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Fountain Wind Project
Impacts on Fire Behavior and Aerial Firefighting
Technical Report

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Fountain Wind Project

Impacts on Fire Behavior and Aerial Firefighting

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1 EXECUTIVE SUMMARY

Fountain Wind, LLC, proposes the development of a wind farm on privately owned timberlands near Highway 299, approximately 6 miles west of Burney and 1 mile west of the existing Hatchet Ridge Wind Farm in Shasta County, California. Comprising 48 turbines, each reaching a maximum height of 610 feet and on a cleared space of approximately 2.5 acres, and adding a new road system, the project aims to contribute significantly to California's renewable energy goals. This report evaluates the project's potential effects on fire behavior and aerial firefighting capabilities.

Areas of Analysis

Fire History: The report acknowledges the history of large fires in eastern Shasta County, such as the Fountain Fire of 1992, which burned 63,960 acres. Understanding the region's susceptibility to wildfires is crucial for evaluating the proposed wind farm's impact (see Figure 1).

Project Features: The Fountain Wind Project entails the installation of 48 turbines on privately owned timberlands. The turbines, with a maximum height of 610 feet, will be situated on a cleared space of approximately 2.5 acres each. A new road network, improved with 687 acres of shaded fuel breaks, will provide access to the turbines and associated infrastructure.

Fire Behavior Study: The analysis includes a comprehensive fire behavior study utilizing historical weather data and fire behavior modeling tools. The analysis concludes that there will be a significant reduction in fire intensity post-development, with flame lengths decreasing and fire spread rates slowing, attributed to the creation of fuel breaks and road systems.

Aerial Firefighting Operations: This analysis includes a thorough examination of CAL FIRE aerial operations, including the proximity of firefighting bases, flight times, and the variety of aircraft available. The report underscores the effectiveness of aerial assets, including air tankers and helicopters, in combating wildfires in California's diverse landscapes and how these assets would operate in an environment with wind turbines and associated infrastructure.

Aerial Firefighting Safety Hazards: Critical infrastructure, including electrical transmission lines and cell towers, are commonplace in the wildland firefighting environment. The turbines and electrical infrastructure associated with the Fountain Wind Project will be added to aerial hazard maps, which are regularly updated to identify newly installed infrastructure. Aerial firefighters are trained to avoid infrastructure such as turbines and their presence does not preclude effective aerial firefighting.

Conclusions

Fire Behavior and Fuel Modification: The report concludes that the Fountain Wind Project is not detrimental or even neutral but is actually a net benefit to fire protection and mitigation efforts in Shasta County. The proposed road systems, fuel reduction, and vegetation clearing around turbines will significantly reduce fire intensity and enhance firefighting capabilities.

Aerial Firefighting Considerations: This report concludes that concerns about turbine hindrance to aerial firefighting are not supported by the evidence and that the project is in fact compatible with firefighting operations. The presence of wind turbines at this location will not preclude the use of aerial firefighting resources in the nearby communities of Round Mountain, Montgomery Creek, or Burney. The report emphasizes not just the overarching benefits of the project on ground-based firefighting operations but also the minimal impact of turbines on firefighting aircraft.

Recommendations

The report recommends ongoing collaboration with fire protection agencies, incorporating identified fire mitigation measures, and updating hazard maps to include the wind farm's infrastructure. Continued communication and coordination with firefighting resources will further optimize the project's integration into regional fire management strategies.

This report serves as a comprehensive guide for evaluating the Fountain Wind Project's impact on fire behavior and aerial firefighting operations, emphasizing its potential as an asset in Shasta County's wildfire mitigation efforts.

2 INTRODUCTION

Cognizant of the history of destructive fires in eastern Shasta County, Fountain Wind, LLC, requested an analysis of the impacts of a proposed wind farm on fire behavior and aerial firefighting capabilities. When completed, the Fountain Wind Project will operate up to 48 turbines designed to a maximum height of 610 feet, each with a cleared area of approximately 2.5 acres. A newly constructed road system will provide access to the turbines and associated infrastructure. The project is planned on "privately owned timber lands near Hwy 299, approximately 6 miles west of Burney and one mile west of the existing Hatchet Ridge Wind Farm".

As illustrated in Figure 1, several large fires have burned tens of thousands of acres of timberlands and impacted numerous communities in eastern Shasta County. Approximately two-thirds of the Fountain Wind Project is planned in the footprint of the Fountain Fire. The Fountain Fire, which started on August 20, 1992, burned 63,960 acres, and destroyed 636 structures. Strong southwest winds gusting up to 25 miles per hour (mph) pushed the fire east from the origin near the intersection of Buzzard Roost and Phillips Roads toward Hatchet Ridge, reaching the outskirts of Burney before being brought under control on August 28. Drought-stressed forest lands, low humidity, and prolonged temperatures of over 100 degrees Fahrenheit contributed to the fire's rapid spread through the forest canopy (called a crown fire), and flying embers ignited spot fires up to a mile ahead of the main fire. With fire suppression resources committed to other blazes burning in the Pacific Northwest, there was a delay in amassing the resources required to fight the Fountain Fire effectively. Once sufficient resources were assigned to the incident, the lack of direct access to the fire's edge in the heavily timbered forest slowed the progress of firefighters constructing containment lines on the rugged and steep terrain.

Informed by the destructive fires that have burned in eastern Shasta County, this comprehensive study uses fire behavior modeling tools and expert analysis of the Fountain Wind Project and associated infrastructure to evaluate the impacts of the project on predicted fire behavior and aerial firefighting operations.

FIGURE 1: EASTERN SHASTA COUNTY FIRE HISTORY 1990-2022, WITH THE FOUNTAIN WIND PROJECT SHOWN IN THE FOOTPRINT OF THE 1992 FOUNTAIN FIRE

3 METHODOLOGY

3.1 Fire Behavior Study Methodology

Historic weather data dating back to 1999 was collected from the closest permanent RAWS (Remote Automated Weather Station), located in Whitmore, in Shasta County.[2] The weather data was run through the FireFamilyPlus fire modeling tool. Developed by the Missoula Fire Sciences Laboratory, this program "is a software package used to calculate fuel moistures and indices from the US National Fire Danger Rating System (NFDRS) using hourly or daily fire weather observations primarily from Remote Automated Weather Stations" (Bradshaw & McCormick, 2000), which allows an analyst to graphically evaluate the weather and display the weather based on percentiles over a given time period.

[2] The National Interagency Fire Center manages 1,700 RAWS around the US and its territories. RAWS units measure wind speed and direction, air temperature and humidity, and precipitation, among other details important for fire management.

Once the weather was assessed, this data was run through two fire behavior programs: BehavePlus (version 6) and the Interagency Fuel Treatment Decision Support System (IFTDSS). BehavePlus, used to predict fire spread rate and spotting distances, was used as a point source ignition to validate the fire behavior findings from IFTDSS. IFTDSS is a geospatial fire behavior modeling program that allows users to modify fuel regimes and to "perform a Quantitative Wildfire Risk Assessment" (Interagency Fuel Treatment Decision Support System) of proposed fuel breaks and other fuel modifications. Behave Plus and IFTDSS use the Rothermel mathematical fire spread equation and must be used by a fire behavior expert experienced and trained to evaluate the data used to model fire behavior and the appropriate interpretation of the resulting model generated fire behavior predictions. (USDA Forest Service)

Fuels data used in the IFTDSS program were downloaded from LANDFIRE (a geo-spatial database used by fire and resource management planners) and are based on the 2022 fuels survey and are derived from some 800,000 sample areas in the United States. As found in LANDFIRE's product description, "Vegetation data drawn from these sources and used by LF include natural community occurrence records, estimates of canopy cover and height per plant taxon, and measurements (such as diameter, height, crown ratio, crown class, and density) of individual trees. Fuel data used include biomass estimates of downed woody material, percentage cover and height of shrub and herb layers, and canopy base height estimates." (United States Forest Service, 2019) Therefore, these data sources are ideally suited for studying the fuels, canopy, and fuel loading on the Fountain Wind Project site.

3.2 Fire Behavior Study Inputs and Assumptions

Assessments were done based on a typical fire season. Weather data was analyzed for the months of May through October. The analysis found that 75% of the wind was from the west, with 98% of the wind measured at speeds of 7 mph or less and 90% of all wind blowing at 4 mph or less. Wind gust speeds were documented at 14 mph or less 90% of the time. During the period of May through October, the average wind gust is 12 mph. This 12 mph wind speed from the west was used in the models to evaluate a worst-case fire scenario.

Notably, less than 1% of the time are the winds equal to or faster than those observed during the Fountain Fire in 1992.

Wind speed and direction were further validated using a Lassen National Forest portable RAWS located several miles east of the project site. This RAWS has been in place since April 2023. Wind speed and direction observations were consistent with data available from the permanent Whitmore RAWS.

Fuel moistures used were 3% for one-hour fuels, 5% for ten-hour fuels, 7% for one-hundred-hour fuels, 50% for live herbaceous fuels, and 100% for live woody fuels. These numbers represent an Energy Release Component (ERC) in the 90th percentile. ERC is the availability of dead and live fuels to burn. An ERC in the 90th percentile means that only 10% of the days since 1999 had worse burning conditions.

3.3 CAL FIRE Aerial Operations Study Methodology

The impacts of the Fountain Wind project on aerial firefighting operations at and near the proposed wind farm were evaluated by interviewing aerial firefighting subject matter experts with decades of experience, reviewing CAL FIRE aerial firefighting best practices, and searching relevant reports, journals, memos, and other documents.

4 FIRE BEHAVIOR STUDY

Installation of the turbines requires constructing a road system south of Hwy 299. This road system will be built on private forest lands covered in dense stands of mostly homogeneous pines planted after the 1992 Fountain Fire. These maturing pine plantations present an extremely high fuel load per acre and have few significant breaks in the contiguous tree canopy. Wildland fires in these dense stands of fuel stubbornly resist containment due to the intensity of the fire developed in the heavy fuels and the lack of access available for firefighters.

Fuel loading[3] along the roadways will be further reduced using 687 acres of shaded fuel breaks (i.e., removing and thinning roadside trees) along all primary and secondary roadways. In addition, approximately 2.5 acres will be permanently cleared around each of the 48 wind turbines. Figures 2 through 4 illustrate how installing all-weather roads, and the 2.5 acres of clear area around each turbine, will break the fuel continuity on ridgelines and provide fire suppression resources with direct access to the area.

[3] "The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area.", (National Wildfire Coordinating Group, (NWCG), 2012)

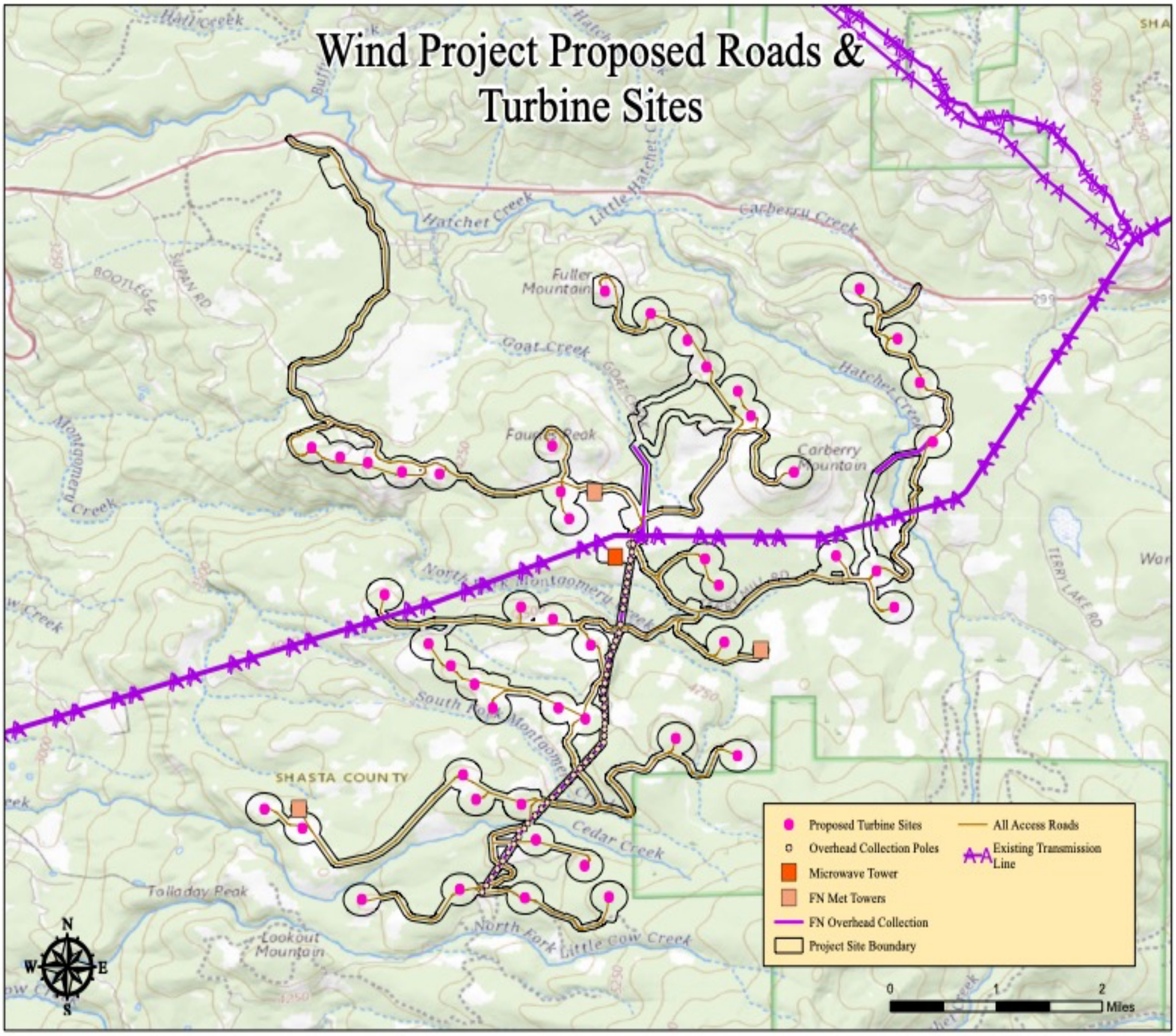

Figure 2: Circles around proposed turbines represent the removal of 2.5-acres of vegetation around the turbines; the road edges are shown to illustrate the shaded fuel breaks along the roadways.

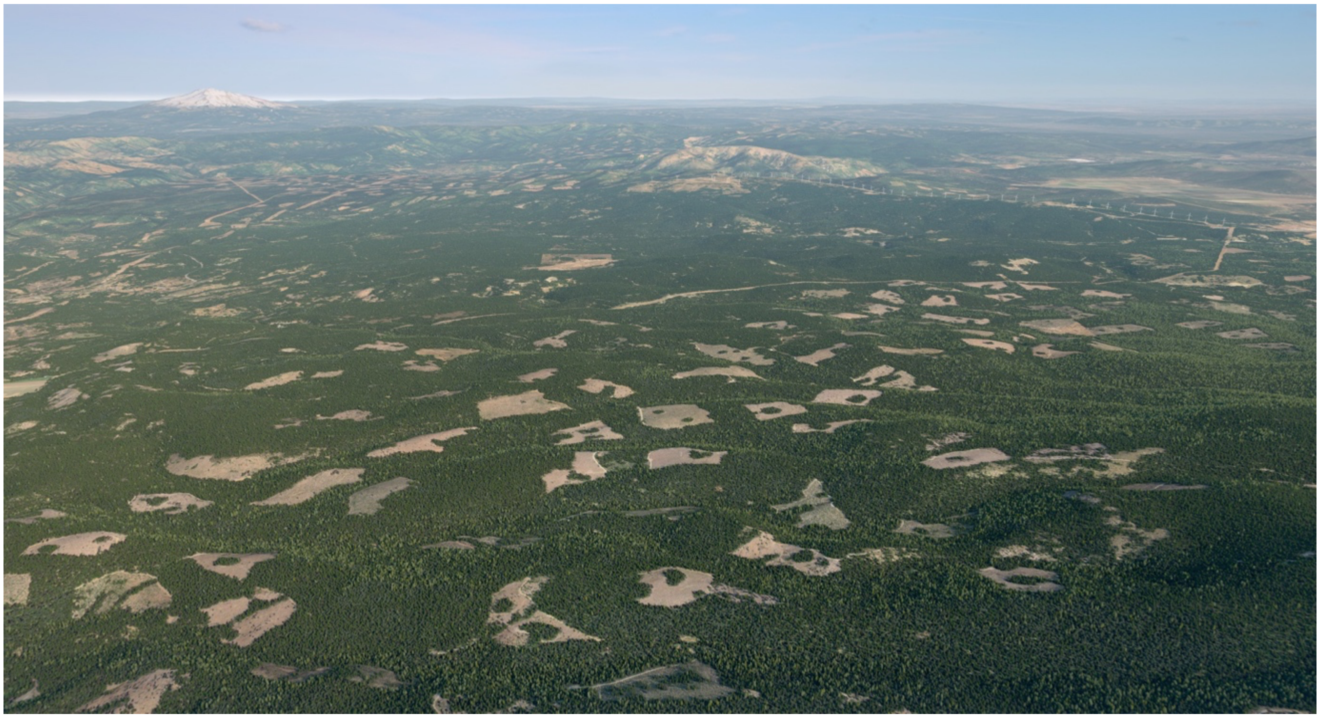

FIGURE 3: EXISTING PROJECT AREA LOOKING NORTH

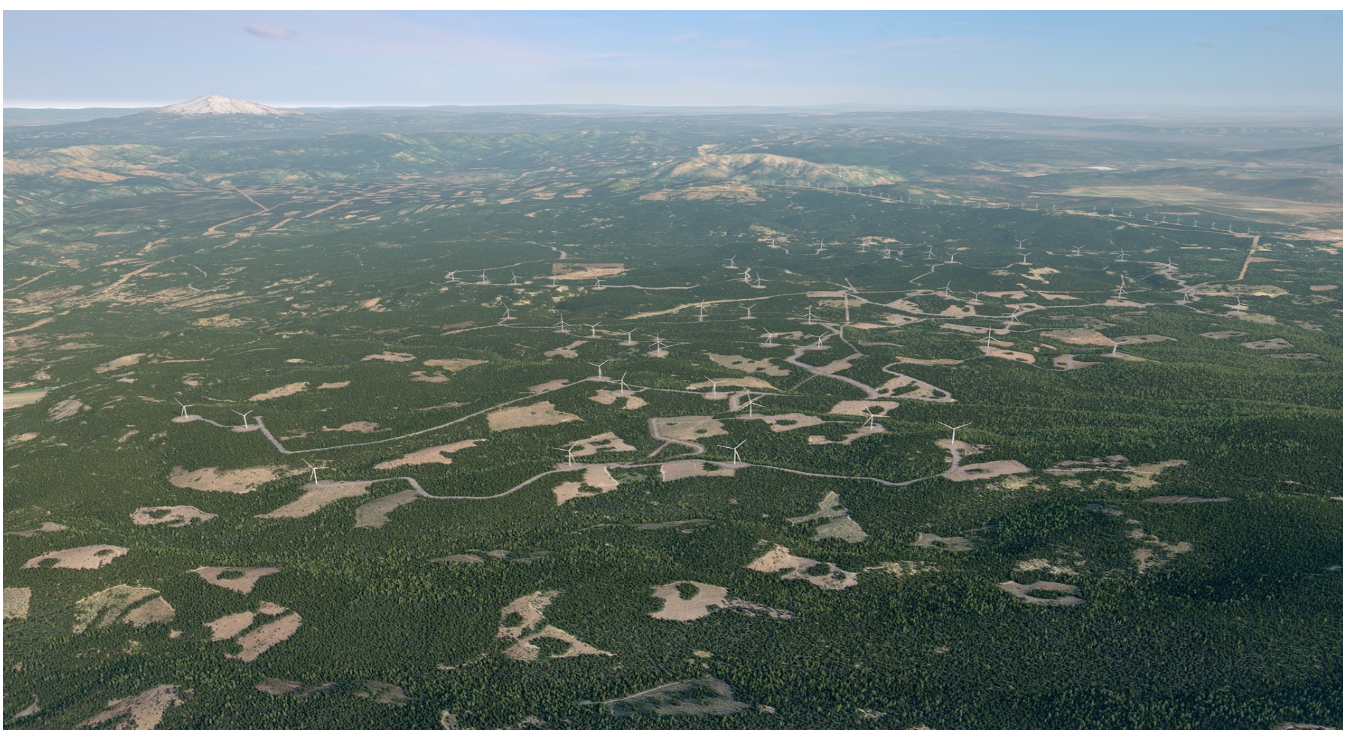

FIGURE 4: RENDERING OF THE PROPOSED PROJECT AREA WITH ROADS AND TURBINE SITES

To assess the impacts of the wind farm on fire behavior in the project area, fire behavior modeling was used to evaluate the flame lengths and rate of fire spread predicted within the project site pre- and post-development of the wind farm. Fire behavior modeling was conducted using historical weather data from the RAWS station closest to the project site in Whitmore, California.

Figures 5 and 6 show flame length modeling of a sample area that is representative of fire behavior predictions across the project site. As shown by the red pixels, existing fuel loading will generate flame lengths exceeding 25 feet over nearly half of the sample area and rates of spread of up to 50 chains[5] per hour on representative slopes and ridges.

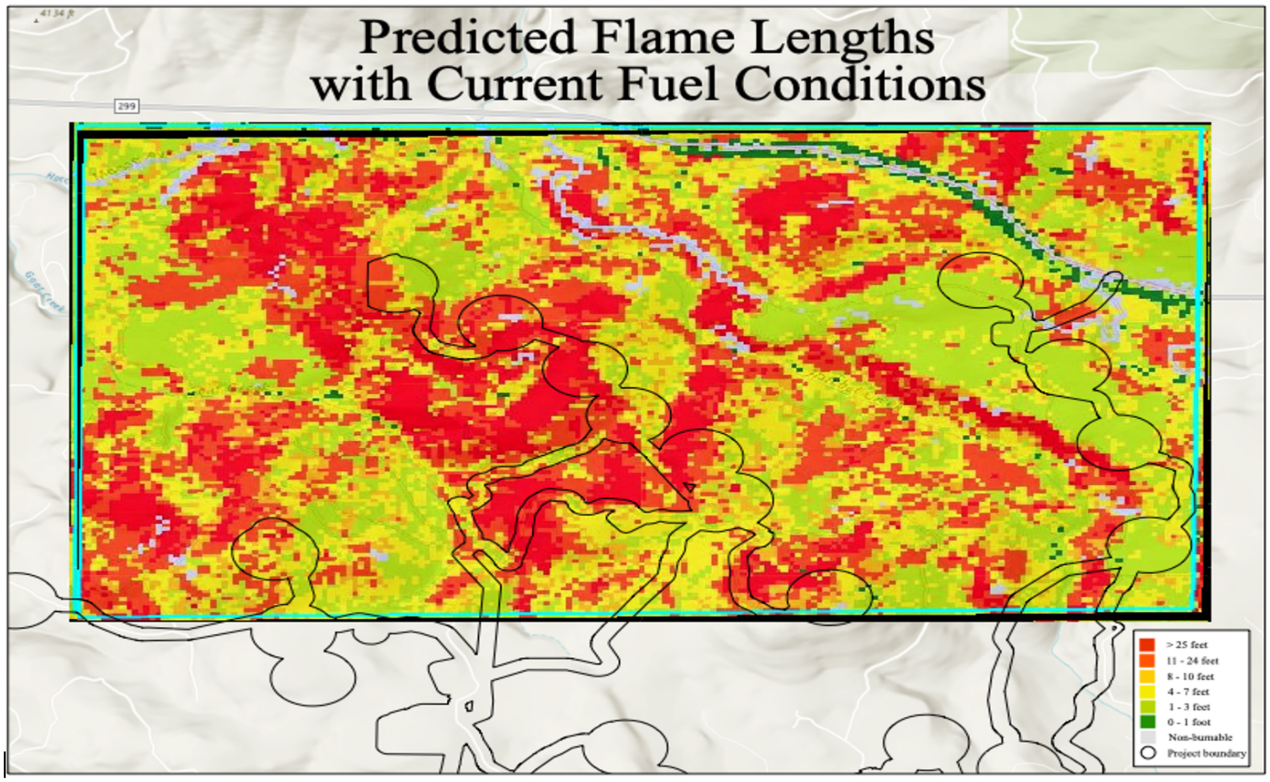

FIGURE 5: FLAME LENGTHS WITH CURRENT FUEL LOADING

[5] A chain equals 66 feet.

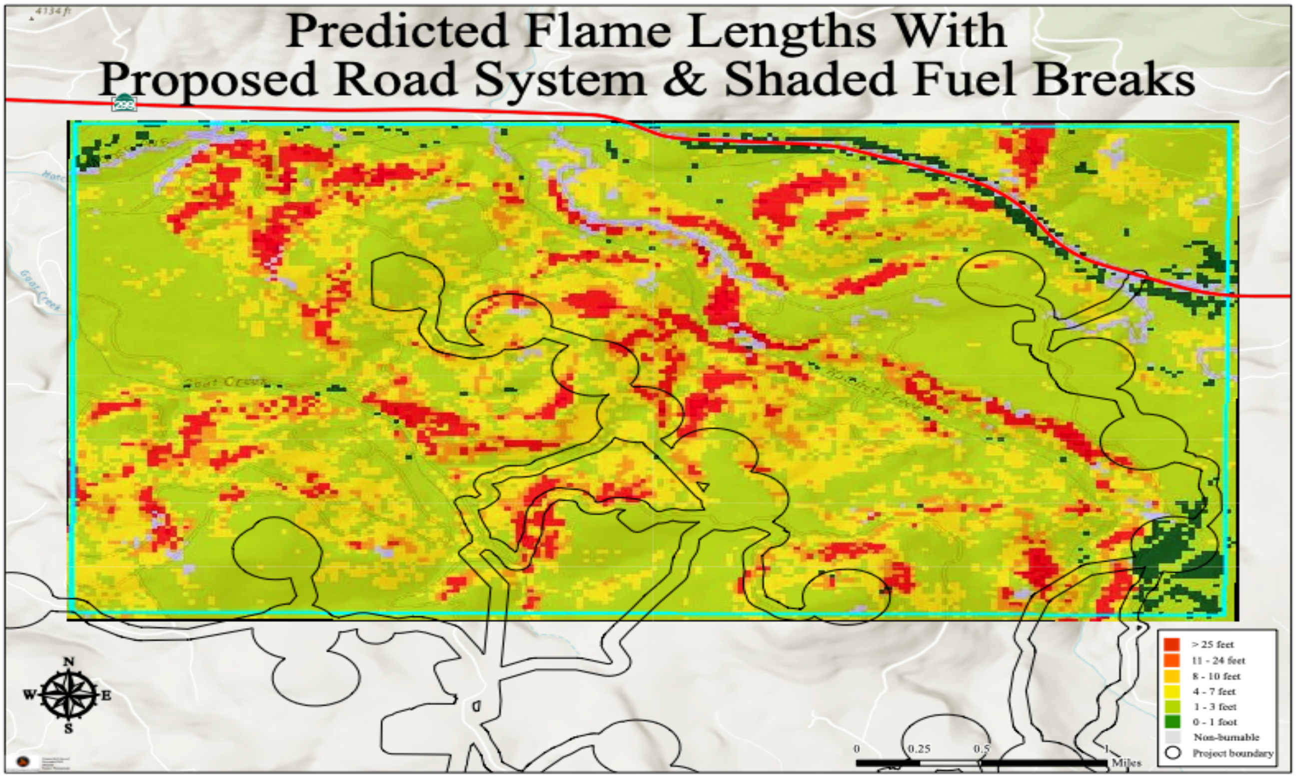

FIGURE 6: FLAME LENGTHS AFTER ROADS AND SHADED FUEL BREAKS ARE COMPLETED

Figures 7 and 8 illustrate the same sample area both before and after the construction of the road system and the completion of the shaded fuel breaks. As seen in this rate of spread modeling, the infrastructure associated with the wind farm will significantly reduce expected flame lengths across the area, thus reducing fire spread rates to 1 to 5 chains per hour.

To be conservative, the 2.5-acre cleared area around each turbine is not represented in the models, but these will further decrease the flame length and rates of spread due to their location on hilltops and ridges where the most intense fire behavior is expected.

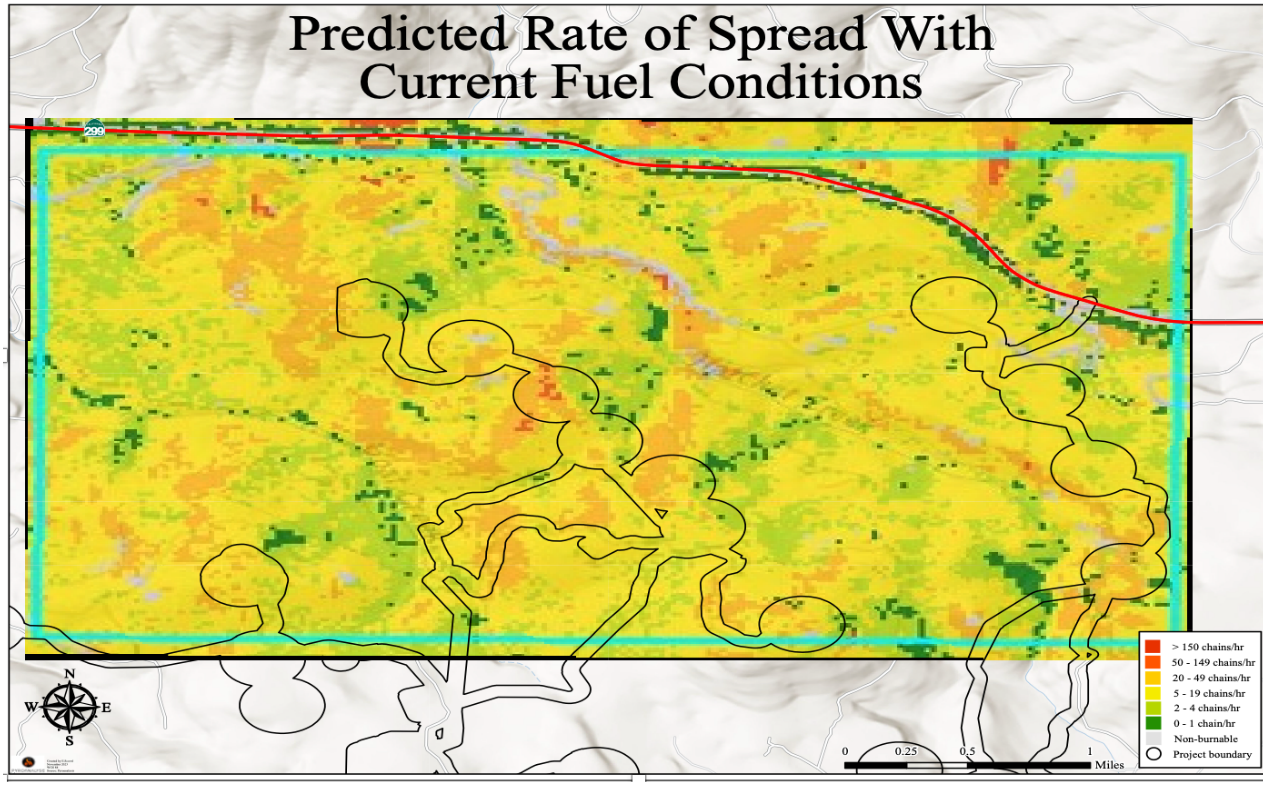

FIGURE 7: RATES OF SPREAD WITH CURRENT FUEL CONDITIONS

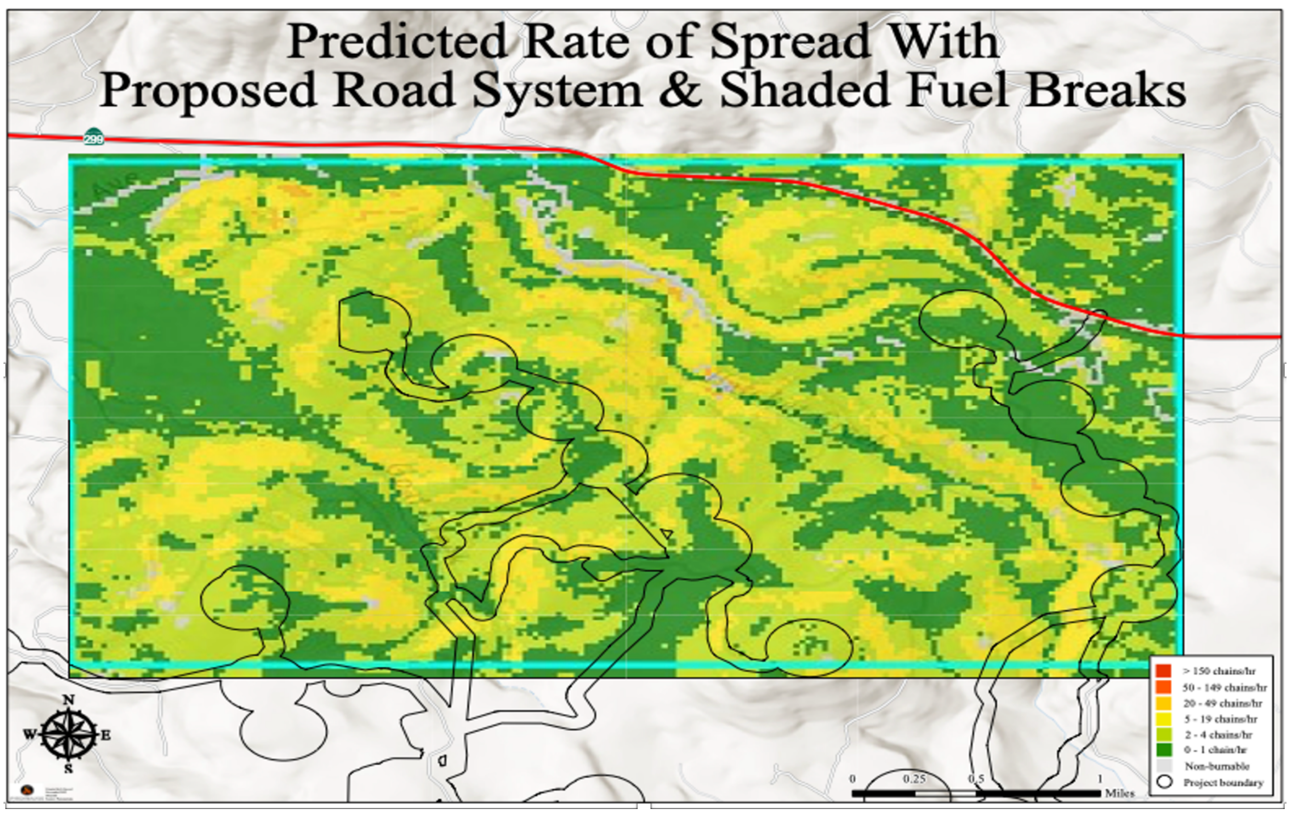

FIGURE 8: RATES OF SPREAD WITH ROADS AND FUEL BREAKS COMPLETED

5 CAL FIRE AERIAL OPERATIONS

It is the long-established goal of CAL FIRE to contain 95% of all wildland fires at 10 acres or less. The combination of aerial and ground firefighting has proven to be an effective strategy used by CAL FIRE to accomplish this goal. This is why 14 air tanker bases and 11 helicopter bases are strategically positioned throughout California to provide air support on fire incidents anywhere in the state in 20 minutes or less. With the largest non-military aerial firefighting fleet in the world, California has a wide variety of both rotor-wing and fixed-wing aircraft designed to fight fire in the state's vast and diverse landscapes.

Redding Air Attack Base, shared by CAL FIRE and the US Forest Service, is the airbase nearest to the Fountain Wind Project. Flight time from the base to the wind farm is approximately 10 minutes. Various firefighting aircraft are stationed at the base, including CAL FIRE's OV-10 Bronco Air Attack plane and two S-2T air tankers. A fire-retardant refilling plant is located at the base, providing immediate retardant reloading for air tankers assigned to area fires. Bieber Helitack, with a helicopter and firefighting crew, is based approximately 18 minutes northeast of the project site. Figure 9 shows the fire stations and air bases from which initial attack resources will respond to an incident on or near the wind farm. The available water sources and prepositioned dip tanks shown on the map will be used by helicopters and fire engines for rapid refill of water or retardant.

When fire danger is high, CAL FIRE will dispatch the following resources to a fire in Shasta County: 1 battalion chief, 6 Type 3 engines, 2 hand crews, 2 bulldozers, 1 water tender, 1 air attack plane, 2 air tankers, and 2 helicopters. Based on fire conditions and incident needs, the air attack supervisor can order additional air resources, including Lead Planes, Very Large Air Tankers (VLAT), Large Air Tankers (LAT), and Type 1 or Type 2 helicopters.

CAL FIRE's S-2T air tankers are nimble and quick aircraft perfectly suited to fight fires across California's mountainous terrain and near critical infrastructure. They can deliver a retardant payload of 1,200 gallons and then quickly refill at Redding Air Base or at any of the many retardant bases strategically located in the state.

VLATs and LATs can deliver a payload ranging from 3,000 gallons to 8,000+ gallons of retardant. LATs can refill at Redding, but due to the size of the VLATs, they must refill at specially equipped bases, such as McClellan, near Sacramento, California. Such large aircraft are not as agile as the smaller air tankers, and with relatively long retardant refill times, they are best suited for treating ridgelines and long sections of fire edge and reinforcing control lines along established roads or dozer lines.

State & Federal Aerial Asset Bases

FIGURE 9: STATE AND FEDERAL AERIAL ASSET BASES

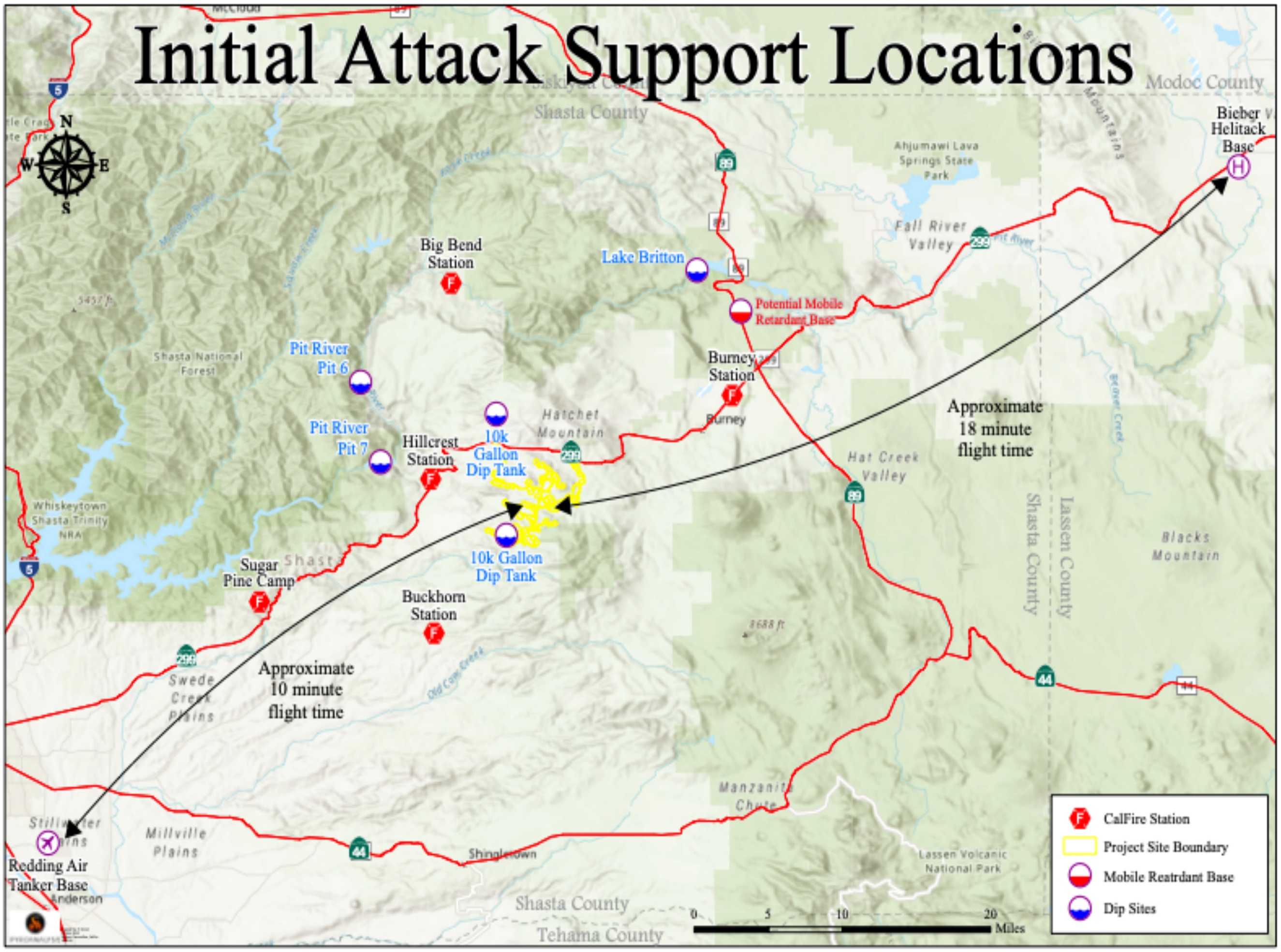

FIGURE 10

Helicopters are an essential tool in the aerial firefighting arsenal. Where fixed-wing aircraft are effectively used to provide perimeter control, reinforce control lines, and pretreat fuels, the more agile and maneuverable helicopter can precisely target sections of fireline inaccessible to fixed-wing aircraft, suppress spot fires outside of control lines, and cool pockets of burning fuel to reduce ember production. The smaller Type 2 helicopters can deliver 300–400 gallons of water or retardant; the much larger Type 1 helicopters can deliver up to 2,400 gallons of water or retardant. The buckets or tanks of the helicopters are quickly refilled at available water sources, such as rivers, lakes, agricultural reservoirs, or fixed storage tanks. Mobile Retardant Bases (MRBs) can be ordered and positioned near the fire incident when requested by the operations chief. MRBs are commonly used when fire tactics require precise application of retardant to support critical control lines or to support firing operations.

As effective as aircraft are in slowing fire spread and protecting communities and critical infrastructure, they must work in concert with ground resources to fully contain a wildfire. This is especially true in heavily timbered and brush-covered mountainous terrain where ground forces are required to build fire control lines by hand or with dozers along the entire fire perimeter. Without firefighters working directly with aircraft to construct fire control lines, the fire will burn through the retardant-covered foliage or water. For this reason, the more quickly ground resources can access the fire edge, the more likely it is that the fire will be controlled at 10 acres or less.

FIGURE 11: TYPE 1 HELITANKER WITH 2,400-GALLON TANK

FIGURE 12: TYPE 2 WITH 360-GALLON BUCKET

5.1 Use of Aircraft Around Critical Infrastructure

Critical infrastructure, including electrical transmission lines and cell towers, are commonplace in the wildland firefighting environment. The turbines and electrical infrastructure associated with the Fountain Wind Project will be added to aerial hazard maps, which are regularly updated to identify newly installed infrastructure. These hazard maps will be available to all pilots assigned to any wildfire incidents near the project area. As then Shasta County CAL FIRE Chief Bret Gouvea pointed out in a memo addressing Fountain Wind Project aerial firefighting considerations: "...every CAL FIRE Air Attack Base has an aerial hazards map that identifies the type of hazard, exact location and height of hazard. Prior to the start of each fire season, all aerial firefighters are briefed on these hazard maps daily. When non-base aircraft arrive at a new base, they are briefed on these hazard location maps. These safety mitigations allow CAL FIRE to conduct aerial firefighting operations throughout the state in various hazard conditions" (Gouvea, 2021). There are many aerial hazards throughout the state that are mapped and considered by CAL FIRE in their use of aircraft to combat wildfire. The Fountain Wind Project will be treated in the same manner as any other aerial hazards.

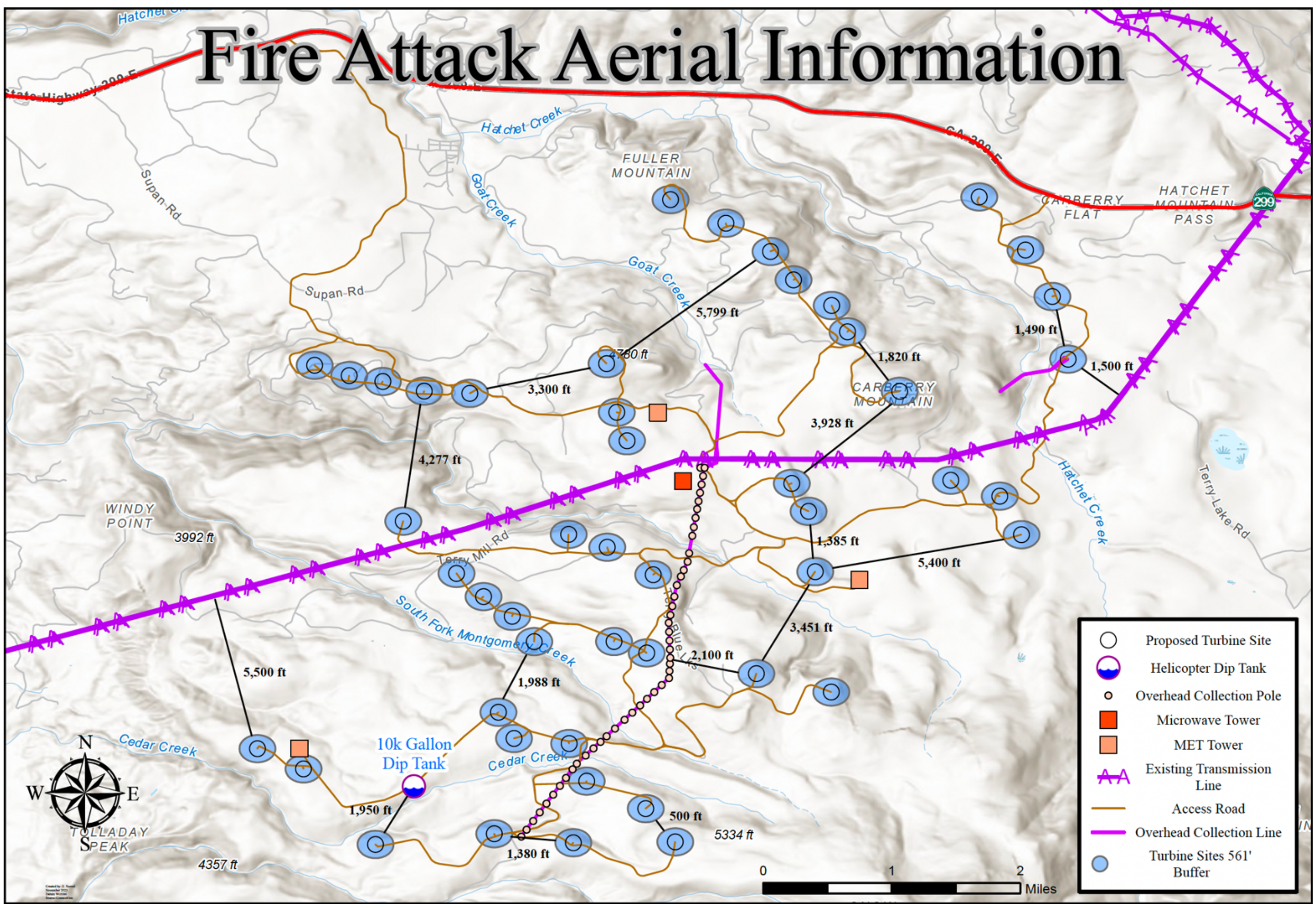

FIGURE 13: FIRE ATTACK AERIAL INFORMATION

Based on the size of the Fountain Wind turbines, which will stand to a height of up to 610 feet from the base to the tip of the 250+ foot blade, they will be less hazardous to aerial operations than the electric transmission towers and powerlines that are ubiquitous across California's forest lands. Commander Wayne Riggs, AFSM, a veteran aerial firefighter with Fire Rescue Victoria in Australia, is experienced in using aircraft to fight fires on wind farms and was interviewed for the article "Between the Towers, Fighting Brush Fires on Windfarms." He told the article's author that "he sees the sheer size of the towers as a benefit, as it makes them highly visible." In addition, he said, "Provided the operators have shut them [the turbines] down, which they can do very easily, I contend that they're much easier to work around than a wire environment because they are much easier to see" (Neil, 2023). His observations were further supported in an after-action review of a fire that burned through the Waterloo Wind Farm in South Australia. The inquiry found that "the wind farm's turbines did not present a hazard to aerial firefighting, and the turbines were clearly visible to the pilots involved in the operations" (Australian Fire and Emergency Services Council Limited, 2018). The visibility of the turbines is further enhanced by red flashing lights installed on the turbines, as required by the Federal Aviation Administration (FAA).

When using aerial assets at a wind farm, the air attack supervisor immediately conducts a hazard analysis before any aircraft takes suppression action on the fire and orders the turbines to be turned off and locked.[6] This allows the air attack supervisor to identify and declare any aerial hazards to all firefighting aircraft. Should any limiting factors exist, the firefighting aircraft makes appropriate adjustments to their actions, which may include ordering a different type of aircraft to provide the safest and most effective support to accomplish the tactical operations required to meet the objectives provided by the incident commander. All air assets, including VLAT and LAT air tankers, may be used to control a wildland fire at or near the Fountain Wind Project.

As illustrated in Figure 14, as much as 1.3 miles of clear space is available between the turbines, which are spaced linearly along the ridgelines, providing a flight corridor between the tower clusters. A 300-foot safety buffer from the tip of the turbine blades is shown in yellow around each of the turbines. The 300-foot separation is a recommendation and aerial operations' best practice used near powerlines and waterways; it is not required by CAL FIRE air operations policy. The air attack supervisor determines the necessary tactics and safety mitigations based on fire behavior and weather conditions.

[6] Fountain Wind turbines may be shut down by personnel at the Remote Operations Control Center, which is staffed 24 hours a day, 365 days per year.

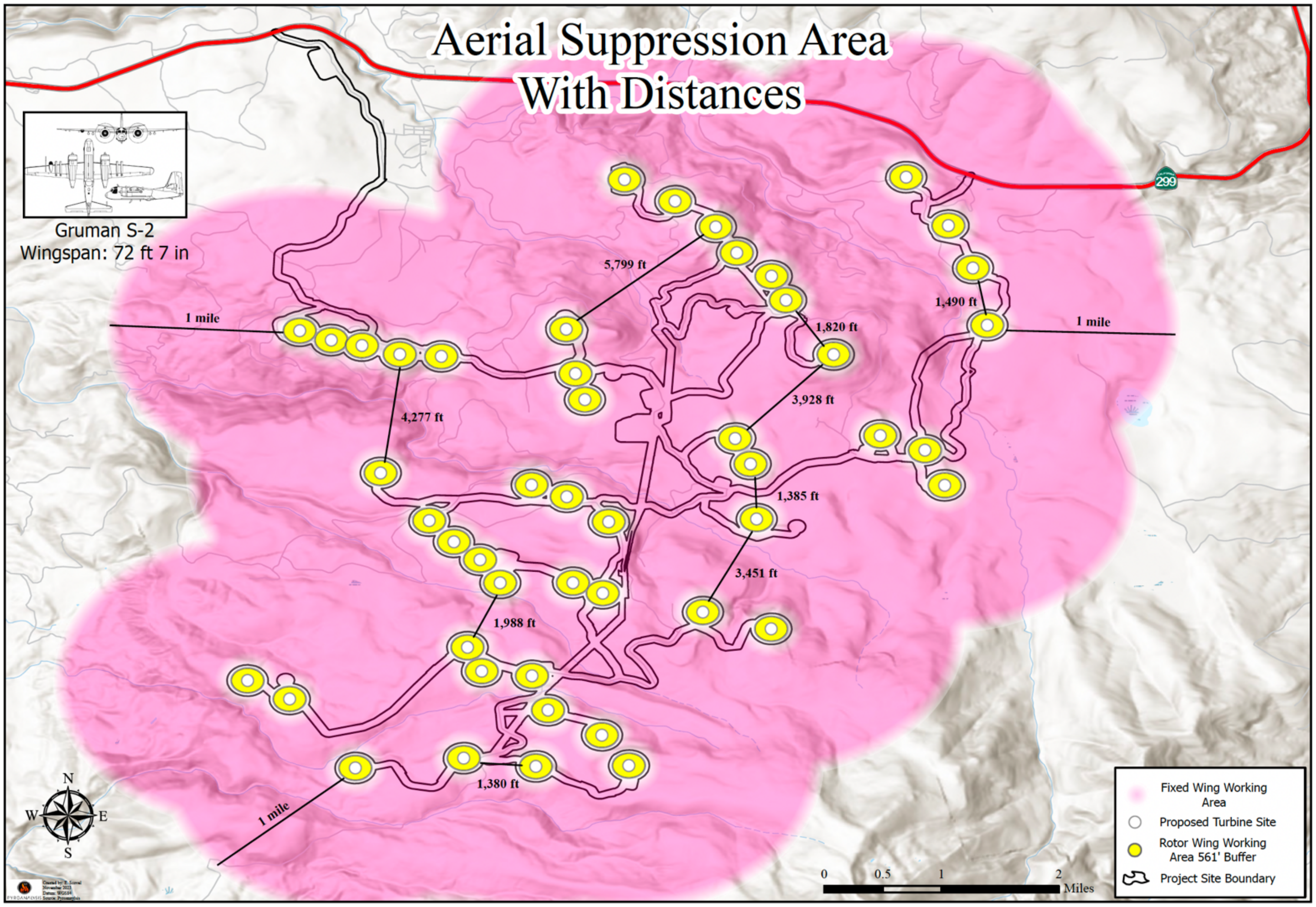

Figure 14: Areas Shaded in Red are areas where the use of Fixed-Wing Aircraft can be considered. The yellow is a 300-foot safety buffer around each turbine.

6 FINDINGS AND CONCLUSIONS

6.1 Fire Behavior and Fuel Modification

PyroAnalysis finds that the Fountain Wind Project is a net benefit to fire protection and mitigation efforts in Shasta County.

In designing the wind farm south of Hatchet Ridge, Fountain Wind, LLC, adhered to industry best practices and has conferred with CAL FIRE and fire control experts to ensure that the project supports Shasta County's wildfire mitigation initiatives. Based on the recommendations of fire experts, plans for fire mitigations on the development site meet or exceed the Conditions of Approval outlined by the Shasta County Fire Department and Planning Department (Zerr, 2021).

Primary access roads constructed to erect and maintain the turbines will be all-weather and a minimum of 20 feet in width, with all vegetation cleared on both sides of the roadway to a distance of 10 feet. A shaded fuel break will be maintained to 100 feet from the primary road's centerline, creating a fire break of 200 feet in width on ridgelines where roads exist. Secondary access roads are to have shaded fuel breaks extending 50 feet from the centerline of each road, and an area of approximately 2.5 acres around each of the turbines will be cleared of flammable vegetation (Barns, 2023).

Fire behavior modeling predicts a drastic reduction in overall fire intensity when these fuel modifications are compared to existing fuel loading on the project site. Fire progression through the canopy in the maturing pine plantations, which can generate flames more than 100 feet in length and contribute to long-range spotting, is significantly reduced or stopped on ridges and in clearings where the contiguous tree canopy is broken by roads and fuel breaks. Further, the rates of spread fall from 50+ chains per hour across the project area to less than 5 chains per hour on all but a few slopes and drainages.

The significance of these access roads and fuel modifications cannot be overstated. Without fuel breaks on ridgelines and easy access to the fire edge, essential ground-based firefighting resources cannot safely and effectively engage in direct fireline construction, delaying fire control. Had adequate access roads and fuel modifications within the proposed project area been developed before the Fountain Fire, firefighters would have had an opportunity to engage the fire in areas that were then inaccessible.

As attested to in their letter dated June 14, 2021, wildland fire control experts Darin Quigley and Syndy Zerr found that with the risk mitigations, Fire Prevention Plan, and fire protection systems designed into the turbines that the Shasta County Environmental Impact Report (EIR) findings were correct and that "the specialists concur that, with the identified mitigation measures as described, together with the other identified mitigation measures that the wildfire risks of the Project would be reduced to a less than significant level" (Zerr & Quigley, 2021). This fact is supported by fire behavior modeling that considers the impacts of the roads and shaded fuel breaks on rates of fire spread, predicting that rates of spread will be reduced from 3,300 feet per hour to 330 feet per hour on all but a few of the slopes and drainages in the project area. Such dramatic reductions are observed because the interwoven conifer tree canopy is broken by the road network and 687 acres of shaded fuel breaks that stop the propagation of crown fire and result in low intensity surface fire[7]. Firefighters cannot safely engage a fire burning through the crowns of the forest canopy and are forced to redeploy to sections of the fire where surface fire spread can be stopped with handlines, dozerlines, and hoselays. The fuel modifications proposed by Fountain Wind, LLC, will provide safe access for firefighters to immediately engage a wildland fire from the network of roads and shaded fuel breaks constructed on the ridges south of Hwy 299 and Hatchet Ridge.

Based on these facts, the Fountain Wind project is a **net benefit** to fire protection and mitigation efforts in eastern Shasta County (Shasta County, 2016). Fire protection agencies responsible for protecting mountain communities are often prevented from constructing needed fuel breaks on private lands due to restrictions on the use of public funds for such projects. With limited funds available for fuel reduction initiatives, development projects on private lands—which include fire access road systems, shaded fuel breaks on ridgelines, water storage tanks, fire protection equipment, and on-site staff capable of early fire detection and notification—should be encouraged and welcomed as an enhancement to public safety.

6.2 Aerial Firefighting Considerations

PyroAnalysis finds that the immediate access provided by the road systems into the wind farm, the fuel modifications created by the roads and shaded fuel breaks, and the 2.5 acres of vegetation removed from around the turbines far outweigh the limited restrictions that the project may have on the use of fixed-wing air resources.

Some have suggested the Fountain Wind Project turbines will prevent aircraft from being effectively used to control a fire on Hatchet Ridge. A study of the project by aerial firefighting experts with decades of wildfire experience and a review of literature on the subject, prove this assertion to be false. Aerial hazards, like electrical transmission lines and towers, are encountered by aircraft at nearly every wildland fire. Chief Bret Gouvea authoritatively addressed this concern, stating: “Aerial hazards do pose a safety concern for aerial firefighters; however, they are something we must work around on a daily basis” (Gouvea, 2021). Standing at up to 610 feet in height and equipped with FAA-required flashing red lights, the turbines are immediately visible to pilots who are equipped with aerial hazard maps that they carefully consult before initiating aerial firefighting operations.

[7] “Fire that burns loose debris on the surface, which includes dead branches, leaves, and low vegetation”. (National Wildfire Coordinating Group, (NWCG), 2012)

Before beginning aerial firefighting operations, the air attack supervisor conducts a hazard and safety analysis. Once the analysis is completed and hazards are acknowledged by air assets, air tankers and helicopters are deployed on the incident as directed by the air attack supervisor. At a fire at or near the Fountain Wind Project, the air attack supervisor knows that the ridgeline layout of the turbines creates a mile or more of separation between many of the turbines. If weather and fire behavior permit, these corridors between turbines may allow for the use of fixed-wing aircraft. Additionally, VLATs and LATs may be deployed when appropriate; the air attack supervisor will utilize the appropriate number and most effective aircraft available. Types 1 and 2 helicopters can be used in proximity to the towers or where fixed-wing aircraft are not able to operate. Helicopters are extremely effective in tight terrain, carrying up to 2,400 gallons of water or fire retardant. Since there are a large number of water sources near the project, including water tanks provided by Fountain Wind, LLC, helicopters can quickly refill and return to the firefight.

Ground-based fire resources are required to control a wildfire; air resources only support firefighters constructing lines around the fire's perimeter. This fact must be emphasized in evaluating the effects of the Fountain Wind Project on fire control tactics. ***The immediate access provided by the road systems into the wind farm, the fuel modification created by the roads and shaded fuel breaks, and the 2.5 acres of vegetation removed around the turbines far outweigh any restrictions that the project may have on the use of air resources.***

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8 PROJECT CONSULTANTS

SHANE LAUDERDALE

Early in his career, Shane developed a passion for community risk reduction, earning a Bachelor of Science in Fire Prevention Technology from Cogswell Polytechnical College and an Associate Degree in Fire Technology from Shasta Community College. He founded PyroAnalysis in 1998 to assist communities, developers, and attorneys in interpreting and applying fire and emergency management principles. As a certified instructor, he has inspired thousands of fire service professionals to create innovative strategies to combat hostile fire and other disasters and was a contributor to the California State Fire Marshal Fire Officer and Fire Investigator certification curriculum.

As a leader in fire and emergency management, Shane has guided communities and institutions through the challenges related to the COVID-19 disaster, developing and evaluating emergency and evacuation plans, and adopting fire codes and standards specifically tailored to the unique needs of the community.

Shane started his career as a firefighter in the summer of 1985 and served with the City of Redding, California Fire Department from 1986 to 2012. During his more than 25 years in Redding, he worked as a firefighter, fire apparatus engineer, arson investigator/inspector, fire captain, operations battalion chief, and deputy chief of administration. In January 2012, he became the operations chief at Chico Fire-Rescue. He served as fire chief in Chico, California, from April 2014 to 2016, where he created the Division of Community Risk Reduction, prioritizing emergency preparedness and risk reduction over the traditional reactive fire service response model.

Shane has served on a Type 1 Incident Management Team since 2001. As an operation section chief and branch director, he has assisted dozens of communities impacted by catastrophic fires and other disasters in California. Incidents include the Thomas Fire of 2017, where he led the evacuation of Ojai and the firefight in Montecito; the Oroville Dam failure; the Camp Fire in 2018; the Kincade Fire of 2019; and the Butte Complex of 2020. He is a member of the Advanced All-Hazard Incident Management (AAIM) training cadre that provides intensive disaster management training and evaluation for All-Hazard Incident Management Teams.

His certifications include NFPA Certified Fire Protection Specialist, Type 1 Operations Section Chief, Type 3 Incident Commander, Certified Chief Fire Officer, Certified Fire Officer, Certified Fire Prevention Officer, Certified Fire Service Instructor, and IAAI/NAFI Certified Fire Investigator.

JOHN MESSINA

Until his retirement in November 2023, John served as the CAL FIRE Assistant Region Chief, overseeing the CAL FIRE's Northern Region Operations and Resource Management Program and providing leadership to six operational units.

He began his fire service career in 1991 as a firefighter working for a federal agency in Northern California. During that time, he attended Chico State University, where he received his bachelor's degree in geography with an emphasis on geographical information systems (GIS). His career started with CAL FIRE in 2000, where he worked through the ranks to become Assistant Region Chief.

John has diverse experience in the fire service, holding positions in operations, aviation, and administration and serving as an executive-level chief officer with CAL FIRE. From 2020 through 2022, John was the Unit Chief of the Butte Unit, where he served as the Fire Chief for Butte County, the Town of Paradise, and the cities of Gridley and Biggs through cooperative fire protection agreements. During his tenure as the Butte Unit/County Fire Chief, he successfully negotiated a new cooperative fire protection agreement with the City of Oroville.

He spent 14 years on a CAL FIRE Incident Management Team as an operation section chief and qualified Type 1 incident commander. Before being promoted to Unit Chief, he was the deputy incident commander of Incident Management Team 5. John has been directly involved in some of California's most notable disasters, including operation section chief of the 2017 Oroville Spillway emergency, and incident commander of the 2018 Camp Fire in Paradise, and as Agency Administrator, he guided and led the 2020 North Complex and 2021 dixie Fire emergency responses. In 2019, he was assigned as an incident commander to California's statewide response to the COVID-19 disaster.

He has extensive experience in all aspects of disaster planning, including community evacuation planning. Working with local, state, and federal officials, he was intricately involved in the recovery and rebuilding process for the Town of Paradise after the Camp Fire and collaborated with government officials to develop local ordinances for more effective wildfire mitigation requirements. To this end, he assisted in developing a local Wildfire Safety Task Force and State/Federal Land Use Coordinating Committee tasked with establishing priorities and providing guidance for wildfire resilience and forest health projects. John has firsthand experience and in-depth knowledge of how significant disasters impact communities and government entities. His experience in mitigation, preparedness, response, and recovery has given him a clear understanding of what community and government leaders face and how to guide them through disaster preparedness and response challenges.

DENNIS BURNS

Dennis began his career in 1977 with the California Division of Forestry and Fire Protection. In 1980, he transferred to the Stanislaus County Fire Department, and in 1985, he took a position with Pleasanton Fire Department, which merged with Livermore in 1987. Dennis retired from Livermore/Pleasanton Fire Department in 2018.

Dennis earned an Associate of Science in Fire Science from Modesto Junior College and a Bachelor of Science in Fire Management from CSU Sacramento.

Dennis has served on national Type 1 Incident Management Teams as a fire behavior analyst (FBAN) since 2000. He chairs the S-590 (Advanced Fire Behavior Interpretation) Steering Committee and is a member of the National Wildfire Coordinating Group (NWCG) Fire Weather Sub Committee and the NWCG Fire Behavior Curriculum Unit.

ALEX LUJAN

Alex served with CAL FIRE from 1983 to 2014. As a captain with CAL FIRE, he specialized in air operations, becoming an air operations branch director on a Type 1 Incident Management Team where he distinguished himself as a leader in the air operations community. After retiring in 2014, he has continued to use his qualifications to serve on major fire incidents across California, working as an agency aviation military liaison/military helicopter manager and HLCO.

His qualifications include air Operations branch director (AOBD), air Support group supervisor (ASGS), helicopter coordinator (HLCO), agency aviation military liaison (AAML), military helicopter manager (MHEM), helibase manager (HEBM), and air operations instructor.