Exhibit D – Need/Extent of the Problem

State of California

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The state's forested upper watersheds are a critical element of California's complex and drought-stricken water system. Restoration investments in these watersheds build resilience in communities, economies, and people by safeguarding watersheds from fire, pests, and invasive species. The Rim Fire (Fire) is the latest in a string of wildfires that has broken records for intensity and size. Incidents like the Fire have cascading effects on water resources and communities long after the fire is gone. The cumulative effects of such events over a period of time can be devastating. These events call for a holistic approach to preventing, managing, and mitigating their effects by enhancing the health of upper watersheds and forests and the resilience of rural communities.

Unmet Need in the MID-URN Area

Per Exhibit B, the target area for California's NDRC application includes the area of the 2013 Rim Fire and the evacuation areas (Attachment E, page 99). As described in Exhibit B, the Fire significantly damaged the environment and public infrastructure. The Fire burned the landscape, retaining walls, drainage infrastructure, historic sites, and cattle grazing infrastructure. Damage on the landscape has led to erosion and sedimentation into streams and reservoirs, reducing water quality and reservoir capacity. Erosion has exacerbated road damage caused by the Fire and limited access to forest roads. The Fire also caused extensive damage to the San Francisco Public Utility Commission's hydroelectric infrastructure in the area.

Earth Economics estimated that in the first year following the Fire, environmental damage measured between $100 and $736 million. These estimates are based on analysis of ecosystem services provided by a healthy forest and watershed. Furthermore, the U.S.

Department of Agriculture Forest Service (USFS) estimated over $40 million in lost recreational uses and visitor fees. This estimate is indicative of the impact on the local communities whose economies are tied to the forest through tourism, recreation, associated services, timber, and wood products.

Addressing these unmet needs requires investment to address immediate risks, but also to restore long-term ecosystem services. In the near term, erosion control measures are needed to prevent infrastructure damage and environmental degradation and sedimentation in downstream water bodies. Investments are needed to support sustainable forest practices that ensure healthy landscapes and support timber and wood product industries. These activities include reforestation of the burned areas, removal of dead wood and establishment of firebreaks to protect reforested areas and critical infrastructure.

The Fire also highlighted the need for community infrastructure improvements to increase resilience. During the Fire, firefighters and residents regularly had to drive several miles or form cell phone brigades to access cellular or broadband services and communicate with other fire crews, command centers, and personnel delivering supplies. Data from the Central Sierra Broadband Consortium shows that at least 50 percent of the County's population resides in unmet or underserved communications infrastructure areas (Appendix E, page 104). The Consortium further detailed the need by identifying Pine Mountain Lake, Cold Springs, Pinecrest, and Strawberry as areas of immediate need (Resolution T-17443).

Water infrastructure also proved to be vulnerable and, in some cases, inadequate. A 15.7-mile-long wooden flume, the Main Tuolumne Canal, brings water from the Lyons Reservoir to the local communities (Appendix E, page 105). Above ground and constructed of wood, the flume carries water through a steep canyon, which is itself at high risk of fire. In some housing

developments near the burn area, fire hydrants and fire suppression infrastructure were also unable to support fire-fighting activities. Wooden flumes are common in rural areas.

Impacted and Distressed Characteristics in the MID-URN Area

Economic and environmental factors already affecting the region accentuated the damage from the Rim Fire. Tuolumne County is an economically fragile area. Unemployment in the Target Area is currently at 15.4 percent, which is 158.4 percent of the national average. The fragility is further enhanced by the nature of the region's workforce. The region's economy is highly tied to the forest through tourism, recreation, associated service industries, timber, and wood products. In 2009, over 20 percent of the workforce was employed in recreation, retail, or accommodation and food services. The workforce is also highly seasonal. The trend in the size of the workforce in the county, averaged for the 2000 to 2011 time period, peaks between July and October. The Rim fire began right before Labor Day weekend, forcing the closure of hotels, portions of Yosemite National Park, Stanislaus National Forest, and other attractions – at a peak time for tourism, recreation, and employment. Local residents suffered not only from these economic impacts, but also from extensive evacuations, exposure to smoke, and disruptions to work, school, and other activities. These impacts were especially challenging for the elderly, the young, and residents reliant on employment in resource-dependent sectors. Smoke from wildfires is an acute problem for children, the elderly, the infirm, and people with disabilities. The public health impacts can be severe (Kunzli et al 2006).

Residents in Tuolumne County have had difficulty obtaining and maintaining homeowner's insurance following the Fire, notably those residents who live at the wildland-urban interface. Access to insurance continues to elude homeowners; lack of insurance could slow economic and physical recovery from the Fire and hinder resilience to similar future incidents.

As discussed in Exhibit B, in addition to the region's fragile economy, current drought conditions and the past history of severe wildfire accentuated the impact of the fire throughout the region (Attachment E, page 103).

Impacts Beyond the MID-URN Area

Almost 60 percent of California's developed water supply originates in the Sierra Nevada region (California Water Plan 2013, fig. 3-11, pg 3-36). When forested areas are exposed to wildfires, impacts on water supply and quality occur due to soil erosion and resultant sedimentation in reservoirs and downstream water conveyance systems (Minear and Kondolf 2009). For example, the impacts from the Fire extend to Don Pedro Reservoir, which provides drinking and irrigation water to the Central Valley, California's agricultural hub. Loss of reservoir capacity to sedimentation is generally ongoing and often permanent (Poff and Hart 2002). The fire also damaged infrastructure in the San Francisco Public Utility's water and power systems, which originate in Tuolumne County. Thus, building resilience in the upper watershed will have wide-reaching effects. This work will also provide a replicable model for how investment in ecological disaster restoration and natural infrastructure can support community and State resilience.

Building resilience will also improve State efforts to improve air quality and reduce greenhouse gas (GHG) emissions. Healthy forests play an important role in climate change due to their ability to store carbon. Forests absorb carbon dioxide from the atmosphere through photosynthesis and store large amounts of carbon in living woody tissue. GHG emissions from large, destructive fires like the Fire can rival the annual emissions from large cities. The Fire released millions of tons of smoke over hundreds of miles (Air Quality Update-August 8, 2103, NOAA News Clip-Smoke) and over 11 million metric tons of GHG emissions, roughly the

equivalent of the annual GHG emissions from 2.3 million motor vehicles (Sierra Nevada Conservancy - Rim Fire Fact Sheet). Dead and dying trees, like those remaining after the fire, can release as much as four to five times more GHG emissions than the event itself. These releases occur for many years as the trees decompose (National Park Service Impacts of Fire Report – pg 20, 21). Carbon storage will continue to be degraded due to vast treeless landscapes, which impugn both air quality and critical carbon storage (Quantitative Evidence for the Increasing Forest Fire Severity – pg 13/report pg 29, highlighted).

Comprehensive Risk Approach for Program Development

The development of the Community and Watershed Resilience Program (Program) relies on a comprehensive risk approach informed by historical data and future risk. The risks considered include the risks of wildfire and other disturbances under historic and future conditions. In developing our program for watershed and community resilience, we will consider these risks systematically.

Historical Risk Data: In California forests in the Sierra Nevada, southern Cascade Range, and montane Modoc Plateau, fire is an inherent process that regulates forest size and shapes forest stands (Collins and Skinner 2013). Research by the USFS and the Center for Wildland and Water Resources shows that most fires were low to moderate severity over at least the last several centuries. Historically, these frequent, low-intensity fires maintained relatively open, patchy stands composed primarily of large, fire-resistant trees across much of the landscape. However, past timber harvesting practices and livestock grazing, coupled with over a century of fire suppression have shifted forest structure and composition to the ponderosa pine, Jeffrey pine, and mixed-conifer types currently populating the Sierra Nevada. This shift produces increased tree densities, smaller average tree diameters, higher

proportions of shade-tolerant tree species, elevated surface fuel loads relative to historic conditions, and reduction in heterogeneity across landscapes. Alongside these changes, the proportion of high-severity fire increased in mixed-conifer forests in the Sierra Nevada from 1984 to 2010 (Collins et al 2011; van Wagtendonk and Fites-Kaufman 2006; and Perry and others 2011). Fire sizes and annual burn area also increased during the same period. These trends are linked to stand- and landscape-scale changes in forest structure and a warming climate. Westerling (2014) shows that the combined long-term impact of human activities increases the risks of large wildfires, often in ways that cannot be easily reversed.

Future Risk Data: The State's series of climate change assessments (described in Exhibit C) have characterized many of the future risks to the MID-URN area and the State as a whole--as a result of a changing climate, among other factors. Future risks include increasing temperatures; shifts in vegetation and ecosystem composition; increase in the frequency and severity of extreme events, including heat waves, extreme storms, and wildfire; and reductions in snowpack in higher elevations. These assessments also look at the combined influence of land use, demographics, and climate change on wildfire in California. This analysis shows that land use decisions can have a large impact on future wildfire risk.

Drought and climate change are expected to lead to increased fire intensity and areas. Drought has a direct effect on water availability, while fires can have an indirect effect. Reservoir capacity can be jeopardized by repeated sediment flushes associated with fires, into the reservoir. This in turn will diminish water storage and downstream available water for human and agricultural consumption.

Data to Understand Historical and Future Risk: Data and information in this proposal came from peer-reviewed research, professional studies, personal communication, agency and

academic reports and tools. These data include detailed records of forest growth patterns in different forest types under different management regimes statewide and California fire characteristics available from the USFS, California Department of Forestry and Fire Protection (CAL FIRE) and universities; and the best available data sets on State water resources from the Department of Water Resources. We used tools identified in Exhibit C such as the Climate Change Indicators, Climate Assessments, and Cal-Adapt.

The Rim Fire Environmental Impact Statement provided a wealth of data including ongoing monitoring projects associated with the 2013 Rim Fire. Yosemite National Park is investigating water quality effects of the Fire through long-term monitoring stations. We used data from the local area surrounding the Fire or from similar ecological and economic conditions elsewhere in the Sierra Nevada. Seventy Forest Inventory and Analysis Project (FIA) permanent plots were remeasured after the Fire, providing high quality before and after data at the individual tree level.[1] These data will be analyzed in NDRC Phase 2. The Sierra Nevada Conservancy is collecting data and information to quantify interventions needed to improve health on other forests in the Sierra Nevada. These data will also be included in Phase 2.

In addition to using peer-reviewed data, we communicated with community leaders, stakeholders, the general public, public agencies, and researchers to further understand the threats, hazards, and vulnerabilities associated with the Fire.

By virtue of pertaining to the conditions of the Fire area, these data are considered the most authoritative data available, and the best data for this geographic area. We expect the Program

[1] Fried, Jeremy. 2015. Personal communication. USFS, Inventory and Analysis Unit. Pacific Northwest Research Station, Portland, Oregon.

we develop from this data to be applicable to similar communities over a broad area of California and the western montane states.

Post-Disaster Threats, Hazards, and Vulnerabilities

As stated at the start of this exhibit, the cumulative effects of this complex of problems can be long-lasting and severe; cascading effects persist long after the fire ends, affecting large areas and the local communities within them. This application focuses on a number of post-disaster threats, hazards, and vulnerabilities, including future wildfire, erosion, sedimentation, invasive species, carbon storage, climate change, economic disruption, and air and water quality. The risks associated with these threats and hazards are exacerbated by several underlying vulnerabilities, including the local economy, unemployment, infrastructure inadequacy, and disadvantaged populations. Data to understand these risks are the same as those outlined above.

Known Unknowns: Known unknowns include the magnitude and direction of climate changes and its effect on wildfire patterns (Hurteau and others 2013), the extent and severity of future drought, and the carbon storage capacity of future forests. The spatial variability of climate change is difficult to predict, as the direction and magnitude of changes in temperatures and climate are likely to vary in different locations in ways that are not well modeled or understood.

Who and What are Affected? These threats, hazards, and vulnerabilities are common in communities and watershed across the Sierra Nevada region. Future risks from the threats, hazards, or vulnerabilities include the cumulative effects of repeated large, high-intensity wildfires on local rural economies. Over time and large areas, impacts can include the elimination of resource based companies such as sawmills and contractors. Capacity for resilience and adaptation is strongly influenced by the size and diversity of a community's economic base.

Magnitude and Likelihood of Risks: Wildfire, drought, water quality and quantity impairment, carbon storage and climate change, and air quality are all real risks that can prove devastating to rural communities.

Addressing Threats and Hazards to Meet Unmet Recovery Needs: Proactive investments in reducing fuel loads in the forest will reduce future fire suppression costs. These savings can then be made available to protect resources with cultural and natural conservation values, to restore forests to a natural fire cycle, and for further tree removal and fuel load reduction. The proposed Program can reduce fire risk by helping low- and moderate-income homeowners and small businesses by removing vegetation to create and maintain 100-foot fire buffers around structures. Wood products from these thinning activities can provide an ongoing source of raw materials for sustainable forest product businesses such as biomass energy. These businesses can drive economic recovery and stability and support local employment in rural areas.

Disproportionate Impacts: As mentioned at the start of this Exhibit, wildfire poses significant public health risks, especially to the elderly, children, and the infirm. The economic impacts disproportionately affect workers in tourism, recreation, and service industries, as well as the timber and wood products industries. The burn area also included tribal lands, historic sites, and other areas of cultural significance.

Importance of Addressing This Risk to the State, Region, and Local Community: By addressing recovery and resilience, forests and water, economy and health simultaneously, we can implement a Program that has utility to forested watersheds in the State and the West. The Program has the potential to magnify impacts well beyond the burn area (Appendix E, page 98).

Existing Conditions that Exacerbate Risk and Vulnerability: California is in the fourth year of a prolonged drought. The drought continues to have a negative impact on sectors such as

agriculture, forestry, and tourism, typically important parts of local economies. The lack of diversity and concentration of resource-dependent industries makes local rural communities highly susceptible to the negative impacts of natural disasters such as the Fire.

Ongoing Work to Address Risks and Barriers to Solution: Tuolumne County has a number of organizations in place that are working to boost the resilience of the region to wildfires and the resulting infrastructure and economic damage. This includes two FireSafe Councils, which work with homeowners and businesses to develop resilience strategies. The Southwest Interface Team (SWIFT) is a bi-county collaboration that has worked to develop and maintain a set of strategic firebreaks to protect communities, timber resources, and other vital assets in the region. These efforts provide strong starting points for this work and need to be complemented by investments in additional forest management activities and infrastructure investment to build the region's resilience.

The Stanislaus National Forest has embarked on a significant program of timber salvage, reforestation, and rehabilitation after the Fire burned material has been removed, to the extent allowed by existing budgets–though more is needed. In these cleared areas, work is under way to prepare and replant. CAL FIRE continues to implement fuels reduction projects in cooperation with private landowners to reduce fire impacts.

Rehabilitation and prevention of wildfires are usually limited by budgets, the availability of a trained work force, and adequate infrastructure such as sawmills and bioenergy plants. The Program is capitalizing on ongoing work and building new partnerships to overcome these barriers.