazard.

Approach Basics

Wildfire is a phenomenon that is controlled completely, from its ignition moment to it being brought under control, by the laws of physics, and perhaps more specifically by the laws of thermodynamics. For a fire to start there has to be materials, typically referred to as “fuels”, that are in a condition where the process of combustion can be started. For a fire to spread, fuels that are in a combustible condition must be available. And lastly, for a fire to be extinguished, combustible materials in the path of the wildfire must be either removed altogether or rendered into states where they are no longer combustible.

The situation where combustible materials are present and become involved is a primary mechanism by which wildfire can ignite and potentially evolve into the catastrophic events, are now being experienced more frequently throughout California. Besides fuel conditions, other basic mechanisms that affect wildfire behavior include the influence of terrain conditions and wind on the rates of wildfire advance, intensities, and residence time at a particular location. Given a constant supply of fuel, wildfire advances at a greater rate as terrain slope increases and in directions that are in uphill alignment. Differing slope aspects (e.g. south-facing slopes versus those that are north-facing) will have different micro-climatological regimes that can result in different vegetation formations, which then define the fuel models present.

Two characteristics of wind have direct mechanistic influences on wildfire behavior:

1. Direction
2. Speed

Absent wind forces, wildfire will advance in directions where fuels are available and at rates set by the combustion process. In the presence of wind, wildfire will 1) move in the direction in which the wind is blowing, providing appropriately combustible fuels are available, and 2) at rates that exceed that of the basic combustion process.

This study will focus on the setting elements that have direct mechanistic influences on wildfire behavior and its associated level of hazard.

Individual Setting Elements (Terrain, Wind, & Vegetation)

TERRAIN CONDITIONS

PROJECT AREA TOPOGRAPHY

The topography of the study area is a combination of west-to-east oriented plateaus in the western portion of the project area, deeply incised rivers and streams, and moderately dissected terrain dominated by multiple ridges also running in west-to-east orientations. Elevation varies by as much as 3000 feet across the study area ranging from 1,400 feet near the west boundary and 4,400 feet along the eastern boundary.

In order to provide a visual tool more useful at planning levels, the slope analysis has been “smoothed” into three slope classes that typically relate to the use of mechanized equipment and its use in the types of vegetation management required for fuel treatment. The geographical distribution of the three types within the study area are shown in Figure 2.

ASPECT

Aspect, or the direction in which terrain is facing, is important as it has an effect on the vegetation (and associated fuel models) that are present.

In the Placerville area the north and easterly facing slopes are typically higher in moisture regimes and cooler. The woody vegetation types are typically denser conifer forest and mixed conifer/hardwood woodland land types whereas the south and western facing slopes are typically drier and warmer and the vegetation types are more open hardwood woodlands, shrublands, and grasslands. Figure 3[1] shows the geographical distribution of the aspects within the study area.

1 *IFTDSS. January 3, 2023.*

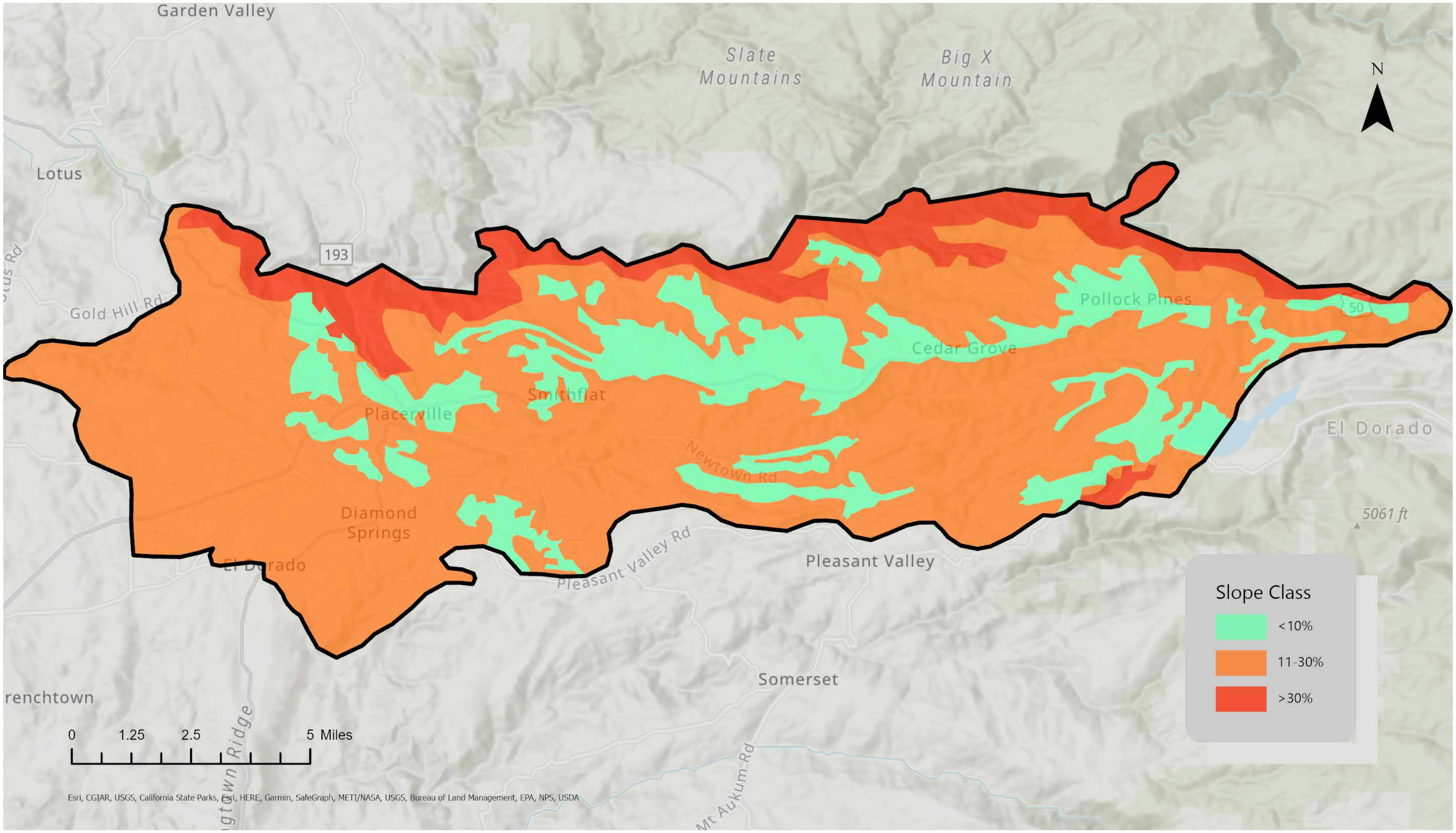


FIGURE 2. GEOGRAPHICAL DISTRIBUTION OF SMOOTHED SLOPE CLASSES

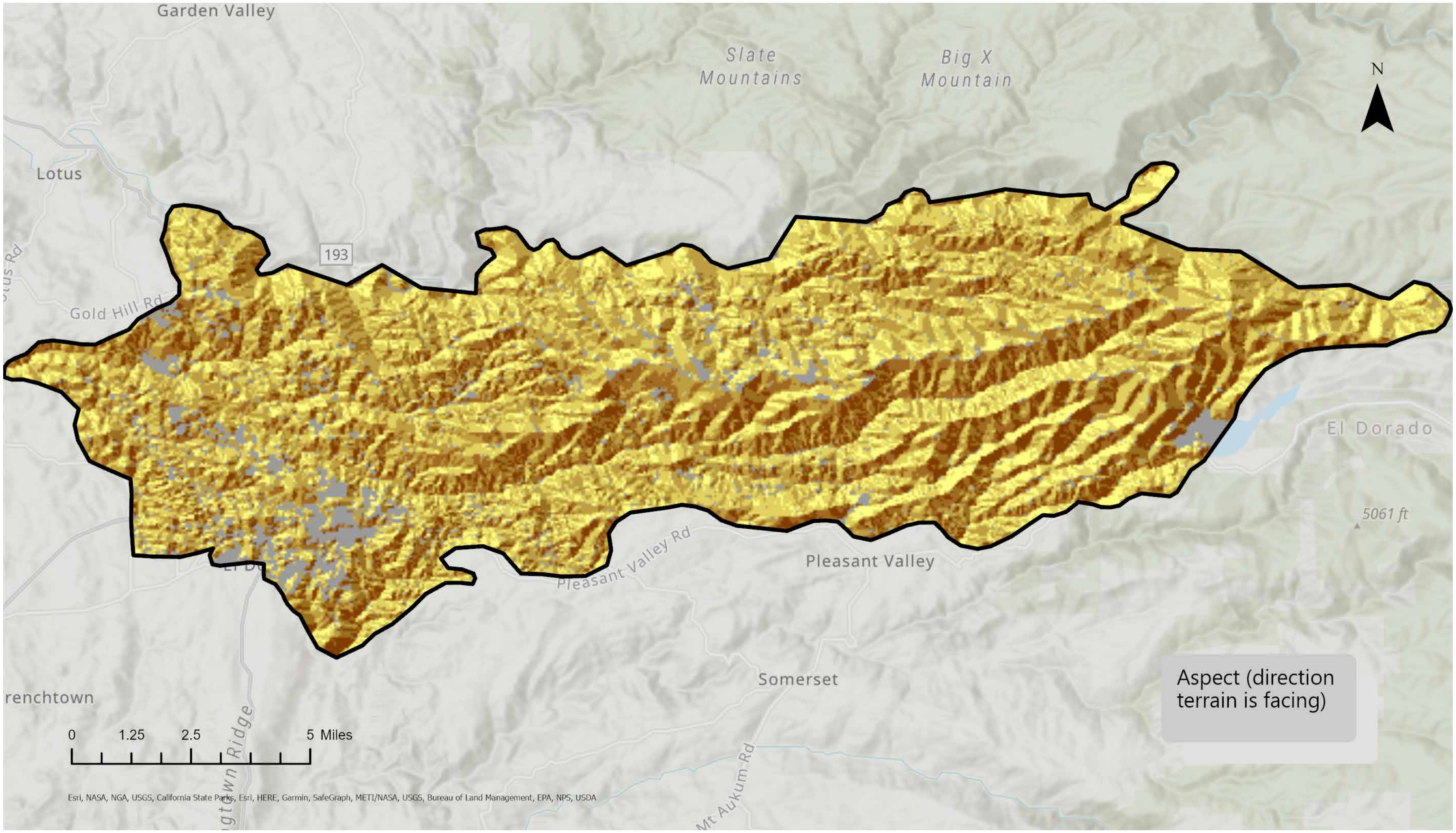


FIGURE 3. GEOGRAPHIC DISTRIBUTION OF ASPECTS

WIND INFLUENCES

Winds are significant influencers of wildfire behavior. In generating wildfire hazard assessments there are typically three categories of wind whose influences on wildfire behavior can be significant: Prevailing, diurnal, and extraordinary. Details regarding these categories of wind, their prevalence and nature of their influences are discussed in subsections below.

It must also be noted that wind, which has significant influence as an individual mechanistic influencer, can also act in concert with other setting conditions that can either exacerbate or minimize its influence.

PREVAILING WINDS

Knowledge of prevailing wind directions and speed is very important when determining 1) the pathways wildfire will take when crossing a landscape, 2) its rate of advance and, 3) the physical mechanisms involved in its advance.

LOCALIZED FLOWS

Localized wind flows, typically referred to as diurnal winds, also have the potential for affecting wildfire behavior within a daily cycle. These winds are generated primarily as a result of differential warming and cooling cycles of the near surface air mass and their directional patterns are established by topography. In general, as the near-surface air mass warms during the day the air rises in up-slope directions, and conversely, moves downhill as the air mass cools in the evening and night time. USDA Forest Service simulation program WindNinja[2] was used to model diurnal wind patterns, directions and velocities for conditions on a specified date and time.

EXTRAORDINARY WINDS

In an evaluation of potential wildfire behavior, and its associated hazard levels, resulting from the potential combinations of prevailing winds and topographic influences (both aspect and slope), it was concluded that there were not many locations within the study area that exhibited very high, or extreme, hazard levels of being involved in a catastrophic wildfire event. However, the fact that the 2021 Caldor Fire occurred in close proximity to the study area (involving essentially the same types of setting features and conditions) indicated that such a high magnitude and destructive event was possible.

An initial comparison of the bearings recorded during the five-day Caldor Fire ignition and "run-up" period with the bearings for area weather stations showed no significant anomalies. Thus, it was concluded that the movement pattern of the Caldor Fire was not significantly influenced by prevailing winds. Further analysis regarding the influence of diurnal winds drew the same conclusion.

In the principal southwest-to-northeast run of the Caldor Fire there was a gain in elevation of approximately 5,000 feet indicating that there would be some slope-related accelerations of the wildfire front. However, the overall rate of advance was indicative of a wind-driven event, and the question was, given the predominance of east-to-west and south-to-north prevailing winds, where did the strong southwest-to-northeast wind component come from? The most reasonable conclusion was an extraordinary wind in the form of a firestorm. The Caldor Fire was believed to have its origin point on the Middle Fork of the Consumnes River and the ability to move uphill (40 to 60 percent slopes) into heavy forest formations on a southwest-facing slope. There was also a strong possibility of a prevailing southwest wind increasing the uphill burn. This combination of uphill runs, trailing winds, and heavy forest formations most likely contributed to a significant increase in fire intensity and the development of firestorm conditions.

The combination of prevailing winds, topographic parameters and vegetation type/fuel models similar to those experienced in the Caldor Fire do exist within the study area; primarily in the north-eastern and eastern portions on lands under the jurisdiction of the USDA Forest Service. It is recommended that an additional and more detailed study of the combined wind, topography, and fuel model patterns within the study area be completed to assess the firestorm development potential.

2 USDA/FS. Rocky Mountain Research Station, Missoula Fire Science Laboratory. Accessed 12/03/2022.

VEGETATION CONDITIONS

For classification of existing vegetation, a set of U.S. Forest Service standards and procedures has been established at the national and regional levels. The CALVEG classification system conforms to the upper levels of the National Vegetation Classification Standard (USNVC) hierarchy as it currently exists. The full report documents the natural vegetation alliance characterizations within the study area. In addition to these naturally occurring vegetation alliances, consideration must also be given to the various agricultural uses and other surface conditions/land use types that characterize the project area as their differences can be important in regard to the nature and intensity of wildfire that they could generate. The wildfire behavior modeling process uses the vegetation type as an input. Through additional study, the relationship between a unit described by its vegetation type and its physical influence on wildfire behavior is established through a process referred to as a *crosswalk*.

WILDFIRE BEHAVIOR MODELING PROGRAM USED FOR THIS ASSESSMENT

The modeling program selected for use in the assessment is referred to as LANDFIRE (Landscape Fire and Resource Management Planning Tools or "LF"). LF is a shared program between the wildland fire management programs of the U.S. Department of Agriculture Forest Service and U.S. Department of the Interior, providing landscape scale geo-spatial products to support cross-boundary planning, management, and operations. The LF Program provides, on a national scale, over 25 geo-spatial layers (e.g. vegetation, fuel, disturbance, etc.), databases, and ecological models that are available to the public. The LF application is offered as a planning tool in the Interagency Fuels Treatment Decision Support System (IFTDSS). The IFTDSS is a web-based application designed to make fuel treatment planning and analysis more efficient and effective. IFTDSS provides access to data and models through one simple user interface.

Special Features and Conditions

ROADS

As an important component in current setting conditions within the study area, an assessment of the level of hazard that a subject road would lose its ability to function if involved in a wildfire event needed to be done. In this context "loss of function" (LOF) pertains to any road, or individual segment thereof, that loses it's ability to provide, 1) access for emergency wildfire response actions, and/or, 2) use for the purpose of evacuation. A general view of the roads evaluated, color-coded by Functional Classification System (FCS) classification, is presented in Figure 4.

COMMUNITIES VULNERABLE TO ELEVATED LEVELS OF IMPACTS FROM WILDFIRE

Some communities, due to their location and nature of their makeup, can be more vulnerable to adverse impacts should they be involved in a wildfire incident. Principal characteristics that distinguish these more vulnerable communities from others are:

- **Direct or reasonable contact with wildland conditions –** In this analysis wildland conditions are defined as being only those directly related by way of their influence on wildfire behavior.

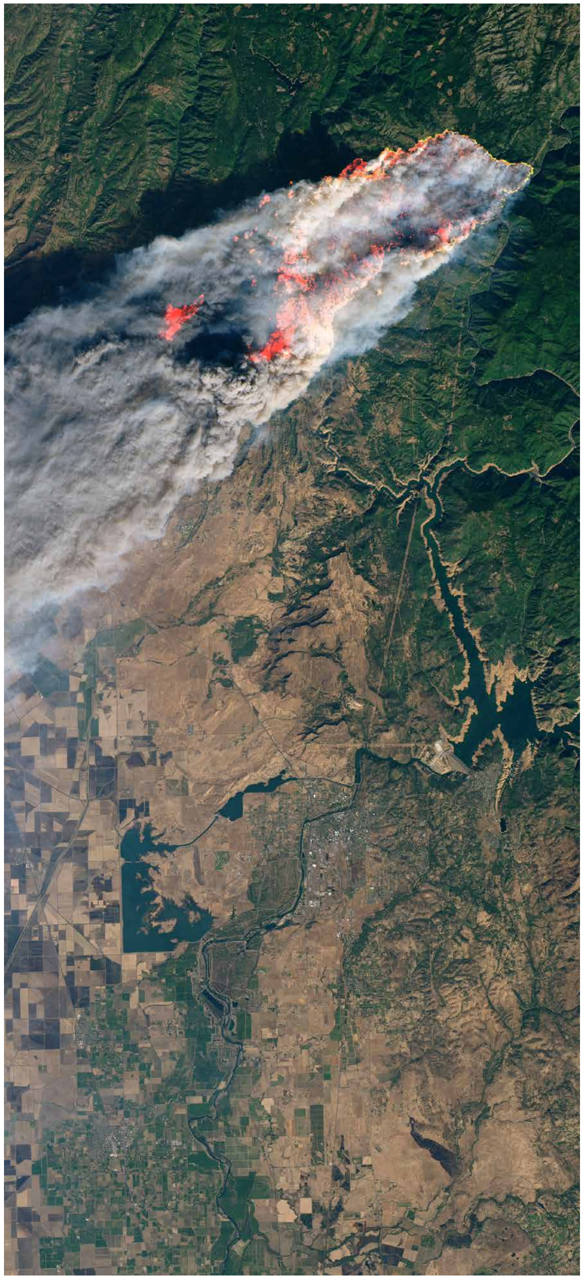
- **Have a single point of road access (some communities could have an additional one-road access point based on other criteria conditions) –** As a wildfire event is evolving the most critical operational elements are 1) getting to the location in order to gain control over the wildfire, and 2) moving any involved citizens out of harm's way via evacuation.

- **What is the nature of the wildfire behavior-related conditions that are within, or directly adjacent to, the community boundaries –** It is important to understand what type of wildfire fuels are present, how they are distributed within the community boundaries, and how critical infrastructure could be adversely impacted.

Using the three interpretation criteria described above, a study was completed for the study area in order to identify and map communities vulnerable to elevated levels of impacts from wildfire. The results of this analysis are present in Figure 5.

HIGH-TENSION ELECTRICAL LINES

High-tension electrical line systems are considered a sensitive feature because they can be both very vulnerable to loss of function should they be involved in a wildfire event and also be a significant source of wildfire ignition. Figure 6 shows the location of the identified high- tension transmission line system.



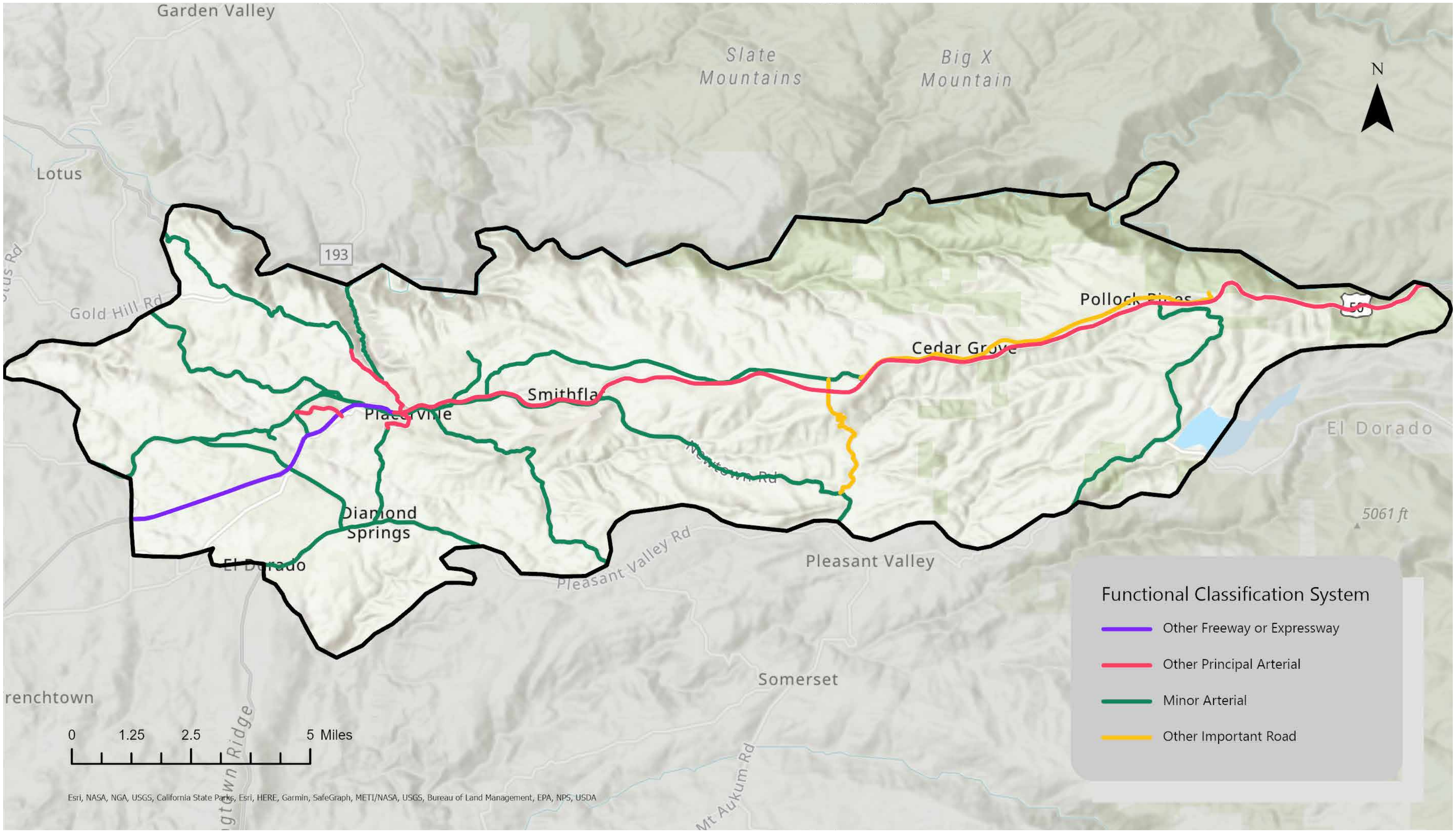


FIGURE 4. ROADS ADDRESSED IN THE LOSS OF FUNCTION ASSESSMENT

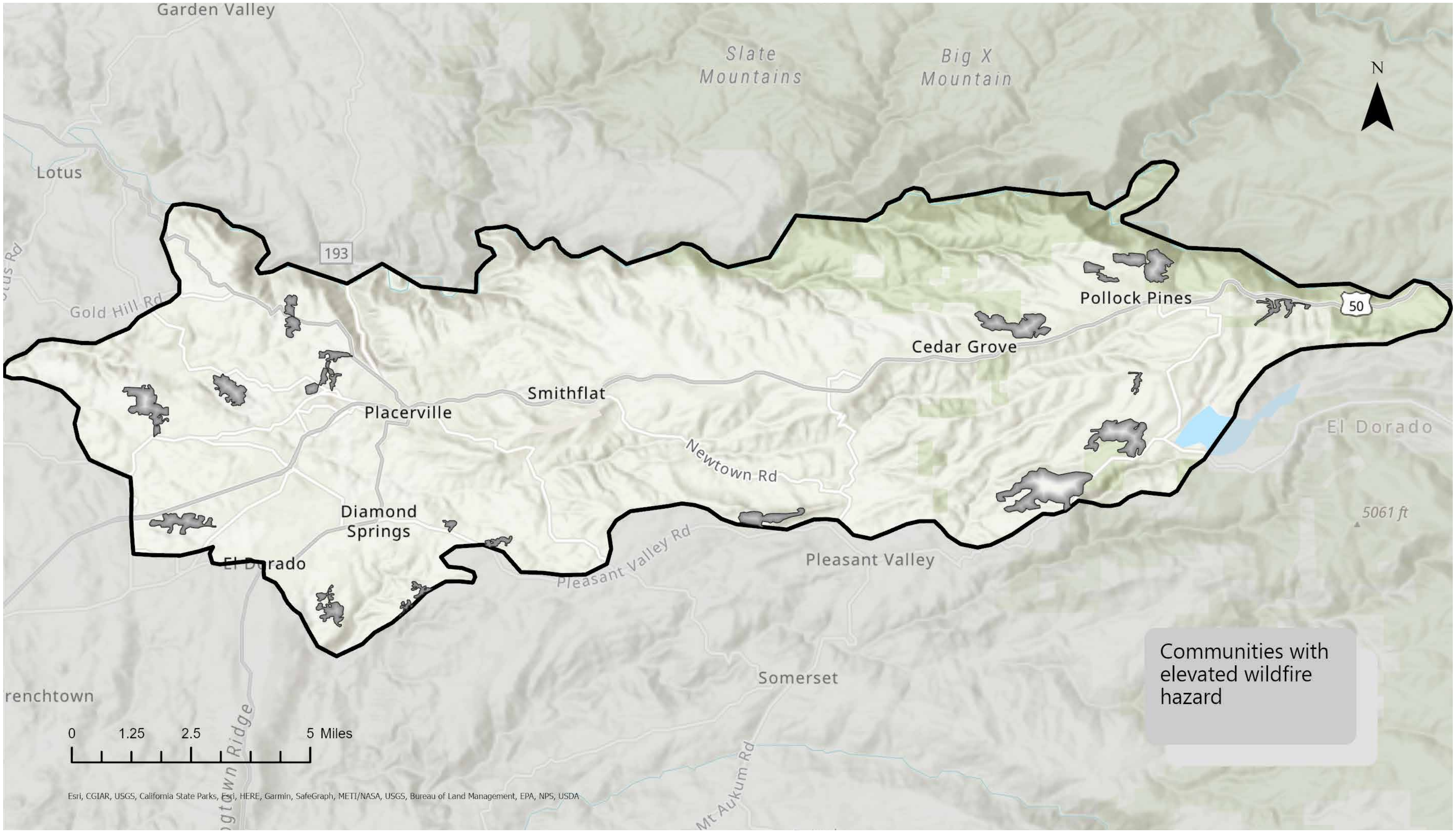


FIGURE 5. GEOGRAPHIC DISTRIBUTION OF THE 25 COMMUNITIES WITH ELEVATED WILDFIRE HAZARD

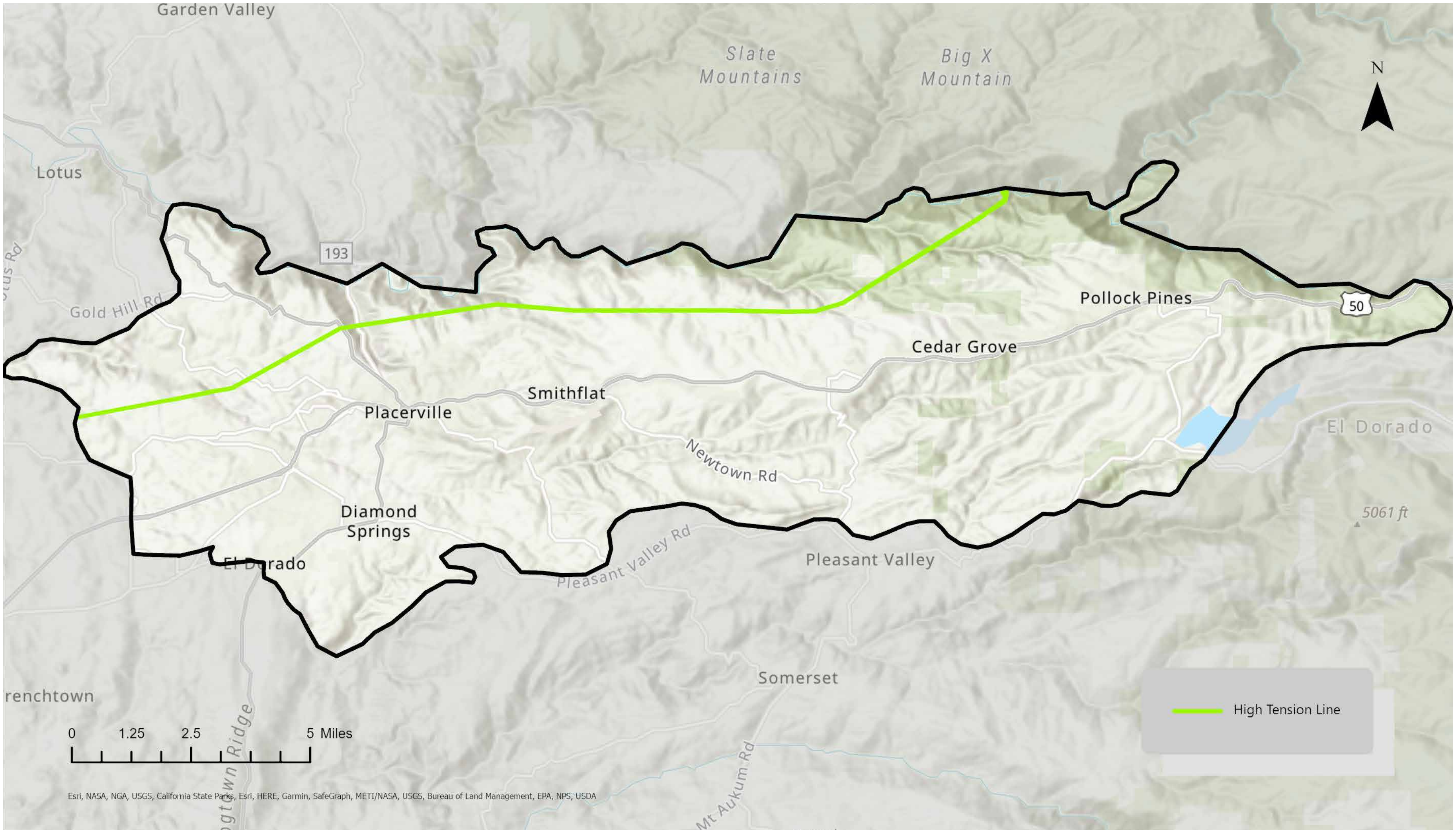


FIGURE 6. ALIGNMENT OF HIGH TENSION POWERLINE TRANSMISSION SYSTEM

Estimation of Wildfire Hazard on a Regional Scale

This regional assessment of wildfire associated hazard levels was completed in two parts. The first addressed hazard contributions arising from each setting component independent of any others and the second addressed situations where the hazard was the product of various combinations of the setting components.

ASSESSMENT OF INDIVIDUAL SETTING COMPONENTS

TERRAIN SLOPE

The mapped slope category locations provided a primary criterion for assigning hazard levels. The primary considerations in making these assignments included 1) the nature and intensity of the fire behavior that could result if a fire event occurred on lands in each category, 2) the resistance to gaining control over the wildfire, and 3) mitigation management implementation constraints. For each category the following discussions describe the 1) specific location within the study area a category is located and 2) provide technical detail supporting the hazard level determination.

- **Low Terrain Slope –** Located primarily in the central portion of the study area, with a west-to-east alignment, the category occupies 9,496 acres (12 percent of the FPSA) and is color-coded in Figure 2 with cyan shading. The category occupies the broader basin along the Highway 50 alignment and narrower valley bottoms and is closely associated with urban, suburban, and agricultural land uses.
- **Moderate Terrain Slope –** Lands in this category are located where slope classes begin to constraint urban, high-density suburban, and agricultural land uses. Also found on lands in this category is a high proportion of the "communities vulnerable to elevated levels of impacts from wildfire". The 54,150-acre (68 percent of the study area) category clearly predominates the surface occupation.
- **High Terrain Slope –** The lands comprising this category occupy 15,549 acres (20 percent of the study area) and significant blocks are found primarily on the southern flanks of the South Fork of the American River and in the Sierra Springs area. These lands are generally considered "wildlands" and the sole development features include utility infrastructure and roads.

A weighted assessment of the study area resulted in the moderate category being applied to the full study area for the Wildfire Hazard (WH) level assignment.

ASPECT

For the purpose of assigning a study area-wide WH level, aspect was analyzed in a manner similar to terrain slope. However, in this case a magnitude factor was assigned based on the microclimate characterizing each aspect category. Microclimates were derived from the aspect digital database and were defined by the characteristics of the vegetation formations occupying each aspect that relate to fuels conditions.

The three WH influencing levels and an associated magnitude factor are described as follows:

Magnitude Factor 1 (low): "Flat" areas lacking directional orientation. Insolation is unaltered by topographic variations, temperatures follow ambient fluctuations, and predominant land uses typically, and predominantly, include urban and high-density suburban development and agricultural endeavors.

Magnitude Factor 2 (moderate): Northwest, North, Northeast, and East oriented categories. These aspects are characterized climatologically by low sun-angles and elevated degrees of shading, cooler temperatures, and elevated levels of humidity. Typical vegetation associations are more mesic in nature including conifer forest, mixed conifer/hardwood formations, hardwood woodlands and scrub formations.

Magnitude Factor 3 (high): West, Southwest, South, and Southeast oriented categories. These aspects are characterized climatologically by higher sun-angles and very little shading, warmer temperatures, and lower levels of humidity. Typical vegetation associations are more xeric in nature including open hardwood woodlands, scrub formations, chaparral formation, and grass/forb formations.

An assessment of the study area resulted in a moderate-high hazard level category being applied to the full study area for the Wildfire Hazard level assignment.

PREVAILING WINDS

Deriving study area WH level assignments considering wind influences alone is challenging. Wind influences are realized when currents flow from one point to another but are only ultimately defined by the conditions the winds encounter as they make their crossing across subject landscapes. When considering whether there are winds present, only two of the four meteorologic stations show significant winds with bearings that enter the study area. The principal bearing for the Placerville weather station was an east-to-west direction in both the non-fire and fire season periods. The Bald Mtn station showed winds that crossed the western third of the study area with winds coming from a south-west position in both seasonal periods.

It was reasonably concluded that the mere presence of prevailing winds did not contribute significantly to a rise in WH level. However, the cumulative effects, i.e. when those wind currents did interact with various features and/or conditions situated in the landscape, could reasonably be a principal contributor to elevated WH levels. Lastly, when considering diurnal and extraordinary winds, it was concluded that these types were too dynamic and unpredictable to determine the nature and intensity of their influences over the study area.

PRESENCE OF FUEL MODELS

Professional experience supports the conclusion that the fuel models present have comparably, the most significant influence on WH levels. Close examination of the CALVEG types contained within the digital database covering the study showed that they align to four distinctly different fuel models. Assessment of the study area resulted in a high category WH level for the fuel models. Further details on this assessment are in the full report located in the Appendix.

Multiple Setting Components – Cumulative Effects

In wildfire situations, the influence of individual setting components (prevailing winds, terrain slope, and aspect) often do not result in observably significant changes in WH levels; the exception being the presence of fuel models. Detectible changes in WH level are usually definable only when two, or more, components act with cumulative effects. An example of this cumulative effect would involve a prevailing wind of notable velocity blowing directly up a 40 percent south-facing slope through dense woodlands or forests. Specifically identifying what combinations of setting components result in undesirable WH conditions and located where they are within an area for which wildfire planning is needed is of primary importance.

Unfortunately, identifying the locations of the full range of possible setting component combinations for an area as large as the Greater Placerville Study Area requires a significant level of effort and was out of the scope of the current project. Not only would the analysis have to address the presence and conditions of the various setting components, but it would most likely also include consideration of specific features or resources that would be vulnerable to adverse impacts from wildfire. These types of multi-variant and geographically descriptive analyses are typically accomplished using standard geographic information systems analysis procedures and would be recommended as logical follow-on projects using the information generated by the current effort.

Interpretation of Results & Recommendations

INDIVIDUAL SETTING CONDITIONS-RELATED RELATIONSHIPS WITH WILDFIRE HAZARD LEVELS

This assessment addressed, 1) the relationships between combinations of three types of individual setting elements and predictable wildfire hazard level, and 2) how the intermixing of the three WH levels affected the overall result. The three types of setting elements were:

- Slope
- Prevailing winds
- Vegetation type-related fuel models

In terms of producing high levels of WH within the PPSA, it was observed that fuel model type had the most apparent correlative relationship. This relationship was clear enough to use the presence of certain fuel model types (forest- and woodland-related) as an initial indicator of higher hazard situations when producing the map of the distribution of WH level classes within the PPSA. The presence of the terrain characteristics slope (due to the "up-hill" augmentation of spread rate), and aspect (due to influence over the type and condition of occupying vegetation), was considered as a second priority influence. Wind factors were considered to have relatively the lowest level of influence as 1) the "wind rose" information did not show typical wind directions that would add higher level of hazard when acting in concert with the other setting elements, and 2) the other two categories of winds, diurnal and "fire storm"-related, showed a low predictability of occurrence that would increase the uncertainty of wildfire event predictability.

The combination of slopes greater than 10 percent, winds blowing directly upslope, and the presence of forest-, or woodland- related fuel models resulted in a "High" level of WH. On the other end of the range, i.e. the "Low" WH level, the areas were characterized by areas with slopes between zero percent and 10 percent, winds generally blowing perpendicular to the slope direction, and surface conditions considered "non-burnable" (water surfaces, active agriculture, dense urban development, etc.). Agricultural endeavors involving orchard and vineyard management did pose some difficulty in defining WH influence. Although technically an agricultural situation, because of its surface vegetation management (tilling), the stands of woody species can produce some effects the same as stands of natural forest or woodland species.

REGIONAL CLASSIFICATION OF WH LEVELS FOR THE PLACERVILLE PROJECT STUDY AREA

The primary result from this assessment is that approximately 40 percent of the area within the PPSA is occupied by ground conditions that produce wildfire behavior with "High" hazard levels. The effect of these surface conditions is ameliorated by the fact that the rest of the acreage of the FPSA, almost 60 percent of the lands are in lower hazard levels. Considering the effects that contributed to the three levels, a reasonable conclusion would be to consider the full area to be in a level slightly less than "Medium".

However, reference to Figure 10 reveals another consideration; the relative positions of each occurrence of the three WH types in relation to each other. It is clear that there is a fairly complex intermixing of the three types and a strong presence of continuous west-to-east pathways of "High" WH level. Typical fire behavior in these areas include fairly high intensity burns, longer residence times, capability for crowning to occur, and production of embers. It is also observable that there is more perimeter distance of contact with "Medium" level tracts than that with the "Low" level WH type. Thus, the "High"-to-"Medium" ignition function could be greatly increased at the whole system level, with an overall WH level of a level designation at just below "High".

With respect to the makeup and location of lands designated as "High" WH levels, two aspects require further discussion. Of the total acreage of the "High" category (31,739) it was determined that 9,670 acres (approximately 30.4 percent) are under the jurisdiction of the USFS/ENF. These lands are located primarily along the northern boundary and eastern tip of the PPSA but are also scattered in smaller parcels in the central and eastern portions of the PPSA. In consideration of future WH level reduction management it is important that USFS/ENF personnel must be fully engaged in developing policy, program, and practices remedies for the hazards posed by conditions on USFS/ENF land.

The second aspect pertains to the potential for these lands designated as "High" WH-level, and the fuel models that currently occupy them, to contribute to the creation of a "fire storm" situation. In general, current literature provides indications that "fire storm" conditions develop when fire is burning up significantly sloped terrain (whether aided by uphill-blowing winds or not) and enters into significantly large tracts where fuel loadings of highly combustible material is high or extreme.

SPECIAL RESOURCE OR FEATURE SITUATIONS

This assessment also addressed the vulnerability to involvement in and/or undesirable impacts from a wildfire incident for three special resource/ feature situations:

- Roads
- Residential developments in suburban or rural settings
- High voltage electrical transmission infrastructure

Given the mapping constraints involved in this regional analysis the primary result, in terms of actionable preventative management information, was identifying the location of these sensitive feature/conditions within the PPSA. The next sections describe a type of analysis that, in subsequent efforts, can provide information regarding specific surface condition management that can be employed to reduce WH level.

SUBSEQUENT ANALYSIS USING THE WH DATABASE – MULTI-STAGE APPROACH

An important type of analysis that becomes possible after the creation of a regional database is referred to as a multi-stage analysis. In this type of analysis, effort can be focused on a smaller portion of the total area covered by identifying an attribute class that would be beneficial to examine in greater detail. In the PPSA assessment the initial stage product generated is a geo-referenced database covering 79,134 acres, whose primary attribute breakdown was into areas of homogeneous wildfire hazard. Subsequent to this study, a a planning-level decision could be made to focus attention on the "High" WH, that covers 31,739 acres of the current study area, representing only 41 percent of the area addressed bythe first stage analyses. A primary benefit to further analysis at this second stage is the ability to utilize a smaller minimum mapping area and thus better account for the surface condition heterogeneity. In this particular example, a third stage analysis is possible; a focus on the tracts of USFS/ENF that are located within the "High" WH category. Knowing where these lands are strategically and what WH-related conditions exist is information that will greatly assist in cooperative wildfire mitigation efforts. This three-stage structure is illustrated in Figure 10, where Stage 1 is constituted by the three levels of WH (polygons with green, yellow and red shading), Stage 2 is the area of the red-shaded "High" WH level, and Stage 3 is the area inside the white-bordered polygons.

It is recommended that further planning use of the results of this initial study involve identifying second-tier studies whose analyses be designed appropriate to the greater level of detail available at each stage. Possible second-tier themes would be:

- Vulnerable communities – would permit identifying specific management approaches to the surface conditions that are leading to the vulnerability
- Critical road segments – would permit identifying specific management approaches to the surface conditions that are leading to the vulnerability
- High-tension electrical transmission infrastructure – identifying adequacy of existing clearance conditions in general and locating areas of current critical hazard
- Conditions on special jurisdictions that would require cooperative WH mitigation management efforts
- Closer examination of the potential for the creation of "firestorm" conditions

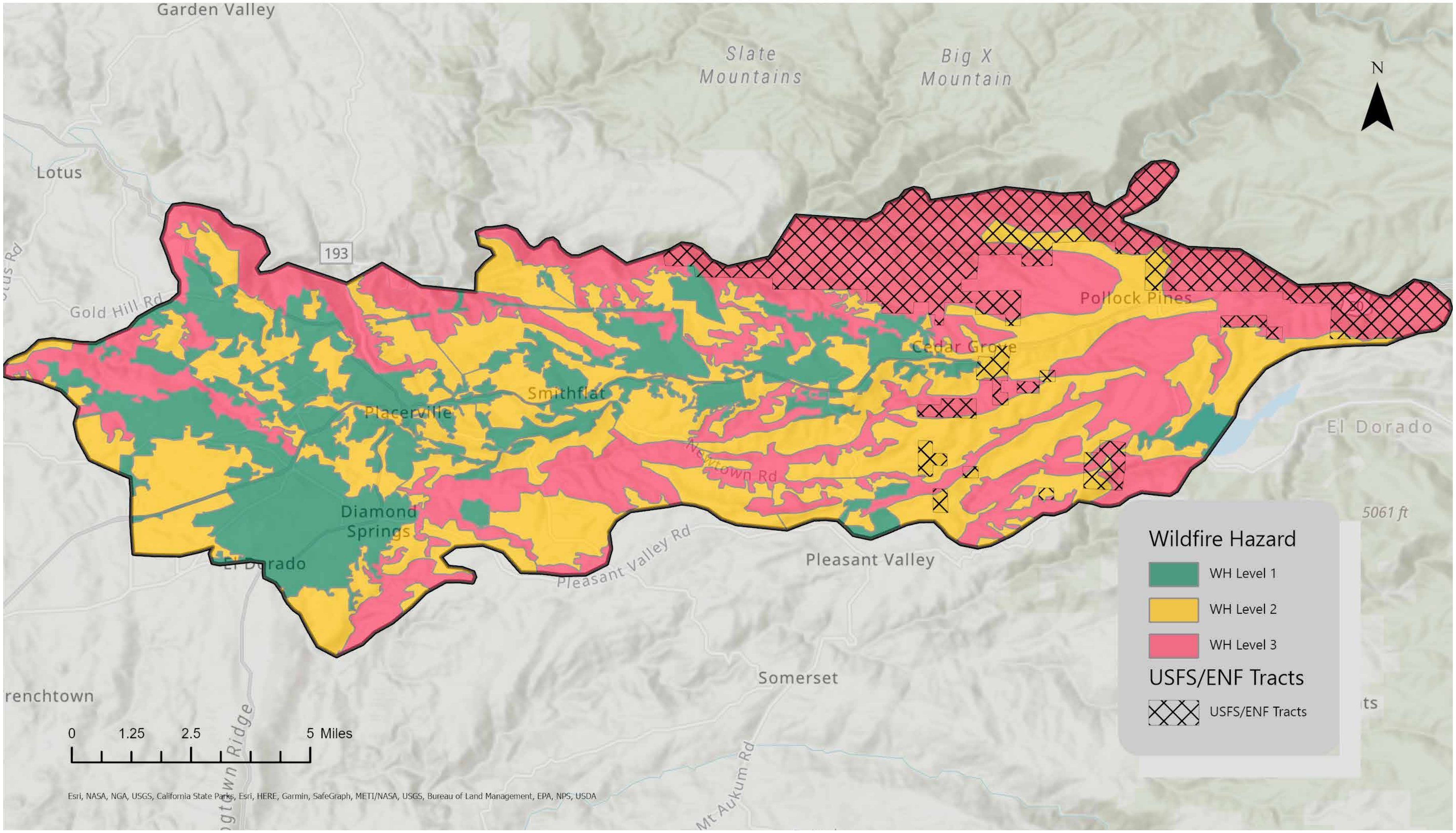
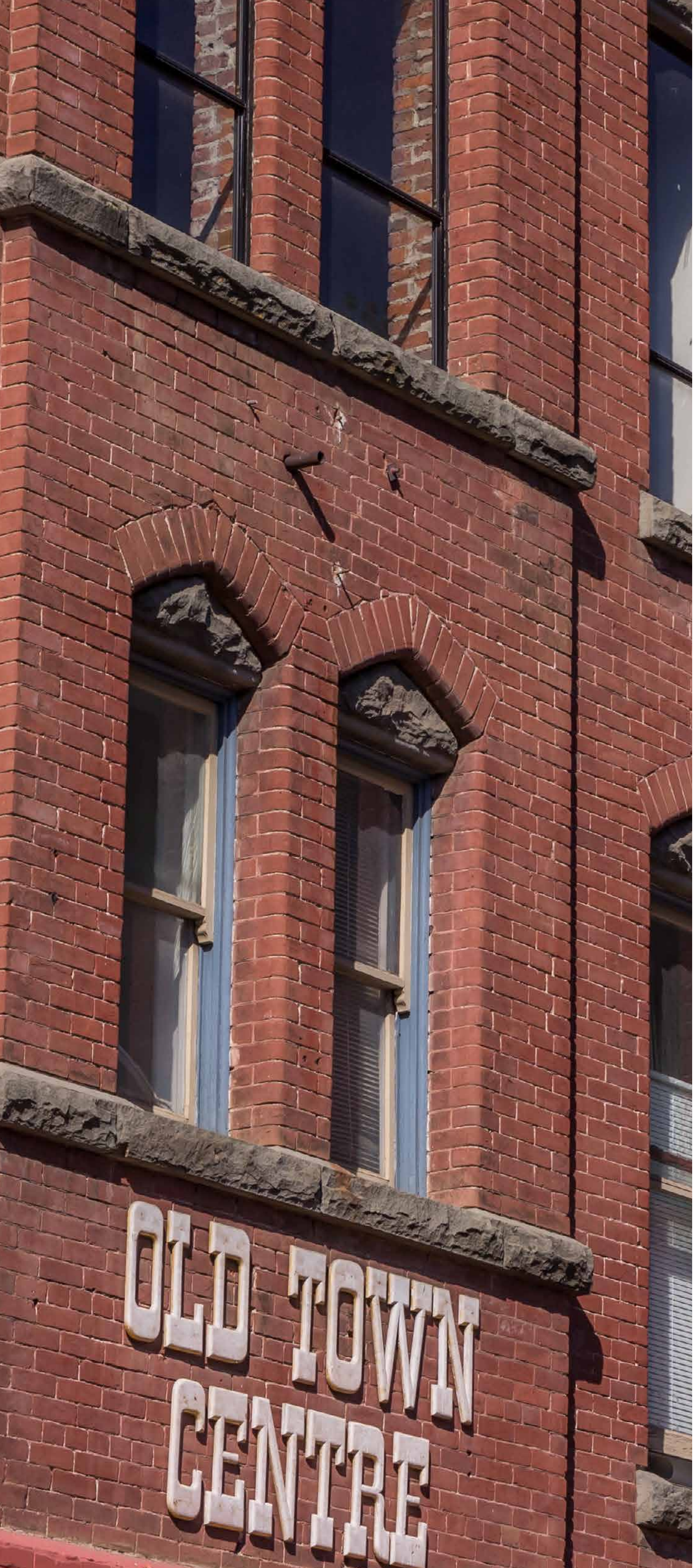


FIGURE 7. MAP OF THE DISTRIBUTION OF WILDFIRE HAZARD LEVELS AND TRACTS OF LAND WITHIN THE JURISDICTION OF THE USFS/ENF



Demographics & High Hazard Communities

THIS SECTION PROVIDES DETAILED INFORMATION ON SENSITIVE COMMUNITY MEMBERS AND VULNERABILITY OF THOSE COMMUNITY MEMBERS TO WILDFIRE.

Background

The Placerville Project Study Area (PPSA), the study area for the Greater Placerville Wildfire Evacuation Preparedness, Community Safety and Resiliency Plan, includes the City of Placerville, as well as several adjacent and nearby communities of unincorporated El Dorado County.

The PPSA is projected to experience increasing frequency and severity of wildfires through the end of the century due to a variety of factors, including increased temperatures and extended drought conditions. Most of PPSA is designated by CAL FIRE as a *very high fire hazard severity zone.* The analysis of vulnerable populations will guide the development of a comprehensive evacuation preparedness plan that centers on the needs of the community's most vulnerable populations.

Methodology

SOCIAL SENSITIVITY METHODOLOGY

The presence of vulnerable populations in the PPSA was identified based on the U.S. Census Bureau's American Community Survey (ACS) and Center for Disease Control (CDC) PLACES health data. U.S. Census ACS presents demographic data by census tract and was used to identify the percentage of the Greater Placerville population that corresponds to each vulnerable group. CDC PLACES health data details the burden and geographic distribution of health measures in greater Placerville and is used for health sensitivity indicators. This memo follows the California Adaptation Planning Guide's (Cal APG) methodology for identifying, grouping, and analyzing vulnerable populations.

Additional vulnerable populations (i.e., geographically isolated individuals, individuals without health insurance, Native Americans, individuals without access to a vehicle, households without broadband internet, and households without a computer) not included in the California Adaptation Planning Guide were identified and analyzed in the vulnerability analysis, as they face disproportionate hazard to wildfire and evacuation challenges.

VULNERABLE POPULATIONS

While all people in a community will experience impacts from wildfire, some may be more affected than others. Many factors can influence sensitivity to wildfires including:

- Health
- Age
- Ability
- Societal disadvantages
- Access to health care and basic needs
- Economic opportunity
- Education

The most vulnerable populations are likely to be disproportionally impacted by wildfires, face challenges in the event of an evacuation, and may have fewer resources to prepare for, adapt to, and recover from wildfires. Following guidance from the Cal APG, vulnerable population groups were identified for the PPSA (Cal OES 2020). The PPSA has a number of vulnerable populations that may disproportionately experience the impacts of climate change.

- Geographically isolated
- Seniors
- Young children
- Linguistically Isolated
- Undocumented individuals
- Unemployed
- Individuals with disabilities
- Individuals with asthma
- Individuals with cardiovascular disease
- Individual without health insurance
- People experiencing homelessness
- Renters
- People of color
- Native Americans
- Individuals without access to a vehicle
- Households without broadband internet
- Households without a computer
- Low-income households
- Outdoor workers
- Visitors

SOCIAL SENSITIVITY INDEX

A social sensitivity index of 19 indicators was created to understand where vulnerable population groups are present in concentrated numbers in the PPSA. Each indicator represents a characteristic that increases an individual's sensitivity to wildfire hazard. These characteristics relate to a person's physiological sensitivity to wildfire and/or the ability of an individual to prepare for, evacuate from, or recover from a wildfire. For more information on why these individuals are considered sensitive to climate change impacts, see the Vulnerability Analysis section.

Table 1 outlines the social sensitivity indicator, indicator descriptions, and percentage of population of households in the PPSA. The indicators were used to assess the geographic spread and proportion of vulnerable populations within the Greater Placerville area.

TABLE 1. SOCIAL SENSITIVITY INDEX INDICATORS IN THE GREATER PLACERVILLE AREA

SOCIAL SENSITIVITY INDICATOR	INDICATOR DESCRIPTION	PERCENTAGE OF POPULATION OR HOUSEHOLDS IN THE GREATER PLACERVILLE AREA
Median Family Household Income[A]	Median Family Household Income	N/A
Median Non-Family Household Income[B]	Median Non-Family Household Income	N/A
People experiencing homelessness[C]	Individuals who currently lack fixed, regular, and adequate housing	0.3%
Undocumented individuals[D]	Individuals residing in the United States without legal documentation	1.2%
Unemployed	Individuals 16 and older who are out of work and able to work but are not	5.6%
Seniors	Individuals 65 years or older	24.6%
Young Children	Individuals 5 years and younger	4.0%
People of Color	All individuals that do not identify as white	15.2%
Renters	Housing units that are renter occupied	21.4%
Outdoor Workers	Individuals who are employed, 16 and older, and work outdoors	7.0%
Visitors	Individuals who are not residents and are visiting the study area for a limited time	Not Available
Linguistically Isolated	Households with individuals who are non or limited English-speaking	2.2%
American Native and Alaskan Native	Individuals that identify as American Native or Alaskan Native	0.8%
Individuals with Disabilities	Individuals with access and functional needs (physical and mental)	14.6%
Individuals with Asthma	Individuals diagnosed with asthma	9.3%
Individuals with Coronary Artery Disease[E]	Individuals diagnosed with coronary artery disease	6.3%
Individuals without access to a vehicle	Households without access to a vehicle	4.5%
Individuals without health insurance	Individuals aged 18 to 64 years old currently uninsured	4.2%
Households without a computer	Households without access to a computer.	6.7%
Households without broadband internet	Households without access to broadband internet.	7.5%

A *For this analysis, a census tract is considered low-income if the median household income is less than 80 percent of the State median household family income ($89,798).*

B *For this analysis, a census tract is considered low-income if the median Non-family household income is less than 80 percent of the State median households non-family income ($50,984).*

C *People experiencing homelessness percentage is representative of El Dorado County and is therefore an overestimate for the Greater Placerville Area.*

D *Undocumented Immigrant percentage is representative of all El Dorado County and is sourced from the California Immigrant Data Portal.*

E *CDC PLACES health data for individuals with cardiovascular disease is not available at the census level for the Greater Placerville area, and therefore individuals with coronary artery disease was used as a proxy.*

Vulnerable & Disadvantaged Communities

Vulnerable populations are disproportionately impacted by wildfires and often face challenges during evacuation. By understanding the spatial distribution of vulnerable populations in the PPSA, community-level resources can be allocated and programs developed to support community members in preparing for, coping with, and recovering from wildfires. An ArcGIS online map viewer was developed for this analysis to spatially display concentrations of vulnerable populations in the PPSA. The map viewer was used to draw insights into the spatial distribution of vulnerable population and guide engagement and programmatic efforts to address disproportionate community impacts from wildfire. Vulnerable populations are grouped below according to a variety of social sensitivity indicators, as outlined in the social sensitivity index section above, as well as potential exposure to wildfire and likelihood of facing evacuation challenges.

INDIVIDUALS WITH HIGH-OUTDOOR EXPOSURE

- People experiencing homelessness
- Outdoor workers
- Visitors

SENSITIVITY OVERVIEW

As of 2019, there were 613 people experiencing homelessness in El Dorado County, though this number fluctuates based on many factors, including weather patterns and ongoing initiatives. An estimated 42 percent of these individuals suffer from a mental health disability and 30 percent suffer from drug or alcohol abuse. These challenges can leave people more susceptible to wildfires and more likely to face evacuation challenges.[3] People experiencing homelessness can often suffer from high rates of respiratory, cardiovascular, and other chronic health conditions and therefore are at greater hazard of injury from wildfire-related hazards such as smoke.[4] People experiencing homelessness often have limited access to shelter and may not have access to transportation to evacuate from smoke engulfed areas.[5] Many may be living in forested and open space areas and are particularly at hazard to wildfires and may face logistical obstacles when seeking to evacuate. They may also not have a location to evacuate to or cannot afford to stay at a hotel or short-term housing rental. The largest concentration of people experiencing homelessness in the Greater Placerville area was located along Broadway between U.S. Route 50 and Airport Road, which are CAL FIRE designated very high fire hazard severity zones. This encampment was recently cleared and the county opened a “navigation center” to assist people experiencing homelessness. Actions like this, which improve outreach to vulnerable population groups, improve evacuation preparedness.

The PPSA is a popular tourist destination for many visitors looking to explore historical sites, the outdoors, or local wineries. Visitors are at hazard because they may not be prepared to receive warning communications during a wildfire event and are more likely to be unsure of how or where to receive help.[6] Visitors may not have access to emergency public health warnings and may not know of appropriate evacuation routes or where to get emergency evacuation information in the event of a wildfire. Visitor deterrence, which could occur during and following a wildfire, may have a notable negative impact on the local economy.

Outdoor workers, visitors, and people experiencing homelessness face high-outdoor exposure, causing them to be more affected by wildfires than the general population. Outdoor workers in the PPSA are employed in a variety of fields including agriculture, construction, and fire protection.

3 *Svoboda, Dylan. 2019. El Dorado County experiences uptick in homelessness. https://www.mtdemocrat.com/news/el-dorado-county-experiences-uptick-in-homelessness/.*

4 *Legislative Analyst’s Office. 2022. Climate Change Impacts Across California: Housing. https://lao.ca.gov/Publications/Report/4584*

5 *California Department of Public Health (CDPH). 2017. Climate Change and Health Profile Report El Dorado County. https://www.cdph.ca.gov/Programs/OHE/CDPH%20Document%20Library/CHPRs/CHPR017ElDorado_County2-23-17.pdf*

6 *Gamble Janet & Balbuls John. 2016. The Impacts of Climate Change on Human Health in the United States. https://health2016.globalchange.gov/low/ClimateHealth2016_09_Populations_small.pdf*

POTENTIAL IMPACTS

Individuals with high outdoor exposure are at greater hazard of injury and death from wildfire events than the general population. Many may face mobility challenges that limit their ability to evacuate. Many may also face communication limitation that can prevent them from receiving critical information during an evacuation event. Some outdoor workers, including firefighters and emergency personnel, may be exposed to hazardous work conditions during wildfire events and may become injured from smoke inhalation or burns. Underlying health conditions for people experiencing homelessness may be exacerbated from contact with wildfire or smoke. Additionally, wildfire hazard may deter visitors, impacting the PPSA economy.[7]

UNDER-RESOURCED INDIVIDUALS

- Low-income households
- Unemployed individuals
- Individuals without health insurance
- Households without a computer
- Households without broadband internet
- Geographically isolated individuals
- Individuals without access to a vehicle
- Renters

SENSITIVITY OVERVIEW

Under-resourced individuals often do not have access or the ability to afford resources needed to prepare for or evacuate from a wildfire. Individuals who are unemployed or are low-income often face financial barriers when preparing for and recovering from wildfires. Individuals in these groups often live in homes that are more likely to be less protected against wildfires. Low-income individuals may not be able to take time off work to address health concerns either caused by or exacerbated by a fire or wildfire smoke.

Individuals without vehicles may not be able to evacuate out of wildfire hazard areas safely and efficiently. Renters have limited ability to implement home hardening retrofits or remodel using fire resistant materials. Renters are more likely to live in housing with older features such as cedar siding, wood shake roofs, or single-paned windows, that make them more vulnerable to igniting by a wildfire.[8] They also are less likely to have air filtration systems that effectively minimize air pollution from wildfire smoke.

Low-income individuals are primarily located in the western and central areas of the PPSA. Geographically isolated individuals may face hardship because they may not have access to or may have to travel far distances to receive access to critical services and medical assistance. They may also face challenges evacuating from isolated areas that have limited exit points.

Households without a computer or broadband internet may not receive emergency alerts or governmental guidance before or during a wildfire, making them particularly vulnerable in evacuation

7 Gamble Janet & Balbuls John. 2016. The Impacts of Climate Change on Human Health in the United States. https://health2016.globalchange.gov/low/ClimateHealth2016_09_Populations_small.pdf

8 Legislative Analyst's Office. 2022. Climate Change Impacts Across California: Housing. https://lao.ca.gov/Publications/Report/4584 scenarios and more likely to be left behind. The largest concentration of individuals without broadband internet are in the north central PPSA. The largest concentration of individuals without a computer are in the central PPSA. According to national Census Bureau data, more than one in six people in poverty had no internet access in 2019. Low-income individuals are more likely to not have access to broadband internet, limiting their access to wildfire safety and evacuation information.[9] Individuals without health insurance are more likely to have undiagnosed preexisting health conditions which may make them more vulnerable to health impacts from wildfire smoke.[10] The largest concentration of individuals without health insurance is in the northwestern and south-central PPSA. Renters have limited control over home improvement and weatherization projects that reduce wildfire hazard. The largest concentration of renter occupied housing is in the north central and northeastern PPSA.

POTENTIAL IMPACTS

Under-resourced individuals may experience great hazard of injuries or death from smoke inhalation or burns than the general population and are more likely to experience financial burden associated with medical treatment.[11] These individuals may have their belongings and homes damaged by a wildfire and be less equipped to replace them if lost. In many areas in the Sierra foothills, home insurance companies have either increased rates or stopped providing insurance coverage to homeowners in high wildfire hazard areas. Increasing rates pose significant cost burdens, particularly to low-income individuals, and lack of insurance coverage can threaten mortgages. Households without a computer or internet may not receive communications to evacuate safely from a wildfire. Subsequently, they may experience economic and health impacts and a greater loss of belongings compared to households with a computer and internet.[12]

INDIVIDUALS FACING SOCIETAL BARRIERS

- People of color
- Native Americans
- Linguistically isolated
- Undocumented individuals

SENSITIVITY OVERVIEW

Individuals facing societal barriers are those that are directly impacted by the social and economic challenges that are ubiquitous in society. These challenges create educational, resource, economic, and health disparities that leave people of color extremely vulnerable to wildfire.[13] According to 2020 U.S. Census data, 16 percent of residents in the PPSA identify as non-white, which includes those that identify as Hispanic or Latino, Black or African American, Asian, Native Hawaiian and other Pacific Islander, or some other race other than White. The largest concentration of individuals that identify as non-white is in the southwestern PPSA. Many of these individuals may face compounding hazards associated with linguistic and income barriers. Undocumented immigrants often lack access to medical services, quality housing, and basic needs. If individuals are not citizens, they are likely to lack access to social and economic services that would allow them to prepare for and evacuate from wildfire. Individuals who are linguistically isolated have no, or limited, English-speaking ability. If evacuation and/or advisory notices, wildfire preparedness materials,

9 *(U.S. Department of Health & Human Services 2021)*

10 *Gamble Janet & Balbuls John. 2016. The Impacts of Climate Change on Human Health in the United States. https://health2016.globalchange.gov/low/ClimateHealth2016_09_Populations_small.pdf (Gamble et al. 2016)*

11 *California Department of Public Health (CDPH). 2017. Climate Change and Health Profile Report El Dorado County. https://www.cdph.ca.gov/Programs/OHE/CDPH%20Document%20Library/CHPRs/CHPR017ElDorado_County2-23-17.pdf*

12 *(Cooley et al. 2012).*

13 *Baird, Rachel. 2008. The Impact of Climate Change on Minorities and Indigenous People. https://minorityrights.org/wp-content/uploads/old-site-downloads/download-524-The-Impact-of-Climate-Change-on-Minorities-and-Indigenous-Peoples.pdf.*

or wildfire mitigation guidance is not provided in non-English versions, these individuals may be less equipped to prepare for or evacuate from a wildfire.[14] The largest concentration of linguistically isolated individuals is in the southwestern PPSA.

The PPSA is located on the ancestral lands of the Sierra Miwok people. The area has a rich human history that continues to this day with tribal groups, such as the Shingle Springs Band of Miwok Indians, having ties to the land.[15] The largest concentration of individuals that identify as American Indian or Alaska Native is in the western PPSA, which is closest to the Shingle Springs Rancheria. Not all residents in the PPSA who identify as American Indian or Native American have ties to tribal communities. Most Native Americans experience some degree of the implications of colonial violence, cultural erasure, and social marginalization, and as a result, they are more likely to be under-resourced and low-income.[16] In 2020, one in three Native Americans across the United States were living in poverty.[17] Native Americans have lower health status and life expectancies compared to other populations due to a variety of factors, including inadequate education, disproportionate poverty, cultural differences, and discrimination in the delivery or accessibility of health services. Native Americans are also less likely to have health insurance, which may limit their ability to seek medical care for injuries or illnesses caused or exacerbated by wildfire.[18] Native Americans are more likely to live in high-hazard areas and less likely to be homeowners, which leaves them vulnerable to wildfire impacts.[19]

POTENTIAL IMPACTS

People of color, undocumented immigrants, and Native Americans are more likely to live in wildfire hazard zones and in housing with insufficient protection against wildfire. Linguistically isolated individuals may not be able to read wildfire or smoke advisory warnings or evacuation guidance, potentially causing them to experience greater exposure to smoke and fire or get left behind during an evacuation. Individuals in these groups may experience injuries or death from smoke inhalation or burns. Undocumented immigrants may not have access to medical services to treat injuries.[20]

INDIVIDUALS WITH CHRONIC HEALTH CONDITIONS OR HEALTH-RELATED SENSITIVITIES

- Seniors
- Young children
- Individuals with disabilities
- Individuals with asthma
- Individuals with cardiovascular disease

SENSITIVITY OVERVIEW

Individuals with chronic health conditions or health related sensitivities are socially and physiologically vulnerable to wildfire. Seniors and individuals with disabilities may have limited or reduced mobility, mental function, or communication abilities, making it difficult to evacuate during or prepare for a wildfire. They may also have medical needs

14 *Gamble Janet & Balbuls John. 2016. The Impacts of Climate Change on Human Health in the United States. https://health2016.globalchange.gov/low/ClimateHealth2016_09_Populations_small.pdf (Gamble et al. 2016).*

15 *(El Dorado County 2022).*

16 *(Lynn et al. 2011)*

17 *Mendez, Michael, Flores-Haro, Genevieve, and Zucker, Lucas. 2020. The (in)visible victims of disaster: Understanding the vulnerability of undocumented Latino/a and indigenous immigrants. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7413658/*

18 *(Indian Health Services 2019).*

19 *Gamble Janet & Balbuls John. 2016. The Impacts of Climate Change on Human Health in the United States. https://health2016.globalchange.gov/low/ClimateHealth2016_09_Populations_small.pdf*

20 *Mendez, Michael, Flores-Haro, Genevieve, and Zucker, Lucas. 2020. The (in)visible victims of disaster: Understanding the vulnerability of undocumented Latino/a and indigenous immigrants. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7413658/*

for electricity which may be impacted during a public safety power shutoff or power outage triggered by a wildfire. Individuals in these groups are more likely to have preexisting medical conditions, or chronic illnesses, that may exacerbate the hazard of illnesses and medical problems from wildfires. The largest concentration of individuals with disabilities is in the southwestern and southeastern PPSA. Individuals with asthma and individuals with cardiovascular disease are more likely to experience health impacts from wildfire because of preexisting conditions or diseases. The largest concentration of individuals with asthma is in the northern PPSA. The largest concentration of individuals with coronary artery disease is in the northeastern PPSA. Data for individuals with cardiovascular disease is not available at the census level for the PPSA; therefore, individuals with coronary artery disease was used as a proxy for this analysis. Seniors often face challenges regulating their temperature due to medications or underlying conditions related to age. The largest concentration of seniors is in the south central and southwestern PPSA. Young children are socially and physiologically vulnerable to climate hazards. They often have limited understandings of wildfires and insufficient resources to independently prepare for and safely evacuate from a wildfire. Young children are reliant on their parental figures to ensure their health, safety, and wellbeing. Children also have vulnerable physical characteristics because they have not fully physiologically developed and are therefore more vulnerable to health effects of wildfire smoke.[21] The largest concentration of young children is in the southwestern PPSA.

POTENTIAL IMPACTS

Individuals with chronic health conditions or health related sensitivities may be more likely to experience injuries or death from smoke inhalation or burns than the general population.[22] These populations are particularly at hazard to respiratory health impacts associated with smoke inhalation of wildfire smoke pollutants. Seniors are vulnerable to health impacts from wildfire smoke pollutants because they are more likely to have underlying respiratory and/or cardiovascular conditions and illnesses. In many cases, seniors are reluctant or less able to leave their homes in an evacuation situation to go to a place unfamiliar. Individuals with disabilities, chronic health conditions, and those with disabilities often need specific assistance and/or transportation to evacuate. They may also have medications or medical equipment that they must bring with them to their evacuation location. Young children may experience respiratory health impacts from wildfire smoke because their respiratory systems are not fully developed and are sensitive to stressors. Individuals with cardiovascular disease may experience severe cardiovascular health impacts if exposed to wildfire smoke pollutants. Individuals with asthma may experience severe respiratory health impacts, such as difficulty breathing, if exposed to wildfire smoke pollutants. Individuals with disabilities, children, and seniors may have difficulty evacuating from wildfires, increasing the hazard of health impacts from wildfire smoke inhalation or fire burns.[23]

21 Kenney WL, Craighead DH, Alexander LM. 2014. Heat waves, aging, and human cardiovascular health. Med Sci Sports Exerc. ;46(10):1891-9. doi: 10.1249/MSS.0000000000000325. PMID: 24598696; PMCID: PMC4155032.

22 California Department of Public Health (CDPH). 2017. Climate Change and Health Profile Report El Dorado County. https://www.cdph.ca.gov/Programs/OHE/CDPH%20Document%20Library/CHPRs/CHPR017ElDorado_County2-23-17.pdf (CDPH 2017).

23 EPA 2022).

CONCLUSIONS

The vulnerable population discussed in this section are not concentrated in high numbers within the PPSA, but are generally distributed. However, there are a few population groups that are more concentrated in certain parts of the PPSA (see Table 2).

Overall, the western and southern areas of the PPSA have the largest proportion of vulnerable populations to wildfire. There is a large concentration of under-resourced individuals located in the central PPSA, primarily in and adjacent to the City of Placerville.

Understanding the proportion and geographic spread of vulnerable populations in PPSA is critical for guiding the wildfire resilience and evacuation preparedness planning process. Findings from this section will help guide the specific type of wildfire mitigation or evacuation preparedness program, or engagement effort for vulnerable populations.

As discussed below, there are communities with limitations on access to major routes in west, north, south, and east districts (as shown in Figure 2 and Figure 3). The north and east districts have the two highest totals of social sensitivity indicator populations and planning for resources to assist these populations, such as those north of Mosquito Road as well as those along Cable Road, will be included in subsequent solutions in this plan.

TABLE 2. GENERAL LOCATIONS OF SENSITIVE POPULATIONS

SOCIAL SENSITIVITY INDICATOR	CENTRAL	WEST	NORTH	EAST	SOUTH
Median Family Household Income	●	●	●		
Median Non-Family Household Income			●	●	●
People experiencing homelessness	Not Mapped				
Undocumented individuals	Not Mapped				
Unemployed	●				●
Seniors		●			●
Young Children				●	●
People of Color		●			
Renters	●	●	●	●	
Outdoor Workers		●	●		
Visitors	Not Mapped				
Linguistically Isolated	●		●		●
American Native and Alaskan Native		●			
Individuals with Disabilities		●	●	●	
Individuals with Asthma		●	●	●	
Individuals with Coronary Artery Disease	●		●	●	
Individuals without access to a vehicle	●		●	●	●
Individuals without health insurance	●		●		●
Households without a computer	●		●		
Households without broadband internet	●		●		
Total Indicators	**8**	**7**	**12**	**7**	**7**

CRITICAL TRANSPORTATION FACILITIES

With sensitive population groups located throughout the county, all major roads in the transportation network contribute to the resiliency of the PPSA. This section discusses the most important transportation facilities to serve vulnerable populations, but for some of these groups access to the system is not the only need. Public transit and outreach are important for the elderly, disabled, and carless residents of the county, among others. Providing support for these communities through preparation and policy is the best way to ensure they are served by the transportation system during a wildfire event. A more general discussion of the transportation system is included in the next section.

HIGH HAZARD COMMUNITIES

In a wildfire event, normal access to roads in the transportation system may be impeded or blocked. Accessibility of the transportation is a critical prerequisite to the subsequent mobility need of communities during an evacuation. High hazard communities, with limited access, are determined by analysis of gateways, traffic bottlenecks, bridges, and rivers. Figure 12 shows accessibility by parcel with the PPSA. Accessibility is broken down into three levels.

- **Low accessibility –** with only one route in/out
- **Medium accessibility –** with up to three routes in/out
- **High accessibility –** with greater than three routes in/out

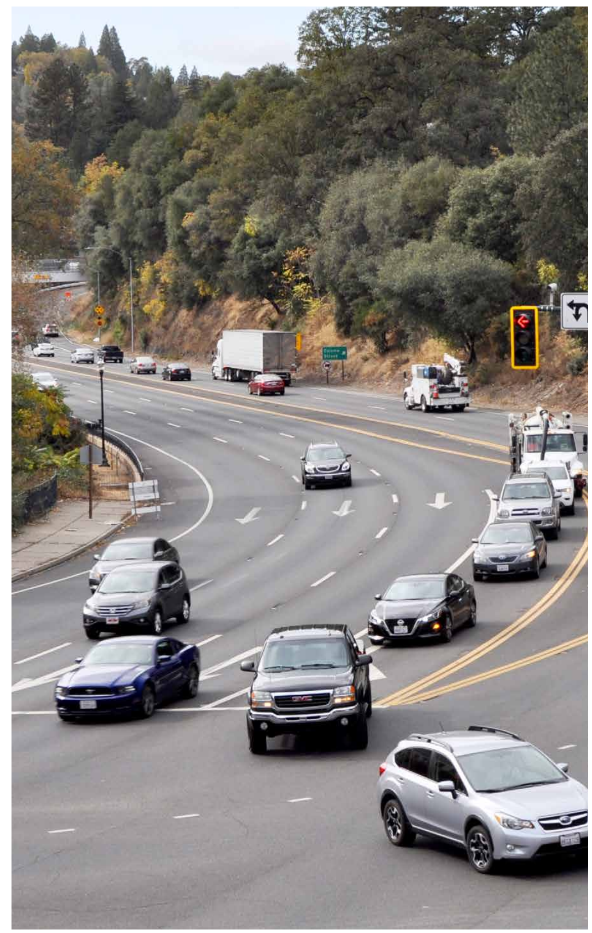
Parcels designated as open space are not shown in the figure. Most parcels in the western half of the PPSA, especially those surrounding Placerville, have high accessibility.

Areas with medium accessibility are:

- **Green Valley Road:** North of Green Valley Road surrounding Countryside Drive and Stagecoach Road - this neighborhood is served by paved minor roads but is further removed from the nearest major road.
- **Sierra Springs:** This neighborhood is near Sly Park Road and Starkes Grade Road and is served by paved minor roads but is further removed from a major road than other parcels.
- **Forebay Road:** Forebay Road is a major road, but the spacing between roads in this part of the study area is larger than the rest and Forebay Road does not connect to any other major roads outside of the PPSA. Therefore, the neighborhoods around Forebay Road have less accessibility than comparable areas around other major roads.

Areas with low accessibility are:

- **Cable Road:** Cable Road is a major road but is partially unpaved. Similar to Forebay Road, it does not connect to any other major roads outside of the PPSA and the parcels along it have lower access than other areas.
- **Old Fort Jim:** The Old Fort Jim area is served by a single unpaved road and parcels in that neighborhood have no other access options.
- **North of Mosquito Road:** This area is bounded on the north by the South Fork American River and has no available crossings or access to SR 193. Mosquito Road is the only nearby major road serving this area.



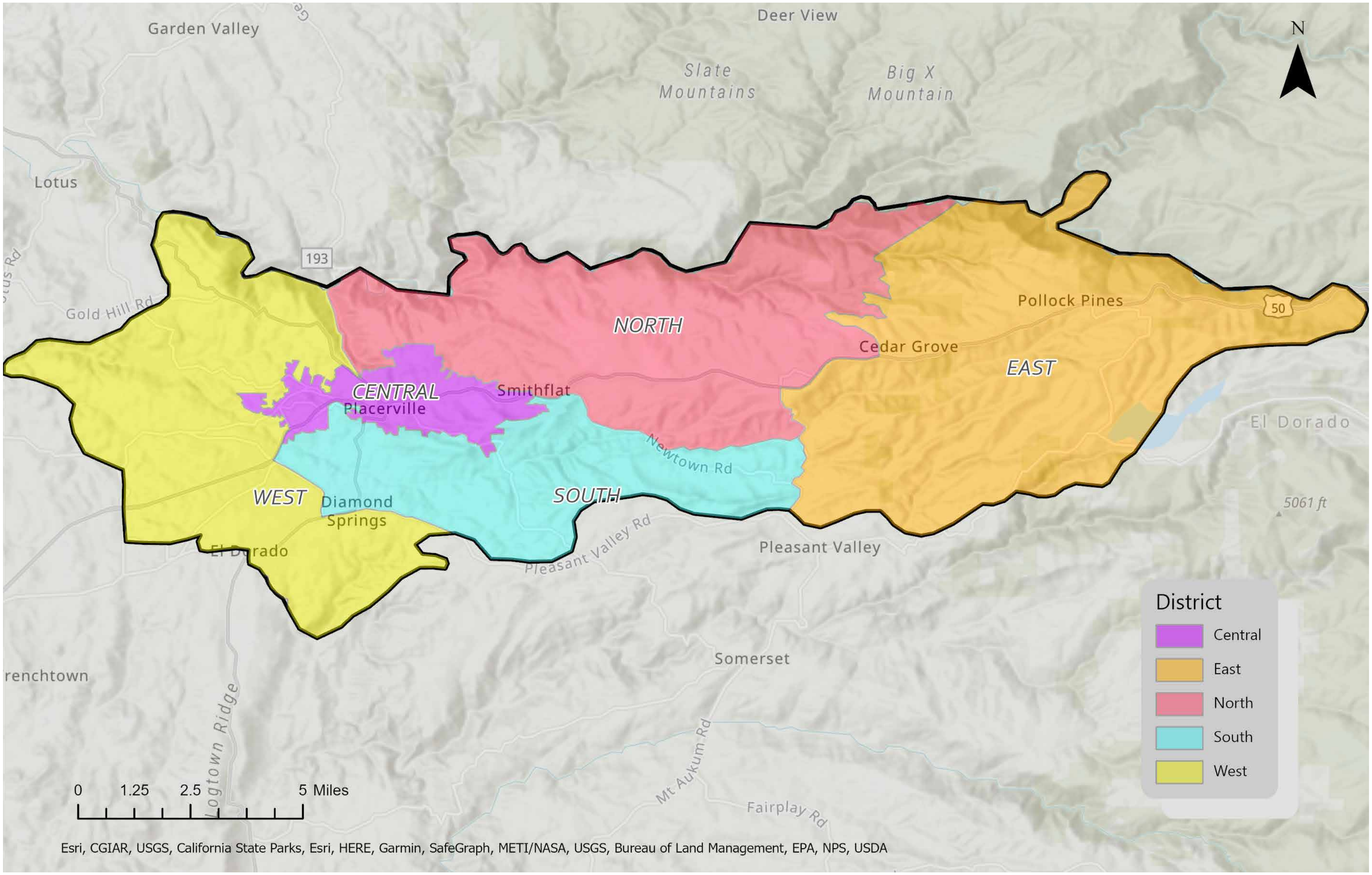


FIGURE 8. ACCESS FOR VULNERABLE POPULATIONS

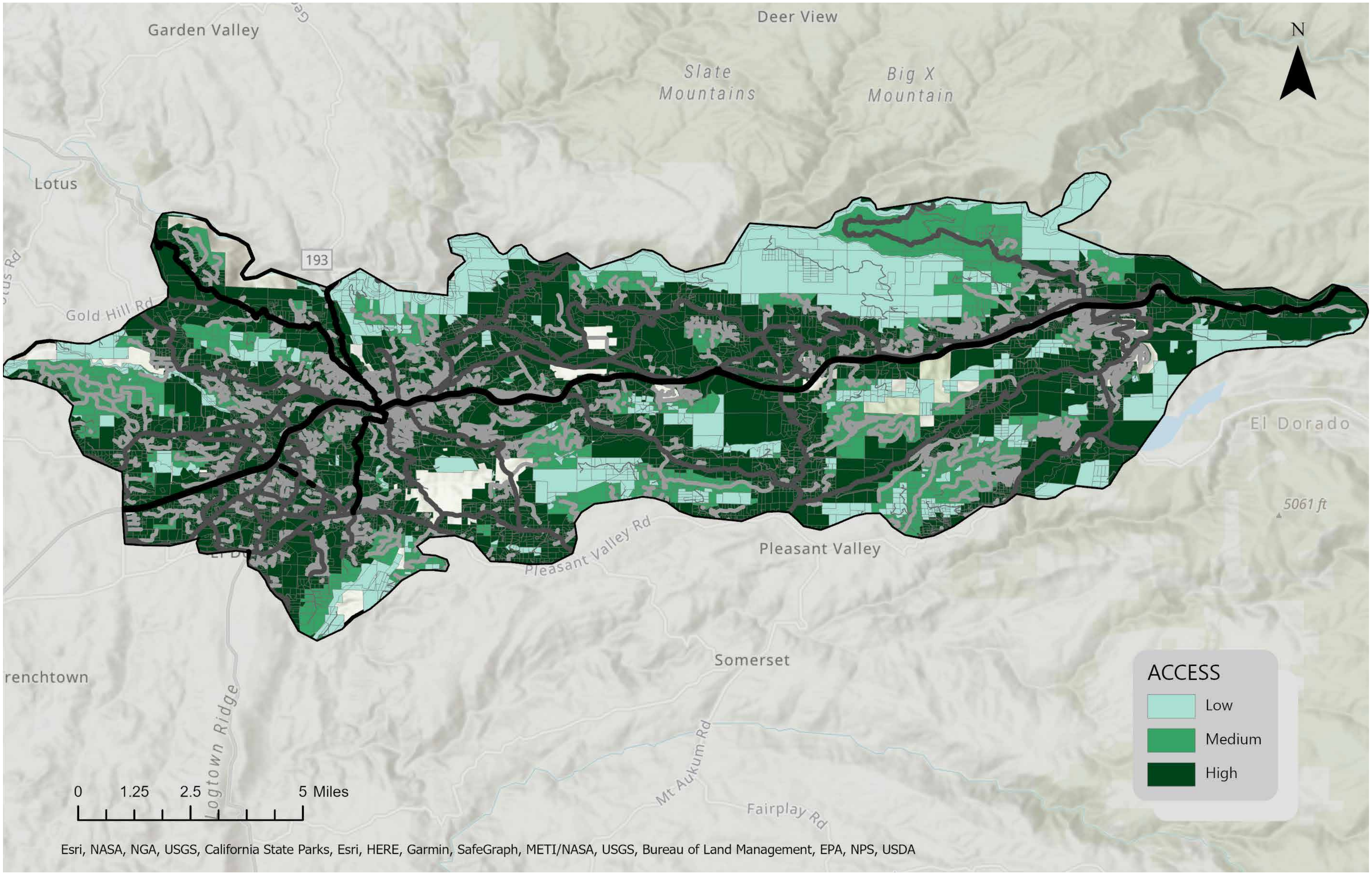
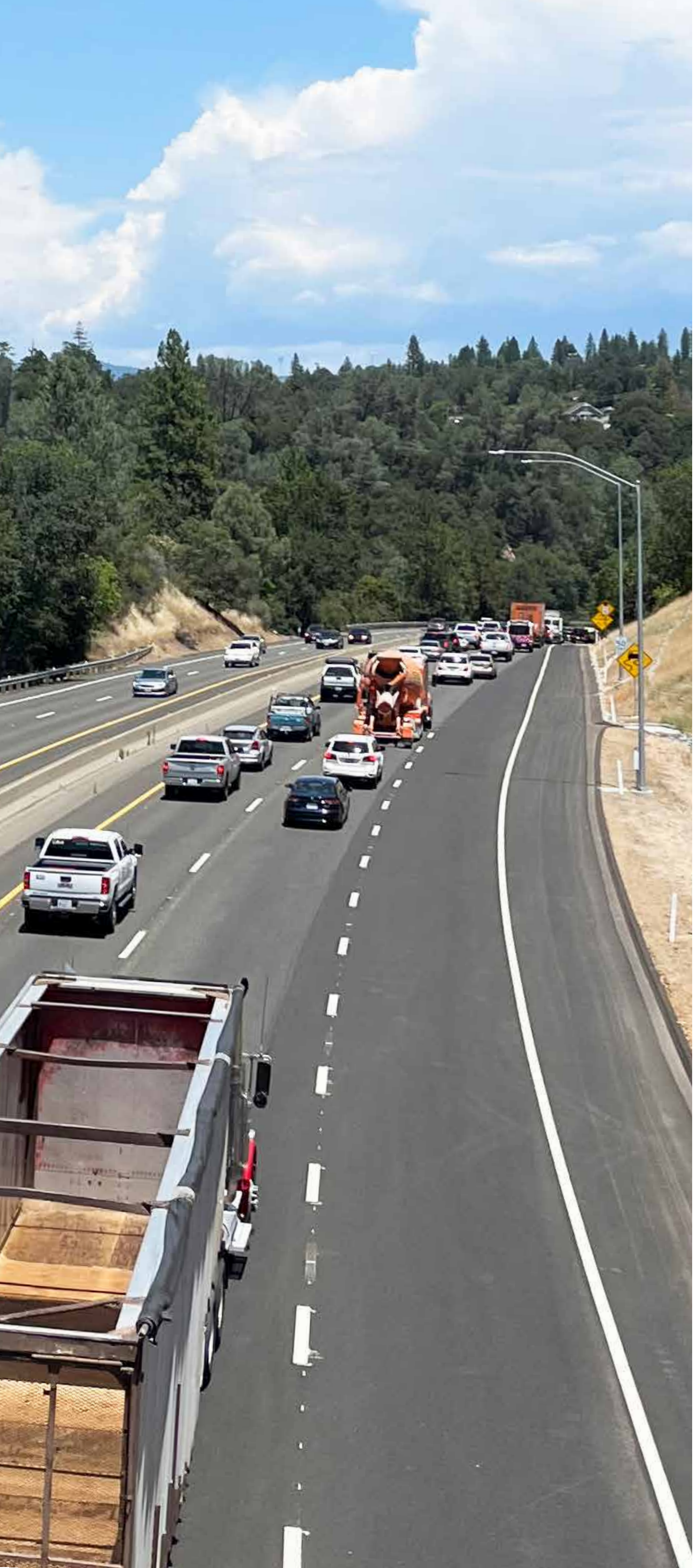


FIGURE 9. PARCEL ACCESSIBILITY



Transportation Network

DURING A WILDFIRE EVENT, A RESILIENT TRANSPORTATION NETWORK WILL CONTINUE TO PROVIDE MOBILITY WITH UNUSUAL ENVIRONMENTAL CONDITIONS. GIVEN THAT A WILDFIRE MAY OCCUR AT ANY TIME OF THE YEAR, AND TRAFFIC VOLUMES AND GENERAL TRANSPORTATION DEMAND HAVE SEASONAL FLUCTUATION, THIS SECTION INCLUDES A COMPARISON OF AVERAGE AND PEAK CONDITIONS, AND DURING THE APPLE HILL FESTIVAL IN OCTOBER. ALSO INCLUDED IS AN INVENTORY OF THE EXISTING TRANSPORTATION SYSTEM INCLUDING GENERAL FUNCTIONAL CLASSIFICATION, ROADWAY PAVEMENT STATUS (PAVED/UNPAVED), AND OTHER TRANSPORTATION RELATED INFRASTRUCTURE, SUCH AS TRAFFIC CAMERAS.

Inventory

The study area is primarily served by US 50, a U.S. route oriented east-west through the City of Placerville and connecting Sacramento to the west with Lake Tahoe to the east. CA 49 is a state highway which is oriented north-south and connects Placerville to historic mining towns such as Auburn and Nevada City. CA 193, also a state highway, oriented east-west, and connecting to the South Fork of the American River. There are also several local county and city roads that provide important connections in the PPSA.

The 10 longest major roads within the PPSA are:

1. **Mosquito Road –** 17 miles in PPSA
2. **Pleasant Valley Road –** 13 miles in PPSA
3. **Sly Park Road –** 11 miles in PPSA
4. **Cable Road –** 9 miles in PPSA
5. **Forebay Road –** 8 miles in PPSA
6. **Carson Road –** 7 miles in PPSA
7. **Starkes Grade Road –** 7 miles in PPSA
8. **Pony Express Trail –** 7 miles in PPSA
9. **Cold Springs Road –** 6 miles in PPSA
10. **Newtown Road –** 6 miles in PPSA

Figure 13 through Figure 15 show the transportation system inventory within the PPSA.

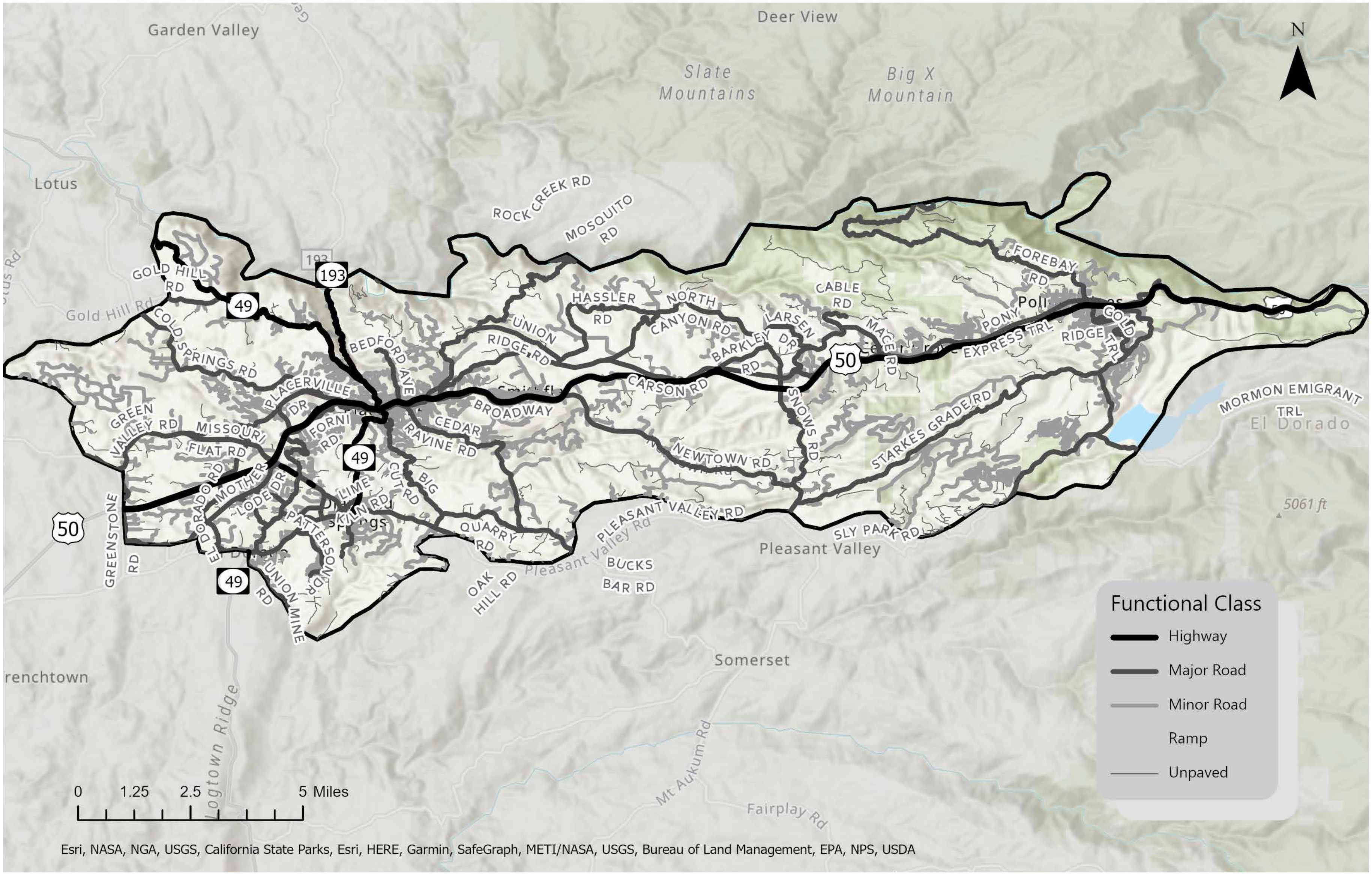


FIGURE 10. ROADWAY CLASSIFICATION

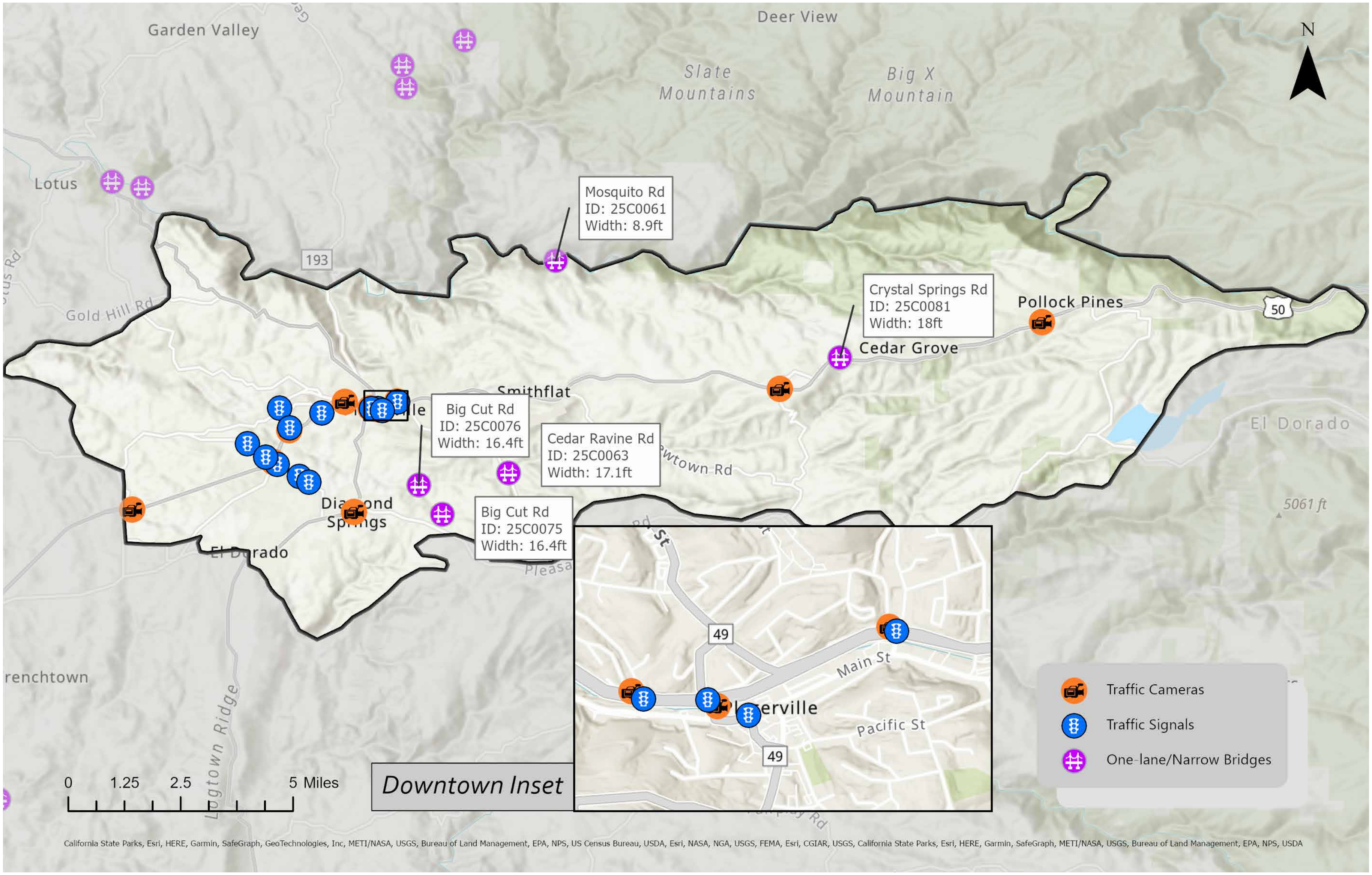


FIGURE 11. BRIDGES, TRAFFIC SIGNALS, AND TRAFFIC CAMERAS

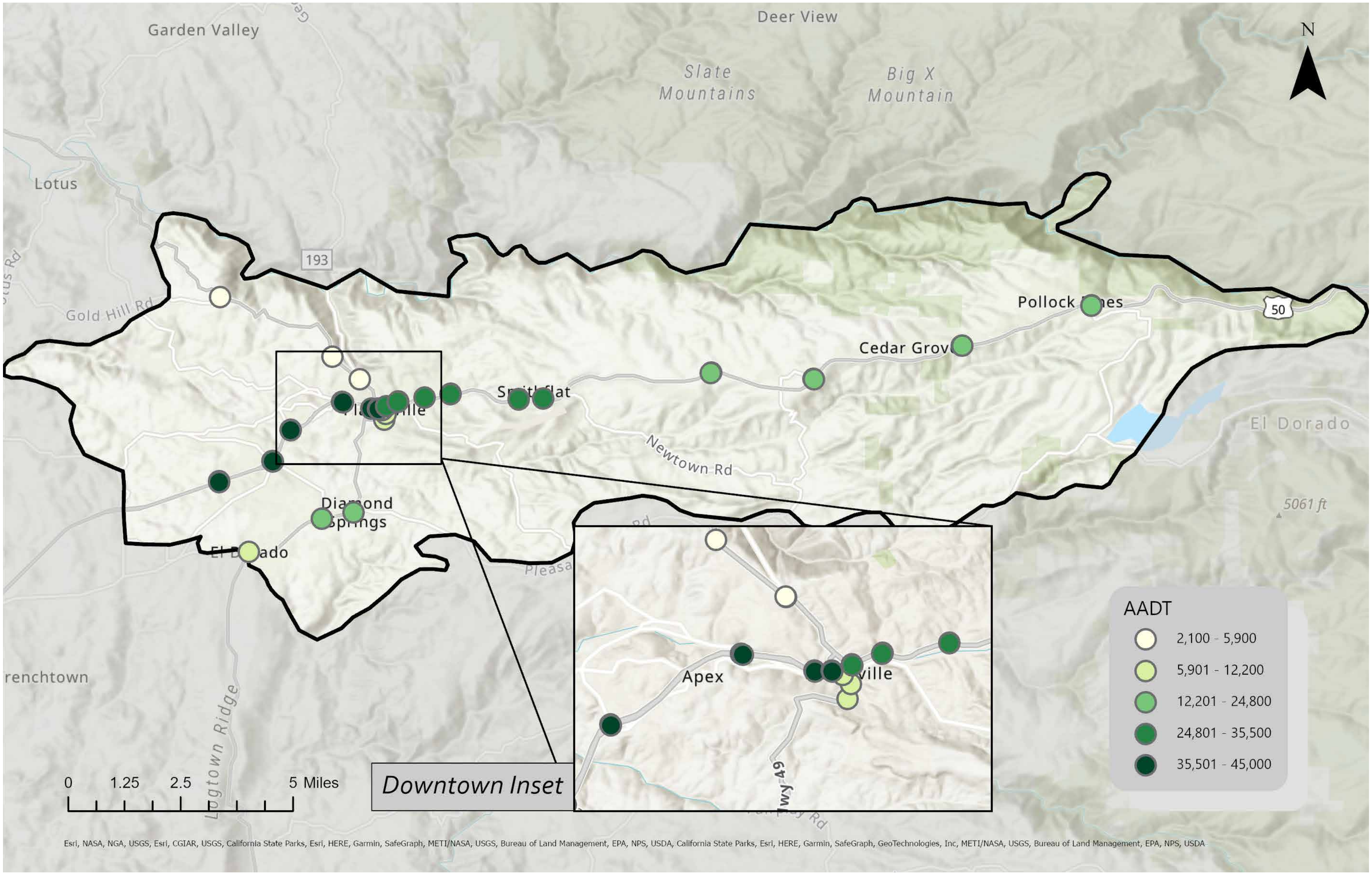


FIGURE 12. TRAFFIC VOLUMES

Figure 13 shows the road network inventory within the PPSA. A majority of the road network within the study area is within the western half, surrounding the City of Placerville and Diamond Springs Census Designated Place (CDP). Network density decreases in the eastern half of the study area with longer distances between intersections of major roads.

Figure 14 shows other transportation infrastructure within the PPSA including one-lane and narrow bridges, traffic signals and traffic cameras. All the traffic signals are in western half of the study area. The traffic signal locations may require event specific signal timing plans or manual traffic control during an evacuation event. The traffic camera locations assist in monitoring traffic conditions during an event. The Narrow bridges are defined as less than 19 feet wide. Narrow and one-lane bridges can pose challenges for evacuating vehicles and responding vehicles to pass each other on the bridge. There are five one lane or narrow bridges in the study area:

- Mosquito Road [ID-061] S. Fork America River (8.9 ft.)
- Crystal Springs Road [ID-081] EID Canal (18.0 ft.)
- Cedar Ravine Road [ID-063] Weber Creek (17.1 ft.)
- Big Cut Road [ID-076] Weber Creek (16.4 ft.)
- Big Cut Road [ID-075] Ringgold Creek (16.4 ft.)

While not shown on a figure, transit services are provided within PPSA by El Dorado Transit.

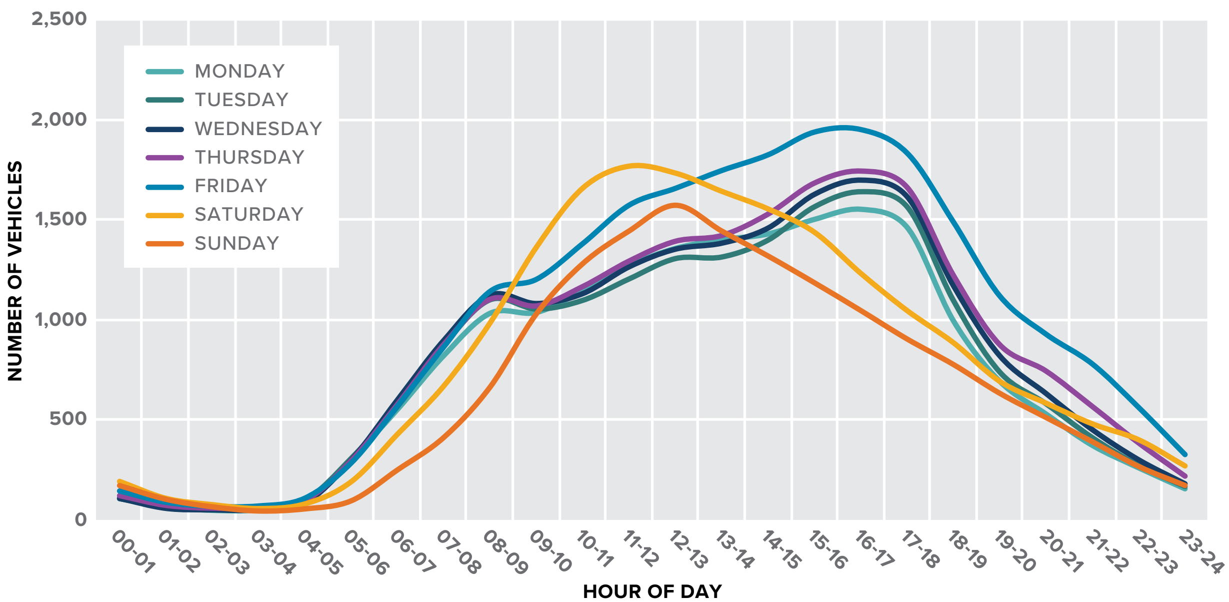


FIGURE 13. DAY OF WEEK PEMS TRAFFIC VOLUMES, 2022

Transit serves to provide mobility solutions for individuals without or unable to operate vehicles, as well as provide an alternative mode of transportation. During an evacuation event, El Dorado Transit closely coordinates with the Office of Emergency Services to support evacuation operations as directed.

Figure 15 shows the average annual daily traffic volume within the PPSA. Traffic volumes vary significantly from east to west along US 50 with the traffic volume west of Placerville roughly double the volume along US 50 in the eastern section. Along SR 49, the traffic volumes are higher south of US 50 near Diamond Springs. North of US 50, traffic volume along SR 49 is the lowest total volume of the available data.

Figure 16 presents the Performance Measurement System (PeMS) traffic volumes on US 50 eastbound at Ray Lawyer Drive by day of week summarized for average 2022. It tells that Friday has outstanding volumes during AM peak to PM peak. Weekend traffic volumes in 2022 reach to peak during mid-day from 10:00 AM to 2:00 PM.

Figure 17 compares the PeMS traffic volumes of the same segment as Figure 16 in October 2022. This comparison provides more details on the traffic pattern in October during the Apple Hill Season. It shows that the volumes on Friday, Saturday, and Sunday vary significantly compared to average 2022. The weekend traffic volumes have more outstanding traffic volumes among mid-day hours from 10:00 AM to 2:00 PM.

Figure 18 shows the comparison of daily traffic volumes by day of week. October weekdays have higher than average traffic volumes. These differences are more pronounced on Friday and weekend days than other weekdays.

In the summer and fall of 2022 a new program called "Trip to Green" along US 50 was tested. This program set the traffic signals along US 50 in Placerville to remain green for the major eastbound and westbound movements on one weekend in August, September, and October. Northbound and southbound through movements were prohibited and access to the side streets was limited to right-in, right-out. During an evacuation, with predictable and controlled side street movements, the Trip to Green program would likely improve mobility and reduce bottlenecks along US 50. During the Caldor Fire, Trip to Green was first used and contributed to serving approximately 1000 additional vehicles on US 50.

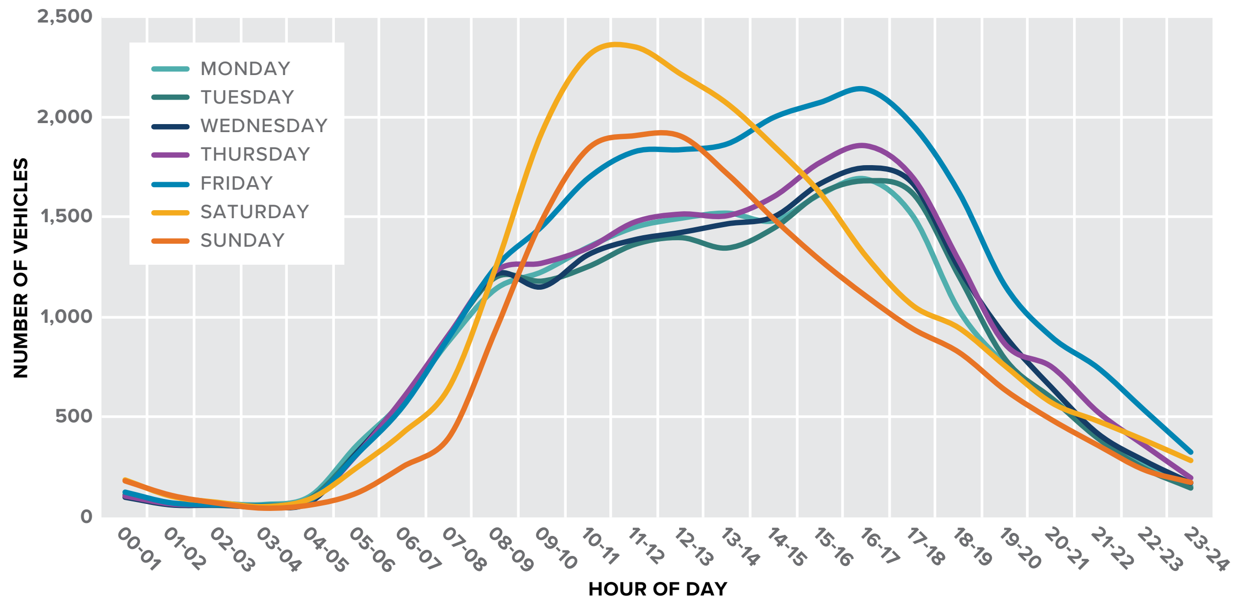


FIGURE 14. DAY OF WEEK PEMS TRAFFIC VOLUMES, OCTOBER 2022

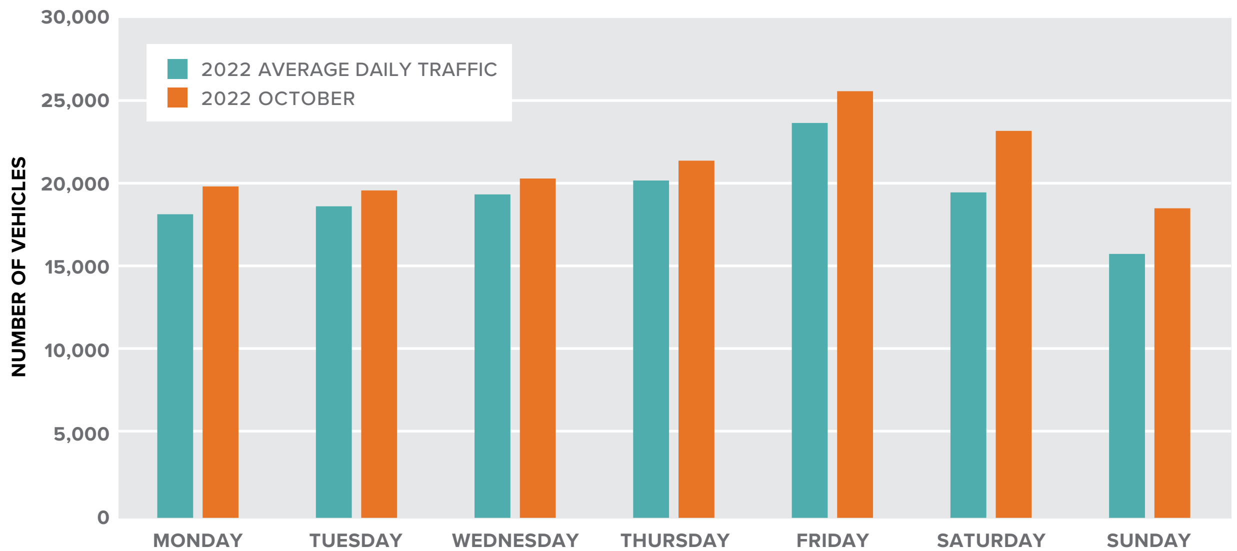


FIGURE 15. COMPARE DAY OF WEEK TRAFFIC VOLUME OF 2022 TO APPLE HILL SEASON

Congestion & Travel Time Reliability Analysis

Congestion and Travel Time Reliability are federal performance measures that form the basis for tracking operational efficiency of passenger vehicles on the network respectively. Both measures rely on National Performance Management Research Data Set (NPMRDS) speed data in 2022 from the Federal Highway Administration (FHWA).

The NPMRDS provides average speed data (five-minute averaging time) for federally defined roadway segments designated as part of the National Highway System (NHS). The FHWA NPMRDS speed data is provided at no cost for State Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs). However, it only covers roadways that are on the NHS. Since the NPMRDS does not cover non-NHS arterial roadways, speed data for any/all non-NHS arterial roadways on network within the study area must be purchased or obtained from alternative sources.

As with all large data sources, some data cleaning is necessary to remove significant outliers such as extreme high-speed e.g., 90+ mph.

CONGESTION

The Federal definition from the National Performance Management Measures Rule is used to define congestion for segments with heavy traffic. The heavy traffic segment threshold for the project study area is triggered if observed average speed is less than 75 percent of free-flow speed. The medium traffic segment threshold is defined as observed speed fills into 75 to 90 percent of free-flow speed. Low traffic segment is defined to as observed speed higher than 90 percent of free-flow speed. This metric is reported as a percentage of a defined network of roadways including:

- Percent of heavy traffic centerline miles on Interstate Highway System
- Percent of heavy traffic centerline miles on the National Highway System
- Percent of heavy traffic centerline miles on the representative local roadway network within Placerville City area

The congestion metrics will be applied to passenger vehicles.

TRAVEL TIME RELIABILITY

Travel time reliability accounts for the variance in travel times associated with motorized travel. The federal threshold for identifying unreliable travel time is road segments with an 80th percentile travel time more than 1.5 times longer than the average travel time. The Highway Capacity Manual (HCM), 6th Edition, defines travel time reliability using the 95th percentile travel time. Both federal and HCM approaches to analyze travel time reliability are included below. The 80th and 95th percentile travel time reliability metrics will be monitored.

The buffer time index (BTI) is defined as the amount of extra time a person needs to account for above the average travel time to ensure being on time 95 percent of the time (approximately one day late per month). If a commute trip usually takes 30 minutes, but there are periodic issues with weather or traffic incidents that can cause the commute to take 45 minutes, the buffer time would be 15 minutes, causing the commuter to be 15 minutes early on an average day, and late only occasionally. The BTI is simply the ratio of buffer time against the average travel time.

Travel time reliability is not the same as congestion or delay. A highly congested trip that is always or nearly always congested will likely have a very good reliability rating because it is predictable.

ROADWAY PERFORMANCE

This analysis reviews heavy traffic to diagnose and assess roadway performance issues. This metric serves as the primary basis for determining deficient corridors on the network. Given the rural characters of the roadway network in study area, the threshold for heavy traffic is triggered when observed average peak hour speed is less than 85 percent of the free-flow speed.

Figure 19 shows segments with heavy, medium, and low traffic reflecting passenger vehicles during the a.m. peak (7:00–9:00 AM), mid-day off-peak (12:00-2:00 PM), and p.m. peak (4:00-6:00 PM). It shows a comparison of the average condition to the seasonal peak period in October during the Apple Hill Festival. The larger maps are also provided in the Appendix.

CONCLUSION

The congestion analysis shows that the majority of segments with heavy traffic are mainly in downtown Placerville and SR 49 south of US 50.

Compared with weekends, weekdays have heavy traffic and lower reliability on SR 49. On October weekends during the Apple Hill season, SR 49 has significant increase of traffic. The congestion of the SR 49 and US 50 interchange area has increased on October weekends, starting from 7:00–9:00 AM. Eastbound US 50 from Carson Road interchange to Pondorado Road also has medium traffic specifically on October weekends.

Driving behavior and travel choices during a wildfire event will deviate from the typical conditions shown in this analysis, but locations with recurring congestion and unreliable travel time may provide insight into other geometric or capacity issues that, if resolved, can improve mobility during a high traffic condition.

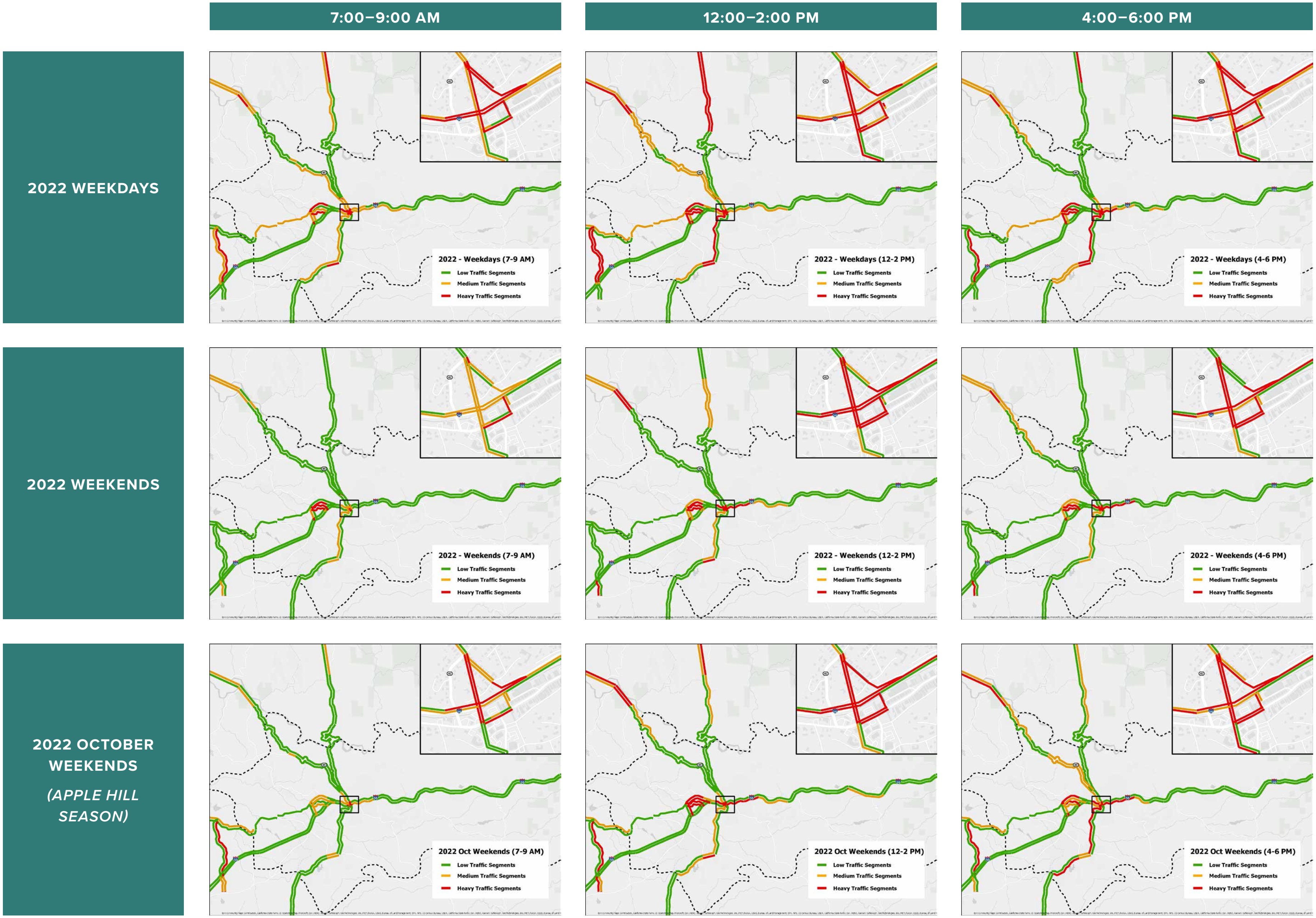
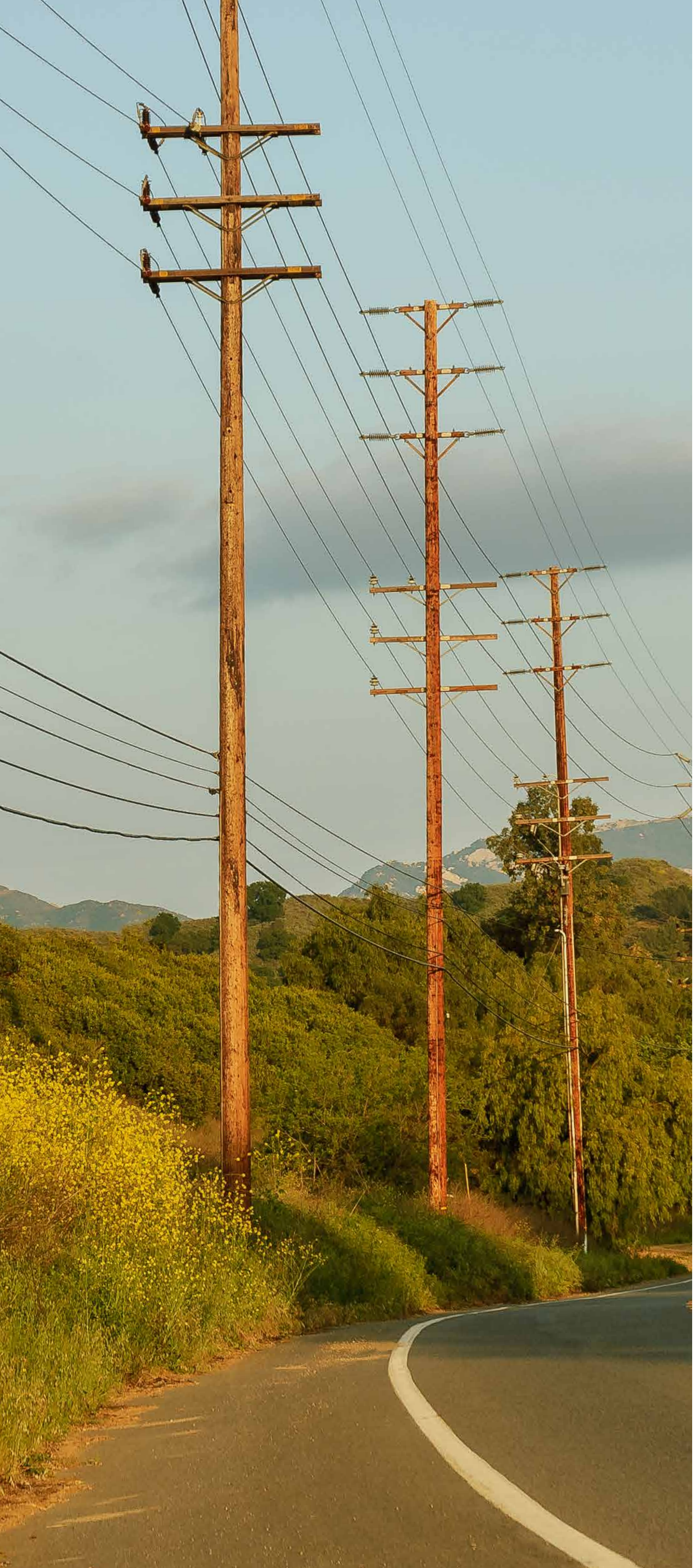


FIGURE 16. OCTOBER WEEKEND HEAVY TRAFFIC AND TRAVEL TIME RELIABILITY MAPS



Utility Network

THE PURPOSE OF THIS SECTION IS TO PROVIDE BACKGROUND INFORMATION ON CRITICAL FACILITIES THAT RELATE TO WILDFIRE HAZARD AND EVACUATION PREPAREDNESS. SPECIFIC FOCUS IS GIVEN TO COMMUNICATIONS NETWORKS, WATER SUPPLY SYSTEMS, AND POWER CONVEYANCE AND DISTRIBUTION. THIS INFORMATION WILL BE USED TO INFORM THE DYNAMIC MODELING CONDUCTED IN THE NEXT PHASE IN THE ASSESSMENT PROCESS.

The County recently compiled a detailed critical facilities and community lifeline database that includes 1,274 facilities.[24] The database was developed in GIS based on a combination of County-provided data, Homeland Infrastructure Foundation-Level Data (HIFLD), and local and jurisdiction-specific input. The critical facilities database was organized by County asset categories (focus areas) and by Federal Emergency Management Agency (FEMA) Community Lifeline (where appropriate).

The County defines a critical facility as a building structure, infrastructure, or system that is essential in providing utility or direction either during the response to an emergency or during the recovery operation. The County organizes critical facilities into four categories (focus areas): essential service, population at hazard, infrastructure at hazarad, and essential business. Of those identified in the County's database, the critical facilities that are located within the established greater Placerville are shown in Table 3. It should be noted that this list is not intended to be comprehensive. It is likely that there are additional facilities.

According to the Climate Vulnerability Assessment, key facilities include key safety and security facilities and lifeline services, specifically County fire and police stations and Emergency Operation Centers (EOCs). Other essential food, water, and shelter services included community facilities like emergency shelters, water and wastewater treatment plans and related infrastructure, and regional parks. Health and medical facilities include hospitals, medical clinics, and health centers. Essential services relate to energy included stationery and point data for electrical substations, EV charging stations, and power plants.

24 Critical facilities were recently compiled by El Dorado County to support its Climate Vulnerability Assessment. Though the report was not completed by the time of this study, this section is informed by data from the Safety Element Advisory Committee Draft (February 2023).

TABLE 3. CRITICAL FACILITIES IN THE GREATER PLACERVILLE AREA

FACILITY TYPE	CATEGORY	QUANTITY
Emergency Medical Services	Essential Service	1
Hospital	Essential Service	1
Emergency Operations Center	Essential Service	1
Fire Station	Essential Service	9
Government Facility	Essential Service	53
Law Enforcement	Essential Service	13
Shelter	Essential Service	11
Communications	Infrastructure	46
Dam	Infrastructure	11
Energy & Utility Services	Infrastructure	1
Power Plants	Infrastructure	2
Power Substation	Infrastructure	5
Wastewater	Infrastructure	3
Water Supply	Infrastructure	6
Health Care	Populations at Hazard	3
Psychiatric Health Facility	Populations at Hazard	1
Child Care	Populations at Hazard	23
Senior Care	Populations at Hazard	13
Senior Community Services	Populations at Hazard	2
College	Populations at Hazard	2
School	Populations at Hazard	43
Prison	Populations at Hazard	2

Aside from the critical service facilities described in more detail in the subsections below, the health facilities, care facilities, and educational facilities that are located in the study area are recommended to be included in the dynamic modeling analysis conducted in the subsequent phase of this study. These facilities all support members of the communities that may require additional support in the context of an evacuation. More information on vulnerable members of the community can be found in Table 2, including those that relate to the types of critical facilities shown in Table 3 and Figure 20.

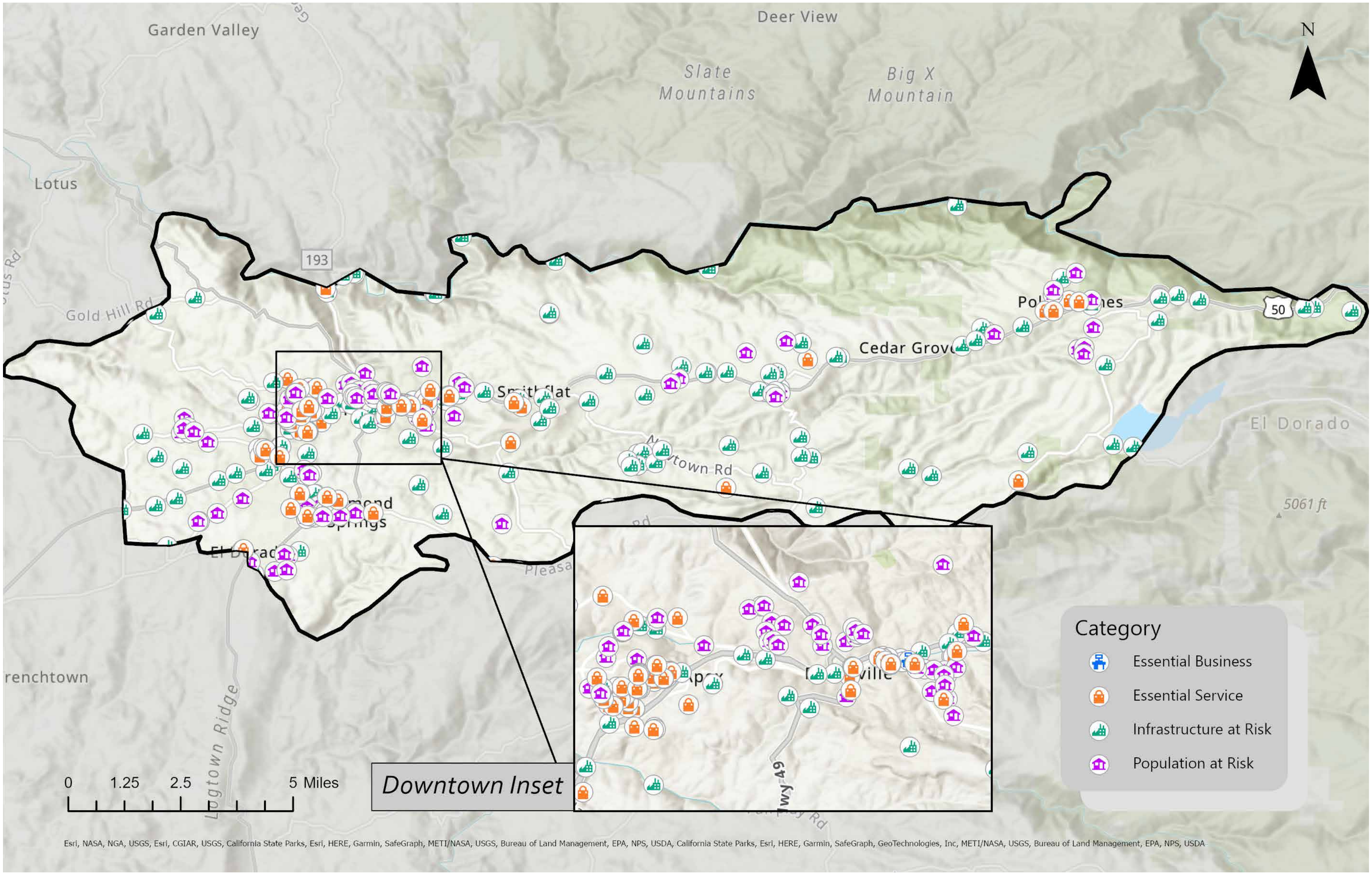


FIGURE 17. CRITICAL FACILITIES

Water Supply

The El Dorado Irrigation District (EID) is responsible for providing potable water supply services to the study area. EID is a special district organized and existing under the California Irrigation District Law (Water Code §20500, et seq.) and authorizing statutes (Water Code §22975, et seq.). EID provides drinking water for homes, schools and businesses and recycled water from its wastewater treatment plants to irrigate front and backyards and public landscapes. The District serves more than 125,000 residents in northern California's El Dorado County.

EID's existing sources of water include both surface water and recycled water. It operates a hydroelectric power project (Project 184) as well as dams, reservoirs and 23 miles of flumes, canals, siphons and tunnels. The study area falls within the EID's Eastern Water Supply Region, and it receives water by gravity flow from EID's eastern supply sources. The City of Placerville receives water from EID as a wholesale customer.

The portion of the potable water system relevant to the study area has two primary points of diversion that deliver raw water to the system: the EID owned and operated Sly Park Dam/ Jenkinson Lake and the EID-owned and operated El Dorado Hydroelectric Federal Energy Regulatory Commission (FERC) Project 184 (Project 184) at Forebay Reservoir. Raw water diverted at these locations is treated at the Reservoir A Water Treatment Plant (WTP) and Reservoir 1 WTP, respectively.

There are several EID pipelines that convey water to the study area. The City of Placerville receives water from the EID system through several turnouts along a section called the El Dorado Main #1 (EDM#1) and EDM#1 Lateral 8.0S. Water from Reservoir 1 and Reservoir A WTPs flow by gravity via several reservoirs and into the South side of the study area via multiple pipelines that flow water to the South of the service area, including the Pleasant Oak Main, the Diamond Springs Main, and EDM#1 Lateral 8.0S. Water from Reservoir A flows by gravity either into El Dorado Main #1 or #2 or Southwest through the Pleasant Oak Main and Diamond Springs Main. This Southwest branch also connects with EDM#1 Lateral 8.0S via the Highway 49 Intertie. In summary, it is possible to deliver water to Placerville if one WTP goes offline or if there is a single point of failure in the conveyance system.

CRITICAL FACILITIES OVERVIEW

The following facilities have been identified as critical to the ability of EID to provide water in the study area. In addition to providing the lifeline service of potable water to the community, the function of these facilities is critical to supporting fire suppression activities. This is because firefighters need sufficient water pressure to effectively protect people and structures.

- **Reservoir 1 Water Treatment Plant:** The facility treats water from the South Fork of the American River via Forebay Reservoir and supplies up to 26 million gallons per day (MGD) of potable water. Raw water is diverted at the El Dorado Forebay where it travels through three miles in the Main Ditch to the Reservoir 1 WTP. The Main Ditch also includes customers receiving raw water.
- **Reservoir A Water Treatment Plant:** The facility treats water from Jenkinson Lake and supplies up to 56 MGD of potable water. Although the production capacity of the Reservoir A WTP is 56 MGD, the annual supply available for diversion at Jenkinson Lake during a normal year is limited to approximately 23,000 acre-feet (AF). Therefore, the average annual production of Reservoir A WTP is limited to approximately 21 MGD, with a maximum day production of approximately 48 MGD.
- **Tank 2 and 2A:** These two 5.5 million gallon storage tanks store water from the Reservoir 1 and Reservoir A WTPs before the system continues Westward towards the study area.
- **Tank 3:** The 1.5 million gallon storage tank is where the EDM 1 Lateral 8.0 S begins, which is the pipeline that provides water to the City of Placerville. It is located on the Eastern side of the City near Highway 50 and is responsible for providing a significant portion of the City's water supply.
- **Tank 4:** This 0.5 million gallon storage tank is located on EDM#1 and EDM#2 to the North of the City and Highway 50.
- **Tank 6:** This 3.5 million gallon storage tank is located on EDM#1 Lateral 8.0S on the Southern side of the City.

SENSITIVITY OVERVIEW

The following sensitivities to wildfire hazard have been identified for the different types of critical water facilities in the study area. The key challenge when different facilities within the water system are at hazard of being impacted by wildfire and power outages is maintaining system pressure. EID staff have developed several workarounds when different facilities and system components go offline for maintaining pressure. These options typically require staff to be on site, which can be challenging and hazardous under disaster conditions. However, maintaining pressure is critical to fire suppression activities and is given high priority in order to maximize the ability of firefighters to protect lives and property.

RESERVOIRS AND WATER TREATMENT PLANTS

The facilities contain equipment and processes that are vulnerable to fire damage. If the facilities were to go offline, they could be bypassed under certain circumstances to maintain pressure. There is no bypass to the Reservoir A WTP, which could lead to an outage. The Reservoir 1 WTP floating cover is also not easily bypassed, which could also cause a widespread outage. The facilities also require power to operate but can be run using small generators if needed.

If power is lost, both facilities can automatically switch to backup power systems. Refueling could also be an issue. At present, the facilities can last two to three days before needing to refuel. Both Reservoir A and 1 WTPs are hardened and feature block buildings that are resistant to fire. EID performs vegetation management activities surrounding the facilities to thin the vegetation and make them easier to protect during a wildfire event. Staff also use remote cameras to monitor conditions at the reservoirs and facilities. Reservoir 1 has a plastic sheeting covering the water, which is particularly vulnerable to burning. Both facilities require onsite staff to support plant operations, such as backwashing and filter maintenance, and access is an issue during wildfire events. Reservoir A has one vehicle access point, and a secondary access point can be used on foot. The site could be reached by helicopter. Reservoir 1 also has one vehicle access point, including for 100 local customers. The site could not be reached by helicopter. Refueling backup generators under wildfire conditions can require special care and escorts by emergency personnel.

FLUMES

There are approximately 16 flumes, which are wooden structures that convey water over mountainous terrain. Damage to several flumes were caused by the Caldor Fire (2021).

TRANSMISSION MAINS

The transmission pipelines are relatively resistant to fire damage because they are below ground and made of fire resistant materials such as cement, iron, and steel. However, service laterals that convey water from the larger transmission mains to customers are typically high density polyethylene (HDPE), which can be more susceptible to fire damage than concrete or metal pipes. If transmission systems are damaged and gaps are created in the system, there have been instances where contaminants such as benzene enter the water system and can be difficult to remove.[25]

PUMP STATIONS

These facilities also contain equipment that is vulnerable to fire damage. Additionally, they require power to function. If smaller pump stations lose their primary power, they can be run using trailered generators and refueling can also be an issue. Similarly to the treatment facilities, staff are needed onsite to manually switch power configurations, which requires direct access. Refueling backup generators under wildfire conditions can require special care and escorts by emergency personnel.

25 *Recent research on wildfire events in California, including the 2018 Camp Fire, 2020 CZU Lightning Complex, and the 2020 Tubbs Fire have indicated a relationship between fire damaged conveyance systems and the introduction of contaminants linked to plastic pipes.*

Power

The Pacific Gas and Electric Company (PG&E) provides electricity and natural gas to the study area. Incorporated in 1905, PG&E is one of the largest energy companies in the United States. It is responsible for the transmission and delivery of energy across a service area that stretches from Eureka in the North to Bakersfield in the South, and from the Pacific Ocean in the West to the Sierra Nevada range in the East. The investor-owned utility company serves 5.5 million electricity customers and 4.5 million natural gas customers. It manages over 100,000 miles of electric distribution lines and 18,000 miles of interconnected transmission lines. It also manages over 42,000 miles of natural gas distribution pipelines and 6,000 miles of transmission pipelines.

PG&E delivers power and natural gas to the study area via large overhead transmission lines from the West. PG&E's grid is interconnected across its service area. Therefore, power demand in the service area is generated through a diverse collection of energy sources, including natural gas, nuclear, large hydropower, and renewable (i.e., wind, solar, geothermal, etc.).

Power utilities in California, including PG&E, have come under scrutiny in recent years by State regulators.[26] Since 2015, six of California's most destructive wildfires have been linked to power line failures. The points of failure include uninsulated lines, older transformers, and other equipment, which can be damaged by falling trees and flying debris, which can spark flames.

Historically, the availability of power in the study area has depended on connectivity with the grid at large. This means that if a specific area becomes disconnected from the grid, then that area experiences a power outage. Power outages have become much more frequent in recent years because PG&E has adopted a strategy known as Public Safety Power Shutoff (PSPS) in order to reduce hazard during extreme wildfire hazard conditions (a combination of low humidity, windy, and/or hot weather conditions). This is done to reduce the hazard of a damaged section of the grid sparking a fire. PSPS events have become more targeted (i.e., effecting smaller areas) and shorter duration as PG&E improves its processes. However, PSPS events in the study area remain frequent in occurrence. Distribution lines are also being retrofitted with Enhanced Powerline Safety Setting (EPSS). This technology shuts off power within a tenth of a second if there is wildfire hazard, such as a tree hitting a line. This has resulted in reduced wildfire hazard but an increase in localized power disruptions. The other benefit of this technology is that smaller sections of the grid are affected by power disruptions, which therefore impacts fewer customers.

CRITICAL FACILITIES OVERVIEW

The following facilities have been identified as critical to the ability of PG&E to provide electrical power to the study area. In addition to providing the lifeline service of power to the community, the function of these facilities is critical to other critical activities in an active evacuation event and/or a wildfire event. Power is required for other critical services, including water and communications. Power outages necessitate shifts to backup power options for facilities and equipment that support critical services if available.

- **Transmission:** Electricity is generated outside of the study area and delivered to local substations via large 115 kV overhead transmission lines. The PG&E transmission line that serves the study area originates in Folsom and extends through the study area and through Placerville towards Camino, Pollock Pines.
- **Substations:** Substations convert voltage and serve as intermediaries between elements of the power grid. The substations in the study area step-down the incoming high voltage received from the transmission lines. The lower voltage power is then transmitted to local distribution networks which is used by the community. There are substations in Diamond Springs, Placerville, White Rock, Camino, and Pollock Pines. Substations are an above-ground collection of equipment that are largely exposed to the elements and include circuit breakers, switches, busbars, lightning arresters, capacitors, and synchronous condensers. Together, the different components enable operators to effectively control the flow of energy and isolate issues when they occur.

26 Electrical System Safety; California's Oversight of the Efforts by Investor-Owned Utilities to Mitigation the Risk of Wildfires Needs Improvement, March 2022

- **Distribution Lines:** Electricity is conveyed from the substations to local residents and businesses through distribution lines which range from 2kV to 35kV. Distribution transformers are scattered throughout the distribution network to step-down voltage for utilization. The distribution network tends to align with local roads. Where feasible, a given location can be connected to more than one substation, this not the case in rural areas such as the study area.
- **Microgrids:** Microgrids are a relatively new type of grid configuration, whereby sections of a distribution network are modified to remain energized if disconnected from the larger regional power grid. There are two microgrids in the study area; one in Placerville, and one in Pollock Pines. The two systems can independently allow their downtown districts (including fire stations, banks, markets, electric vehicle charging stations, etc.) to remain energized during a major power disruption.
- **Community Resource Centers (CRCs):** These facilities are opened by PG&E staff to provide resources, such as air conditioning, heating, water, snacks, supplies, wi-fi, device charging, and restrooms, as well as up-to-date information during PSPS events. There are four CRCs in Placerville and two located in Pollock Pines.

SENSITIVITY OVERVIEW

The following sensitivities to wildfire hazard have been identified for the different types of critical power infrastructure in the study area.

TRANSMISSION

These powerlines receive extensive vegetation treatment and feature very wide setbacks that are cleared of vegetation. As a result, these lines are typically well-distanced from flammable materials and aligned away from major roadways.

SUBSTATIONS

These facilities can be damaged by wildfire and can be sensitive to extreme heat but are typically setback away from vegetation and maintained on a regular basis.

DISTRIBUTION LINES

This equipment is very sensitive to wildfire and high winds, particularly the wooden poles. Uninsulated distribution lines can arc and start fires, particularly if too close to vegetation. Because distribution networks are so large, it is more difficult to maintain effective spacing between the lines and nearby vegetation. There have also been examples of accumulating soot creating a conductive pathway and causing leakage current that may force a shutdown.

Ionized smoke air can act as a conductor, causing arcing between lines or between lines and the ground. High winds can snap poles or damage trees, which then damage poles.

MICROGRIDS

Microgrids are designed to operate independently when power outages occur. This can be done either through mobile backup generators that are temporarily connected to the microgrid or fixed infrastructure that can store energy.

Communications

There are a number of communications systems in the service area used for different purposes. The primary commercial cellular (wireless) service providers are Verizon, AT&T, and T-Mobile. The primary broadband (home internet) service providers are Xfinity (cable), T-Mobile (cellular) AT&T (digital subscriber line), HughesNet (satellite), Viasat (Satellite), Ruralnet (fixed wireless), and Cal.net (DSL and fixed wireless). Public safety and law enforcement organizations in the area use private Land Mobile Radio (LMR) systems to communicate. EID and PG&E also use LMR systems for internal communications. The LMR systems used by different organizations are independent and rely upon separate fixed infrastructure. In addition, there are neighborhood Radio Watch groups throughout the study area to monitor wildfire and evacuation conditions. However, these groups rely on commercial infrastructure (cell towers).

Communications systems serve an essential and irreplaceable role in wildfire and evacuation events. Cellular communications are becoming the primary vehicle for evacuation messaging to the public. These communications inform people if their neighborhoods are under an evacuation warning or under a mandatory evacuation notice. There is also a huge spike in cellular communications as people coordinate with one another which can increase the load on a system that might not be optimally performing because of power outages or wildfire damage. Emergency responders, coordinators, and utility staff also rely upon communication networks in order to provide their essential services, particularly if deployments are necessary to protect or modify infrastructure at remote locations and to coordinate evacuation activities and other critical response activities.

The primary communication systems, both commercial and service provider-based, rely on fixed infrastructure to function. The infrastructure is generally specific to a particular system, but can (and are sometimes) shared by different systems. The fixed infrastructure requires power to function and can therefore be vulnerable to power outages. Many towers have backup power options, which can work for several days before losing power. There are often redundancies built into cellular and LMR networks, such that if one tower goes offline, other towers can compensate for the loss. However, in rural areas, this is not always the case. Commercially based satellite communication networks are an emerging option for cellular communications. This type of network relies on an interconnected network of satellites, which provide coverage over a service area. As a result, they do not have the same vulnerabilities as tower-based systems and can theoretically function more effectively during a wildfire event in which there are power disruptions.

Emergency messaging is provided through the El Dorado County Emergency Alerts system. The system is an emergency notification service that allows emergency officials to notify residents and businesses by telephone, cell phone, text message, email, and social media regarding time-sensitive general and emergency notifications. Only authorized officials have access to the El Dorado County Emergency Alerts system. The system is used to notify residents about imminent threats to health and safety, such as the need to evacuate due to a wildfire or take other appropriate actions in the event of a flood or other critical police activity. The contacts database contains information, which was migrated from the previous “CodeRED” system, but residents are encouraged to verify that their contact information is up to date. The El Dorado County Emergency Alerts system is powered by RAVE Mobile Safety.

CRITICAL FACILITIES OVERVIEW

The following facilities have been identified as critical to the ability of emergency responders, critical service providers, and the public to communicate effectively during a wildfire and an evacuation event in the study area.

- **Cellular Towers:** Also known as cell sites, cellular towers are vertical structures with mounted electric communications equipment and antennas. When a cell phone is used, it emits an electromagnetic radio wave, which is received by the cellular tower’s antenna. The antenna then transmits the signal to a switching center so that it can be conveyed to either another cell phone or a telephone network. The range of the tower is based on line of sight, but can vary based on topography and features of the landscape (i.e., hills, trees, buildings). The range can also depend on other factors such as heights, transmission power, orientation, and weather conditions. Towers can also handle a certain amount of traffic at any given moment. Cellular towers require power and are typically connected to the power grid. Some towers are equipped with backup power, which can last for several days before failing.

There are several towers positioned across the study area in order to provide cellular service for the different commercial cellular providers, including Verizon, AT&T, and T-Mobile. Cellular towers in the study area use internet protocol (IP) for calls. This means that if there is an internet failure in the area, then cellular communications also fail.

- **Radio Towers:** These structures are similar to cellular towers but support the private radio-communication systems used by fire departments, law enforcement, and utilities. Each system has its own dedicated equipment, which it mounts at an elevated location, typically at owned facilities. For example, water utilities often deploy radio antennas and signal repeaters on water towers, taking advantage of their elevated positions and the distribution of these facilities across their service areas. There are also Neighborhood Radio Watch networks which provide local communications that do not depend on commercial networks. These systems are independent networks that rely on locally mounted antennas and repeaters to connect amateur (or “Ham”) radios. For example, the El Dorado County Neighborhood Radio Watch uses simple, affordable, General Radio Mobile Service or “GMRS” Radios to communicate when the power is off and cell phone and Internet service is disabled. Communities will use Community Radio Repeater installations to extend neighborhood radio coverage.
- **Fiber Optic Cables:** Fiber optic cables are either run above or below ground. In the study area, cables are primarily run above ground using the power distribution infrastructure. These cables support internet service connectivity. Xfinity is the fiber-optic internet service provider in the study area. This type of internet connection is available in certain parts of the study area within the fixed-fiber-optic network.
- **Digital Subscriber Line (DSL):** A DSL system is a relatively high-speed internet service provided through existing telephone lines. DSL internet is provided within the telephone (landline) network. It is widely available within the study area.
- **Satellite Networks:** Satellite-based internet providers are relatively new but starting to be available in the study area. Relatively high speed internet connectivity is provided through a network of geostationary satellites. Data is exchanged between the satellites and a number of ground stations called gateways. End users need a modem, to exchange data with ground stations.

SENSITIVITY OVERVIEW

The following sensitivities to wildfire hazard have been identified for the different types of critical communications infrastructure in the study area.

CELLULAR TOWERS

This equipment can be sensitive to wildfire and power outages. If mounted cellular equipment is supported with backup power capabilities, it can continue to operate for up to several days without failing. Damaged or unpowered mounted cellular equipment can lead to communication disruptions for critical service providers, emergency responders, and the public unless there are sufficient backup systems in place to compensate.

RADIO TOWERS

This equipment can similarly be sensitive to wildfire and power outages. If mounted radio equipment is supported with backup power capabilities, it can continue to operate for up to several days without failing. Damaged or unpowered radio equipment can lead to communication disruptions for critical service providers and emergency responders unless there are sufficient backup systems in place to compensate.

FIBER OPTIC CABLES

This equipment is very sensitive to fire damage, which can lead to widespread internet service disruptions. Since above ground fiber optic networks run alongside power distribution networks, they are particularly sensitive to wildfire damage, particularly when mounted on wooden poles.

DIGITAL SUBSCRIBER LINE

This equipment is similarly very sensitive to fire damage because telephone lines are also run alongside power distribution lines. As with fiber optic cables, above ground distribution is particularly sensitive to wildfire damage, which can lead to widespread internet (as well as landline telecommunication) disruptions.

SATELLITE NETWORKS

Satellite networks are perhaps the most robust networks as related to wildfire hazard. Since the only local equipment are the end-user modems, there is relatively low hazard of a local or regional service disruption. The modems do require power, but this can be achieved through small-scale battery backup systems in the case of a widespread power disruption.

Policy & Plan Review

ONE OF THE WAYS IN WHICH THE CITY OF PLACERVILLE AND EL DORADO COUNTY CAN LIMIT WILDFIRE HAZARD IS BY ESTABLISHING POLICY AND REGULATIONS FOR NEW DEVELOPMENT AND REDEVELOPMENT.

The City and County have policies, codes, and regulations which direct property owners to manage fuels and vegetation, maintain adequate defensible space, harden structures, establish emergency vehicle access, install appropriate signage, and meet minimum water flow requirements. Implementation of these actions help reduce the probability of damage and loss from wildfire events.

This section provides an overview of adopted fire related policies and documents and codified standards currently in place for the City of Placerville and El Dorado County. The memo provides a foundation for the development of more stringent and up-to-date fire safety requirements.

El Dorado County Public Health, Noise, and Safety Element

El Dorado County's General Plan is a blueprint for meeting the community's long-term vision for the future. The General Plan includes several elements (or sections) that cover different topics. The Public Health, Noise, and Safety Element, last updated in August 2019, addresses natural and man-made hazards and noise issues that may result in personal injury, loss of life, property damage, or environmental damage. The Element includes wildfire safety objectives and policies that focus on defensible space, new development, and fuel management. The Element also includes an objective and policy that focus on fire prevention education with the community. There are policy gaps in the existing version of the Element, which the County is currently addressing through their 2022 General Plan Safety Element update, including objectives and policies on structure hardening, roadway standards, disaster response, and community preparedness. The County's Defensible Space Work Group (lead by the CAO's Office) is also currently working on amending and improving its Hazardous Vegetation and Defensible Space Ordinance. The policies, objectives, location in the General Plan document, and category are organized in Table 1.

TABLE 4. EL DORADO COUNTY PUBLIC HEALTH, NOISE, AND SAFETY ELEMENT

ITEM	TYPE	LOCATION	CATEGORY
Objective 6.2.1 All new development and structures shall meet "defensible space" requirements and adhere to fire code building requirements to minimize wildland fire hazard	Objective	Page 112	Defensible Space
Policy 6.2.1.1 Implement Fire Safe ordinance to attain and maintain defensible space through conditioning of tentative maps and in new development at the final map and/or building permit stage	Policy	Page 113	Defensible Space
Policy 6.2.1.2 Coordinate with the local Fire Safe Councils, California Department of Forestry and Fire Protection, and federal and state agencies having land use jurisdiction in El Dorado County in the development of a countywide fuels management strategy	Policy	Page 113	Defensible Space
Objective 6.2.2 Regulate development in areas of high and very high fire hazard as designated by the California Department of Forestry and Fire Prevention Fire Hazard Severity Zone Maps	Objective	Page 113	Development
Objective 6.2.2 Regulate development in areas of high and very high fire hazard as designated by the California Department of Forestry and Fire Prevention Fire Hazard Severity Zone Maps	Objective	Page 113	Development
Policy 6.2.2.1 Fire Hazard Severity Zone Maps shall be consulted in the review of all projects so that standards and mitigation measures appropriate to each hazard classification can be applied. Land use densities and intensities shall be determined by mitigation measures in areas designated as high or very high fire hazard	Policy	Page 113	Development
Policy 6.2.2.2 The County shall preclude development in areas of high and very high wildland fire hazard or in areas identified as wildland-urban interface (WUI) communities within the vicinity of Federal lands that are a high hazard for wildfire, as listed in the Federal Register Executive Order 13728 of May 18, 2016, unless such development can be adequately protected from wildland fire hazard, as demonstrated in a WUI Fire Safe Plan prepared by a qualified professional as approved by the El Dorado County Fire Prevention Officers Association. The WUI Fire Safe Plan shall be approved by the local Fire Protection District having jurisdiction and/or California Department of Forestry and Fire Protection. (Resolution 124-2019, August 6, 2019)	Policy	Page 113	Development

ITEM	TYPE	LOCATION	CATEGORY
Objective 6.2.3 Application of uniform fire protection standards to development projects by fire districts	Objective	Page 113	Development
Policy 6.2.3.1 As a requirement for approving new development, the County must find, based on information provided by the applicant and the responsible fire protection district that, concurrent with development, adequate emergency water flow, fire access, and firefighting personnel and equipment will be available in accordance with applicable State and local fire district standards	Policy	Page 113	Development
Policy 6.2.3.2 As a requirement of new development, the applicant must demonstrate that adequate access exists, or can be provided to ensure that emergency vehicles can access the site and private vehicles can evacuate the area	Policy	Page 114	Roadway Standards
Policy 6.2.3.3 Day care centers shall be subject to conformance with all applicable sections of Title 19 of the Fire Code	Policy	Page 114	Development
Policy 6.2.3.4 All new development and public works projects shall be consistent with applicable State Wildland Fire Standards and other relevant State and federal fire requirements.	Policy	Page 114	Development
Objective 6.2.4 Reduce fire hazard through cooperative fuel management activities	Objective	Page 114	Fuel Management
Policy 6.2.4.1 Discretionary development within high and very high fire hazard areas shall be conditioned to designate fuel break zones that comply with fire safe requirements to benefit the new and, where possible, existing development	Policy	Page 114	Fuel Management
Policy 6.2.4.2 The County shall cooperate with the California Department of Forestry and Fire Protection and local fire protection districts to identify opportunities for fuel breaks in zones of high and very high fire hazard either prior to or as a component of project review	Policy	Page 114	Fuel Management
Objective 6.2.5 Inform and educate homeowners regarding fire safety and prevention	Objective	Page 114	Fire Prevention Education
Policy 6.2.5.1 The County shall cooperate with the U.S. Forest Service, California Department of Forestry and Fire Protection, and local fire districts in fire prevention education programs	Policy	Page 114	Fire Prevention Education

City of Placerville Health and Safety Element

The City of Placerville's General Plan includes the Health and Safety Element as Chapter 6. The Health and Safety Element was updated in June 2013. The Element's fire objectives and policies focus on structure hardening, new development, roadway standards, and fuel management. The Element also includes a policy on defensible space requirements. There is a lack of objectives and policies on disaster response, community preparedness, and public engagement. The policies, objectives, location in the General Plan document, and category are organized in Table 5.

TABLE 5. CITY OF PLACERVILLE HEALTH AND SAFETY ELEMENT

ITEM	TYPE	LOCATION	CATEGORY
1. Areas of high and extreme fire hazards shall be the subject of special review, and building and higher intensity uses shall be limited unless the hazards are mitigated to a point acceptable by the Fire Department	Policy	Page 46	Structure Hardening
2. All new development in areas of high and extreme fire hazards as shown in Figure VIII-3 in the Background Report shall be constructed with fire retardant roof coverings.	Policy	Page 46	Development
3. The City shall require the installation of an approved interior sprinkler system in all new combustible wood frame commercial buildings of 5,000 square feet or more	Policy	Page 47	Structure Hardening
4. All new development in areas of high and extreme fire hazards as shown in Figure VIII-3 in the Background Report shall provide for clearance around the structures and the use of fire-resistant groundcover	Policy	Page 47	Defensible Space
5. The City shall encourage the Placerville Fire Department to maintain a regular program of fire inspection for commercial and industrial buildings	Policy	Page 47	Structure Hardening
6. The City will ensure in approving and constructing new roads and streets that they are adequate in terms of width, turning radius and grade to facilitate access by firefighting apparatus. All plans for new streets for areas within the Urban Service Area and/or sphere of influence of the City shall be reviewed by the Placerville Fire Department to ensure that City standards are met since there is a high probability that these areas will be annexed to the City at some point in the future	Policy	Page 47	Roadway Standards
7. All new development shall be required to meet the minimum fire flow rates and other standards specified by the City's Fire Code	Policy	Page 47	Development
8. Future roadway systems and networks shall be designed with at least one means of egress other than the access in all developing areas	Policy	Page 47	Roadway Standards

ITEM	TYPE	LOCATION	CATEGORY
9. The City shall not approve any medium or high-density residential developments unless they are served by a street system with at least two streets capable of carrying peak load traffic	Policy	Page 47	Development
10. Parcel splits and multi-family developments shall not be allowed in areas served by narrow streets	Policy	Page 47	Development
11. In approving commercial, industrial, and multi-family developments, the City shall ensure all structures are located within 150 feet of an access useable by fire trucks	Policy	Page 47	Development
12. Existing streets shall be upgraded to meet City Subdivision Ordinance standards wherever possible	Policy	Page 47	Roadway Standards
13. Parking shall be restricted on streets less than 28 feet in width curb to curb	Policy	Page 47	Roadway Standards
14. The City shall continue to aggressively enforce its fire code and weed abatement regulations	Policy	Page 47	Fuel Management
15. The City shall encourage the Placerville Fire District to enact and enforce a weed abatement ordinance for the unincorporated area within the Fire District's service area	Policy	Page 47	Fuel Management
16. The City shall strive to restrict vehicular access and recreational use of undeveloped foothill areas during critical fire hazard periods	Policy	Page 47	Roadway Standards
17. The City shall adopt a uniform system for numbering structures, residences, and businesses	Policy	Page 47	Structure Hardening
18. The City shall remove obstructions obscuring street signs and require that house numbers be legible from the street. Commercial structures with rear street access shall be identified with the business name and street address in a clear and conspicuous manner on the rear of the building	Policy	Page 47	Roadway Standards

City of Placerville Defensible Space Guidelines

The City of Placerville's Defensible Space Guidelines were developed in alignment with the City's Hazardous Vegetation and Combustible Materials Abatement Ordinance (2019). The document provides public-facing guidelines based on the City's ordinance to guide fuel modification measures to create defensible space around structures. The guidelines describe modification measures for both improved parcels and unimproved parcels, as shown in Table 6.

TABLE 6. CITY OF PLACERVILLE DEFENSIBLE SPACE GUIDELINES

ITEM	LOCATION
IMPROVED PARCELS	
Maintain a defensible space by removing and clearing all flammable and combustible vegetation within 30 feet of any structure. Single specimens of trees or other vegetation may be retained provided they are adequately spaced, well-pruned, and create a condition that avoids spread of fire to other vegetation or to a structure.	Page 3
Dead and dying woody surface fuels and aerial fuels within the Reduced Fuel Zone (30-100 feet) shall be removed. Loose surface fuels shall be permitted to a depth of 3 inches. This guideline is primarily intended to eliminate trees, bushes, shrubs and surface debris that are completely dead or with substantial amounts of dead branches or leaves/needles that would readily burn.	Page 3
Grass/turf areas should be kept green and mowed to 6 inches in height or less;	Page 3
Maintain at all times a ten-foot (10') minimum clearance of vegetation next to the roadside, including private roads and driveways.	Page 3
Down logs or stumps anywhere within 100 feet from a structure, when embedded in the soil, may be retained when isolated from other vegetation. Occasional (approximately one per acre) standing dead trees (snags) that are well-spaced from other vegetation and which will not fall on buildings or structures or on roadways/driveways may be retained.	Page 3
Within the Reduced Fuel Zone (30 – 100 feet), one of the following fuel treatments (6a or 6b) shall be implemented. Properties with greater fire hazards will require greater clearing treatments. Combinations of the methods may be acceptable as long as the intent of these guidelines is met.	Page 3
In conjunction with General Guidelines 1, 2, and 3, above, minimum clearance between fuels surrounding each building or structure will range from 4 feet to 40 feet in all directions, both horizontally and vertically. (Exception: See Continuous Tree Canopy defined in 5b)	Page 3
To achieve defensible space while retaining a stand of larger trees with a continuous tree canopy, apply the following treatments: • Generally, remove all surface fuels greater than 6 inches in height. Single specimens of trees or other vegetation may be retained provided they are adequately spaced, well- pruned, and create a condition that avoids spread of fire to other vegetation or to a building or structure. • Remove lower limbs of trees ("prune") to at least 6 feet up to 15 feet (or the lower 1/3 branches for small trees). Properties with greater fire hazards, such as steeper slopes or more severe fire danger, will require pruning heights in the upper end of this range.	Page 3

ITEM	LOCATION
UNIMPROVED PARCELS OF LESS THAN TWO ACRES	
Dead and dying woody surface fuels and aerial fuels within the Reduced Fuel Zone shall be removed. Loose surface fuels shall be permitted to a depth of 3 inches.	Page 6
Single specimens of trees or other vegetation may be retained provided they are well spaced, well-pruned, and create a condition that avoids spread of fire to other vegetation or to a structure.	Page 7
Down logs or stumps anywhere, when embedded in the soil, may be retained when isolated from other vegetation.	Page 7
Firebreaks shall be disked around the entire perimeter of the parcel. Scraping will also be allowed, provided that the scraped material is removed or spread evenly over the remaining unscraped property.	Page 7
Single specimens of trees or other vegetation may be retained provided they are well spaced, well-pruned, and create a condition that avoids spread of fire to other vegetation or to a structure.	Page 7
Down logs or stumps anywhere within 100 feet from a structure, when embedded in the soil, may be retained when isolated from other vegetation.	Page 7

California Code of Regulations Title 24, Part 9

The California Code of Regulations, Title 24, Part 9, the California Fire Code, includes a sweeping set of regulations for safeguarding life and property from the hazards of fire and explosion, dangerous conditions arising from storage, handling, and use of hazardous materials and devices, and hazardous conditions in the use or occupancy of buildings or premises. The California Fire Code also contains provisions to assist emergency response personnel. The City of Placerville and El Dorado County have adopted the 2019 California Code of Regulations Title 24, Part 9. Both jurisdictions have not yet adopted the 2022 California Fire Code Title 24, Part 9.

El Dorado County Ordinance No. 5101 Vegetation Management and Defensible Space

El Dorado County's Vegetation Management and Defensible Space Ordinance was adopted in February 2020. The defensible space requirements in the ordinance align with the current state requirements to establish a 100-foot defensible space from the front and rear of the structure and maintain a 30-foot defensible space around all buildings/structures. However, the Ordinance does not include requirements that align with SEC 2.5. Section 51182 of the government code, as amended by Assembly Bill No. 3074 in September 2020. The government code requires that more intense fuel reductions be used between five and 30 feet around a structure.

City of Placerville Ordinance No. 1698. Hazardous Vegetation and Combustible Materials Abatement Ordinance

The City of Placerville's Hazardous Vegetation and Combustible Materials Abatement Ordinance was adopted in 2019. The defensible space requirements in the ordinance are in alignment with the current state requirements.

El Dorado County Development Requirements

The County adopted by reference the 2019 California Code of Regulations Title 24, Part 9 as part of the Title 8 Chapter 8 in its municipal code.

City of Placerville Development Requirements

The City adopted by reference the 2019 California Code of Regulations Title 24, Part 9 as part of Title 4, Chapter 1 in its municipal code, with the one modification listed below:

The entire roof covering of every new structure, and any roof covering applied in the alteration, repair or replacement of the roof of every existing structure shall be a fire-retardant roof covering.

Gaps in Policies & Standards

THE CITY OF PLACERVILLE'S HEALTH AND SAFETY ELEMENT AND EL DORADO COUNTY'S PUBLIC HEALTH, NOISE, AND SAFETY ELEMENT MUST MEET SPECIFIC FIRE PROTECTION AND SAFETY REQUIREMENTS, ESTABLISHED BY THE BOARD OF FORESTRY AND FIRE PROTECTION AND OUTLINED IN GOVERNMENT CODE § 65302, BECAUSE BOTH JURISDICTIONS HAVE LAND CLASSIFIED AS VERY HIGH FIRE HAZARD ZONES.

Each safety element's policies were reviewed against the Board of Forestry and Fire Protection's checklist to identify gaps or deficiencies in addressing state required fire protection and safety requirements. A summary of key findings is outlined in Table 7.

TABLE 7. KEY FINDINGS SUMMARY

CATEGORY	KEY GENERAL GAPS/DEFICIENCIES
Private Property and Public Facilities	City and County safety element policy gaps regarding development, private property, and public facilities
Roadway and Access	County safety element policy deficiency regarding roadway and street signage
Landscape and Fire Suppression	City and County safety element policy deficiencies regarding future water supply maintenance and fire break maintenance
Evacuation	City and County safety element gaps in addressing evacuation requirements
Community Engagement and Preparedness	City and County safety element gaps regarding public engagement and outreach efforts specifically for at-hazard populations

Note: 2022 County Safety Plan update pending

Private Property and Public Facilities

Defensible space standards for both the City and the County are in alignment with current state requirements, as described in the California Fire Code, Section 4907.[28] New State defensible space requirements, as described in the California 2022 Fire Code, section 4907, have been developed and all California jurisdictions will be required to adopt requirements around developing an ember-resistant zone within five feet of a structure, once the state develops updated guidance in 2023. Both the City and County do not have safety element policies that meet certain fire protection requirements in Government Code § 65302 and the Board of Forestry and Fire Protection checklist regarding residential development, fire safe design requirements, specific new development standards, and siting of public facilities.

Roadway and Access

The County's Public Health, Noise, and Safety Element does not include policies that address fire protection requirements in Government Code § 65302 and the Board of Forestry and Fire Protection checklist regarding roadway and street signage.

Landscape and Fire Suppression

Neither the City's Health and Safety Element nor the County's Public Health, Noise, and Safety Element meet certain fire protection requirements in Government Code § 65302 and the Board of Forestry and Fire Protection checklist regarding location and maintenance of long-term integrity of water supplies and discussion of fire break maintenance. Assembly Bill 3074 requires that the Board of Forestry and Fire Protection develop the regulation for a new ember-resistant zone within zero to five feet of the home by January 1, 2023. The City and County will be required to adopt this requirement in 2023.

Evacuation

Neither the City's Health and Safety Element nor the County's Public Health, Noise, and Safety Element policies adequately identify minimum standards for evacuation of residential areas in Very High Fire Hazard Severity Zones, as required by the Board of Forestry and Fire Protection and outlined Government Code § 65302.

Infill Development and Concentrated Growth Patterns

Another option for both the City and the County to consider is to mitigate wildfire hazard through land use development policies.[29] There is evidence that promoting higher housing density and infill development reduces wildfire hazard.

Community Engagement and Preparedness

Neither the City nor the County currently have safety element policies that meet certain Board of Forestry and Fire Protection requirements regarding public outreach about defensible space or evacuation or targeted engagement efforts for at-hazard populations.

28 Defensible space requirements, consistent with the California Fire Code, Section 4907, are summarized on the CAL FIRE website. CAL FIRE. 2022. Defensible Space. https://www.fire.ca.gov/programs/communications/defensible-space-prc-4291/. Accessed November 2022

29 Syphard et al, 2013, Land Use Planning and Wildfire: Development Policies Influence Future Probability of Housing Loss. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0071708

Integration into the Plan

This concludes the policy background that serves as a framework for the Greater Placerville Wildfire Evacuation Preparedness Study. The gaps identified provide a foundation for the City and County to develop and adopt fire protection and safety policies and code that adequately meet state requirements and mitigate impacts from wildfire.

Greater Placerville

WILDFIRE EVACUATION PREPAREDNESS STUDY

Envisioning a Fire Adaptive Community

EL DORADO COUNTY TRANSPORTATION COMMISSION

MARCH 2023
REVISED MAY 23RD, 2023

DRAFT

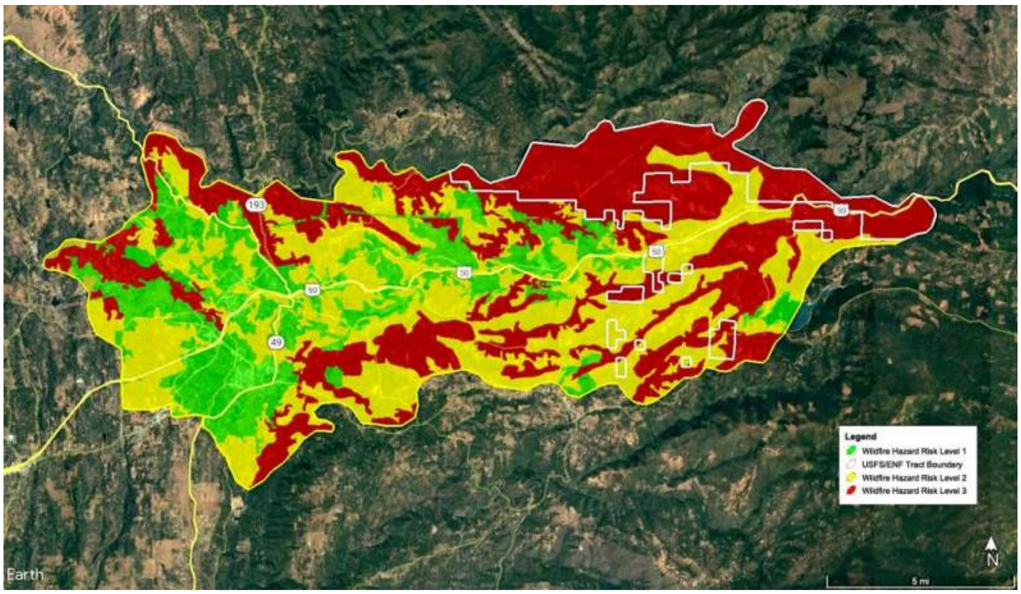
Existing Conditions Report

APPENDIX

EXISTING CONDITIONS REPORT

Wildfire Hazard Assessment

In Support of The Greater Placerville Wildfire Evacuation Preparedness, Community Safety, and Resiliency Plan



Prepared for: DKS Consultants

Prepared by: TSS Consultants

Final Report
May 21, 2023

GLOSSARY of TERMS

All terms included in the following list are to be interpreted solely within the context of their meaning in this Existing Conditions Report prepared for the El Dorado County Transportation Commission. These definitions may not to be applicable to any other situations that are not directly related to the analysis completed herein.

Adverse Impact – A change in the conditions of elements of the setting in which an action has been implemented that is not consistent with the goals or objectives of either a project's proponents or reasonably associated stakeholders.

Baseline Conditions – The full array of setting elements, defined in terms of its status or condition, in which a project takes place at a defined point in time prior to implementation of any project-related actions.

Bole Pruning – The removal of side limbs from the bole of a tree.

Canopy Closure – A measure, usually defined in percentage terms, of the surface area covered over by a leafy overstory crown.

Catastrophic Wildfire Event – A wildfire event where the behavior is sufficiently severe so as to completely remove existing elements occupying a surface area. Examples would include complete removal of forest stands and residential structures.

Community – An aggregation of residential development that has a definable extent (or boundary) and observable community infrastructure (roads, utilities, community services centers, etc.)

Contextual Conditions – Surface feature or conditions that are present and define the context in which a project is located.

Convergence of Evidence – Working toward a decision through successive consideration of multivariate information. It is basically a "course correction" model where accuracy increases as more information is gathered and analyzed

Crosswalk – Typically, the linking of two different sets of data, or derived information, through an "if-then" procedure. In this particular study it involves linking vegetation types (which are typically described in floristic terms) with standard fuel models from which wildfire behavior can be predicted.

Crown – The layer of limb, twig, and leafy material constituting the top portion of a tree.

Cumulative Effects – Change influencing effects that are created when two, or more, individual actions interact to create effects that are different in nature and/or intensity than those when only a single action is taking place.

Cumulative Impacts – Changes to baseline conditions that are caused when cumulative effects are being generated.

Databases – Presentations of raw data, or derived information, that has a unifying theme. They are generally presented in hard-copy map formats or in digital formats. Digital databases utilized in multi-variable assessments associated with wildfire issues typically have the capability of being referenced to standard mapping or image geographic coordinate systems.

Deflection – The distance between a powerline and a surface condition that, in the event of involvement in a wildfire event, could determine the likelihood of "loss of function" damage risk.

Design/Build – Where future actions taken regarding the design, or implementation, of a project depends on what was learned in previous actions.

Desirable species – Species of plants whose treatment within the prescribed management described herein fulfills both the applicant's goals and objectives pertaining to increased protection from adverse wildfire impacts and improving the ecological condition and functioning of the subject plant and animal species involved.

Diurnal Winds – Highly localized winds that respond to daily changes in surface temperatures and whose flow pattern is controlled by detailed topographic structure.

Ecological Functioning – The ability of setting conditions to support an aggregate of plant and animal species sustainably (measured in successive generations) occupying a site.

Effect – The mechanistic influence that can result in a change in status or condition of setting elements.

Emergency Responders – The full set of emergency personnel providing assistance in response to a wildfire incident. Typically includes personnel providing fire, medical, and law enforcement services.

Empirical Evidence - Information that is acquired by direct observation or experimentation.

Extraordinary Winds – Wind patterns (including direction and velocities) that occur only occasionally but can be accompanied by significant adverse impacts.

Fire Season – Typically a seasonal period from April to September, where, in the project area, the climate has average temperatures that are higher and humidity levels that are lower.

Floristic Nature – A manner of defining an aggregation of vegetation species that includes elements like species present, relative composition percentages, basic site requirements, flowering periods, etc.

Fuel – Plant material available for combustion.

Fuel Bed – An aggregation of combustible fuels that is defined by its component materials, material sizes, physical structure, and continuity (or dis-continuities).

Heightened Vulnerability – Where risk of adverse impacts from wildfire is in an elevated level.

Impact – The observable change in the state of a setting element as a result of an effect coming from the implementation of an action.

Influence – A measure of the mechanistic ability of an effect to create a change in a setting element.

Intensity (of an effect or impact) – The degree of the mechanistic ability of an effect to create a change in a setting element.

Interpretation Criteria – Specifically defined observations that lead to a conclusion.

Ladder Fuels – Materials in a multi-storied stand of vegetation that creates a continuous fuel bed from the surface to the overstory crown.

LANDFIRE – A wildfire behavior prediction model created through the Interagency Fuel Treatment Decision Support System program.

Layman Sourced – Observations made by individuals who would not be qualified to implement a professional judgment process but, nonetheless, warrants some measure of consideration.

Lop and Scatter – A treatment that cuts material removed for fuel reduction purposes into sizes that meet appropriate performance standards and is then distributed evenly over the surface of the treated area.

Loss of Function – A situation where a feature, or condition, has been created to perform a defined function but can no longer perform that function due to being involved in a wildfire event.

Maintenance Management – Vegetation management actions designed specifically to keep conditions created in prior management actions

Managing Against – An approach to vegetation management that 1) defines individual plant species whose current influence in a particular area is not in alignment with management goals and objectives, and 2) implements specific actions to reduce, or even eliminate, that influence.

Managing For – An approach to vegetation management that 1) defines individual plant species whose influence in a particular area is in alignment with management goals and objectives, and 2) implements specific actions to augment that influence.

Minimum Mapping Area – The smallest surface area on the ground that would constitute a mapping unit reasonably distinguished from those around them. Considerations that enter into the determination include . but are not limited to:

- The scale of the maps that are to be the reporting base – the smaller the scale the need for a larger minimum mapping area;
- The level of tolerance for the higher degree of ground surface condition heterogeneity that occurs with larger minimum mapping areas, and;
- The nature of the information required to support decisions and actions of the ultimate users of the information coming out of this study.

Multi-stage Inventory Design – An approach that is based on identifying a sub-area within a more general context using management defined selection criteria and then focusing resources on that sub-area.

Nature (of an effect or impact) – The specific mechanistic-related elements that have an observable capability to create change in a setting element.

Non-Fire Season – Typically a seasonal period from October to March, where, in the project areas, the climate has average temperatures that are lower and humidity levels that are higher.

Overstory – Another term for the crown area of forest or woodland formations. Typically, it is defined by canopy closure percentages, thickness, height above the surface, average opening size, etc.

Physical Conditions – The subset of setting conditions that have a physical presence and exert mechanistic influences based on its physical nature.

Prescriptive Guidance Materials – Laying out performance standards using measures that are uninterpretable. For example in protecting riparian values SPR BIO-4 states that the proponent "will design treatments in riparian habitats to . . . retain at least 75 percent of the ***overstory***". This is a measurable performance result and if not attained make the proponent out of compliance with the VTP/PEIR.

Prevailing Winds – Winds that have definable and predictable patterns (typically direction and velocity measures) whose data are collected at official weather stations.

Professional Judgement – A decision situation where there is 1) a lack of empirical evidence upon which to justify the decision, and 2) the decision must be made by a disciple expert whose credibility for making the decision is based on their academic training, practical certifications, and direct experience with the subject material.

Reasonable Sphere of Impact – A subjective determination of the physical extent an effect resulting from implementing a project action can have.

Regular Maintenance Program – A management program designed to conserve conditions created through prior transition management action and is defined by specific vegetation management prescriptions and return intervals.

Sensitive Resources – Resources that have been identified as having a combination of high intrinsic value and susceptibility to adverse impacts if involved in a wildfire event.

Setting – The full array of features and conditions in which a project is located that relate to wildfire issues.

Setting Elements – The individual feature or conditions comprising the overall setting that are 1) observably present, and 2) relate to wildfire issues.

Shaded Fuelbreak – A tract of land where there is an overstory of intermediate and dominant tree canopy, low quantities of "ladder fuels, and low-growing surface vegetation. The tree canopy has openings in it that are large enough to create fuel discontinuities and yet small enough to provide high relative time periods of full, or partial, shade at the ground level.

Site Quality – The ability of a ground area to provide physical habitat elements that allow for vegetation or animal species to occupy the area on a sustainable basis.

Special Interest Features/Conditions – Specific features or ground conditions that do not, themselves, have regional implications but knowledge of their locations within regional databases can be important in studies or management activities.

Subjective Guidance Materials – Materials comprised of guiding instructions that require an advanced level of familiarity with a management situation in order to make appropriate decisions. This situation is where the concept of professional judgment can come into play.

Sward – Basically an area of ground covered by grass species (monocots) but realistically also involves the presence of low-growing broad-leafed species (dicots).

Transition Management – A management approach that involves implementing actions to change ground conditions from those that are less desirable (i.e. inconsistent with management's goals and objectives) to those that are more desirable (i.e. more consistent with management's goals and objectives).

Type Conversion – Complete removal of the physical manifestation, and thus the functioning, of one, or more, setting elements.

Vegetation Formation – A distinctly recognizable aggregation that is defined by a mappable extent, commonly observed plant species, and homogeneous plant species compositions and structures.

Vegetation Management Prescription – A detailed set of instructions for implementing vegetation management.

Wildfire Behavior – The aggregation of physical and mechanistic manifestations that an uncontrolled fire exhibits as it ignites and crosses a landscape. The principal elements include spread rates, manner of spread (surface travel or ember spread), flame lengths, fire intensity, residence time at a particular location, and within-structure behavior.

Wildfire Event – A discrete occurrence of un-controlled fire that has a defined start point (location and date/time), defined area of impact, and a defined period of evolution to the point of control.

Wildfire Hazard Level – The relative degree of likelihood that a wildfire event, causing adverse impacts, will take place at a subject location within the Placerville Study Area (PPSA)

Wind Rose – A graphical portrayal of winds showing direction and other metadata typically present in annual and month summary formats.

LIST of ABBREVIATIONS

AB	Assembly Bill (California)
AMSL	Above Mean Sea Level
APN	Assessor's Parcel Number
BOF	California State Board of Forestry and Fire Protection
CAL FIRE	California Department of Forestry and Fire Protection
Caltrans	California Department of Transportation
Cal/VTP	California Vegetation Treatment Program (California State Board of Forestry)
CCR	California Code of Regulations
CE	Cumulative Effects
CEQA	California Environmental Quality Act
CFPR	California Forest Practice Rules
DCP	Data Collect Platform (California weather stations)
EDCTC	El Dorado County Transportation Commission

ED/RCD	El Dorado and Georgetown Divide Resource Conservation District
EE	Empirical Evidence
FCS	Functional Classification System (Caltrans)
FHA	Federal Highway Administration
FHSZ	Fire Hazard Severity Zone
FRAP	Fire and Resources Assessment Program
FS	Fire Season
GSEI	Google Earth Satellite Imagery
IC	Interpretation Criteria
LRA	Local Responsibility Area
MM	Mitigation Measure
NOAA	National Oceanic and Atmospheric Administration
NFS	Non-Fire Season
PEIR	Programmatic Environmental Impact Report
PRC	Public Resources Code
PPSA	Placerville Project Study Area
PWP	Public Works Program
RAWS	Remote Automated Weather Stations
RCD	Resource Conservation District
RPF	Registered Professional Forester
SFB	Shaded Fuel Break
SIF/C	Special Interest Feature or Condition
SPR	Standard Project Requirements
SRA	State Responsibility Area
TA	Treatment Approach
TL	Treatment Landscape
USDA/FS	United States Department of Agriculture/Forest Service
USF&WS	United States Fish and Wildlife Service
USFS	United States Forest Service
USGS	United States Geological Survey
USDI	United States Department of the Interior
USDI/BLM	United States Department of the Interior/Bureau of Land Management
USDI/NPS	United States Department of the Interior/National Park Service
VMRX	Vegetation Management Prescription
WHL	Wildfire Hazard Level

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EXISTING CONDITIONS REPORT

In Support of the Greater Placerville Wildfire Evacuation Preparedness, Community Safety and Resiliency Plan

Executive Summary

Planning Context

The primary purpose behind conducting the wildfire assessment portion of the El Dorado County Transportation Commission's (EDCTC) Greater Placerville Wildfire Evacuation Preparedness, Community Safety, and Resiliency Plan is to provide information needed for EDCTC's project and secondarily, to provide information to other agency personnel conducting regional-scale wildfire-related planning in the Placerville area. The principal result from the assessment was a geo-referenceable map of locations characterized by their differing levels of ***wildfire hazard levels*** (”WHL”)***.*** The nature of the levels defined in this Project basically reflect those in the Office of the State Fire Marshal's ***Fire Hazard Severity Zone*** ("FHSZ") program[1], but the identification process used different input variables and resulted in a different hierarchal classification. This departure from the state-wide approach resulted from a difference in the goals and objectives laid out for EDCTC's project.

The primary goals and objectives specific to the 79,134-acre Placerville Project Study Area ("PPSA"), shown in Figure 1, called for 1) the identification of different WHLs, and 2) mapping their distribution within the PPSA, However, other aspects entered into the design and implementation of the study that included considerations regarding how best to take the information appropriate to the regional scale and use it to guide:

- Subsequent studies focused on identified sub-areas of concern, and
- Identifying appropriate management actions that, when implemented, would lower the currently determined wildfire hazard levels.

A comparative examination of the mapping specifications and information content of the input variable characterizing the state-wide FHSZ system led to the conclusion that the goals and objectives of the Project would not be met by simply adopting existing methodology. Three specific goal- and objectives-related aspects led to this decision to design an approach different than that of the currently existing FHSZ procedure:

- The 2-kilometer (>800 acres) ***minimum mapping area*** base would not provide an adequate base to utilize the results for the Project area as a Stage 1 information base to guide subsequent studies in a ***multi-stage*** type of
- Lack of input variables that led to a model output that clearly described how wildfire physically crossed a landscape to a certain location and what would be its nature upon the arrival, and;
- Did not lead to an understanding of what actions to take in the field to reduce the potential for, and nature of, adverse effects.

[1] OSFM. 2023.

Basic Approach

The basic approach employed in this assessment has been implemented by TSS in several similar project situations involving wildland/urban wildfire hazard analyses and has successfully fulfilled the stated goals and objectives. The approach is characterized by the following procedures, information inputs, and reporting specifications:

- Identifying a project area suitable for the assessment of wildfire hazards;
- Research designed to identify information suitable for supporting the analyses conducted and conclusions reached;
- Identifying industry-standard data analysis models;
- Using appropriate decision models, define WHL classes appropriate to the Project's goals, objectives and conditions within the PPSA;
- Identify setting elements that have overriding influence over wildfire behavior in the PPSA;
- Define ***special interest features/conditions*** ("SIF/C") that need consideration with regard to wildfire hazards;
- Human interpretation of Google Earth satellite imagery to identify, and map, WHL conditions and SIF/Cs within the PPSA;
- Preparing a geo-referenced map, with a minimum mapping area of 100 acres, of the distribution of the WHLs within the PPSA;
- Prepare geo-referenced maps of the distribution of SIF/Cs within the PPSA;
- Provide digital files of WHL and SIF/C occurrences for use in subsequent analyses
- A comprehensive report of results

Assessment Results

Wildfire Hazard Levels

Through a process based primarily on professional judgment five ***setting elements*** were identified for consideration in identifying WHL:

- Terrain slope;
- Terrain Aspect;
- Prevailing Winds;
- Extraordinary Winds, and;
- Vegetation Type-Related Fuel Models

Again, primarily through the application of professional judgment, three WHL classes were defined and described by their unique recognizable attributes: Low, Medium, and High. The results of the WHL class mapping effort is presented in Figure 25. The surface areas determined to be occupied by each class were:

Low WHL = 16,292 acres;
Medium WHL = 31,103 acres, and;

High WHL = 31,739 acres

Based on an analysis of the WHL contribution made be each setting element, in terms of intensity of the influence and surface area covered a PPSA-wide figure was estimated to be Medium Low-to-Medium. However, when adding the potential influence on WHL resulting from the degree of geographical intermixing, as shown in Figure 25, the estimate was raised to a straight Medium rating.

Special Interest Features/Conditions

Roads

With the objective of identifying important roads that could lose their ability to function, should they be involved in a wildfire event, twenty-six roads, in three Caltrans' Functional Classification System ("FCS") categories[2], and seven additional roads of local importance, were identified and surveyed. A general view of the roads addressed, color-coded by FCS classification, is presented in Figure 17

The surveys were conducted through interpretation of the Google Earth Pro[3] satellite imagery ("GESI") and the primary criterium for assigning hazard level, again denoted as "Low", "Medium", and "High", was the relative presence of high hazard vegetation type-related fuel models. Each road was broken down into segments based on this fuel model presence and the lineal distance for each segment was recorded. Below are summarized the mileage of all roads surveyed broken out by WHL class.

Low WHL = 42.31 mi.;
Medium WHL = 29.97 mi., and;
High WHL = 38.34 mi.

Vulnerable Communities

A class of communities that have a shared elevated vulnerability from wildfire event involvement was also addressed in this study. A total of twenty-five communities were identified through interpretation of the Google Earth satellite imagery. The two principal criteria for recognizing this type of community were, 1) high levels of contact with wildland conditions, and 2) restricted access by surface roads. For each identified community the perimeter was located on the satellite imagery, its surface area of coverage determined (in acres), and the Latitude and Longitude of the approximate center point recorded.

A total surface area of 2,106.6 acres was determined to be occupied by these communities. The location of each community within the PPSA is shown in Figure 18 and a detailed list of the communities appears in Table 10.

[2] Caltrans. January 28, 2022.
[3] Google Earth. December 29, 2022.

High Tension Electrical Transmission Lines

High tension electrical line systems are considered a sensitive feature because they can be both very vulnerable to loss of function should they be involved in a wildfire event but they can also be a significant source of wildfire ignition. Figure 15 shows the location (red line), within the PPSA, of the 16.8-mile high tension transmission line corridor. Close examination show potential WHL issues due to close proximity to fuel models, in both underwire and peripheral positions, that can generate extreme fire behaviors.

Conclusions and Recommendations

The results of the basic WHL assessment indicated the process was successful in creating a regional framework of hazard levels against which other databases can be directly compared. It was believed the setting elements selected for inclusion in the analyses were those that 1) do have overriding influences on how wildfire can travel over a landscape, and 2) provide adequate information on the physical processes that are in force and that can be managed to reduce hazard levels.

It was also concluded that the regional nature of the mapped information restricts it use for identifying on-the-ground management appropriate for location-specific issues within the PPSA. In consideration of this use restriction, it is recommended that the regional data base created through this Project activity be used as a guidance tool for designing location-, or subject-, focused follow-on studies. For example, the assessment of the selected roads for loss of function considered only the presence of fuel models when setting the hazard level. It is recommended that for this, and the two other, SIF/Cs, that subsequent assessment be conducted allowing for a greater concentration of focus due to the restricted surface area involved

Introduction

Approach Basics

Decision Models Employed

Decisions Based on Empirical Evidence

Decision processes based on ***empirical evidence*** (EE) are defined by processes where EE is information that researchers generate to help uncover answers to questions that can have significant implications regarding the subject being addressed. With regard to the subject being addressed the intent is to predict the possible adverse impacts on the ***sensitive resources*** characterizing the PPSA. The information being generated in this Project situation involves 1) identifying the presence of ***setting elements*** that can exert ***influence*** on ***wildfire behavior***, 2) determining the ***nature*** and ***intensity*** of the influence on wildfire behavior, and 3) identifying the presence of sensitive resources within the Project area that have ***heightened vulnerability*** to ***adverse impacts*** should they be involved in a ***wildfire event***. One example of empirical evidence generated for this Project would be a map, and associated geo-referenced database, showing distribution of fuel model types within the PPSA

Decisions Based on Professional Judgment

Situations where EE is not sufficient to assure decisions that are reasonably accurate and consistent are not uncommon, especially when dealing with disciplines where standardized testing and/or experimentation is difficult due to the very nature of the subject resource. An example pertinent to this Study's situation is the complex changes in wildfire behavior when the wildfire is advancing over a highly complex topography and is subject to highly changeable wind patterns due to diurnal climatological changes. In these situations where empirical evidence is lacking, a bridge to making the required decisions that are more accurate and consistent can be supplied by the application of ***professional judgment***. Professional judgment is an industry-standard approach and in some instances has been codified in regulatory codes or guidelines (CEQA Guidelines, §15063(a)(3)[4] and California Forest Practice Act §4552[5]). The professional judgment approach incorporates into the decision process 1) a critical evaluation of whatever empirical information is available, 2) academic education, 3) certification training, and 4) practical experience.

Convergence of Evidence

A ***convergence of evidence*** decision process employs gathering, and considering, several different types of information in order to form a required decision. The process relies on 1) the human capacity for dealing simultaneously with several bits of information and 2) professional judgment. The process considers the potential result of the influence of each individual single element and how they will most likely react in concert with others.

Employing a Mechanistic Analysis Approach

Wildfire is a phenomenon that is controlled completely, from its ignition moment to it being brought under control, by the laws of physics, and perhaps more specifically by the laws of thermodynamics. For a fire to start there has to be materials, typically referred to as "fuels", that are in a condition where the process of combustion can be started. For a fire to spread fuels that are in a ***combustible condition*** must, again, be available. And lastly, for a fire to be extinguished, combustible materials in the path of the wildfire must be either removed altogether or rendered into states where they are no longer combustible.

It must be noted that an understanding of the mechanistic manner in which wildfire is influenced by the various setting elements is very important, not only from the standpoint of bringing wildfire event under control, but also how to design and implement hazard-reducing actions to lower WHLs for future protections. Identifying the key elements in the mechanistic relationship between wildfire and its setting elements will open up the ability to intentionally change (or manage) the nature of those elements and benefit from more reasonable wildfire behavior in the future.

[4] California Code of Regulations, Title 14, Division 6, Chapter 3. 1998.
[5] California Public Resources Code, Division 4, Chapter 8. January 2019.

A wildfire event is initiated when a source of significant heat is introduced into the combustible materials present (typically referred to as a "fuelbed"), and ignition occurs if the thermodynamic conditions are supportive. In this initial ignition phase the mechanisms involved are determined by 1) the nature and intensity of the ignition source, and 2) the combustible nature of the fuelbed. As a wildfire enters the phase where it moves from one location to another there are other basic mechanisms that affect ***wildfire behavior*** nature and intensity; those that are associated with terrain conditions (slope and aspect) and winds. For example, given a constant supply of readily combustible fuel, wildfire advances at a greater rate as terrain slope increases, and potentially even greater rates if the is also a wind blowing in an upslope direction. Differing ***slope/aspect*** combinations (e.g. south-facing slopes versus those that are north-facing) will have different micro-climatological regimes that can result in different ***vegetation formations***. As will be discussed subsequently, different vegetation formations can then have correspondingly significantly different ***fuel models*** which then sets into motion differing wildfire behavior-controlling mechanisms.

Two characteristics of wind have direct mechanistic influences on wildfire behavior: Direction and speed. Absent wind forces wildfire will advance in directions where fuels are available and at rates set by the basic needs of the combustion process. In the presence of wind wildfire will 1) move in the direction in which the wind is blowing providing appropriately combustible fuels are available, and 2) at rates that exceed that of the basic combustion process.

This study will focus on those ***setting elements*** that have that have direct mechanistic influences on wildfire behavior and its associated hazard level.

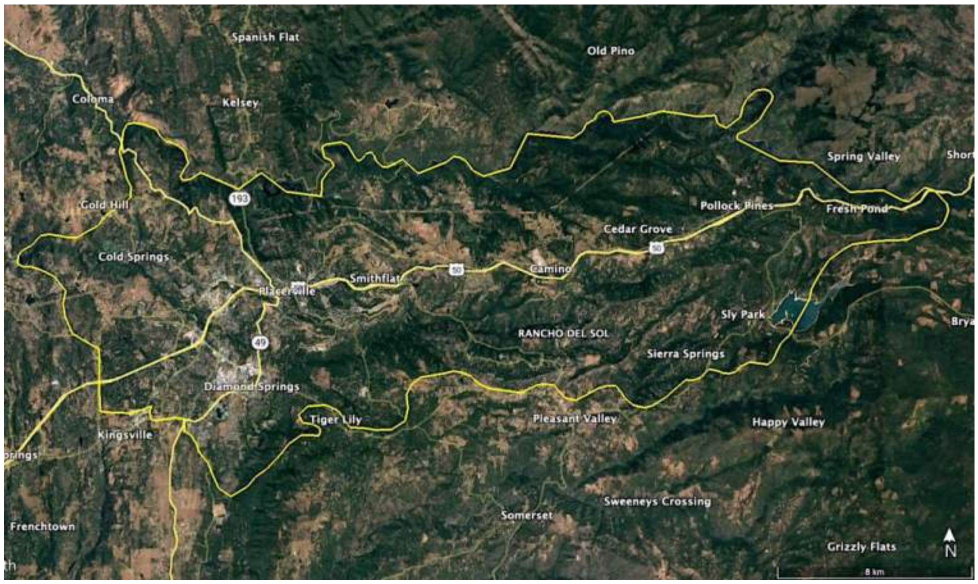
General Setting

Placerville Project Study Area (PPSA)

The project area is located in Eldorado County approximately 40 miles east-northeast from the metropolitan area of Sacramento, California. The 79,134-acre PPSA is located on the western-facing slopes of the foothills of the Sierra Nevada Mountain range, is bisected, in an west-to-east direction, by Highway 50 with the City of Placerville, and surrounding urban development, in the southwest portion.

Figure 1 shows the project study area, outlined in yellow, against a Google Earth Satellite image ("GESI") along with the roads in the general project location. The Placerville Project Study Area ("PPSA") is comprised of 79,134 acres, large enough to enable TSS Consultants to examine conditions in areas on the perimeter of the PPSA that would be reasonable pathways for wildfire to approach the interior of the PPSA.

Figure 1. The Project Study Area addressed in the analysis.



General Climate

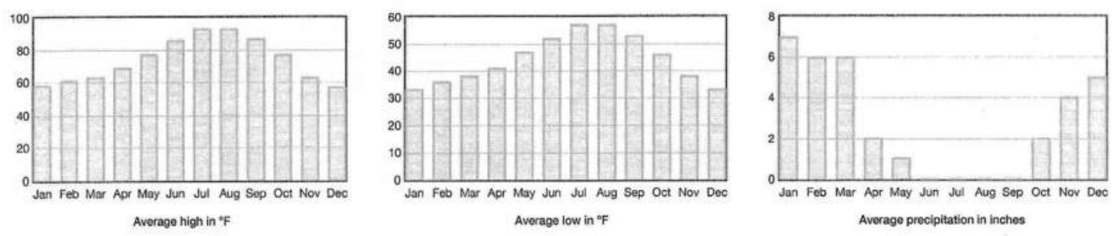
The patterns of temperature and precipitation for the Placerville PPSA are typical of sites with similar latitudes and elevations on the western slope of the Sierra Nevada foothills: Hot and dry summer months with little or no precipitation, and conversely, cool moister conditions with a clear majority of the precipitation in the winter months. Precipitation is generally in the form of rainfall in the western portions of the project area with a potential for snowfall above an elevation of 3,000' AMSL in the eastern portions. Monthly summaries for high and low temperatures and inches of precipitation are presented in Table GS-1 and Figure GA-3 below[6]. This climatological information was the principal consideration when creating the "***fire season***"/"***non-fire season***" categorization used in guiding the inputs in the two ***LANDFIRE***[7] wildfire behavior modeling runs. This correspondence is clearly evident when the shading convention used throughout this assessment (red shading for "fire season"-associated information and bright green for the "non-fire season"-associated information) is applied in Table GS-1. Lastly, typical rainfall intensity (2-year 1-hour rainfall measured in hundredths of an inch) is in the 60 to 80 range which is considered to be in the "High" to "Extreme" categories as used in CAL FIRE's Estimated Surface Soil Erosion Hazard rating procedure[8].

[6] WorldClimate.com. 2022.
[7] IFTDSS. September 16, 2022.
[8] California Forest Practice Rules. 2020.

Table 1. Monthly averages for elements of the weather characterizing the project area

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature – High (°F)	58	61	63	69	77	86	93	93	87	77	63	57
Temperature – Low (°F)	33	36	38	41	47	52	57	57	53	46	38	33
Precipitation (inches)	7	6	6	21	1	0	0	0	0	2	4	5

Figure 2. Graphical presentations of monthly temperature and precipitation information.



Project Area Topography

The topography is a combination of west-to-east oriented plateaus in the western portion of the project area, deeply incised rivers and streams, and moderately dissected terrain dominated by multiple ridges also running in west-to-east orientations. Elevation rises from approximately 1,425' AMSL at the western point of the project area to a maximum of approximately 4,359' at the eastern point.

Demographics

The City of Placerville occupies a land area of 3,738 acres (5.84 sq. mi.) and the US Census Bureau's 2021[9] estimate was 10,869 inhabitants. Placerville is the Eldorado County seat and, having been incorporated in 1854, is rich in California gold rush history. A majority of Diamond Springs, with a US Census Bureau's 2020 population estimate of 11,384 inhabitants[10], lies within the project area.

[9] United States Census Bureau. Accessed 12/03/22
[10] Ibid.

Emergency Response Apparatus

For ICS Type 5 and 4 wildfire incidents occurring within the PPSA, primary responsibility for first response lies in two fire protection districts ("FPD"), El Dorado County (Area No. 3 in Figure 3) and Diamond Springs/El Dorado (No. 8). Two other FPDs, Garden Valley (No. 2) and Mosquito (No 9), could have some jurisdictional overlap with the PPSA but it would be minor in nature. For higher order incidents implementing a multi-agency incident command effort would in involve resources from the local FPDs, CAL FIRE, and the United States Forest Service. Figure 3 shows the jurisdictional areas served by each FPD in relation to an approximation of the PPSA (denoted by the red-lined oval). and Table 2 provides details, including their station numbers, locations, and staffing patterns, for the five responding agencies with a reasonable likelihood of involvement.

Figure 3. Jurisdictional boundaries of fire departments in the Placerville area.

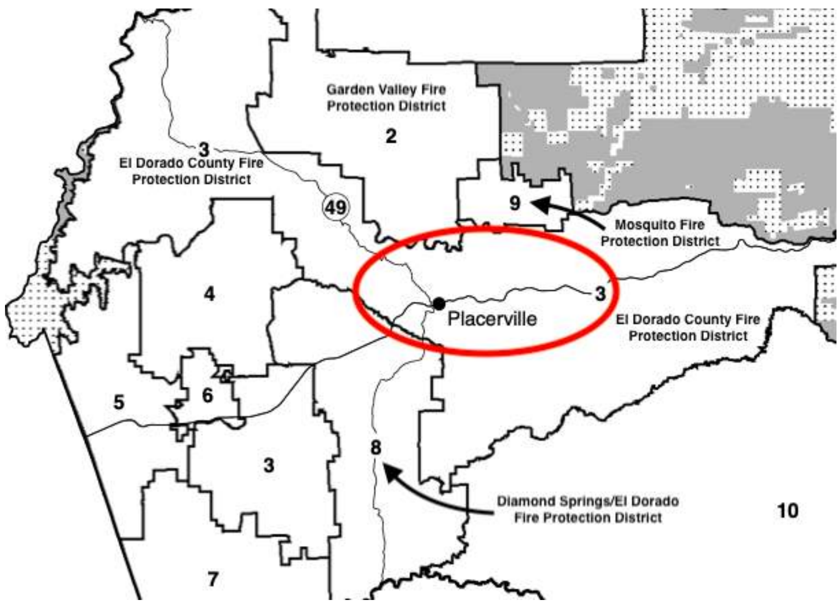


Table 2. Agencies providing emergency wildfire response in the PPSA

Agency	Station	Location	Staffing Level
Cal Fire	20	Camino	Staffed
Cal Fire	43	El Dorado	Staffed
El Dorado County Fire	17	Pollock Pines	Staffed
El Dorado County Fire	18	Sierra Springs	Unstaffed
El Dorado County Fire	19	Pleasant Valley	Staffed
El Dorado County Fire	21	Camino	Staffed
El Dorado County Fire	23	Oak Hill	Unstaffed
El Dorado County Fire	25	Placerville	Staffed
El Dorado County Fire	26	Placerville	Unstaffed
Diamond Springs Fire	46	El Dorado	Unstaffed
Diamond Springs Fire	48	Missouri Flat	Unstaffed
Diamond Springs Fire	49	Diamond Springs	Staffed
Mosquito	75	Mosquito	Part Time Staffed
USFS		Pacific	Seasonal
USFS		Pacific Helicopter	Seasonal
USFS		Sly Park	Seasonal

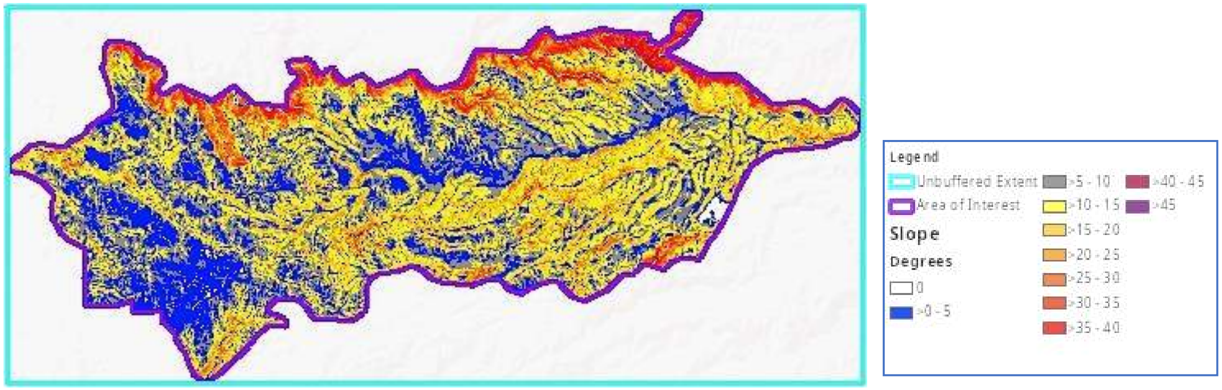
Individual Setting Elements Addressed in this Study

Terrain Conditions

Regional Slopes

The topography is a combination of west-to-east oriented plateaus in the western portion of the project area, deeply incised rivers and streams, and moderately dissected terrain dominated by multiple ridges also running in west-to-east orientations. Elevation rises from approximately 1,425' AMSL at the western point of the project area to a maximum of approximately 4,359' at the eastern point.

Figure 4. Slope classes comprising the digital terrain database used in this assessment.



In Figure 4[11] is presented the full set of slope classes contained within the digital ***database*** that has been "clipped" to the PPSA and used as a data source in this assessment. It is clear that this visual product would be difficult to employ in the more general planning application required due to the large number, and relatively small size, of the individual polygons. As such, the "raw" polygonal data will be delivered as a set of .kmz-format digital files enabling subsequent uses in GIS procedures. Table 3 presents a summary of the surface area occupied by each slope class. Note that the digital database shown in Figure 3 has slope value attributes presented in degrees and the class boundaries, shown n Table 3, have been reinterpreted to approximate slope percentage (a measure more commonly used when assessing slope stability and applying the industry standards of the potential impacts of use of heavy equipment in these areas.

Table 3. Slope classes and their corresponding areas of surface occupation in the PPSA.

Terrain Description Classes	Occupation of FPA Surface Area	
	Percentage	Acres
Flat (0% -5%)	3.0%	2,398
Undulating (5% - 15%)	13.0%	10,304
Moderately Sloping (15% - 25%)	15.7%	12,396
Hilly (25% - 40%)	41.5%	32,839
Moderately Steep (40% - 60%°)	15.0%	11,901
Steep (60% - 100%)	8.2%	6,514
Very Steep (>100%)	3.5%	2,782
	Total Acreage	79,134

In order to provide a visual tool more useful at planning levels the full database results have been reinterpreted and "smoothed" into three slope classes that typically relate to the use of mechanized equipment and its use in the types vegetation management required for fuel

[11] IFTDSS. January 3, 2023.

treatment. The geographical distribution of the three types within the PPSA are shown in Figure 5 and the surface area occupied by each "smoothed" class in Table 4.

Figure 5. Geographical distribution of the three "smoothed" slope classes within the PPSA.

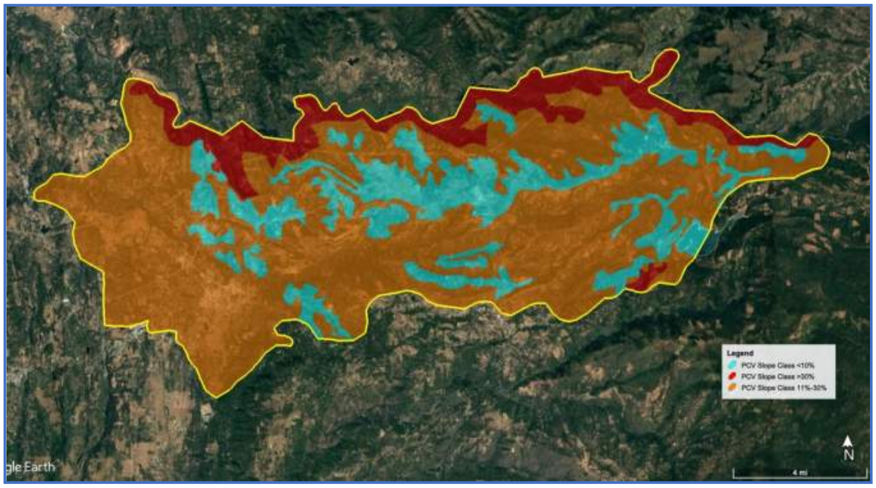


Table 4. Absolute, and relative percentage, of acres within each "smoothed" slope class.

Slope Class	Surface Area (ac.)	Percentage
<10%	15,391	19.5
11% - 30%	54,246	68.5
>30%	9,457	12.0
Total	79,134	

To provide further contextual information seven elevational profiles were prepared; two aligned with the west-to-east axis orientation of the Placerville PPSA and five crossing the PPSA in a north-to-south orientation. Examples of the west-to-east and north-to-south profiles are shown in Figures 6 and 7, respectively. The full set of profiles can be found in the attached Addendum III

Figure 6. An example of a west-to-east elevational profile for the PPSA.

Figure 7. An example of a north-to-south elevational profile for the PPSA.

Aspect

Aspect, or the direction in which terrain is facing, is important as it has an effect on the vegetation (and associated fuel models) that are present. In the Placerville area the north and easterly facing slopes are typically higher in moisture regimes and cooler. The woody vegetation types are typically denser conifer forest and mixed conifer/hardwood woodland land types whereas the south and western facing slopes are typically drier and warmer, and the vegetation types are more open hardwood woodlands, shrublands, and grasslands. Figure 8[12] shows the geographical distribution of the aspects within the PPSA. The regions of blue shading are the areas where slopes are so low that a directional indication was not possible to determine. This database will be part of this study's deliverables and, although it was not possible within the scope of work for this study, can be broken down into finer directional categories using subsequential GIS efforts.

[12] IFTDSS. January 3, 2023.

Figure 8. Geographic distribution of aspects in the PPSA

Table 5. Aspect classes and their corresponding areas of surface occupation in the PPSA.

Category Descriptions		Occupation of FPA Surface Area	
General	Bearing Category	Percentage	Acres
Flat	n/a	6.9%	5457
N	0	0.3%	235
NE	1-89	19.9%	15733
E	90	0.1%	112
SE	91-179	18.0%	14243
S	180	0.3%	209
SW	181-269	28.0%	22158
W	270	0.3%	249
NW	271-359	26.2%	20738
		Total Acreage	79,134

Wind Influences

Winds are significant influencers of wildfire behavior. In generating wildfire hazard assessments there are typically three categories of wind whose influences on wildfire behavior can be significant: Prevailing, diurnal, and extraordinary. Details regarding these categories of wind, their prevalence and nature of their influences are discussed in subsections below.

It must also be noted that wind, which has significant influence as an individual mechanistic influencer, also acts in concert with other setting conditions that can either exacerbate or minimize its influence.

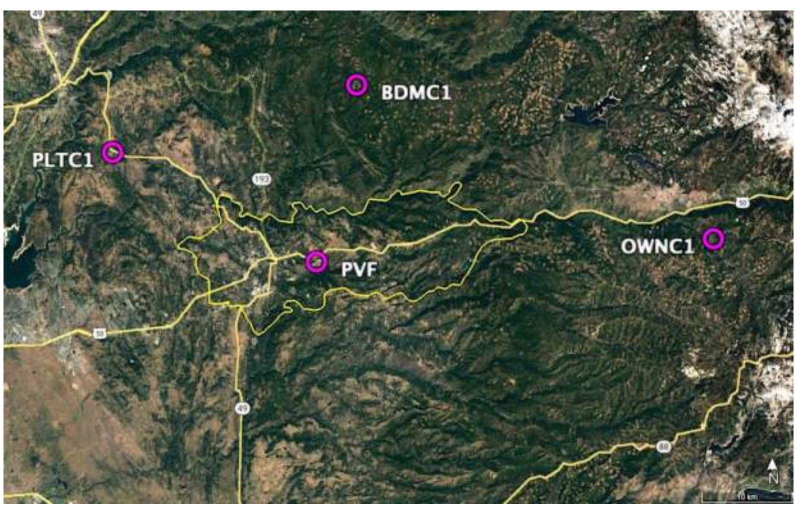
Prevailing Winds

Knowledge of ***prevailing wind*** directions and speed is very important when determining 1) the pathways wildfire will take when crossing a landscape, 2) its rate of advance and, 3) the physical mechanisms involved in its advance. Data regarding prevailing winds were recorded at four weather stations that were within a ***reasonable sphere of impact*** with respect to exerting influence on wildfire behavior within the FPA. The four stations were:

- Placerville [PVF: California DCP][13]
- Bald Mountain [BDMC1: California ASOS][14]
- Owens Camp [OWNC1: California ASOS][15]
- Pilot Hill [PLTC1: California ASOS][16]

The locations of these four weather stations, relative to the PPSA and indicated by magenta circles, are shown in Figure 9 and pertinent information for each station presented in Table 6. The information shown in the table has been separated into three categories, 1) location data and annual summaries of wind information, 2) a six-month summary of wind information for a period identified as the "***non-fire season***" (October to March), and 3) a second six-month summary for the period identified as the "***fire season***" (April to September). In Figures 9 and 10 the wind information recorded at each station is indicated by colored arrows, bright green for the NFS and red for the FS. The data for all the stations typically showed two "bundles" (BD) of wind bearings; one bundle showing clearly dominating characteristics (indicated by the solid-lined arrows) and a second with less domination (indicated by the hashed arrows).

Figure 9. Locations of the four weather stations providing prevailing wind information.



[13] ISU-Mesonet, 12 May 2022.
[14] Ibid, 11 September 2022
[15] Ibid, 11 September 2022a
[16] Ibid, 11 September 2022b

Figure 10. Wind directions associated with the four weather stations in the non-fire season.

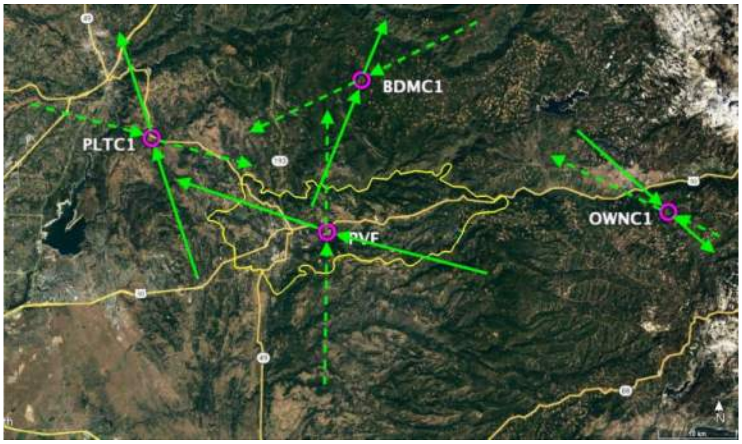


Figure 11. Wind directions associated with the four weather stations in the fire season.

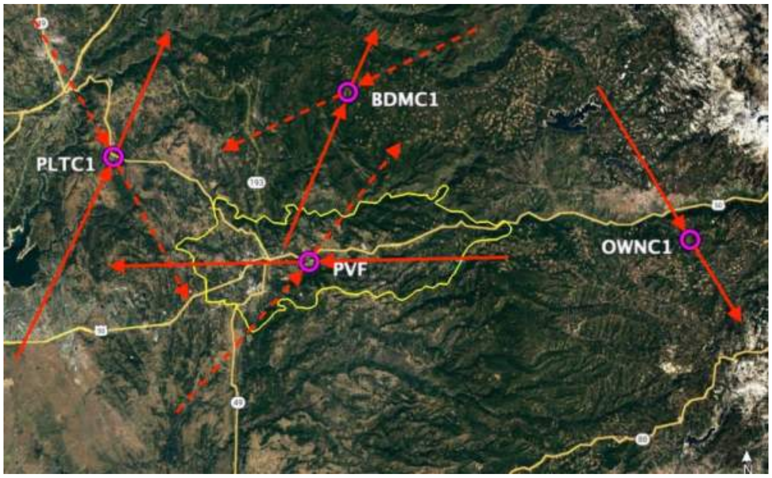


Table 6. Wind information recorded at the four weather stations used in this analysis.

		Meteorological Station			
		BMC1	**OWNC1**	**PLTC1**	**PVF**
Metadata	Network	CA ASOS	CA ASOS	CA ASOS	CA DCP
	Distance (mi.)	11.5	26.1	17.4	Within FPA
	Bearing to Station	7°	91°	292°	n/a
	Collection Period	12/10 – 9/22	12/10 – 9/22	12/10 – 9/22	7/09 – 9/22
Wind Data – Annual Summary	Bearing L1	BD: 190°-210°	BD: 290°-330°	BD: 120°- 220°	BD: 70°-110°
	Bearing L2	BD: 0°-90°	BD: 100°-120°	BD: 260° - 310°	BD: 150°-300°
	Speed-(mph)	3.5	1.7	3.0	5.7
	Calm Conditions	36.6%	69.6%	46.1%	16.6%
Wind Data – Non-Fire Season	Bearing L1	BD: 190°-210°	BD: 90°-160°	BD: 130°-210°	BD: 60°-110°
	Bearing L2	BD: 20°-80°	BD: 300°-330°	BD: 270°-300°	BD: 160°-190°
	Wind Speed	4.1	1.5	3.0	6.0
	Calm Conditions	33.9	75.1	50.0	18.3
Wind Data – Fire Season	Bearing L1	BD: 190°-230°	BD: 290°-330°	BD: 130°-160°	BD: 60°-120°
	Bearing L2	BD: 10°-80°	n/a	BD: 140°-210°	BD: 200°-240°
	Wind Speed	2.9	1.9	3.3	5.6
	Calm Conditions	42.1	64.2	41.8	15.9

Localized Flows

Localized wind flows, typically referred to as ***diurnal winds***, also have the potential for affecting wildfire behavior within a daily cycle. These winds are generated primarily as a result of differential warming and cooling cycles of the near surface air mass and their directional patterns are established by topography. In general, as the near-surface air mass warms during the day the air rises in up-slope directions, and conversely, moves downhill as the air mass cools in the evening and nighttime. A brief survey of available literature regarding diurnal wind velocities over dissected mountainous terrain showed wind velocities ranging from approximately 4.5 to 13.4 miles/hour[17 & 18]. For a standard of comparison these velocities correspond to Force 2-Gentle Breeze to the lower end of the Force 4 category-Moderate Breeze on the Beaufort Wind Scale[19]. No literature was found that addressed impacts on wildfire behavior resulting from cumulative effects produced by the combination of prevailing and diurnal winds.

The United States Forest Service has developed a computer simulation program, known as WindNinja[20], to model diurnal wind patterns, directions, and velocities, for conditions on a specified date and time. Just to provide an example of the Wind Ninja product a run of the model was completed for a portion of the PPSA for weather conditions that occurred at 1407 hrs. on the 17th of August 2021. Due to the fine detail produced a small portion of the results are presented

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17 Ashkenzy and Yizhaq, October, 2022.
18 Mostafaepour, et.al., November, 2013.
19 National Weather Service. Accessed December 4, 2022.
20 USDA/FS. Rocky Mountain Research Station, Missoula Fire Science Laboratory. Accessed 12/03/2022.

in Figure 12. In this figure the wind directions are indicated by each arrow's alignment and the arrow colors, orange, yellow, and green indicate velocities, in miles per hour, of 6.45-8.59, 4.30-6.44, and 2.15-4.29, respectively. Deliverables for this WindNinja run will include both .kmz (Google Earth applications) and .shp (ESRI applications) format files. The WindNinja software package is available through the US Forest Services WindNinja portal.

Figure 12. Results of the Wind Ninja diurnal wind direction modeling analysis.

It is notable that the WindNinja results, generated for conditions on the indicated date time, showed general pattern similarities to prevailing winds recorded at the Placerville, Bald Mountain, and Pilot Hill weather stations in the "fire season" (see Figures 11). It must be kept in mind that the very nature of a diurnal wind pattern is that it can change direction and velocity within a 24-hour period unless they are being overridden by strong prevailing or extraordinary winds.

Extraordinary Winds

In an evaluation of potential wildfire behavior, and its associated levels of risk, resulting from the potential combinations of prevailing winds and topographic influences (both aspect and slope), it was concluded that there were not many locations within the FPA that exhibited very high, or extreme, hazard levels of being involved in a catastrophic wildfire event. However, the fact that the 2021 Caldor fire occurred in close proximity to the PPSA (involving essentially the same types of setting features and conditions) indicated that such a high magnitude and destructive event was possible.

Additionally, more detailed analyses were conducted for this study that addressed daily prevailing wind data recorded at two of the weather stations during the period of the Caldor Fire "run-up": Bald Mountain (BMC1) and Owens Camp (ONWC1). From the full data set available at each station daily wind directions and speeds were extracted starting on the fire ignition date of August 14, 2021, and continuing through a five-day "run-up" period. The data from each weather station were compiled into a “wind rose” format and the results are presented in Figures 13 and 14, below.

Figure 13. Wind Rose data recorded at the Bald Mtn RAWS: August 14-18, 2021.

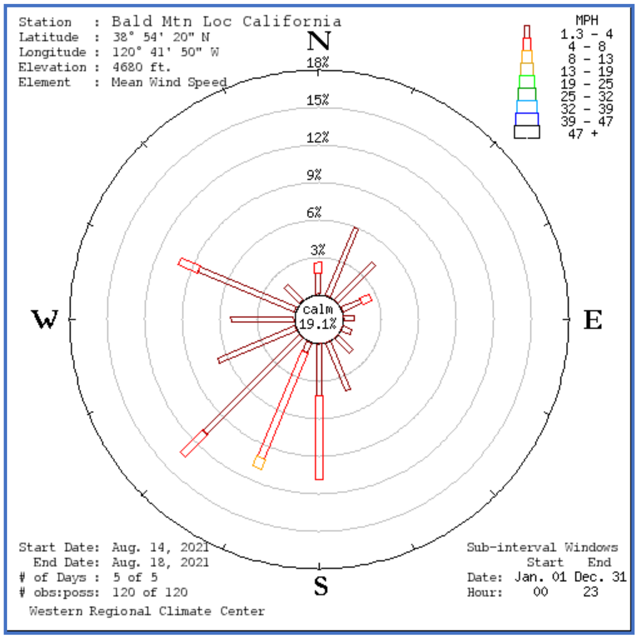
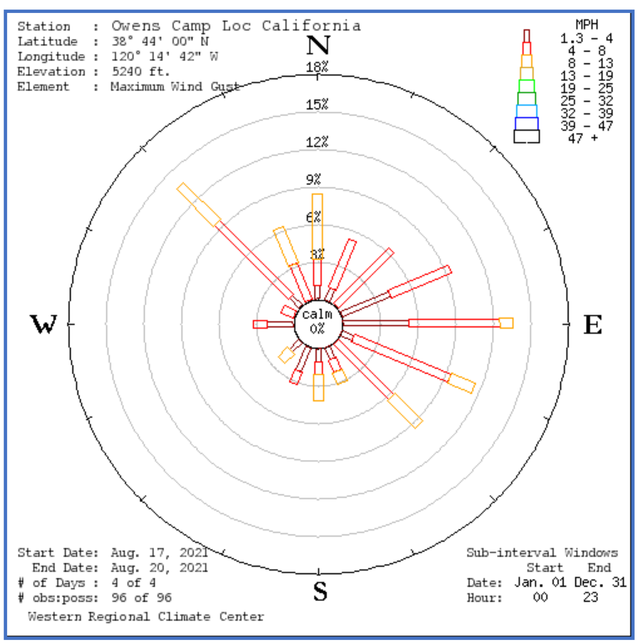


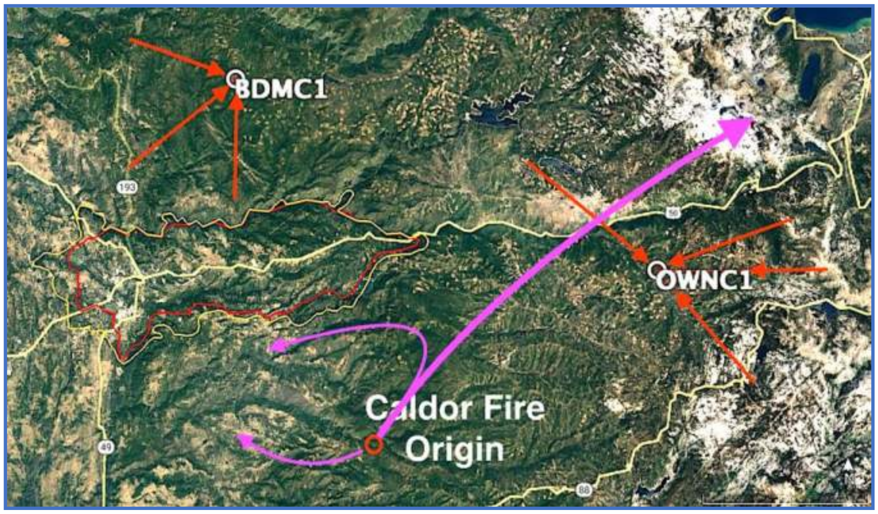
Figure 14. Wind Rose data recorded at the Owens Camp RAWS: August 17-20, 2021.



The principal wind bearings were then plotted on the GESI for each station along with the PPSA extent and the principal movement pattern of the Caldor fire. These results are displayed in

Figure 15. An initial comparison of the bearings recorded during the five-day Caldor Fire ignition and "run-up" period with the bearings for the same stations in Figures 7 and 8 showed no significant anomalies. Thus, it was concluded that the movement pattern of the Caldor Fire was not significantly influenced by prevailing winds. Further analysis regarding the influence of diurnal winds drew the same conclusion.

Figure 15. Movement patterns of the Caldor Fire in comparison with prevailing winds.



In the principal southwest-to-northeast run of the fire[21] there was a gain in elevation of approximately 5,000 feet indicating that there would be some slope-related accelerations of the wildfire front. However, the overall rate of advance was indicative of a wind-driven event and the question was, given the predominance of east-to-west and south-to-north prevailing winds where did the strong southwest-to-northeast wind component come from? The most reasonable conclusion was an ***extraordinary wind*** in the form of a firestorm. The Caldor Fire was believed to have its origin point on the Middle Fork of the Consumnes River and the ability to rapidly burn uphill (40% to 60% slopes) into heavy forest formations on a southwest-facing slope. There was also a strong possibility of a prevailing southwest wind increasing the uphill burn. This combination of uphill runs, trailing winds, and heavy forest formations most likely contributed to a significant increase in fire intensity and the development of firestorm conditions.

The combination of prevailing winds, topographic parameters, and vegetation type/fuel models similar to those of the Caldor Fire exist within the PPSA; primarily in the north-eastern and east portions on lands under the jurisdiction of the USDA/FS. It is recommended that additional, more detailed, study of the combined wind, topography, and fuel model patterns within the PPSA be completed in order to assess the potential for firestorm development.

Vegetation Conditions

Natural Vegetation Alliances Characterizing the Full Project Study Area

[21] USDA/FS. October, 2021

The project is located in the North Sierran[22] Ecological Province and within the PPSAthe vegetation cover is characterized by the following Alliances[23].

- Mixed Conifer – Fir (MF)
- Mixed Conifer – Pine (MP)
- Gray Pine (PD)
- Riparian Mixed Hardwood (NR)
- Interior Mixed Hardwood (NX)
- Canyon Live Oak (QC)
- Blue Oak (QD)
- Valley Oak (QL)
- Interior Live Oak (QW)
- Montane Mixed Hardwoods (TX)
- Greenleaf Manzanita (CG)
- Upper Montane Mixed Shrub (CM)
- Lower Montane Mix Chaparral (CQ)
- Scrub Oak (CS)
- Whiteleaf Manzanita (CW)
- Upper Montane Mixed Chaparral (CX)
- Annual Grasses and Forbs (HG).

In addition to these naturally occurring vegetation alliances consideration must also be given to the various agricultural uses and other surface conditions/land use types that characterize the project area as their differences can be important in regard to the **nature** and ***intensity*** of wildfire that they could generate. Clipping of the CALVEG vegetation database to the full project area produced the following type map that is more specific than the alliances listed in the above section (see Figure 16) and the surface area covered for each mapped category (see Table 7).

[22] USDA/FS. December 17, 2022.
[23] CalVeg. July 5, 2022

Figure 16. Map of the CALVEG types in the full project area.

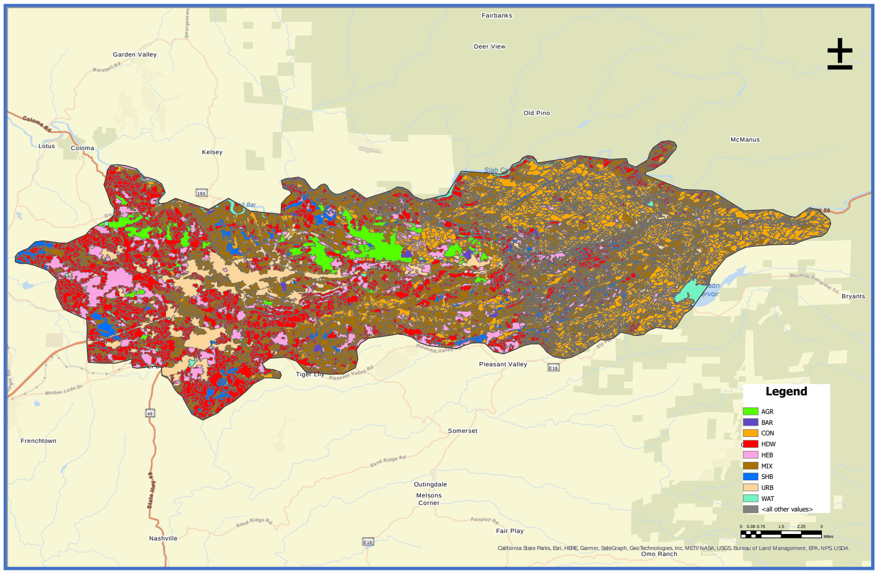


Table 7. Surface area covered for each CALVEG type mapped in the PPSA.

CALVEG Type	Type Description	Surface Area (ac.)
MIX	Mixed Conifer/Hardwood	24,696
HDW	Hardwood dominated	18,817
CON	Conifer dominated	17,399
HEB	Grassland/Forbs	6,915
URB	Urban	5,282
AGR	Agricultural	2,591
SHB	Shrub dominated	2,384
WAT	Water Surface	688
BAR	Barren Lands	423
	Total	79,195

Relationship Between Vegetation Types and Fuel Models

However, after presenting the vegetation type information that is a core element of the Study’s setting, an additional, very clear, distinction must be made concerning the information actually driving the modeling activities and assessment of wildfire behavior and impacts. This assessment is based on ***mechanistic influences*** (as was previously discussed in an introductory section) that affect wildfire’s ability to ignite, cross landscapes, and impact conditions, at defined locations. In general, these “behavior predictive” models describe how wildfire moves 1) across the surface of the ground, 2) vertically from the ground into the overstory crown, 3) horizontally through the crown material, and 4) creates burning material that becomes air-borne and “jumps” ahead of the surface-associated fire advance line. These processes are controlled purely by the laws of physics and the ***floristic nature*** of a setting element (generally defined by a distinctive set of individual species present and their relative dominance) does not have a significant influence on wildfire behavior when compared to the physical mechanisms. The setting element that does have this ability to generate significantly different results, with respect to wildfire behavior, is fuel. The specific characteristics of fuels that exert a significance influence include, 1) the amount of flammable material present (either measured in weight or volume), 2) the size classes of material present, and, 3) the structural arrangement, both horizontally and vertically, of the fuels (also referred to ***as fuel-bed continuity***).

Thus, the wildfire behavior modeling process continues to use vegetation type as inputs as mapping vegetation types is an entrenched industry-standard procedure. However, there is now, for use in wildfire modeling applications, an additional step that needs to occur. Through additional study the relationship between a unit described floristically and its physical influence on wildfire behavior has been established and now it is commonly referred to as a ***crosswalk***.

In addition to these naturally occurring vegetation types, consideration must also be given to the various agricultural uses that characterize the project area as their differences can be important regarding the nature and intensity of wildfire that they could generate. Clipping of the CALVEG vegetation database to the PPSA produced the following type map that is more specific than the association types listed in the above section (Figure 16) and the surface area covered for each type (Table 7).

Wildfire Behavior Modeling Program Used for this Assessment

The modeling program selected for use in the assessment is referred to as LANDFIRE (Landscape Fire and Resource Management Planning Tools or "LF"), LF is a shared program between the wildland fire management programs of the U.S. Department of Agriculture Forest Service and U.S. Department of the Interior, providing landscape scale geo-spatial products to support cross-boundary planning, management, and operations. The LF Program provides, on a national scale, over 25 geo-spatial layers (e.g. vegetation, fuel, disturbance, etc.), databases, and ecological models that are available to the public for the U.S. and insular areas. The LF application is offered as a planning tool in the Interagency Fuels Treatment Decision Support System (IFTDSS). The Interagency Fuel Treatment Decision Support System (IFTDSS) is a web-based application designed to make fuel treatment planning and analysis more efficient and effective. IFTDSS provides access to data and models through one simple user interface. It is available to all interested users, regardless of agency or organizational affiliation.

The fuel model crosswalk for the vegetation types mapped in the FPR is derived from the thirteen Fuel Models described by H.E Anderson[24]. Brief descriptions of these thirteen types follows and Table 8 shows the crosswalk fuel models used in the Landfire wildfire behavior prediction runs:

- FBFM2 - Fire Behavior Fuel Model 2, Fire Spread is through the fine herbaceous fuels primarily surface fires

[24] Anderson H.E. 1982.

- FBFM4 - Fire Behavior Fuel Model 4, Fires are intense with fast spread involving the foliage and live and dead fine woody material in the crowns. Stands of mature California mixed Chaparral
- FBFM5 - Fire Behavior Fuel Model 5 Shrub Group Fire is generally carried in the surface fuels of shrubs. Fire is generally not very intense. Shrubs are short.
- FBFM8 - Fire Behavior Fuel Model 8. Timber Group Slow burning ground fires with low flame lengths Generally stands are closed canopy stands of short needle conifers or hardwoods with fire in the compact litter layer
- FBFM9 - Fire Behavior fuel Model 9 Timber Group Fire runs through the surface litter faster than model 8. Both Long needle conifer stands and hardwood stands
- FBFM10 - Fire Behavior Fuel Model 10 Timber Group Fire burns with greater intensity Dead and down fuels are greater than other types
- FBFM12 - Fire Behavior Fuel Model 12 Timber group Fires spread rapidly with High intensities. Stand is dominated with high fuel loadings on the surface. Very few areas have this type of Fuel Model in the project area only those areas with slash from timber sales that are not treated.

Table 8. Surface area and associated fuel model(s), for each CALVEG type mapped.

CALVEG Type	Surface Area (ac.)	Fuel Models	
		Anderson[25]	Scott/Burgan[26]
MIX	24,696	FBM 9 and 10	
CON	17,399	FBM 9 and 10	
HDW	18,817	FBM 4 and 5	
SHB	2,384	FBM 4 and 5	
HEB	6,915	FBM 2	
URB	5,282		NB1
AGR	2,591		NB3
WAT	688		NB8
BAR	423		NB9
	79,195		

For the CALVEG types identified in the FPR only five related closely to those in Anderson's classification system with three of the CALVEG types being a combination of two Anderson classes. The four remaining CALVEG types were considered as having non-burnable surface conditions, were classified by Scott and Burgan in their later work as such, and did not result in fire behavior predictions.

Lastly, with respect to the fuel model(s) identified for two CALVEG types, AGR and URB, there is a serious need for further study. The AGR type has a broad range of fuel characteristics, mimicking those in the CON, HDW, and MIX for the mature orchards and, similarly, DHB for vineyards and shrub producing fruits. The URB type is often, in the Placerville setting, embedded in a matrix of CON. HDW, MIX, DHB, and HEB and wildfire behavior is dictated by the non-urban conditions. These locations are in fact suburban features, and evaluation of the

[25] Anderson H.E. 1982

[26] Scott J.E and R.E. Burgan. 2005

potentially adverse wildfire impacts can be lost on a regional planning scale as they become included in the broader category

Special Interest Features and Conditions

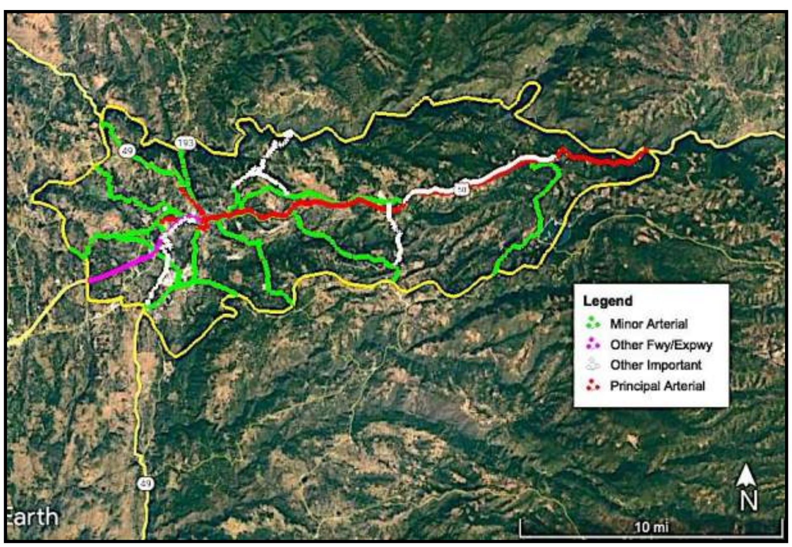
Roads

As an important component to the current setting conditions within the PPSA is an assessment of the level of risk that a subject road would lose its ability to function if involved in a wildfire event. In this context ***loss of function*** ("LOF") pertains to any road, or individual segment thereof, that loses it ability provide, 1) access for emergency wildlife response actions, and/or, 2) uses for the purposes of evacuation.

For the initial baseline setting process the primary criterion for making the decision regarding the specific level of LOF risk a subject road segment could be subject to involves identifying the fuel model(s) that directly border any of the distinct segments comprising the named road.

The selection of the specific roads addressed in this assessment was guided by the hierarchal framework set out in Caltrans' Functional Classification System ("FSC")[27] and the specific road locations shown on six FSC maps covering the PPSA[28]. Twenty-six roads, in three Caltrans' classifications, were identified within the PPSA. In addition, seven additional roads were identified, and included in the study, by project governance as being important to local interests. A general view of the roads addressed, color-coded by FSC classification, is presented in Figure 17

Figure 17. Roads addressed in the assessment of loss of function (LOF).



The assessment addressed a total of 33 named roads, comprised of 256 distinctly different segments. For each distinctly identifiable segment the following actions occurred: 1) One of the

[27] Caltrans, 2022.
[28] Caltrans CRS Grid Maps (6), 2022.

three possible WHL level was assigned based on the presence of adjacent fuel model(s), 2) the segment's length was determined using the "Add Path" function available as part of the Google Earth Pro platform, and 3) a .kmz file was stored for the segment.

Table 9. Results of the road vulnerability assessment.

Class	Ground Distance by Vulnerability Level (mi.)				Named Roads	
	High	Medium	Low	Total	Number	Segments
Freeway/Other Expressway	0.00	1.30	2.28	3.58	1	10
Principal Arterials	0.28	10.18	14.16	24.62	9	45
Minor Arterials	20.25	11.60	19.12	50.97	16	123
Local Interest	17.81	6.89	6.75	31.45	7	78
Vulnerability Level Totals (mi.)	38.34	29.97	42.31	110.62	33	256
Vulnerability Level Totals (%)	34.7%	27.1%	38.2%			

The results shown in the above Table 9 provide 1) an indication of the magnitude of each hazard level, in terms of the lineal distances involved, and 2) the ability to define, with additional follow-on study, road-site treatment zone widths (and therefore an estimate of acreages) within which hazard reducing management could be implemented. The full set of road-by-road results is too voluminous to efficiently present in this report, however, they are included herein as Addendum II to this report.

Communities Vulnerable to Elevated Levels of Impacts from Wildfire

Some ***communities***, due to their location and nature of their makeup, can be more vulnerable to adverse impacts should they be involved in a wildfire incident. Principal characteristics that distinguish these more vulnerable communities from others are:

- Direct, or at least, reasonable contact with wildland conditions – In this analysis wildland conditions are defined as being only those directly related by way of their influence on wildfire behavior. More precisely, the focus is on those conditions that could reasonably result in generating dangerous wildfire behaviors;
- Have a single point of road access (some communities could have an additional one road access point based on other criteria conditions – As a wildfire event is evolving the most critical operational elements are 1) getting to the location in order to gain control over the wildfire, and 2) moving any involved citizens out harms ways via evacuation, and;
- What is the nature of the wildfire behavior-related conditions that are within, or directly adjacent to, the community boundaries – It is important to understand what type of wildfire fuels are present, how they are distributed within the community boundaries, and how critical infrastructure could be adversely impacted.

Using the three ***Interpretation Criteria*** ("IC") criteria described above, a study was completed for the PPSAto identify and map the subject communities. The initial step involved conducting a thorough interpretation of the Google Earth Satellite Imagery (GESI) for the PPSA. The objective was to identify rural-residential developments that met the three ICs. Where the criteria-based decision process identified a suitable candidate community its boundary was defined and put into proper geographic position on the GESI. This process identified 25 separate locations that met the criteria requirements. The results of this analysis are presented in the following Figure 18 and Table 9. Figure 18 shows, over current GESI images, the geographic distribution of the locations that met the selection criteria. This figure shows the set of yellow-shaded polygons of selected locations within the PPSA (yellowed-lined boundary). Table 9 presents, for the 25 selected locations, each location's metadata: Identifier code, surface area occupied, and the geographic coordinates of the surface road access point. The deliverables resulting from this task area will include:

- map, delivered as the hard-copy (Figure 18), and,
- digital files of the polygons representing each community, in agreed-to formats, to support their GIS use in subsequent studies.

Figure 18. Locations of the 25 communities with elevated vulnerability to wildfire impacts.

Table 10. Specifications of communities with elevated vulnerability to wildfire impacts.

Development	Surface Area (ac.)	Access Point	
		Latitude(˚)	Longitude (˚)
Quick Silver Road	33.5	38.770338	-120.594036
Pinewood Lane	22.9	38.769991	-120.594446
Sherman Way	72.6	38.772023	-120.582223
Deep Haven Road	137.0	38.767523	-120.578535
Audubon Drive	269.0	38.757005	-120.692523
Mortara Circle	204.0	38.720432	-120.880175
Silver Lode Drive	143.0	38.693203	-120.861481
Mattie Circle	36.9	38.674173	-120.790896

Big Oak Road	65.2	38.674173	-120790896
Larkin Mine Road	17.8	38.691696	-120.790956
Kearns Road	34.0	38.686233	-120.779262
Thorson Drive	122.0	38.691115	-120.694779
Rainbow Trail	266.0	38.716866	-120.580167
Old Carson Road	70.3	38.754268	-120.546679
Arundel Road	23.5	38.739792	-120.581117
Granite Hill Road	41.2	38.757000	-120.838562
Teal Pond Road	46.1	38.756152	-120.836826
Diana Street	42.2	38.744862	-120.820157
Hidden Spring Circle	24.1	38.7366616	-120.831325
Woodridge Court	19.0	38.736164	-120.830305
Rising Hill Road	27.9	38.739457	-120.859429
Patterson Drive	103.0	38.675601	-120.826359
Gilmore Road	231.0	38.751317	-120.608606
Prescott Avenue	24.8	38.744141	-120.783708
Stone Lane	27.9	38.734374	-120.826436

High Tension Electrical Lines

High tension electrical line systems are considered a sensitive feature because they can be both very vulnerable to loss of function should they be involved in a wildfire event, but they can also be a significant source of wildfire ignition. Figure 15 shows the location within the PPSA of the identified high tension transmission line system. The line's location is indicated by the red line.

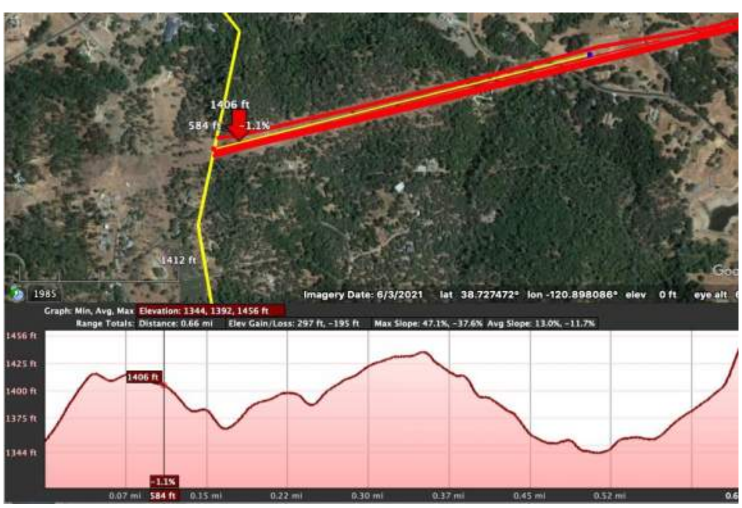
Figure 19. The alignment of the high-tension electrical line corridor with the PPSA.

A closer examination of the vegetation conditions, both below the high-tension transmission lines themselves and clearance at the sides showed a wide range of maintenance actions that would be required for appropriate clearance. For example, Figure 20 presents an example where there are well cleared tracts under the lines but also significantly-sized patches that appear to be both fully connected with the vegetation on both sides of the corridor in un-managed condition directly below the lines themselves. Without direct field observation it was not possible to evaluate the ground-to-line separation distance (also referred to as ***deflection***) but there are certainly indications of a need for both transition vegetation management and routine maintenance.

A second example, shown in Figure 21, is in an area in the extreme western portion of the PPSA.

Figure 20. Patchy pattern of vegetation cover within the HTL corridor.

Figure 21. Section of the HTL Corridor on western edge of FPA.



Estimation of Wildfire Hazard on a Regional Scale

This assessment of, and subsequent conclusions drawn regarding regional wildfire associated hazard levels was completed in two parts. The first addressed hazard contributions arising from each setting component independent of any of the others and the second addressed situations where the mechanistic influences were the product of various combinations of individual components acting in concert.

The number of WHLs levels that would constitute the regional deliverable map product was set at three through discussions at the project governance level. The categories were denoted as Low, Moderate, and High. The discussions also acknowledged that a finer breakdown would require subsequent analyses; most likely conducted within a ***multi-stage inventory***, and not within the scope of work for this Study.

Assessment of Individual Setting Components

Terrain Slope

As a result of applying a professional judgement process to assigning WHLLs based on terrain slope it was concluded that the slope categories reported on in Figure 5 and Table 3 formed an appropriate basis for assigning hazard levels. The primary considerations in making these assignments included 1) the nature and intensity of the fire behavior that could result if a fire event occurred on lands in each category, 2) the resistance to gaining control over the wildfire, and 3) mitigation management implementation constraints. For each category the discussions below describe the specific location within the PPSA each category is located and provides more detail behind that assignment:

- Low – Located primarily in the central portion of the PPSA, with a west-to-east alignment, the category occupies 15,403 acres (19.5% of the PPSA) and is color-coded in Figure 6 with cyan shading. The category occupies the broader basin along the Highway 50 alignment and narrower valley bottoms and is closely associated with urban, suburban, and agricultural land uses;
- Moderate – Lands in this category are located where slopes classes begin to constraint urban, high-density suburban, and agricultural land uses. Also found on lands in this category is a high proportion of the “communities vulnerable to elevated levels of impacts from wildfire”. The 54,288-acre (68.5% of the PPSA) category clearly predominates the surface occupation, and;
- High – The lands comprising this category occupy 9,464 acres (12.0% of the PPSA) and significant blocks are found primarily on the southern flanks of the South Fork of the American River and in the Sierra Springs area. These lands are generally considered “wildlands” and the sole development features include utility infrastructure and roads.

A single WHL level assignment for the terrain slope component characterizing the PPSA could be developed by using a system of three linear equations where there are two input variables, and the result is a comparable ranking figure. The first input variable would be a "weighting" factor for the category that determines the category's comparative magnitude of influence and the second would be the percentage of the category's PPSA occupation. Using the simplest weighting factors of, Low = 1, Moderate = 2, and High = 3. The three equations would be:

Low: 1 x 19.5 = 19.5 — Contribution to Total = 10.1%
Moderate: 2 x 68.5 = 137.0 — Contribution to Total = 71.2%
High: 3 x 12.0 = 36.0 — Contribution to Total = 18.7%
Total Score = 192.5

The individual equations produced ranked contributions and then when summed, a total value unique to the relationship of slope's influence on WHL. The combination of a very low percentage of surface area that is without distinct slope influences (basically flat or very gently sloped) and the assigned magnitude factor produced a minor contribution (10.1%) to the overall score. The lands assigned a Magnitude Factor 2 (i.e. those with moderate slopes) clearly dominated the Contribution to Total value; a result of the category covering a very high proportion of the PPSA's surface area. Even with the highest Magnitude Factor, the relatively low percentage of occupied surface in the PPSA of Category 3, produced a relatively moderate Contribution to Total value. In a process that applied professional judgement to these results of the analysis of a slope's influence, it was concluded that the overall WHL level for the PPSA would be in a Moderate category.

Aspect

For the purposes of assigning a PPSA-wide WHL level aspect would be analyzed in a manner similar to terrain slope. However, in this case the magnitude factor would be assigned based on the microclimate characterizing each aspect category derived from the aspect digital database and the characteristics of the vegetation formations occupying each aspect that relate to fuels conditions.

Table 11. Categories of aspect derived from the digital database utilized in this analysis.

Category Descriptions		Occupation of FPA Surface Area	
General	Magnitude Factor	Percentage	Acres
Flat	1	6.9%	5461
N	2	0.3%	235
NE	2	19.9%	15744
E	2	0.1%	112
SE	3	18.0%	14255
S	3	0.3%	209
SW	3	28.0%	22175
W	3	0.3%	249
NW	2	26.2%	20755

Total Acreage	79,195

Once again there are three WHL influencing levels and an associated magnitude factor: 1, 2, and 3. Table 10 shows the assigned factor for each aspect category. Brief descriptions of the differentiating characteristics are:

Magnitude Factor 1: “Flat” areas lacking directional orientation. Insolation is unaltered by topographic variations, temperatures follow ambient fluctuations, and predominant land uses typically, and predominantly, include urban and high-density suburban development and agricultural endeavors.

Magnitude Factor 2: Northwest, North, Northeast, and East oriented categories. These aspects are characterized climatologically by low sun-angles and elevated degrees of shading, cooler temperatures, and elevated levels of humidity. Typical vegetation associations are more mesic in nature including conifer forest, mixed conifer/hardwood formations, hardwood woodlands and scrub formations.

Magnitude Factor 3: West, Southwest, South, and Southeast oriented categories. These aspects are characterized climatologically by higher sun-angles and very little shading, warmer temperatures, and lower levels of humidity. Typical vegetation associations are more xeric in nature including open hardwood woodlands, scrub formations, chaparral formation, and grass/forb formations.

Once again, deriving a PPSA-wide determination of the WHL level sourced from the aspect component involved three equations with the same input variables (magnitude factor and surface occupation percentage). These equations were as follows:

Magnitude Factor 1: 1 x 6.9 = 6.9 Contribution to Total = 2.9%
Magnitude Factor 2: 2 x 46.5 = 93.0 Contribution to Total = 38.8%
Magnitude Factor 3: 3 x 46.6 = 139.8 Contribution to Total = 58.3%
Total Score = 239.7

The individual equations produced ranked contributions, and then when summed, a total value unique to the relationship of aspect’s influence on WHL. The combination of a very low percentage of surface area that is without distinct aspect influences (basically flat or very gently sloped) and the assigned magnitude factor produced a very minor contribution (2.9%) to the overall score. The lands assigned Magnitude Factors 2 and 3 showed almost equal land occupation percentages and their respective contributions were determined solely based on the factor difference. In a process that applied professional judgement to these results it was concluded that the overall WHL level for the PPSA would be in a Moderate-to-Moderately High category.

Prevailing Winds

Deriving PPSAWHL assignments is, in general, problematic for wind influences alone. Wind influences are realized when currents flow from one point to another but are only ultimately defined by the conditions the winds encounter as they cross a landscape. When considering whether there are winds present only two of the four meteorologic stations show significant winds with bearings that enter the PPSA: Placerville [PVF] and Bald Mtn [BDMC1] as seen in Figures 11 and 12, and in the data presented in Table 5. The principal bearing for the Placerville station, which had recorded winds that traversed significant portions of the PPSA, was an east-to-west direction in both the non-fire and fire season periods (Figures 11 and 12 resp.) The Bald Mtn station showed winds that crossed the western 1/3rd of the PPSA with winds coming from a south-west position, again in both seasonal periods.

Not only would wind presence be considered, at most, to a moderately-low level but the attributes show similar impact potential. The highest average annual wind speed was 5.7 mph at the Placerville station. This is in a Beaufort Classification 2 and considered to be a “light breeze”[29]. Lastly, from data recorded at all four weather stations the average annual percentage of “calm” conditions was 42.3.

It was reasonably concluded that the mere presence of prevailing winds did not contribute significantly to a rise in WHL level. However, the cumulative effects, i.e. when those wind currents did interact with various features and/or conditions situated in the landscape, could reasonably be a principal contributor to elevated WHL levels.

Lastly, when considering diurnal and extraordinary winds, it was concluded that these types were too dynamic and unpredictable to consistently determine the nature and intensity of their influences over the PPSA.

Presence of Fuel Models

Professional experience supports the conclusion that the fuel models present have a significant influence on WHL levels. Close examination of the CALVEG types contained within the digital database covering the PPSA showed that they “cross-walked” to four distinctly different fuel models. Below, in Table 9, are listed the CALVEG types along with 1) the surface area occupied within the PPSA, 2) the occupation percentage, 3) the assigned influencing magnitude factor, and 5) the standardized source classification.

[29] NOAA/NWS. January 2023.

Table 12. CALVEG type-to-standard fuel model types crosswalk for the PPSA

CALVEG Type	Surface Area (ac.)	Occupation Percentage	Magnitude Factor	Fuel Models	
				Anderson[30]	Scott/Burgan[31]
MIX	24,696	31.2%	4	FBM 9 and 10	
CON	17,399	22.0%	4	FBM 9 and 10	
HDW	18,817	23.8%	3	FBM 4 and 5	
SHB	2,384	3.0%	3	FBM 4 and 5	
HEB	6,915	8.7%	2	FBM 2	
URB	5,282	6.7%	1		NB1
AGR	2,591	3.3%	1		NB3
WAT	688	0.9%	1		NB8
BAR	423	0.5%	1		NB9
	79,195				

Below, broken out by magnitude factor are greater details supporting the material presented in Table 9.

Magnitude Factor 1: Basically, surfaces that will not support the advancement of fire occupying 8,894 acres (11.4%) of the PPSA. The acreage figure for the agriculture category (AGR:NB3) does not consider that there is a difference, with respect to fire behavior, between the arborescent types (orchards, vineyards, woody shrubs) and row, cereal, and feedstock types. This category assigned the lowest magnitude factor, Includes Scott/Burgan fuel models, NB1, NB3, NB8, and NB9.

Magnitude Factor 2: A mix of vegetation formations comprised of grass/forb swards and sparse brush within grass/forb swards that occupies 6,915 acres (8.7%) of the PPSA. This category is comprised of a sole fuel model, Anderson's fuel:

- FBM2 – Fire Behavior Fuel Model 2: Fire spread is through the fine herbaceous fuels and are typically surface fires only with low intensities and flame lengths.

Magnitude Factor 3: A spectrum of hardwood and brush/scrub formations comprised of three principal types: Open hardwood formations with grass/forb, medium density mixed hardwood formations, and scrub/brush lands occupying 21,201 acres (26.8%) of the PPSA. This category includes the following Anderson fuel models:

- FBFM4 – Fire Behavior Fuel Model 4: Fires are intense with fast spread involving the foliage and live and dead fine woody material in the crowns. Fuel bed is primarily stands of mature California mixed Chaparral.
- FBFM5 – Fire Behavior Fuel Model 5: Fire is generally carried in the surface fuels of shrubs. Fire is generally not very intense and with low flames due to the short stature of the species involved.

[30] Anderson H.E. 1982
[31] Scott J.E and R.E. Burgan. 2005

Magnitude Factor 4: Taller, dense, and multi-layered formations dominated by conifer species and a hardwood/conifer mix occupying 42,095 (53.2%) of the PPSA. This category includes the following Anderson fuel models:

- FBFM9 – Fire Behavior fuel Model 9: Fire runs through the surface litter faster than model 8. Formation is characterized by a mix of conifer and hardwood species and stands that are multi-storied in structure. This fuel model will carry both surface and full structure involvement and can be a significant source of embers.
- FBFM10 – Fire Behavior Fuel Model 10: Fire burns with greater intensity as dead and downed fuels are in greater proportions than other types. Formation is characterized by a mix of conifer and hardwood species and stands that are multi-storied in structure. This fuel model will carry both surface and full structure involvement and can be a significant source of embers

It was determined that for deriving a PPSA-wide determination of WHL level, four separate equations were warranted, that they used the same input variables (magnitude factor and surface occupation percentage), and also the same percentage value contribution to the accumulating total for the PPSA. These equations were as follows:

Magnitude Factor 1:	1 x 11.4 = 11.4	Contribution to Total = 3.54%
Magnitude Factor 2:	2 x 8.7 = 17.4	Contribution to Total = 5.40%
Magnitude Factor 3:	3 x 26.8 = 80.4	Contribution to Total = 24.97%
Magnitude Factor 4:	4 x 53.2 = 212.8	Contribution to Total = 66.09%

When considering assigning an overall WHL level to the Placerville PPSA it was clearly evident that a significant majority of the surface area (80.0%) was occupied by fuel models that could reasonably generate moderately high-to-dangerous wildfire behavior if involved in an incident. This preponderance of influence dictated the finding that, for the PPSA, overall WHL level would be in the "High" category due to the fuel models present.

Multiple Setting Components – Cumulative Effects

In wildfire situations the influence of individual setting components (prevailing winds, terrain slope, and aspect) often do not result in observably significant changes in WHL levels; an exception being, as described in the previous section, the presence of fuel models. Detectible changes in WHL level are usually definable only when two, or more, components act in combination; a process often referred to as "***cumulative effects***" ("CE"). An example of this combining process would involve a prevailing wind of notable velocity blowing directly up a 40% south-facing slope through dense woodlands or forests. Specifically identifying what combinations of setting components result in undesirable WHL conditions and locating where they are within an area where wildfire planning is needed is of primary importance.

Unfortunately, identifying the locations of the full range of possible setting component combinations for an area as large as the PPSA requires a significant level of effort and was out of the scope of the current project. Not only would the analysis have to address the presence and conditions of the various setting components, but it would most likely also include consideration of specific features, or resources, that would be vulnerable to adverse impacts from wildfire. These types of multi-variant and geographically descriptive analyses are typically accomplished using standard geographic information systems analysis procedures and would be recommended as logical follow-on projects using the information generated by the current effort.

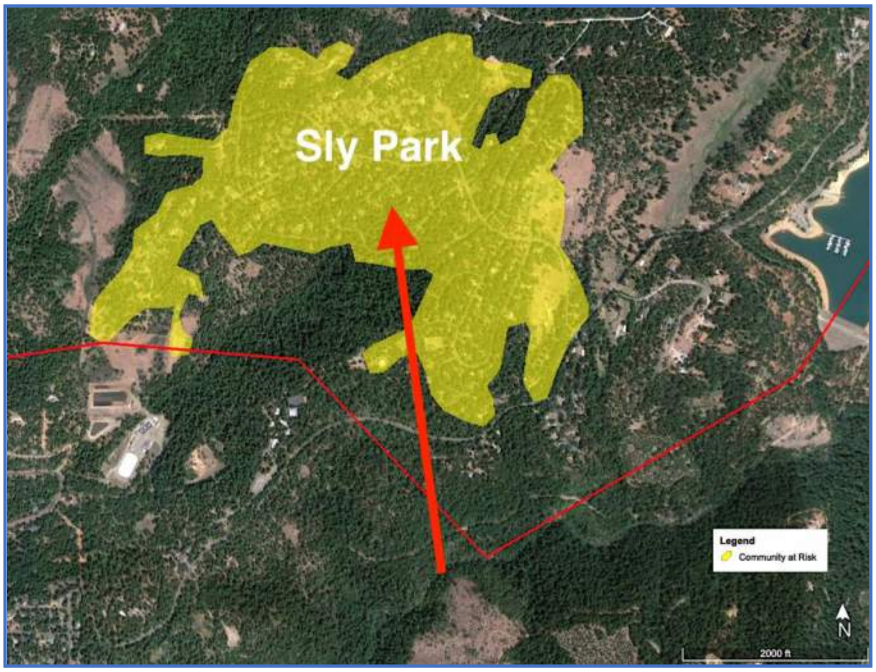
Simply for illustrative purposes pertaining to the potential for subsequent multi-variable analysis, below are three discussions regarding actual condition scenarios with multi-variable, wildfire-related locations within the PPSA.

Scenario 1 – This scenario considers the presence of seven conditions that have been determined to have the potential for characterizing communities that have elevated vulnerability to wildfire in the PPSA, including four ***setting influencers*** and three ***contextual conditions***:

- Prevailing winds;
- Blowing up steep slopes
- On a south facing slope;
- Through fuel models that could produce dangerous wildfire behaviors;
- Approaching special interest feature/conditions (e.g. Communities with heightened vulnerability to wildfire impacts);
- Where roads servicing the area have heightened vulnerability to loss of function during a wildfire event, and;
- Accessible to the public during the defined fire season.

Figure 19 shows the Sly Park residential development that is at the top of a ½-mile long 45% south facing slope originating in the Sly Park Creek drainage. The intervening vegetation formations include dense conifer/hardwoods and mixed hardwoods which are characterized by fuel models that have a high potential for producing extreme fire behaviors. The heavy red arrow shows a wind bearing that was exhibited in the data recorded at both the Placerville [PVF] and Bald Mtn [BDMC1] weather stations. Lastly, the roads serving the development and the immediate surrounding areas are most likely heavily trafficked in the fire season by recreationists using the Jenkinson Lake facilities. These roads are potential sources of wildfire ignition and are very vulnerable to loss of function should they be involved in a wildfire event. This scenario represents a situation that, from the standpoint of wildfire risk, would reasonably need to be considered very high if not extreme.

Figure 22. A location subjected to a multi-component assessment of wildfire hazard.



Scenario 2 – This scenario considers the presence of five conditions that have been determined to characterize locations in the PPSA, including three setting influencers and two contextual conditions:

- Very steep slopes
- On a north facing slope
- Through fuel models that could produce dangerous wildfire behaviors
- Presence of special interest feature/conditions (e.g. high tension electrical transmission lines)
- Where roads servicing the area have heightened vulnerability to loss of function during a wildfire event

Figure 23 shows a portion of the northeastern portion PPSA above the South Fork of the American River. The lands shown are on a ¾-mile long 55% - 65% north facing slope originating from the river. The intervening vegetation formations include dense conifer/hardwoods, mixed hardwoods, and scrub/brush which are characterized by fuel models that have a potential for producing moderate-to-high WHL levels. However, combustibility quotients could be diminished by the more mesic conditions on the north-facing slopes. In contrast to the conditions described in Scenario 1 none of the four weather stations used in this assessment recorded prevailing winds (neither principal nor secondary bearing groups) that would blow upslope in this situation. The only special feature in this location is a high-tension electrical transmission line, Lastly, there are roads serving the area, but they are most likely very lightly trafficked and potentially closed in the fire season. Although, this scenario does have setting components that could generate higher WHL levels (high slope and heavily wooded fuel models) and a high value infrastructure feature there is the lack of a prevailing wind component and human user presence. This is a situation where it would be reasonable to assign it a WHL level no greater than Moderate.

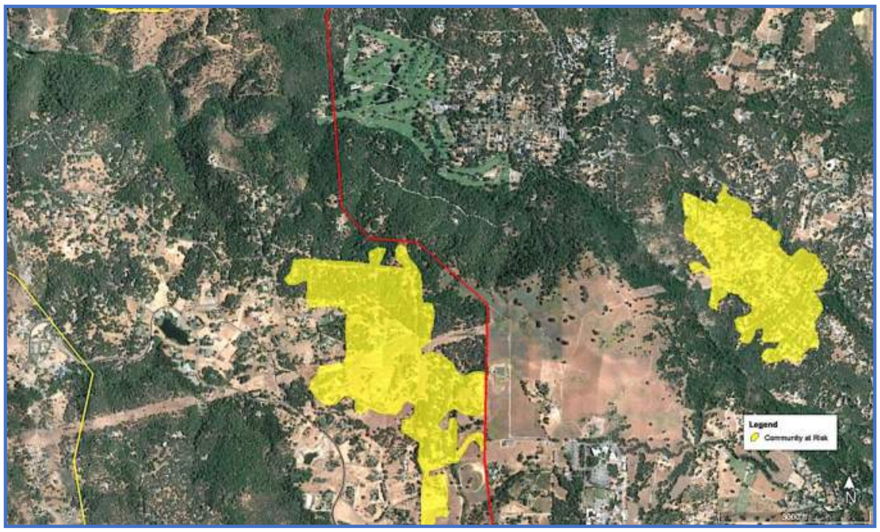
Figure 23. A location illustrative of a five-component assessment of wildfire hazard.

Scenario 3 – This scenario considers the presence of six conditions that have been determined to characterize locations in the PPSA, including three setting influencers and three contextual conditions:

- Low-to-moderate slopes
- Predominantly very gently sloping area and north facing slopes
- Comprised of a complex mosaic of fuel models that could produce a full range of WHL levels
- Presence of special interest feature/conditions (e.g. Communities with heightened vulnerability to wildfire impacts and a high tension electrical transmission line)
- Where roads servicing the area have heightened vulnerability to loss of function during a wildfire event
- Accessible to the public during the defined fire season

Figure 24 shows a complex mosaic of land uses, fairly diffuse suburban and rural residential developments, naturally vegetated areas, moderately incised drainages, and special interest features in the northwest corner of the Placerville PPSA. The natural vegetation formations are mixed hardwood woodlands, scrub/brush formations which are characterized by fuel models that have a potential for producing moderate-to-high WHL levels. There is a drainage that runs the full length of the area shown with vegetation cover that has fuel model characteristics that could be a pathway allowing wildfire to move through the entire area shown. The agricultural uses appear to be primarily open grazing lands and feedstock production; fuel models that typically produce low WHL levels. The intermixing of agricultural land uses and patches of natural vegetation basically create a "buffered" system with respect to restricting the landscape-level movement of a wildfire. However, there is an elevated WHL associated with the positioning of the two communities in the continuous patches of woodlands. Therefore, it would be reasonable to assign a WHL level of low-to-moderate in this third scenario.

Figure 24. A location illustrative a six-component assessment of wildfire hazard.



The preceding three scenarios present information that would be of great value when formulating regional-level policies, strategic plans, and practice formulation. Unfortunately, that kind of identification and evaluation were outside of the scope of the project's regional effort and would have to be accomplished during subsequent assessments. It is recommended that subsequent studies be designed and implemented using a multi-stage assessment approach. The regional information base developed for this project can be used to identify limited areas within the PPSA that, because of their elevated wildfire hazard and consequential threat to valuable or critical resources, warrant further in-depth analyses.

Distribution of Wildfire Hazard Levels within the Project Study Area

Employing a ***convergence of evidence*** approach a discipline expert, experienced in both wildfire behavior analysis and satellite image interpretation, identified and mapped on the GESI surface areas whose setting elements indicated the appropriate WHL level classification. The analyst considered 1) the effects of having the individual setting elements addressed in the analysis present (terrain conditions (slope and aspect), vegetation type-related fuel model, and the wind influences), and 2) if present how would each individual setting interact with the others to produce cumulative effects. Furthermore, the analyst needed to produce mapping units (or polygons) with a relatively high level of heterogeneity of ground conditions due to constraints put on the process by the ***minimum mapping area*** requirement.

The evaluation proceeded in the following manner. Applying a very basic assumption that the vegetation type-related fuel model present exerts the greatest influence on wildfire behavior, the analyst first determined the vegetation type-related fuel model present in the subject area. This process was based on the analyst's experience with field conditions in the Placerville area, satellite imagery interpretation skill level, and reference to the CalVeg database. The next step was to determine, for the area initially defined by the presence of the VTR fuel model, the slope percentage, and aspect, categories represented. Again, this second step involved the analyst's capability and reference to the slope and aspect databases used as inputs in the LANDFIRE fire behavior modelling. Lastly, the evaluation included the wind influence potential (for all three types). Once the influencing factors were identified for a subject area then the most likely cumulative effects scenario was considered and the subject area was mapped on the GESI, then one of the three possible WHL levels was assigned. A map of the distribution of the three WHL levels within the PPSA is shown in Figure 25 and a summary of the surface areas by WHL level is presented in Table 12.

Figure 25. Distribution of the Wildfire Hazard levels within the PPSA.

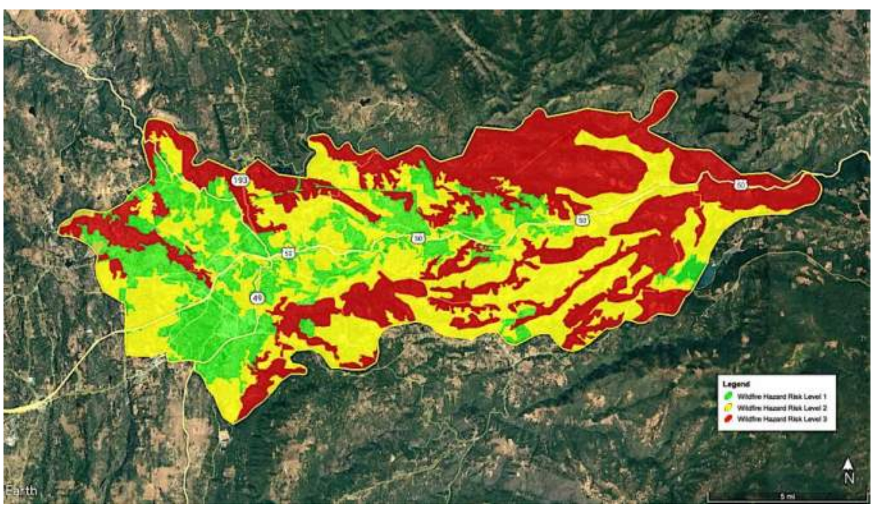


Table 13. Acreage and mapping specifications for Wildfire Hazard levels within the PPSA

WHL Level	Surface Areas of WHL Levels		Map Shade
	Acres	Percentage	
Low (1)	**16,292**	**20.6**	**Green**
Medium (2)	**31,103**	**39.3**	**Yellow**
High (3)	**31,739**	**40.1**	**Red**
Total Acres	**79,134**		

Interpretation of Results and Recommendations

Relationships of Individual Setting Elements with Wildfire Hazard Levels

This assessment addressed, 1) the relationships between three types of individual setting elements and predictable wildfire hazard level, and 2) how various combinations of setting elements influenced WHL and 3) how the intermixing of the three WHLs affected the overall result. The three types of setting elements were:

- Slope
- Prevailing winds
- Vegetation type-related fuel models

In terms of producing high levels of WHL within the PPSA, it was observed that fuel model type had the most apparent correlative relationship. This relationship was clear enough to use the presence of certain fuel model types (forest- and woodland-related) as an initial indicator of higher hazard situations. The presence of terrain characteristics slope (due to the "up-hill" augmentation of spread rate) and aspect (due to influence over the type and condition of occupying vegetation) was considered as a second priority influence. Wind factors were considered to have relatively the lowest level on influence as 1) the "wind rose" information did not show typical wind directions that would add higher level of hazard when acting in concert with the other setting elements, and 2) the other two categories of winds, diurnal and "fire storm-related, showed a low predictability of occurrence that would increase the uncertainty of wildfire event predictability.

The combination of slopes greater than 10%, winds blowing directly upslope, and the presence of forest-, or woodland- related fuel models resulted in a "High" level of WHL. On the other end of the range, i.e. the "Low" WHL level, those areas were characterized by slopes between 0% and 10%, winds generally blowing perpendicular to the slope direction, and surface conditions considered "non-burnable"(water surfaces, active agriculture, dense urban development, etc.). Agricultural endeavors involving orchard and vineyard management did pose some difficulty in defining WHL influence. Although technically an agricultural situation because of its surface vegetation management (tilling) the stands of woody species can produce some effects the same as stands of natural forest or woodland species.

Regional Classification of WHL levels for the Project Study Area

The primary result from this assessment is that approximately 40% of the area within the PPSA is occupied by ground conditions that produce wildfire behavior with “High” hazard levels. The effect of these surface conditions is ameliorated by the fact that almost 60% of the lands are in lower hazard levels. Considering the effects that contributed to the three levels, a reasonable conclusion would be to consider the full area to be in a level slightly less than “Medium.”

However, reference to Figure 26 reveals another consideration; the relative position of each of the three types to each other. There is a fairly complex intermixing of the three types and there is a very strong presence of continuous west-to-east pathways of “High” level WHL. Typical fire behavior in these areas includes fairly high intensity burns, longer residence times, capability for crowning to occur, and production of embers. It is also observable that there is more perimeter distance of contact with “Medium” level tracts than with “Low” level WHL. Thus, the “High”-to-“Medium” ignition function could be greatly increased at the whole system level, with an overall WHL level of a level designation at just below “High”.

With respect to the makeup and location of lands designated as “High” WHL levels, two issues require further discussion. Of the total acreage of the “High” category (31,739) it was determined that 9,670 acres (approximately 30.4%) are under the jurisdiction of the USFS/ENF. These lands are located primarily along the northern boundary and eastern tip of the PPSA but are also scattered in smaller parcels in the central and eastern portions of the PPSA. The first issue is that USFS/ENF personnel must be fully engaged in developing policy, program, and practices remedies for the hazards posed by conditions on their lands.

The second issue is the potential for lands designated as “High” WHL-level, and the fuel models that currently occupy them, to contribute to the creation of a “fire storm” situation. In general, current literature provides indications that “fire storm” conditions develop when fire is burning up significantly sloped terrain (whether aided by uphill-blowing winds or not) and enters into significantly large tracts where fuel loadings of highly combustible material is high or extreme.

Special Resource or Feature Situations

This assessment also addressed the vulnerability to involvement in and/or undesirable impacts from, a wildfire incident for three special resource/feature situations:

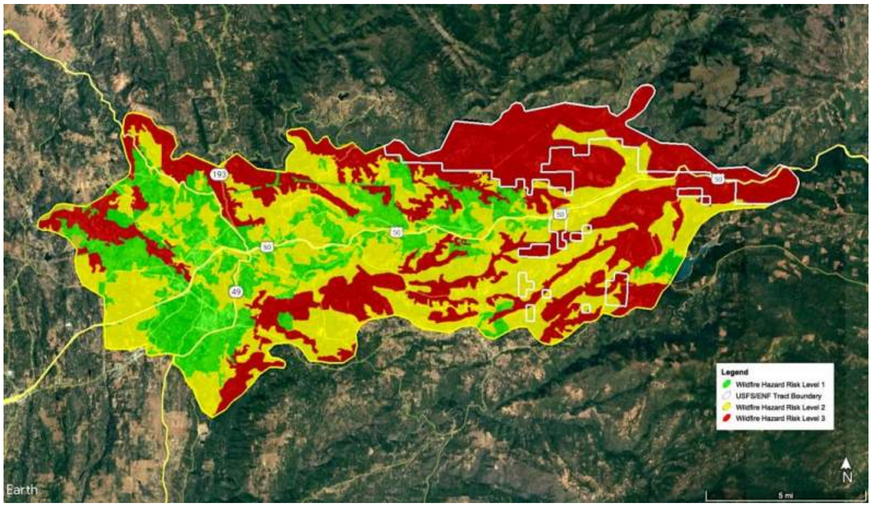
- Roads
- Residential developments in suburban or rural settings
- High voltage electrical transmission infrastructure

Given the mapping constraints involved in this regional analysis, the primary result, in terms of actionable preventative management information, was to identify the location of the three special resource/feature situations within the full study area. The next sections describe a type of analysis that, in subsequent efforts, can provide information regarding specific surface condition management that can be employed to reduce WHL level.

Subsequent Analysis Using the WHL Database

An important type of analysis that becomes possible after the creation of a regional database is referred to as a multi-stage analysis. In this type of analysis, effort can be focused on a smaller portion of the total overall area by identifying an attribute class that would be beneficial to examine in greater detail. For this project, the initial, Stage 1 assessment generated a geo-referenced database covering 79,134 acres, whose primary attribute breakdown was into areas of homogeneous wildfire hazard. Subsequently, a Stage 2 assessment was conducted on the "High" WHL that covered only 31,739 acres or 41% of the Stage 1 assessment area. A primary benefit to the Stage 2 assessment was the ability to utilize a smaller minimum mapping area to account for the surface condition heterogeneity. While it is outside of the scope of the current project, a third stage of analysis is possible; a focus on the tracts of USFS/ENF in PPSA that are located within the "High" WHL category. Knowing where these lands are strategically and what WHL-related conditions exist is information that could greatly assist cooperative wildfire mitigation efforts. This three-stage structure is illustrated in Figure 26 [which is under construction] where Stage 1 is constituted by the three levels of WHL (polygons with green, yellow and red shading), Stage 2 is the area of the red-shaded "High" WHL level, and Stage 3 is the area inside the white-bordered polygons.

Figure 26. **Distribution of WHL levels and tracts of USFS/ENF land within the PPSA.**



It is recommended that future analysis utilizing this information select Stage 2 attribute themes, or add an additional stage or stages, and that the analysis be designed appropriate to the greatest level of detail available at each stage. Examples of possible Stage 2 themes include:

- Vulnerable communities – would permit identifying specific management approaches to the surface conditions that are leading to the vulnerability;
- Critical road segments - would permit identifying specific management approaches to the surface conditions that are leading to the vulnerability;
- High tension electrical transmission infrastructure, specific hazards and mitigation approaches;
- Role of diurnal winds;
- Examination of the effect minimum mapping area constraints have on the quality of information generated; consideration of greater use of multi-stage project designs.

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Addendum 1

BIOGRAPHICAL SKETCHES of PRINCIPAL SCIENTISTS

Tad Mason, Chief Executive Officer

Tad Mason has over 39 years of experience in the fields of bio-energy project development, natural resources management, cellulosic fuels/feedstock supply chain development, and hazardous forest fuels reduction. Mr. Mason has hands-on experience in all aspects of natural resources management, from preparation of forest/range management plans to advising decision makers on key land management/resource utilization policies.

As the CEO of TSS Consultants, and a Registered Professional Forester, Mr. Mason leads a team of professionals who are well versed in the tasks required to successfully develop bio-energy projects. Critical tasks such as developing fuel/feedstock supply availability assessments, generating fuel/feedstock procurement plans, negotiating fuel/feedstock procurement agreements, conducting financial analyses, obtaining environmental permits, negotiating power sales agreements, assisting with plant design and providing technology assessments are key to the successful development of a bio-energy facility. Mr. Mason also assists clients with development and implementation of communications plans targeting stakeholders, peer groups and state/federal policymakers. Community support is an integral component of every successful bio-energy project.

Mr. Mason has worked closely with a variety of resource managers in the agriculture and forest sectors. Much of his work is in support of optimized utilization of cellulosic byproducts generated during commercial land management and agriculture/forest products manufacturing activities. As bio-energy technologies and fuel/feedstock markets continue to evolve, fuel/feedstock harvest, collection, processing and transport operations will continue to be essential. Mr. Mason has significant experience in fuel/feedstock supply chain infrastructure development.

Mr. Mason served as manager of fuel supply with Pacific Energy (now Covanta Energy) for over 12 years. In this role, he developed, coordinated, procured and managed fuel supplies for four commercial-scale biomass power generation facilities. Fuel availability assessment and supply chain development utilizing a variety of woody biomass fuels (urban wood waste, agricultural residuals, and forest thinning material) were a major focus. Contract negotiation and establishment of long-term fuel procurement agreements, including multiple-year forest fuels thinning contracts and forest stewardship contracts, were an important part of the fuels procurement process. In addition he was closely involved with company start up, strategic long-term planning, fiscal budgeting, management of field operations and community outreach.

Mr. Mason received his B.S. degree in Forestry from the University of California at Berkeley in 1979. Mr. Mason and TSS Consultants have managed bio-energy project assessments throughout North America (28 states and 6 provinces) for a diverse set of clients, including public resource management agencies, Indian tribes, private sector enterprises, public utilities, private investment firms and community stakeholder groups.

Mr. Mason is an active member of the Northern California Society of American Foresters and the California Licensed Foresters Association. He has served on numerous committees and task forces, including the Western Governors' Association Biomass Task Force, University of California Forest Products Laboratory Advisory Board, Western Governors' Association Forest Health Advisory Committee, California Forest Products Commission Board of Directors, University of California Woody Biomass Utilization Work Group, California Oak Mortality Task Force, and the Oregon Forest Biomass Work Group.

Mr. Mason's professional and community service recognition include the California Association of Resource Conservation Districts Forestry Award, California Board of Forestry Francis H. Raymond Award, William Main Distinguished Visitor Lecturer (University of California at Berkeley), Society of American Foresters Fellow Award, Northern California Society of American Foresters Forestry Achievement Award, and the American Pulpwood Association Forestry Activist Award.

Steven Daus, Ph.D., Senior Planner-Natural Resources

In his 41-year professional career Dr. Daus has served both national and international clients with natural resources project needs. Between 1979 and 1998, as both a short- and long-term contractor for private companies and international agencies, he participated in natural resources development and regulatory compliance projects in 12 countries throughout South-east Asia, the Indian sub-continent, and Africa. Elements common to all of these projects included, project identification and detailed scoping, regulatory compliance, project implementation assistance, and mentorship-based technology transfer. His clients included Louis Berger International, Inc., World Bank, United Nations Development Program, and the United States Agency for International Development (USAID).

Since 1990 Dr. Daus has served clients requiring the expertise of an experienced wildland fire and fuels planning and management specialist. These clients included individual landowners, community groups, residential developers, federal, state, and county agencies, and non-governmental organizations. He has provided project assistance to clients that have been privately funded, California State funded, or supported through grants (various CAL FIRE programs and federal sources: USDA, FEMA, etc.).

Dr. Daus received a Bachelor of Science degree from the School of Forestry, University of California, Berkeley in 1970. His areas of emphasis included general forest management, range science, and remote sensing-aided inventories. He remained at the School of Forestry and subsequently received a Master of Science degree in Wildland Resource Science in 1972 with emphasis on forest and range ecosystem dynamics and remote sensing applications. He generated a Master's Thesis entitled "Application of Side-Looking Airborne Radar in Inventory of Natural Resources". He then completed a course of study with the Graduate Ecology Group at UC Davis and received a Doctorate in Ecology in 1979. His area of study was quantitative analysis of ecological systems and his thesis was entitled “A User Sensitive Clustering Algorithm For Use With Landsat Muti-spectral Scanner (“MSS”) Digital Data in Remote Sensing Aided Inventories of Natural Resources“.

Dr. Daus provided services as a California Registered Professional Forester with an associated Archaeological Survey certification until his retirement in 2017. He has had past affiliations with the California Licensed Foresters Association, the American Planning Association-California Chapter, California Oak Foundation, and is a current member of the Society of American Foresters and the International Society of Tropical Foresters.

Barry Callenberger, Wildland Fire Specialist

With 50 Years of wildfire experience, Barry has worked as a firefighter, Hotshot Crew Superintendent, district fuels officer, Type I Incident Commander and Operations Section Chief, and as Regional Prescribe Fire Specialist for the US Forest Service South West Region in California. Since 1997, Barry has worked in the private sector, consulting on numerous wildland hazard mitigation and ecological restoration projects across the western United States.

As owner and principal of WILDLAND Rx, Barry has provided wildfire expertise to a wide range of clients including the US Army, the Tahoe Regional Planning Agency, the US Forest Service, and numerous community-based firesafe councils in California and Nevada. From 1997-2004 he ran the Prescribed Fire and Fuels Management Division of North Tree Fire – a private wildland fire contracting company. In this role, he managed contracts for prescribed fire and fuels management, developed prescribed fire burn plans, provided direction on suppression approaches, conducted fuels analysis, and managed heavy equipment and burn personnel on prescribed burns and fuels projects.

Mr. Callenberger is skilled in the use of fire behavior analysis computer programs such as BEHAVE, FARSITE FLAMMAP, NEXUS, FUELS MANAGEMENT ANALYIST PLUS, FIREFAMILY Plus, NFSPUFF, SASEM, RAMS, PCHA, IIAA, and FOFEM.

Community Planning and Community Wildfire Protection Plans

Plumas Corporation, Plumas County Fire Safe Council
Validation of existing fuel profiles, analysis of expected fire behavior using BEHAVE and FLAMAP, identification and mapping of fuel treatment projects, and prioritization of fuels treatment projects for the county.

Community Wildfire Protection Plan for the California Portion of the Lake Tahoe Basin

Worked with Steve Holl Consulting and C.G. Celio and Sons in the development of the CWPP providing support for meetings and Fire hazard analysis, project prescription and locations

Tahoe Basin California
Developed a fuels treatment strategy for the seven fire protection districts within the Tahoe Basin. Presented the strategy to the fire districts and the community.

Hoopa Valley Tribal Forestry
Wrote a Fuels Management Plan and the necessary NEPA documentation for the Hoopa Valley Reservation which allowed them to create a funding stream for fuels treatment projects. Prioritized projects to provide wildland fire safety for resources and the community.

Amador County Fire Safe Council
Fuel reduction project layout and administration of contracts for fuels reduction. Wrote a Community Wildfire Protection Plan for town of Volcano.

El Dorado Fire Safe Council
Wrote Community Wildfire Protection Plans for Grizzly Flat, (and updated the original CWPP twice), Diamond Springs/Eldorado FPD, El Dorado County FPD, Gold Hill Estates, Georgetown FPD, Volcanoville, Royal Equestrian Estates Fire Plan. Provided support for meetings and Fire hazard analysis, project prescription and locations for the current El Dorado County CWPP.

California Department of Forestry and Fire Protection, Cameron Park Fire District
Developed risk and hazard maps for Cameron Park and modeled fire behavior for community meetings using FARSITE and FLAMMAP

Tahoe Regional Planning Authority
Combined all the Tahoe Basin Community Wildfire Protection Plans into one document.

Tulare County Community Wildfire Protection Plan
Worked with Steve Holl on the CWPP for the communities of the Tulare County foothills in the development of the CWPP providing support for meetings and Fire hazard analysis, project prescription and locations.

Yuba County Foothill Community Wildfire Protection Plan
Worked with Deer Creek Resources in the development of the CWPP providing support for meetings and Fire hazard analysis, project prescription and locations

Sierra County Community Wildfire Protection Plan
Developed the CWPP for all of the private lands in Sierra County Worked with Deer Creek Resources in the development of the CWPP providing support for meetings and Fire hazard analysis, project prescription and locations

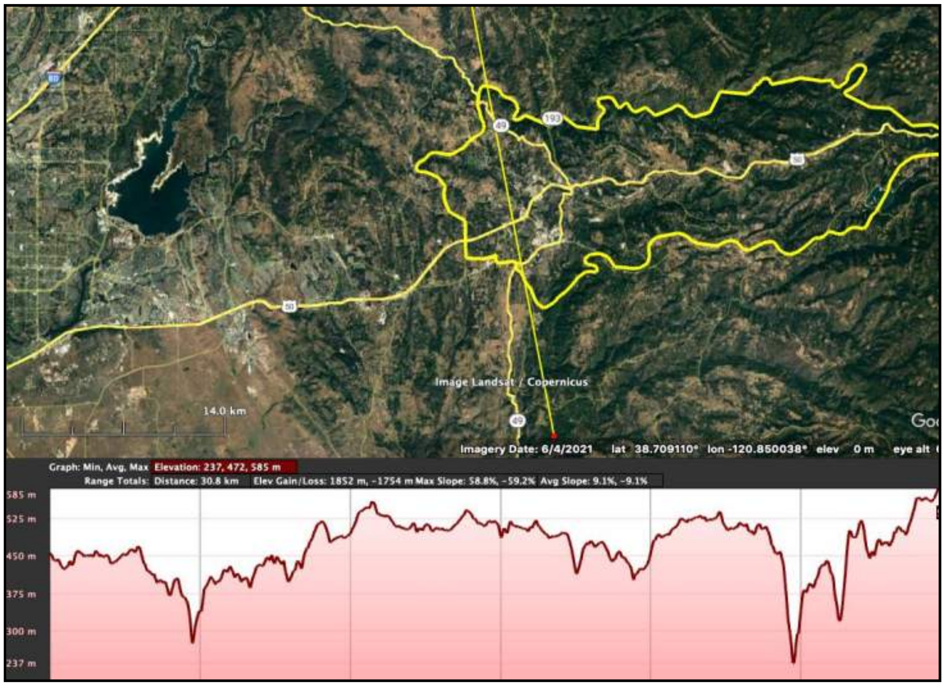
Truckee Fire Protection District Community Wildfire Protection Plan
Created a CWPP for the Truckee Fire District with the help of Deer Creek GIS that included the communities within the Truckee Fire District. Worked with Deer Creek Resources in the development of the CWPP providing support for meetings and Fire hazard analysis, project prescription and locations

Wheeler Crest Community Wildfire Protection Plan
Worked with Deer Creek Resources on the development of the CWPP for two communities in the southern end of Mono County and provided the community with a hazard evaluation of the private parcels in the communities

Barry is one of only a few private contractors that is currently qualified by the US Forest Service as a Prescribed Fire Planner and Burn Boss I.

Addendum II

TOPOGRAPHIC PROFILES of the PROJECT STUDY AREA



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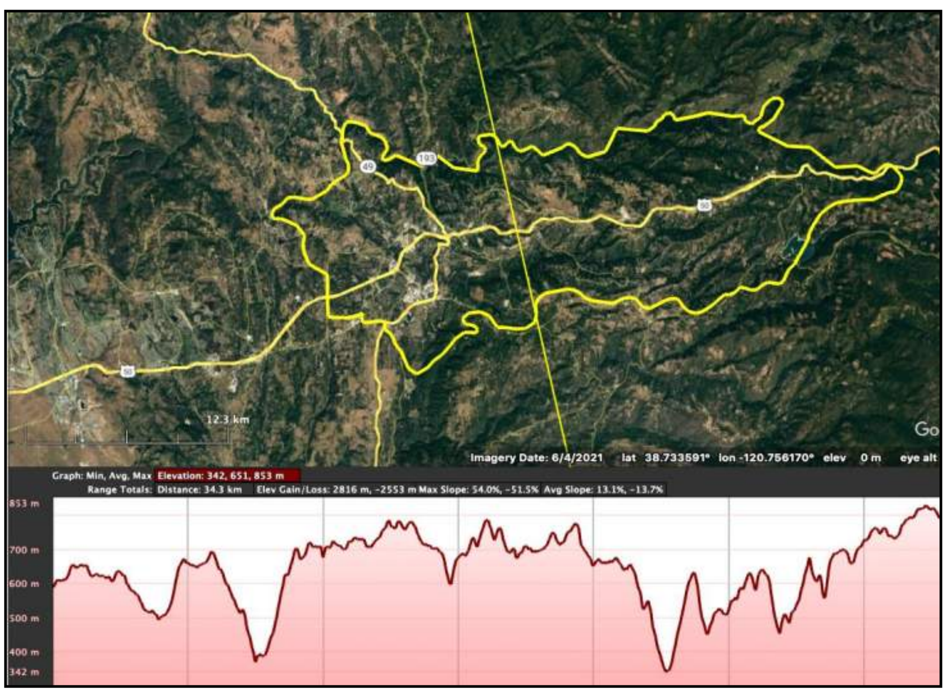

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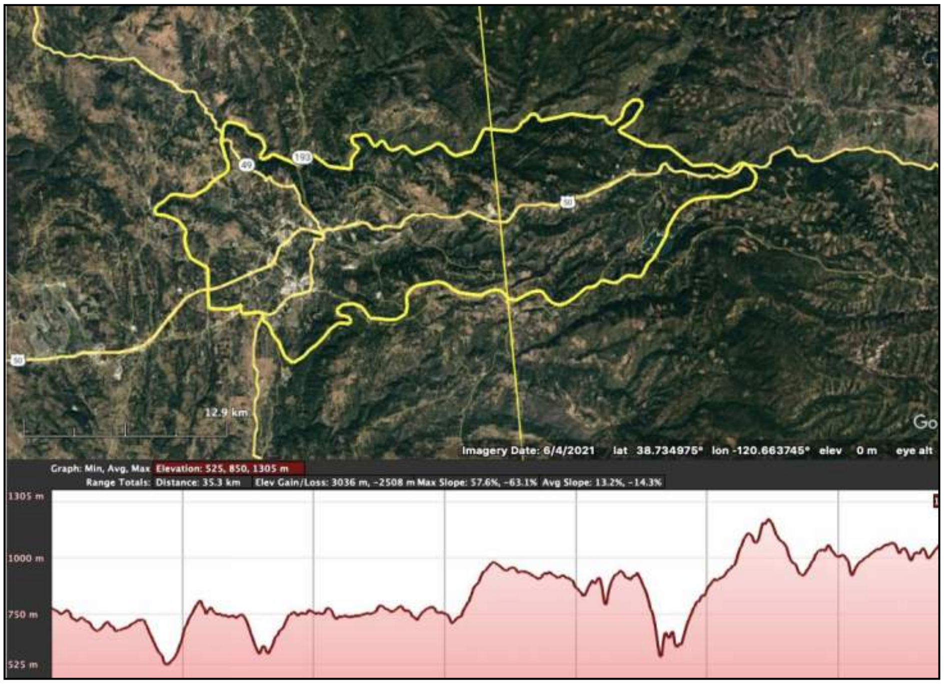

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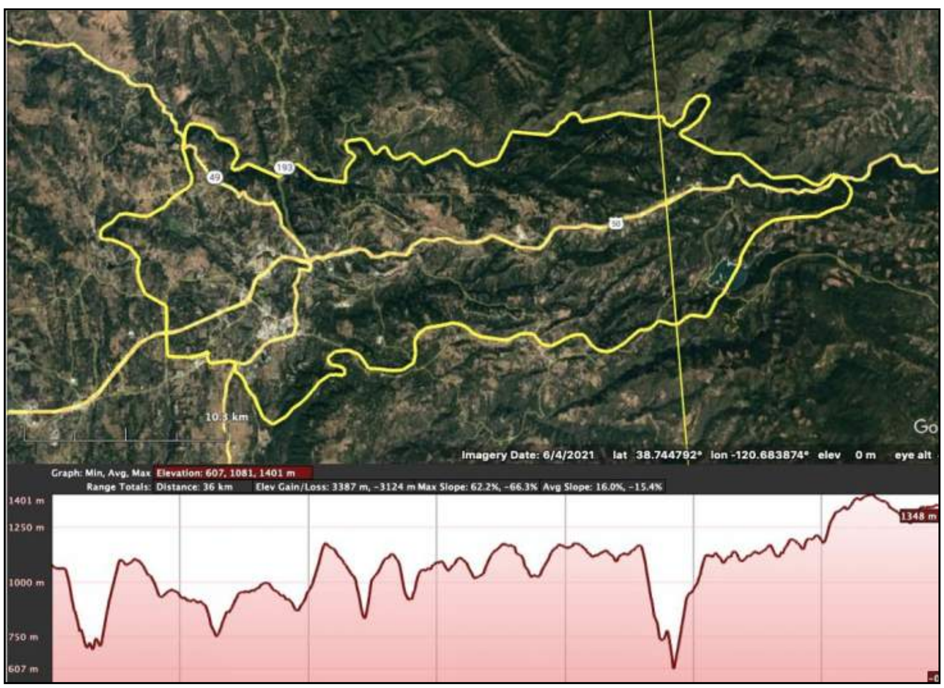

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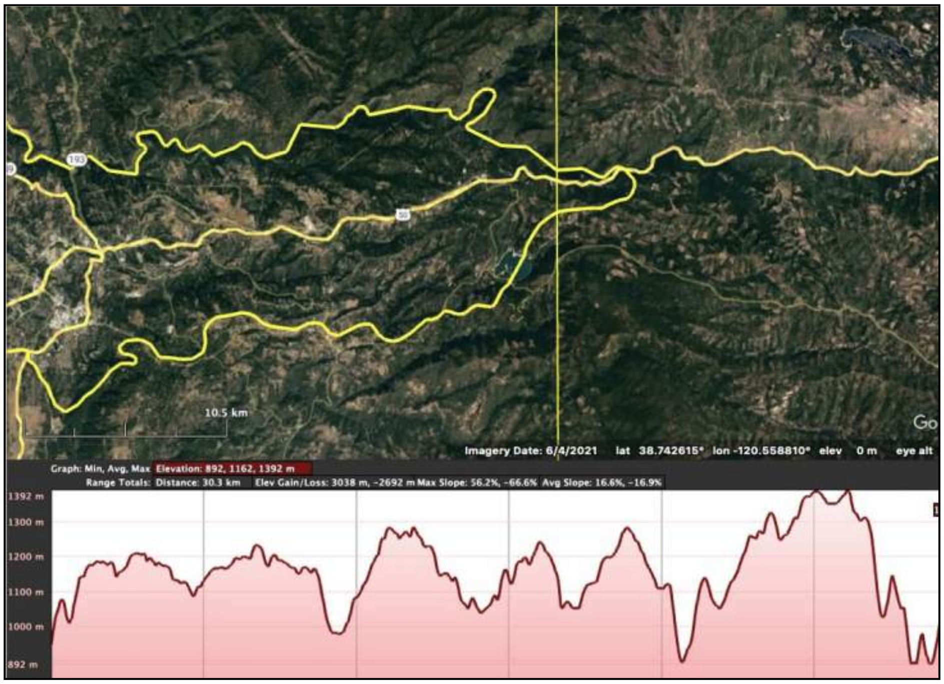

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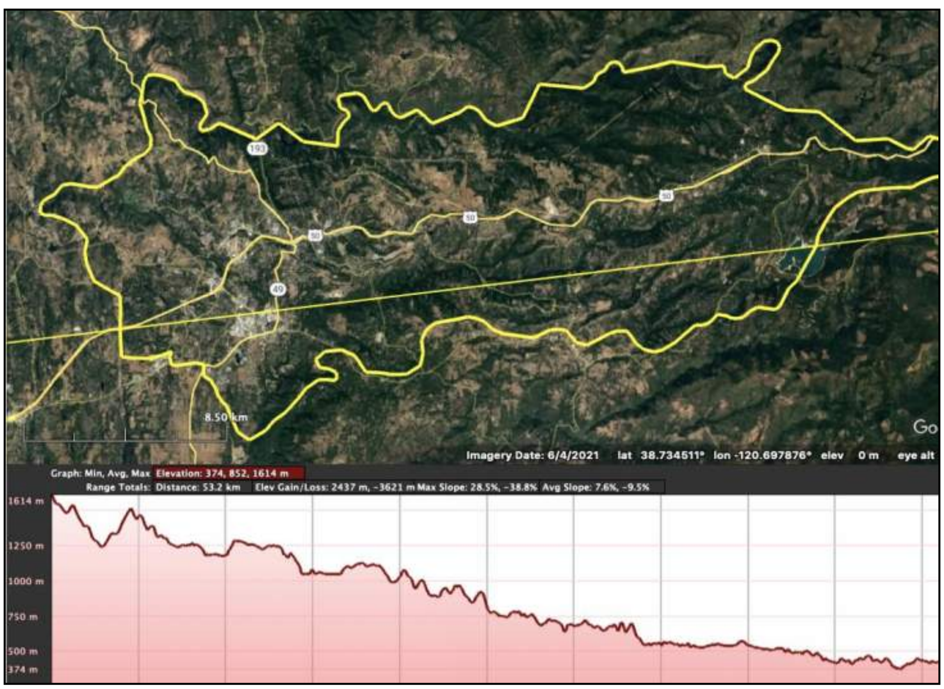

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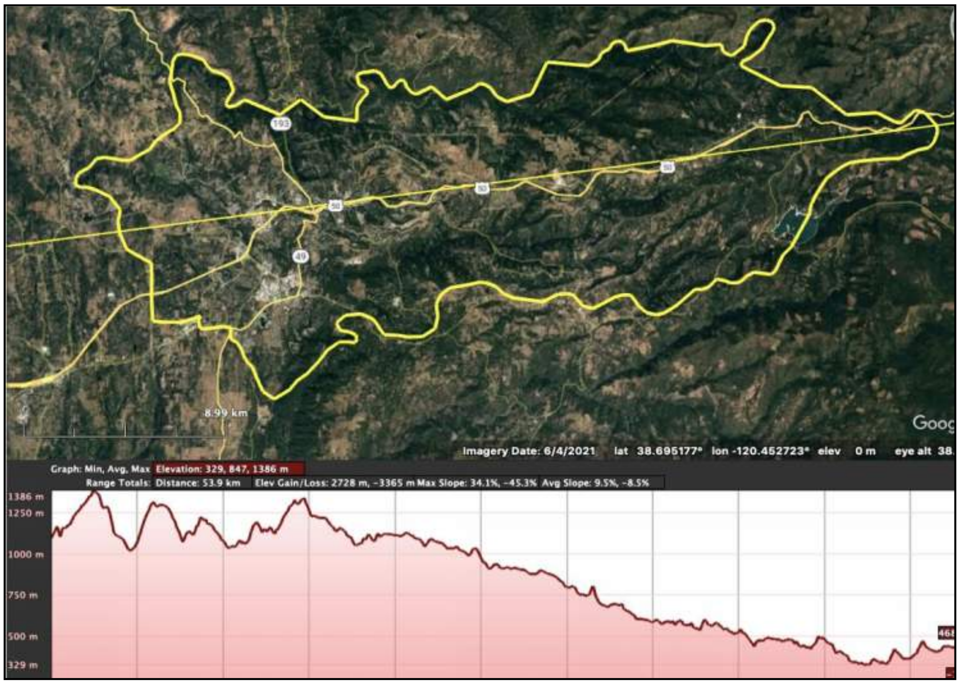

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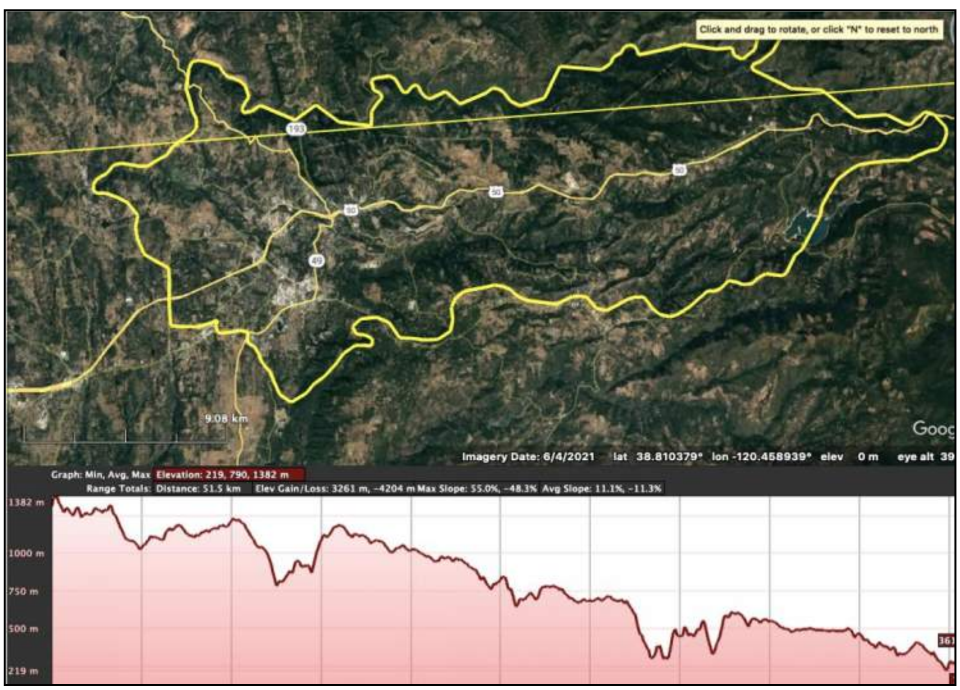

Profile 8

Addendum III

ROAD VULNERABILITY STUDY

Individual Road Segment Results

Roads		Segments	
Name	Type	VUL LVL	Length (')
Forni Rd.	LI	H - 1	3134
		H - 2	3977
		H - 3	717
		H - 4	675
		H - 5	1135
		H - 6	696
			10334
		M -1	1435
		M -2	1063
		M -3	1104
		M -4	1069
			4671
		L - 1	1207
		L - 2	764
		L - 3	6948
		L - 4	5197
14	29121		14116
Pony Express Rd.	LI	H - 1	994
		H - 2	6483
		H - 3	1356
		H - 4	7724
			16557
		M - 1	1767
		M - 2	2849
		M - 3	1236
		M - 4	730
		M - 5	553
			7135
		M -1	1910
		M -2	384
		M -3	1141
		L - 4	2051
		L - 5	362
14	29540		5848

Roads		Segments	
Name	Type	VUL LVL	Length (')
Mosquito Rd. 2	LI	H - 1	1755
		H - 2	3607
		H - 3	1736
		H - 4	9518
			16616
		M -1	778
		M -2	1667
		M -3	774
		M -4	2233
			5452
		L - 1	337
		L - 2	546
	22951	10	883
Union Ridge	LI	H - 1	689
		H - 2	654
			1343
		M -1	658
		M -2	1337
			1995
		L - 1	1702
		L - 2	1533
		L - 3	981
		L - 4	1793
	9347	8	6009
Snows Rd.	LI	H - 1	6718
		H - 2	1882
			8600
		M -1	1882
		M -2	983
		M -3	1366
			4231
		L - 1	731
		L - 2	3483
		L - 3	720
	17765	8	4934

Roads		Segments	
Name	Type	VUL LVL	Length (')
Sly Park Rd.	LI	H - 1	7030
		H - 2	12553
		H - 3	2846
		H - 4	2744
		H - 5	4389
			29562
		M -1	494
		M -2	1611
		M -3	373
		M -4	1216
		M -5	631
		M -6	3405
			7730
		L - 1	822
12	38114		822

Roads		Segments	
Name	Type	VUL LVL	Length (')
Ridgeway Dr.	LI	H -1	776
		H -2	2396
		H -3	744
		H -4	7093
			11009
		M - 1	2325
		M - 2	2162
		M - 3	685
			5172
		L - 1	354
		L - 2	1269
		L - 3	455
		L - 4	266
		L - 5	687
12	19212		3031

Roads		Segments	
Name	Type	VUL LVL	Length (')
US 50	Frwy	M -1	723
		M -2	806
		M -3	2914
		M -4	747
		M -5	1566
			6756
		L - 1	1260
		L - 2	912
		L - 3	918
		L - 4	6220
		L - 5	2744
	18810	10	12054

Roads		Segments	
Name	Type	VUL LVL	Length (')
US 50	PA	M - 1	2668
		M - 2	640
		M - 3	4112
		M - 4	2172
		M - 5	2129
		M - 6	891
		M - 7	2324
		M - 8	2847
		M - 9	5585
		M - 10	991
		M - 11	4203
		M - 12	9730
		M - 13	7596
		M - 14	3559
			49447
		L - 1	11079
		L - 2	2796
		L - 3	2266
		L - 4	1259
		L - 5	11856
		L - 6	1181
		L - 7	8556
		L - 8	2125
		L - 9	5062
		L - 10	1472
		L - 11	1166
		L - 12	501
26	98766		49319
Coloma Rd.	PA	H - 1	839
			839
		M - !	1138
			1138
		L -1	2537
		L -2	3350
4	7864		5887
Spring St.	PA	L-1	1176
1	1176		1176

Roads		Segments	
Name	Type	VUL LVL	Length (')
Main St.	PA	L -1	302
1	302		302
Pacific St.	PA	L -1	1380
1	1380	1	1380
Sacramento St. (SR 49)	PA	H -1	647
			647
		L - 1	587
		L - 2	959
3	2193	3	1546
Ray Lawyer Dr.	PA	M -1	2294
			2294
		L - 1	1972
		L - 2	488
3	4754		2460
Placerville Dr.	PA	M -1	622
			622
		L - 1	9039
		L - 2	2057
3	11718		11096
Main St.	PA	M -1	243
			243
		L - 1	326
		L - 2	1248
3	1817		1574

Roads		Segments	
Name	Type	VUL LVL	Length (')
Golden Chain Hwy (SR 49)	MA	H - 1	6284
			6284
		M -1	732
		M -2	1045
			1777
		L - 1	526
		L - 2	2808
	11395	5	3334
Pleasant Valey Rd.	MA	H - 1	1931
		H - 2	3955
			5886
		M -1	764
			764
		L -1	5778
		L -2	1789
		L -3	11252
		L -4	499
	25968	7	19318
Missouri Flat Rd.	MA	M - 1	4353
		M - 2	1127
			5480
		L -1	5654
		L -2	6938
	18072	4	12592
Pierroz Rd.	MA	L - 1	789
	789	1	789
Midtown Commbellack Rd.		H - 1	477
		H - 2	539
			1016
		M - 1	1470
			1470
		L - 1	306
		L - 2	1183
	3975	5	1489

Roads		Segments	
Name	Type	VUL LVL	Length (')
Cold Springs Rd.	MA	H - 1	879
		H - 2	2704
		H - 3	4283
		H - 4	507
		H - 5	469
		H - 6	1005
		H - 7	764
			10611
		M - 1	956
		M - 2	952
		M - 3	590
		M - 4	1074
		M - 5	877
		M - 6	1645
			6094
		L - 1	1213
		L - 2	1272
		L - 3	1720
		L - 4	1508
		L - 5	2267
18	24685		7980
Green Valley Rd.	MA	H - 1	1263
		H - 2	2769
		H - 3	234
		H - 4	304
		H - 5	3734
			8304
		M - 1	1967
		M - 2	2589
		M - 3	563
			5119
		L - 1	829
		L - 2	577
		L - 3	2033
		L - 4	335
		L - 5	1082
		L - 6	2982
		L - 7	1472
15	22733		9310

Roads		Segments	
Name	Type	VUL LVL	Length (')
Coloma Rd.	MA	H - 1	6247
		H - 2	1889
		H - 3	3935
		H - 4	1298
		H - 5	549
		H - 6	1077
			14995
		M - 1	1192
		M - 2	997
		M - 3	1214
		M - 4	790
		M - 5	3191
			7384
		L - 1	1047
		L - 2	708
		L - 3	541
		L - 4	1231
15	25906		3527
Georgetown Rd.	MA	H -1	11461
			11461
		L -1	924
2	12385		924
Newtown Rd.	MA	H - 1	521
		H - 2	478
		H - 3	6368
		H - 4	11013
		H - 5	1417
			19797
		M - 1	1780
		M - 2	2498
		M - 3	1439
		M - 4	2185
		M - 5	814
			8716
		L - 1	1377
		L - 2	1794
		L - 3	1384
13	33068		4555

Roads		Segments	
Name	Type	VUL LVL	Length (')
Broadway Ct.	MA	H - 1	876
			876
		M - 1	1138
		M - 2	1706
		M - 3	832
			3676
		L - 1	5494
		L - 2	1706
6	11752		7200
Carson Rd.	MA	H - 1	414
		H - 2	2476
		H - 3	1344
		H - 4	486
			4720
		M - 1	1197
		M - 2	484
		M - 3	833
		M - 4	1905
		M - 5	2342
		M - 6	1155
		M - 7	2750
			10666
		L - 1	494
		L - 2	864
		L - 3	2590
		L - 4	3790
		L - 5	6989
		L - 6	3938
		L - 7	3973
18	38024		22638
Mosquito Rd.	MA	H - 1	956
		H - 2	1412
			2368
		M -1	2510
			2510
		L - 1	2017
4	6895		2017
Point View Dr.	MA	H - 1	1951
1	1951		1951

Roads		Segments	
Name	Type	VUL LVL	Length (')
Cedar Ravine Rd.	MA	H -1	4533
		H -2	3585
		H -3	10525
			18643
		M -1	5454
		M -2	2583
			8037
		L -1	1430
		L -2	1658
		L -3	262
8	30030		3350
Jacquier Rd.	MA	L - 1	1951
1	1951		1951