County of Lake Tree Mortality Program

Pre-Assessment Sample Survey Report

On October 30, 2015, Governor Brown issued an emergency declaration requiring public agencies to identify areas of tree mortality that hold the greatest potential to result in wildfire and/or falling trees that threaten life and property throughout California. In conjunction with local partners, Lake County has been working to identify, quantify, and study hazardous trees stricken by drought and other impacts such as beetles, oak borers, fungus, and disease. In conjunction with those efforts, the County of Lake engaged Tetra Tech to perform survey sampling to determine the potential scope for a CDAA Hazardous Tree Removal program.

Sampling Overview

To determine if a CDAA program is a viable option for this area, the County of Lake commissioned a study that when performed would test the severity of the tree mortality issue in Lake County and quantify positive tree mortality and secondary infected tree cases within a sample region. The surveys would be broken up into two sections, Public ROW (within 15 ft of the edge of the road), and Private Property (15-100 ft from the edge of the road). Arborists would identify dead and dying trees affected by drought, and determine if any secondary issues exist, such as bark beetles. A sampling region was chosen in south Lake County both for its density of conifer trees, and the relative proximity of Tier 1 Infrastructure threatened by hazardous trees previously identified by CalOES in 2016. There are approximately 161.4 miles of county-maintained roadways in the sample region. Along those roads, 126 sample points were randomly computer selected for survey. Survey teams were to sample within 100ft of those randomized center-points, and on participating properties directly adjacent.

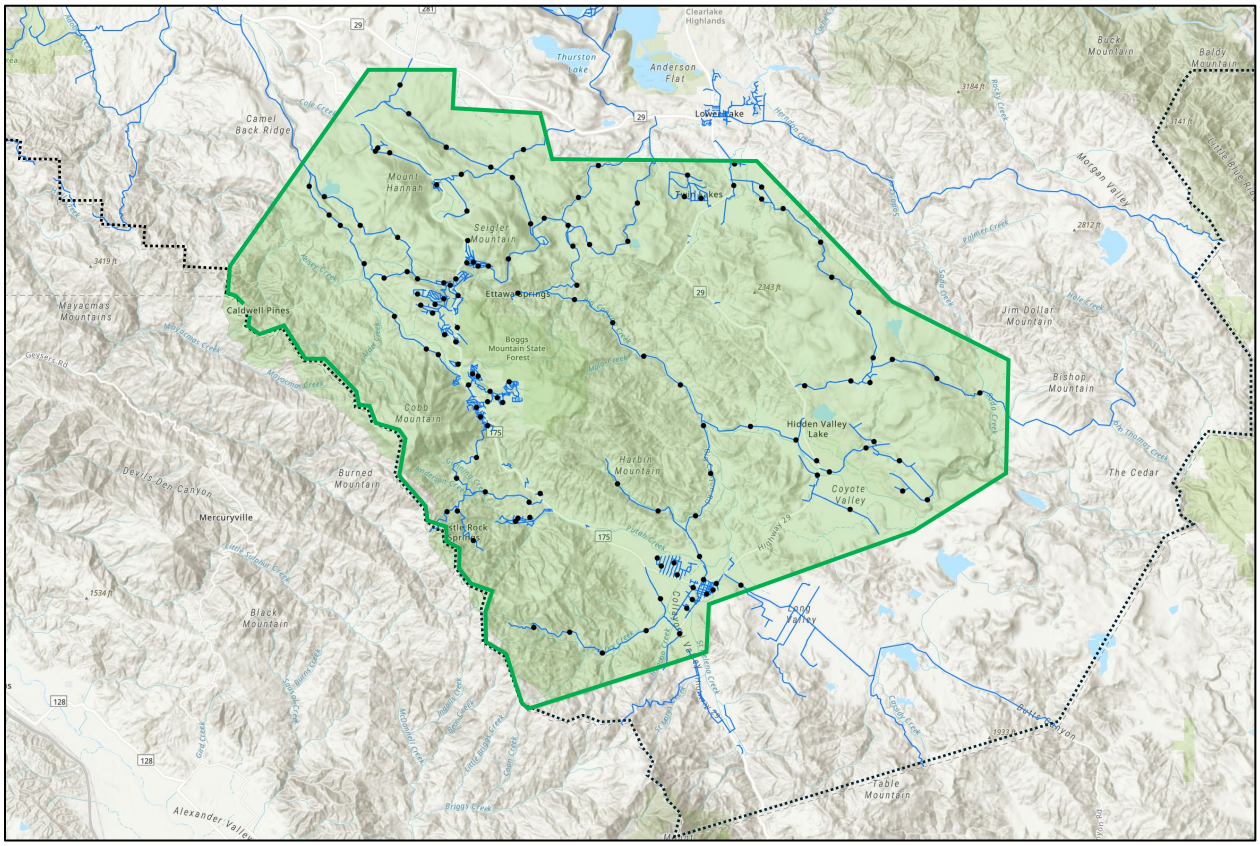

Image 1 – Map of Sample Survey Region with County Road Survey Locations

As shown in Image 1 (*previous page*), the survey points were randomized along county roads using ArcGIS spaced out every 1.2 miles as a parameter. After finalizing the locations, an analysis was performed to characterize the environment of each sample location based on tree density and development. Dense forest land made up nearly 50% of the sample locations, while light forested areas made up an additional 35% of the sample points. Urban areas like Middletown and grasslands like Coyote Valley experience lower risk from tree mortality due to their limited tree canopy and location. On the other hand, development within the Cobb Valley which is a heavily forested area experiences a significant increase in risk due to tree mortality. Likewise rural County connector roads such as Bottle Rock Rd, Harrington Flat Rd, and Seigler Springs Rd share a year-round threat from felled due to high winds and failing trees as a result of prolonged years of drought. By classifying these sample points, qualitative associations could be made to the sample data points as well.

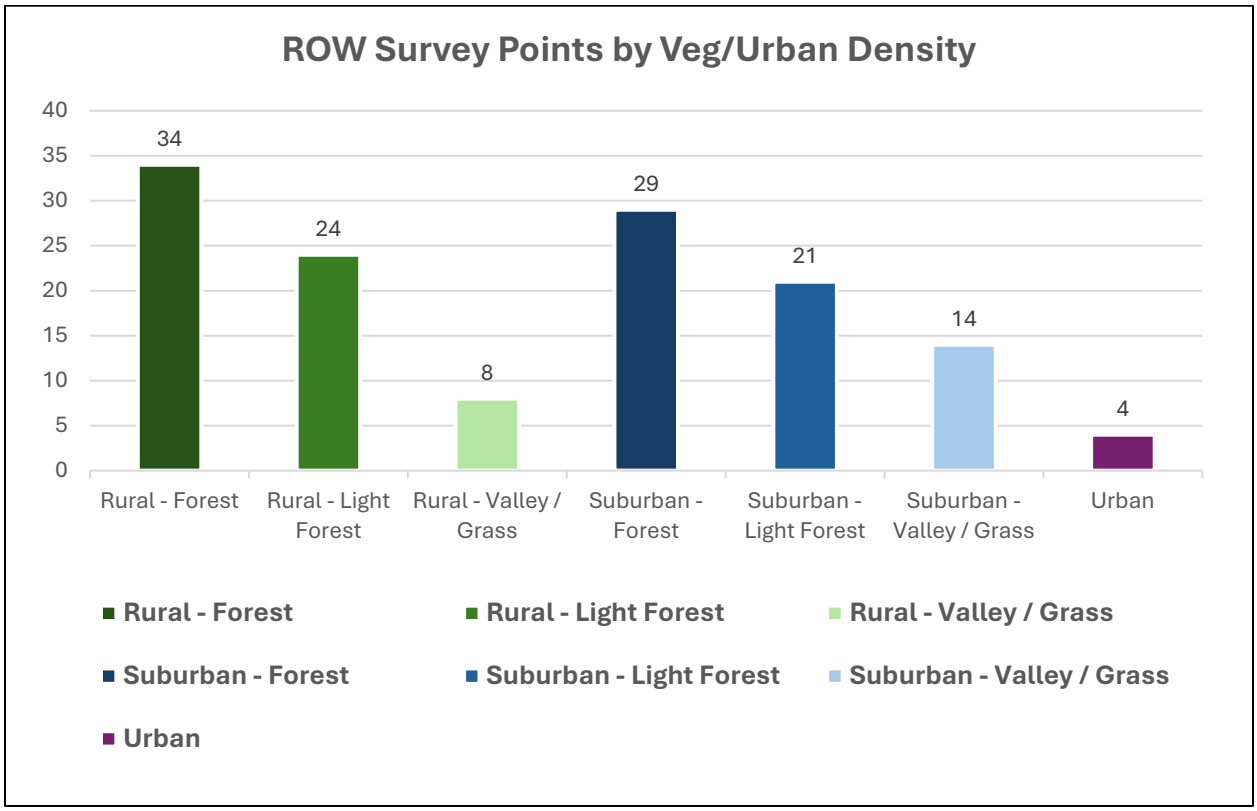

Chart 1 – ROW Survey Locations by Tree Canopy / Development Characteristics

Rural = Low density residential with open land in between structures / fence lines

Suburban = Medium density small acreage lots, still contain tree volume

Urban = High density development with minimal tree canopy

Forest = Dense vegetation and tree canopy, minimal disturbance

Light Forest = >50% tree canopy, moderate ground vegetation clearing / development

Valley / Grass = Low density tree canopy, grasslands, flat lands between mountains

Tree Mortality & Infestation Transmission

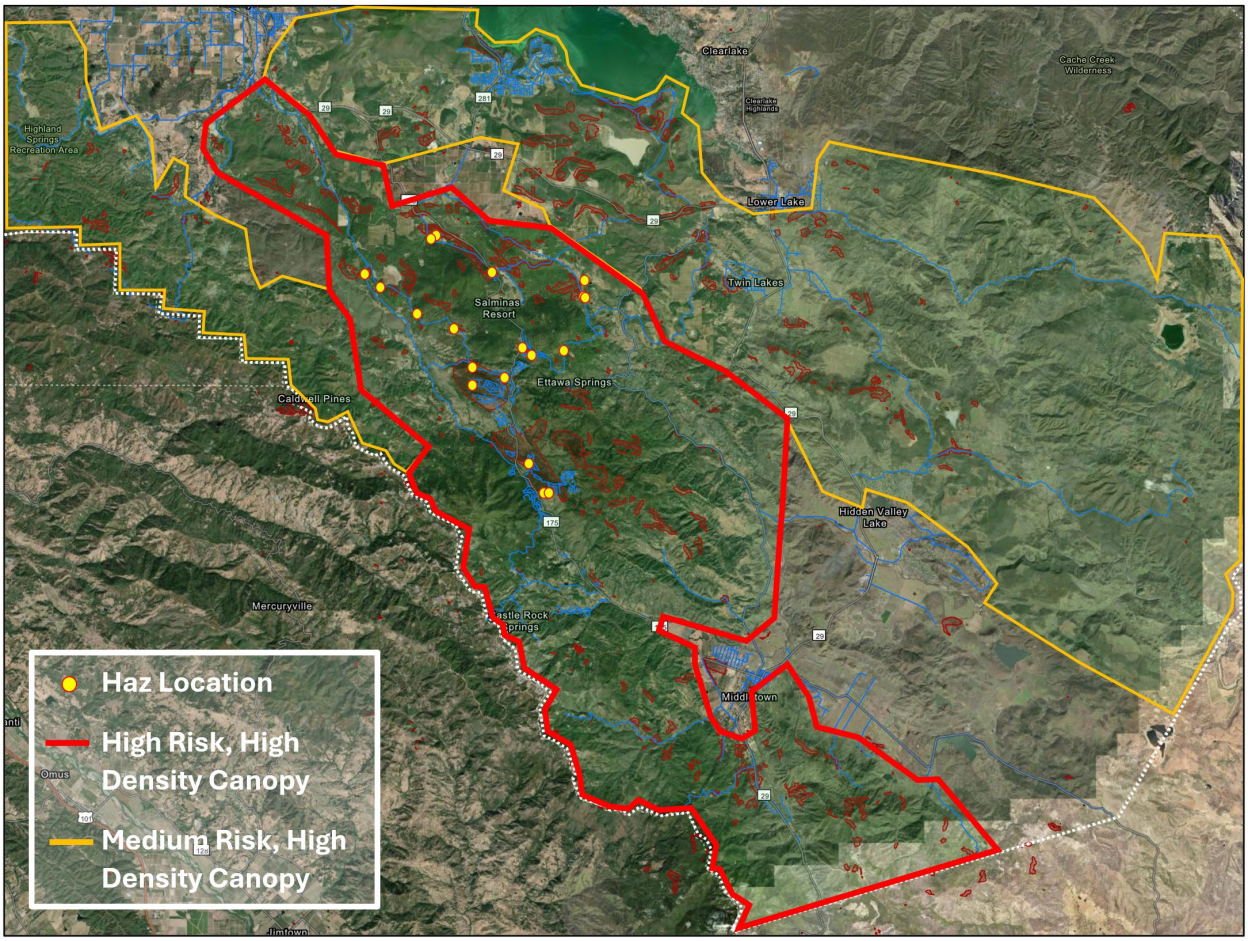

Image 2 – Surveyed Hazard Locations, at Risk Vegetative Zones, and Tier 1 Infrastructure vs ESRI Hybrid Contrast Visual Aerial Background

Pictured above (Image 2), the southern region of Lake County contains hundreds of square miles of dense forest and mountainous terrain. This type of heavily forested environment is at a high risk for drought related tree mortality and therefore increasingly susceptible to secondary illness such as bark beetles and fungus. Coniferous trees in particular grow in colonies and rely on the support received from similar trees growing next to them. As a colony begins to decline due to drought, the adverse effects of the environment begin to impact trees in the core of the colony at an exponential rate. A colony of pines or furs in rapid decline are now weakened against infestation and disease.

Since the State Declaration in 2015, tree colony conditions in Lake County have been in significant decline due to multi-year droughts extending through 2022. As a result of tree colony decline in the County, an expansive segment of the region was determined to have bark beetle infestations. These infestations were almost exclusively found in older tree mortality areas as identified in the CalOES layer from 2016. That sampling metric is consistent with US Forest Service information on the spread of bark beetles throughout a region. “Bark Beetles can increase dramatically when sufficient food is available. Typically, this is in the form of drought-stressed trees,” says the USDA, “Often many trees are killed over the landscape; likened to that of wildfire. In many years, more trees are killed by bark beetles than by fire!”. That means the tree mortality identified in Lake County almost a decade ago is now an expansive feeding ground for a fast growing and pervasive beetle population. Each year this problem is left unmitigated, the faster the amount of beetle caused tree mortality will increase.

Based on that knowledge, the survey data was analyzed for patterns between sampled bark beetle / fungus locations vs developed areas and transmission corridors. All hazard locations identified on the map were confirmed dead trees due to drought, and all of the trees surveyed in the ROW were confirmed to be infected with either bark beetles or fungus. Confirmed locations of bark beetles were centralized to the Cobb Valley region including Bottle Rock Road, Harrington Flat Road, the Seigler Mountain area, and north into the Mount Hannah area. These positive case samples clearly illustrate a comprehensive and growing area of bark beetle infestation with a significant amount of fuel ahead of it. Due to the randomized method used for sampling, the full boundary of the infestation may be much larger than indicated, especially given the prolonged period of drought throughout the county over the last decade. A full inspection of all county-maintained ROWs would provide a much clearer data mapping of the infection boundaries and allow planners to develop a true scope of response.

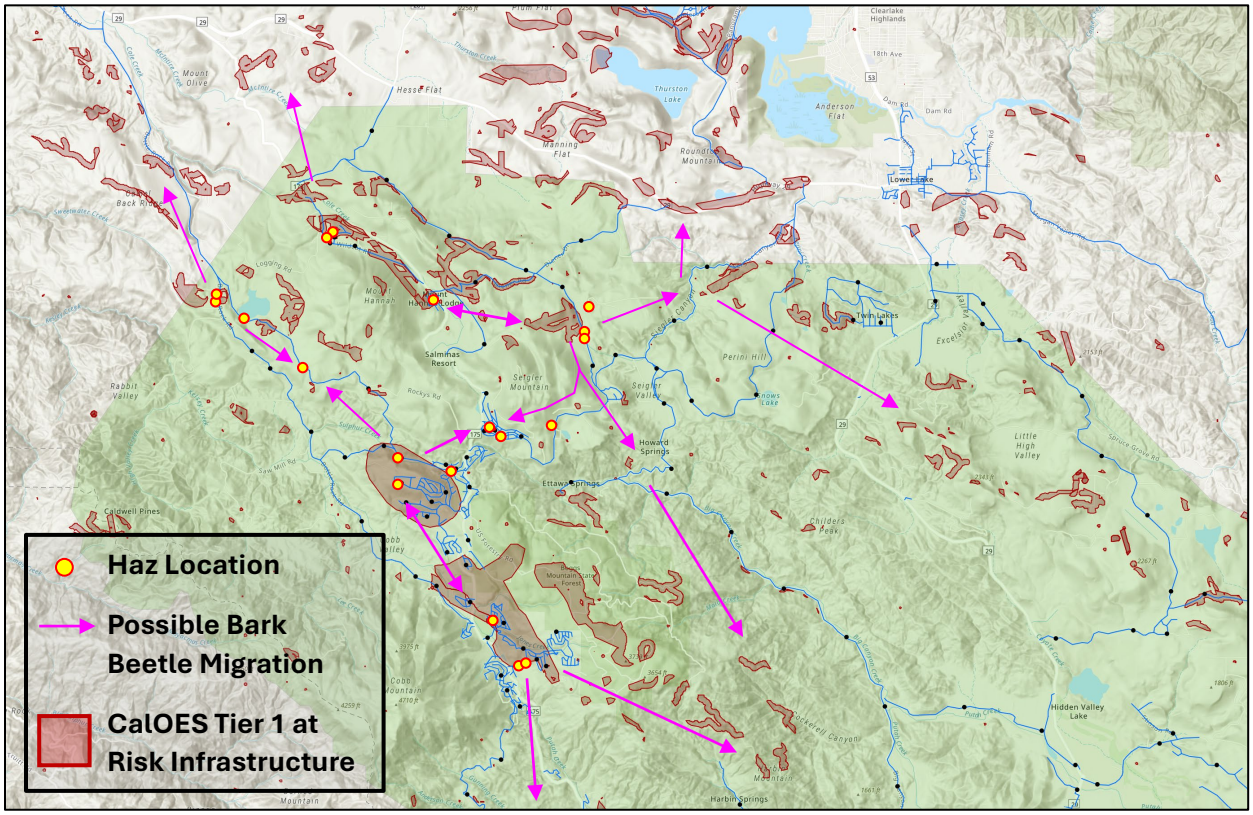

Image 3 – Drought and Bark Beetle Propagation Potentials

Per the USDA and US Forest Service, tree mortality due to drought is exponentially increased for each year a continuous or persistent drought condition exists. While not all effected trees will die off immediately, drought conditions extending past 3-5 years will significantly weaken evergreen trees throughout the forest. Stressed trees are not able to fend off bark beetle attacks due to their inability to adequately produce resin. The more stressed the tree the more susceptible it may be, however beetle populations can determine their devastation potential. Poor crown condition is often indicative of stress. During low population levels, attacks are primarily on trees stressed by injury, poor site conditions, overcrowding, root disease, or old age. As beetle populations increase, attacks may involve most trees 6 inches in diameter or greater in the outbreak area, regardless of their apparent health. This means populations can swell and expand quickly in optimum conditions.

California High Hazard Zones (Tier 1) GIS Layer

“On October 30, 2015, Governor Brown issued an emergency declaration requiring public agencies to identify areas of tree mortality that hold the greatest potential to result in wildfire and/or falling trees and threaten people and property in these areas. Once identified, these areas will be prioritized for removal of dead and dying trees that present a threat to public safety. Tier One High Hazard Zones are areas where assets to be protected and tree mortality directly coincide. These are the areas designated by state and local governments as being in greatest need of dead tree removal, pursuant to the California Governor's Emergency proclamation on October 30, 2015. These areas are considered as having the highest potential of being a safety issue to people, buildings and infrastructure. Dead trees heighten wildfire risk and can be hazardous if they fall. This service represents the latest official release of HHZ. It will be updated annually when a new version is released. As of June 2019, it represents HighHazardZones19_1. **”** - CalOES Open Data Portal

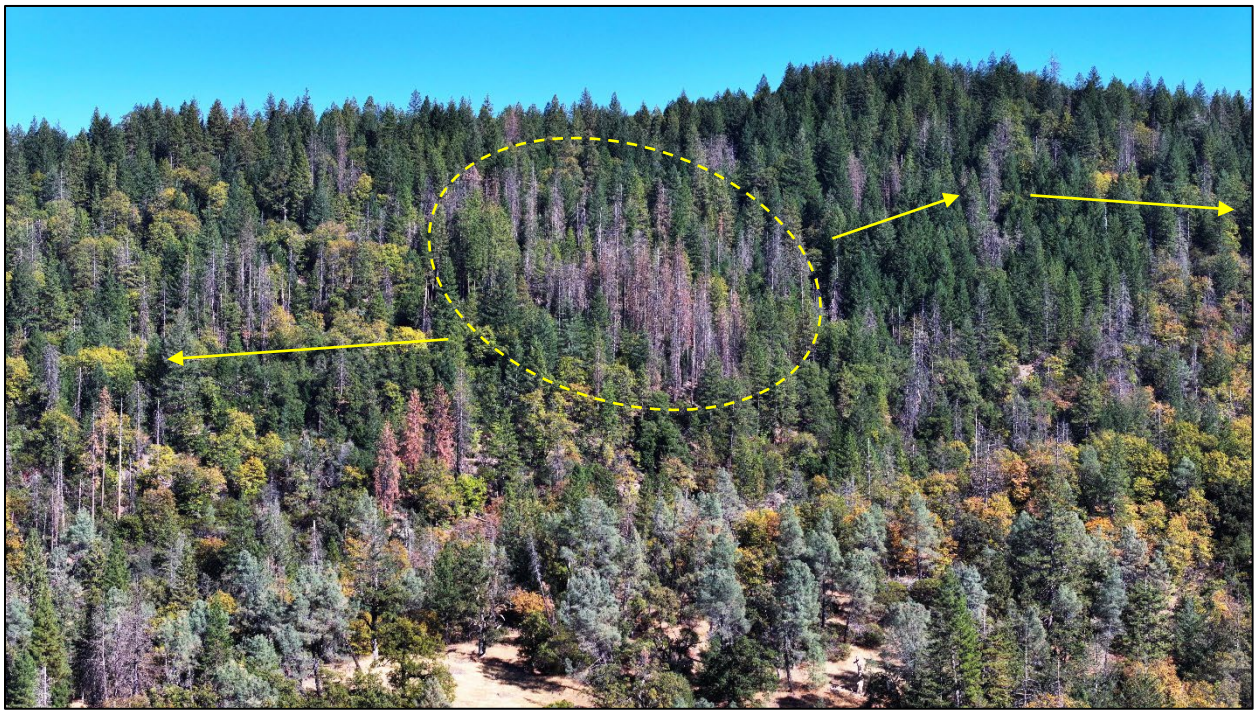

Image 4 – Drone image of Bark Beetle Outbreak in southern Lake County, CA – Oct 2024

Throughout southern Lake County, the propagation of tree mortality and infection is visible from the air and driving along mountainsides. The aerial image above captured by a drone in late October 2024 clearly depicts a bark beetle outbreak in a tight colony of trees. However, the image also clearly indicates runs of dead trees where scout beetles can move between beetle colony outbreaks and other new potential food sources. As new food sources are found, scout beetles release a chemical pheromone that calls other beetles to their location. In high tree mortality regions, this process can be quickly repeated several times throughout a season leading to a fast growing and a fast moving beetle population. Removing hazardous trees along major county roadways can create cut-off corridors to slow or stop the spread of beetles across valleys (much the way a fire break works on wildfires) helping to reduce the year over year boundary expansion of the beetle population. It would be too large an effort to remove the beetle threat completely; however, reducing food source options and creating defensible spaces around infrastructure can slow their progress until nature can heal the forest and force the beetle swarm to reduce or go dormant.

ROW Sample Results

During the ROW portion of the Pre-Assessment survey, data from 126 locations across 161.4 miles of county-maintained roads was collected and analyzed. As part of the statistical sampling process, teams selected one side of the roadway only and surveyed between the road's edge and a 10-15ft offset (general ROW easement), or until limited by fencing or another form of private boundary. Trees were examined within a 100 ft stretch of road's centerline survey point, and only trees within the boundary that were drought affected and/or showing signs of bark beetle or fungus infestation were surveyed and marked. Sampling criteria was kept strict to develop a cleaner estimation model. In total, approximately 0.074% of county easement within the sample region was surveyed, and only 0.019% of the 615.58 total centerline miles of county-maintained roads in Lake County.

ROW Sample	Road Name	Segment Type	# of Hazards	Tree Type	Secondary Disease
55	Gifford Springs Rd	Suburban – Forest	2	Ponderosa Pine	Bark Beetle
64	Niblick Rd	Suburban – Forest	1	Douglas Fir	Bark Beetle
82	Fox Dr	Suburban – Forest	1	Ponderosa Pine	Bark Beetle
92	Harrington Flat Rd	Rural – Forest	1	Ponderosa Pine	Bark Beetle
94	Fishery Springs Rd	Suburban – Forest	1	Ponderosa Pine	Bark Beetle
96	Redwood Rd	Suburban – Forest	1	Ponderosa Pine	Bark Beetle
99	Loch Lomond Rd	Suburban – Forest	1	Ponderosa Pine	Bark Beetle
107	Admiral Way	Suburban – Forest	1	Ponderosa Pine	Fungus
116	Bottle Rock Rd	Rural – Forest	2	Ponderosa Pine	Bark Beetle
119	Harrington Flat Rd	Suburban – Forest	1	Ponderosa Pine	Bark Beetle
120	Harrington Flat Rd	Rural – Forest	2	Ponderosa Pine	Bark Beetle
121	Harrington Flat Rd	Rural – Forest	1	Ponderosa Pine	Bark Beetle
132	Saddle Rd	Rural – Forest	1	Ponderosa Pine	Bark Beetle
133	Wildcat Rd	Rural – Forest	1	Ponderosa Pine	Bark Beetle

Table 1 – ROW Survey Positive Sample Locations with Hazard Sample Data

A total of 14 ROW sample locations were found to have positive cases of Tree Mortality and either Bark Beetles or Fungus infestation. A total of 17 trees, Ponderosa Pines and Douglas Firs, were identified while surveying those sample locations, results are listed in Table 1. Based on those samples, the following estimations were derived for a possible CDAA Program:

12,600 ft of County Roads Sampled

229.73 Estimated ROW Only Hazards within total Sample Region

885.14 Estimated ROW Only Hazards across all County-Maintained Roads

While this seems like a statistically low number, most trees threatening residents and county-maintained roads are 100-200 ft tall conifer trees located on private property just outside of the ROW. To adequately address the problem of tree mortality and bark beetle transmission throughout the county, a CDAA tree removal program would need to include private property hazard removal.

Extrapolating for an expanded ROW program that would mitigate even the tallest hazards from reaching the roadway or critical infrastructure, the following estimates were calculated to model tree removal between the road's edge and an expanded boundary onto private property:

Estimated Probable Positive Tree Mortality in 100ft Extended ROW CDAA Program:

1,700	Estimated within Sample Region
5,900	Estimated within Overall County

Estimated Probable Positive Tree Mortality in 200ft Extended ROW CDAA Program:

3,100	Estimated within Sample Region
11,730	Estimated within Overall County

Image 5 – Hazardous Tree w/ Bark Beetles threatening a public road and power lines

Statistically, these calculations represent the number of probable positive tree mortality cases and secondary infection cases that would likely be found within a given region based on the number of county-maintained miles within that boundary zone. Due to variables such as home development, environmental ecology, topography, and the density of remaining healthy non-stressed forest vs the population of bark beetles, local randomized sampling is inherently subject to a margin of error. Selecting sample locations in a single-blind randomized method when trying to calculate for a quantity that may not be equally distributed can fail to fully attribute for clusters of dense mortality or infestation and therefore underestimate potential hazardous tree quantities. Other estimates and analysis performed by 3rd Party regional partners using aerial imaging and scanning indicates a potentially much larger hazardous tree population.

To accurately scope the extent to which tree mortality and secondary infections have affected tree populations across the county, a full scope right-of-way survey along all 615 centerline miles of county-maintained roadway should be conducted. With that data set, a full model of tree mortality expansion could be developed to more accurately determine the territorial boundaries of pests such as bark beetles and oak borers across the county and where potential food sources exist for future expansion. Determining the full extent of infestation in the county is a critical first step in the final process of developing an action plan. Much the way a firebreak can extinguish a fuel source, creating defensive boundaries could prevent rapid expansion and allow the bark beetles to exhaust their potential food sources faster limiting their reproduction the next season. This process can only be effective if the full extent of bark beetles in the region are understood and mapped. Much like a fire too, if even a small group hops the line, the infestation can flare back up with a new food source and begin rapid propagation again. To produce a comprehensive scope of effected trees, the larger the populated data source collected, the higher the resolution of the analysis will be.

Private Property Sample Results

In total, Lake County has approximately 64,000 parcels of property spanning from small urban lots to large acreage parcels. Within the sampling region, there were roughly 7,100 total parcels identified based on County GIS data. For the purposes of this sampling, the field was narrowed by criteria such as the property must be adjacent to a county-maintained roadway, the property must be within proximity to a sample point, and the property must meet the legal criteria to lawfully allow crews to survey and operate on the property. This narrowed the pool of eligible sample properties all the way down to 493 parcels. Over the span of 4 months, 73 ROEs (within the sample region) were collected representing a 15% response rate from interested property owners.

7,100	Parcels located within the Sample Region
493	Parcels met the initial criteria for Sample Surveying
73	Parcels received applications and ROEs

There were two major factors that lead to a reduction in expected in applications. First, large acreage parcel owners are concerned over the terms of the ROE and the implications that archeological and

tribal reviews can have on their property based on experiences of other ranchers and landowners during past events like the Valley Fire and PG&E work. Second, a larger than average number of non-primary residences are owned in the Cobb Valley region which makes homeowner outreach more complicated. Both types of properties are necessary for a successful PPDR program. The larger parcels are needed in the program to help create large stretches of defensible spaces along roads, and the small suburban parcels are needed to eliminate direct hazards to homes, infrastructure, and utilities in a compact space. For a successful CDAA PPDR program, shareholders and partners will need to work with the local community to communicate program expectations and collaborate with state and tribal agencies to mitigate concerns.

Results from the initial PPDR sampling set were inconclusive, from a scoping perspective. Out of 34 properties sampled, only 3 were found to have hazards for a total of 7 hazards within proximity to a ROW survey point. While this was representative of the location and terrain of the sampled parcels, it was limited by the statistical parameters of the sampling performed. Because of the randomization of ROW sample points, not all parcels sampled were located within an identified mortality hot zone (as described in the ROW section) even though they met all other parcel criteria for sampling. Given this, an effective full scope PPDR program should be precluded by a full scale ROW survey to develop the outer boundaries of the tree mortality and beetle infestation problem within the county. If beetles do act like a wildfire, identifying both the boundaries of the fire and what fuel sources lie ahead of it is critical to the development of an action plan.

Conclusion

Based on the survey sample data collected, tree mortality and bark beetle infestations appear to be widespread and increasing throughout Lake County. Coupling the sample data with hazard maps from CalOES depicts the very real image that tree mortality and secondary infections such as bark beetles are a growing and pervasive problem in Lake County. In 2015 Governor Brown declared this issue as a state of emergency because it is a problem that will continue to grow unless it is slowed down by hazardous tree removals and mitigation. In 2024, the dangerous impact of tree mortality is being felt throughout Lake County, CA. If dead and dying trees are not removed or mitigated, the bark beetle infestation will continue to grow and significantly increase the threat to human life due to falling trees and an increased fire fuel load as beetle populations move through healthy tree colonies.

Reducing the risk to human life and critical infrastructure as a result of tree mortality and bark beetle infestation is a priority for the County of Lake. Creating defensible spaces along roadways and around homes and infrastructure is necessary for the safety and functionality of the community. Based on the height of the hazardous tress that pose a potential threat, a 200 ft defensible space between hazards and infrastructure is critical. While the risk to community infrastructure is greatest in developed areas of the county, rural areas provide a higher level of potential transmission for bark beetles and other secondary illnesses given the higher concentration of trees per acre. Running a full scope PPDR program to reduce hazards around homes and infrastructure within these higher risk areas will reduce injuries, fatalities, and other incidents long term that currently put residents at extreme risk and can burden emergency services during a response event.

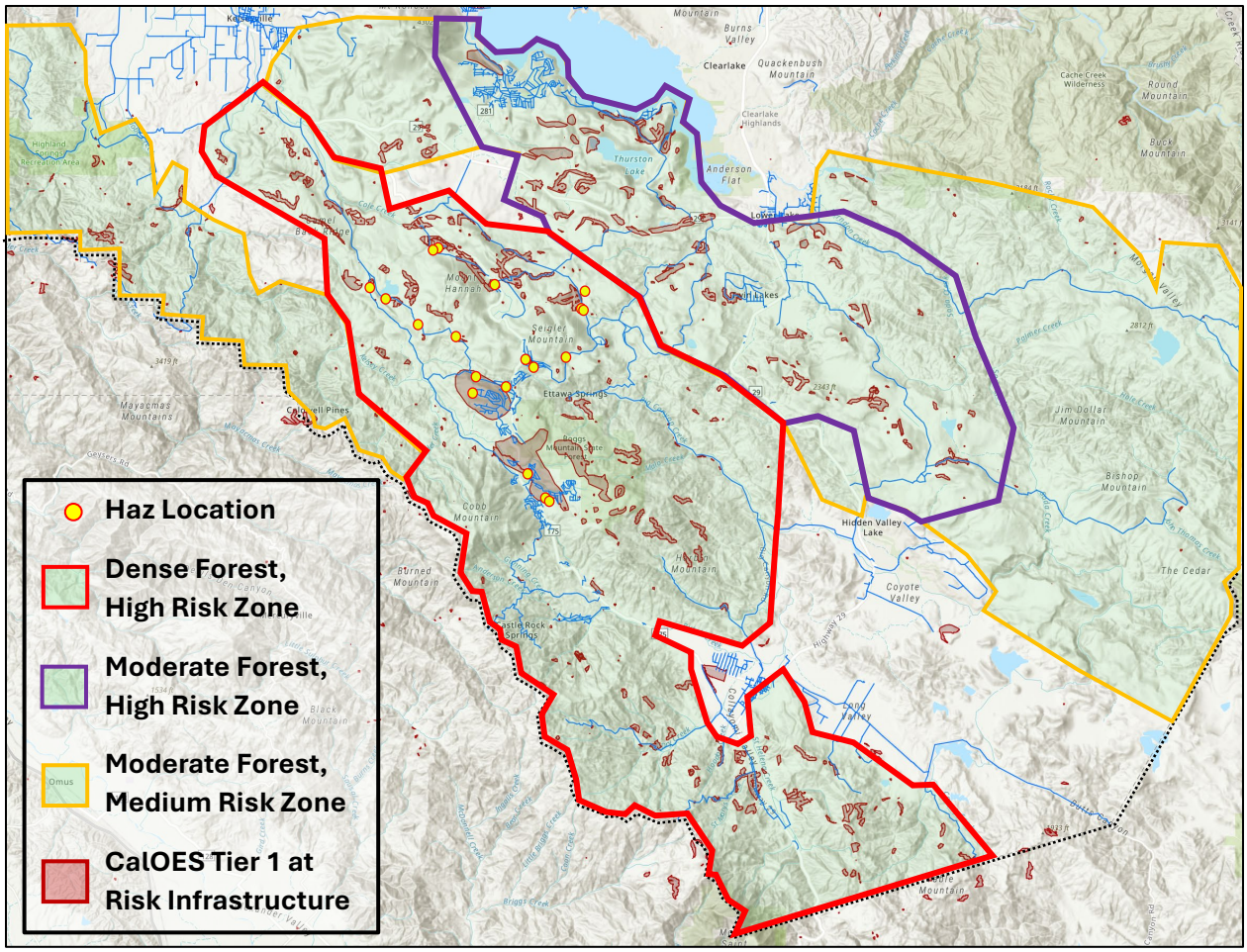

Image 6 – Topographic View of Hazardous Regions vs Sample Points and High Threat Areas