**2008 BUTTE FIRES**
**CA-CDF-000593**

**September, 2008**

**State Emergency Assessment Team (SEAT)**

**Affecting Watersheds in Butte, Plumas and Tehama Counties California**

**DRAFT**

# Executive Summary

**2008 Butte Fires CA-CDF-000539**
Affecting watersheds in Butte, Plumas and Tehama Counties, California

## Introduction

On June 10, 2008, the 1,001 acre Ophir Fire started in the Southwestern portion of Butte County and began a series of fires that the SEAT team would eventually refer to as the "2008 Butte Fires". Within this progression of fires, the Humboldt Fire, at 23,333 acres, started on June 11, 2008. The Humboldt Fire was followed by a significant lightning storm that impacted the region throughout Northern California on June 23, 2008, resulting in 38 new fires for a total of 89,440 acres in Butte, Plumas and Tehama Counties. On August 3, 2008, the Craig Fire started in Butte County and burned an additional 1,999 acres, bringing the total number of fires to 41, for a combined total of 115,773 acres. In addition to this significant acreage burned, there were 182 homes destroyed and another 51 damaged.

Both a Federally sponsored interagency Burned Area Emergency Response (BAER) team, dispatched on July 5, 2008, and a Multi-agency State Emergency Assessment Team (SEAT), under the direction of The Office of Emergency Services (OES), deployed On September 11, 2008, were tasked with assessing their respective areas of jurisdiction encompassed within the 2008 Butte Fires. The reports produced by these two teams overlap between state (SRA) and federal responsibility areas (FRA).

The following report addresses SRA directly impacted by the fire and impacts on adjacent lands where other values at risk may be threatened as a result of the fire complex. Once the values at risk and potential impacts were identified for only those fires where they were found to exist, the team was then tasked with making both general and specific recommendations to avoid or mitigate impacts related to public life, safety, health, and/or the environment.

## Goals of the Team

The key objectives were:

- To identify on-site and downstream threats to public health and safety and to personal property and improvements from land sliding, debris torrents, flooding, road hazards, tree hazards and other fire induced problems, and

- To identify threats to watershed resources, including: excessive erosion, impaired water quality; threats to wildlife, fisheries, and botanical values; cultural resources and recreational opportunities arising from fire effects; and human related impacts from fire suppression activities (e.g. fire line construction) or increased access now available...

## Recommendation

State specialists were assigned to the SEAT with expertise in geology, hydrology, civil engineering, forestry, fisheries biology, wildlife biology, botany, and archaeology. Specialists' reports included both general as well a specific mitigating recommendations. Final recommendations are included near the end of the report (See Table of Contents); of these similar recommendations amongst the SEAT members were combined to reduce redundancy.

## Final Draft Report

On September 26, 2008, the team had completed all of their assessment and produced their final draft report to present to OES, which follows this summary.

## Disclaimer

The scope of the assessment and the information contained in this report should not be construed to be either comprehensive or conclusive, or to address all possible impacts that might be ascribed to the fire effect. Post fire effects in each area are unique and subject to a variety of physical and climatic factors which cannot be accurately predicted. The information in this report was developed from cursory field examination by licensed resource professionals and should be viewed in conjunction with other relevant sources of information. Neither the State of California or any other Agency or Department participating as a member of the State Emergency Assessment Team (SEAT) makes any warranty, express or implied, nor assume any legal liability for the information disclosed herein.

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# BUTTE STATE EMERGENCY ASSESSMENT TEAM (SEAT) REPORT, SEPTEMBER 2008

**2008 Butte Fires CA-CDF-000539**
Affecting watersheds in Butte, Plumas and Tehama Counties, California

## INTRODUCTION

The State Agency Emergency Assessment Team (SEAT) was deployed to Butte County to evaluate values at risk in the affected burn areas of fires included within the 2008 Butte Fires.

Post-fire assessments are conducted by the SEAT to:

- Identify on-site and downstream threats to public health and safety and to personal property and improvements from land sliding, debris torrents, flooding, road hazards, tree hazards and other fire induced problems.

- Identify threats to watershed resources, including: excessive erosion; impaired water quality; threats to wildlife, fisheries, and botanical values; cultural resources and recreational opportunities arising from fire effects and contributing human related impact such as increased access now available from loss of vegetation and along newly constructed fire lines.

- Determine measures needed to prevent or mitigate identified threats.

Note: Although not tasked with assessing the Suppression Repair efforts after the fires, the team did note where items of repair may still be necessary and will provide their locations to the responsible agency.

SEAT Technical Specialists conducted surveys on substantial portions of the burned areas consistent with these objectives. These surveys were used in conjunction with other relevant, reliable sources of information to assess if emergency rehabilitation treatment is needed to mitigate or prevent threats to human life, loss or damage to property and infrastructure, or damage to the environment.

## SETTING

The 2008 Butte Fires encompass areas scattered throughout Butte County, southeastern Tehama County, and western Plumas County (Map #1, Appendix III). The majority of the fires are located east of Chico and north of Oroville. The topography ranges from relatively flat to undulating ground within the Sacramento Valley, gentle to steep ground, but of low

relief, located within the foothills immediately east of the Sacramento Valley, to rugged terrain of moderate to high relief within the mountains of the Sierra Nevada.

The fires are within the Northern Sacramento River Basin and are drained by portions of Big Chico Creek, Butte Creek, North Fork Feather River, and Middle Fork Feather River.

Access to the fires is provided by main State Highways, rural County roads, and private logging roads. The State Highways, from north to south, include: Highway 32, Highway 99, Highway 191, Highway 70, and Highway 162. Additional access is provided by the Union Pacific Railroad, which parallels Highway 70 along the North Fork Feather River.

The fires generally occur adjacent to or overlap the communities of Paradise, Magalia, Concow, Deadwood, Stirling City, and Oroville. Also included are rural developments that are not associated with any city or town hub. Western Paradise, Ophir, and Concow, were the most impacted communities by the loss of numerous residential structures among them.

## FIRE HISTORY

On June 10, 2008, the 1,001 acre Ophir Fire started in the southwestern portion of Butte County, the first of a string of 41 fires that this SEAT team would eventually refer to as the "2008 Butte Fires". This fire was a rapidly spreading, wind driven grass fire that destroyed several homes and was essentially contained the same day. After the Ophir, the Humboldt fire, at 23,333 acres, started on June 11, 2008, followed by a significant lightning event occurring throughout Northern California on June 23, 2008, which resulted in 38 new fires, for a total of 89,440 acres in Butte, Plumas and Tehama counties. Lastly the Craig Fire, at 1,999 acres, started on August 3, 2008 in Butte County, originating from a structure fire. Of the lightning fires started, the majority were quickly contained. However, some grew to become large fires on their own, while others grew together and became larger fire complexes, including the Butte and Canyon complexes, which took several weeks to contain with CAL FIRE and the USDA Forest Service (USFS) still putting out hot spots up to the day of the completion of this team's assessment.

Along with the acreage burned, the loss of homes, structures, and other property was significant. The number of homes destroyed or damaged for each fire includes:

1. Ophir Fire-1 damaged, 17 destroyed.
2. Camp Fire-4 damaged, 105 destroyed.
3. Humboldt-46 damaged, 68 destroyed.
4. Friend-Darnell Fire- 1 destroyed.
5. Craig Fire- 1 destroyed.

A Federally sponsored interagency Burned Area Emergency Response (BAER) team was dispatched on July 5, 2008 to the Butte Lightning Complex, which included the Butte Complex and Canyon Complex. The BAER team was not responsible for three man-caused fires that included the Ophir, Humboldt and Craig fires. Their final report was completed and approved on September 18, 2008.

On September 11, 2008, the SEAT was deployed to further assess the 2008 Butte Fires with a focus on areas that were not fully assessed during the BAER effort, or that were primarily in State Responsibility Areas (SRA) outside of the scope of the BAER Team.

## AREA OF INVESTIGATION

Altogether the 2008 Butte Fires include a total of 41 individual fires that amount to approximately 115,773 burned acres within Butte, Tehama and Plumas Counties (Map #1, Appendix III). The Cold Fire, located in central Plumas County, is not shown on Map #1. After discussing each fire with CAL FIRE personnel knowledgeable with each fire setting and performing a desktop review of available resources, including aerial photos, soil survey data, topographic and geologic maps, and the USFS BEAR report, several of the smaller, outlying fires located away from recognized roads, anadroumous fisheries, and human development, were eliminated. Through this process, the original 41 fires were reduced to 8 fires that required more detailed assessments to be performed. (See Appendix III for a list of all 41 fires) The 8 fires include the: Humboldt, Belden, Camp, Friend-Darnell, Craig, Smokey, Inskip, and Breakneck. The following is a list of each fire and the amount of area burned.

**Table 1 – List of Fires Assessed and Acreage**

| Fire | Acreage Burned | Fire | Acreage Burned |
|---|---|---|---|
| Humboldt | 23,333 | Craig | 1,999 |
| Belden | 474 | Smokey | 1,324 |
| Camp | 49,643 | Inskip | 104 |
| Friend-Darnell | 3,845 | Breakneck | 771 |

## METHOD APPROACH

The SEAT is composed of professionals spanning a multitude of disciplines related to the physical sciences, engineering, and archeology. The Disciplines integrated in this assessment, included: geology, hydrology, civil engineering, forestry, fisheries biology, wildlife biology, botany, and archaeology. A complete list of individual members is provided in the following section.

The SEAT methodology included:

1. Discussing the fire areas with fire suppression personnel familiar with the fires from both Cal Fire and the USFS;
2. Performing a literature review of available maps and documents that included:
    - Topographic maps,
    - Geologic maps,
    - Soils maps,
    - Vegetation maps,
    - Burn intensity maps,
    - Fire history maps, and

- The USFS BAER report (BAER, 2008).

3. Conducting interviews with local stakeholders, including local residences of Concow, private landowners, and State and Federal agencies. A complete list of stakeholders is provided in Appendix II.
4. Performing aerial and ground reconnaissance of the fire areas.
5. Discussing the areas identified at risk due to the fires and compiling this report.

Geographical Information System (GIS) mapping and analyses aided the SEAT members in focusing on areas of concern and potential risks. Maps identifying the fire perimeters, responsible fire protection agencies (SRA), Burned Area Reflectance Classification (BARC), geology, watershed divides, soil type, vegetation cover type, and fire history are located in Appendix III. In addition, summary tables listing acreages for fires, SRA, BARC, soil types, and burned watersheds, and stream lengths for burned waterways are located in Appendix III.

## SEAT MEMBERS

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## STAKE HOLDERS

As discussed, members of the community, private entities, and members of State and Federal Agencies were contacted to elevate the awareness of the SEAT and to develop a list of concerns that should be addressed by the SEAT. A list of individuals the SEAT contacted is provided in Appendix II. In addition to the individuals listed, the SEAT team attended a community meeting hosted by the Butte Fire-Safe council on September 11, 2008 to discuss the concerns of fire impacted areas with members of the Concow community.

## FIELD SURVEY

The fire areas were evaluated from the air using a helicopter provided by Cal Fire on September 12, 2008 and September 13, 2008. These overview flights were followed by ground inspections performed on September 14, 2008 through September 22, 2008. The ground inspections were limited to driving the main roads within the fire areas. Representative photos of burn areas taken during the field survey are included in Appendix IV.

## FIRE EFFECTS and VALUES AT RISK – OVERVIEW

Landscapes subjected to fire have an increased potential for in-channel floods, debris slides, flows, landslides, sediment erosion, instability in stands of damaged or dead trees, movement of large and small woody debris and loss or destruction of wildlife, cultural and historical resources, recreational opportunities, and ecosystems including riparian, aquatic,

and upland forests, to name a few. The basic mechanisms behind these fire effects on these and specific resources are due to:

- The loss of vegetative cover resulting in:
    a. Increases in surface water runoff, and soil saturation;
    b. Reduction of concealment for wildlife, shade for fisheries, or for hiding cultural resources from human destruction;
    c. Reduction of plant root strength for hill slope support; and
    d. Increased potential for ingress by man activities;
- Loss of organic surface layers:
    a. Reducing infiltration due to the removal of duff; and
    b. Increasing the dehydration of the underlying soils;
- Development of hydrophobic soils, increasing the potential for sheet erosion;
- The simplification of surficial runoff patterns;
- The loss of timber stands:
    a. Increasing the threats from dead, dying or down trees;
    b. Increasing insect and disease activities resulting in further loss of this valuable resource;
    c. Increasing the mobilization of large and small woody debris during high water flow events; and
    d. Increasing the impacts of wind events on trees or timber stands left standing;
- Disruption of natural drainage patterns and aggregations of soil materials from fire suppression activities;
- Introduction of hazardous materials and debris from fire impacted structures.

These fire-related impacts can adversely affect "values at risk", which are broadly defined as human life, property, and natural resources. Broken out by discipline, the following provides general information of recognized fire effects that could adversely impact identified values at risk within the fires assessed.

**Geology**

The eight fires assessed are spread over a large geographic area and occur within two geomorphic provinces, including the Sierra Nevada and the Cascade Range (CGS Note 36). Each of these geomorphic provinces have unique geologic, climatic, and topographic characteristics that demonstrate varying conditions of geologic concern related to excessive soil erosion, landslides, rock fall and debris torrents. Such geologic concerns are identified throughout the burned areas assessed, and are adversely impacted by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss of vegetative cover.

The identified risks associated with fire-induced geologic factors, such as landsliding, debris flows, rock fall, and floods, include: 1) the possible loss of life and infrastructure related to roads and structures located adjacent to and down gradient of watercourses and

landslide prone slopes; 2) the loss of infrastructure related to local roads, bridges, railroad tracks, and domestic water supply sources; and 3) the loss of natural resources related to excessive sediment and debris entering local watercourses and reservoirs.

**Hydrology**

Areas affected by the fires assessed drain portions of the Sacramento River Basin. Surface water bodies directly impacted by the fires include small portions of Big Chico Creek, Butte Creek, North Fork Feather River, Middle Fork Feather River (i.e., Little Last Chance Creek to Lake Oroville), and Lake Oroville. Beneficial uses for these impacted water bodies include: 1) municipal and domestic water supply; 2) agriculture (e.g., irrigation and stock watering); 3) power generation; 4) contact and non-contact recreation; 5) warm and cold freshwater habitats; 6) warm and coldwater migration; 7) warm and coldwater spawning habitat; and 8) wildlife habitat (CVRWQCB, 2007).

The primary water quality constituents affected by these fires include color, sediment, settleable material, suspended material, and turbidity. Fire-induced increases in mass wasting, increases in peak flow, and extensive tree mortality can result in increases in floating material, primarily in the form of large woody debris. Post fire delivery of organic debris to stream channels can potentially decrease dissolved oxygen concentrations in streams. Fire-induced mortality within riparian zones can lead to stream temperature increases. Fire-derived ash inputs can increase pH, alkalinity, conductivity, and nutrient flux (e.g. ammonium, nitrate, phosphate, and potassium). Post fire increases in runoff and sedimentation within the urban interface may also lead to increases in chemical constituents, oil/grease, and pesticides.

**Engineering**

The principal concern within the fires assessed is the increased potential for in-channel floods, surface erosion of hillsides that border residences and creeks, and debris flows which could result in plugging of drainage features and damage to bridges and railroads.

The risk to the water resources of the Concow reservoir is a concern to the community of Concow and the surrounding communities. Sediment deposits in stream courses will likely increase nutrients and loss of capacity in Concow reservoir. Because Concow reservoir is a municipal water supply that diverts water into Lake Oroville, the potential threat to water quality as a vital resource to the State Water Project at Lake Oroville is of particular concern.

**Forestry**

There is a wide variety of vegetation types within the fire areas. They range from Sierra Mixed Conifer forests, Ponderosa Pine, to Montane Hardwood-Conifer, Mixed Oak woodland, Mixed Chaparral, and Annual Grassland.

The conifer forests associated with these fires had a range of effects from low to high. Those portions of forest that the fire burned from moderate to high have the most risk associated to them. These effects can be attributed to the pre-fire heavy fuel loads, low fuel moisture levels, low humidity's, high temperatures, aspect, slope, direction of the burn (upslope or backing downslope) and various wind events experienced in these areas. The North Camp and Belden fires also burned through portions on the 2001 Storrie Fire area with the resulting effect of this re-burning most likely delaying the recovery of the timber stands in these areas.

Fire injuries sustained to trees that were not directly killed, particularly within areas of low burn intensity where fires backed down slope, can have a longer lasting impact on tree health and may contribute to mortality beyond this time frame, especially when combined with other stressors such as drought, insects, rot and windthrow.

Although continued loss of these valuable and scenic forests stands will most definitely be a significant loss for both environmental and economic concerns, secondary effects will be felt where dead and damaged trees around homes, outbuildings, driveways, frequently traveled roads, and other improvements will continue to weaken and will become a risk to life, safety, and property. In addition, increased fuel loads due to lack of post fire management could lead to increased risk for future catastrophic fire and increased resistance to control from increased standing and downed large woody debris.

Further, the immediate and long term loss of these forested landscapes on the other resources at risk can be perpetuated or compounded where either lack of immediate or long term management to reestablish these forests results in their converting to competing non-forested vegetation that is more prone to catastrophic fires or where human development takes advantage of the removal of these stands by the fire and coverts these areas to other uses.

Note: The following is a brief description of the team's need to address concerns raised over this significant post fire activity occurring in many of the burned over timber stands within the fire areas and where addressing it under any other section of this report would not have highlighted its importance.

Timber harvesting to capture the value of burned over timber stands post fire is occurring over significant number of acres in many of the fire areas. The resulting cumulative impacts on the resources and to infrastructure such as roads and drainage facilities were not part of the team's mission to address. But the team did consult with the local Butte Forest Practice inspector, Jim McDaniel to determine if impacts when added to the impact caused by the fires would be a concern. Through the interdisciplinary review of these harvesting operations, the recommendations provided by them as well as from Mr. McDaniel along with the Licensed Timber Operators (LTO) also following the State Forest Practice Rules, impacts should reduced and not contribute significantly to those impacts addressed by SEAT. In addition, measures were observed on the ground, such as ripping cleared areas for replanting will help in the infiltration of rainfall thus reducing runoff.

## Fisheries

During the 2008 Butte Fires, forested slopes were destroyed of covering vegetation. Interception of precipitation by plant foliage breaks the impact of raindrops on the ground and prevents puddling and causes erosion of the soils. This increases the potential for surface erosion and mass soil movement. The resulting debris and sediments block streams and smother spawning beds, fish eggs, and young fish. The quality of water is lowered by the addition of soil particles, ash from burning, and organic material. When organic material decomposes it consumes the oxygen in the water and releases carbon dioxide which can kill aquatic organisms. Reduced vegetation cover causes faster runoff, higher peak flows, and more erosion. These factors combined, compromise the ability of fish and other aquatic organisms to succeed at each stage of their life history.

Because disturbances by fire are a fundamental characteristic of aquatic ecosystems, many species have evolved life history strategies to deal with post fire effects. Consequently, many species will recover. However, there is a low to moderate threat to aquatic species of special concern throughout the 2008 Butte Fires and an elevated concern for Threatened and Impaired species in the Butte Creek and Big Chico Creek drainages.

## Wildlife

The 2008 Butte Fires burned 56,944 acres under State responsibility including valuable upland and lowland habitat types that supported numerous sensitive species. It is nearly certain that significant amounts of mammals, birds, reptiles, amphibians, and even insects perished or lost important habitat in the fires. However, many species were likely able to move out of the way of the approaching fires to areas that were not burned or they found shelter in moist areas such as streams or creeks, underground, or even in large rocky outcrops and caves. Also, not all of the habitat within the fire perimeter was burned, and a significant amount within the State responsibility lands burned in a low intensity mosaic pattern, probably providing long-term habitat improvement to many native wildlife species.

Most of these vegetation communities that were affected have evolved with periodic fires and may naturally regenerate within a few years. Many wildlife species dependent on this habitat, including the endangered species, and have also evolved to live in a fire-adapted ecosystem and over time they are likely to recover.

## Botany

Many non-native plants are found in California wildlands, but some are much more invasive and noxious than others. Invasive weeds are very effective at occupying disturbed soil and displacing native plants and habitat. Non-native invasive weeds have the potential to displace native vegetation, degrade habitat function, and lower ecosystem stability. Ecological stability relates to the value of native plant communities for wildlife habitat and watershed function.

The potential values at risk, in relation to invasive noxious weeds are the ecological stability of native plant communities and the degradation of Region 5 Sensitive plant habitat. The 2008 Butte fires impacted a variety of different plant communities and environments. The majority of the fire area can be classified as mixed conifer forest.

The unknowing introduction of invasive noxious weeds into areas disturbed by fire suppression and rehabilitation has the potential to establish persistent weed populations. These persistent populations could affect the structure and habitat function of plant communities within the burn area.

Botanical values that are at risk include special status plant species and natural communities. The special status plants and natural communities should recover from the fires naturally. Therefore, post-fire human activities and not the fires by themselves present the greatest threats due to the potential for damaging riparian vegetation, inhibiting regeneration of native plants, and introducing invasive weeds.

**Archeology**

Previous archaeological survey and other work in the areas affected by the 2008 Butte Fires have demonstrated the presence of an extensive array of different cultural resources in the areas affected. Many of these are historically or scientifically significant and are resources that deserve attention toward protection before, during, and after wild fires. These kinds of resources are becoming increasingly scarce in forested settings where catastrophic fires can and do occur. The main post-fire threats would come from similar risks in this report identified for property and infrastructure along with increased risk of disturbance and destruction from human activities now that the fire have made these site more accessible.

## VALUES AT RISK – DETAILED

The following is a summary of both general and site-specific values at risk that were identified by the SEAT. Included in the discussion of each value at risk is a qualitative ranked from low, moderate, to high. A low ranking means there is a possibility of occurrence, a moderate ranking means the event is likely, and a high ranking means that there is a near inevitability of the event or effect occurring. These rankings do not rate the severity of an event or the resulting level of damage, only the likelihood of occurrence. Most threats arise from pre-existing conditions exacerbated by fire effects thus elevating the risk, although some are directly attributable to fire effect alone. For a complete discussion of both the general and site-specific values at risk summarized here, please refer to the attached Technical Specialists Reports within Appendix I.

**General values at risk**

- **Road Drainage; Rank, High:** Several culverted road crossings were observed along the main road systems within the burn areas associated with the Humboldt,

Camp, and Friend-Darnell fires. Many of the culverts observed do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the fire. As a result, the capacity of the culverts within the entire burn area are interpreted to have a moderate to high risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that are not conditioned to handle such flows. The net result being a loss in access, capital expenses related to repairing the failed crossings, and increased sediment entering the local watercourses.

In addition to the culverts being insufficiently sized, several roads constructed with inboard ditches and cross drains were observed within the Humboldt, Camp, and Friend-Darnell fires. Due to the increased runoff anticipated from the burned slopes, it is unlikely that the current spacing between the cross-drains is sufficient, resulting in excessive erosion of the inboard ditch and the potential for the cross-drains to be overwhelmed by debris and flows. This scenario has the same adverse affects as described above for culvert crossings.

- **Residential Structures; Rank, High:** The Concow area within the Camp Fire and portions of the Humboldt, Friend-Darnell, and Craig Fires contain community developments or isolated residences that are dispersed across the landscape. Structures within these communities/fires that reside adjacent to or within swales, watercourses, represent a potential risk that they could be impacted by excessive, fire-induced debris flows, slides, and flooding.

- **Post Fire Hazardous Materials; Rank, Low:** Hazardous contaminants and household debris left in the wake of burned out homes present a risk to local ecosystems and water quality. The area most affected by this is the community of Concow, located in the Camp Fire, which drains into the West Branch Feather River.

- **Forest Ecosystem; Rank, High:** Conifer stands within the fire areas are at risk of post-fire mortality resulting from bug infestation. In addition, increased fuel load due to lack of post fire management could lead to increased risk for future catastrophic fire and increased resistance to control from increased standing and downed large woody debris.

- **Hazard Trees; Rank, High:** Dead and damaged trees around homes, outbuildings, driveways, frequently traveled roads, and other improvements will continue to weaken and will become a risk to life, safety, and property.

- **Fisheries; Rank, Moderate:** Out of the eight fires assessed, the classes of species identified at risk were fish, amphibian and aquatic invertebrates. The following specific species were identified for the Humboldt Fire to be at risk: spring-run Chinook salmon, Central Valley steelhead, western pond turtle, and foothill yellow-

legged frog. Fire-induced sediment and organic materials entering these watercourses can adversely impact fish and other aquatic species.

- **Botanical Impacts; Rank, Low:** Emergencies to botanical resources is related to the loss of natural community integrity due to potential spread of invasive weeds from post-fire effects.

- **Archeological Impacts; Rank, Moderate:** The Butte Fires have put a number of cultural properties at risk. Most of that risk is of a generic potential for subsequent events that might damage or otherwise alter these resources. Some of those generic risks to which many site locations are now exposed include:
    - Accelerated or altered surface erosion due to lack of surface vegetation.
    - Enhanced public access due to loss of vegetation, construction of fire suppression lines, or loss of gates and other means to limit entry.
    - Debris cleanup, which might include removal of cultural artifacts of historical significance.
    - Overzealous brush removal response to fire events that may lead to damage to known or unknown resources.

- **Recreational Impacts; Rank, Moderate:** Recreational opportunities may be affected or curtailed due to losses in infrastructure (e.g. trails, roads, and campgrounds) and impacts to wildlife and the environment (e.g. upland wildlife and fish habitat, navigable waterways, and general water quality).

**Site-specific values at risk**

Site-specific values at risk were identified in the field as areas where discrete fire-related impacts to values at risk were recognized. Included in this are areas with particular concern that present high levels of risk, such as road segments, rivers, and railroad tracts that are long linear features on the landscape. The locations of these features are identified on Detail Map #1-6 in Appendix III. Table 2 lists the co-ordinances for each feature, where applicable, and their level of risk.

- **Point H-1; Rank, High:** H-1 is a segment of road along Centerville Road that is at risk of debris slides and rock fall.
- **Point B-1; Rank, High:** B-1 is a box culvert that spans Little Indian Creek and is at risk of being impacted by debris flows and flooding
- **Point B-2; Rank, High:** B-2 is a Highway 70 bridge that spans Chips Creek that is at risk of being impacted by debris flows and flooding
- **Point B-3; Rank, high:** B-3 includes a trailer park and other outbuildings located at the mouth of Little Indian Creek that are at risk of debris flows and flooding.
- **Point NC-1; Rank, Moderate:** NC-1 is a water supply intake for the community of Tobin, California. Field evidence indicates that this intake has a moderate risk of being impacted by slide debris and sediment.

- **Point SC-1; Rank, High:** SC-1 is a cabin founded on an alluvial/colluvial fan deposit adjacent to Flea Valley Creek that is at risk of being impacted by debris flows and flooding.
- **Point SC-2; Rank, Moderate:** SC-2 includes an arch culvert crossing and several cabins located immediately down gradient of the crossing that are within the channel zone of Flea Valley Creek. The culvert and cabins are at risk of debris flows and flooding.
- **Point SC-3; Rank, Moderate:** SC-3 is a railroad bridge that spans Flea Valley Creek and has a moderate risk of being impacted by debris and flooding.
- **Point SC-4; Rank, High:** Segments of the Pulga access road have a high risk of being impacted by debris slides and rock fall.
- **Point SC-5; Rank, Moderate:** SC-5 is the Concow Reservoir, which is at risk of increased sedimentation, flooding, and wood debris entering the reservoir.
- **Point SC-6; Rank, Moderate:** SC-6 is a box culvert that spans a tributary of Concow Reservoir and is at risk of being impacted by wood debris and flooding.
- **Point SC-7; Rank, Moderate:** SC-7 is a PG&E power line tower that is at risk of failing due to increased slide activity.
- **Point FD-1; Rank, Moderate:** FD-1 is a residence founded on an alluvial/colluvial fan deposit adjacent to Bean Creek that is at risk of being impacted by debris flows and flooding.
- **Point FD-2; Rank, Moderate:** FD-2 is a surface water diversion located within Bean Creek that is at risk of being damaged by debris flows and flooding.
- **Point FD-3; Rank, Moderate:** FD-3 is a box culvert that spans Bean Creek and is at risk of being impacted by debris flows and flooding.
- **Point FD-4; Rank, Moderate:** FD-4 is a box culvert that spans Bean Creek and is at risk of being impacted by debris flows and flooding.
- **Highway 70; Rank, High:** Segments of Highway 70 located beneath fire-impacted slopes have a high risk of being impacted by debris slides, flooding, and rock fall.
- **Union Pacific Railroad; Rank, High:** Segments of the Union Pacific Railroad that parallels Highway 70 and the North Fork Feather River is at risk of being impacted by debris slides/flows, flooding, and rock fall.
- **PG&E Access Road; Rank, High:** Segments of a PG&E access road to high voltage power lines within the North Fork Feather River corridor are at risk of being impacted by debris slides/flows, flooding, and rock fall.
- **PG&E Reservoirs; Rank, Moderate:** PG&E reservoirs within the North Fork Feather River are at risk of increased sedimentation, flooding, and woody debris.

## RECOMMENDATION

The following provides a summary of recommendations to reduce the potential adverse affects posed by the fires. Included are both general and site-specific recommendations addressing values at risk. For a complete discussion of the recommendations summarized here, please refer to the attached Technical Specialists Reports in Appendix I. Table 2 provides an abbreviated summary of the recommendations.

**General values at risk**

- **Road Drainage; Rank, High:** The controlling agency/owner of the roads within the burn area is encouraged to perform additional analyses to assess the capacity of each culvert or cross drain and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings within and down gradient of the burn area.

  Site-specific analyses should be performed by the controlling agency/owner to assess the potential impacts from debris torrents, debris flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings within and down gradient of the burn area. The controlling agency/owner is encouraged to include the State Resource Water Quality Control Board and Fish and Game in the review and prioritization of the culverts.

  It is recommended that the appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings within and immediately down gradient of the burn area. Activities that are recommended to be incorporated in the monitoring and maintenance program include:

  (a) Performing inspections during the winter months, particularly after heavy rain storms;
  (b) Remove any material collected in the pipe that reduces its capacity; and
  (c) Remove debris within the channel immediately up gradient of the pipe to reduce subsequent plugging potential.

  Depending on the circumstances behind suspect crossings that are determined to have a high risk of failure, treatments that could be applied, include:

  (a) Replacing the culvert with a rock-lined ford;
  (b) Replacing the culvert with an appropriately sized culvert;
  (c) Installing a relief culvert;
  (d) Installing a debris rack or stand pipe on the existing culvert; and
  Constructing a critical dip to divert flow back into the channel as soon as possible (See Geology Technical Specialist Reports).

- **Residential Structures; Rank, High:** Site-specific analyses are recommended to evaluate and address residences located within, or immediately adjacent to, drainage ways (e.g. rivers, streams, channels, swales, etc.) that are below fire-impacted areas. The analyses should include evaluating the risk of increased flows and debris emanating from burned areas, and provide engineered solutions, as required (See Geology Technical Specialist Reports).

- **Post Fire Hazardous Materials; Rank, Low:** Responsible agencies should specifically assess the need for cleanup of household and industrial waste within the Concow Reservoir watershed. Prioritization should be given to cleaning up waste

adjacent to stream channels and in convergent areas (See Hydrology Technical Specialist Report).

- **Forest Ecosystem; Rank, High:** Landowners and property managers need to evaluate existing stands of conifer forests to determine current mortality as well as future mortality. Trees that have been damaged but have not been killed by the fires should be also evaluated due to the inherent risk of bark beetle attack over the next one to three years. Areas that have increased mortality should be considered for fire salvage or other harvesting methods, including biomass where practical. Harvest activities should provide some snag retention for wild life habitat and large woody debris recruitment to local watercourse (See Forestry and Wildlife Technical Specialist Reports).

- **Hazard Trees; Rank, High:** Landowners and property managers need to be aware and monitor the increased mortality that will continue for the next several years. Areas of most concern are adjacent to homes, outbuildings, driveways, frequently traveled roads, and other improvements. During strong wind events awareness and caution should be elevated when around weakened trees (See Forestry Technical Specialist Report).

- **Fisheries; Rank, Moderate:** Recommendations include:
  - Butte Creek should be visually monitored for water quality impacts (e.g. increased turbidity) during the early part of the wet season when precipitation intensity exceeds 0.5 inches per hour (see http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=PDE). If elevated turbidity is present in Butte Creek, hydrologically connected roadside ditches should be inspected for sediment laden water. To mitigate potential drainage impacts from roads see: http://ntl.bts.gov/lib/24000/24600/24650/Chapters/I_Ch7_Drainage_of_Low_Volume_Roads.pdf
  - Educational outreach and signage should be used to inform OHV users of potential water quality impacts from OHV traffic on abandoned firelines. Furthermore, placing barriers at access points to the firelines can minimize water quality impacts from the OHV traffic.
  - Landowners interested in preventing soil erosion on their property should apply at least 70% ground cover to the soil surface. Ground cover should consist of USDA certified weed free straw or biomassed native vegetation (See Fisheries and Hydrologist Technical Specialist Reports).

- **Botanical Impacts, Rank, Low:** Recommendations include:
  - Monitoring;
  - Survey special status plant populations;
  - Erosion control on selected bulldozer lines; and
  - Surveys for invasive weeds in key areas and prompt weed control (See Botany Technical Specialist Reports).

- **Archeological Resources; Rank, High:** Mitigation of the potential risks to archeology would involve:
    - Informing landowners of the potential or the actual existence of any cultural resources that may exist on their properties to promote their stewardship and reduce the threats to the resource;
    - Re-establish vegetation or provide other erosion control measures where appropriate,
    - Block or reduce public access to critical resources, and
    - Monitor subsequent activity in sensitive locations.

- **Recreational Impacts; Rank, Moderate:** The impacts to recreational activities and the controllable factors that affect them are addressed through implementing recommendations above for factors impacting infrastructure and resources. The recreation managers should make themselves aware of these hazards identified and either curtail use or close facilities or improvements during periods when potential threats identified will occur or after damages result and have not been repaired. Where dead or dying trees pose a hazard, they should be removed and in the case of navigable waters, boaters need to be made aware of the potential to encounter floating large woody debris. This debris should be removed or corralled after storm events when and where feasible.

**Site-specific values at risk**

- **Point H-1; Centerville Road:** To reduce the potential impacts, it is recommended that the controlling agency monitor the road for increased rock fall and debris slide hazards. As required, perform increased maintenance to remove accumulated debris and place signage warning travelers of the hazard.
- **Point B-1; Box Culvert, Little Indian Creek:** Recommendations include performing monitoring during the winter months, re-configuration an existing debris rack, and maintaining the inlet to the culvert and up gradient channel to maximize the structures capacity to convey debris and flows (see Geologist and Engineering Technical Specialist Reports).
- **Point B-2; Box Culvert, Chips Creek:** Recommendations include performing monitoring during the winter months, re-configuration an existing debris rack, and maintaining the inlet to the culvert and up gradient channel to maximize the structures capacity to convey debris and flows (see Geologist and Engineering Technical Specialist Reports).
- **Point B-3; Trailer Park, Little Indian Creek:** Recommendations include removing the trailers from the area during the winter months, monitoring and maintaining the channel system adjacent to and up gradient of the trailer park, and/or engineering and constructing a revetment structure to assist in defecting debris flow material and flood waters away from the structures (see Geologist Technical Specialist Reports).
- **Point NC-1; Tobin Water Supply:** Install a debris deflector, if one isn't present, and monitor and maintain (see Engineering Technical Specialist Reports).

- **Point SC-1; Cabin, Flea Valley Creek:** It is recommended to restrict occupancy during the wet winter and spring months, relocate the structure, install rock slope protection, and monitor and maintain (see Geologist and Engineering Technical Specialist Reports).
- **Point SC-2; Arch Culvert, Flea Valley Creek:** Install debris rack, investigate hydraulic capacity of structure, and monitor and maintain (see Geologist and Engineering Technical Specialist Reports).
- **Point SC-3; Railroad Bridge, Flea Valley Creek:** Install debris rack, investigate hydraulic capacity of structure, and monitor and maintain (see Geologist and Engineering Technical Specialist Reports).
- **Point SC-4; Pulga Access Road:** It is recommended that the controlling agency address drainage structures, as described under the general recommendations, perform increased monitoring and maintenance (see Geologist Technical Specialist Reports), and place signage warning travelers of the hazard, as required.
- **Point SC-5; Concow Reservoir:** Dredge, apply applicable BMPs (see Engineering Technical Specialist Report), and monitor and maintain.
- **Point SC-6; Box Culvert, Trib. to Concow Res.:** Install debris rack, place rock slope protection, investigate hydraulic capacity of structure, and monitor and maintain (see Engineering Technical Specialist Report).
- **Point SC-7; Power line Tower:** Investigate and repair, as required (see Geologist Technical Specialist Report).
- **Point FD-1; Residence, Bean Creek:** It is recommended to restrict occupancy during the wet winter and spring months, relocate the structure, install control measures to re-direct flows and debris, and monitor and maintain (see Geologist Technical Specialist Report).
- **Point FD-2; Water inlet, Bean Creek:** Install screen over the inlet and place large riprap to protect the intake structure (see Geologist and Engineering Technical Specialist Reports).
- **Point FD-3; Culvert, Bean Creek:** Install an early warning system, install a debris rack, and monitor and maintain (see Engineering Technical Specialist Report).
- **Point FD-4; Culvert, Bean Creek:** Install an early warning system, install a debris rack, and monitor and maintain (see Engineering Technical Specialist Report).
- **Highway 70; Affected Segments:** It is recommended that the controlling agency monitor the Highway 70 corridor for increased rock fall and debris slide hazards. As required, perform increased maintenance along problematic road segments to remove the debris and place signage warning travelers of the hazard (see Geologist Technical Specialist Reports).
- **Union Pacific Railroad; Affected Segments:** It is recommended that the controlling agency/owner monitor the railroad corridor for increased rock fall and debris slide hazards. As required, perform increased maintenance along problematic segments (see Geologist Technical Specialist Reports).
- **PG&E Access Road; Affected Segments:** It is recommended that the controlling agency/owner monitor the road for increased rock fall and debris slide hazards. As required, perform increased maintenance along problematic road segments to remove the debris and place signage warning travelers of the hazard (see Geologist Technical Specialist Reports).

## TREATMENT RANKING

In describing each of the site-specific values at risk identified above, the risk of fire-related impacts is qualitatively ranked from low, moderate, to high. In addition, recommendations were made to reduce the potential impacts to life, infrastructure, and resource to acceptable levels. In order to prioritize which value at risk should receive treatment, a qualitative analysis was performed that incorporates both the risk and effectiveness of the proposed recommendations. This analysis was performed for only those sites where site-specific recommendations are made.

The process developed to assist in the prioritization includes the following matrix, which is divided into the overall rank of the potential impact by the level of effectiveness of the proposed recommendations. The three levels of risk include low, moderate, and high, which are defined as unlikely to occur, possible to occur, and almost certain to occur, respectively. The interpreted effectiveness of the proposed recommendations includes both an estimate of the approximate cost and efficiency that the recommendations have in reducing the level of risk. The effectiveness of the proposed recommendations are divided into three levels, which include: poor, good, and very good. These levels are defined as having a low, moderate, and high success rate in improving the overall impacts to the value at risk. The matrix is as follows:

TREATMENT PRIORITIZATION MATRIX

| | | Interpreted Effectiveness of Recommendations | | |
|---|---|---|---|---|
| | | Very Good | Good | Poor |
| Risk To Value at Risk | High | 6 | 5 | 3 |
| | Moderate | 5 | 4 | 2 |
| | Low | 3 | 2 | 1 |

Values at risk that demonstrate the highest priority to treat are those sites that rank 5 or higher; sites that should likely receive treatment rank between 2-4; and sites that should not be considered for treatment include sites that rank between 1-2.

Table 2 lists the values at risk identified and the overall treatment prioritization.

**Table 2 - Sumary of Site-Specific Values at Risk**

| Values At Risk | | Latitude | Longitude | Potential Impact | Recommendations (abbreviated) | Potential Impact Rank | Recommendation Effectiveness | Treatment Priority |
|---|---|---|---|---|---|---|---|---|
| Union Pacific Railroad | Union Pacific Railroad segments beneath fire burned slopes | Not applicable | Not applicable | Debris slides/flows, rock fall | Investigate crossing structures and repair as required, monitor and maintain. | High | Very Good | 6 |
| SC-4 | Pulga access road | 39° 47' 55.99" | 121° 27' 5.06" | Debris slides/flows, rock fall | Investigate crossing structures and repair as required, monitor and maintain, and install signage. | High | Very Good | 6 |
| Highway 70 | Hwy 70 road segments beneath fire burned slopes | Not applicable | Not applicable | Debris slides/flows, rock fall, flooding | Investigate crossing structures and repair as required, monitor and maintain, and install signage. | High | Very Good | 6 |
| SC-6 | Box culvert over tributary to Concow Res. | 39° 46' 52.71" | 121° 30' 19.60" | Debris passage, flooding, scour | Install debris rack rock slope protection, investigate hydraulic capacity, monitor and maintain | Moderate | Very Good | 5 |
| PG&E Access Road | Access road to transmission line corridor within North Fork | Not applicable | Not applicable | Debris slides/flows, rock fall | Investigate crossing structures and repair as required, monitor and maintain. | High | Good | 5 |
| FD-1 | Single-family residence | 39° 37' 44.23" | 121° 19' 45.21" | Debris flows, flooding | Restrict occupancy, relocate, install rock slope protection, monitor and maintain. | Moderate | Very Good | 5 |
| B-3 | Trailer park and ancillary improvements | 40° 0' 25.42" | 121° 15' 48.42" | Debris flows, flooding | Restrict occupancy, relocate, install rock slope protection, monitor and maintain. | High | Good | 5 |
| B-2 | Hwy 70 Bridge over Little Indian Creek | 40° 0' 18.81" | 121° 15' 47.80" | Debris passage, flooding, scour | Reconfigure existing debris rack, monitor and maintain | High | Good | 5 |
| B-1 | Hwy Box culvert over Chips Creek | 40° 0' 1.28" | 121° 16' 13.46" | Debris passage, flooding, scour | Reconfigure existing debris rack, monitor and maintain | High | Good | 5 |
| SC-7 | PG&E power line support tower | 39° 48' 7.74" | 121° 27' 0.28" | Landslides | Investigate and repair, as required. | Moderate | Good | 4 |
| SC-5 | Concow Reservoir | 39° 46' 12.30" | 121° 31' 12.77" | Wood debris, sedimentation, flooding | Dredge, practice BMPs, and monitor and maintain. | Moderate | Bad | 4 |
| SC-3 | Union Pacific Railroad bridge over Flea Valley Creek | 39° 48' 8.67" | 121° 26' 50.56" | Debris passage, flooding, scour | Install debris rack, investigate hydraulic capacity, monitor and maintain. | Low | Good | 4 |
| SC-2 | Arch culvert over Flea Valley Creek and adjacent cabin structures | 39° 48' 13.80" | 121° 27' 1.28" | Debris passage, flooding, scour | Install debris rack, investigate hydraulic capacity, monitor and maintain. | Moderate | Good | 4 |
| SC-1 | Cabin adjacent to Flea Valley Creek | 39° 48' 17.48" | 121° 27' 7.91" | Debris flows, flooding | Restrict occupancy, relocate, install rock slope protection, monitor and maintain. | High | Bad | 4 |
| NC-1 | Tobin water supply intake | 39° 56' 9.87" | 121° 19' 7.19" | Debris flows, sedimentation | Install debris deflector, monitor and maintain | High | Bad | 4 |
| H-1 | Road segment - Centerville Road | 39° 44' 2.47" | 121° 42' 8.11" | Debris slides, rock fall | Monitor, maintain, and install signage. | Moderate | Good | 4 |
| FD-2 | Surface water intake | 39° 37' 21.96" | 121° 19' 38.53" | Debris flows, flooding | Install debris deflector, monitor and maintain | High | Bad | 4 |
| PG&E reservoirs | PG&E power generation reservoirs within North Fork | Not applicable | Not applicable | Wood debris, sedimentation, flooding | Monitor and maintain. | Moderate | Bad | 3 |
| FD-4 | Culvert crossing over Bean Creek | 39° 37' 35.02" | 121° 19' 42.24" | Debris passage, flooding, scour | Install debris rack and early worning system, investigate hydraulic capacity, monitor and maintain. | Low | Good | 3 |
| FD-3 | Culvert crossing over Bean Creek | 39° 37' 33.44" | 121° 19' 41.11" | Debris passage, flooding, scour | Install debris rack and early worning system, investigate hydraulic capacity, monitor and maintain. | Low | Good | 3 |

## REFERENCES

The USDA-Forest Service, 2008 Butte-Lighting Complex & Canyon Complex Burned Area Emergency Response (BAER) Completed Report was the document most commonly used by the specialist who prepared this SEAT Report.

For all other references used, please refer to the individual specialist reports attached.

**DRAFT TECHNICAL SPECIALIST'S**
**STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report**

**Resource: Geology**

**Fire Name:** BTU Lightning Fires **Month/Year:** September 2008
2008 Butte Fires CA-CDF-000593

**Author Name:** Don Lindsay, Certified Engineering Geologist #2323
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## OVERVIEW

The 2008 Butte Fires is comprised of 41 individual fires that amount to approximately 115,773 burned acres within Butte, Tehama and Plumas Counties, California. The fires are spread over a large geographic area (Map #1) and occur within three geomorphic provinces, each with unique geologic (Map #4) and topographic characteristics that demonstrate varying predisposed conditions of geologic concern, which can be adversely affected by the reduction in vegetative cover resulting from fire.

Consequently, the goal of this assessment was to evaluate the possible elevated risk that the burned area within each fire poses to life, property, and resources from geologic hazards such as landslides, debris flows, rock falls, and localized debris torrents, floods, and hyperconcentrated flows.

After performing a desktop review of available resources [including aerial photos, soil survey data, topographic and geologic maps, and a draft fire-area assessment report performed by the USFS (BEAR, 2008)] and discussing each fire with CalFire personnel knowledgeable with each fire setting, several of the smaller, outlying fires located away from recognized values at risk, such as roads, anadromous fisheries, and human development, were eliminated from having to perform a focused assessment on. In all, the 41 fires were reduced to 8 fires that required more detailed assessments to be performed. The fires include the: Humboldt, Belden, Camp, Friend-Darnell, Craig, Smokey, Inskip, and Breakneck.

Presented in the following is a synopsis of our investigation of each of the eight fires, which includes: 1) a discussion of the physical setting of the fire area, 2) the survey methods performed in evaluating the fire, 3) our observations related to the local geomorphology and geologic concerns, 4) a discussion of the identified values at risk, and 5) our recommendations to reduce potential adverse effects caused by the fire. The following synopses were written to be standalone documents by specific fire. Consequently, there is some overlap between fires where there are similarities in geology,

geomorphology, and values at risk. Following the synopses are a summary of all recognized values at risk listed in order of priority to receive treatment.

Due to the expedited nature of this evaluation, there are likely to be areas within the burn area and other locations of potential values at risk that were not observed or assessed, and other areas where the potential risks are either higher or lower than our initial reconnaissance-level review concludes.

**HUMBOLDT FIRE**

## 1.1 Resource Condition Assessment

A. Resource Setting

The Humboldt fire encompasses about 23,333 acres of land in Butte County, immediately down gradient of the town of Paradise, California (Detail Map #1).

The Humboldt fire resides near the break between the western flank of the Sierra Nevada and southern Cascade Range geomorphic provinces (CGS Note 36). The fire is primarily underlain by bedrock composed of well-indurated and interbedded, volcanic lahar flows, volcaniclastic sediments, and tuffs of Pliocene age. Collectively, this bedrock material is referred to as the Tuscan Formation. At lower elevations within the burn area, where the channels of Butte Creek and Little Chico Creek have incised down through the Tuscan Formation, there are exposures of well-indurated basalt flows belonging to the Lovejoy Basalt of Miocene age and less–indurated alluvial deposits composed of mudstone and sandstone belonging to the Modesto Formation of Pleistocene age (Saucedo and Wagner, 1992).

As a result of the deposition and subsequent erosion of the interbedded volcanic deposits of the Tuscan Formation, the local topographic expression within the Humboldt fire exhibits alternating ridge-swale topography. The ridge tops form plateaus that exhibit smooth, rolling slopes with a general dip to the southwest. Moving to the flank of the ridge tops, the slope gradients become very steep (>65%) and the topographic expression consists of bench-step topography as a result of deferential weathering between layered volcanic flow deposits. At the base of the ridge, within the lower elevations of the fire, the slopes transition to smooth, rolling, low gradient ground near the valley bottoms occupied by several watercourses, including Butte Creek, Little Chico Creek, and Little Dry Creek. Elevations within the burn area range from 200 feet to about 1,600 feet above sea level.

According to fire history records provided by CalFire (http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=fire), a good majority of the area encompassed by the Humboldt fire had previously burned in several fires that span over the last 40 years (Detail Map #8). This fire history suggests that the conditions present after the most recent Humboldt fire are not new to the watershed.

B. Survey Methods

The Humboldt fire was investigated from the air via a helicopter provided by CalFire on 12 September 2008. This overview flight was followed by a ground inspection performed on 14 September 2008 and 19 September 2008. The ground inspection included driving the main roads within the fire area, including the Skyway, Neal Road, Honey Run Road, and Centerville Road.

## 1.2 Observations

A. General Observations

The vegetative cover within the Humboldt fire is composed of oak savanna consisting mostly of native grasses with sparsely located oak trees. This vegetative cover transitions into a cover dominated by brush in the upper elevations of the fire area. Observations indicate that the burn severity was moderate to high along the steeper slopes flanking the local watercourses. In contrast, low to moderate burn severity was observed within low gradient ground adjacent to areas of high antecedent moisture, such as along the riparian corridors of the major watercourses and in areas where springs daylight the surface.

As described, the Humboldt fire is underlain by interbedded, well-indurated volcanic deposits that have been eroded to expose bench-step topography with slopes that exceed 65% in gradient. Observations of the steep slopes within the fire indicate that the dominant mass-wasting process at work includes isolated, shallow debris slides and rock fall. No evidence of large-scale, deep-seated slides were observed.

Field observations indicate the presence of erosion features consisting of incised rills and channels occurring within the headwalls and along the steep flanks of numerous swales within the burn area.

Due to the steep nature of the surrounding hill slopes and tributary channels flanking the local watercourses, sediment mobilized through riling and mass-wasting is interpreted to have a moderate potential of delivering to the watercourses.

Both the riling and mass-wasting features described above, particularly since they occur within shallow soils, can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss in vegetative cover.

B. Specific Observations

Site-specific observations were made of several road crossings, over-steepened slopes, and residential properties positioned along several of the main roads within the burn area. These high-value sites were evaluated in more detail from the regional overview to better assess potential risks from near-site debris flow, rock fall, floods, and other geologic hazards that may be present and that are not readily obvious after performing the regional overview. Of the several structures evaluated within or slightly down gradient of the burn area, only one over-steepened slope was interpreted as posing a significant risk to human life and infrastructure. The location of this slope is shown on Detail Map #1 and is briefly described in the following.

## 1.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of life and infrastructure related to roads, and the loss of natural resources related to excessive sediment entering Butte Creek, which is a recognized anadromous fishery.

General

Several culverted road crossings were observed along Honey Run Road and Centerville Road. The size of the culverts do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the burn. As a result, the capacity of the culverts is interpreted to have a moderate risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that are not conditioned to handle such flows. The net result being a loss in access, capital expenses related to repairing the failed crossings, and increased sediment entering the local watercourses.

The biologic assets present within the local watercourses, particularly Butte Creek, are covered in other specialist reports.

Site-Specific

One segment of Centerville Road was identified as presenting a risk to life and infrastructure due to debris sliding and rock fall.

**Point H-1** is a segment of road located at about W39$^{o}$ 43' 52.61" and N-121$^{o}$ 42' 11.61 that is down gradient of steep to overhanging slopes. In this area, the slopes immediately above Centerville Road exhibit signs of rock fall and isolated debris slides. The vegetative cover along the slopes consists mostly of a dense canopy of oak trees that have been moderately to severely burned, resulting in an estimated 80% reduction in canopy. This reduction in canopy, and subsequent lose in root strength, coupled with the presence of existing slide activity, suggests that there is a high risk of increased sliding and rock fall that could impact the road. However, due to the short slope height and limited soil development along the slope, it is assumed that any failure that develops will likely only partially block access along Centerville Road.

## 1.4 Recommendations

A. General Recommendations:

Road Drainage Structures

Performing hydrologic and hydraulic analyses for each culvert along fire-impacted segments of Honey Run Road and Centerville Road was outside the scope of this investigation. However, the controlling agency/owner of Honey Run Road and Centerville Road is encouraged to perform such analyses to assess the capacity of each

culvert and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings inside the burn area.

Site-specific analyses within the watershed of each culvert should be performed to assess the potential impacts from debris torrents, debris flows, hyperconcentrated flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings inside the burn area.

It is recommended that the appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings. Activities that are recommended to be incorporated in the monitoring and maintenance program should include:

(a) Performing inspections during the winter months, particularly after heavy rain storms;
(b) Remove any material collected in the pipe that reduces its capacity to convey water and debris; and
(c) Remove debris within the channel immediately up gradient of the pipe to reduce subsequent plugging potential.

Depending on the circumstances behind suspect crossings that are determined to have a high risk, treatments that could be applied include:

(a) Replacing the culvert with a rock-lined ford;
(b) Replacing the culvert with an appropriately sized culvert;
(c) Installing a relief culvert;
(d) Installing a debris rack or stand pipe on the existing culvert; and
(e) Constructing a critical dip to divert flow back into the channel as soon as possible.

B. Site-Specific Recommendations:

**Point H-1:** To reduce the potential impact of rock fall and debris slide activity along Centerville Road, it is recommended that the controlling agency monitor the road for increased rock fall and debris slide hazards. As required, perform increased maintenance to remove accumulated debris and place signage warning travelers of the hazard.

**BELDEN FIRE**

## 2.1 Resource Condition Assessment

A. Resource Setting

The Belden fire encompasses about 474 acres in Plumas County, southwest of the town of Belden, California (Detail Map #2).

The burned area resides within the Sierra Nevada geomorphic province (CGS Note 36) and is underlain by bedrock belonging almost entirely of metasedimentary rock of the Calaveras Complex of Permian age (Saucedo and Wagner, 1992). The rocks exposed within the burn area consist of well-indurated, siliceous shale with interbedded layers of metavolcanics, and to a lesser extent isolated areas of sulfide enrichment. Mantling this bedrock is a thin layer of soil composed of gravelly loam.

Topographically, the Belden fire encompasses the southeastern terminus of a dominant, southeast trending ridge that is flanked to the southwest by Chips Creek and to the northeast by Little Indian Creek. The slopes adjoining the ridge are steep and exhibit high relief with long slope lengths. Several sub-parallel swales flank the ridge and flow approximately perpendicular into Chips Creek and Little Indian Creek. Truncating the ridge is the incised valley of the southwestern flowing, North Fork Feather River. Paralleling the North Fork Feather River immediately down gradient of the burn area is Highway 70.

B. Survey Methods

The Belden fire was investigated from Highway 70 on 14 September 2008 and 19 September 2008.

## 2.2 Observations

A. General Observations

Prior to the fire, the vegetative cover within the burn area consisted largely of a dense cover of mixed hardwoods and brush, with isolated zones of mixed conifers. Based on field observations and on discussions with people familiar with the local fire history, it was identified that portions of the Belden fire were previously burned in 2000 as part of the Storrie fire. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations, the southwest facing slopes burned hot compared to the northeast facing slopes. Moreover, the fire burned most severe in areas previously impacted by the Storrie fire. In areas that were mostly timbered, particularly at the lower elevations flanking Chips Creek and Little Indian Creek, the burn severity was low.

Field evidence suggests that isolated debris flows, slides, and falls can occur along the steep slopes flanking Chips Creek and Little Indian Creek. Many such failures appear to have been entrained into debris torrents and flows that have culminated in mixed colluvial and alluvial deposits occurring at the mouth of Chips Creek and Little Indian Creek.

The mass-wasting features described above can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss of vegetative cover.

B. Specific Observations

Site-specific observations were made of the watercourse crossings located along Highway 70 at Chips Creek and Little Indian Creek, and of several residences located at the mouth of Little Indian Creek. These high-value sites were evaluated in more detail from the regional overview to better assess potential risks from near-site debris flow, rock fall, floods, and other geologic hazards that may be present and that are not readily obvious after performing the regional overview. The locations of high-values at risk identified through our observations are shown in Detail Map #2 and are briefly described in the following.

## 2.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of life and infrastructure related to residential structures, bridges, and public highway corridors within the burn area, and the loss of natural resources related to excessive sediment entering the local watercourses.

Items identified as values at risk include: 1) residences at the mouth of Little Indian Creek; 2) drainage structures at the mouth of Little Indian Creek and Chips Creek, and 3) portions of State Highway 70 immediately below the burn area (Detail Map #2).

**Point B-1** corresponds to a box culvert that conveys Little Indian Creek beneath Highway 70 (W40$^{o}$ 0’ 1.28”, N-121$^{o}$ 16’ 13.46”). This area was identified as having a risk of post-fire flooding and debris deposits that could impact the capacity of the box culvert, which, in turn, could cause flooding and debris to flow out of the existing channel and onto Highway 70. The rate of deposition and flooding is unknown, but could occur rapidly under extreme conditions; thereby, threatening the life of travelers on Highway 70. The placement of a trash rack constructed out of “I” beams driven into the stream channel, and the presence of debris flow deposits partially burying an abandoned structure and a dozer, confirms that debris flows have been a problem in the past and pose a concern of similar occurrences in the future.

**Point B-2** corresponds to a Highway 70 bridge that spans over Chips Creek (W40$^o$ 0' 18.81", N-121$^o$ 15' 47.80"). Similar to the conditions present at Little Indian Creek, the Chips Creek is a site known to have been impacted by debris flows. Efforts including excavating out the existing channel and installing an "I" beam trash rack have been performed by CalTrans to reduce the impacts of debris flows and flooding. Despite these mitigative efforts, however, there remains a risk that future debris flows could impact the bridge and adjacent road prism beneath Highway 70.

**Point B-3** is located immediately up gradient of the box culvert mentioned in Point B-1 and corresponds to the site of a trailer park (W40$^o$ 0' 25.42", N-121$^o$ 15' 48.42"). The trailer park resides on debris flow deposits at the mouth of Little Indian Creek and is in jeopardy of being impacted by similar debris flows in the future.

Note: Although our discussions of Points B-1 through B-3 above describe debris flows and floods that have occurred in the past, it should be mentioned that the overall high likelihood of these types of adverse events occurring in the future has only been slightly exacerbated by the Belden fire. This is primarily due to the fact that the Belden Fire footprint occupies only a small area of the overall watershed within Chips Creek and Little Indian Creek. Moreover, the burn intensity within this small footprint was interpreted to be low, thus further reducing any adverse affects caused by the fire. This, combined with the observation that a majority of the debris flow deposits at the mouth of Chips Creek and Little Indian Creek are composed of granitic rock derived from sources located high in the watershed, indicates that the bulk of slide activity is likely occurring within areas located up gradient of the Belden fire. These observations are presented here to better explain why there is an interpreted low fire-induced risk while maintaining a high naturally-occurring risk of debris flows and floods impacting Highway 70 and the adjacent structures.

**State Highway 70:** Portions of State Highway 70 traverse beneath steep slopes within the burn area. Roots and organic matter often assist in retaining rocks and other debris on steep slopes. The loss of this organic matter due to the fire can therefore cause an increased risk of rock and debris fall that may impact Highway 70.

## 2.4 Recommendations

A. Site-Specific Recommendations:

**Point B-1:** The primary issue that can adversely affect the box culvert structure at Highway 70 is debris slides/flows that initiate up gradient within the watershed of Little Indian Creek. To identify slide prone areas, both within the burn area and up gradient, is difficult, and to stabilize them against failure present even more of a challenge. As a result, it is our recommendation to address issues at the box culvert as they occur.

Debris slide slopes are most prone to fail after high intensity storm events, particularly after an appreciable amount of rain has already occurred to saturate the soils blanketing the hillside. To this end, it is recommended that the appropriate controlling agency should

perform consistent monitoring and maintenance of the box culvert. Activities that are recommended to be incorporated in the monitoring and maintenance program include:

(a) Performing inspections during the winter months, particularly after heavy rainstorms that occur after December 15th of each year. As a general suggestion, it is recommended that the owner/residence monitor daily and anticipated rainfall information provided at **http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=SRL**. For storms that are predicted to have more than 2.5 inches of rain over a 12 hour time period, it is recommended to have visual observations made at least once during or shortly after the storm. For storms of similar magnitude, but occurring after December 15th of each year, or after about 50% of the average annual rain fall has occurred, it is suggested that full-time monitoring be performed until at least 12 hours after the storm has passed.

(b) Remove any material collected in the existing debris rack or box culvert to maintain the structures capacity to convey water and debris; and

(c) Remove debris within the channel immediately up gradient of the existing debris rack to reduce subsequent plugging potential.

Additional recommendations addressing the box culvert at B-1 are provided in the engineering specialist report.

**Point B-2:** Please refer to the recommendations discussed above under B-1. Additional recommendations addressing the bridge at B-2 are provided in the engineering specialist report.

**Point B-3:** For similar reasons presented under B-1 above, it is recommended that the owners and residence within the trailer park relocate the trailers during the winter months to reduce the potential impacts to human life and infrastructure. If this is determined to be infeasible, it is then recommended to initiate a monitoring and maintenance program similar to that described for Point B-1.

In addition to the monitoring and maintenance program, the owner/residence may want to have a revetment structure designed and installed to assist in deflecting debris flow material and high water away from any improvements within the trailer park. Such a revetment may include rock slope protection (RSP) or a retaining wall.

**State Highway 70**: To reduce the potential impact of rock and debris fall along Highway 70, it is recommended that the controlling agency monitor the Highway 70 corridor for increased rock fall and debris slide hazards. As required, perform increased maintenance along problematic road segments to remove the debris and place signage warning travelers of the hazard.

**CAMP FIRE**

## 3.1 Resource Condition Assessment

A. Resource Setting

The Camp fire encompasses about 49,649 acres of land within portions of Butte and Plumas Counties (Map #1).

The Camp fire resides within the Sierra Nevada Geomorphic province (CGS Note 36) and is roughly bordered by Jordan Hill Road in the southwest, the North Fork Feather River to the southeast, Opapee Creek to the northeast, and portions of the West Branch Feather River, Concow Road, and Lynch Road to the northwest. Due to its expanse over varied terrain, the Camp fire can be subdivided into two topographic, geologic and geomorphic unique regions, discussed in the following as the North domain and the South domain.

The North domain is approximately defined as the area within the Camp fire that extends northeast from the southeast trending Dogwood Creek located just north of Pulga, California. The North domain is mostly underlain by bedrock belonging to the Grizzly Pluton of Early Cretaceous age. The Grizzly Pluton is an intrusive igneous rock that fluctuates from quartz diorite to quartz monzonite in composition (Saucedo and Wagner, 1992).

Topographically, the North domain consists of steep, planer slopes along the northwest flank of the North Fork Feather River. From the river's edge, these slopes extend upward for more than 1,600 feet to a break in slope forming the divide between the West Brach Feather River and the North Fork Feather River. The slopes along the crest of the divide exhibit rolling, relatively low relief slopes of low to moderate gradient.

The South domain encompasses the burn area extending southwest of Dogwood Creek, and includes developed areas such as Pulga, Concow, and Deadwood. Unlike the North domain, the bedrock beneath the South domain does not consist of just one primary rock type, but consists of an assemblage of varying rock types with a complex geologic history belonging to the Central Belt of the Sierra Nevada. Starting at Dogwood Creek and going south, the local bedrock beneath the South domain consists of intrusive quarts diorite of the southwestern exposure of the Grizzly Pluton, alternating northwest-trending bands of metavolcanic, metasedimentary, and ultramafic rock, followed by intrusive quartz diorite of the Concow Pluton. Many of these varying rock types are separated by faults.

The topographic expression within the South domain is somewhat more dissected compared to the North domain due largely to the varying rock types, large-scale sliding, and structural control within the area. The slopes are generally rolling with a bench-step morphology and slope gradients ranging from very steep along the incised drainages of

Flea Valley Creek and the West Branch Feather River to near horizontal within the valley bottom occupied by Concow Reservoir.

According to fire history records provided by CalFire (http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=fire), portions of the Camp fire had previously burned, starting in the 1940s and extending to present time (Detail Map #8).

B. Survey Methods

The Camp fire was investigated from the air via a helicopter provided by CalFire on 12 September 2008. This overview flight was followed by a ground inspection performed on 14 September 2008, 16 September 2008, and 19 September 2008. The ground inspection included driving the main roads within the fire area, including Concow Road, Lynch Road, Jordan Hill Road, Pulga Road, and Highway 70, which mostly parallels the North Branch Feather River and is located on the opposite side of the river as a Union Pacific Railroad track.

## 3.2 Observations

A. General Observations

Prior to the fire, the vegetative cover within the North domain can be roughly described as a mixed stand of hardwoods with an understory of brush occurring along the steep slopes that flank the North Fork Feather River. The vegetative cover on the gentle slopes along the divide, consist of a mixed stand of conifer trees. In the South domain, the vegetative cover consisted of largely mixed hardwood stands and brush with isolated areas of mixed conifer stands. The majority of the conifer stands were located at the upper elevations within the watershed in areas underlain by metasedimentary and metavolcanic rock. In some areas, particularly up gradient of the Concow Reservoir, the vegetative cover was sparse where the underlying bedrock consists of ultramafic rock. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations and on burn area severity maps provided by the USFS (BAER, 2008), the North domain did not get burned too severely, with the exception of some isolated pockets within the steep slopes above the North Fork Feather River. This is in stark contrast to the South domain, where a majority of the fire area had a moderate to high burn severity. Some of the most intensely burned areas were observed immediately below Flea Mountain, at the head of the Flea Valley Creek drainage. In other areas, particularly in timbered ground within portions of the Flea Valley Watershed, the burn severity was low to moderate. However, it appears that the timber mortality in these areas is extremely high and it is suspected that after only a few years a majority of the remaining timber will succumb to wind damage, snow load, and bug kill. Thus, the true effects of the fire in regards to vegetative cover may be realized 5 to 10 years after the initial burn. The vegetative cover in areas within riparian corridors appears to have sustained very little burn damage.

Field observations indicate the presence of erosion features consisting of incised rills and channels occurring within the headwalls and along the steep flanks of swales within both the North and South domains, particularly where the underlying geology consists of granitic rock with a moderately developed soil and/or colluvial deposit. Based on the geomorphic expression of many of these features, it appears that they form as a result of concentrated runoff eroding the soils rather than linked to shallow debris slide failures.

The dominant mass-wasting failure types within the North domain consist of rock fall and isolated to coalescing debris slides and flows occurring along the over-steepened slopes perched above the North Fork Feather River. Although not dominant, the North domain does contain large-scale, deep-seated rotational slide failures. Such features were observed on slopes above the developed areas of Storrie and Tobin. Field evidence suggests that these slides occurred during geologic and climatic conditions that don't persist today, and had temporarily dammed the North Fork Feather River. Today, isolated debris slides and rotational slides were observed along the toe slope of these larger slide features.

In somewhat of a contrast to the North domain, the dominant mass-wasting failure types present within the South domain consist of large rotational and translational slide complexes. These slide complexes encompass a large portion of the burn area along Highway 70, north of Jarbo Gap, within the southern flank of Flea Valley Creek, and in the mountains to the west of Concow Reservoir. These deep-seated features correspond to the geologic complex zone of bedrock previously described that trends to the northwest and bisects the burn area south of Flea Mountain. Similar to the North domain, active debris slides and rotational slides were observed within toe slope and colluvial deposits of several of the larger features. Several of these recent slides have impacted Highway 70, an access road to Pulga, and the Union Pacific Railroad.

The riling and shallow mass-wasting features described above within both the North and South domains can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss of vegetative cover.

B. Specific Observations

Site-specific observations were made of residences and road corridors located inside and immediately down gradient of the burn area. These high-value sites were evaluated in more detail from the regional overview to better assess potential risks from near-site debris flow, rock fall, floods, and other geologic hazards that may be present and that are not readily obvious after performing the regional overview. The locations of high-values at risk identified through our observations are shown in Detail Map 1 and Detail Map 2 for North domain and South domain, respectively, and are briefly described in the following.

## 3.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of life and infrastructure related to isolated structures within the burn area, the loss of infrastructure related to the local road systems and a community water supply intake, and the loss of natural resources related to excessive sediment entering the local watercourses.

General

Several culverted road crossings were observed along the main road systems within the burn areas of both the North domain and the South domain. Many of the culverts observed do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the fire. As a result, the capacity of the culverts within the entire burn area are interpreted to have a moderate risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that are not conditioned to handle such flows. The net result being a loss in access, capital expenses related to repairing the failed crossings, and increased sediment entering the local watercourses.

In addition to the culverts being insufficiently sized, we observed several areas where the road drained to an inboard ditch that flowed into cross-drains. Due to the increased runoff anticipated from the burned slopes, it is unlikely that the current spacing between the cross-drains is sufficient, resulting in excessive erosion of the inboard ditch and the potential for the cross-drains to be overwhelmed by debris and flows. This scenario has the same adverse affects as described above for culvert crossings.

The Concow area within the South domain represents a community development that is dispersed across the landscape. As a result, not all residential structures were observed. If there are structures within this community that reside adjacent to or within swales, there is a potential risk that they could be impacted by excessive, fire-induced flows and debris.

Site-Specific

Site-specific values at risk within the North domain include a water supply inlet to the community of Tobin, a PG&E access road, the Union Pacific Railroad, Highway 70, and PG&E power facilities (Detail Map #2).

**Point NC-1** is the water supply inlet to the community of Tobin located at about W39$^{o}$ 56’ 9.87” and N- 121$^{o}$ 19’ 7.19”. Due to the severity of the burn and the high erosive nature of the decomposed granitic soils within the watershed above, there is a high risk that turbid water and sediment will impact the water supply. An engineering analysis addressing this water intake is provided in other specialist reports.

**PG&E Access Road:** The PG&E access road is a mid-slope road that parallels power transmission lines along the debris slide slopes located above the North Fork Feather River. Field evidence indicates that this road has been previously impacted by debris slide activity. Many debris slides have occurred within swales located above culvert crossings that extend beneath the road prism. Due to the surrounding fire, there is an

interpreted moderate risk that debris slides and flows will occur and overwhelm the crossings. The net result being a loss in access, capital expenses related to repairing the failed crossings, a risk of debris slide material impacting the Union Pacific Railroad located down gradient, and increased sediment entering the North Fork Feather River.

**Union Pacific Railroad:** The Union Pacific Railroad is positioned below debris slide slopes that have been impacted by fire. The Union Pacific Railroad is at risk of being moderately impacted by rock fall, debris slides, and blown culverts caused by the reduction in canopy and root strength by the fire. The loss of access along the railroad could threaten life, infrastructure, and general commerce.

**State Highway 70:** Portions of State Highway 70 traverse beneath steep slopes within the burn area. Roots and organic matter often assist in retaining rocks and other debris on steep slopes. The loss of this organic matter due to the fire can therefore cause an increased risk of rock and debris fall that may impact Highway 70.

**PG&E Reservoirs:** Several PG&E dams and power generation facilities are located down gradient of the burn area within the North Fork Feather River. Although the dams were not identified to be at risk of a direct impact by fire-induced slides or rock fall, it is recognized that the facilities will likely be impacted indirectly by increased sedimentation and log debris entering the reservoirs. An engineering evaluation of potential impacts that this may have is addressed in other specialist reports.

Site-specific values at risk within the South domain include residential structures within Pulga, the Pulga access road, the Union Pacific Railroad, Highway 70, PG&E power line supports, and the Concow Reservoir (Detail Map #3).

**Point SC-1** is a cabin located at about W39$^{o}$ 48’ 17.48” and N- 121$^{o}$ 27’ 7.91”. The cabin is founded on an alluvial/colluvial fan deposit at the mouth of an unnamed class III swale. The class III swale up gradient of the cabin appears to have been moderately burned, resulting in an anticipated reduction in canopy of about 50% or more. This reduction in canopy, coupled with the naturally steep slopes within the swale (i.e. 65% and greater), and the presence of an existing alluvial/colluvial deposit at its mouth with Flea Valley Creek, suggests a high risk of increased flooding and debris slide/flow activity.

Despite the high likelihood that the structure could be impacted by flows and debris emanating from the class III swale, representing a high risk to loss of infrastructure, there is likely only a low risk to loss of life based on the anticipated low occupancy rate of the cabin.

**Point SC-2** encompasses an arch culvert crossing and several cabins located immediately down gradient of the crossing that are within the channel zone of Flea Valley Creek (W39$^{o}$ 48’ 13.80”, N-121$^{o}$ 27’ 1.28”). Field evidence indicates that the footing of the arch culvert has been scoured out in the past and temporarily repaired with riprap. In addition, the cabins appear to have been impacted by high flows within the channel, as indicated by debris marks on the upstream cabin and its down stream shift on its

foundation. Mitigative actions including a revetment composed of grouted rock slope protection was constructed to protect the cabins, however, it appears as though it has been compromised by scour.

Observations of the slopes flanking Flea Valley Creek indicate the presence of both isolated shallow debris slides and coalescing rotational and translational slide complexes with a lineage of activity spanning many thousands of years ago to present. Because of the recognized slide activity within the watershed, and because of the high mortality rate of vegetation within the watershed as a result of the fire, it is our belief that increased sliding, debris flows, and runoff is likely to occur within Flea Valley Creek. It is our opinion that the arch culvert crossing and cabins are at a high level of risk of being impacted by debris and high flows.

**Point SC-3** is a Union Pacific Railroad bridge crossing that spans Flea Valley Creek (W39$^{o}$ 48’ 8.67”, N-121$^{o}$ 26’ 50.56”). For similar reasons described above, it is our opinion that this railroad crossing has a moderate risk of being jeopardized by additional debris and flows resulting from the up gradient fire.

**Point SC-4** includes the Pulga access road (W39$^{o}$ 47’ 55.99”, N-121$^{o}$ 27’ 5.06”). The Pulga access road is a mid-slope road that provides access to the town of Pulga from Highway 70. The road crosscuts large rotational slide deposits that are composed of inherently weak colluvium. Evidence of this is the location of numerous recent, road-induced slides within the cut slope and fill prism of the road. Although it is unlikely that the large-scale, deep-seated slides could be destabilized by the reduced root strength and evapotranspiration provided by the vegetative cover, there is a moderate risk of shallow debris slides and small rotational slides to develop within the colluvium as a result of the burn. Such failures represent a moderate risk of impacting the Pulga access road.

**State Highway 70:** Similar to the Pulga Access Road, Highway 70 crosscuts large rotational slide deposits that are composed of inherently weak colluvium. Evidence of this is the location of numerous recent, road-induced slides within the cut slope and fill prism of Highway 70, between Jarbo Gab and the North Fork Feather River bridge. The reduction in root strength and evapotranspiration provided by the vegetative cover, presents a moderate risk of increased slide activity above Highway 70. Moreover, the loss of organic matter due to the fire can cause an increased risk of rock and debris fall that may impact Highway 70.

**Point SC-5** is of the Concow Reservoir (W39$^{o}$ 46’ 12.30”, N-121$^{o}$ 31’ 12.77”). It is recognized that fire-induced erosion and isolated debris slides is likely to occur within the upper watershed of Concow Reservoir. These effects will likely reduce the capacity of the reservoir, impact water quality, and increase the volume of wood debris entering the reservoir. An engineering evaluation of these potential impacts is addressed in other specialist reports.

**Point SC-7** points to a PG&E power line tower (W39$^{o}$ 48’ 7.74”, N-121$^{o}$ 27’ 0.28”) located off of Pulga Road that was recognized as being at risk of collapsing due to a loss in bearing capacity, as a result of shallow slide activity. Currently, there are several head

scarps that extend to within about 50 feet of the tower. The slopes up gradient of the tower were impacted by fire. Although the up gradient burn was not intense, it may adversely affect the balance of forces acting within the slope to cause a reactivation of the adjacent slides and the subsequent collapse of the tower.

Although we only identified one tower that was at risk due to the fire, it may be possible that there are additional towers that were not observed that could also be at risk.

### 3.4 Recommendations

A. General Recommendations for both the North and South domains:

<u>Road Drainage Structures</u>

Performing hydrologic and hydraulic analyses for each culvert and cross drain was outside the scope of this investigation. However, the controlling agency/owner of the roads within the burn area is encouraged to perform such analyses to assess the capacity of each culvert and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings within and down gradient of the burn area.

Site-specific analyses should be performed by the controlling agency/owner to assess the potential impacts from debris torrents, debris flows, hyperconcentrated flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings within and down gradient of the burn area. The controlling agency/owner is encouraged to include the State Resource Water Quality Control Board and Fish and Game in the review and prioritization of the culverts.

It is recommended that the appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings within and immediately down gradient of the burn area. Activities that are recommended to be incorporated in the monitoring and maintenance program include:

(a) Performing inspections during the winter months, particularly after heavy rain storms;
(b) Remove any material collected in the pipe that reduces its capacity; and
(c) Remove debris within the channel immediately up gradient of the pipe to reduce subsequent plugging potential.

Depending on the circumstances behind suspect crossings that are determined to have a high risk of failure, treatments that could be applied, include:

(a) Replacing the culvert with a rock-lined ford;
(b) Replacing the culvert with an appropriately sized culvert;
(c) Installing a relief culvert;
(d) Installing a debris rack or stand pipe on the existing culvert; and
(e) Constructing a critical dip to divert flow back into the channel as soon as possible.

Residential Structures

Site-specific analyses are recommended to evaluate and address residences located within drainage ways (e.g. rivers, streams, channels, swales) that are below fire-impacted areas. The analyses should include evaluating the risk of increased flows and debris emanating from burned areas, and provide engineered solutions, as required.

B. Site-Specific Recommendations for North Domain: Point NC-1: Please refer to the engineering specialist reports for recommendations pertaining to the water supply inlet for the community of Tobin.

**PG&E Access Road:** Because of the potential adverse impacts associated with the PG&E road and its proximity to the down gradient Union Pacific Railroad, it is our recommendation to apply the same general recommendations listed above for general road drainage structures.

**Union Pacific Railroad:** Debris slide slopes are most prone to fail after high intensity storm events, particularly after an appreciable amount of rain has occurred to saturate the soils blanketing the hillside above the railroad track. As a result, it is recommended that the appropriate controlling agency should perform consistent monitoring and maintenance of the railroad and its drainage structures. Activities that are recommended to be incorporated in the monitoring and maintenance program include:

(a) Performing inspections during the winter months, particularly after heavy rainstorms that occur after December 15th of each year. As a general suggestion, it is recommended that the owner/residence monitor daily and anticipated rainfall information provided at **http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=SRL**. For storms that are predicted to have more than 2.5 inches of rain over a 12 hour time period, it is recommended to have visual observations made at least once during or shortly after the storm. For storms of similar magnitude, but occurring after December 15th of each year, or after about 50% of the average annual rain fall has occurred, it is suggested that full-time monitoring be performed until at least 12 hours after the storm has passed.

(b) Remove any deposited material within drainage structures to maintain the structures capacity to convey water and debris.

**State Highway 70**: To reduce the potential impact of rock and debris fall along Highway 70, it is recommended that the controlling agency monitor the Highway 70 corridor for increased rock fall and debris slide hazards. As required, perform increased maintenance along problematic road segments to remove the debris and place signage warning travelers of the hazard.

**PG&E Reservoirs:** Our general observations indicate that there is a moderate risk of large woody debris and increased sedimentation that could impact the reservoirs. An engineering evaluation of these potential impacts is addressed in other specialist reports.

C. Site-Specific Recommendations for South Domain

**Point SC-1:** To reduce the risk to human life, we recommend not occupying the structure during the winter and early spring months. Because the structure is within the channel zone, it is interpreted that any additional mitigation will be too expensive to perform and will outweigh the value of the structure. For this reason, no recommendations to address the structure are provided. Additional discussions pertaining to this site are provided in the engineering specialist report.

**Point SC-2:** Please refer to the engineering specialist report for recommendations addressing the arch culvert and adjacent cabins.

**Point SC-3:** Please refer to the monitoring and maintenance recommendations for railroad structures addressed above for the North Domain. In addition, please refer to the engineering specialist reports for recommendations pertaining to this structure.

**Point SC-4:** Please refer to the monitoring and maintenance recommendations for Highway 70 and the PG&E access road discussed above for the North Domain.

**State Highway 70**: Please refer to the monitoring and maintenance recommendations for Highway 70 and the PG&E access road discussed above for the North Domain.

**Point SC-5:** Our general observations indicate that there is a high risk of excessive soil erosion to occur within the watershed that will result in sediment infilling the Concow Reservoir. An engineering evaluation of potential impacts that this may have is addressed in other specialist reports.

**Point SC-7:** It is recommended that additional investigation work be performed by a licensed Engineering Geologists or Geotechnical Engineer to assess the slope conditions beneath, and immediately above, the power line tower identified as SC-7. Moreover, it is recommended that a similar assessment be performed on the remaining towers that are within fire-impacted areas.

**FRIEND-DARNELL FIRE**

## 4.1 Resource Condition Assessment

A. Resource Setting

The Friend-Darnell fire encompasses about 3,845 acres of land northwest of the confluence of Bean Creek and the Middle Fork Feather River (Detail Map #4).

The burned area resides primarily within the Sierra Nevada geomorphic province (CGS Note 36) and is underlain by bedrock belonging to the Bald Rock Pluton of Early Cretaceous age. The Bald Rock Pluton is an intrusive igneous rock that is composed of quartz diorite (Saucedo and Wagner, 1992).

Topographically, the Friend-Darnell consists of alternating ridge-swale topography occurring along the flanks of a dominant, southeast-trending ridge. Runoff within the Friend-Darnell fire occurs as sheet flow into the swales and higher order watercourses where it flows to the northeast into the Middle Fork Feather River or to southwest into Bean Creek. Slope gradients within the burn area range between moderately steep to steep, except where adjacent to Bean Creek and along the crest of local ridge tops. Elevations within the burn area range from about 1,400 feet above mean sea level adjacent to the confluence of Bean Creek and the Middle Fork Feather River, to about 2,800 feet above mean sea level near the crest of the dominant ridge top.

According to fire history records provided by CalFire (http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=fire), the entire area encompassed by the Friend-Darnell fire had previously burned within the past 80 years (Detail Map #8). This fire history suggests that the conditions present after the most recent fire are not new to the watershed.

B. Survey Methods

The Friend-Darnell fire was investigated from the air via a helicopter provided by CalFire on 12 September 2008. This overview flight was followed by a ground inspection performed on 17 September 2008. The ground inspection included driving the Bean Creek Road through the fire area.

## 4.2 Observations

A. General Observations

Prior to the fire, the vegetative cover consisted mostly of mixed hardwood stands and brush, with isolated areas of mixed conifer trees within the upper elevations. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations and on burn area severity maps provided by the USFS (BAER, 2008), the south and west facing slopes burned hot compared to the north and east facing

slopes. Moreover, the fire burned most severe in areas located within the upper watershed. The vegetative cover within the riparian corridors appears to have sustained very little burn damage.

Field observations indicate the presence of erosion features consisting of incised rills and channels occurring within the headwalls and along the steep flanks of swales within the watershed. Based on the geomorphic expression of these features, it appears that they form as a result of concentrated runoff eroding the soils rather than linked to shallow debris slide failures.

Field evidence suggests that isolated debris flows, slides, and falls occur along the steep channel walls of the local stream courses and within the headwall slopes in the upper elevations. Many such failures appear to have culminated in mixed colluvial and alluvial deposits occurring at the mouth of tributary channels that drain into Bean Creek.

The riling and mass-wasting features described above can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss of vegetative cover.

B. Specific Observations

Site-specific observations were made of several residences positioned along Bean Creek. These high-value sites were evaluated in more detail from the regional overview to better assess potential risks from near-site debris flow, rock fall, floods, and other geologic hazards that may be present and that are not readily obvious after performing the regional overview. Of the several structures evaluated within or slightly down gradient of the burn area, only one structure was identified as being at risk. The location of this structure is shown on Detail Map #4 and is briefly described in the following.

## 4.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of life and infrastructure related to an isolated structure within the burn area, the loss of infrastructure related to the local road systems, and the loss of natural resources related to excessive sediment entering the local watercourses.

General

Several culverted road crossings were observed along the main road systems within the burn area. Many of the culverts observed do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the burn. As a result, the capacity of the culverts within the entire burn area are interpreted to have a moderate to high risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that are not conditioned to handle such flows. The net result being a loss in access, capital expenses related to repairing the failed crossings, and increased sediment entering the local watercourses.

In addition to the culverts being insufficiently sized, we observed several areas where the road drained to an inboard ditch that flowed into cross-drains. Due to the increased runoff anticipated from the burned slopes, it is unlikely that the current spacing between the cross-drains is sufficient, resulting in excessive erosion of the inboard ditch and the potential for the cross-drains to be overwhelmed by debris and flows. This scenario has the same adverse affects as described above for culvert crossings.

Site-Specific

Items identified as values at risk include a residence and a surface water supply inlet located immediately adjacent to Bean Creek (Detail Map #4).

**Point FD-1** is a modular residence located at about W39$^{o}$ 37' 44.23" and N- 121$^{o}$ 19' 45.21". The residence is founded on an alluvial/colluvial fan deposit at the mouth of an unnamed class III swale. The class III swale up gradient of the cabin appears to have been lightly burned, resulting in an anticipated reduction in canopy of about 40% or more. This reduction in canopy, coupled with the naturally steep slopes within the swale (i.e. 65% and greater), and the presence of an existing alluvial/colluvial deposit at its mouth with Bean Creek, suggests that the residence could be impacted by increased flooding and debris flows emanating from the class III swale.

**Point FD-2** is a surface water diversion located within Bean Creek (W39$^{o}$ 37' 21.96", N-121$^{o}$ 19' 38.53"). It appears that the diverted water is used as irrigation water and possibly as drinking water. The inlet consist of a check dam within the stream that re-directs water into a pipe. No screen over the pipe was observed. The increased flows, sediment, and debris resulting from the up-gradient burn present a moderate risk to this diversion.

## 4.4 Recommendations

A. General Recommendations:

Road Drainage Structures

Performing hydrologic and hydraulic analyses for each culvert and cross drain was outside the scope of this investigation. However, the controlling agency/owner of the roads within the burn area is encouraged to perform such analyses to assess the capacity of each culvert and develop a rank based on flow alone that can be used to prioritize the treatment of culvert crossings within and down gradient of the burn area.

Site-specific analyses should be performed by the controlling agency/owner to assess the potential impacts from debris torrents, debris flows, hyperconcentrated flows, and sedimentation resulting from winter rains. The results of these focused assessments should also be used to prioritize the treatment of culvert crossings within and down gradient of the burn area. The controlling agency/owner is encouraged to include the State Resource Water Quality Control Board and Fish and Game in the review and prioritization of the culverts.

It is recommended that the appropriate controlling agency/owner should perform consistent monitoring and maintenance of the crossings within and immediately down gradient of the burn area. Activities that are recommended to be incorporated in the monitoring and maintenance program include:

(a) Performing inspections during the winter months, particularly after heavy rain storms;
(b) Remove any material collected in the pipe that reduces its capacity; and
(c) Remove debris within the channel immediately up gradient of the pipe to reduce subsequent plugging potential.

Depending on the circumstances behind suspect crossings that are determined to have a high risk of failure, treatments that could be applied, include:

(a) Replacing the culvert with a rock-lined ford;
(b) Replacing the culvert with an appropriately sized culvert;
(c) Installing a relief culvert;
(d) Installing a debris rack or stand pipe on the existing culvert; and
(e) Constructing a critical dip to divert flow back into the channel as soon as possible.

B. Site-Specific Recommendations:

**Point FD-1:** To reduce the potential of excessive flows and slide debris from impacting the residence, it is recommended to relocate the residence away from the swale. Alternatively, the site should be evaluated to determine if an engineered structure could be designed and constructed that will provide free drainage around the residence and protect it from slide debris.

**Point FD-2:** To reduce the potential of excessive flows and debris from impacting the water inlet, it is recommended to either remove the pipe during the winter months, or protect the pipe using a filter screen and large riprap. Any treatment of the inlet within the channel zone will likely require approval by the California Regional Water Quality Control Board and the California Department of Fish and Game.

## CRAIG FIRE

### 5.1 Resource Condition Assessment

A. Resource Setting

The Craig fire encompasses about 1,999 acres of land positioned up gradient Lake Oroville, California (Detail Map #4).

The burned area resides within the Sierra Nevada geomorphic province (CGS Note 36) and is underlain by bedrock belonging to the Bald Rock Pluton of Early Cretaceous age.

The Bald Rock Pluton is an intrusive igneous rock that is composed of quartz diorite (Saucedo and Wagner, 1992).

The Craig fire is located on the northern flank of a dominant, east-west trending ridge. Slopes within the fire area exhibit rolling topography with moderate to steep slopes that extent from the ridge top to Lake Oroville below. Elevations within the burn area range from about 900 feet to about 2,500 feet above sea level.

B. Survey Methods

The Craig fire was investigated from the air via a helicopter provided by Cal Fire on 12 September 2008. This overview flight was followed by a ground inspection performed on 17 September 2008. The ground inspection included driving to the top of the dominant ridge overlooking the burn area. Due to encountering locked gates, further access into the burn area was unavailable.

## 5.2 Observations

A. General Observations

Prior to the fire, the vegetative cover consisted mostly of brush and mixed hardwood stands with isolated areas of mixed conifer trees located in the upper elevations. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations, the upper elevations within the fire area were moderately to severely burned.

Field observations indicate the presence of erosion features consisting of incised rills and channels occurring along steep drainage swales that bisect the burn area. In addition, isolated debris slide slopes were observed within a few headwall features located in the upper elevations of the burn.

The riling and shallow mass-wasting features described above can be adversely affected by the loss of vegetative cover. The primary mechanisms for this are the loss of mechanical support (root cohesion and anchoring) of the hillslope materials and the increases in runoff resulting from reductions in interception, infiltration, and evapotranspiration caused by the loss of vegetative cover.

## 5.3 Emergency Determination

Although several residences were observed within the burn area, they were generally located outside local swales and away from steep headwall slopes that exhibited a high potential of sliding. As a result, the only value at risk identified was the possibility of sediment impacting Lake Oroville, which was determined to be insignificant. As a result, no recommendations were made.

## SMOKEY FIRE

### 6.1 Resource Condition Assessment

A. Resource Setting

The Smokey fire encompasses about 1,323 acres of land positioned up gradient of Big Chico Creek, in Tehama County, California (Detail Map #5).

The fire is located within the Cascade Range geomorphic province and is primarily underlain by bedrock composed of well-indurated and interbedded, volcanic lahar flows, volcaniclastic sediments, and tuffs of Pliocene age. This bedrock material is referred to as the Tuscan Formation (Saucedo and Wagner, 1992).

The Smokey fire is bisected by Little Smokey Creek, which flows to the southwest, and is roughly bounded to the west and east by two prominent, interfluvial ridges that parallel Little Smokey Creek. Elevations within the burn area range from 3,100 feet to about 4,400 feet above sea level.

B. Survey Methods

The Smokey fire was investigated from the air via a helicopter provided by Cal Fire on 12 September 2008. No field reconnaissance was performed.

### 6.2 Observations

Prior to the fire, the vegetative cover consisted mostly of mixed conifer and hardwood stands. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations, the overall burn intensity was low to moderate with more severe burn areas occurring along the ridge tops. The riparian corridor surrounding Little Smokey Creek appeared to be intact with very minimal fire damage.

Field observations indicated that the ridge tops are actively being harvested.

### 6.3 Emergency Determination

No significant threat to a value at risk was identified due to the low burn intensity and large buffer provided by the intact riparian zone surrounding Little Smokey Creek. As a result, no recommendations are made.

## INSKIP FIRE

### 7.1 Resource Condition Assessment

A. Resource Setting

The Inskip fire encompasses about 103 acres of land positioned up gradient of the West Branch Feather River, in Butte County, California (Detailed Map #5).

The fire is primarily underlain by bedrock composed of well-indurated Pliocene volcanic flow deposits (Saucedo and Wagner, 1992).

The Inskip fire is located on the crest of a prominent ridge that is straddled by the West Branch Feather River to the west and Fish Creek to the east. Elevations within the burn area range from 4,000 feet to about 4,220 feet above sea level.

B. Survey Methods

The Inskip fire was investigated from the air via a helicopter provided by CalFire on 12 September 2008. No field reconnaissance was performed.

### 7.2 Observations

Prior to the fire, the vegetative cover consisted mostly of mixed conifer and hardwood trees. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations, the overall burn intensity was low with more severe burn areas occurring as isolated pockets along the ridge top. Two, mid-slope roads positioned on either side of the ridge top bound the lower elevations of the fire. The riparian corridors of the West Branch Feather River and Fish Creek were unburned.

### 7.3 Emergency Determination

Due to the low burn intensity and the large buffer provided by the intact riparian zones along West Branch Feather River and Fish Creek, no significant threat to a value at risk was identified, and no recommendations are made.

## BREAKNECK FIRE

### 8.1 Resource Condition Assessment

A. Resource Setting

The Breakneck fire encompasses about 771 acres of land positioned up gradient of the Big Kimshew Creek, east of Stirling City, Butte County, California (Detailed Map #5).

The fire is primarily underlain by bedrock composed of well-indurated, metadiorite bedrock belonging to the Central Belt of the Sierra Nevada (Saucedo and Wagner, 1992).

The Breakneck fire is located on the eastern flank of a south trending interfluvial ridge positioned west of Big Kimshew Creek. Slopes within the burn area are steep, planar and extend into Big Kimshew Creek and Breakneck Canyon, a tributary to Big Kimshew Creek. Elevations within the burn area range from 3,600 feet to about 4,800 feet above sea level.

B. Survey Methods

The Inskip fire was investigated from the air via a helicopter provided by CalFire on 12 September 2008. No field reconnaissance was performed.

### 8.2 Observations

Prior to the fire, the vegetative cover consisted mostly of mixed conifer and hardwood trees. Discussions of the vegetative cover are covered under other specialist reports.

Based on our observations, the overall burn intensity was low with the more severe burn areas occurring within isolated pockets along the ridge top. The riparian corridors along Big Kimshew Creek and Breakneck Canyon were left mostly intact.

Geomorphic evidence suggests that the steep slopes on the western flank of Big Kimshew Creek are prone to isolated, shallow, debris slides and rock fall.

### 8.3 Emergency Determination

Although there is a recognized potential that isolated, shallow, debris slides and rock fall can occur within the burn area along the western flank of Big Kimshew Creek, the overall risk that these types of failures have on values at risk is considered low due to the low intensity burn in this region, the overall competency of the slopes, and the long distance to any value at risk. As a result, the Breakneck fire is interpreted as having no significant threat and, therefore, no recommendations are made.

## SUMMARY OF TREATMENT PRIORITY

In describing each of the site-specific values at risk identified in the individual fire synopses above, the risk of fire-related impacts is qualitatively ranked from low, moderate, to high. In addition, recommendations were made to reduce the potential impacts to life, infrastructure, and resource to acceptable levels. In order to prioritize which value at risk should receive treatment, a qualitative analysis was performed that incorporates both the risk and effectiveness of the proposed recommendations. This analysis was performed for only those sites where site-specific recommendations are made.

The process developed to assist in the prioritization includes the following matrix, which is divided into the overall rank of the potential impact by the level of effectiveness of the proposed recommendations. The three levels of risk include low, moderate, and high, which are defined as unlikely to occur, possible to occur, and almost certain to occur, respectively. The interpreted effectiveness of the proposed recommendations include both an estimate of the approximate cost and efficiency that the recommendations have in reducing the level of risk. The effectiveness of the proposed recommendations are divided into three levels, which include: bad, good, and very good. These levels are defined as having a low, moderate, and high success rate in improving the overall impacts to the value at risk. The matrix is as follows:

TREATMENT PRIORITIZATION MATRIX

| | | Interpreted Effectiveness of Recommendations | | |
|---|---|---|---|---|
| | | Very Good | Good | Bad |
| Risk To Value at Risk | High | 6 | 5 | 3 |
| | Moderate | 5 | 4 | 2 |
| | Low | 3 | 2 | 1 |

Values at risk that demonstrate the highest priority to treat are those sites that rank 5 or higher; sites that should likely receive treatment rank between 2-4; and sites that should not be considered for treatment include sites that rank between 1-2.

The following lists the values of risk identified and the overall treatment prioritization.

| Values At Risk | | Risk of Impact | Recommendation Effectiviness | Treatment Priority |
|---|---|---|---|---|
| Highway 70 | Hwy 70 road segments beneath fire burned slopes | High | Very Good | 6 |
| SC-4 | Pulga access road | High | Very Good | 6 |
| Union Pacific Railroad | Union Pacific Railroad segments beneath fire burned slopes | High | Very Good | 6 |
| B-1 | Hwy Box culvert over Chips Creek | High | Good | 5 |
| B-2 | Hwy 70 Bridge over Little Indian Creek | High | Good | 5 |
| B-3 | Trailer park and ancillary improvements | High | Good | 5 |
| FD-1 | Single-family residence | High | Very Good | 5 |
| PG&E Access Road | Access road to transmission line corridor within North Fork Feather River | High | Good | 5 |
| FD-2 | Surface water intake | High | Bad | 4 |
| H-1 | Road segment - Centerville Road | Moderate | Good | 4 |
| NC-1 | Tobin water supply intake | Moderate | Bad | 4 |
| SC-1 | Cabin | High | Bad | 4 |
| SC-2 | Arch culvert over Flea Valley Creek and adjacent cabin structures | Moderate | Good | 4 |
| SC-3 | Union Pacific Railroad bridge over Flea | Moderate | Good | 4 |
| SC-5 | Concow Reservoir | Moderate | Bad | 4 |
| SC-7 | PG&E power line support tower | Moderate | Good | 4 |
| PG&E reservoirs | PG&E power generation reservoirs within North Fork Feather River | Moderate | Bad | 3 |

## REFERENCES

California Geologic Survey, Note 36 – California Geomorphic Provinces, revised 12/02.

Saucedo, G.J. and Wagner, D.L., 1992, Geologic map of the Chico quadrangle, California, California Department of Conservation – Division of Mines and Geology, Scale 1:250,000

USDA-Forest Service, 2008 Butte-Lighting Complex & Canyon Complex Burned Area Emergency Response (BAER). Draft document.

**DRAFT TECHNICAL SPECIALIST'S**
**STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report**

**Resource: Hydrology/Water Quality**

**Fire Name:** BTU Lightning Fires **Month/Year:** September 2008
2008 Butte Fires CA-CDF-000593

**Author Name:** Drew Coe, Hydrologist
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## 1. BACKGROUND

This report assesses potential hydrologic and water quality impacts to watersheds draining the 2008 Butte Fires. The incident consists of 41 separate fires covering 115,775 acres in Butte and Plumas Counties (Map 1). Since the majority of the fires are relatively small in size, this report will discuss seven of the larger fires comprising 82,189 of the total acreage. Focus will be on assessing hydrologic and water quality impacts on private land within the State Responsibility Areas (SRA Map # 3).

Areas affected by the 2008 Butte Fires drain portions of the Sacramento River Basin. Surface water bodies directly impacted by the fires include portions of Big Chico Creek, Butte Creek, North Fork Feather River, Middle Fork Feather River (i.e., Little Last Chance Creek to Lake Oroville), and Lake Oroville. Beneficial uses for these impacted water bodies include: 1) municipal and domestic water supply; 2) agriculture (e.g., irrigation and stock watering); 3) power generation; 4) contact and non-contact recreation; 5) warm and cold freshwater habitats; 6) warm and coldwater migration; 7) warm and coldwater spawning habitat; and 8) wildlife habitat (CVRWQCB, 2007).

Wildfires primarily affect water quality through increased sedimentation (Wondzell and King, 2003). As a result, the primary water quality constituents affected by these fires include color, sediment, settleable material, suspended material, and turbidity. Fire-induced increases in mass wasting along with extensive tree mortality can result in increases in floating material – primarily in the form of large woody debris. Post fire delivery of organic debris to stream channels can potentially decrease dissolved oxygen concentrations in streams. Fire-induced mortality within riparian zones can lead to stream temperature increases. Fire-derived ash inputs can increase pH, alkalinity, conductivity, and nutrient flux (e.g. ammonium, nitrate, phosphate, and potassium), although these changes are generally short lived (Stevan and Dean, 2003). Post fire increases in runoff and sedimentation within the urban interface may also lead to increases in chemical constituents, oil/grease, and pesticides. This report will primarily address impacts related to sediment.

Due to the rapid nature of the assessment, this report will address the relative magnitude of impacts from the fire on hydrologic processes (i.e., peak flows), surface erosion (i.e., rainsplash, sheetwash, rilling, and gullying), and water quality. Whenever possible, impacts are assessed on a watershed basis using stream names listed on USGS topographic maps. The assessment does not refer to Calwater planning watersheds, as the spatial boundaries for these watersheds are not based solely on hydrologic boundaries.

The following assumptions were used for assessment:

1) Post fire increases in runoff and erosion are directly proportional to the percentage of burned area within a watershed and the severity of the fire;
2) Post fire impacts are greatest for high severity fires, and percent ground cover is lowest for high severity fire;
3) Ground cover is the primary driver for post fire increases in runoff and erosion (Dr. Lee MacDonald, Colorado State University, personal communication)
4) Concentrated areas of high burn severity will have more impacts than dispersed areas;
5) Generally, hydrologic and surface erosion impacts to values of concern will decrease with increasing distance from burned areas. This is based on the assumption that impacts attenuate in the downstream direction due to in-channel storage, dilution, etc.

## 2. HUMBOLDT FIRE

### Resource Assessment

**A.** Resource Setting

The Humboldt Fire is comprised of 23,333 acres in Butte County, CA. Approximately 2000 acres burned in the Butte Creek watershed, with the remaining fire area drained by adjoining small tributaries of the Sacramento River (Detailed Map 1). Drainage density is relatively low, with most drainages having an elongate shape. Hillslopes leading down to stream channels are generally planar. Soils are derived from mudflows of the Tuscan Formation (see Geologist Specialist report). Soils are generally shallow, somewhat poorly drained, and range in texture from gravelly to very cobbly loam.

Fire severity mapping using the Burned Area Reflectance Classification (BARC) method indicated that 44% of the area within the fire perimeter is unburned, 28% burned at low severity, and 28% burned at moderate severity (Map 2). The majority of the Butte Creek watershed burned at low intensity, with small areas of moderate severity fire adjacent to and upslope of the Centerville Road. In the remainder of the Humboldt Fire, patches of moderate to high severity fire are concentrated within upper Comanche Creek, headwater

tributaries of Little Chico Creek, and headwater drainages near the southwest city limits of Paradise.

**B.** Survey Methods

The Humboldt Fire was assessed by CALFIRE helicopter on 14 September, 2008. Portions of the Humboldt Fire were also assessed via automobile on 14 September, 2008. The automobile survey included areas within the Dry Creek drainage, unnamed drainages near the southwest city limits of Paradise, and the Butte Creek canyon along Centerville Road.

## Observations

**A.** General Observations

Observations of fire severity is generally consistent with those mapped using BARC. Recovery of vegetation is already occurring on most hillslopes, and relatively high ground cover exists due to the patchy nature of the fire as well as abundant leaf and needle cast. Most riparian areas are lightly burned or unburned. Overall relief is low and slopes generally do not exceed 60% except in localized areas (see Geologist's Specialist Report). Due to the shallow nature of the soils the dominant form of runoff is assumed to be saturation overland flow and subsurface stormflow. This results in a "flashy" runoff regime regardless of fire impacts. Due to the high rock content of the soil, the relative lack of moderate to high burn severity, and the relative abundance of ground cover, expected increases in post fire runoff and surface erosion for the entire Humboldt Fire is relatively low.

**B.** Specific Observations

Portions of the Butte Creek Canyon were assessed due to the elevated risk of fine sediment delivery to anadromous Butte Creek. Most of the area within the Butte Creek canyon mapped as moderate burn severity appears to be from backfiring along the Centerville Road. These burned areas adjacent to Butte Creek have relatively short slope lengths and the burned hillslopes are generally planar in form. Erosion rates from planar hillslopes can be less than 1/3 the value of erosion rates from convergent areas (Benavides-Solorio and MacDonald, 2005)), due to the difference in dominant erosion process (i.e., sheetwash vs. rill erosion and gullying). In addition, the riparian zone between the Centerville Road and Butte Creek is largely intact, resulting in high sediment filtering efficiency for fine sediment. There is a chance for localized sediment delivery when hillslope sediment is deposited within hydrologically connected roadside ditches.

Field observations indicate that newly rehabilitated bulldozer firelines within portions of the Humboldt Fire are being utilized by off highway vehicles (OHV). Unless OHV-related use of these firelines is discouraged or prohibited, firelines may become a chronic source of fine sediment to drainages within the Humboldt Fire.

## Emergency Determination

The values at risk in this assessment are Spring-run Chinook salmon (SRCS) and Central Valley steelhead (CVS) residing in Butte Creek (see Fisheries Technical Report). Due to the relatively low burn acreage within Butte Creek, the preponderance of low burn severity within the Canyon, and limited connectivity of burned areas to Butte Creek, there is a low to moderate potential for fine sediment impacts to the anadromous fisheries of Butte Creek.

Other values at risk include water quality in the headwater drainages near the southwest city limits of Paradise, headwaters of Comanche Creek, and small tributaries of Little Chico Creek. Primary impacts to water quality will be increases in turbidity, sediment, and settleable solids due to increased hillslope erosion. In-channel increases in these constituents will diminish rapidly as hillslope vegetation recovers. Impacts to these drainages will be localized in scale, and will diminish in the downstream direction due to in-channel storage and dilution. Impacts to water quality will be persistent where OHV traffic continues to utilize fireline as recreational corridors.

## Recommendations

**A.** General Recommendations

1. Butte Creek should be visually monitored for water quality impacts (e.g. increased turbidity) during the early part of the wet season when precipitation intensity exceeds 0.5 inches per hour (see http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=PDE). If elevated turbidity is present in Butte Creek, hydrologically connected roadside ditches should be inspected for sediment laden water. To mitigate potential drainage impacts from roads see:
http://ntl.bts.gov/lib/24000/24600/24650/Chapters/I_Ch7_Drainage_of_Low_Volume_Roads.pdf
2. Educational outreach and signage should be used to inform OHV users of potential water quality impacts from OHV traffic on abandoned firelines. Furthermore, placing barriers at access points to the firelines can minimize water quality impacts from the OHV traffic.
3. Landowners interested in preventing soil erosion on their property should apply at least 70% ground cover to the soil surface. Ground cover should consist of USDA certified weed free straw or biomassed native vegetation.

# 3. BELDEN FIRE

## Resource Assessment

**A.** Resource Setting

The Belden Fire is comprised of 2,131 acres in Plumas County, CA (Detail Map # 2). The Belden Fire drains into Chips Creek and Little Indian Creek, which are tributaries to the North Fork of the Feather River (NFFR). The fire primarily burned the southwest facing hillslopes draining into lower Chips Creek and the northwest facing hillslopes draining into lower Little Indian Creek. A very small percentage of the fire burned hillslopes adjacent to

Highway 70. Soils are primarily derived from metasedimentary rock (see Geologist Specialist report) and are shallow, excessively drained, with a gravelly sandy loam texture. Portions of the Belden Fire overlapped with the Storrie Fire from the year 2000 (Map # 8). Areas overlapping the Storrie Fire are dominated by shrub species and have little or no conifer overstory due to high mortality.

Fire severity mapping using the BARC method indicates that 44% of the area within the fire perimeter is unburned, 28% burned at low severity, and 28% burned at moderate severity (Map # 2). Approximately 70% of the burned area is within the lower Chips Creek watershed, whereas the majority of the remaining area (i.e., ≤ 30%) is within the lower watershed of Little Indian Creek. Approximately 5-10% of the entire Chips Creek and Little Indian Creek watersheds were burned by a patchwork of low to moderate severity wildfire.

**B.** Survey Methods

The Belden Fire was assessed by helicopter on 14 September, 2008. Portions of the Belden Fire were also assessed via automobile on 15 September, 2008. Areas visited within the Belden Fire include the alluvial fans at the mouths of Chips Creek and Little Indian Creek.

## Observations

**A.** General Observation

Observations of fire severity are generally consistent with those mapped using BARC. However, reflectance of the fire area may be overestimated due to the overlap with the historic high severity Storrie Fire of 2000 and the abundance of bedrock outcrops within the fire area. As a result, the BARC method may have overestimated the proportion of moderate severity fire relative to the actual conditions. Ongoing impacts from the 2000 Storrie Fire were observed on the helicopter flight, and these included the presence of numerous active unstable areas (Jonathan Mulder, C.E.G. 1352, personal communication) (see Geologist Specialist Report).

**B.** Specific Observations

Field observations indicate that dwellings are located on the alluvial fan of Little Indian Creek. The Highway 70 bridges are also located on the alluvial fans of Little Indian Creek and Chips Creek. Trash racks are present above each of the bridges.

## Emergency Determination

The values at risk in this assessment are structures at the bottom of Little Indian Creek (**B-1**), and the Highway 70 bridges at the mouths of Little Indian Creek (**B-3**) and Chips Creek (**B-2**) (Detailed Map 2) (Table 1). Peak flow impacts from the Belden Fire will be minimal because the areas burned within the Little Indian Creek and Chips Creek watersheds are

small relative to the total watershed area (i.e., approximately 5%), and 72% of the fire areas was unburned or burned at low severity.

Due to the persistent impacts from the Storrie Fire, hydrologic impacts to the values at risk may include flooding due to a mass wasting induced rapid increase in channel bed elevation (see Geologist Specialist Report). Rapid changes in channel bed elevation may also induce channel avulsions across the alluvial fan. This poses a significant hazard to the structures at the bottom of Little Indian Creek, especially if structures are located near the apex of the alluvial fan. Channel avulsion may also occur when sediment and debris becomes lodged above the trash racks located upstream of the Highway 70 bridges.

Other values at risk include water quality in Little Indian Creek, Chips Creek, and the North Fork of the Feather. Risks to water quality posed by the Belden Fire include increased turbidity, sediment, and settleable solids. Impacts to water quality from surface erosion will be relatively low due to the low proportion of watershed area burned within the Little Indian Creek and Chips Creek drainages. These impacts will diminish as vegetation recovers. Mass wasting and fluvial transported large woody debris will increase floating material in the North Fork Feather River. This may potentially affect PG&E hydroelectric facilities downstream.

**Recommendations**

**A.** General Recommendation

**1.** Increase awareness of hydrogeomorphic hazards present at **B-1** and **B-2** (see Geologist Specialist Report).

**2.** Refer to Engineer Specialist Report for recommendations regarding the impacts of floating material to PG&E hydroelectric facilities

## 4. NORTH CAMP FIRE

**Resource Assessment**

**A.** Resource Assessment

The North Camp Fire assessment area is the portion of the Camp Fire north of Dogwood Creek (Detail Map 2). The North Camp Fire is comprised of 23,973 acres within Butte and Plumas Counties. The North Camp Fire is drained by Rock Creek and by various small tributaries to the NFFR. The small tributaries to the NFFR include Dogwood Creek, Camp Creek, Cedar Creek, Swamp Creek, Rock Creek, Jackass Creek, Granite Creek, and Chambers Creek. Elevations in the burned area range from approximately 1600 feet near the mouth of Dogwood Creek to 6400 feet in the headwater of Rock Creek. Relief and

hillslope gradients are generally high. Soils are primarily derived from granitoid rocks, and are relatively deep, well drained, and range in texture from sandy loam to coarse sandy loam.

Fire severity mapping using BARC method indicate that approximately 75% of the North Camp Fire area is dominated by low severity fire and unburned areas. Moderate severity and high severity wildfire comprise 20% and 5% of the fire area, respectively. Patches of moderate and high severity wildfire are concentrated in the upper portions of Camp Creek, lower Jackass Creek, Granite Creek, Chambers Creek, and hillslopes adjacent to Highway 70.

**B.** Survey Methods

The North Camp Fire was assessed by helicopter on 14 September, 2008. Field reconnaissance for portions of the North Camp Fire was via Highway 70, Pulga Road, and Camp Creek Road. Particular attention was paid to the municipal water supply at Jackass Creek for the community of Tobin.

## Observations

**A.** General Observations

Observations of fire severity were generally consistent with those mapped using the BARC method. However, due to the size of the fire and limited access to the majority of the fire area it was difficult to assess the overall accuracy of the fire severity mapping.

**B.** Specific Observations

The Jackass Creek drainage above the Jackass Creek water diversion was burned at moderate severity, with much of the fire concentrated in the lower hillslopes of the drainage. Hillslopes above the Pulga and Camp Creek Roads were inspected for fire damage. Along these roads, relatively high surface cover is on the ground due to leaf and needle cast.

## Emergency Determination

The values at risk in this assessment are the municipal water supply for the community of Tobin at Jackass Creek (**NC-1**) (Table 1). Risks to the structures are discussed in the Geologist and Engineer's Specialist Reports. Increased runoff and sediment has the potential to affect drainage structures along the midslope PG&E access road (aka Pulga Road; Storrie Road; Camp Creek Road). Risks to water quality for the municipal water supply include increased turbidity, sediment, settleable solids, and floatable material. Predicted sediment delivery to Jackass Creek is 11 tons per acre for the first year, with a rapid decrease within 2-5 years (BAER, 2008), and this prediction does not include sediment inputs from mass wasting. Given that mass wasting is the dominant erosion

processes within the affected portions of the drainage (see Geologist Specialist Report), it is not cost-effective to treat the hillslopes within the Jackass Creek drainage.

Additional values at risk include downstream PG&E hydroelectric structures. Mass wasting and fluvial transport of large woody debris will increase abundance of floating material in the NFFR.

**Recommendations**

**A.** General Recommendation

**1.** Implement best management practices to avoid fire-induced erosional impacts to midslope PG&E access road. See Geologist Specialist Report for general recommendations regarding roads.

**2.** Refer to Engineer Specialist Report for recommendations regarding the impacts of floating material to PG&E hydroelectric facilities

## 5. SOUTH CAMP FIRE

**Resource Assessment**

**A.** Resource Setting

The South Camp Fire assessment area is the portion of the Camp Fire south of Dogwood Creek (Detail Map 3). The South Camp Fire is comprised of 25,670 acres within Butte County. The South Camp Fire is drained by Concow Creek, Flea Valley Creek, and various small tributaries to the NFFR and West Branch of the North Fork of the Feather River (West Branch NFFR). Concow Reservoir is located within the southern portion of the fire and receives drainage from Concow Creek and Cirby Creek. The size of the reservoir is approximately 0.75 $mi^2$, and the reservoir has a watershed area of approximately 15 $mi^2$. Capacity of the reservoir is estimated to be 7000 acre-feet with an average inflow of approximately 22,000 acre-feet per year (http://www.southfeather.com/Board/2008/072208_PowerDivision_Manager.pdf).

The South Camp Fire ranges in elevation from approximately 1200 to 4200 feet. Hillslopes within Flea Valley Creek drainage are particularly steep, and total relief exceeds 2700 feet. Drainage density is relatively high within the fire area. Soils within the fire area are derived from granitoid, ultramafic, metavolcanic, and metasedimentary rock (see Geologist Specialist Report). Soils vary in depth, drainage, and soil texture according to lithology. The soils immediately surrounding Concow Reservoir are generally derived from weathered granitoid rocks, and have a relatively high erosion hazard rating.

Fire severity mapping using BARC method (Map # 2) indicates that the South Camp Fire has the highest concentration of moderate to high severity fire in the 2008 Butte Fire Complex. The South Camp Fire contains approximately 15% unburned areas, 45% low severity fire, and 40% moderate to high severity fire. The highest proportion of moderate

to high severity fire is concentrated in Flea Valley Creek and watersheds draining to Concow Reservoir.

**B.** Survey Methods

The South Camp Fire was assessed by helicopter on 14 September, 2008. Field reconnaissance for portions of the South Camp Fire was via Highway 70, Pulga Road, Concow Road, Rim Road, and Jordan Hill Road on September 15-16, 2008. Particular attention was paid to residences and civil structures around Concow Reservoir and in/near the community of Pulga.

## Observations

**A.** General Observations

Observations of burn severity were generally consistent with those mapped using the BARC method. The areas mapped as high severity were void of ground cover but did not display signs of high soil heating. The highest concentrations of moderate/high severity fire are located in the upper portions of Concow Creek, Cirby Creek, along the Jordan Hill Road, and along the upper and southwest portions of the Flea Valley Creek drainage. Approximately 50% of the upper Concow Reservoir watershed was burned by moderate/high severity wildfire, and approximately 60% of the Flea Valley Creek drainage was burned by moderate/high severity wildfire.

Field observations indicated that significant household waste and possibly industrial waste exists in portions of the burned areas. Also, extensive emergency salvage logging operations are currently being conducted throughout the South Camp Fire area.

**B.** Specific Observations

The community of Pulga near the mouth of Flea Valley Creek was inspected for values at risk. Values at risk included cabins, the Pulga Road box culvert across Flea Valley Creek, and the Union-Pacific railroad crossing over Flea Valley Creek. One cabin located above the Pulga Road box culvert crossing is within the channel zone of Flea Valley Creek. The cabin shows signs of current occupation. Five of the older, unoccupied cabins directly below the box culvert were within the channel zone of Flea Valley Creek. Further downstream, the newer, occupied cabins appear to be built upon an alluvial fan at the mouth of Flea Valley Creek. For specific discussion regarding the Pulga Road box culvert and Union-Pacific railroad crossing see the Geologist and Engineer Specialists Report.

Site specific observations were made of road-stream crossings in and around Concow Reservoir. These include road-stream crossing along Concow Road, Hoffman Road, the Camelot subdivision, and Jordan Hill Road. These crossings were downstream of the most severely burned areas. In particular, a box culvert where Concow Road crosses an unnamed tributary to Concow Reservoir shows previous signs of overtopping. No homes

within the Concow area appear to be within the channel zone of streams significantly affected by the fire

**Emergency Determination**

The values at risk due to fire-related increases in peak flows include the cabin above the Pulga Road box culvert (**SC-1**), the Pulga Road box culvert (**SC-2**), the five older cabins below the box culvert (**SC-2**), and the Union-Pacific railroad crossing (**SC-3**) (Table 1). Fire related increases to peak flows are expected to be moderate to high due to the relatively high percentage of the watershed burned at moderate to high severity. The USFS BAER report indicates that peak flows in Flea Valley Creek will approximately double for the 5-year return interval, 6-hour duration storm. However, it is unclear in the report whether the entire watershed was modeled for runoff, or if only USFS land was modeled. Hydrologic impacts should not be considered in isolation from geologic hazards, as the two can combine synergistically to create catastrophic downstream effects. For details on geologic hazards regarding **SC-1**, **SC-2**, and **SC-3** see the Geologist Technical Report.

Additional values at risk due to fire-related increases in peak flows include the Concow Road crossing over an unnamed tributary to Concow Reservoir (**SC-6**). The crossing shows some signs of overtopping during previous flood flows. The left-bank fill on the outlet side of the crossing is oversteepened and is eroding due to poor drainage from the approaches. Fire-induced peak flows at this crossing will be relatively high because the drainage area above the crossing has a very high percentage of moderate to high severity fire. **SC-6** is at high risk given that the crossing may have overtopped during previous winters, the left-bank fill is currently eroding, and peak flows will be significant increased.

Values at risk include water quality in Flea Valley Creek watershed. Using the WEPP model, the USFS BAER report (2008) predicts that 8-22 tons per acre of sediment delivery will occur in Flea Valley Creek during the first year. However, hillslope treatments within Flea Valley Creek are not cost effective given that hillslopes are steep and mass wasting is the dominant erosion process. Large woody debris transport from mass wasting and fluvial processes is expected to increase the abundance of floating material in the NFFR. This could potentially affect downstream PG&E hydroelectric structures.

Values at risk also include water quality in the Concow Reservoir watershed (**SC-5**). The BAER report (2008) estimates sediment delivery to Concow Reservoir as 43 tons per acre for the first year post fire. The estimated sediment delivery rate to Concow Reservoir assumes that hillslopes have burned at moderate severity and have no ground cover. Assuming a worst-case scenario where the entire watershed area is delivering sediment to Concow Reservoir at the modeled rate (i.e., no ground cover), we assume that first year post-fire sediment inputs to the reservoir will equal less than 3% of the reservoir's capacity[1].

Erosion into Concow Reservoir (**SC-5**) can be minimized by adding ground cover to the soil surface prior to the start of the wet season. However, the scale of treatment necessary

[1] Assuming a bulk density of 1.6 Mg $m^{-3}$.

to prevent water quality impacts to the reservoir is cost prohibitive. Landowners conducting Emergency Salvage Operation should be encouraged to spread logging slash across hillslopes as ground cover.

Additional water quality impacts to Concow Reservoir include the delivery of industrial and household chemicals via post fire runoff and erosion (**SC-5**). The greatest risk to water quality is from waste materials located near stream channels and/or in convergent areas (i.e., swales). Priority should be given to cleaning up industrial and household waste in these areas.

**Recommendations**

**A.** General Recommendations

**1.** In and around Concow Reservoir, landowners interested in preventing soil erosion on their property should apply at least 70% cover to the soil surface. Ground cover should consist of USDA certified weed free straw or biomassed native vegetation. Landowners conducting Emergency Salvage Operations should be encourage to spread logging slash across otherwise bare hillslopes.

**2.** Responsible agencies should specifically assess the need for cleanup of household and industrial waste within the Concow Reservoir watershed. Prioritization should be given to cleaning up waste adjacent to stream channels and in convergent areas (i.e., swales).

**3.** Refer to Engineer Specialist Report for recommendations regarding the impacts of floating material to PG&E hydroelectric facilities

**B.** Specific Recommendations

**1.** For specific recommendations regarding **SC-1**, **SC-2**, **SC-3, and SC-6** please refer to the Geologist and Engineer Specialist Reports.

## 6. FRIEND-DARNELL FIRE

**Resource Assessment**

**A.** Resource Setting

The Friend-Darnell Fire is comprised of 3,845 acres in Butte County, CA (Detailed Map 4). Areas within the Friend-Darnell Fire primarily drain to Bean Creek and tributaries to the Middle Fork of the Feather River (MFFR). Soils are primarily derived from granitoid rock (see Geologist Specialist report) and are moderately deep, well drained, with a sandy loam texture. Drainage density within the fire area is relatively high and hillslope gradients are generally steep

Fire severity mapping using the BARC method indicates that 8% of the area within the fire perimeter is unburned, 38% burned at low severity, 41% burned at moderate severity, and 13% burned at high severity (Map 2). The majority of the moderate and high severity fire burned within the upper portions of the Bean Creek watershed.

**B.** Survey Methods

The Friend-Darnell Fire was assessed by CALFIRE helicopter on 14 September, 2008. Field reconnaissance for portions of the Friend-Darnell Fire was via the Bean Creek Road on 17 September, 2008. Particular attention was paid to homes and domestic water supply intakes within the Berry Creek Rancheria, and to drainage structures along the Berry Creek Road.

## Observations

**A.** General Observations

Observations of burn severity were generally consistent with those mapped using the BARC method. The fire was most severe in the northeast headwaters of Bean Creek. The hillslopes within this area are steep, void of ground cover, and have little or no potential for leaf or needle cast.

**B.** Specific Observations

Two road-stream crossings were inspected along the Bean Creek Road where it crosses Bean Creek. Both crossings contained multiple small diameter culverts (i.e., 24-36" CMPs), and signage indicates that they were built in the 1930s. The diameters of the individual culverts are small relative to the channel width, and both crossings showed previous signs of overtopping due to debris blockage. Inlets and outlets for both culverts are armored with concrete. The upper crossing has a poorly defined critical dip (i.e., diversion potential dip) draining back into the right bank of Bean Creek. The crossing has a moderate risk of stream diversion down the Bean Creek Road. The lower crossing has no risk of stream diversion down the road.

Residential structures and domestic water supply intakes were inspected within the Bean Creek Rancheria. A house and a trailer are adjacent to Bean Creek. The house is outside the channel zone of Bean Creek, whereas the trailer is within 10-20 feet of the active channel. A water supply intake is located approximately 50 feet upstream of the trailer and consists of a small diameter pipe (i.e., approximately less than 4"). In the vicinity of the water intake pipe, an old irrigation ditch exits the Bean Creek channel and leads directly to the trailer. The trailer appears to be uninhabited. The house is currently occupied, and appears to be receiving domestic water from a well adjacent to Bean Creek.

## Emergency Determination

Values at risk include portions of the Bean Creek Road below the upper Bean Creek crossing (**FD-3**) (Table 1). A moderate potential for stream diversion exists at this crossing if fire-induced peak flows, sediment, and debris combine to plug the culvert. In particular, the Bean Creek Road could get washed out if Bean Creek is diverted down the inside ditch of the road. The Upper Bean Creek crossing has a low potential for catastrophic failure given that the inlets and outlets are so heavily armored, and the crossing has survived historical floods from the 1950s, 1960s, and 1990s.

Values at risk also include the lower Bean Creek crossing (**FD-4**). As mentioned previously, this culvert has plugged in the past. Plugging of the culverts is likely given the likelihood for fire-induced flooding, sediment transport, and debris transport. However, given its location within the channel zone there is low potential for stream diversion at this site. The Lower Bean Creek crossing has a relatively low potential for catastrophic failure given that the inlets and outlets are so heavily armored, and the crossing has survived historical floods from the 1950s, 1960s, and 1990s.

Additional values at risk include the stream adjacent trailer within the Bean Creek Rancheria (**FD-1**) and the domestic water supply intake upstream of the trailer (**FD-2**). The Geology Specialist Report discusses hazards related to **FD-1**. Given the relatively large fire-induced increases in runoff and erosion, the water intake at **FD-2** will likely plug.

The Friend-Darnell fire will adversely affect water quality in the Bean Creek drainage. Impacts will include relatively high increases in turbidity, sediment, and settleable solids due to accelerated runoff and erosion. Hillslope treatments to mitigate these impacts will not be cost-effective due to the steepness of the hillslopes and the relatively large area (i.e., 2000 acres) affected by moderate to high severity fire.

## Recommendations

**1.** At the upper Bean Creek road crossing (**FD-3**), redefine the existing critical dip draining to the right bank of Bean Creek. Furthermore, the inside ditch should be blocked so that diverted water does not continue to flow down the road. See Engineer Specialist Report for further details.

# 7. CRAIG FIRE

## Resource Assessment

### A. Resource Setting

The Craig Fire is comprised of 1,999 acres in Butte County, CA. Hillslopes within the Craig Fire primarily drain to the Middle Fork Feather arm of Lake Oroville. Soils are primarily derived from granitoid rock (see Geologist Specialist report) and are moderately

deep, well drained, with a sandy loam texture. Hillslope gradient within the drainage area are generally steep. No BARC map was provided for the Craig Fire

**B.** Survey Methods

The Craig Area was inspected by helicopter on 14 September, 2008. Field reconnaissance for portions of the Craig Fire was performed on 17 September, 2008.

**Observations**

Field observations indicate that the majority of the fire area was burned at low to moderate severity. Expected hydrologic and water quality impacts to values of concern (e.g. Lake Oroville) are low.

## 8. Inskip-Breakneck Fires

The Inskip and Breakneck Fires were field inspected on 13 September, 2008. The Breakneck is 771 acres in size and drains to Big Kimshew Creek and the West Branch NFFR. The Inskip Fire is 466 acres and drains to the West Branch NFFR. Values at risk include cold water fisheries of the West Branch NFFR. Due to the fact that the fires were small, fire severities were generally low, and the fires were confined to upper hillslopes, they present a relatively low risk for accelerated runoff and surface erosion. Refer to the Geologist Specialist Report for details regarding geologic hazards.

**Table 1.** Locations of specific values at risk referred to in the Hydrology/Water Quality Specialist Report.

| ID_Number | Description | Latitude | Longitude |
|---|---|---|---|
| FD-1 | Bean Ck. Trailer | 39° 37' 44.23" | 121° 19' 45.21" |
| FD-3 | Bean Ck. Upper Xing | 39° 37' 33.44" | 121° 19' 41.11" |
| FD-4 | Bean Ck. Lower Xing | 39° 37' 35.02" | 121°19' 42.24" |
| FD-2 | Bean Ck. water intake | 39° 37' 21.96" | 121° 19' 38.53" |
| B-2 | Chips Ck. Bridge | 40° 0' 18.81" | 121° 15' 47.80" |
| B-1 | Little Indian Ck. Bridge | 40° 0' 1.28" | 121° 16' 13.46" |
| NC-1 | Jackass Ck. Water Intake | 39° 56' 9.87" | 121° 19' 7.19" |
| SC-5 | Concow Rd. Xing | 39° 46' 12.30" | 121° 31' 12.77" |
| SC-6 | Concow Reservoir | 39° 46' 52.71" | 121° 30' 19.60" |
| SC-2 | Pulga Rd. Xing / Cabins | 39° 48' 13.80" | 121° 27' 1.28" |
| SC-3 | Railroad Xing | 39° 48' 8.67" | 121° 26' 50.56" |
| SC-1 | Upper Pulga Cabin | 39° 48' 17.48" | 121° 27' 7.91" |

## 9. References.


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**DRAFT TECHNICAL SPECIALIST'S**
**STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report**

**Resource: Civil Engineering**

**Fire Name: 2008 Butte Fires CA-CDF-000593** **Month/Year:** September 2008

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## OVERVIEW

The portion of the Butte Fire Complex included in this investigation is comprised of 41 fires that amount to approximately 115,773 burned acres within Butte County, California. The forty one fires are spread over a large geographic area within Butte, Plumas and Tehama Counties (Map # 1). The fires spread over 57,086 acres of Federal lands, 56, 944 acres of State owned lands, and 1300 acres of private lands.

The goal of this assessment was to evaluate the possible elevated risk that the burned area within each fire poses to life, property, and resources caused by post-fire hazards such as landslides, debris flows, rock falls, and localized debris torrents and flood flows.

Presented herein is a description of our investigation of each of the eight fires, assessed according to high, moderate and low priorities in terms of predicting threats to life, property, and resources. The remaining 33 fires are not addressed due to their remote location, access, or Federal jurisdiction. The eight fires addressed in this report include: 1) a discussion of the physical setting of the fire area, 2) the survey methods in evaluating the post-fire impacts to lives and infrastructure, 3) our observations related to the local geomorphology and its influence on posing potential risks from landslides, debris flow, rock fall and erosion, that in turn have the potential to threaten life, property and resources, 4) a discussion of the identified values at risk, and 5) our recommendations to reduce potential adverse effects caused by the fire.

The Civil Engineering specialist's responsibilities of the SEAT include addressing general impacts to physical infrastructure as it relates to post-fire threats to life, property and resources. This assessment includes surveying bridges, culverts, roads, hydropower facilities and associated appurtenances, water delivery systems, reservoirs, dams, railroad crossings, residences and businesses.

The approach of the SEAT report is multi-disciplined in nature, and as such, integrates information drawn from other specialists' assessments. This is particularly true in the case of this Civil Engineering Specialist Report, which often draws from the Hydrologist's Specialist Report for use in assessing the post-fire runoff effects on the design capacity of culverts and reservoirs per hydrologic models. Similarly, this report will also rely on emergency determinations given in the Geologist's Specialist Report in terms of predicting landslides, debris flows, rock fall, and localized erosion conditions that can pose potential threats to infrastructure.

It should also be noted that the time constraints given for producing the SEAT report prohibits an in-depth analysis of impacts to infrastructure and the consequent recommended mitigation measures in terms of precise sizing of culverts to meet the demands of increased flood flows, preliminary designs to replace debris damaged foundations, and site specific re-grading needs to realign altered stream courses caused by debris and sediment flow impacts. Furthermore, there are likely to be areas within the burn perimeter and other locations of potential values at risk that were not observed or assessed, as well as other areas where the potential risks are either higher or lower than our initial reconnaissance-level assessment concludes.

## AREAS OF PARTICULAR CONCERN

The water quality in Lake Oroville may experience detrimental impacts due to the debris flow, rock fall and soil erosion created by the burned watersheds above its headwaters. This in turn can lead to increased turbidity and sedimentation induced upon the watersheds' streams and tributaries that flow down slope to the State Water Project at Lake Oroville. These impacts are discussed in more detail in the Hydrologist's Specialist Report as well as in the US Forest Service Butte Lightning Complex BAER Hydrologist's Report (BAER, 2008).

According to the Butte Lightning Fire Complex US Forest Service BAER Report (BAER, 2008), specific areas of risk of increased flood and debris flows include Concow, Storrie, Pulga, Little Indian Creek, and the Berry Creek Rancheria. These areas were predicted to have increased stream flows during the burned area recovery period. The SEAT team did access Concow, Little Indian Creek and the Berry Creek Rancheria, and in so doing, basically concurred with the US Forest Service BAER Report findings related to these.

## HUMBOLDT FIRE

### 1.1 Resource Condition Assessment

A. Resource Setting

The Humboldt Fire encompasses about 23,330 acres of land, all of which lies in Butte County. The burned area resides within the southwest region of Butte County and burned a total of 23,350 acres, which contained about 400 acres of federal land, 22,900 acres of State land, and 60 acres of private lands.

Topographically, the Humboldt Fire ranges in elevation from about 200 to 1600 feet above mean sea level.

Based on our observations and on Burned Area Reflectance Classification (BARC) maps provided by the USFS (BEAR, 2008), the Humboldt Fire had a low to moderate burn intensity, as evidenced by viewing **photos for H-1 and Detail Map # 1 Point H-1.**

B. Survey Methods

In order to properly access the risk to life, property and resources, a preliminary desktop research was done using geographic maps, Burned Area Reflectance Classification (BARC) maps, hydrologic data and other available resources. Before performing our on the ground field surveys, the Humboldt Fire was investigated from the air by a helicopter on September 13th. On the ground follow-up surveys were conducted by driving the roads within the Humboldt Fire's perimeter during two field days, September 15th and 19th. The first field outing took the team members along Centerville and Honey Run roads. The second field excursion took us to Humboldt and Skyview roads. In order to view the residences and land that withstood damage from the fire, we took a diversion off Skyview Road and traveled west along Abby Road.

## 1.2 Observations

A. General Observations

The focus of our September 19th field investigation was done by driving the roads of Skyway, Honey Run Road, Abby and Centerville Road within the burn area.

We observed a low to moderate intensity burn along the side slopes of Butte Creek Canyon that flanks Butte Creek (**Detail Map # 1, photo H-1**). The homes and access road that border Butte Creek are potentially subject to flooding due to the denuded slopes cause by the fire. One active landslide was evident along Centerville Road near the intersection of Honey Run Road. Please see the Geologist's Specialist Report for more detail on this particular landslide and consequential impacts to drainage culverts that cross the roadway.

Some homes along Centerville and Abby Road as well as the surrounding area were burned, however many remain intact due to the checkerboard burn patterns characteristic of the Humboldt Fire.

## 1.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of natural resources related to sediment entering Butte Creek, which is a recognized anadromous fishery stream course populated with Spring Run Chinook Salmon. (See the Fisheries Biologist's Specialist Report for more detail regarding observations and threats to anadromous fisheries in Butte Creek).

Several culverted road crossings were observed along Centerville Road. The size of the culverts which appear to be limited in design capacity due to the increased runoff, may not adequately convey the additional flows and debris that will occur as a result of the burn. As a result, this may lead to the culvert crossings either failing or diverting flows to areas that in turn cause road pavement failures, flooding of property, and the like. The consequence of these occurrences would result in costly solutions, not only related to repairing the damaged crossings, but also from a threat to anadromous and native fisheries by way of increased sediment deposits in Butte Creek.

For a site specific assessment of an active landslide that jeopardized a drainage culvert road crossing at a point along Centerville Road near its intersection with Honey Run Road, please see the Geologist's Specialist Report.

The Forestry, Fisheries and Biological issues related to the above mentioned values at risk are addressed in the respective disciplinary specialist's reports.

## 1.4 Recommendations

A. General Recommendations:

1. Performing hydrologic and hydraulic analyses for the series of drainage culverts that provide drainage along Centerville Road was not feasible due to the time constraints of producing this report. However, the local controlling agency/owner is encouraged to employee a licensed engineer or certified professional to perform such analyses to reassess the capacity of the two bridges being mindful of the increased storm water runoff, debris flows, and sedimentation caused by the fire.

2. Where bridges and culverted road crossings pass over Butte Creek, particularly where debris flows and vegetation persist, It is recommended that a series of I beams upstream of the road crossings be placed in a "V" shape configuration with the apex pointing upstream so as to avoid causing debris buildup while still providing deflection of debris that could cause damage to the conveyance structures (Weaver and Hagans, June 1994).

3. It is highly recommended that maintenance crews perform debris removal of in channel vegetation and debris to decrease the chance of flooding. Developing a maintenance schedule based on a ranking of flow can be used to prioritize the treatment of conveyance structures along the tributaries that feed into the Lower Butte Creek.

4. It is suggested that the appropriate agency/owner should perform consistent monitoring and maintenance of the crossings. For general mitigation activities related to concrete conveyance bridge structure, see reference links to websites for this particular Best Management Practices (BMP) as well as the pertinent references located at the end of this report.

## BELDEN FIRE

### 2.1 Resource Condition Assessment

a) Resource Setting

The Belden fire encompasses about 475 acres of land in Plumas County, most of which lies in the Plumas National Forest. The burned area spread over 473 acres of federal land, with only 1.5 acres of State land burned.

The Belden fire is accessed along Highway 70 and bridges over two predominant creeks, namely Little Indian Creek and Chips Creek.

b) Survey Methods

The Belden fire was investigated on September 19th and consisted of an on the ground survey accessed from Highway 70 adjacent to the town of Belden. During this inspection, the SEAT made site-specific assessments across bridge crossings located at Little Indian Creek and Chips Creek.

### 2.2 Observations

A. General and Specific Observations

The focus of our field investigation was in the area of the burn that resides to the west of the town of Belden, and can be readily seen from Highway 70.

Based on our observations and on Burned Area Reflectance Classification (BARC) maps provided by the USFS (BEAR, 2008), the Belden fire had a low to moderate burn intensity, as evidenced by viewing **photos B-2 and B-4** as well as **Detail Map # 2 points B1 and B2.**

In that this reach of Highway 70 has geological conditions conducive to landslides, falling rock debris, and soil erosion, Little Indian Creek's bridge crossing (**Map**

**Point B-1**) as well as Chips Creek's bridge crossing (**Map Point B-2**), were subjects of concern in the region of the Belden fire. Homes located adjacent and upslope above Little Indian Creek sit below slopes burned by the fire and as such, are subject to debris flows and sediment transport. (See Geologist's Specialist Report). Also, see the SEAT Hydrologist's Specialist Report for an estimate of the increased storm water runoff as a symptom of the impervious nature of the denuded slopes caused by the Belden fire above these creeks.

B. Site Specific Observations

Little Indian Creek (**Detail Map # 2 Point B-1 , Photo B-1**) shows evidence of past flooding, with the visually apparent build up of sediment and debris upstream of the concrete bridge that crosses Highway 70 and conveys flow to the North Branch of the Feather River. Mitigation measures have been installed, including a series of steel I beam columns located approximately 100 feet upstream and located perpendicular to the stream channel. The columns are strategically placed to catch and divert woody debris to prevent and/or curtail damage to the concrete conveyance channel, abutments, and to allow flood waters to pass under the bridge more readily. Homes above the bridge are subject to mud flows caused by a build up of sediment, as the landslide potential in this region is prevalent (see Geologist's Specialist Report). There are trailer homes nearby the mouth of the channel upstream of this bridge. It appears that the pre-existing condition of flash floods and debris hazards and sediment flow is now exasperated by the likely occurrence of increased flood waters and debris flows that will occur this winter due to the fire.

Chips Creek also shows evidence of past flooding above the concrete bridge crossing of Highway 70. The multi-span bridge is apparently designed to convey large flows from the watershed above (**Detail Map # 2 Point B-2 , Photo B-3**). Similar to Little Indian Creek, a series of I beams are positioned perpendicular to the stream a distance upstream from the bridge. Again, this suggests that prior to the fire, flash floods with problematic debris flows were an issue at this site, and are now only exasperated by the increased runoff originating from the denuded watershed (see Hydrologist's Specialist Report).

## 2.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of trailer homes and residences above Little Indian Creek due to flash floods, sediment build-up, and debris flow hazards.

There is a potential value at risk at Chips Creek, where fast moving woody debris can damage the bridge mid-span column and abutments. The series of I beams that are intended to block fast moving debris may cause debris to dam up at that location due to their configuration perpendicular to the stream course. This debris

build up could force water to rise and pass woody debris around and over the blockage which could in turn subject the bridge to impacts and cause structural damage.

The hydrological and geological findings related to these values at risk are addressed in the respective disciplinary specialist's reports.

## 2.3 Recommendations

A Site-Specific Recommendations:

1. Performing hydrologic and hydraulic analyses for each of the two bridge crossings was not feasible due to the time constraints of producing this report. However, the local agency/owner is encouraged to perform such analyses to reassess the capacity of the two bridges being mindful of the increased storm water runoff, debris flows, hyper concentrated flows, and sedimentation caused by the fire.

2. It is highly recommended to excavate and reinstall the series of steel I beams upstream of both bridges to a "V" shape reconfiguration with the apex pointing upstream so as to avoid causing buildup while still providing deflection of debris that could cause damage to the conveyance structures (Weaver and Hagans, June 1994).

3. It is highly recommended that maintenance crews perform debris removal of in channel vegetation and debris to decrease the chance of flooding. Developing a maintenance schedule based on a ranking of flow can be used to prioritize the treatment of conveyance structures along the tributaries that feed into the North Branch of the Feather River.

4. It is suggested that the appropriate agency/owner should perform consistent monitoring and maintenance of the crossings.

5. It is recommended that the local jurisdictional agency alert residents by either installing early warning devices, developing evacuation plans, and post warning signs where identification of potential hazards are imminent.

6. If not already in place, develop road closure plans if potential hazards are identified.

7. For additional Best Management Practices to curtail impacts to structures due to flooding and debris flow, see the references at the end of this report that give the web links to Best Management Practices (BMPs) that apply to Detail Map **# 2, B-1 and B-2** values at risk.

## CAMP FIRE

### 3.1 Resource Condition Assessment

A. Resource Setting

The Camp Fire was divided into two geographical boundaries separated by Dogwood Road due to the geologic, topographic, geomorphologic, and distribution of values at risk between the two domains. The Camp fire in entirety encompasses about 23,000 acres of State land and 26,500 acres of federal land in Butte and Plumas Counties (Detail Map # 2 and #3).

B. Survey Methods

The North and South sections of the Camp fire were investigated from the air via a helicopter provided by CAL FIRE on September 13th. This overview flight was followed by a ground inspection performed by a majority of the team on September 15th, with a second field visit attended by the Geologist, Archeologist, CAL FIRE SEAT leader and Civil Engineer on September 19th. The ground inspection included driving the main roads within the fire area. The areas visited on September 15th were limited to Pulga Road and Highway 70 where mid to lower elevations of the burn areas were assessed. The author will address values at risk along these two corridors, and defer to other SEAT specialist's reports for assessments of additional values at risk seen elsewhere within the fire perimeter of South Camp.

### 3.2 Observations

A. General Observations

Based on our observations and on Burned Area Reflectance Classification (BARC) maps provided by the USFS (BEAR, 2008), the Camp fire had a low to moderate burn intensity, as evidenced by viewing **photos SC-1, SC-2, SC-3, SC-4, SC-5 and SC-6)** as well as **Detail Map # 2 points NC-1 and Detail Map # 3 Points SC-1, SC-2, SC-3, SC-5, and SC-6).**

B. **Site-Specific Observations: Detail Map # 2 Point NC-1 – Tobin Water Supply Line and Intake**

The water supply line that supplies the town of Tobin (map point NC-1) appears to be damaged by non-fire related impacts such as landslide debris fall. The intercepting water supply intake that delivers water to the town of Tobin was not inspected during our SEAT survey. However, by witnessing the condition of the leaking supply line above the intake, it is recommended that the water supply features be promptly inspected by the responsible local water agency. Assuming that the water intake may have a potential for reduced capacity issues, similar

practices recommended for bridge intakes and culverted road crossings can be applied.

C. **Site-Specific Observations: Detail Map # 3 Point SC-1 – Mystic Valley Retreat Cabin**

Within the burn perimeter of the South Camp fire near the town of Pulga, an access road leads to a series of cabins within the Mystic Valley retreat area that borders Flea Valley Creek.

The creek is choked with woody debris, which indicates that flash floods and debris flows are prone to cause havoc in this area. This fact is underscored in the Geologist's Specialist Report and supported visually by viewing the overwhelming presence of vegetation that chokes the stream crossings **(Photo SC-1)**. It is also evident that the occurrence of floods are common by viewing the undermined condition of the banks, as well as the cabin which appears to have been damaged by flood waters (see Map 4 and Photo SC-1).

D. **Site-Specific Observations: Detail Map # 3 Point SC-2- Series of cabins in Mystic Valley and Pipe Arch Culvert Creek crossing**

Approximately 200 feet downstream of the first cabin that lies within the Mystic Valley and is bordered by Flea Valley Creek, lies a series of remote cabins that appear to be in danger due to the risk of flooding created by the presence of large woody debris and thick vegetation that smother the channel's alignment. The series of cabins that lie within the lower canyon appear to be at risk, largely due to the landslide prone areas that pre-existed before the fire and are now at an even higher risk for experiencing floods and debris flow due to the increased runoff from denuded hillside slopes created by the fire (see Geologist's Specialist Report).

Some of the cabins in the valley are accessed by a pipe arch culvert bridge **(Photo SC-2).** As with most of this creek, the arch culvert is subject to debris flows and torrents, both pre-existing and increased by the surrounding fire conditions.

E. **Site-Specific Observations: Detail Map # 3 Point SC-3 – Union Pacific Railroad Crossing and access road crossing above the town of Pulga**

At an access road location near Pulga, SEAT members were able to view the maintenance outbuildings and operating facilities of the Union Pacific Railroad that runs parallel to the Highway 70 corridor. The fire burned from moderate to high intensity on already landslide prone steep slopes that border the railroad tracks (see Geologist's Specialist Report). Flea Valley Creek runs under the railroad crossing and a private access road crossing supported by wooden columns and trusses. The road crossing lies immediately adjacent and parallel to the multi-span concrete railroad bridge. The wooden bridge provides access to cabins, one of which was burned by the fire. **(See photo SC-1, and Detail Map # 3 Point SC-3)**

As noted in the Geologist's Specialist Report, much of the hillsides that were burned in the fire created a higher risk to already landslide prone slopes adjacent to the railroad. The Union Pacific railroad staff were present at the site, and noted to the SEAT team that they had an emergency action plan both on a year round basis, and on an accelerated schedule prior to rain storms. In so doing, Union Pacific appears to be well prepared for emergency threats to life and property due to landslides, debris flow, and rock fall, which are common occurrences along the railroad's reach in this area near Pulga. The SEAT CAL FIRE lead followed up with a phone conversation to a representative of Union Pacific, who verified that this information stated by the employees we talked to at the site.

F. **Site-Specific Observations: Detail Map # 3 Point SC-4 – Pulga Access Road (See Geologist's Specialist Report)**

G. **Site Specific Observations: Detail Map # 3 Point SC-5- Concow Reservoir**

The Concow Reservoir is located downstream of moderate to severely burned watershed above its headwaters, where debris flows, sedimentation and chemicals from ash and other fire related residue deposits will likely make their way downstream via the tributaries that feed into the reservoir. The author did not make a field visit of the Concow Reservoir to inspect the reservoir in person. As such, only general recommendations are included herein as to values at risks due to post-fire impacts to the reservoirs dam and spillway, nor its appurtenant features.

H. **General and Site-Specific Observations: Detail Map # 3 Point SC-6 – Concow Creek Box Culvert**

The burn severity is moderate to severe in the Concow region. Field observations note that woody debris and sediment deposits would be prevalent in this region of Concow.

The Concrete Box Culvert Road crossing is armored with rock at the inlet and has approximate dimensions of 10 feet in height by 12 feet in width. The house that lies adjacent to the north of the culvert road crossing appears to be lower in elevation relative to the crossing, and as such, may be subject to flooding should debris flow from post-fire conditions clog the culvert. Furthermore, the road's low point occurs 50 yards or so north of the culverted road crossing, likely causing uncontrolled flow conditions that could raise havoc to surrounding infrastructure and resources not originally designed for these flows.

### 3.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of life and infrastructure related to a residences (**Detail Map # 3 Points SC-1, SC-2, SC-3** and **SC-6**) within the burn area, the loss of infrastructure related to the local transportation systems and conveyance features (Detail **Map # 3 Points SC-2, SC-3, SC-6**), and the

loss of natural resources related to excessive sediment and debris entering the local watercourses (**Detail Map # 3 Points SC-5 and SC-6**).

General and Site Specific

Several culverted road crossings were observed along the main Mystic Valley and Concow Creek egresses within the burn area **(Detail Map # 3 Point SC- 2)**. Although many of the culverts within the watershed have been recently replaced with culverts and/or have had inlet protection installed with sand bags and concrete headwalls to handle flood events, it is possible that they may be susceptible to excessive flows and slide debris as a result of the recent fire. Culverts and bridges that convey flows past the nearby cabins, do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the burn. As a result, the capacity of the culverts within the entire burn area are interpreted to have a high risk of getting overwhelmed and may lead to the culvert crossings either failing or causing flows to be re-routed to areas that could cause havoc to surrounding infrastructure and resources.

The south bank of the stream channel adjacent to these cabins has been lined with rock slope protection, but was observed to be eroded. This erosion could potentially lead to slope failure, causing the cabins in that locality to be subject to hazardous conditions, particularly when intense storm events that produce high flows occur.

The Union Pacific Railroad bridge and adjacent private access road bridge within the province of Pulga **(Detail Map # 3 Point SC-3 and Photo SC-4)** is exposed to potential damage to the concrete bridge abutments and wooden truss supports from debris flow and torrents.

For additional commentary on the sediment and debris flows that threaten life, property, and resources due to the fire, please see the Butte Lightning Fire Complex Soils Specialist BAER report (BAER, 2008) as well as the SEAT Geologist's Specialist Report.

## 3.4 Recommendations

A. **Site-Specific Recommendations: Detail Map # 2 Point NC-1 (Tobin Water Supply)**

1. Best Management Practices (BMPs), such as such as installation of debris deflectors, monitoring, and maintenance of the intake structure, channel, and water supply line and appurtenances, should be applied where applicable. The pipeline's leakage witnessed at the site suggests a full inspection be made of the entire water delivery system, with consequent repairs or replacements implemented where necessary.

2. For additional mitigation activities related to debris deflectors, see additional recommended Best Management Practices (BMPs) in the list of references and

web links at the end of this Specialist Report as they apply to site specific conditions for (**Detail Map # 2 Point NC-1).**

B. **Site-Specific Recommendations: Detail Map # 3 Point SC-1 (Cabin adjacent to Flea Valley Creek)**

1. Cleaning out the existing earthen stream channel to increase its capacity to convey flows and debris

2. Repairing or replacing the rock-slope protection along the bank of the channel banks to increase its capacity to resist scour and to direct flows and debris away from the cabin

3. Maintaining the higher elevation gradient of the cabin to keep it free of large woody debris that could migrate down gradient and become lodged creating a debris dam that increases the diversion potential within the channel

4. Performing routine monitoring by abiding by US Forest Service standard specifications for establishing clearing distances from the cabin to better visually access the presence of any slide activity that could migrate down gradient and compromise the cabin

5. It is recommended that the local jurisdictional agency alert residents by installing early warning devices and/or applying evacuation plans that include identification of potential hazards

6. If not already in place, develop road closure plans if potential hazards are identified

7. For additional Best Management Practices to curtail impacts to structures due to flooding and debris flow, see the respective BMPs associated with this site as listed in web links and references at the end of this Specialist Report.

C. **Site-Specific Recommendations: Detail Map # 3 Point SC-2 (Series of Cabins along Flea Valley Creek and Pipe Arch Culvert road crossing)**

1. Performing hydrologic and hydraulic analyses for each of these culverted road crossings was not feasible due to the time constraints of producing this report. However, the controlling agencies/owners are encouraged to perform such analyses to reassess the capacity of the access road and culvert crossings above the cabins being mindful of the increased stormwater runoff, debris flows, hyper-concentrated flows, and sedimentation caused by the fire. Appropriate sediment measures should be installed, such as mulches and log terraces to

control runoff (Butte County Resource Conservation District-BCRD/National Soil Conservation).

2. It is recommended that a professional engineer or certified professional employed by the road crossing's responsible agency should analyze the box culvert's ability to carry the increased runoff as a result of the burned watershed upstream.

3. The bank that shows evidence of erosion of existing rock slope protection should be either repaired or replaced to ensure that the bank is stable. Monitoring of the rock slope protection's performance should be done after major storm events.

4. It is highly recommended that maintenance crews perform debris removal of in channel vegetation and debris to decrease the chance of flooding. Developing a maintenance schedule based on a ranking of flow can be used to prioritize the treatment of conveyance structures along the tributaries that feed into receiving stream courses.

5. It is highly recommended to install a series of steel I beams upstream of both road crossings after maintenance has been performed in a "V" shape configuration with the apex pointing upstream so as to avoid causing buildup while still providing deflection of debris that could cause damage to the conveyance structures (Weaver and Hagans, June 1994).

6. It is suggested that the appropriate agency/owner should perform consistent monitoring and maintenance of the crossings.

7. It is recommended that the local jurisdictional agency alert residents by installing early warning devices and/or applying evacuation plans that include identification of potential hazards.

8. If not already in place, develop road closure plans if potential hazards are identified.

9. For general mitigation activities related to concrete conveyance bridge structures, see additional recommended Best Management Practices in the list of references and web links at the end of this Specialist Report as they apply to site specific conditions applicable to **Map Points SC-1 and SC-2.**

D. **Site-Specific Recommendations: Point SC3 (Union Pacific Railroad bridge and road access crossing)**

1. The stream area immediately upstream of the bridge and under the bridge should be cleared of woody debris and dead trees to allow the free flow of water. The design capacity of the passage ways under the bridge will likely be reduced if pre-storm preventative maintenance is not conducted. It is

recommended that a debris deflection rack, which consists of steel I beams, should be installed upstream of the road crossing to deflect debris away from the road crossings truss supports, as well as the railroad bridge support column and bridge abutments.

2. For general mitigation activities related to concrete conveyance bridge structures, see additional recommended Best Management Practices in the list of references and web links at the end of this Specialist Report as they apply to site specific conditions applicable to Detail **Map # 3 Point SC-3 and Photo SC-4).**

3. It is recommended that a professional engineer or certified professional employed by the Union Pacific Railroad should analyze the box culvert's ability to carry the increased runoff as a result of the burned watershed upstream

E. **Site-Specific Recommendations: Detail Map # 3 Point SC-5 (Concow Reservoir)**

The reader is recommended to review both the Geologist's and Hydrologist's Specialist Reports as well as the Butte Lightning Complex BAER report (BAER,2008) for observations and assessments of the surrounding geology and watershed's post-fire impacts that may have consequences to the reservoir's capacity for receiving floodwaters and debris flow.

F. **Site-Specific Recommendations: Point SC-6 (Residence adjacent to Concow Creek's Box Culvert road crossing)**

Beyond performing the culvert treatments 1-4 listed above for Concow Creek's box culvert road crossing, it would be prudent to protect the residence adjacent to Concow Creek to reduce the potential of excessive flows and side flow debris from impacting the cabin by way of:

1. Cleaning out the existing earthen stream channel to increase its capacity to convey flows and debris,

2. Repairing or replacing the rock-slope protection along the bank of the channel to increase its capacity to resist scour and to direct flows and debris away from the cabin,

3. Maintaining the higher elevation gradient of the cabin to keep it free of large woody debris that could migrate down gradient and become lodged creating a debris dam that increases the diversion potential within the channel,

4. Performing routine monitoring by abiding by US Forest Service standard specifications for establishing clearing distances from the cabin to better visually

5. It is recommended that the local jurisdictional agency alert residents by installing early warning devices and/or applying evacuation plans that include identification of potential hazards,

6. It is recommended that a professional engineer or certified professional employed by the road crossing's responsible agency should analyze the box culvert's ability to carry the increased runoff as a result of the burned watershed upstream, and

7. For general mitigation activities related to concrete box culvert road crossing structures, see additional recommended Best Management Practices in the list of references and web links at the end of this Specialist Report as they apply to site specific conditions applicable to **Map Point SC-6.**

## FRIEND-DARNELL FIRE

### 4.1 Resource Condition Assessment

A. Resource Setting

The Friend Darnell fire encompasses about 2150 acres of federal land and 1700 acres of State land in Butte County (Detail Map # 4).

B. Survey Methods

The Friend Darnell Fire was investigated from the air by a helicopter on 13 September. On the ground follow-up surveys were conducted by driving the roads within the Friend Darnell's fire perimeter during 19 September.

The investigation consisted of driving the main roads along Bean Creek in the Berry Creek Rancheria region and surrounding region. Due to limited field time, only the areas within the lower elevations of the burn area that had the highest risk to life and development were assessed.

### 4.2 Observations

A. General Observations

The Draft Butte Lightening Complex & Canyon Complex – 2008 BAER Soils Specialist Report (BAER, 2008) indicates that there is a potential for flooding of Bean Creek that could likely threaten road infrastructure and homes in the Berry Creek Rancheria. The author of this report was responsible for assessing two stream crossings along Bean Creek. The discussion of those site-specific observations, emergency determinations, and recommendations for mitigative

measures follows. (see the Geologist's Specialist Report for other potential values at risk within the perimeter of the Friend Darnell Fire).

Based on our observations and on Burned Area Reflectance Classification (BARC) maps provided by the USFS (BEAR, 2008), the Friend Darnell Fire had a moderate to high burn intensity, as evidenced by viewing **photos FD-1, FD-2, FD-3 and FD-4 and Detail Map # 4 Points FD-1, FD-2, FD-3, and FD-4).**

B. **Site-specific Observations: Point FD-3**

The road crossing at Bean Creek (**Map Point FD-3)** is a multi-barreled culverted road crossing consisting of 2-36 inch diameter concrete encased pipes that straddle the centerline of the channel and 3-24 inch Corrugated Metal Pipe (CMP) culverts that provide overflow capacity in the event the main culverts are overwhelmed by flash floods. The channel upstream is choked with vegetation and no trash racks appear to exist upstream. The sturdy concrete headwalls and rocked slopes at the inlet suggest this road culvert has been designed for intense rainfall during a short period of time. The access road leading into the crossing is lower by a few feet, and as such, suggests that the road has been designed as a crude overflow spillway that appears to be active during flood events when the 2 CMP main culverts and 3 overflow culverts cannot provide sufficient passage to convey the flows downstream within the channel banks.

C. **Site-specific Observations: Point FD-4**

The road crossing at Bean Creek that is designated as value at risk **Map Point FD-4** is a multi-barreled culverted road crossing consisting of 2-36 diameter concrete encased conduits that straddle the centerline of the channel's alignment. The channel both upstream and downstream is choked with woody debris and vegetation and no trash racks appear to exist upstream. The sturdy concrete headwalls and rocked slopes at the inlet suggest this road culvert has been designed for intense rainfall during a short period of time.

## 4.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of infrastructure related to the local transportation systems and conveyance features (**Detail Map # 4 Points FD-3, FD-4**), and the loss of natural resources related to excessive sediment and debris entering the local watercourses (**Detail Map # 4 Points FD-3 and FD-4**).

<u>Site Specific</u>

A multi-culvert road crossing (**Detail Map # 4 Point FD-3**) that provides access across Bean Creek and lies upstream of the Berry Creek Rancheria has a possibility of flooding during intense storm events. The burned watershed in this area will likely

increase the runoff from the hill slopes above, and thus add to the risk of flooding out homes downstream in the Berry Creek Rancheria community.

The Bean Creek multi-culvert road crossing (**Detail Map # 4 Point FD-4**) has a possibility of impact damage to the mid-span column of the bridge from debris flow. The size of the culverts do not appear to provide sufficient capacity to convey the likely increased flows and debris that will occur as a result of the burn. As a result, the capacity of the culverts appear to be at a risk of getting overwhelmed and may lead to the culvert crossings either failing or causing uncontrolled flows to potentially damage infrastructure downstream.

## 4.4 Recommendations

A. **Site-Specific Recommendations: Detail Map # 4 Point FD-3, (multi-culverted road crossing with 2-36 inch culverts and 3-24 inch overflow culverts) and Map Point#4 FD-4, (2-36 inch diameter concrete encased conduits)**

1. Performing hydrologic and hydraulic analyses for each of these culverted road crossings was not feasible due to the time constraints of producing this report. However, the controlling agencies/owners are encouraged to perform such analyses to reassess the capacity of the access road and culvert crossings above the cabins being mindful of the increased storm water runoff, debris flows, hyper-concentrated flows, and sedimentation caused by the fire. Appropriate sediment measures should be installed, such as mulches and log terraces to control runoff (Butte County Resource Conservation District-BCRD/National Soil Conservation Service).

2. It is highly recommended that maintenance crews perform debris removal of in channel vegetation and debris to decrease the chance of flooding. Developing a maintenance schedule based on a ranking of flow can be used to prioritize the treatment of conveyance structures along the tributaries that feed into receiving stream courses.

3. It is recommended that the local jurisdictional agency alert residents by installing early warning devices and/or applying evacuation plans that include identification of potential hazards to the residents of Berry Creek Rancheria.

4. It is highly recommended to install the series of I beams upstream of both road crossings after maintenance has been performed in a “V” shaped configuration with the apex pointing upstream so as to avoid causing buildup while still providing deflection of debris that could cause damage to the conveyance structures.

# CRAIG FIRE

## 5.1 Resource Condition Assessment

A. Resource Setting

The burned area resides within southern region of Butte County and burned a total of 1999 acres, of which contained about 816 acres of federal land, and 1183 acres of State land. (Detail Map # 4). Topographically, the Craig Fire ranges in elevation from about 900 feet to 2500 feet above mean sea level.

B. Survey Methods

The Craig Fire was investigated from the air via a helicopter provided by CAL FIRE on September 13th. Due to limited time of this SEAT assignment, these fires were flown to determine whether a ground survey was warranted to assess threats to life, property and resources. After viewing the Craig Fire from an aerial viewpoint, the SEAT determined that it warranted a ground survey. The on the ground survey of the Craig fire took place on September 17. The field investigation consisted of driving along the ridge road of Crystal Ranch Road. Due to limited field time and difficulties accessing gated property, only the areas within the certain locations of the burn area were assessed. The assessment was limited to conversations with landowners, and obtaining contact information from neighbors of homes located down slope of the Crystal Ranch ridge.

## 5.2 Observations

A. General Observations

The focus of our field investigation was in the area of the burn that is accessed from Crystal Ranch Road where residents are scattered both at the top of Crystal Peak and down slope within the burn area.

## 5.3 Emergency Determination

The values at risk considered in this assessment include the possible loss of homes down slope of Crystal Ranch Road within the burn area (see Geologist's Specialist Report for assessment of the potential for rock fall and landslides in this area). During this field visit, a valid assessment could not be made as to the threat to lives and property down slope of the ridge due to lack of access. Therefore, at the time of this writing, an emergency determination in terms of residents and developments at risk cannot be made.

The values at risk due to highly eroded conditions of the road pose a risk to home owners who use the Crystal Ranch Road for accessing their property during and

after storm events. The erosional affects that likely will cause plugging of drainage features pose a treat to home owners in terms of gaining safe access to their property during and after storm events.

## 5.4 Recommendations

A. General Recommendations:

1. The controlling agencies/owners are encouraged to perform such analyses to reassess the capacity of the Crystal Ranch Road as well as fire suppression access roads and culvert crossings being mindful of the increased storm water runoff, debris flows, hyper-concentrated flows, and sedimentation caused by the fire.

2. It is highly recommended that maintenance crews perform debris removal of in channel vegetation and debris within culvert crossings to decrease the chance of flooding. Developing a maintenance schedule based on a ranking of flow can be used to prioritize the treatment of conveyance structures along the tributaries that feed into receiving stream courses.

3. It is suggested that the appropriate agency/owner should perform consistent monitoring and maintenance of the road crossings.

4. For general mitigation activities related to culverted road crossing, and erosion control measures for roads, please refer to the additional list of BMPs as they apply to these values at risk in the reference section at the end of this report.

# INSKIP/BREAKNECK/SMOKEY FIRES

## 6.1 Resource Condition Assessment

A. Resource Setting

The Inskip Fire encompasses about 104 acres of State land in Butte County. The Breakneck Fire encompasses approximately 771 acres of State land. The Smokey Fire encompasses approximately 418 acres of Federal land and 906 acres of State land for a total burned area of over 2199 acres (Detail Map # **5).**

B. Survey Methods

The Inskip, Breakneck and Smokey fires were investigated from the air via a helicopter provided by CAL FIRE on September 13th. Due to limited time of this SEAT assignment, these fires were flown to determine whether a ground survey was warranted to assess threats to life, property and resources.

## 6.2 Observations

A. General Observations

These three fires were assessed from the air and eliminated as having little to no effect on risks to life, property and resources.

Based on our observations and on Burned Area Reflectance Classification (BARC) maps provided by the USFS (BEAR, 2008), the Inskip, Smokey and Breakneck Fires had a low burn intensity.

For additional information pertaining to the aerial reconnaissance observations made by the Geologist and Hydrologist, see their respective Specialist's Reports.

## 8.0 References and Literature Cited

Napper, Carolyn. 2006.Burned Area Emergency Response Treatments Catalog (BAERCAT), 0625 1801P, San Dimas, CA;US Department of Agriculture, Forest Service, San Dimas Technology and Development Center

William E. Weaver, PHD. : Hagans, Danny K. June 1994 – Pacific Watershed Associates. Handbook for Forest and Ranch Roads- A guide for planning, designing, constructing, reconstructing, maintaining and closing wildland roads. Prepared for the Mendocino County Resource Conservation District in cooperation with the California Department of Forestry and Fire Protection and the USDA Soil Conservation Service.
http://www.krisweb.com/biblio/gen_mcrcd_weaveretal_1994_handbook.pdf

Barkley, Yvonne, August 2006. After the Burn: Assessing and Managing Your Forestland after a Wildfire. Idaho Forest, Wildlife and Range Experiment Station, Moscow, Idaho.

Kleinschmidt, Kara L., McComb, Soil Scientist, August 2008 Burned Area Emergency Report (BAER) - Soils Report. Butte Lightning Complex and Canyon Complex Fires, Feather River Mount Hough Ranger Districts, Plumas and Lassen Counties. USDA Forest Service.

Perez, Edward, Water Resources Engineer, November 2007. State Burned Area Emergency Response Specialist Report for the Harris Fire. Department of Water Resources.

Butte County Resource Conservation District, Butte County Watershed Restoration and Erosion Control: A Landowners Post-fire Decision Making Guide; www.buttecounty.org

Additional Recommended Best Management Practices (BMPs) web link references for Civil Features at Prioritized Values at Risk:

General Construction Best Management Practices – Guidelines:
http://www.palomar.edu/ehs/Storm%20Water/BMPS%20Full%20Doc.pdf

Caltrans for all Best Management Practice needs:
http://www.caltrans.ca.gov/hq/construc/stormwater/manuals.htm

NRCS Guidelines for Wildfire Best Management Practices:
http://www.mt.nrcs.usda.gov/technical/fires/ and
http://www.cnr.uidaho.edu/extforest/Publications.htm

**DRAFT TECHNICAL SPECIALIST'S**
**STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report**

**Resource: Forestry**

**Fire Name:** BTU Lightning Fires **Month/Year:** September 2008
2008 Butte Fires CA-CDF-000593

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## I. Resource Condition Assessment

### A. Overview

The Butte Fires encompass 41 fires that total 115, 773 acres. Three of the fires in the Butte Complex were man caused (Ophir, Humboldt, and Craig) while the remaining fires were caused by the lightning storm that swept across northern California on June 21, 2008. Of the forty-one fires, the State Emergency Assessment Team (SEAT) identified six fires that are considered a potential threat to human life, property, and watershed resources.

The purpose of the SEAT post fire watershed assessment and recovery operation was to identify on-site and downstream threats to public health or safety from landslides, debris torrents, flooding, road hazards, and other fire related problems. In addition to these, other goals were to identify threats to watershed resources, including: excessive erosion, impaired water quality; threats to wildlife, fisheries, botanical values, and cultural resources. Lastly, the team was tasked to determine measures needed to prevent or mitigate identified threats during on the ground field inspections.

This assessment was to evaluate and identify both the direct and indirect effects of the recent fires on the existing forest systems and associated Mixed Chaparral and Mixed Oak woodland habitats. Due to the large geographic area of these fires there is a wide variety of vegetation types. They range from Sierra Mixed Conifer forests, Ponderosa Pine, to Montane Hardwood-Conifer, Mixed Oak woodland, Mixed Chaparral, and Annual Grassland.

### B. Resource Setting

1. Humboldt Fire

   The Humboldt Fire was an arson caused wind driven fire that started on June 11, 2008. The fire is 23,333 acres in size and is located in Butte County between the city of Chico and the town of Paradise. This fire is within several drainages that ultimately reach the Sacramento River. Ninety-nine percent of this fire burned on private property.

   From north to south the CALWATER version 2.2 state planning watersheds associated with the Humboldt Fire are Lower Little Chico Creek, Tom's Creek, Hole in Rock, Long Bell, Paradise, Upper Knox Flat, Stone Coal Flat, and West Branch. The topography associated with the Humboldt Fire has slopes ranging from gentle to vertical along the buttes.

   The major soil types associated with the Humboldt Fire are from the Toomes-Supan series which makes up 93% of the fire area and Tuscan-Anita series which makes up the remaining 7% of the fire area. Natural vegetation associated with these soils includes annual grasses and forbs, scattered blue oak, ceanothus, shrubs, and Gray pine. Use includes mostly dryland range and pasture with a few areas in irrigated pasture.

   Of the vegetation cover types within the Humboldt Fire, 43% is in hardwood forest/woodland, 40% is herbaceous, 8% in shrub, and 7% is in mixed conifer/hardwood woodland.

   Other vegetation observed in the burn area includes scattered black oak, Canyon live oak, madrone, whiteleaf and greenleaf manzanita, mountain whitethorn, deerbrush, and poison oak. Some Ponderosa pine occurs in the upper drainage areas.

2. Belden Fire

   The Belden Fire is a 474 acre lightning caused fire that burned on U.S.F.S. property north of State Highway 70 near the small community of Belden. The fire is flanked by State Highway 70 to the south, Chips Creek to the west, and Little Indian Creek to the east. Chips Creek and Little Indian Creek are tributary to the North Fork of the Feather River which State Highway 70 closely parallels.

   Chips Creek is the only CALWATER version 2.2 State planning watershed associated with the Belden Fire. The terrain associated with the Belden Fire is considered rugged and steep, especially on the slopes leading to Chips and Little Indian Creek.

   The major soil types associated with the Belden Fire are the Kistim-Hollowtree-Deadwood series. Natural hardwoods and shrubs associated with these soils includes tanoak, madrone, California huckleberry, canyon oak, greenleaf manzanita, and interior liveoak. Natural conifers associated with

these soils include open mixed stands of Ponderosa pine and sugar pine, Douglas-fir, and incense-cedar.

Of the vegetation cover types within the Belden Fire, 49% is in conifer forest/woodland, 36% is mixed conifer/hardwood woodland, 12% is in hardwood forest/woodland, and 2% is in barren rock.

3. Camp Fire

The Camp Fire is a lightning caused fire and is by far the largest in the Butte and Canyon complex of fires. It is 49,642 acres in size and 53% of the fire burned on private property while the other 47% burned on U.S.F.S. property. The Camp Fire originated from four other fires (Camp, Lynch, Long, and Pit) that burned together into one large fire. The Camp Fire's southern flank parallels State Highway 70 and its northeast flank is just south of the community of Belden in Plumas County. The Camp Fire's southwest flank extends to the community of Concow in Butte County. Because of the large size of the fire, various ownerships, and values at risk, SEAT decided to separate the Camp Fire into two fires, North Camp and South Camp.

North Camp: The dividing line between North Camp and South Camp is Dogwood Creek which is approximately one mile northeast of the small community of Pulga. Most of North Camp burned on USFS property.

From south to north the CALWATER version 2.2 State planning watersheds associated with North Camp are Dogwood Creek, Lockerman Creek, Swamp Creek, North Valley Creek, and Chambers Creek. The terrain associated with North Camp is rugged and is nearly vertical on some of the slopes leading to North Fork of the Feather River.

The major soil types associated with North Camp are from the Wapi-Holland-Chaix-Arrastre series. Native vegetation is open to semi-dense stands of ponderosa pine and incense cedar with some Douglas-fir, white fir, sugar pine, black oak and canyon live oak with an understory of bear clover and manzanita.

South Camp: The dividing line between South Camp and North Camp is Dogwood Creek which is approximately one mile northeast of the small community of Pulga. Most of South Camp burned on private property in the community of Concow, and on private timberland managed by Sierra Pacific Industries (SPI) and Soper Wheeler Company.

From east to west, the CALWATER version 2.2 State planning watersheds associated with South Camp are Dogwood Creek, Cirby Creek, Flea Valley Creek, Concow Creek, Empire Creek, and a portion of Fall Creek to the northwest. The terrain associated with the South Camp is not as rugged as North Camp, but there are steep areas on the slopes leading to Pulga and gentler terrain in the community of Concow.

Sixty-two percent of the soil series in the South Camp area is Josephine-Holland-Aiken. Twenty-two percent is Nuens-Cohasset and the rest is made up of Toomes-Supan and Goulding-Auburn soil series. Native vegetation is Douglas fir, ponderosa pine, Pacific madrone, California black oak, tanoak, incense cedar, sugar pine, cascade Oregongrape, whiteleaf and greenleaf manzanita, and deerbrush. The dominant tree is ponderosa pine.

4. Friend-Darnell Fire

The Friend-Darnell Fire burned 3,845 acres in the Bean Creek drainage just east of Lake Oroville. Bean Creek drains into the Middle Fork of the Feather River at a point where this segment of river is considered a branch of Lake Oroville. The fire is thought to have been caused by spotting from the lightning caused Frey Fire that is on the east side of Middle Fork of the Feather River. Fifty-five percent of the burned area is on U.S.F.S. property while the rest is on privately owned property.

Bean Creek is the CALWATER version 2.2 State planning watershed that is associated with the Friend-Darnell Fire. The terrain leading to Bean Creek is steep while the slopes along the ridgetops are moderate and in some area considered gentle.

The soil type associated with the Friend-Darnell Fire is from the Wapi-Holland-Chaix-Arrastre series. Native vegetation is open to semi-dense stands of ponderosa pine and incense cedar with some Douglas-fir, white fir, sugar pine, black oak and canyon live oak with an understory of manzanita.

Of the vegetation cover types within the Friend-Darnell Fire, 50% is in mixed conifer/hardwood woodland, 32% is in hardwood forest/woodland, 6% is in barren rock, 4% is in shrub, while only 1% is herbaceous.

5. Craig Fire

The Craig Fire is a 1,999 acre fire that was started on August 3, 2008 from a house fire. The fire burned just south of the Middle Fork of the Feather River at a point where this segment of river is considered a branch of Lake Oroville.

Island Bar Hill is the CALWATER version 2.2 State planning watershed that is associated with the Craig Fire. The terrain associated with the Craig Fire is moderate.

The major soil types associated with the Craig Fire are from the Wapi-Holland-Chaix-Arrastre series. Native vegetation is open to semi-dense stands of ponderosa pine and incense cedar with some Douglas-fir, white fir, sugar pine, black oak and canyon live oak with an understory of manzanita.

Of the vegetation cover types within the Craig Fire, a majority is in mixed conifer/hardwood woodland while the rest is in hardwood forest/woodland and shrub.

6. Smokey – Inskip - Breakneck Fires

Because of the relatively small size of the fires, ownerships, location, and values at risk, SEAT decided to condense the Smokey, Inskip, and Breakneck fires into one assessment.

The Smokey Fire is a 1,323 acre lightning caused fire that is located in Tehama County just west of State Highway 32. Approximately 68% of the fire burned on privately owned timberland while 32% burned on U.S.F.S. property. The Smokey Fire burned within the Ninemile Creek CALWATER version 2.2 State planning watershed. The terrain associated with the Smokey Fire is steep leading to Little Smokey Creek and moderate to gentle on the ridgetops that are on both sides of Little Smokey Creek.

The Inskip Fire is a 103 acre lightning caused fire that is located in Butte County approximately 2 miles west to northwest of CAL FIRE's Bald Mountain lookout. This fire burned entirely on privately owned timberland between Fish Creek and West Branch Creek. The Inskip Fire burned within the Fish Creek CALWATER version 2.2 State planning watershed. The terrain associated with the Inskip Fire is gentle on the ridgetop, but becomes steep on the slopes leading toward Fish Creek and West Branch Creek.

The Breakneck Fire is a 771 acre lightning caused fire that is located in Butte County approximately 1.5 miles east of the community of Stirling City. This fire burned entirely on privately owned timberland west of Breakneck Canyon. The Breakneck Fire burned within the Big Kimshaw Creek CALWATER version 2.2 State planning watershed. The terrain associated with the Breakneck Fire is very steep on the slope leading to Breakneck Canyon.

The major soil types associated with the Smokey, Inskip, and Breakneck Fires are from the McCarthy-Cohasset-Aiken series on the Smokey and Inskip Fires and Nuens-Cohasset on the Breakneck Fire. Native vegetation is ponderosa pine, Douglas-fir, white fir, sugar pine, incense-cedar and scattered black oak and madrone. Shrubs are squawcarpet, whiteleaf and greenleaf manzanita, deerbrush, and mountain whitethorn.

Most of the vegetation cover types within the Smokey, Inskip, and Breakneck Fires are conifer forest/woodland while a third of the area is mixed conifer/hardwood woodland.

## II. Findings of the On-The-Ground Survey (Observations)

### A. Survey Methods

Reconnaissance methods were performed by both vehicle and by travel on foot through portions of all fires except for the Smokey, Inskip, and Breakneck fires. On September 13 and 14, 2008 SEAT members participated in a helicopter flights to visually assess the severity of the burn and condition of the associated watersheds for all of the fires.

1. Humboldt Fire

   I participated in fire suppression repair activities on the Humboldt Fire just before the fire was declared contained. I conducted an in depth reconnaissance and coordinated equipment and crews in the drainages south of Skyway Road to Round Valley Ranch Road. This area includes drainages and neighborhoods off of Neal Road and Wayland Road. While on SEAT, I re-visited some of the watercourse crossing repair work and took note of the ATV route that has been created since the construction of the dozer fireline. We drove Honey Run Road, Centerville Road, and Humboldt Road. In addition, the western portion of the burn was observed during our helicopter flights.

2. Belden Fire

   The Belden Fire was evaluated during SEAT's September 14$^{th}$ helicopter flight. We also drove to the State Highway 70 crossings of Chips Creek and Little Indian Creek.

3. Camp Fire

   The Camp Fire was evaluated during SEAT's helicopter flights and during an on the ground visit to the Concow and Pulga areas.

4. Friend-Darnell Fire

   The Friend-Darnell Fire was evaluated during SEAT's helicopter flights and during an on the ground visit to the Bean Creek drainage area.

5. Craig Fire

   The Craig Fire was evaluated during SEAT's helicopter flights and during an on the ground visit on Craig Access Road which is off of the Lumpkin Road.

6. Smokey – Inskip - Breakneck Fires

The Smokey, Inskip, and Breakneck Fires were evaluated during SEAT's September 13th helicopter flight. It was determined during the flight that the fires are in remote areas and there are no values at risk, therefore, SEAT did not conduct any further evaluations.

B. Observations and Values at Risk

The 2008 Butte Fires burned a considerable amount of forested area. These burned forests and unburned trees within the burn or adjacent to the burn will likely be impacted from insects. Wood borers in the families Buprestidae and Cerambycidae are principal colonizers of trees killed or severely damaged by fire. Because they colonize trees that are dead or dying, they are not considered a direct threat to tree survival. Bark beetles, in contrast, are more likely to colonize trees that are lightly to moderately injured by fire and may kill trees that might otherwise have survived. Guidelines that estimate tree survival take these insects into account. Most fire-related mortality takes place within 3-4 years following the fire, and this is the time frame for which survival estimates apply. Fire injuries can, however, have a longer lasting impact on tree health and may contribute to mortality beyond this time frame, especially when combined with other stressors. Rot entering damaged trees combined with wind will also play a role in number of trees lost due to windthrow.

The impacts of fire are highly variable across the landscape and from tree to tree due to such factors as the distribution and abundance of fuel, topographic influences, and weather. Additionally, tree susceptibility to injury varies by species, vigor, and time of year. Less vigorous trees are more susceptible to damage, and all trees are most susceptible to injury during the early part of the growing season when height growth is occurring. Fire intensity early in the season may be reduced by higher moisture contents in fuels and duff, but this was not the case for the 2008 Butte Fires. Because of ongoing drought and this year's dry spring, there were drier fuels and a greater number of drought stressed trees across the landscape than would normally occur at this time of year. Also, the early summer fires corresponded with the height of activity for a number of bark beetle species.

1. Humboldt Fire

Of the 23,333 acres that burned, the burn intensity was severe on 1% of the fire area, moderate on 17% of the fire area, low on 44% of the fire area, and 38% of the area within the fire perimeter is considered unburned.

The values at risk are the residences that are scattered throughout the burn area. Burned oak trees and Gray pine were observed within close vicinity to many of the homes, outbuildings, driveways, frequently traveled roads, and other improvements. As these burned trees continue to weaken limbs may break off (widow makers), the bole of the tree may snap off , or the entire tree

may uproot. There is a moderate risk that these weakened trees may cause damage to property. This risk will increase through time as the trees continue to decay and especially during times of strong winds.

There is also a moderate risk to life and safety if people are around the weakened tree when a limb breaks (widow makers), or the tree's bole snaps off, or if the tree uproots.

2. Belden Fire

Of the 474 acres that burned, the burn intensity was moderate on 28% of the fire area, low on 27% of the fire area, and 45% of the area within the fire perimeter is considered unburned. The fire is in a remote area and severe burn intensities did not occur, therefore, there are no values at risk associated with these forested areas.

3. Camp Fire

Of the 49,643 acres that burned, the burn intensity was severe on 10% of the fire area, moderate on 31% of the fire area, low on 34% of the fire area, and 25% of the area within the fire perimeter is considered unburned.

North Camp: Most of the burn area is on U.S.F.S. property where there are no values at risk associated with these forested areas. It should be noted that much of the northern half of this fire burned within the 2000 Storrie Fire area. This fire burned hot, therefore, much of North Camp burned in an area where significant mortality was already present.

South Camp: A majority of the burn area is on private property. The values at risk are mainly the residences in the Concow and Pulga areas. Burned hardwood trees and conifers were observed within close distance to many of the homes, outbuildings, driveways, frequently traveled roads, and other improvements. As these burned trees continue to weaken limbs may break off (widow makers), the bole of the tree may snap off, or the entire tree may uproot. There is a moderate risk that these weakening trees may cause property damage. This risk will increase through time as the trees continue to decay and especially during times of strong winds.

There is also a moderate risk to life and safety if people are around the weakened tree when a limb breaks (widow makers), or the tree's bole snaps off, or if the tree uproots.

4. Friend-Darnell Fire

Of the 3,845 acres that burned, the burn intensity was severe on 13% of the fire area, moderate on 41% of the fire area, low on 38% of the fire area, and 8% of the area within the fire perimeter is considered unburned.

The Friend-Darnell Fire is in a remote area and there are no homes in the burn area that are at risk of being damaged by burned trees. Therefore, it was determined that there are no values at risk associated with these forested areas.

5. Craig Fire

Of the 1,999 acres that burned in the Craig Fire there are areas that burned hot where the foliage was completely consumed. There are other areas that resemble islands within the fire area that did not burn as hot and dead foliage remains on much of the burned vegetation. An occasional green crown can be seen in the areas where the fire did not burn as intensely, but the base of these trees did burn and tree survival is not likely.

During SEAT's on the ground survey we noticed that three homes exist within the burn area. Therefore, the homes and any other residences that are within or adjacent to the burn area may be at risk. There may be burned trees within close vicinity to the homes, outbuildings, driveways, frequently traveled roads, and other improvements. As these burned trees continue to weaken limbs may break off (widow makers), the bole of the tree may snap off, or the entire tree may uproot. There is a moderate risk that these weakened trees may cause damage to property. This risk will increase through time as the trees continue to decay and especially during times of strong winds.

There is also a moderate risk to life and safety if people are around the weakened tree when a limb breaks (widow makers), or the tree's bole snaps off, or if the tree uproots.

6. Smokey – Inskip - Breakneck Fires

Of the 1,324 acres that burned in the Smokey Fire, the burn intensity was severe on 4% of the fire area, moderate on 14% of the fire area, low on 42% of the fire area, and 40% of the area within the fire perimeter is considered unburned.

Of the 104 acres that burned in the Inskip Fire, the burn intensity was low on 5% of the fire area, and 95% of the area within the fire perimeter is considered unburned. Severe and moderate burn intensities did not occur.

Of the 771 acres that burned in the Breakneck Fire, the burn intensity was severe on 1% of the fire area, moderate on 16% of the fire area, low on 45% of the fire area, and 38% of the area within the fire perimeter is considered unburned.

The Smokey, Inskip, and Breakneck Fires are in a remote area where no homes exist. Therefore, it was determined that there are no values at risk associated with these forested areas.

## III. Emergency Determination

Conifer stands within the 2008 Butte Fires area should be evaluated for existing mortality from the fires as well as future mortality as trees succumb to the affects of fire. Trees that have not been killed by fire with light to moderate fire damage could also be at an increased risk to bark beetle mortality in the next one to three years. Increased fuel load due to lack of post fire management could lead to increased risk for future catastrophic fire and increased resistance to control from increased standing and downed large woody debris.

The following are some general guidelines for evaluating the survival of fire-injured trees.

(a) When no green foliage remains on a fire-damaged tree, the tree is already dead or likely to die.

(b) For most conifers, foliage death is roughly equivalent to twig and bud death. For these trees, if 35% or more of the foliage remains green, the tree is likely to survive. For the 2008 Butte Fires, this should be modified to 40% or more green foliage for trees of average or above vigor and to 50% or more for trees of lower vigor.

(c) Ponderosa and Jeffrey pines have different criteria. For these species, foliage death is often greater than twig or bud death. Hence, the amount of green foliage remaining on the tree immediately following the fire usually underestimates the proportion of the crown (twigs and buds) that is still alive. For trees evaluated during the same season as the fire, if 10% or more of the foliage remains green, the tree is likely to survive. For the 2008 Butte Fires, this should be modified to 20% or more green foliage. For trees evaluated after bud break the year following injury, if 50% or more of the crown is alive, the tree is likely to survive. This should be modified to 60% or more for trees of lower vigor.

(d) The amount of cambium killed at the base of the bole is also an important consideration in tree survival. The above guidelines for crown damage assume that light to moderate cambial kill has occurred. For most conifers, this means cambial kill of less than 25% of the circumference of the bole at the base of the tree. Cambial kill can be difficult to assess, particularly when the damage is light to moderate. When bark is completely blackened and has been eroded to the point where its structure is no longer discernable, assume that the cambium beneath is dead.

(e)

## IV. Recommendations

Evaluate existing stands of mixed conifer forests to determine current mortality as well as future mortality. Trees that have been damaged but have not been killed by the fires should be also evaluated due to the inherent risk of bark beetle attack over the next one to three years.

Areas that have increased mortality should be considered for fire salvage and or biomass where practical. Forested areas that have been affected by the fire should also be evaluated for the next several years for mortality and possible future management.

Harvesting of live, injured trees that are not predicted to survive will enable wood to be utilized before it is degraded by insects and pathogens, and will remove trees that potentially could serve as breeding sites for bark beetles. The removal of these trees will also assist in preparing the site for re-forestation activities. Re-forestation activities may include ripping planting rows for better soil drainage and root growth, planting of seedlings, and future tree release activities such as managing competing vegetation and thinning less desirable trees as the plantation becomes established.

Landowners and property managers need to be aware and monitor the increased mortality that will continue for the next several years. Areas of most concern are adjacent to homes, outbuildings, driveways, frequently traveled roads, and other improvements. During strong wind events awareness and caution should be elevated when around weakened trees.

In addition, as forested areas within the burn open up due to tree harvesting or natural decay, the surrounding unburned forest stands will be more susceptible to additional windthrow during strong wind events.

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BARC Map

USDA Plumas National Forest 2002 Map

Butte County Street and Road Atlas 2000 Map

**TECHNICAL SPECIALIST'S**
**STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report**

**Resource: Fisheries**

**Fire Name:** BTU Lightning Fires **Month/Year:** September 2008
2008 Butte Fires CA-CDF-000593

**Author Name:** Clint Garman, Associate Fishery Biologist
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## I. Resource Condition Assessment

### A. Setting

The portion of the 2008 Butte Fires included in this investigation is comprised of forty-one fires that amount to approximately 115,773 burned acres within Butte, Plumas and Tehama Counties, California. The Butte SEAT determined that 33 of the fires were of no risk to human life, property or natural resources. The remaining eight fires burned approximately 81,000 acres and were under State Responsible Areas (SRA) (Map # 3) and evaluations of potential risks were conducted. The eight fires are spread over a large geographic area (Map # 1). The fires are generally located west of the Sierra Crest, where the Sierra Nevada and Cascade Range blends together.

See the Geologist, Hydrologist and Forestry Technical Reports for a holistic perspective.

### B. Survey Methods

The Butte SEAT surveyed wildfire areas by rapid air reconnaissance and ground/vehicle based transportation with assistance from a Burned Area Reflectance Characteristic (BARC) Map (Map # 2). The aquatic species analysis is based on aerial and site-specific review from September 13$^{th}$ through September 19$^{th}$. Additionally, review of aquatic resources potentially impacted by this fire included a search of the California Natural Diversity Database (CNDDB) for occurrences of sensitive species (rare, threatened, or endangered) within the burn area (attached Table 1). A CNDDB occurrence database overlaid on a GIS fire perimeter polygon shapefile also assisted in the search for potentially affected rare, threatened or endangered species (attached FMap # 1). Fires that are within the USFS (BAER, 2008) jurisdiction were not assessed by the Butte SEAT.

Due to the rapid assessment involved in this evaluation, there are likely to be areas within the burn area and other locations of potential values at risk that were not observed or assessed.

## II. Findings of the On-The-Ground Survey (Observations)

### A. Humboldt Fire

Values at Risk - spring-run Chinook salmon, Central Valley steelhead, western pond turtle, foothill yellow-legged frog.

The Humboldt Fire encompasses about 23,333 acres of land with approximately 2,000 acres of the burn located north of the Skyway and its watershed drains directly into Butte Creek. Spring-run Chinook salmon (SRCS), (*Oncorhynchus tshawytscha)*, occur in Butte Creek and are listed as threatened under both the California and Federal Endangered Species Acts. Additionally, Central Valley steelhead (*Oncorhynchus mykiss irireus)* occupy habitat in Butte Creek and is federally listed as threatened. Butte Creek is one of three remaining streams that form a basis for population trends for SRCS in the Central Valley of California. The other two are nearby Deer and Mill Creeks, located to the north in Tehama County.

Butte Creek SRCS return to their natal stream beginning in late February, ending in June. SRCS are sexually immature during the freshwater migration to their natal stream. Within the natal stream, SRCS seek deep holding pools to over-summer. The pools provide adequate cover and cool water temperatures enabling the salmon to conserve energy for gonad maturation and future spawning. In mid-September, when water temperatures begin to cool, spawning commences. The length of time for egg incubation and hatching is dependant upon average daily water temperatures. Juvenile emergence from the gravel occurs as early as late-November. A small portion of juveniles over-summer and emigrate as yearlings the next fall.

SRCS escapement estimates conducted on Butte Creek from 1967 - 1991 averaged approximately 360 adult salmon. With watershed restoration efforts, adult SRCS estimates from 2001-2007 average approximately 10,000 adults. (Tracy McReynolds, Dept. of Fish and Game, pers. comm.)

Additionally, Northwestern Pond Turtle (*Actinemys marmorata*) and Foothill Yellow-Legged Frog (*Rana boylii*) are present in the area.

### B. Belden Fire

Values at Risk- fish, amphibian, aquatic invertebrates

The Belden Fire encompasses about 474 acres of land in Plumas County. Little Indian Creek borders the northern flank of the burn area and Chips Creek borders the southern flank of the fire. (Little Indian Creek) @ (N40.00.5938 W121.26.2451) perennial stream, metal trash racks upstream of Hwy 70 road crossing, water temp.12°C
(Chips Creek) @ (N40.00.0724 W121.27.0469) perennial stream, water temp.12.5°C,

metal trash rack approx. 300 ft. upstream of Hwy 70 road crossing. Low to moderate burn intensity throughout the burn area and the riparian corridor. Expect some upslope sediment to deposit in water course. Both are tributary to the North Fork of the Feather River (NFFR). There were no significant salmonids species to protect.

C. Camp Fire

Values at Risk- fish, amphibians, aquatic invertebrates

The Camp fire is a large fire that encompasses 49,649 acres of land within both Plumas and Butte Counties. The Butte SEAT team decided to divide the fire into two different regions called North Camp Fire and South Camp Fire. Dogwood Creek drainage was determined to be the dividing line.

North Camp Fire

Chambers Creek - after air reconnaissance (September 13th) and BARC Map analysis it did not appear that the watershed above Chambers Creek burned substantially. Low intensity burn. Re-burn through 2000 Storrie Fire (Map # 8). No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

Jackass Creek - Box culvert @ (N39.93.5142 W121.31.7161) not blocked and riparian vegetation not moderately burned. The upslope watershed previously burned by the Storrie Fire (Map # 8). No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

Rock Creek - after air reconnaissance (September13th) and BARC analysis it did not appear that the watershed above Rock Creek burned substantially (Map # 2). Upper watershed consists of granite rock outcroppings. No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

Camp Creek - @ (N39.83.8205 W121.42.908) - stream crossing. No visible damage to riparian zone. Upper watershed consists of granite rock outcroppings. No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

Dogwood Creek - stream crossing. No visible damage to riparian zone. Upper watershed consists of granite rock outcroppings. No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota

South Camp Fire

Cirby Creek – south facing slope overview (N39.47.877 W121.29.598) in upper watershed burned with high intensity. Drainage into Concow creek. No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

Unnamed tributary to Concow Creek – above Concow Reservoir
High intensity burn, little vegetation left. A box culvert @ (N39.46.908 W121.30.305)

observed 1 trout, 1 bass, and several cyprinids. Potential high sediment and debris loads in heavy winter could plug culvert. No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

Concow Creek – below Concow Reservoir
After air reconnaissance and BARC analysis it did not appear that the watershed below Concow Reservoir watershed burned substantially (Map # 2). Appeared to be a low intensity burn of understory vegetation. Drainage into West Branch of Feather River (WBFR). No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

Flea Valley Creek - air reconnaissance showed high intensity burn in the upper watershed. Ground survey showed little damage to the riparian corridor. Potential foothill yellow-legged frog and red-legged frog habitat. No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota. Post fire road work along Pulga Road may dump sediment into Flea Valley Creek during winter storm events.

West Branch Feather River - After air reconnaissance and BARC analysis it did not appear that the WBFR watershed burned substantially (Map # 2). The fire burned with low intensity down the drainage until it extinguished along the creek. No significant salmonid fisheries to protect. Potential yellow-legged frog habitat affected along east side of the WBFR.

D. Friend - Darnell Fire

Values at Risk – fish, amphibians, aquatic invertebrates

The Friend – Darnell Fire encompasses about 3,845 acres of land in Butte County.
No damage to riparian zone @ (N39.37.747 W121.19.749) on Bean Creek. Water temperature 16°C. No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota. Pre-existing upstream fish passage problem (culvert) on downstream side of road crossing. Upslope of stream crossing in upper watershed had very high burn severity. Fire area drains to the Middle Fork of Feather River (MFFR).

E. Craig Fire

Values at Risk – fish indirectly as watershed flows to MFFR

The Craig Fire encompasses about 1106 acres of land in Butte County. Vantage point at top of Craig Access road (N39.37.355 W121.19.684) Burn area suffered low burn intensity in most areas. No perennial stream in burn area. No species of special concern located. High soil disturbance from creation of dozer line. No significant salmonid fisheries to protect. Fire area drains to the MFFR.

F. Smokey Fire

Values at Risk - fish, amphibians, aquatic invertebrates

The Smokey Fire encompasses about 1,324 acres of land in eastern Tehama County. Air reconnaissance (September 13th); burn occurred on top of slope, good buffer zone above riparian corridor which did not burn. Watershed drains into Big Chico Creek. BARC analysis showed low burn intensity throughout the fire (Map # 2). No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

G. Breakneck Fire

Values at Risk - fish, amphibians, aquatic invertebrates

The Breakneck Fire encompasses about 771 acres of land in Butte County. Air reconnaissance (September 13th); steep terrain, low intensity burn, patchy burn pattern, good buffer leading to riparian corridor. Watershed drains into Big Kimshew Creek. No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

H. Inskip Fire

Values at Risk - fish, amphibians, aquatic invertebrates

The Inskip Fire encompasses about 104 acres of land in Butte County. Air reconnaissance (September13th); ridge top burn, affected watershed drains to West Branch of Feather River to the north and Fish Creek to the south. Low intensity burn, patchy burn pattern, good buffer leading to riparian corridor. No significant salmonid fisheries to protect. However, it is home to a variety of other aquatic biota.

## III. Condition of Values at Risk

The magnitude of the impacts of fire on water quality as it relates to aquatic organisms is primarily driven by fire severity, and not necessarily by fire intensity. Fire severity is a qualitative term describing the amount of fuel consumed, while fire intensity is a quantitative measure of the rate of heat release In other words, the more severe the fire, the greater the amount of fuel consumed and nutrients released, and the more susceptible the site is to erosion of soil and nutrients into the stream where they could potentially affect water quality (Neary et al. 2005). Wildfires usually are more severe than prescribed fires. As a result, they are more likely to produce significant effects on water quality. Small streams with high fuel loads and high severity fire are the ones most likely to suffer immediate aquatic organism mortality from fire.

Such watershed impacts accelerate the delivery of sediment to stream channels. The lack of vegetative cover and change in soil structure increase the amount of surface runoff in

response to storms, resulting in fast-moving water with increased ability to erode and transport sediment on hillslopes. The low permeability of the soil and lack of a forest canopy to impede rainfall causes water to accumulate on the ground surface. This water then moves downstream as sheets of water (sheetwash erosion) or gathers in small streams that form rills and gullies. Under normal conditions, sheetwash and rill erosion are not significant processes on forested hillslopes, but after intense fires, the frequency and magnitude of such processes caused by watershed changes can persist for several years (Meehan, 1991).

The increased transport of sediment from burned hillslopes can overwhelm the sediment-carrying capacity of a stream, resulting in excessive deposits of fresh sediment in stream channels. The amount of time the sediment remains stored in the channels depends on the amount of sediment available on hillslopes for transport, the period of time that is required for the conditions to stabilize on hillslopes, the frequency and size of stream flows available for scouring the sediment from the channel, and the physical characteristics of stream channels that govern the velocity of flows through a particular channel reach.

The main concern for the Butte 2008 Fires is the potential for detrimental downstream organic pollution from post fire events and the subsequent effects upon each life history stage of aquatic species. The downstream impacts to each individual drainage depends on several factors; slope stability, intensity and frequency of rainfall, upslope burn severity, sediment delivery, post fire plant regeneration, soil composition and potential needle cast. Other Technical Reports comment on the aforementioned impacts associated with the 2008 Butte Fires.

General Direct and Indirect Effects on Fish, Amphibians, and Reptiles

Key factors in immediate post fire fish mortality are the size of the riparian area, the riparian fuel load, fire severity, and stream size. The effects of wildland fire on fish are mostly indirect, with most studies demonstrating the effects of ash flows, changes in hydrologic regimes, and increases in suspended sediment on fish and aquatic organisms. The largest problems arise from the long term impact on habitat that includes changes in stream temperature due to plant understory and overstory removal, ash-laden flows, increases in flood peak flows, and sedimentation due to increased landscape erosion.

Amphibians are relatively vulnerable to fire kill because they are less mobile than other animals and often seek shelter in leaf litter or old logs that are consumed by fire. Typically, however, California's amphibians prefer moist habitats, which generally remain unburned except in the most intense wildfires, and thus show better survivorship (Nichols and Menke1984).

Reptiles generally exhibit low mortality from fire, because they retreat into burrows or rocks to escape the flames. However, some reptile species habitually hide in litter or under logs and thus are vulnerable to fire-induced mortality (Nichols and Menke 1984).

## IV. Emergency

Many of the watersheds within the 2008 Butte Fires suffered detrimental impacts from the wildfires. However, because disturbances such as fire are a fundamental characteristic of aquatic ecosystems, many species have evolved life history strategies to deal with post fire effects. Consequently, many species will recover. However, there is a low to moderate threat to aquatic species of special concern throughout the 2008 Butte Fires and an elevated concern for T&E species in the Butte Creek and Big Chico Creek drainages. Emergency actions are not suggested for aquatic habitat at this time. Recommendations for treatments and monitoring are given in the following section that may document the effects of the wildfire on aquatic species.

## V. Recommendations

A. General Recommendations:

The extent and severity of the fires on localized streams within the 2008 Butte Fires will likely produce an increase in sediment transport and erosion this coming winter. It is likely that there will be an increase in the amount of sediment and debris from previous years. To minimize the streams effect on fishes and other aquatic species by this years fire, any affected stream should be evaluated when it has been determined that T&E fishes and aquatic species have been recently documented within that given stream. With the support of a qualified biologist familiar with local streams, an assessment will be made in the field to determine a best management plan for that stream. Efforts at minimizing the negative effects on threatened species, and species of concern and their critical habitat should be monitored and managed to return to pre-fire conditions before adverse impacts occur in order to record damages due to excessive runoff and related pollution. Implement Best Management Practices (BMP) for erosion control upstream to stabilize and minimize the amount of upslope erosion caused by post fire sediment/debris transport. Conduct post-fire surveys for fish and aquatic species and their habitat.

Any mitigation efforts or projects that fall within one of these categories: stream diversions and obstructions, working within or adjacent to a lake or stream, discharges into stream, sensitive species, Natural Community Conservation Plan (NCCP), should be conducted under Fish and Game Code 1602 guidelines to protect aquatic species impacted by the restoration efforts. Additionally, if the instream work is within waters that support any Federal or State listed species; permits should be obtained from the appropriate entities. (e.g., Fish and Game, National Marine Fisheries Service, BOR, USFWS, Regional Water Quality Control Board).

B. Specific Recommendations:

1. Reference (Appendix 1) and (Map # 1) for species of concern in each fire area.

2. The Humboldt Fire - encompasses about 23,333 acres of land in Butte County. Within the Humboldt Fire perimeter, approximately 2000 acres (3 sq. miles) of burned watershed directly affects runoff into Butte Creek. A low to moderate risk exists to SRCS and

Central Valley steelhead from potential sediment and turbidity delivery from swales and side channels that drain directly from the watershed and into Butte Creek which may adversely affect salmonid eggs deposited in the gravels within their spawning habitat during storm events. See Hydrologist Technical Report.

Culvert maintenance performed along Honey-Run Road and Centerville Road by Butte County Public Works should be coordinated with the Department of Fish and Game under Section 1602 of the Fish and Game Code. Following recommendations for culvert monitoring and maintenance will decrease the amount of sediment/debris delivery in Butte Creek. See Geologist Technical Report.

In other portions of the Humboldt Fire where fire suppression disturbed riparian habitat and opened up OHV use, signage and/or barricades should be installed to discourage use and possible future degradation of riparian corridors.

Homeowners and private landowners interested in soil erosion control methods should refer to the following website for information about remedies available to reduce the risk and find possible recovery tips associated with wildfires. This would help minimize sediment delivery into Butte Creek.
ftp://ftpfc.sc.egov.usda.gov/CA/programs/EWP/azpmsarwldfrrecovery.pdf

Mitigation measures to reduce the risk of soil erosion and turbidity should be employed before sediment delivery is transported to the stream bed. The terrain is not too steep and soil stabilization could be achieved by landowners with proper erosion control treatment techniques (e.g. BMPs) described by the SEAT Civil Engineering Technical Report.

Turbidity readings at USGS gage (BCK) from California Data Exchange Center (CDEC) should be monitored to evaluate post wildfire sediment discharged into Butte Creek and monitor any affects the resulting sediment has to anadromous fish populations. Refer to SEAT Hydrologist Technical Report for sediment monitoring thresholds.

3. The Belden Fire - encompasses approximately 474 acres of which 44.3% was unburned and 27.4% was a low intensity burn. An increase of sediment and runoff is expected without major risk to water quality. Refer to SEAT Hydrologist Specialist Report. Through a desktop review of the local topographic and geologic setting, it was determined that the Belden Fire represented little to no risk to salmonids as a result of the fire. Consequently, no recommendations are provided.

4. The Camp Fire - encompasses about 49,643 acres of land, of which 41.1% burned with moderate to severe intensity. A low to moderate risk exists to species of special concern. The foothill yellow-legged frog and hardhead minnow are known to occur in the NFFR (Craig Geldard, PG&E per. comm.) Since a large portion of the Camp Fire contains tributaries to the NFFR an increase in sediment delivery can be expected to occur throughout the affected watershed. However, the effects of this fire would be diluted within the NFFR due to the relatively small percentage of the watershed that was burned, and from the many non-fire affected tributaries that drain into the NFFR.

The North Camp Fire – encompasses about 23,973 acres of land and experienced a low to moderate burn severity over approximately 70%of the fire area. It includes Chambers Creek, Jackass Creek, Rock Creek, Camp Creek and Dogwood Creek. Since portions of these creeks contain habitat utilized by species of special concern, any upslope erosion control mitigation efforts should include pre-survey inspections by the responsible entities to minimize potential disturbance to the species. Hillslopes that are not too steep should have mitigation measures to reduce the risk to species of concern populations by controlling soil erosion before it is transported to the stream bed.

The South Camp – encompasses about 25,670 acres of land and experienced moderate to high burn severity throughout approximately 40% of the area. Consideration for the protection of foothill yellow-legged frogs and possibly the red-legged frog habitat should be undertaken when soil erosion mitigation efforts are conducted in the Flea Valley Creek drainage. Pre-survey inspections by the responsible entities prior to any mitigation measures should be conducted to minimize potential disturbance to the species. Recommendation measures referring to road and culvert maintenance and monitoring in the Butte SEAT Geologist Technical Report should reduce the amount of sediment released into the creek from potential debris torrents and sediment that effects water quality within the Flea Valley Creek area and to the NFFR. The Cirby Creek and Concow Creek area suffered areas of high burn intensity (Map #2) with little to no potential for needle cast to help minimize soil erosion control problems anticipated this winter. Since Cirby Creek, Concow Creek and the unnamed tributaries south of Cirby Creek have potential California red-legged frog (CRLF) habitat, measures as described by USFS (BAER, 2008) for erosion control should be taken to minimize the possible degradation to CRLF habitat. Any upslope erosion control mitigation efforts should include pre-survey inspections by the responsible entities to minimize potential disturbance to the species.

5. Friend-Darnell Fire - encompasses about 3,845 acres of land in Butte County. A moderate to severe burn occurred in over 53% of the fire perimeter leaving little to no needle cast protection for soil protection. An increase in sediment and runoff can be expected during storm events. See the SEAT Hydrologist Technical Report. Since the Friend/Darnell Fire contains potential habitat for California red-legged frog (federally listed as threatened) the set of prescriptions described by the USFS (BAER, 2008) report, erosion could be minimized to reduce the amount of sediment and turbidity delivered to Bean Creek (a tributary to MFFR) due to losses of upslope stability of the wildfire. Also, following measures described by the SEAT Geologist Technical Report for mitigating culvert and road erosion, the amount of sediment delivered through Bean Creek and eventually to the MFFR could be reduced. However, the effects of this fire on aquatic species would be diluted within the MFFR due to the small percentage of the watershed affected, and due to the low to moderate burn severity and the findings in the SEAT Hydrologist Specialist Report.

6. Craig Fire - encompasses about 1,999 acres of land in Butte County. Since the area is not too steep, stabilization could be achieved on private land by following the general guidelines given in the Butte County Watershed Restoration and Erosion Control pamphlet provided by Butte County RCD. Concerned citizens should also utilize web based information to help them find ways to reduce the risk of wildfire and recovery techniques used in post fire erosion control, such as:

ftp://ftpfc.sc.egov.usda.gov/CA/programs/EWP/azpmsarwldfrrecovery.pdf
This would help minimize the amount of fine sediment and turbidity that is expected to be delivered to the MFFR after storm events.

7. Smokey Fire - encompasses about 1,324 acres of land in eastern Tehama County. The Smokey Fire was not visited by on the ground reconnaissance. An aerial survey determined the fire burned with low intensity throughout much of the fire perimeter. BARC analysis confirmed approximately 42% (562 acres) burned with low intensity, and approximately 40% (534 acres) was unburned. Big Chico Creek is downslope of the burned watershed which is habitat for SRCS and Central Valley steelhead. However, any increase in sediment and turbidity delivered to the creek should not impact their habitat since the uppermost holding and spawning habitat for SRCS and Central Valley Steelhead is approximately 10 miles downstream. There is not enough risk to justify implementation of mitigation measures.

8. Breakneck Fire - encompasses about 771 acres of land in Butte County. The Breakneck Fire was not visited by on the ground reconnaissance. An aerial survey determined the fire burned with low intensity throughout much of the fire perimeter. BARC analysis confirmed approximately 45% (345 acres) burned with low intensity, and approximately 38% (294 acres) was unburned. Big Kimshew Creek is downslope of the fire and is tributary to the West Branch of the Feather River (WBFR). Through a desktop review of the local topographic and geologic setting, and the assessment of the SEAT Hydrologist Technical Report, it was determined that the Breakneck Fire represented little to no risk to salmonids as a result of the fire. Consequently, an on-site review was not performed and no recommendations are provided.

9. Inskip Fire – encompasses about 104 acres of land in Butte County. The Inskip Fire was not visited by on the ground reconnaissance. An aerial survey determined the fire burned with low intensity and in a mosaic pattern throughout much of the fire perimeter. The WBFR lies to the north and Fish Creek to the south of the Inskip Fire. The BARC analysis confirmed only 5 acres burned within the fire perimeter at low intensity. It was a ridge top burn and it was determined that the Inskip Fire represented little to no risk to salmonids as a result of the fire. Consequently, an on-site review was not performed and no recommendations are provided.

## V. References

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Table 1

Potential rare, threatened, and endangered species that could be potentially affected by the 2008 Butte Fires.

| Species of concern associated with the Butte SEAT | | | |
|---|---|---|---|
| FIRE NAME | QUADNAME | SCINAME | COMNAME |
| **Humboldt Fire** | HAMLIN CANYON | Botrychium minganense | mingan moonwort |
| | PARADISE WEST | Monardella follettii | Follett's monardella |
| | PARADISE WEST | Rana boylii | foothill yellow-legged frog |
| | PARADISE WEST | Myotis thysanodes | fringed myotis |
| | PARADISE WEST | Rupertia hallii | Hall's rupertia |
| | PARADISE WEST | Agrostis hendersonii | Henderson's bent grass |
| **Beldon Fire** | BELDEN | Sidalcea robusta | Butte County checkerbloom |
| | BELDEN | Fritillaria eastwoodiae | Butte County fritillary |
| | BELDEN | Trifolium jokerstii | Butte County golden clover |
| | BELDEN | Calystegia atriplicifolia ssp. buttensis | Butte County morning-glory |
| | BELDEN | Haliaeetus leucocephalus | bald eagle |
| **Camp Fire** | BERRY CREEK | Cypseloides niger | black swift |
| | BERRY CREEK | Penstemon personatus | closed-throated beardtongue |
| | BERRY CREEK | Packera eurycephala var. lewisrosei | Lewis Rose's ragwort |
| | BERRY CREEK | Hibiscus lasiocarpus | woolly rose-mallow |
| | BERRY CREEK | Limnanthes floccosa ssp. californica | Butte County meadowfoam |
| | BERRY CREEK | Clarkia mosquinii | Mosquin's clarkia |
| | BERRY CREEK | Rupertia hallii | Hall's rupertia |
| | BERRY CREEK | Clarkia mildrediae ssp. mildrediae | Mildred's clarkia |
| | BERRY CREEK | Trifolium jokerstii | Butte County golden clover |
| | BERRY CREEK | Branchinecta lynchi | vernal pool fairy shrimp |
| | BERRY CREEK | Sidalcea robusta | Butte County checkerbloom |
| | BERRY CREEK | Rhynchospora californica | California beaked-rush |
| | BERRY CREEK | Clarkia gracilis ssp. albicaulis | white-stemmed clarkia |
| | BERRY CREEK | Hibiscus lasiocarpus | woolly rose-mallow |
| | BERRY CREEK | Trifolium jokerstii | Butte County golden clover |

Table 1 (continued)

Potential rare, threatened, and endangered species that could be potentially affected by the 2008 Butte Fires.

| FIRE NAME | QUADNAME | SCINAME | COMNAME |
|---|---|---|---|
| **Camp Fire** | BERRY CREEK | Phrynosoma coronatum (frontale population) | coast (California) horned lizard |
| | BERRY CREEK | Trifolium jokerstii | Butte County golden clover |
| | BERRY CREEK | Fritillaria eastwoodiae | Butte County fritillary |
| | BERRY CREEK | Haliaeetus leucocephalus | bald eagle |
| | BERRY CREEK | Clarkia biloba ssp. brandegeeae | Brandegee's clarkia |
| | CHEROKEE | Calystegia atriplicifolia ssp. buttensis | Butte County morning-glory |
| | CHEROKEE | Rhynchospora californica | California beaked-rush |
| | CHEROKEE | Imperata brevifolia | California satintail |
| | CHEROKEE | Lewisia cantelovii | Cantelow's lewisia |
| | PARADISE EAST | Lewisia cantelovii | Cantelow's lewisia |
| | PARADISE EAST | Lewisia cantelovii | Cantelow's lewisia |
| | PARADISE EAST | Penstemon personatus | closed-throated beardtongue |
| | PARADISE EAST | Sedum albomarginatum | Feather River stonecrop |
| | PARADISE EAST | Viola tomentosa | felt-leaved violet |
| | PARADISE EAST | Utricularia intermedia | flat-leaved bladderwort |
| | PARADISE EAST | Monardella follettii | Follett's monardella |
| | PULGA | Agrostis hendersonii | Henderson's bent grass |
| | PULGA | Allium jepsonii | Jepson's onion |
| | PULGA | Packera eurycephala var. lewisrosei | Lewis Rose's ragwort |
| | PULGA | Stellaria longifolia | long-leaved starwort |
| | PULGA | Clarkia mildrediae ssp. mildrediae | Mildred's clarkia |
| | PULGA | Botrychium minganense | mingan moonwort |
| | PULGA | Fissidens pauperculus | minute pocket moss |
| | PULGA | Clarkia mosquinii | Mosquin's clarkia |
| | STORRIE | Lupinus dalesiae | Quincy lupine |
| | STORRIE | Rana sierrae | Sierra Nevada yellow-legged frog |
| **Friend-Darnell** | BRUSH CREEK | Carex vulpinoidea | brown fox sedge |
| | BRUSH CREEK | Fritillaria eastwoodiae | Butte County fritillary |
| | BRUSH CREEK | Packera eurycephala var. lewisrosei | Lewis Rose's ragwort |
| | BRUSH CREEK | Clarkia mosquinii | Mosquin's clarkia |
| | BRUSH CREEK | Pandion haliaetus | osprey |
| | BRUSH CREEK | Clarkia gracilis ssp. albicaulis | white-stemmed clarkia |

Table 1 (continued)

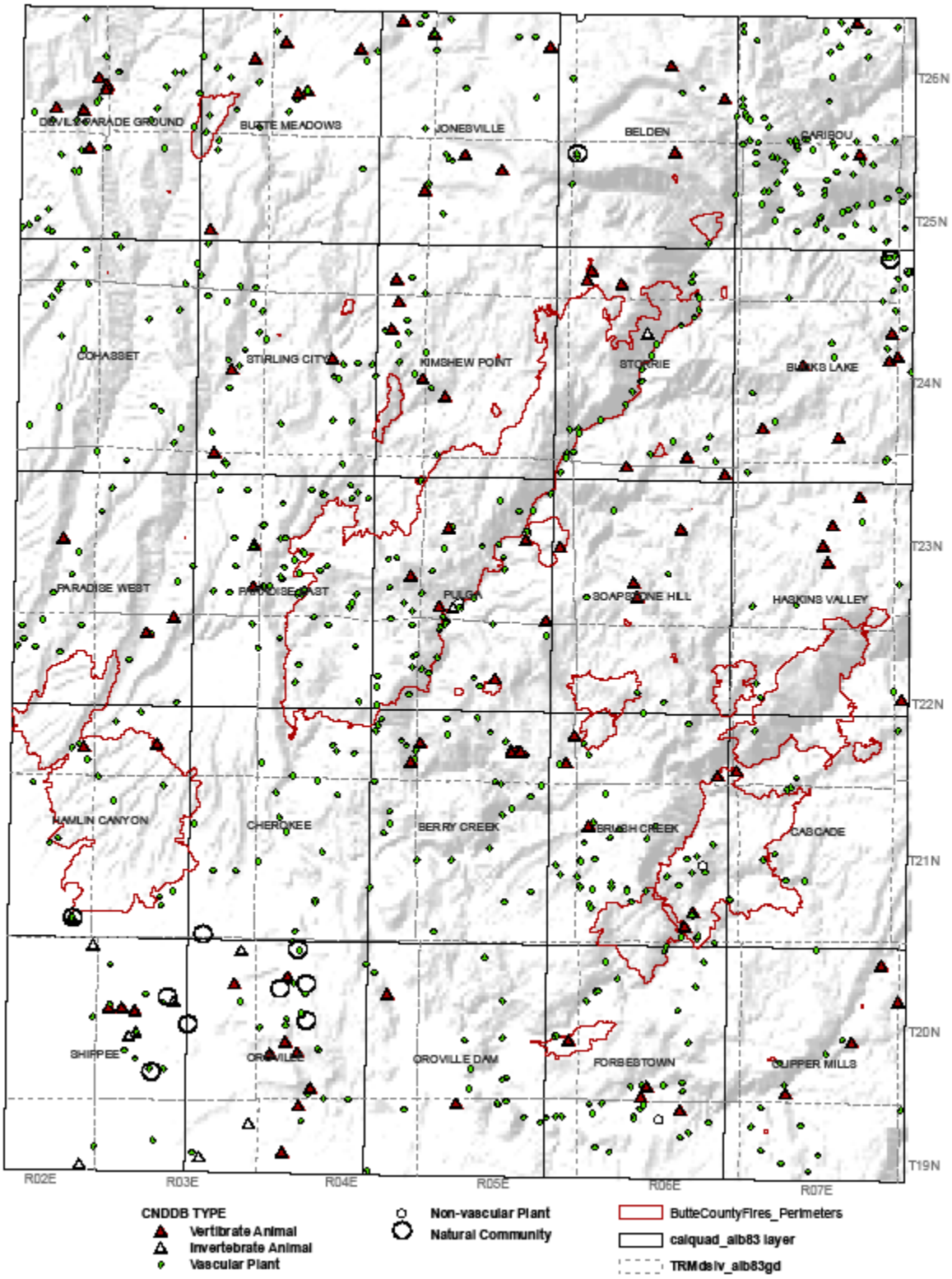
Potential rare, threatened, and endangered species that could be potentially affected by the 2008 Butte Fires.

| FIRE NAME | QUADNAME | SCINAME | COMNAME |
|---|---|---|---|
| **Friend-Darnell** | BRUSH CREEK | Paronychia ahartii | Ahart's paronychia |
| | BRUSH CREEK | Haliaeetus leucocephalus | bald eagle |
| | BRUSH CREEK | Actinemys marmorata marmorata | northwestern pond turtle |
| | BRUSH CREEK | Pandion haliaetus | osprey |
| | BRUSH CREEK | Falco peregrinus anatum | American peregrine falcon |
| | BRUSH CREEK | Sidalcea robusta | Butte County checkerbloom |
| | BRUSH CREEK | Trifolium jokerstii | Butte County golden clover |
| | BRUSH CREEK | Limnanthes floccosa ssp. californica | Butte County meadowfoam |
| **Craig Fire** | FORBESTOWN | Rhynchospora capitellata | brownish beaked-rush |
| | FORBESTOWN | Calystegia atriplicifolia ssp. buttensis | Butte County morning-glory |
| | FORBESTOWN | Rana cascadae | Cascades frog |
| | FORBESTOWN | Penstemon personatus | closed-throated beardtongue |
| | FORBESTOWN | Arabis constancei | Constance's rock-cress |
| | FORBESTOWN | Sedum albomarginatum | Feather River stonecrop |
| | FORBESTOWN | Rana boylii | foothill yellow-legged frog |
| | FORBESTOWN | Rupertia hallii | Hall's rupertia |
| | FORBESTOWN | Packera eurycephala var. lewisrosei | Lewis Rose's ragwort |
| | OROVILLE DAM | Fritillaria eastwoodiae | Butte County fritillary |
| | OROVILLE DAM | Calystegia atriplicifolia ssp. buttensis | Butte County morning-glory |
| | OROVILLE DAM | Calystegia atriplicifolia ssp. buttensis | Butte County morning-glory |
| | OROVILLE DAM | Rana draytonii | California red-legged frog |
| | OROVILLE DAM | Lewisia cantelovii | Cantelow's lewisia |
| **Smokey Fire** | BUTTE MEADOWS | Clarkia mildrediae ssp. mildrediae | Mildred's clarkia |
| | BUTTE MEADOWS | Clarkia mosquinii | Mosquin's clarkia |
| | BUTTE MEADOWS | Northern Basalt Flow Vernal Pool | Northern Basalt Flow Vernal Pool |
| | BUTTE MEADOWS | Northern Basalt Flow Vernal Pool | Northern Basalt Flow Vernal Pool |
| | BUTTE MEADOWS | Accipiter gentilis | northern goshawk |

Table 1 (continued)

Potential rare, threatened, and endangered species that could be potentially affected by the 2008 Butte Fires.

| FIRE NAME | QUADNAME | SCINAME | COMNAME |
|---|---|---|---|
| **Smokey Fire** | BUTTE MEADOWS | Northern Hardpan Vernal Pool | Northern Hardpan Vernal Pool |
| | BUTTE MEADOWS | Northern Volcanic Mud Flow Vernal Pool | Northern Volcanic Mud Flow Vernal Pool |
| | BUTTE MEADOWS | Actinemys marmorata marmorata | northwestern pond turtle |
| | BUTTE MEADOWS | Juncus leiospermus var. leiospermus | Red Bluff dwarf rush |
| | BUTTE MEADOWS | Oncorhynchus tshawytscha spring-run | spring-run chinook salmon |
| | BUTTE MEADOWS | Agelaius tricolor | tricolored blackbird |
| | BUTTE MEADOWS | Monardella douglasii ssp. venosa | veiny monardella |
| | BUTTE MEADOWS | Branchinecta lynchi | vernal pool fairy shrimp |
| | DEVILS PARADE GROUND | Sagittaria sanfordii | Sanford's arrowhead |
| | DEVILS PARADE GROUND | Carex sheldonii | Sheldon's sedge |
| | DEVILS PARADE GROUND | Lasionycteris noctivagans | silver-haired bat |
| | DEVILS PARADE GROUND | Monardella stebbinsii | Stebbins' monardella |
| | DEVILS PARADE GROUND | Branchinecta lynchi | vernal pool fairy shrimp |
| | DEVILS PARADE GROUND | Lepidurus packardi | vernal pool tadpole shrimp |
| | DEVILS PARADE GROUND | Eumops perotis californicus | western mastiff bat |
| | DEVILS PARADE GROUND | Clarkia gracilis ssp. albicaulis | white-stemmed clarkia |
| | DEVILS PARADE GROUND | Empidonax traillii | willow flycatcher |
| **Breakneck Fire** | KIMSHEW POINT | Fritillaria eastwoodiae | Butte County fritillary |
| | KIMSHEW POINT | Rupertia hallii | Hall's rupertia |
| **Inskip Fire** | STIRLING CITY | Carex limosa | mud sedge |
| | STIRLING CITY | Corallorhiza trifida | northern coralroot |
| | STIRLING CITY | Accipiter gentilis | northern goshawk |
| | STIRLING CITY | Actinemys marmorata marmorata | northwestern pond turtle |
| | STIRLING CITY | Martes pennanti (pacifica) DPS | Pacific fisher |
| | STIRLING CITY | Antrozous pallidus | pallid bat |
| | STIRLING CITY | Lupinus dalesiae | Quincy lupine |




(FMAP # 1). CNDDB occurrences overlaid spatially on the 2008 Butte Fires.

**DRAFT TECHNICAL SPECIALIST'S**

**STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report**

**Resource: Wildlife**

**Fire Name:** BTU Lightning Fires **Month/Year:** September 2008
2008 Butte Fires CA-CDF-000593

Author Name: Terri Weist
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## WILDLIFE

### I. Resource Setting

The 2008 Butte Fires burned 57,086 acres of land in federal responsibility and 56,944 acres under State responsibility, including valuable upland and lowland habitat types that supported numerous sensitive species. Most of the vegetation communities that were affected have evolved with periodic fires and will naturally regenerate within a few years. The fires have impacted many species of wildlife and their habitats within the Butte Fire complex.

Most of the vegetation communities that were affected by the 2008 Butte Fires have evolved with periodic fires and will naturally regenerate within a few years (Map # 7). The fires have impacted many species of wildlife and their habitats within the Butte Fire burned areas. It is nearly certain that significant amounts of mammals, birds, reptiles, amphibians, and even insects perished or lost important habitat in the fire. However, many species were likely able to move out of the way of the approaching fire to areas that were not burned, or they found shelter in moist areas such as streams or creeks, underground, or even in large rocky outcrops and caves. Also, not all of the habitat within the fire perimeter was burned, and a significant amount within the State-Responsibility lands burned in a low intensity mosaic pattern, probably providing long-term habitat improvement to many native wildlife species.

Habitats affected by the burn include Map # 7:

- Sierran Mixed Conifer Forest
- Yellow Pine Forest
- White Fir Forest

- Montane Hardwood-Conifer
- Montane Hardwood
- Montane Chaparral-Plantation
- Montane Chaparral
- Montane Riparian
- Wet Meadow

**Wildlife Response to Fire:**

Changes in animal populations immediately after fire derive from emigration and mortality during fire and, in some cases, immigration during and immediately after fire. Immigration and emigration behaviors during fire are largely dependent on the type of animal; animal mortality during fire is largely dependent on the type of fire, the type of animal, and the animal's corresponding behavioral responses to fire (Lyon et al. 1978).

Birds' responses to fire vary, but they generally show no fear of fire. Some fly ahead of a burn or escape into unburned refuges, some ignore fires, and many insectivorous birds, birds of prey, and other birds are attracted to smoke where insects are abundant (Lyon et al. 1978; Nichols and Menke 1984).

Most small mammals react to fire by hiding or seeking shelter. Small nonburrowing mammals live and hide in flammable shelters above ground and thus suffer heavy direct losses in wildfires (Quinn 1979); small burrowing mammals are much less affected directly by wildfires because of the insulation of the soil (Sampson 1944; Lyon et al. 1978; Quinn 1979). Small rodents are also more likely to exhibit panic behavior and have been observed to run in circles or even back into fires, making them more susceptible to mortality (Nichols and Menke 1984).

Although there is certainly some vertebrate mortality during fire, the most common opinion is that direct deaths from fires are rare, and such mortality does not have significant long-term impacts on species' populations (Lyon et al. 1979).

Fires that occurred within the Butte Lightening Complex may have resulted in temporary loss of habitat for listed or sensitive species. However, population viability of any of the species listed in W-Tables 1(a) and 2 (b) are not at risk. Many species will benefit from habitat changes that result after fire if the habitat is not immediately modified (i.e., replanted with conifers and sprayed with herbicides).

## I. Resource Condition Assessment

A. Setting:

1. Humboldt

CNDDB search showed that a peregrine falcon was detected on the perimeter of the Humboldt fire. The status of this species after the fire is unknown. The Humboldt fire provided marginal winter habitat for mule deer. Fire intensity varied with a mosaic of completely burned areas to unburned patches (Map # 2)

2. Belden

This fire was within federal forest lands and therefore beyond the scope of this report. However, northern goshawk (*Accipiter gentiles*), was the only listed wildlife species of concern to occur in the burn area on private lands. American pine marten (*Martes americana*) have been documented on adjacent federal lands.

3. North Camp

This fire had a low to moderate fire severity classification (Map # 2). A bald eagle nest occurs within the burn on USFS lands. This fire contains several sensitive plant occurrences (see Botanical Technical Report).
A peregrine eyrie is located on the Pulga road off of Highway on USFS lands. 70 on northeast side of the North Fork, Feather River Canyon (USFS BAER Report, 2008).

4. South Camp

Valley Elderberry Longhorn Beetle (federally listed threatened) has been detected on USFS lands. Other species detected on adjacent USFS lands include western pond turtle (*Actinemys marmorata*), silver haired bat (*Lasionycteris noctivagans*) and fringed myotis (*Myotis thysanodes*). It is likely that these species reside within private lands in this burn.

5. Friend-Darnell

A bald eagle nest is located along the perimeter of this burn.

6. Craig

A bald eagle nest was located within the burn area.

7. Smokey

Encompassed about 1,324 acres of land in eastern Tehama County. The Smokey Fire was not visited by on the ground reconnaissance. An aerial survey determined the fire burned with low intensity throughout much of the fire perimeter. BARC analysis confirmed approximately 42% (562 acres) burned with low intensity, and approximately 40% (534 acres) Of the 1,324 acre Smokey fire, 46 acres was classified as severe. There were no listed or sensitive wildlife species within the Smokey Fire.

8. Breakneck

Encompassed about 771 acres of land in Butte County. The Breakneck Fire was not visited on the ground reconnaissance. An aerial survey determined the fire burned with low intensity throughout much of the fire perimeter. BARC analysis confirmed approximately 45% (345 acres) burned with low intensity, and approximately 38% (294 acres)
No sensitive or listed species were found within this burn.

9. Inskip Fire

The Inskip Fire encompasses about 104 acres of land in Butte County. Air reconnaissance (September13th); determined the fire burned with low intensity and in a mosaic pattern throughout much of the fire perimeter with ridge top burn, No listed species were found within this burn.

Survey Methods

The initial review of wildlife resources potentially impacted by this fire included a search of the California Natural Diversity Database (CNDDB) for occurrences of sensitive species (rare, threatened, or endangered) within the burn area (WMap # 1 and Table W-2), and the soil burned severity map (Map # 2), generated from a satellite image of the burned area (called a Burned Area Reflectance Classification, or BARC.) In addition to CNDDB occurrences and map analysis, field visits were conducted to view impacts to selected species and habitats. In addition, aerial flights were conducted to survey the burn sites on September 13 and 14$^{th}$, 2008.

## II. Findings of the On-The-Ground Survey (Observations)

### A. Identify Values at Risk

It is likely that many of the sensitive wildlife species within the burned area survived the fire, and will likely recover from losses to individual animals and/or habitat; however

some level of impacts from the fire have occurred for certain sensitive species that have been documented in the burn areas (Table W-1(a)). Given the habitat suitability within and adjacent to individual fire areas, it is possible that other non-documented species could occur (Table W-1(b)). The following section reports and discusses these impacts.

1. Humboldt

   No immediate risks were identified to wildlife resources. Post fire remediation may provide a larger risk to wildlife then the actual fire. Invasive weed species can become established and preclude native forage for wildlife from recovering.

2. Belden

   No immediate risks were identified to wildlife resources.

3. North Camp

   No immediate risks were identified to wildlife resources. Post fire remediation may provide a larger risk to wildlife then the actual fire. Invasive weed species can become established and preclude native forage for wildlife from recovering.

4. South Camp

   No risks were identified to wildlife resources. Post fire remediation may provide a larger risk to wildlife then the actual fire. Invasive weed species can become established and preclude native forage for wildlife from recovering. The peregrine eyrie was not impacted by the fire.

5. Friend-Darnell

No risks were identified to wildlife resources. A bald eagle nest was located within the fire perimeter but the nest tree was not affected. Extensive bulldozer lines were observed and will be problematic to natural vegetative recover (see botanical report).

6. Craig

No risks were identified to wildlife resources. However, a bald eagle nest was located within the burn area. The nest tree was not burned however.

7. Smokey

Since there were no sensitive or listed species within this fire, no risks were identified to wildlife resources.

**III** Recommendations

A. Specific Recommendations

1. Allowing sites to revegetate naturally is preferred to seeding or drilling. However, erosion control measures are necessary, particularly on steep slopes. We recommend the utilization of certified weed-free straw, straw with tackifier, and erosion control blankets (jute netting with straw or coir filling).

2. In severe or moderately severe fire areas, remove livestock in areas that have been subject to livestock grazing to allow vegetation to recover. This will also eliminate interspecies competition with native ungulates.

3. Snags provide valuable habitat to bird and other species. Forestry practices should leave 1 to 2 snags of varying size classes within every 5 acres of a salvage timber stand.

4. Similarly, large down woody debris should be allowed to remain on burn sites to provide refugia to wildlife during recovery of the site.

**Emergency Determination –**

No emergency determinations for wildlife have been identified as a result of the fire. However, post fire remediation can cause more damage to wildlife habitat then the actual fire caused.

Introduction of noxious weeds, especially through introduction for slope stabilization, immediate reforestation of burned forest sites and complete snag removal can be detrimental to wildlife recovering from the fires.

**Treatments to Mitigate the Emergency**

I. Treatment Type

A. Habitat recovery:

Early seral stage species benefit from forb and brush growth following a fire. It is likely that some species became dislodged and disoriented from home ranges that were burned and will require food sources to sustain them through the upcoming winter and spring. However, immediate salvage logging and reforestation circumvents this process, eliminating forage to sustain species.

Snag Recruitment:

North Camp, and Craig fires contained areas of severe burned areas. Snag recruitment, containing various size classes should be left on the landscape to provide habitat for woodpeckers. Snags will eventually fall and provide habitat for many wildlife species that depend upon beetles and other insects as well as denning sites for mustelids and other species.

. Bulldozer Line Damage:

During fire fighting activities, wide swaths of habitat were destroyed on the North Camp and Craig Fires. Top soil is lost and remaining soil is compacted as a result of dozer activity. This can prevent natural revegetation of native flora. In addition, noxious weeds can be introduced through inoculation from contaminated equipment. (See Botanical Report)

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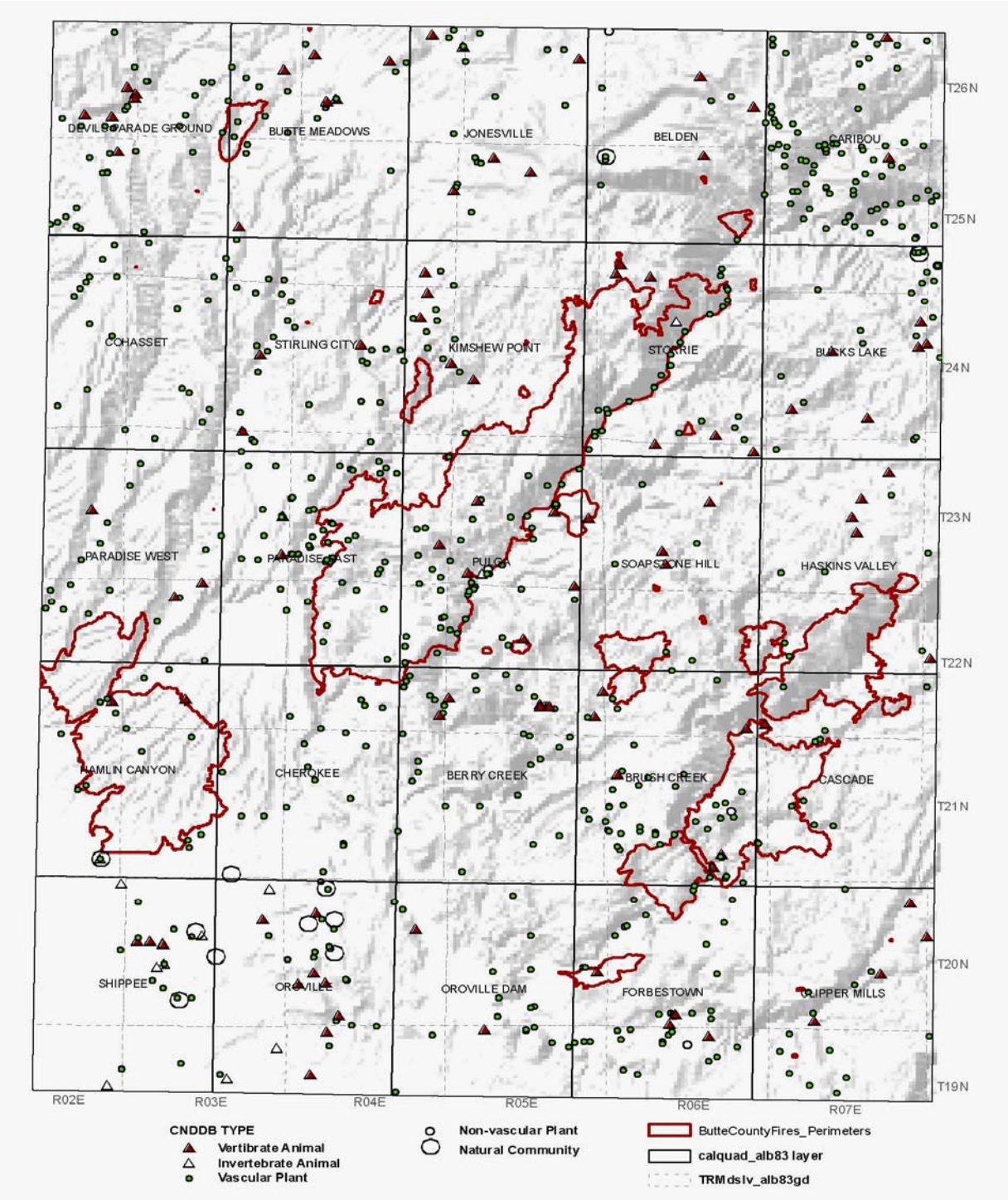
Table W-1(a). Sensitive wildlife species known to occur within the Butte Lightening Complex – Canyon Complex

| Common Name | Scientific Name | Status |
|---|---|---|
| Bald Eagle | *Haliaeetus leucocephalus* | State Threatened |
| Northern Goshawk | Accipiter gentilis | State Species of Concern |
| Peregrine falcon | Falco peregrinus anatum | State Endangered |
| Black swift | *Cypseloides niger* | State Species of Concern |

Table W-1(b) – Sensitive wildlife species **potentially** impacted by the Butte Lightening Complex – Canyon Complex (USFS BAER Report, 2008)

| Common Name | Scientific Name | Status |
|---|---|---|
| Northern Goshawk | Accipiter gentilis | State Species of Concern |
| California spotted owl | *Strix occidentalis occidentalis* | State Species of Concern |
| Sierra Nevada red fox | *Vulpes vulpes necator* | State Threatened species |
| Ringtail | *Bassariscus astutus* | State Fully Protected |
| Pacific fisher | *Martes pennanti pacifica* | Candidate for federal listing |
| California wolverine | *Gulo gulo luteus* | State threatened species |
| Pallid bat | *Antrozous pallidus* | State Species of Concern |
| Townsend's Big eared bat | *Corynorhinus townsendi* | State Species of Concern |
| Western red bat | *Lasiurus blossevillii* | State Species of Concern |
| Fringed myotis | *Myotis thysanodes* | State Species of Concern |
| Townsend big-eared bat | *Corynorhinus townsendii* | State Species of Concern |




WMAP # 1: Map depicting CNDDB (California Natural Diversity Database) occurrences within burn perimeters on the Butte Lightening Complex Fires (CA-CDF-00393)

<INSERT Table 2 (labeled CNNDB Table 2.pdf) here>

**DRAFT TECHNICAL SPECIALIST'S**
**STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report**

**Resource: Botany**

**Fire Name:** BTU Lightning Fires **Month/Year:** September 2008
2008 Butte Fires CA-CDF-000593

**Assembled by:** Terri Weist
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The following botany report was primarily written by Jim Belsher-Howe, Botanist, Mt Hough RD, Plumas NF and Lynée Cavaille, Botanist, Beckwourth RD, Plumas NF in the 2008 USFS BAER report.

**Resource Conditions Assessment**

The 2008 Butte fires started on June 21, 2008. Burn intensity varied on the landscape from moderate severity to low severity (USFS BAER Report 2008).

**A Threat to Ecosystem Integrity exists from invasive weeds.** Many non-native plants are found in California wildlands, but some are much more invasive and noxious than others. Invasive weeds are very effective at occupying disturbed soil and displacing native plants and habitat. Non-native invasive weeds have the potential to displace native vegetation, degrade habitat function, and lower ecosystem stability. Ecological stability relates to the value of native plant communities for wildlife habitat and watershed function.

The potential values at risk, in relation to invasive noxious weeds are the ecological stability of native plant communities and the degradation of Region 5 Sensitive plant habitat. The 2008 Butte fires impacted a variety of different plant communities and environments. The majority of the fire area can be classified as mixed conifer forest.

The unknowing introduction of invasive noxious weeds into areas disturbed by fire suppression and rehabilitation has the potential to establish persistent weed populations. These persistent populations could affect the structure and habitat function of plant communities within the burn area.

Forest Service direction is to minimize the establishment of non-native invasive species to prevent unacceptable degradation of the burned area. Consequently, delayed assessment of roads, dozer lines, drop points, helispots, and safety zones is necessary to detect the spread and introduction of weeds in the first year after fire. Assessing the

establishment of weeds and treating small outlying populations before they expand, will prevent the weeds from becoming serious threats to the recovery of native plants.

Any new noxious weed populations established in the fire area also threaten all nearby public and private lands. Agricultural lands around the fire area may be degraded due to noxious weed spread.

Water quality may also be threatened when noxious weeds displace native riparian and wetland plant species. Many native wetland plants prevent riparian soil erosion while some noxious weeds do not. (USDA-FOREST SERVICE FS-500-8, Reference FSH 2509.13, 2008)

Based on the above information and specific field observations, the probability that the vegetation will recover rapidly, without any treatment, is highly variable and dependent on pre-fire vegetation communities and structures, burn severity, and specific post-fire site conditions. Most of the fire areas were burned at low to moderate severity, or unburned and so will experience rapid vegetation recovery.

Ground cover will reestablish through resprouting of shrubs and herbaceous species. These areas also are likely to have some needle cast that will provide ground cover and reduce overland flow and erosion. Low and moderate burn severity areas could experience some herbaceous growth and resprouting of shrubs by the first rain event this year, especially in lower elevations.

Observations confirmed that vegetation already was seen to be resprouting in areas. Recovery will significantly increase by next growing season. Some moderately burned areas have no dead needles on the trees. These areas will not have future needle cast to provide ground cover and reduce erosion, however since they only burned moderately, they should experience resprouting and revegetation similar to other moderately burned areas with needle cast potential (USFS BAER Report, 2008).

**Survey Method**

The initial review of wildlife resources potentially impacted by this fire included a search of the California Natural Diversity Database (CNDDB) for occurrences of sensitive species (rare, threatened, or endangered) within the burn area (WMap1 and W-Table2). Review of the botanists' report for the BAER Report (USDA-FOREST SERVICE FS-500-8, Reference FSH 2509.13, 2008) assisted in review of botanical resources and values at risk assessment.

**I Values at Risk**
**Fire Name:**

Humboldt Fire

The Humboldt fire contains the following sensitive plant species:
Butte County checkerbloom (*Sidalcea robusta*) a state threatened species
pink creamsacs (*Castilleja rubicundula ssp. Rubicundula*)
Hoover's spurge (*Chamaesyce hooveri*)
Butte County fritillary (*Fritillaria eastwoodiae*)
woolly rose-mallow (*Hibiscus lasiocarpus*)
veiny monardella (*Monardella douglasii ssp. Venosa*)
hairy orcutt grass (*Orcuttia pilosa*)
Greene's tuctoria (Tuctoria greenei)

Belden:
No sensitive or listed plant species are known to exist within the fire perimeter on private lands.

North Camp
Sensitive plant species occur within this fire including Cantelow's lewisia (*Lewisia cantelovii*), and Mildred's clarkia (*Clarkia mildrediae* ssp. *mildrediae*).

South Camp
Sensitive plant species include:
closed-throated beardtongue (*Penstemon personatus*)
white-stemmed clarkia (*Clarkia gracilis ssp. Albicaulis*),
Butte County fritillary (*Fritillaria eastwoodiae*),
Cantelow's lewisia (*Lewisia cantelovii*), and
Jepson's onion (*Allium jepsonii*).

Friend-Darnell
Butte County fritillary (*Fritillaria eastwoodiae*)

Craig
The only sensitive plant to occur on private lands within the Craig fire is Mosquin's clarkia (*Clarkia mosquinii*)

Smokey
The only sensitive plant within the fire perimeter of the Smokey fire was Hall's rupertia (*Rupertia hallii*). This plant occurred within the high severity portion of the burn (Map 2).

Neither Inskip nor Breakneck fires had CNDDB occurrences within the fire perimeter.

## II. Resource Condition Assessment

### A. Resource Setting

Several invasive noxious weed species are known to occur within the Butte Fires Complex (Table W-3).

Noxious weeds are managed according to priorities that are based on ratings given by the California Department of Food and Agriculture (CDFA). For this reason not all noxious weeds are addressed in this document.

Table W-3. Invasive Noxious Weeds Known In, and Adjacent to the Butte Lightning Complex Fires Area

| Scientific Name | Common Name |
|---|---|
| *Centaurea solstitialis* | Yellow Starthistle |
| *Cytisus scoparius* | Scotch broom |
| *Genista monspessulana* | French broom |

.

Yellow Starthistle is known from several locations between Concow and Pulga, numerous locations along State Hwy 70, Forest Service road 26N26 and spurs, and Horse Ridge. It is also well established on private lands in and near the fires. It is found along access roads to the fires and roads within the fire perimeters (USFS BAER Report, 2008).

Dozer lines, drop points, and safety zones serve as weed dispersal areas or corridors and suppression equipment can act as weed vectors. Movement of fire suppression and rehab equipment can disperse and spread noxious weeds to and from areas within the fire and among home units. Dispersal of weeds from fire equipment movement poses a significant risk to post-fire regeneration. Roadsides and dozer lines will be most impacted by this threat (USFS BAER Report, 2008).

If any weeds were introduced, they could take advantage of the disturbance associated with the fire and displace native vegetation, degrade habitat function, lower ecosystem stability. The lack of native vegetation in burned area and the disturbed soil provide habitat that is highly susceptible to infestation by noxious weeds.

Known occurrences of yellow starthistle, Scotch broom, and French broom were burned over. Heavy equipment and vehicles act as vectors to spread seeds of this highly aggressive weed. The newly disturbed ground around throughout the fire and at the known infestation provide habitat that is very likely to favor the weed.

## III. Emergency Determination

The unknowing introduction of invasive noxious weeds into areas disturbed by fire suppression and rehabilitation has the potential to establish persistent weed populations. These persistent populations could affect the structure and habitat function of plant communities within the burn area. Forest Service direction is to minimize the establishment of non-native invasive species to prevent unacceptable degradation of the burned area. Consequently, delayed assessment of roads, dozer lines, drop points, helispots, and safety zones is necessary to detect the spread and introduction of weeds in the first year after fire. Assessing the establishment of weeds and treating small outlying populations before they expand, will prevent the weeds from becoming serious threats to the recovery of native plants.

Any new noxious weed populations established in the fire area also threaten all nearby public and private lands. Agricultural lands around the fire area may be degraded due to noxious weed spread. Water quality may also be threatened when noxious weeds displace native riparian and wetland plant species. Many native wetland plants prevent riparian soil erosion while some noxious weeds do not.

## IV. Treatments to Mitigate the Emergency

### A. Treatment Type

The treatment is noxious weed detection surveys of all roads, dozer lines, drop points, and safety zones affected by the 2008 Butte Fires. These areas should be surveyed for evidence of introduction or spread of noxious weeds. Promptly control weed populations upon detection, and follow up with monitoring and control for at least two years.

### B. Treatment Objective

Evaluate and eliminate the potential for noxious invasive weed establishment and spread, in all areas affected by the 2008 Butte Fires.

### C. Treatment Description

Inspect all areas and monitor for newly established weed occurrences. Monitoring should include documentation and hand pulling small new weed occurrences at the time of inspection.

Documentation of new infestations will include:

- GPS negative and positive inspection results
- Establish photo points
- Map perimeter of new infestation
- Treatment method
- Dates of treatment
- Evaluate success in subsequent inspection

Inspections and monitoring should be accomplished during June, July, and August of 2009.

Erosion Control Measures

Allowing sites to revegetate naturally is preferred to seeding or drilling. However, erosion control measures are necessary, particularly on steep slopes. We recommend the utilization of certified weed-free straw, straw with tackifier, and erosion control blankets (jute netting with straw or coir filling).

(http://www.sccgov.org/SCC/docs/Planning,%20Office%20of%20(DEP)/attachments/Water%20Collaborative/6_of_7_WC.pdf)

Should the choice is to use seed to revegetate an area, we recommend using seed from local seed sources such as provided by the following California Native Plant Society website:

http://www.cnps.org/cnps/horticulture/nurseries.php

**D. General Recommendations**:

1. Minimize the amount of vegetation removed while clearing chokepoints in watercourse channels, to those essential to reduce risk to life and property. Vegetation smaller than 3 inches in diameter should be left in the channel, and only the actual channel should be cleared (unless a threat to life and property exists upslope of the channel).

2. Implement recommendations to repair culverts and improve drainage from fire damaged areas to minimize the potential for erosion and sediment deposition into creeks and rivers, and implement best management practices throughout the watershed to minimize sediment mobilization and transport.

3. Redistribute soil that was piled into berms or piles during creation of bulldozer lines to increase site re-colonization by native plants, except for water control structures such as water bars.

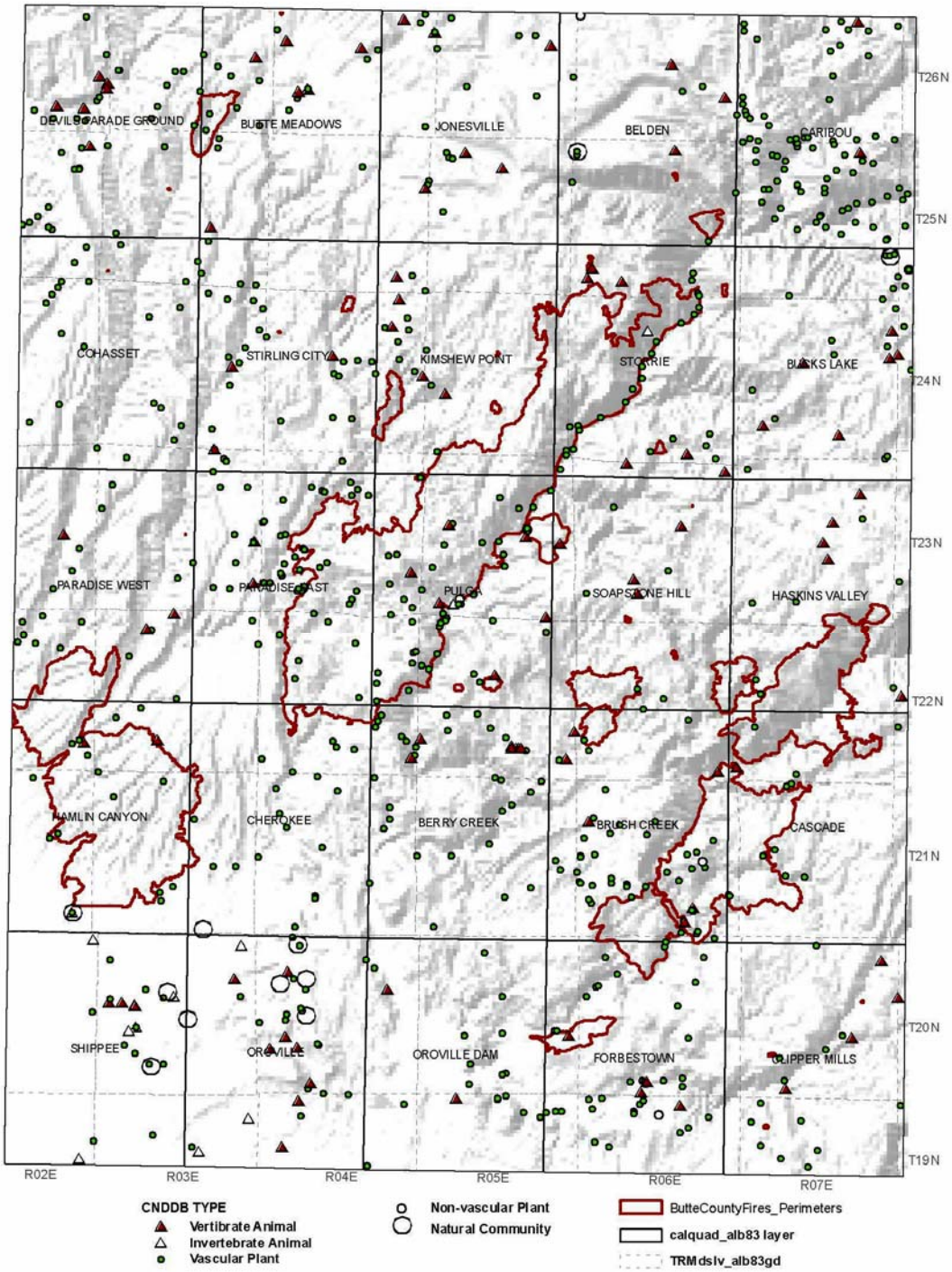
4. Block or disguise entrances to bulldozer lines with boulders, logs, gates, shrubs or other means to minimize trespass by motorized vehicles.

5. Avoid planting or seeding non-native or invasive species.

6. Conduct invasive weed surveys during the 2009 and 2010 growing season along bulldozer lines.

7. Avoid livestock grazing in burned areas until at least the 2009-2010 growing season (longer if rainfall is below the long-term average in the year following the fire).

8. Avoid disturbing islands of unburned vegetation, which provide wildlife habitat as well as seed source for natural revegetation.




WMAP 1: Map depicting CNDDB (California Natural Diversity Database) occurrences within burn perimeters on the Butte Lightening Complex Fires (CA-CDF-00393)

**Table 2 - Sumary of Site-Specific Values at Risk**

| Values At Risk | | Latitude | Longitude | Potential Impact | Recommendations (abbreviated) | Potential Impact Rank | Recommendation Effectiveness | Treatment Priority |
|---|---|---|---|---|---|---|---|---|
| Union Pacific Railroad | Union Pacific Railroad segments beneath fire burned slopes | Not applicable | Not applicable | Debris slides/flows, rock fall | Investigate crossing structures and repair as required, monitor and maintain. | High | Very Good | 6 |
| SC-4 | Pulga access road | 39° 47' 55.99" | 121° 27' 5.06" | Debris slides/flows, rock fall | Investigate crossing structures and repair as required, monitor and maintain, and install signage. | High | Very Good | 6 |
| Highway 70 | Hwy 70 road segments beneath fire burned slopes | Not applicable | Not applicable | Debris slides/flows, rock fall, flooding | Investigate crossing structures and repair as required, monitor and maintain, and install signage. | High | Very Good | 6 |
| SC-6 | Box culvert over tributary to Concow Res. | 39° 46' 52.71" | 121° 30' 19.60" | Debris passage, flooding, scour | Install debris rack rock slope protection, investigate hydraulic capacity, monitor and maintain | Moderate | Very Good | 5 |
| PG&E Access Road | Access road to transmission line corridor within North Fork | Not applicable | Not applicable | Debris slides/flows, rock fall | Investigate crossing structures and repair as required, monitor and maintain. | High | Good | 5 |
| FD-1 | Single-family residence | 39° 37' 44.23" | 121° 19' 45.21" | Debris flows, flooding | Restrict occupancy, relocate, install rock slope protection, monitor and maintain. | Moderate | Very Good | 5 |
| B-3 | Trailer park and ancillary improvements | 40° 0' 25.42" | 121° 15' 48.42" | Debris flows, flooding | Restrict occupancy, relocate, install rock slope protection, monitor and maintain. | High | Good | 5 |
| B-2 | Hwy 70 Bridge over Little Indian Creek | 40° 0' 18.81" | 121° 15' 47.80" | Debris passage, flooding, scour | Reconfigure existing debris rack, monitor and maintain | High | Good | 5 |
| B-1 | Hwy Box culvert over Chips Creek | 40° 0' 1.28" | 121° 16' 13.46" | Debris passage, flooding, scour | Reconfigure existing debris rack, monitor and maintain | High | Good | 5 |
| SC-7 | PG&E power line support tower | 39° 48' 7.74" | 121° 27' 0.28" | Landslides | Investigate and repair, as required. | Moderate | Good | 4 |
| SC-5 | Concow Reservoir | 39° 46' 12.30" | 121° 31' 12.77" | Wood debris, sedimentation, flooding | Dredge, practice BMPs, and monitor and maintain. | Moderate | Bad | 4 |
| SC-3 | Union Pacific Railroad bridge over Flea Valley Creek | 39° 48' 8.67" | 121° 26' 50.56" | Debris passage, flooding, scour | Install debris rack, investigate hydraulic capacity, monitor and maintain. | Low | Good | 4 |
| SC-2 | Arch culvert over Flea Valley Creek and adjacent cabin structures | 39° 48' 13.80" | 121° 27' 1.28" | Debris passage, flooding, scour | Install debris rack, investigate hydraulic capacity, monitor and maintain. | Moderate | Good | 4 |
| SC-1 | Cabin adjacent to Flea Valley Creek | 39° 48' 17.48" | 121° 27' 7.91" | Debris flows, flooding | Restrict occupancy, relocate, install rock slope protection, monitor and maintain. | High | Bad | 4 |
| NC-1 | Tobin water supply intake | 39° 56' 9.87" | 121° 19' 7.19" | Debris flows, sedimentation | Install debris deflector, monitor and maintain | High | Bad | 4 |
| H-1 | Road segment - Centerville Road | 39° 44' 2.47" | 121° 42' 8.11" | Debris slides, rock fall | Monitor, maintain, and install signage. | Moderate | Good | 4 |
| FD-2 | Surface water intake | 39° 37' 21.96" | 121° 19' 38.53" | Debris flows, flooding | Install debris deflector, monitor and maintain | High | Bad | 4 |
| PG&E reservoirs | PG&E power generation reservoirs within North Fork | Not applicable | Not applicable | Wood debris, sedimentation, flooding | Monitor and maintain. | Moderate | Bad | 3 |
| FD-4 | Culvert crossing over Bean Creek | 39° 37' 35.02" | 121° 19' 42.24" | Debris passage, flooding, scour | Install debris rack and early worning system, investigate hydraulic capacity, monitor and maintain. | Low | Good | 3 |
| FD-3 | Culvert crossing over Bean Creek | 39° 37' 33.44" | 121° 19' 41.11" | Debris passage, flooding, scour | Install debris rack and early worning system, investigate hydraulic capacity, monitor and maintain. | Low | Good | 3 |

# S.E.A.T. Specialist Report:
# Archaeological and Historical Resources

**Fire Name:** BTU Lightning Fires **Month/Year:** September 2008
2008 Butte Fires CA-CDF-000593

**Gerrit L. Fenenga, Ph.D.**
**Cal Fire Archaeologist**
**Sacramento Headquarters**

## I. Potential Values at Risk

Cultural resources such as historic structures or prehistoric archaeological sites have unique, but important values to California citizens. Some of these, such as the historic bridge and rail system of the Feather River Canyon, are still functioning parts of infra-structure important to modern Californians, although they also are significant historical resources. Other cultural resources, however, are of less obvious importance to the average person. Archaeological locations on the landscape where ancient Native Americans ground acorns or quarried stone are interesting, but to most of us, these kinds of resources certainly do not manifest the same risk potential as historic structures which are still in use and may have direct connections to living people. There are many different kinds of cultural resources, however, and these may have many different values attached to them. For example, this region of California is historically very important due to the 19th Century Gold Rush. Consequently, a significant amount of local tourism results from interest in visiting and seeing locations and vestiges of that past. The archaeological record of that past is widely scattered throughout this area and many people come to seek it out, which contributes to the local economic base of small communities throughout the region. Conversely, a small family cemetery with wooden grave markers located out in the forest on land that was allotted to a Native American Maidu family by the U.S. Government has a different kind of value, especially to living relatives of the family that once lived there.

Archaeological resources ranging from Native American village sites, to abandoned sawmills and camps, to Emigrant Trail systems are unique and non-renewable. Further, these resources are very fragile in nature and once they are altered or destroyed, they can not be fixed or replaced. Fire, fire suppression, and post-fire events and processes can each potentially have detrimental effects to those resources. The potential associated risks to cultural resources include both 1) generic risks, (such as accelerated erosion, that might occur anywhere within or near the burn areas), and 2) case specific risks that apply only to a particular resource location. The latter might include an historic building situated below an adjacent unstable slope. Most of the risks identified in this study are of a generic nature, but there are some locations where site specific risks exist. Historic infra-

structure, such as the Union Pacific Railway, has not been assessed in this report since these resources will be evaluated elsewhere.

## II. Resource Condition Assessment

### Resource Setting

The area of the 2008 Butte Fires is situated in a region of cultural significance beginning in prehistoric times and continuing through the historic era. California has been occupied by people for more than 12,000 years and the State contains an enormously rich and complex archaeological record. The majority of the fires were located within the ethno-historic tribal territory of the Concow tribe, commonly known as the Northern Maidu. The northern boundary of the fire complex, however, extends just slightly into the territory of the Southern Yana, or Yahi, the tribe that is known historically as that of Ishi, the infamous "last wild Indian" in North America. Ishi wandered into a slaughter house in Oroville some distance from his tribal territory in 1911, so he would have had to travel through some portion of the recently burned area on his way to being discovered and arrested by the Butte County sheriff. Although not identified during this fire event, an historic Indian trail proceeded along the course of the Northern Fork of the Feather River, and he likely would have taken this route.

The Northern Maidu, or Concow, lived in permanent village sites scattered throughout the lower elevations of the foothills. They would disperse seasonally into the higher elevations in a yearly cycle of hunter-gatherer subsistence. Archaeological evidences of this Native Californian lifestyle are present within and around the vicinity of the 2008 Butte Fires. Some of these locations were identified during the event, while others were previously known and recorded. These archaeological remains range from large village site complexes to small gathering or processing locations. Many of these archaeological sites were burned over and several were impacted by fire suppression activities.

The Concow relied on the use of acorns which were often processed in bedrock mortars, so these features are common indicators of the archaeological remains of their villages and other activity areas. They also built and lived in semi-subterranean earthen houses, as well as larger community structures ("*kum*" or dance houses) which today exist only as subtle surface depressions at old village or camp locations, unless they are excavated to expose their architectural features. The Concow still are alive and well in this community and there are several Native reservations here, one of which (Enterprise Rancheria) was directly effected by the Craig Fire. The surviving Native village and other site locations that occur in this area are resources of extreme concern to the members of these Maidu tribal groups.

The historic use of the Butte Fire area by non-native peoples has gone through a series of thematic periods, each of which has left some physical evidence on the

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## IV. **Summary and Recommendations**

Previous archaeological survey and other work in this area have demonstrated the presence of an extensive array of different cultural resources in the area affected by the 2008 Butte Fires. Many of these are historically or scientifically significant and are resources that deserve attention toward protection before, during, and after wild fires. Ideally, people and agencies have fire plans in place before events like the 2008 fire siege occur. The Feather River District of the Plumas National Forest, for example, was able to quickly provide CAL FIRE archaeologists with a ranked listing of heritage resources at risk during the fire, allowing them to get out ahead of the flames and to help protect several different sites with perishable wooden components before the fire arrived. Private land owners are less likely to have as many cultural resources or to be as prepared for an emergency, but those that do own archaeological sites, especially old cabin sites and such, should consider brush clearance or other possible protection measures. These kinds of resources are becoming increasingly scarce in forested settings where catastrophic fires can and do occur. The first recommendation in this report is that landowners become aware of the potential or the actual existence of any cultural resources that may exist on their properties. This knowledge is the first step toward protection and stewardship of these kinds of resources.

As stated in the beginning of this report, the Butte fires have put a number of cultural properties at risk and that most of that risk is of a generic potential for subsequent events that might damage or otherwise alter these resources. Some of those generic risks to which many site locations are now exposed include:

- Accelerated or altered surface erosion due to lack of surface vegetation.
- Enhanced public access due to loss of vegetation, construction of fire suppression lines, or loss of gates and other means to limit entry.
- Debris cleanup which might include removal of cultural artifacts of historical significance.
- Overzealous brush removal response to fire events that may lead to damage to known or unknown resources.

Mitigation of these potential generic risks would involve knowledge of the resources presence, re-vegetation or other erosion control where appropriate, efforts to block or reduce public access to critical resources, and monitoring subsequent activity in sensitive locations.

There were several instances in which site specific potential risks resulting from the 2008 Butte Fires were identified. These include:

- Historic cabins at Pulga, particularly the one at 431 Pulga Road. Risks here involve the potential for large woody debris to come down the creek and for the culvert at the bridge crossing to become plugged up which could cause debris to come over the top of the bridge and encounter the cabins.
- Burned Native American Village site at the east end of Yellow Wood Road in Concow. This site is located along a low terrace formation on both sides of a Class I drainage at the base of a steep, heavily burned slope. Unless the soils above this site are stabilized by vegetation, a considerable amount of sediment will wash off the hill above and potentially might impact the site below. Cleanup of this property may also adversely impact this resource also, if any ground disturbance is involved.
- Burned Native American Village site (CA-BUT-1485 or USFS site 05-11-54-00125) located north of the old Crain Sawmill site along the west side of Rim Road. This site contains bedrock mortars in steatite outcrops that have become unstable due to loss of root support that held them in place along the edge of a small stream bank. The burn has resulted in the undercutting of the bank below the mortars on the south side of the seasonal creek where they are situated. One or two season's rain will likely displace these mortars into the stream drainage.

Mitigation of these risks should involve monitoring of the Pulga location during rain events and careful cleanup of the property on Yellow Wood

Road to minimize additional damage to that site, along with monitoring during and after any major rain event. The last site could be stabilized, but since this is unlikely, the events and stability situation should be documented and existing U.S. Forest Service and California Historical Resources Information System archaeological records should be amended to reflect recent developments and conditions.

Lastly, any future involvement with the Native American sites here, such as additional survey and site identification work or site specific mitigation should involve consultation with local Native American tribal representatives. The archaeological sites in this area are of great concern to them and they are aware of many locations that may be intangible to non-Native people, but which are of significance to tribal members. Cal Fire maintains a current list of appropriate local Native American contacts for Butte, Plumas, and Tehama Counties on its website. To obtain a contact, go to the Resource Management link, and then the Archaeology Program link at www.fire.ca.gov.

**2008 Butte Fires Archaeology Report:**
**Executive Summary**

1) The areas burned in the 2008 Butte Wildfire events contain large numbers of a wide variety of significant Cultural Resources. These include a range of prehistoric Native American archaeological sites and historic properties associated with important events such as the California Gold Rush and early logging history. Some of the historic properties associated with this region are still functioning critical infrastructure such as rail, water, and transportation systems. Others remain only as ruins or other residues which are fragile and non-renewable resources.
2) Potential risks resulting from the 2008 fires can be characterized as either **Generic Potential Risks** or as **Site Specific Potential Risks**.
3) **Generic Potential Risks** include:
    - Accelerated or altered surface erosion due to lack of surface vegetation.
    - Enhanced public access due to loss of vegetation, construction of fire suppression lines, loss of gates and other means to limit entry.
    - Debris cleanup which might include removal of cultural artifacts of historical significance.
    - Overzealous brush removal response to fire events that may lead to damage to known or unknown resources.
4) **Site Specific Potential Risks** identified in this study include:
    - Historic cabins at Pulga, particularly the one at 431 Pulga Road. Risks here involve the potential for large woody debris to come down the creek and for the culvert at the bridge crossing to become plugged up which could cause debris to come over the top of the bridge and encounter the cabins.
    - Burned unrecorded Native American Village site at the east end of Yellow Wood Road in Concow. This site is located along a low terrace formation on both sides of a Class I drainage at the base of a steep, heavily burned slope. Unless the soils above this site are stabilized by vegetation, a considerable amount of sediment will wash off the hill above and potentially might impact the site below. Cleanup of this property may also adversely impact this resource also, if any ground disturbance is involved.
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# S.E.A.T. Specialist Report:
# Archaeological and Historical Resources

**Fire Name:** BTU Lightning Fires **Month/Year:** September 2008
2008 Butte Fires CA-CDF-000593

**Gerrit L. Fenenga, Ph.D.**
**Cal Fire Archaeologist**
**Sacramento Headquarters**

## I. Potential Values at Risk

Cultural resources such as historic structures or prehistoric archaeological sites have unique, but important values to California citizens. Some of these, such as the historic bridge and rail system of the Feather River Canyon, are still functioning parts of infra-structure important to modern Californians, although they also are significant historical resources. Other cultural resources, however, are of less obvious importance to the average person. Archaeological locations on the landscape where ancient Native Americans ground acorns or quarried stone are interesting, but to most of us, these kinds of resources certainly do not manifest the same risk potential as historic structures which are still in use and may have direct connections to living people. There are many different kinds of cultural resources, however, and these may have many different values attached to them. For example, this region of California is historically very important due to the 19th Century Gold Rush. Consequently, a significant amount of local tourism results from interest in visiting and seeing locations and vestiges of that past. The archaeological record of that past is widely scattered throughout this area and many people come to seek it out, which contributes to the local economic base of small communities throughout the region. Conversely, a small family cemetery with wooden grave markers located out in the forest on land that was allotted to a Native American Maidu family by the U.S. Government has a different kind of value, especially to living relatives of the family that once lived there.

Archaeological resources ranging from Native American village sites, to abandoned sawmills and camps, to Emigrant Trail systems are unique and non-renewable. Further, these resources are very fragile in nature and once they are altered or destroyed, they can not be fixed or replaced. Fire, fire suppression, and post-fire events and processes can each potentially have detrimental effects to those resources. The potential associated risks to cultural resources include both 1) generic risks, (such as accelerated erosion, that might occur anywhere within or near the burn areas), and 2) case specific risks that apply only to a particular resource location. The latter might include an historic building situated below an adjacent unstable slope. Most of the risks identified in this study are of a generic nature, but there are some locations where site specific risks exist. Historic infra-

structure, such as the Union Pacific Railway, has not been assessed in this report since these resources will be evaluated elsewhere.

## II. Resource Condition Assessment

### Resource Setting

The area of the 2008 Butte Fires is situated in a region of cultural significance beginning in prehistoric times and continuing through the historic era. California has been occupied by people for more than 12,000 years and the State contains an enormously rich and complex archaeological record. The majority of the fires were located within the ethno-historic tribal territory of the Concow tribe, commonly known as the Northern Maidu. The northern boundary of the fire complex, however, extends just slightly into the territory of the Southern Yana, or Yahi, the tribe that is known historically as that of Ishi, the infamous "last wild Indian" in North America. Ishi wandered into a slaughter house in Oroville some distance from his tribal territory in 1911, so he would have had to travel through some portion of the recently burned area on his way to being discovered and arrested by the Butte County sheriff. Although not identified during this fire event, an historic Indian trail proceeded along the course of the Northern Fork of the Feather River, and he likely would have taken this route.

The Northern Maidu, or Concow, lived in permanent village sites scattered throughout the lower elevations of the foothills. They would disperse seasonally into the higher elevations in a yearly cycle of hunter-gatherer subsistence. Archaeological evidences of this Native Californian lifestyle are present within and around the vicinity of the 2008 Butte Fires. Some of these locations were identified during the event, while others were previously known and recorded. These archaeological remains range from large village site complexes to small gathering or processing locations. Many of these archaeological sites were burned over and several were impacted by fire suppression activities.

The Concow relied on the use of acorns which were often processed in bedrock mortars, so these features are common indicators of the archaeological remains of their villages and other activity areas. They also built and lived in semi-subterranean earthen houses, as well as larger community structures ("*kum*" or dance houses) which today exist only as subtle surface depressions at old village or camp locations, unless they are excavated to expose their architectural features. The Concow still are alive and well in this community and there are several Native reservations here, one of which (Enterprise Rancheria) was directly effected by the Craig Fire. The surviving Native village and other site locations that occur in this area are resources of extreme concern to the members of these Maidu tribal groups.

The historic use of the Butte Fire area by non-native peoples has gone through a series of thematic periods, each of which has left some physical evidence on the

land. Many of these historical archaeological residues also were identified by the archaeologists assigned to the incident. The entire region was investigated by immigrant fortune hunters during the era of the California Gold Rush, and some areas of the fire complex contain significant quantities of past mining evidence. This is especially true along the western margin of the fires where the Northern Fork of the Feather River was extensively placer-mined. There also was considerable drift mining in the metamorphic rocks in this section of the fire. Some mining persists in this region, but on a much smaller scale than in past history. Following the Gold Rush, logging became important in this region and a number of sawmills were established within the area. Typical of these was the location within the center of the fire complex known as "Rag Dump." This site was once the location of the "Defiance Sawmill" which was established in 1874 and abandoned for financial reasons in 1879. Today, only traces of its existence remain. Virtually all, if not all, of the entire fire complex area has been logged in the past. In some places this has been done several times, and of course, this practice continues into the present day. Evidence of the logging industry can be found throughout the fire area in the form of cut tree stumps, logging roads and skid trails, log landing decks, tree plantations, and clear-cut sections of forest.

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## APPENDIX II

### Contacts

| Name | Affiliation |
|---|---|
| Shawn Obrien | Butte County |
| John Ofarrell | Del Oro Water District |
| George Farber | Paradise Irrigation District |
| Mike Edwards | Thermalito Irrigation District |
| Derrel Naruto | Cal Trans |
| Jack Bean | Sierra Pacific Industries |
| Alexis Vertolli | Butte County RCD |
| Diane Brink | Bureau of Land Management |
| Brent Foster | Mooretown Rancheria |
| Chris Walters | California Tribal Nations |
| Vicki Newlin | Butte County Water and Resource Conservation Dept. |
| Stacey Cepello | Department of Water Resources |
| Bill Cochran | Department of Water Resources |
| Chris Bujalski | Burea of Indian Affairs |
| Bill Ward | NRCS, Davis UCD |
| Ren Reynolds | Enterprise Rancheria |
| Ron Recker | Berry Creek Rancheria |
| Adrienne Truex | Department of Fish and Game |
| Tracy McReynolds | Department of Fish and Game |
| Craig Geldard | Pacific Gas and Electric |
| Jayme Boucher | Thermalito Water and Sewer District |
| Mike August | USDA Forest Service |
| Mike Taylor | USDA Forest Service |
| Bob Foster | Department of Parks and Recreation |
| Bob Dickinson | Union Pacific Railroad |
| Bob Foster | Department Parks and Recreation |
| Bob Dickinson | Union Pacific Railroad |

APPENDIX III

GIS DATA

MAPS & TABLES

MAPS

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| Map # 4 | Geology Map & Legend |
| Map # 5 | Watershed Map |
| Map # 6 | General Soil Map & Legend |
| Map # 7 | Vegetation Map |
| Map # 8 | Fire History Map |
| Map # 9 | Detail Map Index |
| Detail Map # 1 | Values At Risk |
| Detail Map # 2 | Values At Risk |
| Detail Map # 3 | Values At Risk |
| Detail Map # 4 | Values At Risk |
| Detail Map # 5 | Values At Risk (Note: No Values At Risk shown on Detail Map #5) |
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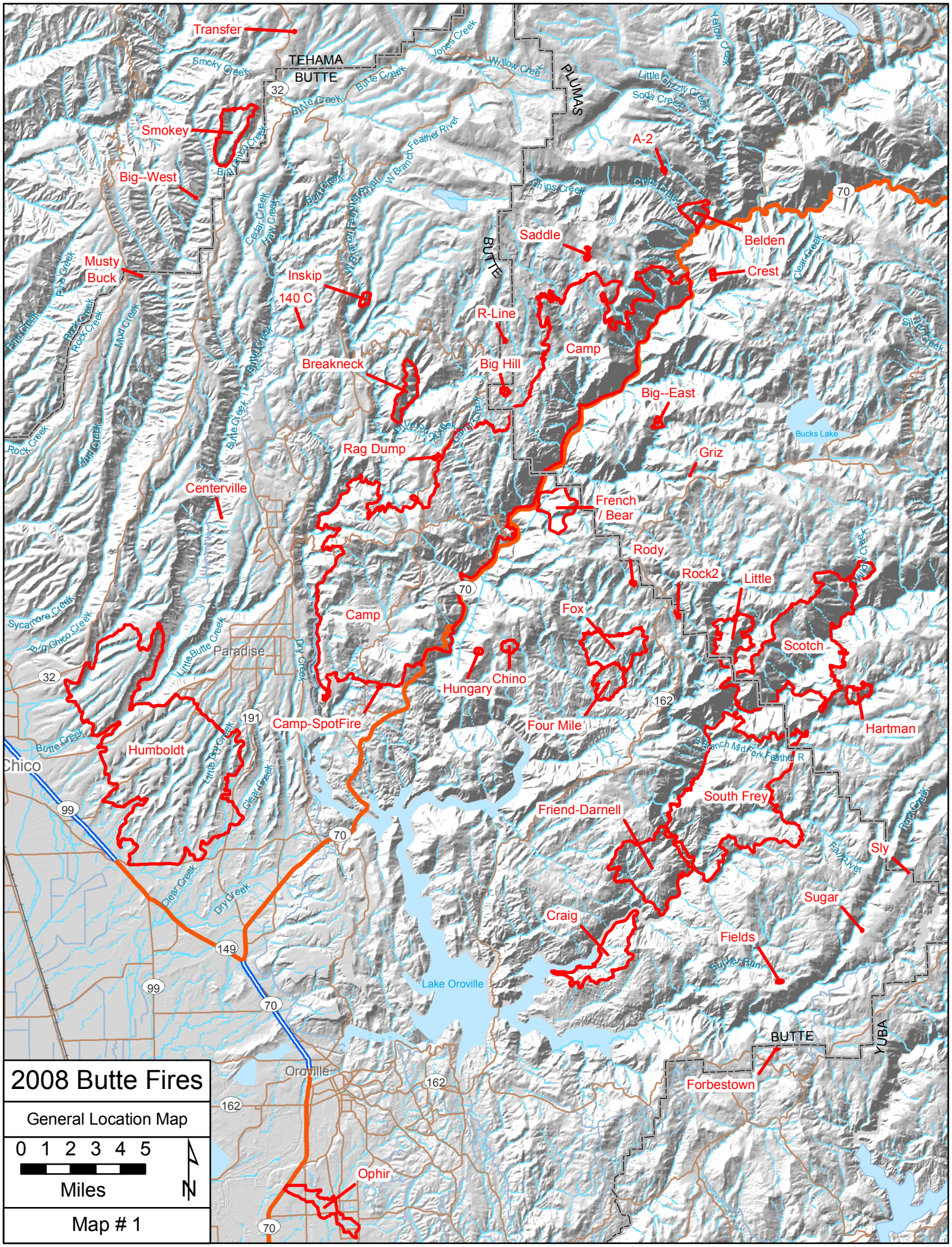
| TABLE # 4 | Fires Categorized by Soils (acreage) |
| TABLE # 5 | Fires Categorized by Stream Name & Type (mileage) |
| TABLE # 6 | Watersheds within Fire Perimeters (acreage) |


2008 Butte Fires
General Location Map
0 1 2 3 4 5
Miles
N
Map # 1
Transfer
Smokey
Big--West
Musty Buck
Inskip
140 C
Breakneck
Rag Dump
Centerville
Humboldt
Camp-SpotFire
Camp
Hungary
Chino
Saddle
R-Line
Big Hill
Big--East
Griz
French / Bear
Rody
Rock2
Little
Fox
Four Mile
Scotch
Hartman
South Frey
Friend-Darnell
Sly
Sugar
Craig
Fields
Forbestown
Belden
Crest
A-2
Ophir
TEHAMA
BUTTE
PLUMAS
YUBA
Paradise
Chico
Oroville
Lake Oroville
Bucks Lake
Butte Creek
Feather River
Clear Creek
Dry Creek
Little Butte Creek
Big Chico Creek
Sycamore Creek
Rock Creek
Mud Creek
Cedar Creek
Hay Creek
Jones Creek
Willow Creek
Smoky Creek
Little Grizzly Creek
Soda Creek
Yellow Creek
Chips Creek
Silver Creek
Willow Creek
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Sugar Run
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Pine Creek
Elm Creek
W Branch Feather River
S Branch Middle Fork Feather R
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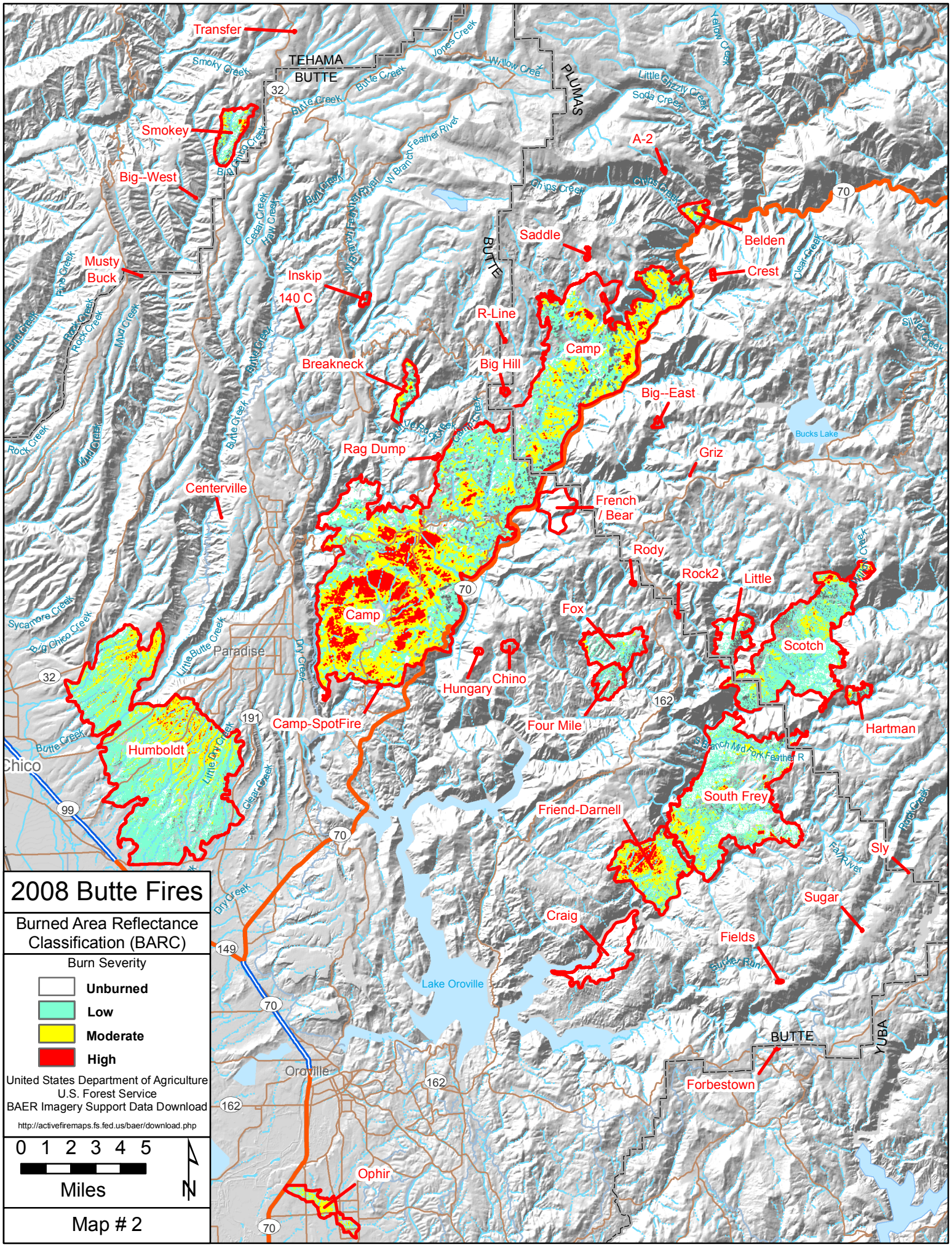
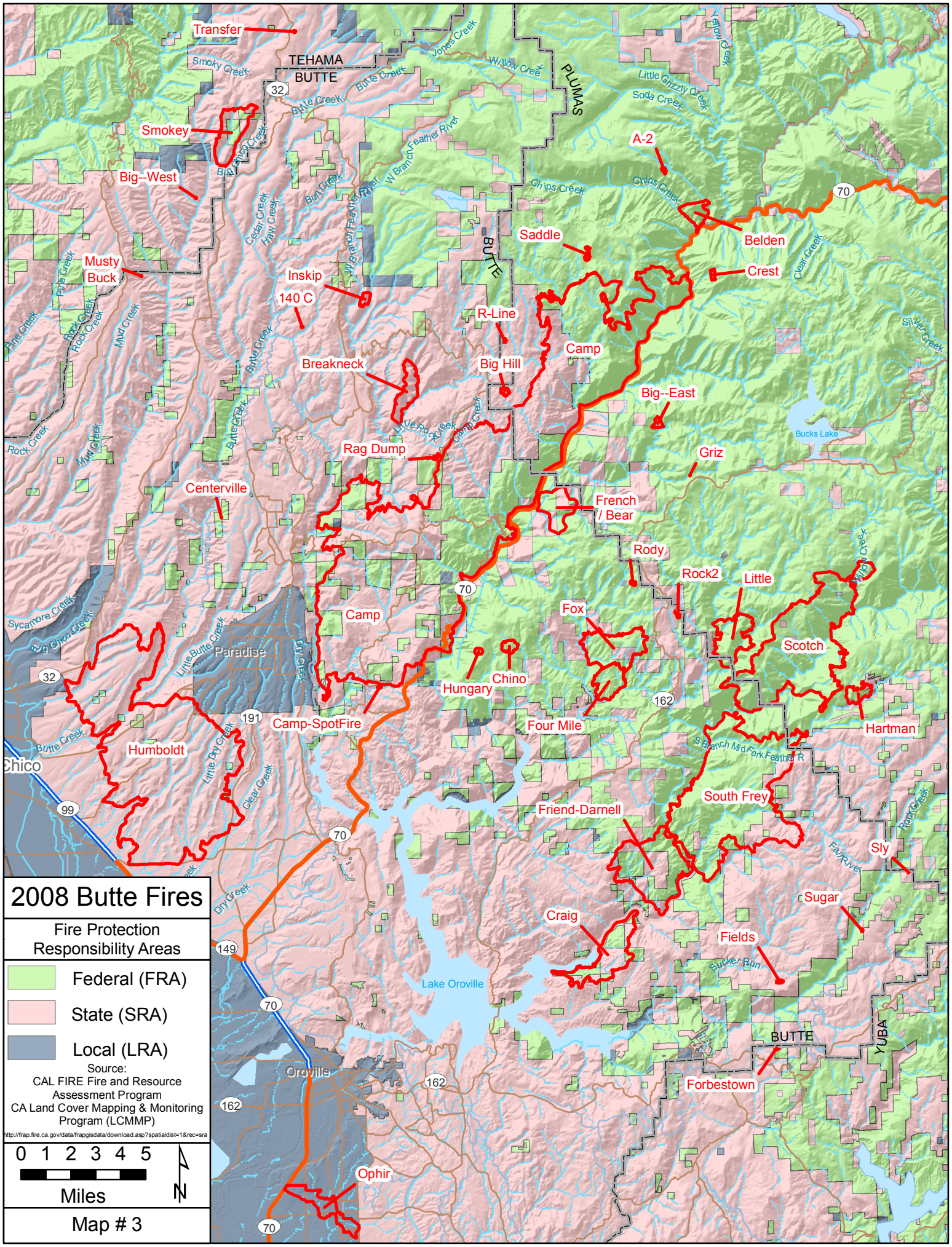
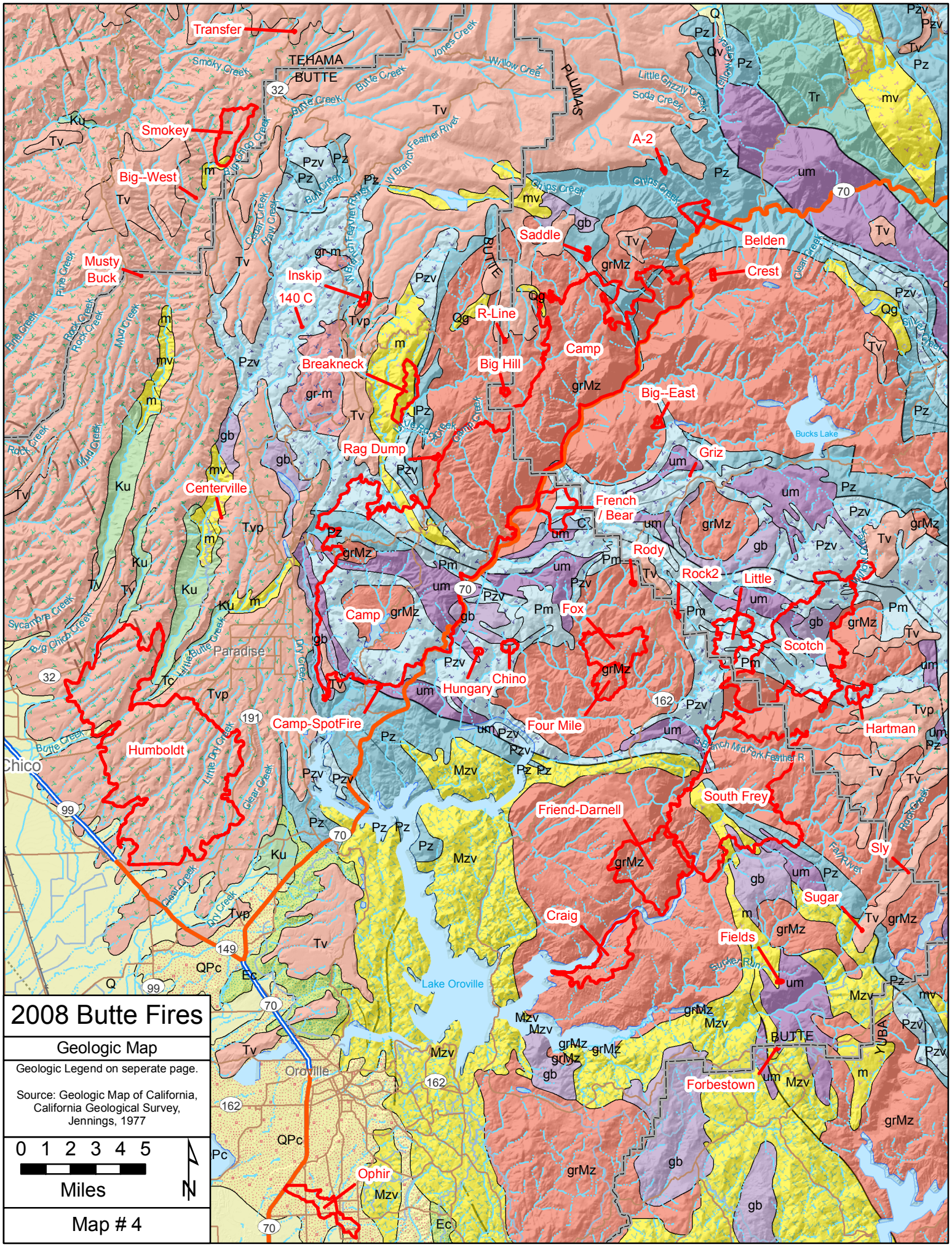
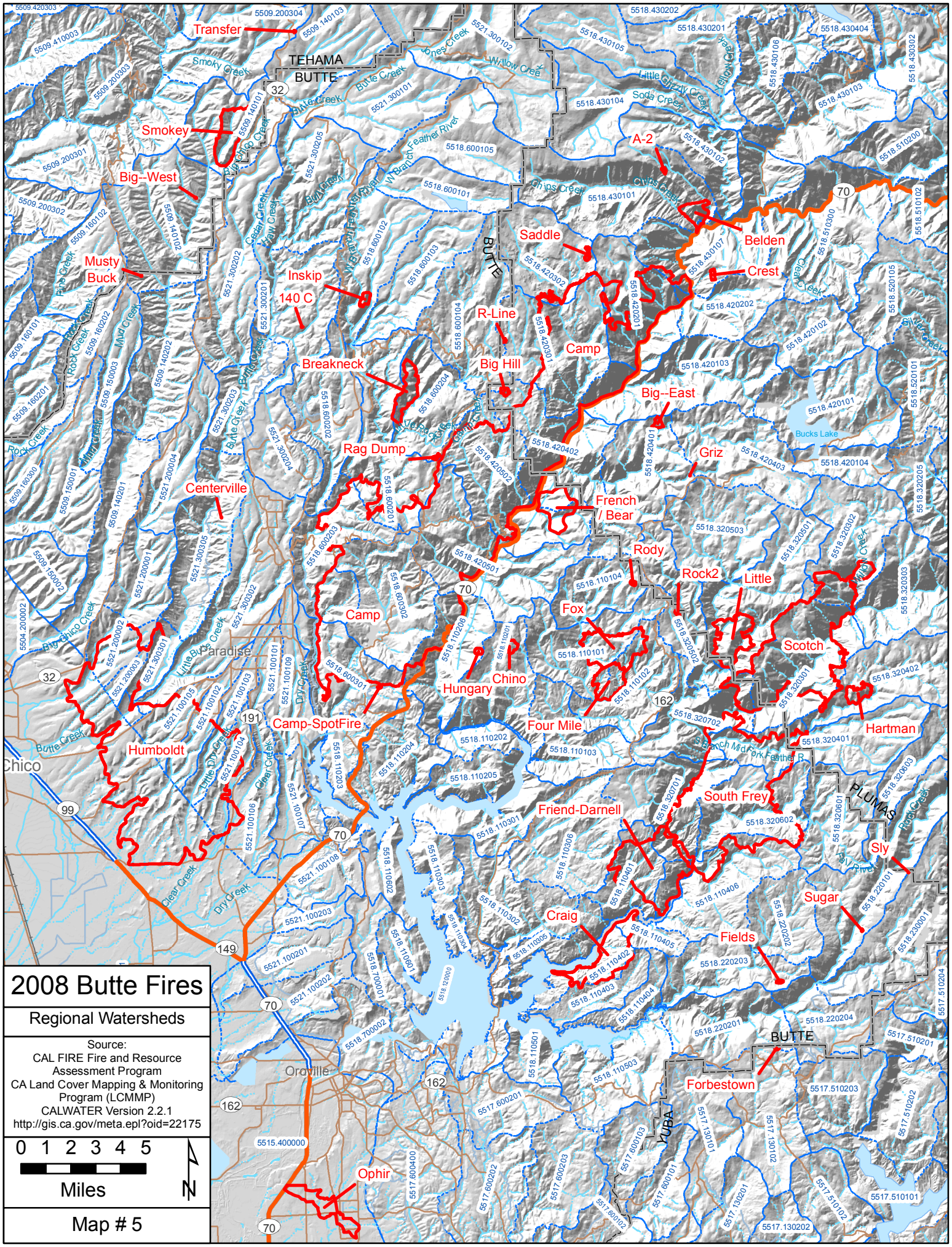
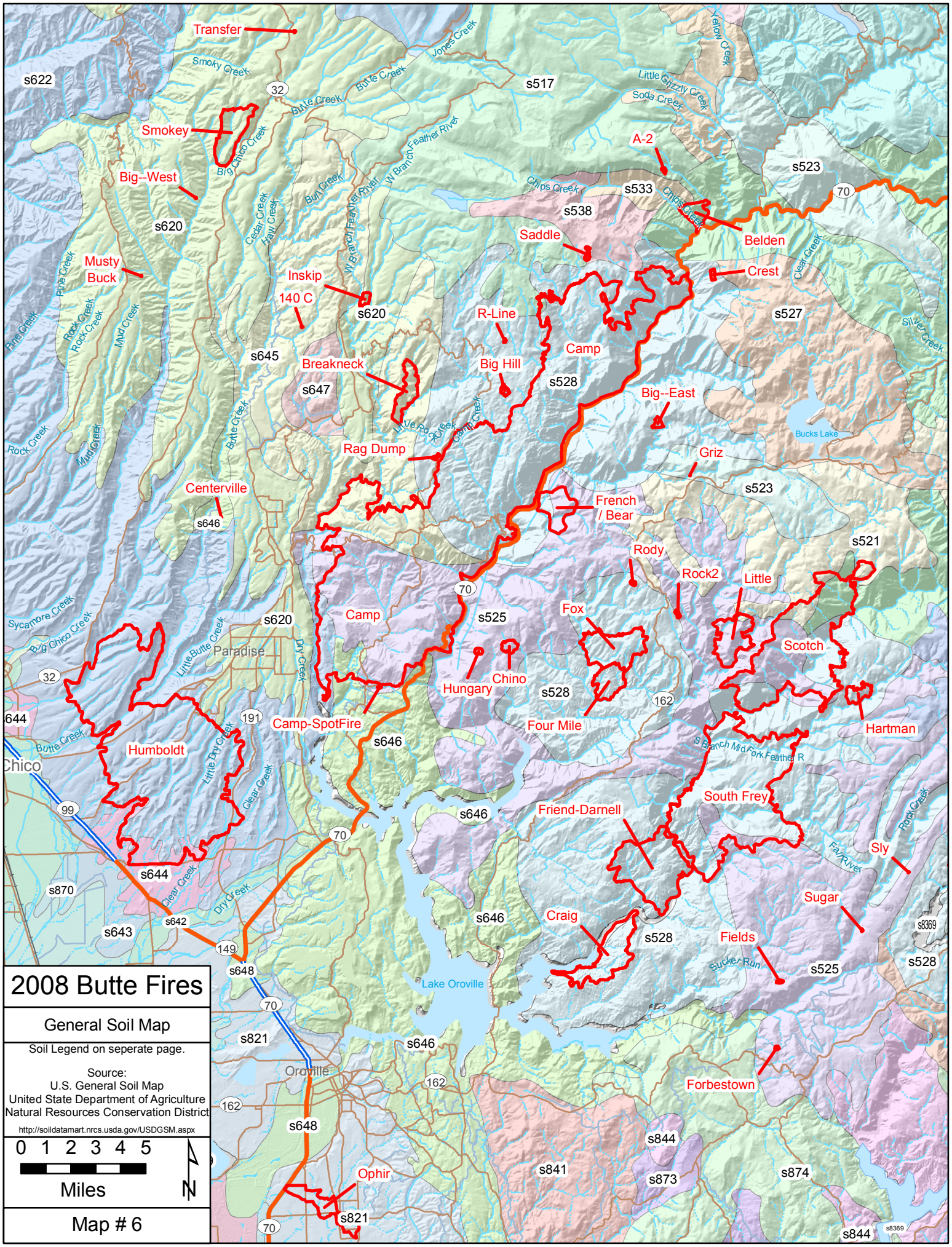

2008 Butte Fires
Burned Area Reflectance Classification (BARC)
Burn Severity
Unburned
Low
Moderate
High
United States Department of Agriculture
U.S. Forest Service
BAER Imagery Support Data Download
http://activefiremaps.fs.fed.us/baer/download.php
0 1 2 3 4 5
Miles
N
Map # 2
Transfer
Smokey
Big--West
Musty Buck
Inskip
140 C
Breakneck
Rag Dump
Centerville
Humboldt
Camp-SpotFire
Camp
R-Line
Big Hill
Saddle
A-2
Belden
Crest
Big--East
Griz
French / Bear
Rody
Rock2
Little
Fox
Chino
Hungary
Four Mile
Scotch
Hartman
South Frey
Friend-Darnell
Sly
Sugar
Craig
Fields
Forbestown
Ophir
TEHAMA
BUTTE
PLUMAS
YUBA
Paradise
Chico
Oroville
Lake Oroville
Bucks Lake
Butte Creek
Feather River
Dry Creek
Little Butte Creek
Sycamore Creek
Big Chico Creek
Rock Creek
Mud Creek
Fire Creek
Cedar Creek
Hay Creek
Jones Creek
Willow Creek
Smoky Creek
Little Grizzly Creek
Soda Creek
Yellow Creek
Chips Creek
Clear Creek
Silver Creek
Little Dry Creek
Sucker Run
Fall River
Rock Creek
32
70
99
149
162
191


2008 Butte Fires
Fire Protection Responsibility Areas
Federal (FRA)
State (SRA)
Local (LRA)
Source:
CAL FIRE Fire and Resource Assessment Program
CA Land Cover Mapping & Monitoring Program (LCMMP)
http://frap.fire.ca.gov/data/frapgisdata/download.asp?spatialdist=1&rec=sra
0 1 2 3 4 5
Miles
N
Map # 3
Transfer
Smokey
Big--West
Musty Buck
Inskip
140 C
Breakneck
Centerville
Rag Dump
Camp
Camp-SpotFire
Humboldt
Saddle
R-Line
Big Hill
A-2
Belden
Crest
Big--East
Griz
French / Bear
Rody
Rock2
Little
Fox
Scotch
Chino
Hungary
Four Mile
Hartman
South Frey
Friend-Darnell
Sly
Sugar
Craig
Fields
Forbestown
Ophir
TEHAMA
BUTTE
PLUMAS
YUBA
Paradise
Chico
Oroville
Lake Oroville
Bucks Lake
Smoky Creek
Butte Creek
Jones Creek
Willow Creek
Little Grizzly Creek
Soda Creek
Yellow Creek
W Branch Feather River
Big Chico Creek
Cedar Creek
Hay Creek
Burt Creek
Chips Creek
Clear Creek
Silver Creek
Fine Creek
Rock Creek
Mud Creek
Sycamore Creek
Little Butte Creek
Dry Creek
Little Dry Creek
Little Rock Creek
Camp Creek
S Branch Mid Fork Feather R
Fall River
Sutter Run
32
70
99
149
162
191


2008 Butte Fires
Geologic Map
Geologic Legend on seperate page.
Source: Geologic Map of California, California Geological Survey, Jennings, 1977
0 1 2 3 4 5
Miles
N
Map # 4
Transfer
Smokey
Big--West
Musty Buck
Inskip
140 C
Breakneck
Rag Dump
Centerville
Camp-SpotFire
Humboldt
Camp
Saddle
R-Line
Big Hill
Camp
Big--East
Griz
French / Bear
Rody
Rock2
Little
Fox
Scotch
Chino
Hungary
Four Mile
Hartman
South Frey
Friend-Darnell
Sly
Sugar
Craig
Fields
Forbestown
Ophir
A-2
Belden
Crest
TEHAMA
BUTTE
PLUMAS
YUBA
Chico
Paradise
Oroville
Lake Oroville
Bucks Lake
Butte Creek
Feather River
Smoky Creek
Jones Creek
Willow Creek
Little Grizzly Creek
Soda Creek
Ships Creek
Clear Creek
Dry Creek
Little Butte Creek
Sycamore Creek
Big Chico Creek
Rock Creek
Mud Creek
Pine Creek
Cedar Creek
Hay Creek
Bull Creek
Big Chico Creek
Little Dry Creek
Roy Creek
Silver Creek
Sucker Run
Fall River
Branch Mid Fork Feather R
Q
QPc
Ec
Pc
Tc
Tvp
Tv
Ku
Pz
Pzv
Pm
Mzv
grMz
gb
um
m
mv
gr-m
Qg
C
Tr
Qv
70
32
99
149
162
191


2008 Butte Fires
Regional Watersheds
Source:
CAL FIRE Fire and Resource Assessment Program
CA Land Cover Mapping & Monitoring Program (LCMMP)
CALWATER Version 2.2.1
http://gis.ca.gov/meta.epl?oid=22175
0 1 2 3 4 5
Miles
N
Map # 5
Transfer
Smokey
Big--West
Musty Buck
Inskip
140 C
Breakneck
Centerville
Rag Dump
Camp
Camp-SpotFire
Humboldt
Hungary
Chino
Four Mile
Friend-Darnell
Craig
Fields
Forbestown
Ophir
Sugar
Sly
South Frey
Hartman
Scotch
Little
Rock2
Rody
Fox
French / Bear
Big--East
Griz
Big Hill
R-Line
Saddle
Camp
Belden
Crest
A-2
TEHAMA
BUTTE
PLUMAS
YUBA
Chico
Paradise
Oroville
Bucks Lake




# 2008 Butte Fires

General Soil Map

Soil Legend on seperate page.

Source:
U.S. General Soil Map
United State Department of Agriculture
Natural Resources Conservation District

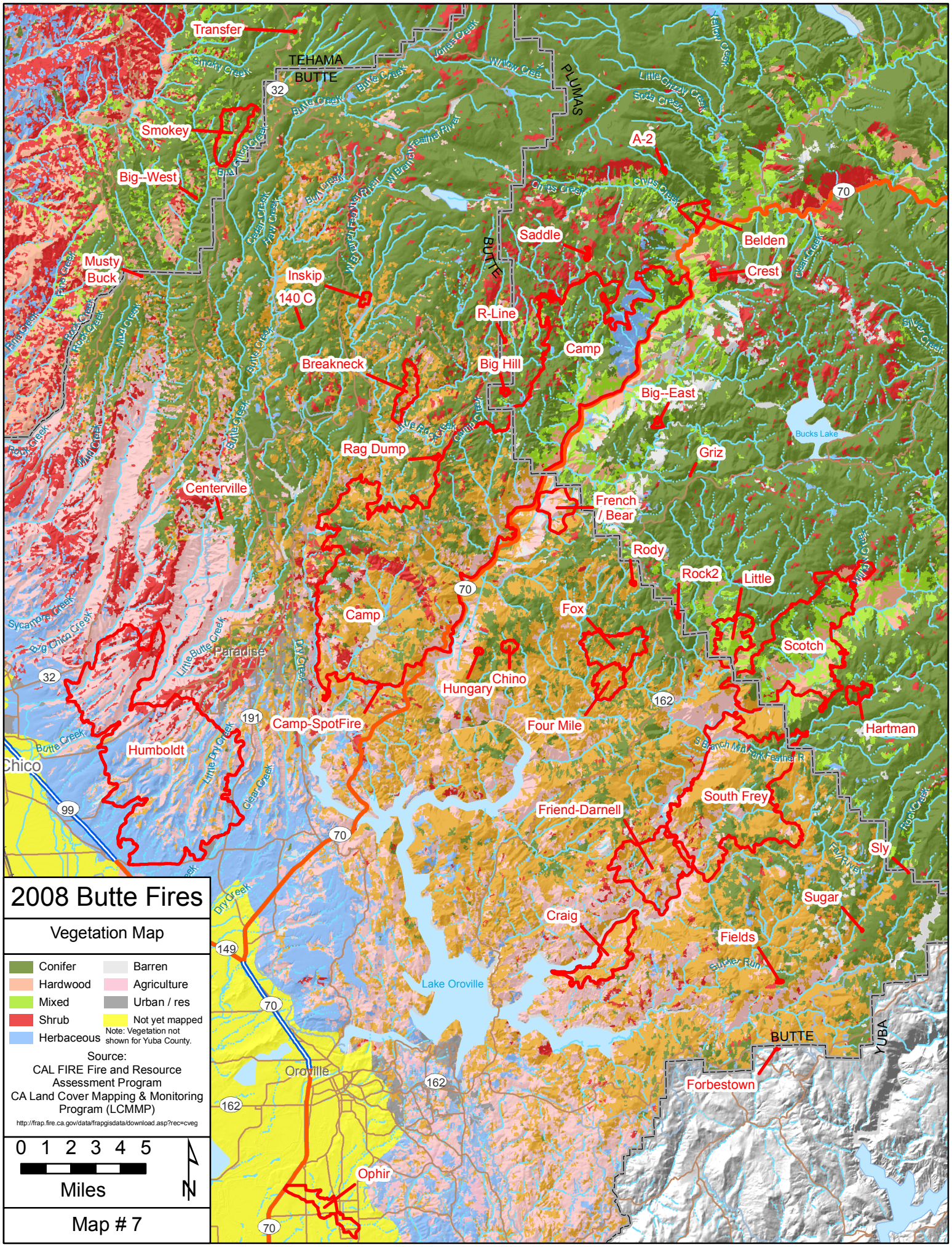
http://soildatamart.nrcs.usda.gov/USDGSM.aspx

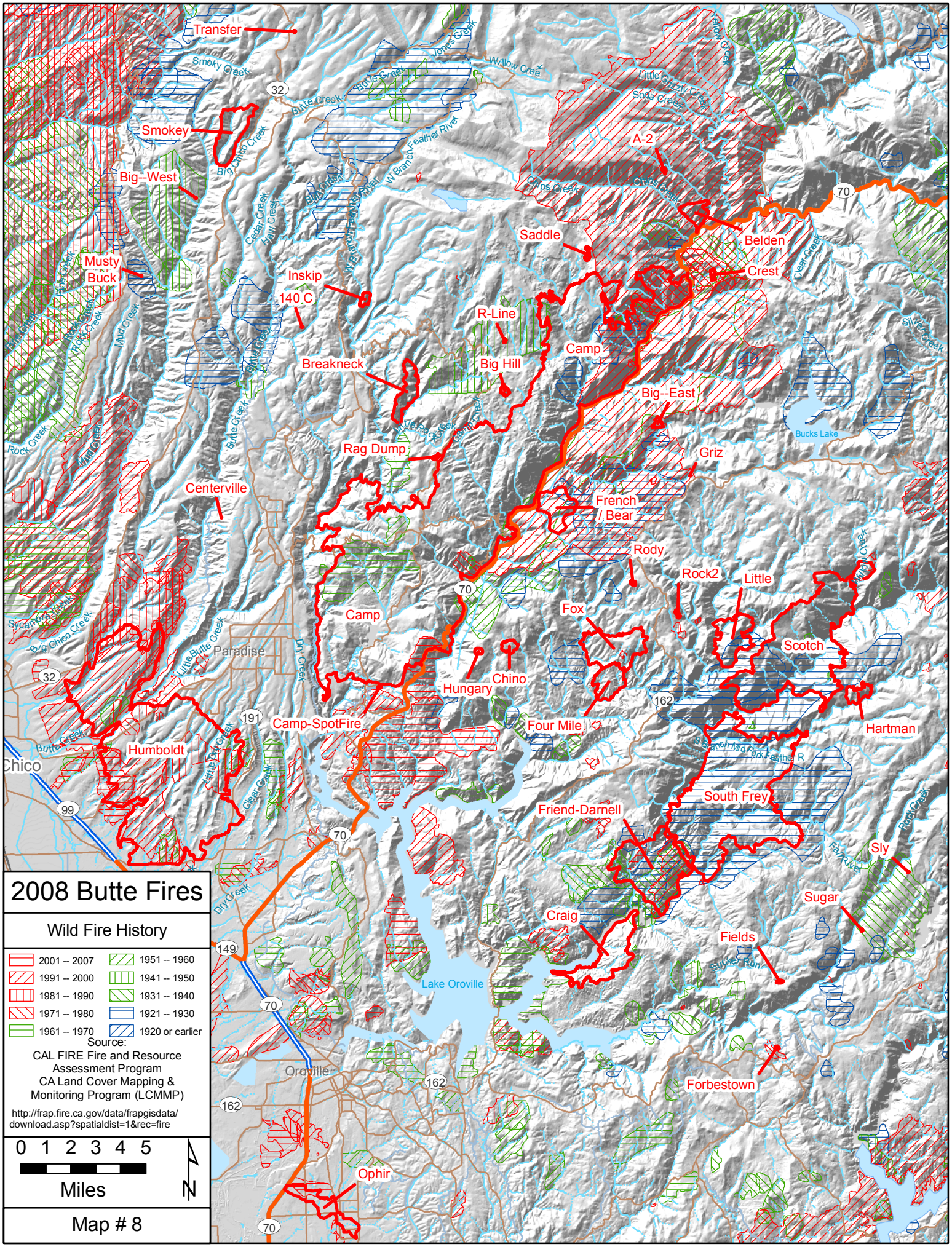
0 1 2 3 4 5

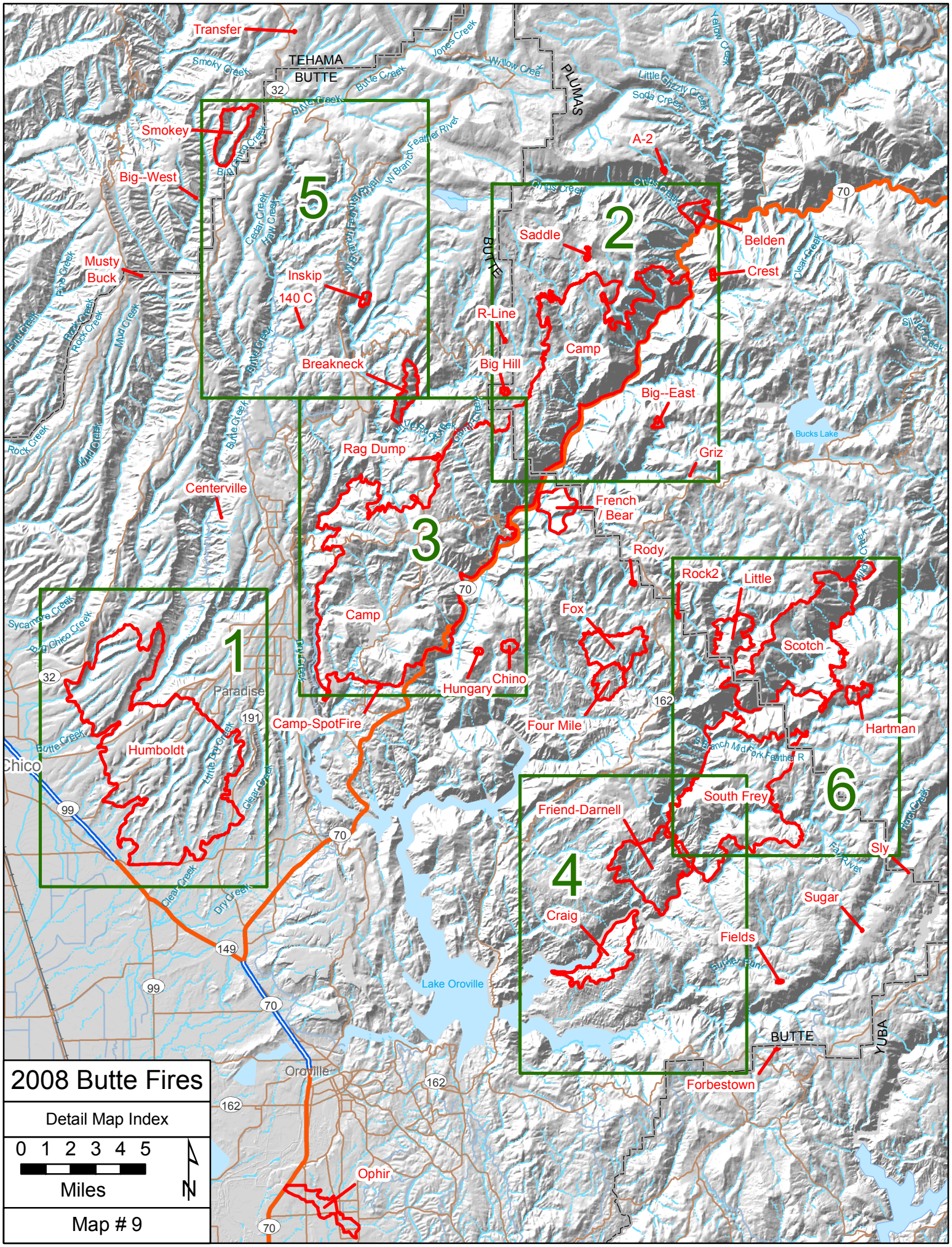
Miles

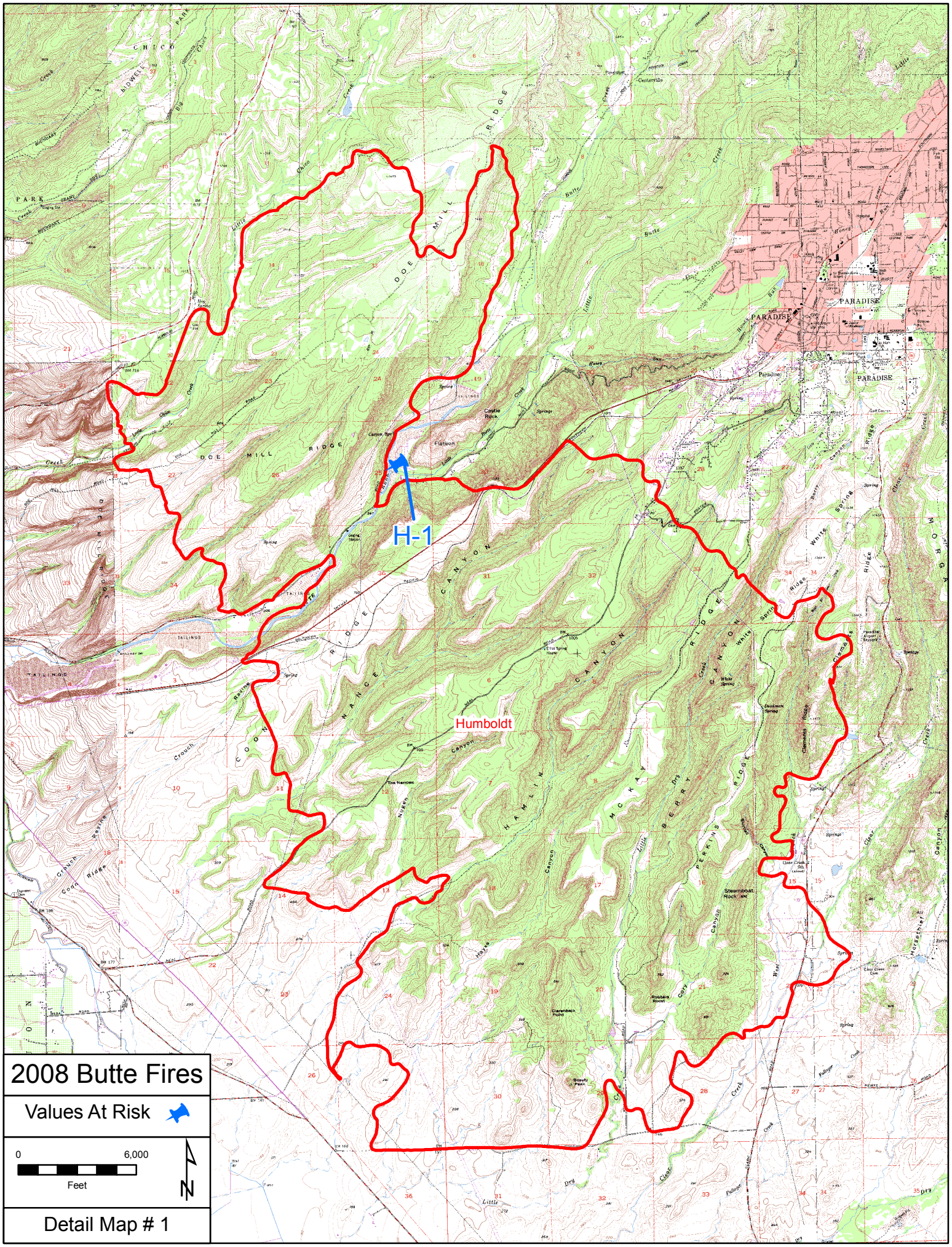
N

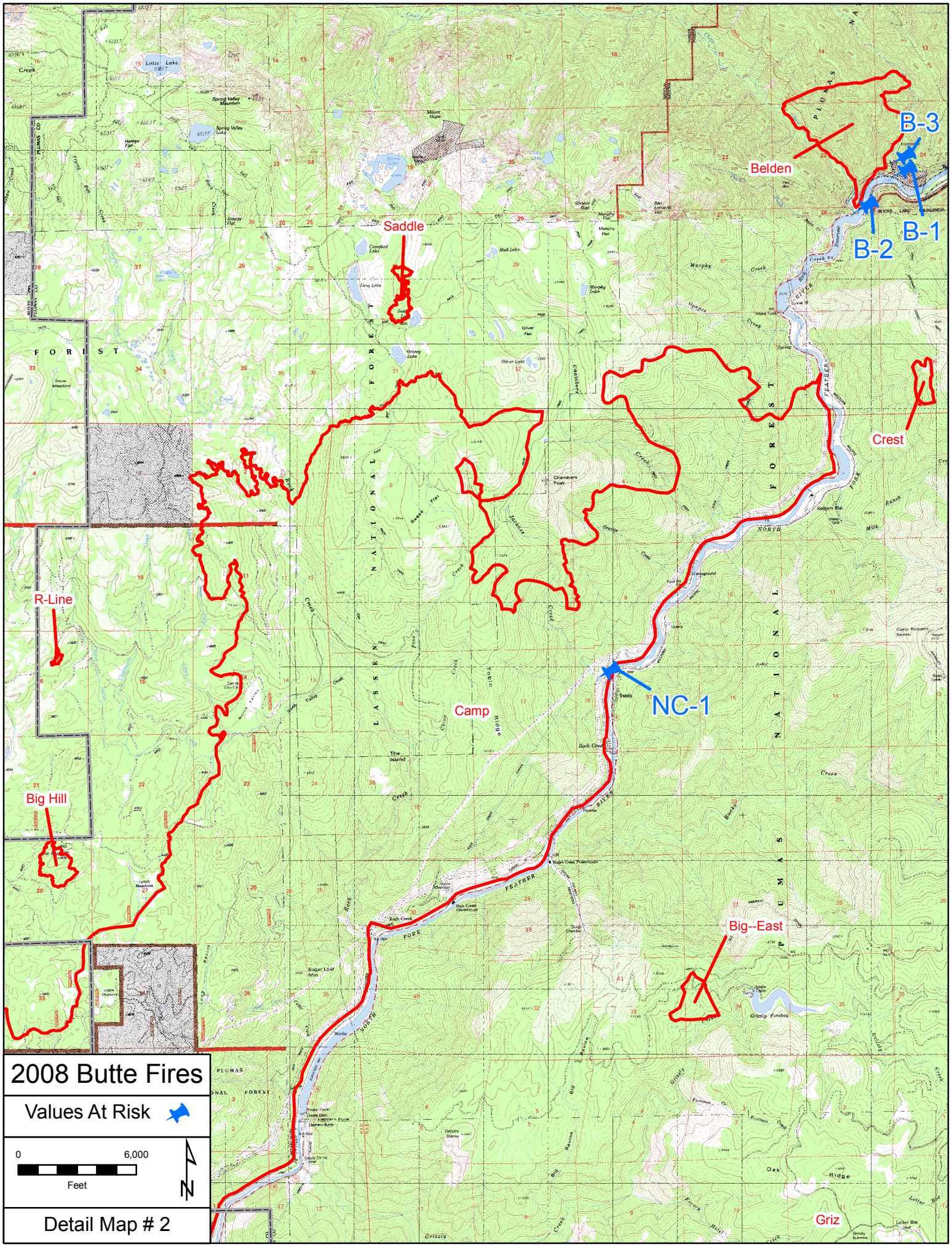
Map # 6

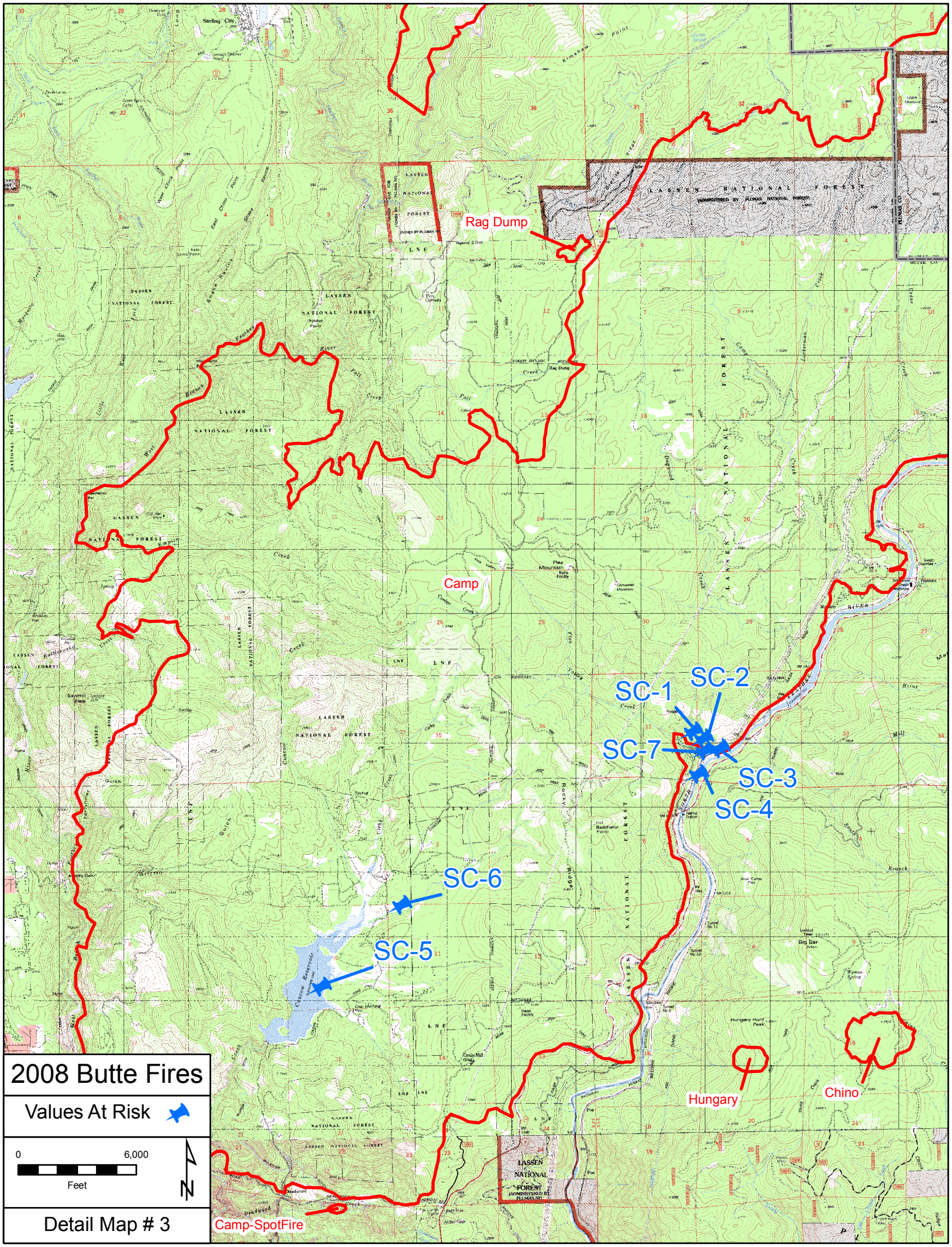

2008 Butte Fires
Vegetation Map
Conifer
Hardwood
Mixed
Shrub
Herbaceous
Barren
Agriculture
Urban / res
Not yet mapped
Note: Vegetation not shown for Yuba County.
Source:
CAL FIRE Fire and Resource Assessment Program
CA Land Cover Mapping & Monitoring Program (LCMMP)
http://frap.fire.ca.gov/data/frapgisdata/download.asp?rec=cveg
0 1 2 3 4 5
Miles
N
Map # 7
Transfer
Smokey
Big--West
Musty Buck
Inskip
140 C
Breakneck
Centerville
Rag Dump
Camp
Big Hill
R-Line
Saddle
A-2
Belden
Crest
Big--East
Griz
Bucks Lake
French / Bear
Rody
Rock2
Little
Fox
Scotch
Hartman
Chino
Hungary
Four Mile
Camp-SpotFire
Humboldt
Paradise
Chico
Friend-Darnell
South Frey
Sly
Sugar
Craig
Fields
Lake Oroville
Oroville
Forbestown
Ophir
TEHAMA
BUTTE
PLUMAS
YUBA
32
70
162
191
99
149

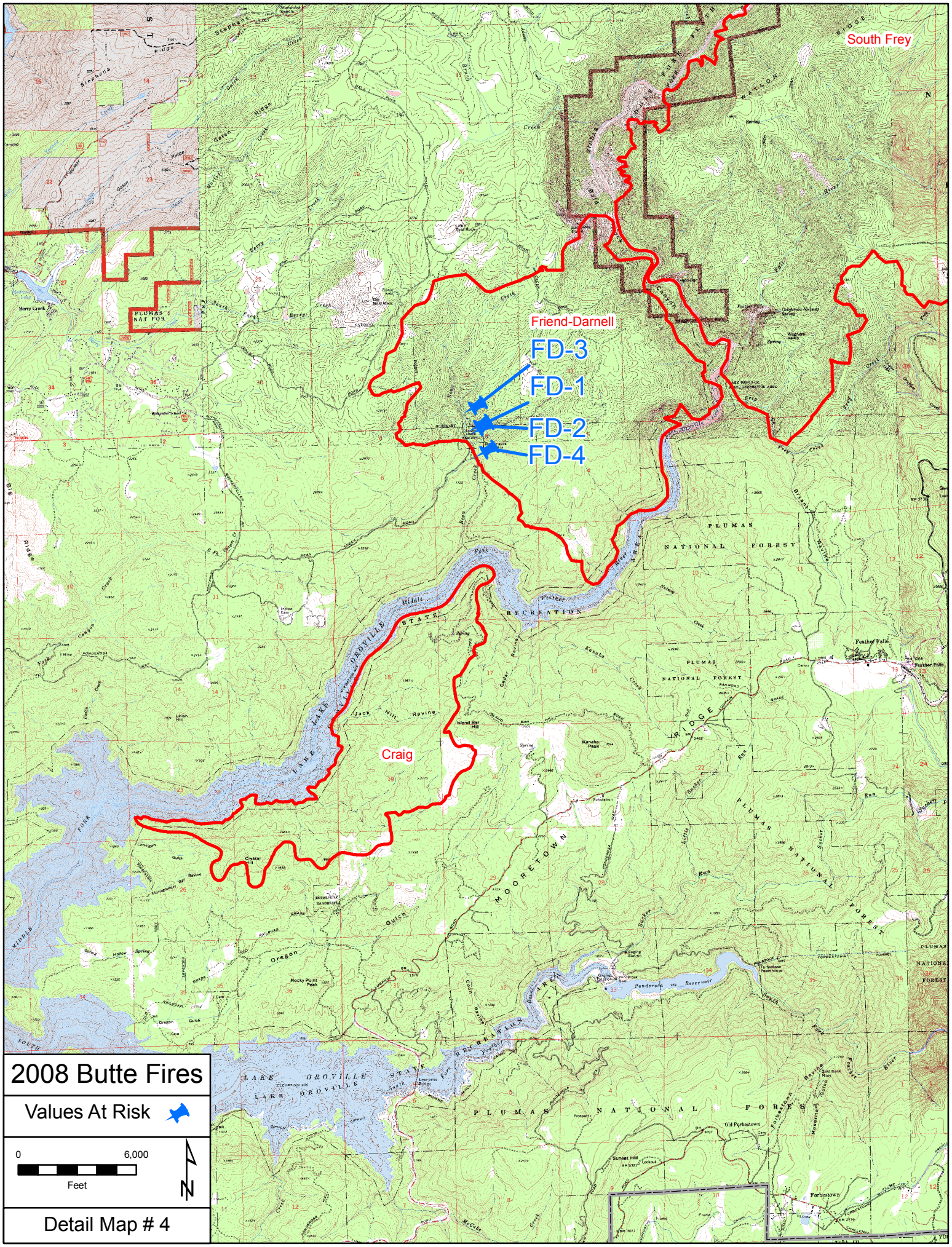

2008 Butte Fires
Wild Fire History
2001 -- 2007
1991 -- 2000
1981 -- 1990
1971 -- 1980
1961 -- 1970
1951 -- 1960
1941 -- 1950
1931 -- 1940
1921 -- 1930
1920 or earlier
Source:
CAL FIRE Fire and Resource Assessment Program
CA Land Cover Mapping & Monitoring Program (LCMMP)
http://frap.fire.ca.gov/data/frapgisdata/download.asp?spatialdist=1&rec=fire
0 1 2 3 4 5
Miles
N
Map # 8
Transfer
Smokey
Big--West
Musty
Buck
Inskip
140 C
Breakneck
R-Line
Big Hill
Saddle
A-2
Belden
Crest
Camp
Big--East
Griz
Rag Dump
Centerville
French / Bear
Rody
Rock2
Little
Fox
Camp
Scotch
Chino
Hungary
Camp-SpotFire
Four Mile
Hartman
Humboldt
South Frey
Friend-Darnell
Sly
Sugar
Craig
Fields
Forbestown
Ophir
Paradise
Chico
Oroville
Lake Oroville
Bucks Lake
Smoky Creek
Butte Creek
Big Chico Creek
Cedar Creek
Hay Creek
Mud Creek
Rock Creek
Little Butte Creek
Dry Creek
Clear Creek
Jones Creek
Willow Creek
Little Grizzly Creek
Soda Creek
Clips Creek
W Branch Feather River
Silver Creek
Fair River
Sugar Run
Wild Creek
Fork Feather R
32
70
162
191
99
149

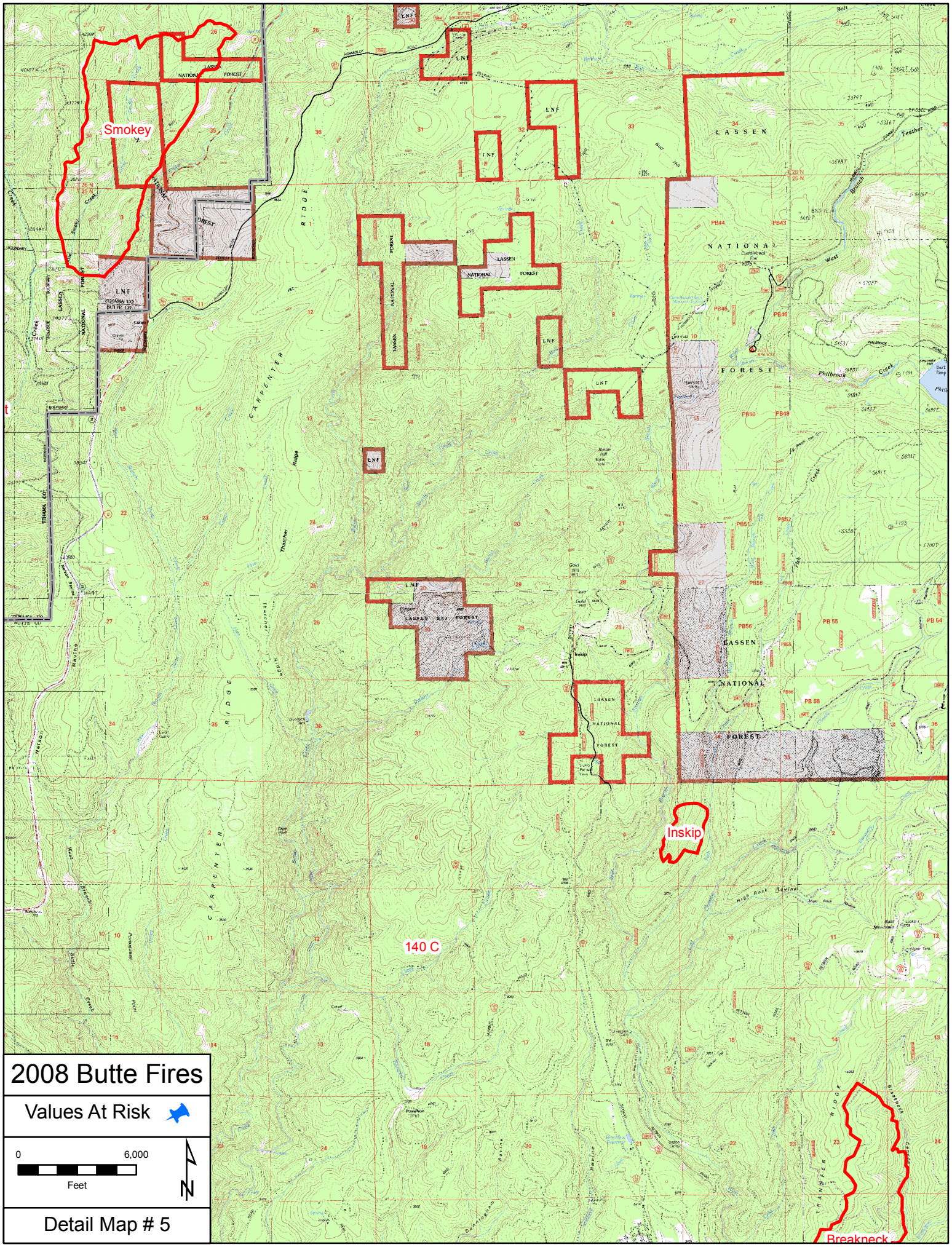

2008 Butte Fires
Detail Map Index
0 1 2 3 4 5
Miles
N
Map # 9
1
2
3
4
5
6
Transfer
Smokey
Big--West
Musty Buck
Inskip
140 C
Breakneck
Centerville
Humboldt
Saddle
R-Line
Big Hill
Camp
Big--East
Griz
Belden
Crest
A-2
Rag Dump
Camp
Camp-SpotFire
Hungary
Chino
French / Bear
Rody
Fox
Four Mile
Rock2
Little
Scotch
Hartman
South Frey
Friend-Darnell
Craig
Sly
Sugar
Fields
Forbestown
Ophir
TEHAMA
BUTTE
PLUMAS
YUBA
Paradise
Chico
Oroville
Lake Oroville
Bucks Lake
Smoky Creek
Butte Creek
Jones Creek
Willow Creek
Little Grizzly Creek
Soda Creek
Yellow Creek
Cedar Creek
Hay Creek
W Branch Feather River
Feather River
Clear Creek
Silver Creek
Fine Creek
Rock Creek
Mud Creek
Sycamore Creek
Big Chico Creek
Dry Creek
Little Dry Creek
Sutter Run
Branch Middle Fork Feather R
32
70
191
99
149
162

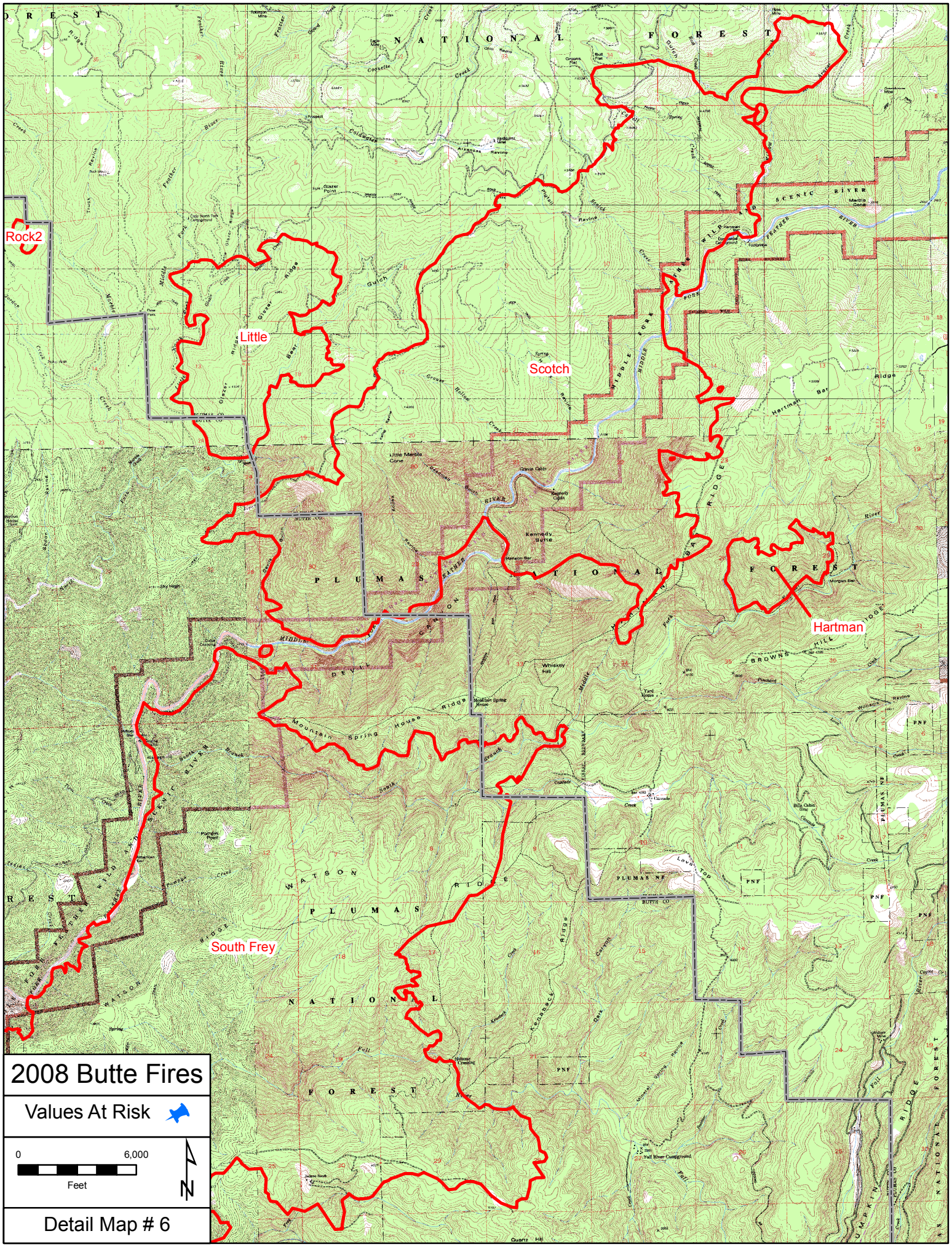

2008 Butte Fires
Values At Risk
0
6,000
Feet
N
Detail Map # 1
H-1
Humboldt
PARADISE
DOE MILL RIDGE
COON RANGE RIDGE
HAMLIN CANYON
MCKAY CANYON
BERRY RIDGE
PERKINS CANYON
WHITE SPRING RIDGE
CHICO PARK
Castle Rock
Flatiron
Steamboat Rock
Robbers Roost
Clarenback Ruins
Sawtooth Peak
The Narrows
Tailings


Belden
B-3
B-1
B-2
Saddle
Crest
R-Line
Camp
NC-1
Big Hill
Big--East
Griz
2008 Butte Fires
Values At Risk
0
6,000
Feet
N
Detail Map # 2


2008 Butte Fires
Values At Risk
0
6,000
Feet
N
Detail Map # 3
Rag Dump
Camp
SC-1
SC-2
SC-3
SC-4
SC-5
SC-6
SC-7
Hungary
Chino
Camp-SpotFire
LASSEN NATIONAL FOREST


South Frey
Friend-Darnell
FD-3
FD-1
FD-2
FD-4
Craig
PLUMAS NATIONAL FOREST
LAKE OROVILLE STATE RECREATION AREA
MOORETOWN RIDGE
Jack Hill Ravine
Feather Falls
Forbestown
2008 Butte Fires
Values At Risk
0
6,000
Feet
N
Detail Map # 4


Smokey
Inskip
140 C
Breakneck
LASSEN NATIONAL FOREST
LNF
CARPENTER RIDGE
TEHAMA CO
BUTTE CO
2008 Butte Fires
Values At Risk
0
6,000
Feet
N
Detail Map # 5


Rock2
Little
Scotch
Hartman
South Frey
2008 Butte Fires
Values At Risk
0
6,000
Feet
N
Detail Map # 6

2008 Butte Fires
Fire Acreage & Square Miles

| FireName | Acres | Sq. Miles |
|---|---|---|
| 140 C | 1.9 | 0.00 |
| A-2 | 16.5 | 0.03 |
| Belden | 474.4 | 0.74 |
| Big Hill | 59.3 | 0.09 |
| Big--East | 73.7 | 0.12 |
| Big--West | 1.6 | 0.00 |
| Breakneck | 771.3 | 1.21 |
| Camp | 49,642.8 | 77.57 |
| Camp-SpotFire | 6.6 | 0.01 |
| Centerville | 0.4 | 0.00 |
| Chino | 158.7 | 0.25 |
| Cold | 5,513.0 | 8.61 |
| Craig | 1,999.3 | 3.12 |
| Crest | 39.1 | 0.06 |
| Fields | 16.9 | 0.03 |
| Forbestown | 14.4 | 0.02 |
| Four Mile | 835.3 | 1.31 |
| Fox | 1,867.2 | 2.92 |
| French / Bear | 1,065.8 | 1.67 |
| Friend-Darnell | 3,845.1 | 6.01 |
| Griz | 0.1 | 0.00 |
| Hartman | 330.6 | 0.52 |
| Humboldt | 23,333.0 | 36.46 |
| Hungary | 41.9 | 0.07 |
| Inskip | 103.5 | 0.16 |
| Lewis | 0.9 | 0.00 |
| Little | 1,384.3 | 2.16 |
| Musty Buck | 0.8 | 0.00 |
| Ophir | 1,000.6 | 1.56 |
| Rag Dump | 21.8 | 0.03 |
| R-Line | 4.2 | 0.01 |
| Rock2 | 24.4 | 0.04 |
| Rody | 18.8 | 0.03 |
| Saddle | 34.2 | 0.05 |
| Scales | 2.3 | 0.00 |
| Scotch | 9,349.7 | 14.61 |
| Sly | 0.4 | 0.00 |
| Smokey | 1,323.6 | 2.07 |
| South Frey | 12,390.0 | 19.36 |
| Sugar | 2.1 | 0.00 |
| Transfer | 2.8 | 0.00 |
| **TOTAL:** | **115,773.0** | **180.90** |

2008 Butte Fires

Fires Categorized by Responsible Agencies (acreage)

| Fire Name | Federal | State | Local | Total |
|---|---|---|---|---|
| 140 C | | 1.9 | | 1.9 |
| A-2 | 16.5 | | | 16.5 |
| Belden | 472.9 | 1.5 | | 474.4 |
| Big Hill | | 59.3 | | 59.3 |
| Big--East | 73.7 | | | 73.7 |
| Big--West | | 1.6 | | 1.6 |
| Breakneck | | 771.3 | | 771.3 |
| Camp | 22,825.9 | 26,579.0 | 238.0 | 49,642.8 |
| Camp-SpotFire | | 6.6 | | 6.6 |
| Centerville | 0.4 | | | 0.4 |
| Chino | 158.7 | | | 158.7 |
| Cold | 5,483.6 | 29.4 | | 5,513.0 |
| Craig | 816.5 | 1,182.8 | | 1,999.3 |
| Crest | 39.1 | | | 39.1 |
| Fields | | 16.9 | | 16.9 |
| Forbestown | 12.6 | 1.8 | | 14.4 |
| Four Mile | 832.0 | 3.3 | | 835.3 |
| Fox | 1,454.6 | 412.6 | | 1,867.2 |
| French / Bear | 579.6 | 486.1 | | 1,065.8 |
| Friend-Darnell | 2,146.4 | 1,698.7 | | 3,845.1 |
| Griz | 0.1 | | | 0.1 |
| Hartman | 250.0 | 80.6 | | 330.6 |
| Humboldt | 392.5 | 22,879.6 | 60.9 | 23,333.0 |
| Hungary | 41.9 | | | 41.9 |
| Inskip | | 103.5 | | 103.5 |
| Lewis | | 0.9 | | 0.9 |
| Little | 1,384.1 | 0.2 | | 1,384.3 |
| Musty Buck | | 0.8 | | 0.8 |
| Ophir | | | 1,000.6 | 1,000.6 |
| Rag Dump | 20.7 | 1.1 | | 21.8 |
| R-Line | | 4.2 | | 4.2 |
| Rock2 | 8.3 | 16.1 | | 24.4 |
| Rody | 18.8 | | | 18.8 |
| Saddle | 34.2 | | | 34.2 |
| Scales | 2.3 | | | 2.3 |
| Scotch | 9,191.9 | 157.9 | | 9,349.7 |
| Sly | | 0.4 | | 0.4 |
| Smokey | 417.8 | 905.7 | | 1,323.6 |
| South Frey | 10,409.2 | 1,980.8 | | 12,390.0 |
| Sugar | 2.1 | | | 2.1 |
| Transfer | | 2.8 | | 2.8 |
| **TOTAL:** | **57,086.4** | **56,944.1** | **1,299.4** | **115,773.0** |

2008 Butte Fires
Burned Area Reflectance Classification (BARC)

| Camp | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 56,307 | 12,517 | 25.2% |
| Low | 75,301 | 16,739 | 33.7% |
| Moderate | 68,248 | 15,171 | 30.6% |
| Severe | 23,466 | 5,216 | 10.5% |
| TOTAL | 223,322 | 49,643 | 100.0% |

| Humboldt | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 39,441 | 8,769 | 37.6% |
| Low | 46,448 | 10,326 | 44.3% |
| Moderate | 18,303 | 4,069 | 17.4% |
| Severe | 760 | 169 | 0.7% |
| TOTAL | 104,952 | 23,333 | 100.0% |

| South Frey | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 23,399 | 5,203 | 42.0% |
| Low | 24,888 | 5,534 | 44.7% |
| Moderate | 6,555 | 1,458 | 11.8% |
| Severe | 881 | 196 | 1.6% |
| TOTAL | 55,723 | 12,390 | 100.0% |

| Scotch | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 12,871 | 2,862 | 30.6% |
| Low | 23,415 | 5,207 | 55.7% |
| Moderate | 5,112 | 1,137 | 12.2% |
| Severe | 650 | 145 | 1.5% |
| TOTAL | 42,048 | 9,350 | 100.0% |

| Friend-Darnell | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 1,341 | 298 | 7.8% |
| Low | 6,598 | 1,467 | 38.2% |
| Moderate | 7,017 | 1,560 | 40.6% |
| Severe | 2,335 | 519 | 13.5% |
| TOTAL | 17,291 | 3,845 | 100.0% |

2008 Butte Fires
Burned Area Reflectance Classification (BARC)

| Fox | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 5,162 | 1,147 | 61.5% |
| Low | 2,799 | 622 | 33.3% |
| Moderate | 402 | 89 | 4.8% |
| Severe | 37 | 8 | 0.4% |
| TOTAL | 8,400 | 1,867 | 100.0% |

| Little | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 3,880 | 863 | 62.4% |
| Low | 2,205 | 491 | 35.4% |
| Moderate | 135 | 30 | 2.2% |
| Severe | 1 | 0 | 0.0% |
| TOTAL | 6,221 | 1,384 | 100.0% |

| Smokey | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 2,397 | 534 | 40.3% |
| Low | 2,524 | 562 | 42.4% |
| Moderate | 820 | 183 | 13.8% |
| Severe | 207 | 46 | 3.5% |
| TOTAL | 5,948 | 1,324 | 100.0% |

| French / Bear | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 2,405 | 534 | 50.1% |
| Low | 2,074 | 461 | 43.2% |
| Moderate | 319 | 71 | 6.6% |
| Severe | 0 | 0 | 0.0% |
| TOTAL | 4,798 | 1,066 | 100.0% |

| Ophir | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 1,209 | 269 | 26.9% |
| Low | 1,512 | 336 | 33.6% |
| Moderate | 1,768 | 393 | 39.3% |
| Severe | 13 | 3 | 0.3% |
| TOTAL | 4,502 | 1,001 | 100.0% |

2008 Butte Fires
Burned Area Reflectance Classification (BARC)

| Four-Mile | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 7,236 | 494 | 59.7% |
| Low | 4,351 | 297 | 35.9% |
| Moderate | 489 | 33 | 4.0% |
| Severe | 37 | 3 | 0.3% |
| TOTAL | 12,113 | 827 | 100.0% |

| Breakneck | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 1,325 | 294 | 38.1% |
| Low | 1,555 | 345 | 44.7% |
| Moderate | 559 | 124 | 16.1% |
| Severe | 36 | 8 | 1.0% |
| TOTAL | 3,475 | 771 | 100.0% |

| Belden | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 944 | 210 | 44.3% |
| Low | 584 | 130 | 27.4% |
| Moderate | 603 | 134 | 28.3% |
| Severe | 0 | 0 | 0.0% |
| TOTAL | 2,131 | 474 | 100.0% |

| Hartman | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 814 | 181 | 54.7% |
| Low | 547 | 122 | 36.8% |
| Moderate | 110 | 24 | 7.4% |
| Severe | 17 | 4 | 1.1% |
| TOTAL | 1,488 | 331 | 100.0% |

| Chino | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 646 | 144 | 90.7% |
| Low | 47 | 10 | 6.6% |
| Moderate | 19 | 4 | 2.7% |
| Severe | 0 | 0 | 0.0% |
| TOTAL | 712 | 159 | 100.0% |

2008 Butte Fires
Burned Area Reflectance Classification (BARC)

| Inskip | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 443 | 99 | 95.1% |
| Low | 23 | 5 | 4.9% |
| Moderate | 0 | 0 | 0.0% |
| Severe | 0 | 0 | 0.0% |
| TOTAL | 466 | 104 | 100.0% |

| Crest | | | |
|---|---|---|---|
| Burn Intensity | Pixel Count | Acreage | % Total |
| Unburned | 159 | 35 | 90.3% |
| Low | 8 | 2 | 4.5% |
| Moderate | 9 | 2 | 5.1% |
| Severe | 0 | 0 | 0.0% |
| TOTAL | 176 | 39 | 100.0% |

2008 Butte Fires
Fires Categorized By Soils (acreage)

| Fire Name and Soil Type | Sum of Acres |
|---|---|
| **140 C** | 1.9 |
| Neuns-Cohasset (s645) | 1.9 |
| **A-2** | 16.5 |
| Yallani-Sheld-Lava flows-Inville (s517) | 16.5 |
| **Belden** | 474.4 |
| Hoosimbim-Hollowtree-Holland-Gavel-Bollibokka (s533) | 0.3 |
| Kistirn-Hollowtree-Deadwood (s550) | 474.1 |
| **Big Hill** | 59.3 |
| Wapi-Holland-Chaix-Arrastre (s528) | 59.3 |
| **Big--East** | 73.7 |
| Wapi-Holland-Chaix-Arrastre (s528) | 73.7 |
| **Big--West** | 1.6 |
| McCarthy-Cohasset-Aiken (s620) | 1.6 |
| **Breakneck** | 771.3 |
| Neuns-Cohasset (s645) | 771.3 |
| **Camp** | 49642.8 |
| Goulding-Auburn (s646) | 986.3 |
| Josephine-Holland-Aiken (s525) | 15229.7 |
| Neuns-Cohasset (s645) | 5848.6 |
| Toomes-Supan (s622) | 1357.6 |
| Wapi-Holland-Chaix-Arrastre (s528) | 26127.7 |
| Yallani-Sheld-Lava flows-Inville (s517) | 92.9 |
| **Camp-SpotFire** | 6.6 |
| Josephine-Holland-Aiken (s525) | 6.6 |
| **Centerville** | 0.4 |
| Goulding-Auburn (s646) | 0.4 |
| **Chino** | 158.7 |
| Josephine-Holland-Aiken (s525) | 158.7 |
| **Cold** | 5513.0 |
| Kistirn-Hollowtree-Deadwood (s550) | 1756.0 |
| Waca-Gibsonville (s524) | 3757.0 |
| **Craig** | 1999.3 |
| Wapi-Holland-Chaix-Arrastre (s528) | 1988.0 |
| Water (s8369) | 11.3 |
| **Crest** | 39.1 |
| Wapi-Holland-Chaix-Arrastre (s528) | 39.1 |
| **Fields** | 16.9 |
| Josephine-Holland-Aiken (s525) | 16.9 |
| **Forbestown** | 14.4 |
| Josephine-Holland-Aiken (s525) | 14.4 |
| **Four Mile** | 835.3 |
| Wapi-Holland-Chaix-Arrastre (s528) | 835.3 |

2008 Butte Fires
Fires Categorized By Soils (acreage)

| | |
|---|---|
| **Fox** | 1867.2 |
| Wapi-Holland-Chaix-Arrastre (s528) | 1867.2 |
| **French / Bear** | 1065.8 |
| Josephine-Holland-Aiken (s525) | 756.7 |
| Wapi-Holland-Chaix-Arrastre (s528) | 309.0 |
| **Friend-Darnell** | 3845.1 |
| Wapi-Holland-Chaix-Arrastre (s528) | 3834.4 |
| Water (s8369) | 10.6 |
| **Griz** | 0.1 |
| Weitchpec-Rock outcrop-Ishi Pishi-Ipish-Grell-Beaughton (s523) | 0.1 |
| **Hartman** | 330.6 |
| Wapi-Holland-Chaix-Arrastre (s528) | 330.6 |
| **Humboldt** | 23333.0 |
| McCarthy-Cohasset-Aiken (s620) | 0.4 |
| Toomes-Supan (s622) | 21867.5 |
| Tuscan-Anita (s644) | 1465.0 |
| **Hungary** | 41.9 |
| Josephine-Holland-Aiken (s525) | 41.9 |
| **Inskip** | 103.5 |
| McCarthy-Cohasset-Aiken (s620) | 103.5 |
| **Lewis** | 0.9 |
| Wapi-Holland-Chaix-Arrastre (s528) | 0.9 |
| **Little** | 1384.3 |
| Josephine-Holland-Aiken (s525) | 1312.1 |
| Trojan-Sattley-Franktown (s521) | 72.2 |
| **Musty Buck** | 0.8 |
| McCarthy-Cohasset-Aiken (s620) | 0.8 |
| **Ophir** | 1000.6 |
| Redding-Corning (s821) | 1000.6 |
| **Rag Dump** | 21.8 |
| Wapi-Holland-Chaix-Arrastre (s528) | 21.8 |
| **R-Line** | 4.2 |
| Wapi-Holland-Chaix-Arrastre (s528) | 4.2 |
| **Rock2** | 24.4 |
| Josephine-Holland-Aiken (s525) | 23.4 |
| Wapi-Holland-Chaix-Arrastre (s528) | 1.0 |
| **Rody** | 18.8 |
| Wapi-Holland-Chaix-Arrastre (s528) | 18.8 |
| **Saddle** | 34.2 |
| Rubble land-Rock outcrop-Lava flows (s538) | 34.2 |
| **Scales** | 2.3 |
| Josephine-Holland-Aiken (s525) | 2.3 |
| **Scotch** | 9349.7 |
| Josephine-Holland-Aiken (s525) | 3710.2 |

2008 Butte Fires

Fires Categorized By Soils (acreage)

| | |
|---|---|
| Josephine-Holland-Aiken (s525) | 1621.2 |
| Trojan-Sattley-Franktown (s521) | 1083.8 |
| Wapi-Holland-Chaix-Arrastre (s528) | 2934.5 |
| **Sly** | 0.4 |
| Josephine-Holland-Aiken (s525) | 0.4 |
| **Smokey** | 1323.6 |
| McCarthy-Cohasset-Aiken (s620) | 1323.6 |
| **South Frey** | 12390.0 |
| Josephine-Holland-Aiken (s525) | 1612.6 |
| Wapi-Holland-Chaix-Arrastre (s528) | 10777.4 |
| **Sugar** | 2.1 |
| Josephine-Holland-Aiken (s525) | 2.1 |
| **Transfer** | 2.8 |
| McCarthy-Cohasset-Aiken (s620) | 2.8 |
| **Grand Total** | 115773.0 |

2008 Butte Fires
Fires Categorized By Stream Name & Type

| Firename, stream name & type | Miles |
|---|---|
| **Belden** | **0.22** |
| **Chips Creek** | **0.17** |
| Perrennial | 0.17 |
| **Indian Creek** | **0.05** |
| Perrennial | 0.05 |
| **Breakneck** | **0.39** |
| **Big Kimshew Creek** | **0.08** |
| Perrennial | 0.08 |
| **(blank)** | **0.31** |
| Intermittent Stream | 0.31 |
| **Camp-Lynch-Long-Pit** | **106.89** |
| **Camp Creek** | **6.04** |
| Perrennial | 6.04 |
| **Cedar Creek** | **2.61** |
| Intermittent Stream | 0.69 |
| Perrennial | 1.92 |
| **Chambers Creek** | **0.75** |
| Perrennial | 0.75 |
| **China Creek** | **1.41** |
| Intermittent Stream | 1.41 |
| **Cirby Creek** | **2.67** |
| Intermittent Stream | 0.60 |
| Perrennial | 2.07 |
| **Concow Creek** | **9.05** |
| Artificial Path | 1.73 |
| Intermittent Stream | 3.51 |
| Perrennial | 3.80 |
| **Dogwood Creek** | **4.76** |
| Perrennial | 4.76 |
| **Empire Creek** | **2.32** |
| Intermittent Stream | 1.90 |
| Perrennial | 0.42 |
| **Fall Creek** | **0.48** |
| Intermittent Stream | 0.34 |
| Perrennial | 0.13 |
| **Flea Valley Creek** | **2.43** |
| Perrennial | 2.43 |
| **Granite Creek** | **1.10** |
| Intermittent Stream | 1.10 |
| **Jackass Creek** | **1.62** |
| Perrennial | 1.62 |
| **Little North Valley Creek** | **0.32** |

| | |
|---|---|
| Perrennial | 0.32 |
| **Lockerman Creek** | **2.89** |
| Perrennial | 2.89 |
| **North Valley Creek** | **1.68** |
| Perrennial | 1.68 |
| **Pine Creek** | **3.61** |
| Perrennial | 3.61 |
| **Rock Creek** | **5.40** |
| Perrennial | 5.40 |
| **Swamp Creek** | **3.25** |
| Intermittent Stream | 0.62 |
| Perrennial | 2.62 |
| **(blank)** | **54.52** |
| Artificial Path | 0.43 |
| Intermittent Stream | 46.19 |
| Perrennial | 2.26 |
| Pipeline Near Surface | 5.65 |
| **Camp-SpotFire** | **0.13** |
| **(blank)** | **0.13** |
| Canal/Ditch | 0.13 |
| **Chino** | **0.28** |
| **Chino Creek** | **0.28** |
| Perrennial | 0.28 |
| **Cold** | **7.59** |
| **Cold Water Creek** | **2.97** |
| Perrennial | 2.97 |
| **Fish Creek** | **1.58** |
| Perrennial | 1.58 |
| **Miller Creek** | **0.09** |
| Perrennial | 0.09 |
| **Nelson Creek** | **0.44** |
| Perrennial | 0.44 |
| **Oliver Creek** | **0.57** |
| Perrennial | 0.57 |
| **Peoria Creek** | **0.52** |
| Perrennial | 0.52 |
| **(blank)** | **1.42** |
| Intermittent Stream | 0.31 |
| Perrennial | 1.11 |
| **Craig** | **2.33** |
| **(blank)** | **2.33** |
| Intermittent Stream | 2.33 |
| **Crest** | **0.18** |
| **(blank)** | **0.18** |
| Intermittent Stream | 0.18 |
| **Forbestown** | **0.13** |
| **(blank)** | **0.13** |

| | |
|---|---|
| Canal/Ditch | 0.13 |
| **Four Mile** | **1.56** |
| **(blank)** | **1.56** |
| Intermittent Stream | 1.56 |
| **Fox** | **5.09** |
| **Coon Creek** | **0.93** |
| Perrennial | 0.93 |
| **Fox Creek** | **2.03** |
| Intermittent Stream | 2.03 |
| **Haphazard Creek** | **1.16** |
| Perrennial | 1.16 |
| **(blank)** | **0.96** |
| Intermittent Stream | 0.96 |
| **French / Bear** | **1.60** |
| **Bear Ranch Creek** | **0.75** |
| Perrennial | 0.75 |
| **(blank)** | **0.85** |
| Pipeline Underground | 0.85 |
| **Friend-Darnell** | **7.84** |
| **Bean Creek** | **2.03** |
| Intermittent Stream | 1.56 |
| Perrennial | 0.47 |
| **(blank)** | **5.81** |
| Artificial Path | 0.23 |
| Intermittent Stream | 5.58 |
| **Humboldt** | **64.11** |
| **Butte Creek** | **1.46** |
| Perrennial | 1.46 |
| **Clear Creek** | **1.18** |
| Perrennial | 1.18 |
| **Hamlin Slough** | **0.92** |
| Intermittent Stream | 0.92 |
| **West Branch Clear Creek** | **1.87** |
| Intermittent Stream | 0.61 |
| Perrennial | 1.26 |
| **(blank)** | **58.67** |
| Intermittent Stream | 46.39 |
| Perrennial | 12.29 |
| **Little** | **3.72** |
| **Glazer Creek** | **1.17** |
| Perrennial | 1.17 |
| **Little North Fork of Middle Fork Feather River** | **1.67** |
| Perrennial | 1.67 |
| **(blank)** | **0.88** |
| Intermittent Stream | 0.88 |
| **Ophir** | **3.33** |
| **(blank)** | **3.33** |

| | |
|---|---|
| Canal/Ditch | 0.42 |
| Intermittent Stream | 2.90 |
| **Scotch** | **22.44** |
| **Catrell Creek** | **2.00** |
| Intermittent Stream | 2.00 |
| **Grouse Hollow Creek** | **1.60** |
| Perrennial | 1.60 |
| **Middle Fork Feather River** | **4.08** |
| Perrennial | 4.08 |
| **Mount Ararat Creek** | **0.41** |
| Intermittent Stream | 0.41 |
| **Scotch Creek** | **1.56** |
| Intermittent Stream | 1.56 |
| **Willow Creek** | **1.33** |
| Perrennial | 1.33 |
| **(blank)** | **11.46** |
| Intermittent Stream | 11.46 |
| **Smokey** | **3.17** |
| **Big Chico Creek** | **0.73** |
| Perrennial | 0.73 |
| **Little Smoky Creek** | **2.44** |
| Perrennial | 2.44 |
| **South Frey** | **24.54** |
| **Cascade Creek** | **0.50** |
| Perrennial | 0.50 |
| **Fall River** | **5.46** |
| Perrennial | 5.46 |
| **Frey Creek** | **0.92** |
| Perrennial | 0.92 |
| **Middle Fork Feather River** | **2.13** |
| Artificial Path | 0.19 |
| Perrennial | 1.94 |
| **Pompys Creek** | **1.17** |
| Intermittent Stream | 1.17 |
| **South Branch Middle Fork Feather River** | **4.96** |
| Perrennial | 4.96 |
| **(blank)** | **9.40** |
| Artificial Path | 0.24 |
| Intermittent Stream | 8.19 |
| Perrennial | 0.97 |
| **Grand Total** | **255.54** |

## 2008 Butte Fires
## Watersheds Within Fire Perimeters

| Fire Name | CalWater # | Cal Fire Watershed Name | DWR Watershed Name | Acres Burned | Percent of Fire Acreage | Total Watershed Acreage | Percent of Watershed Burned |
|---|---|---|---|---|---|---|---|
| **140 C** | | | | | | | |
| | 5521.300201 | Timbered Crater | undefined | 1.9 | 100.0% | 8899.0 | 0.0% |
| **A-2** | | | | | | | |
| | 5518.430101 | Chips Creek | Butt Valley | 16.5 | 100.0% | 14132.9 | 0.1% |
| **Belden** | | | | | | | |
| | 5518.430101 | Chips Creek | Butt Valley | 440.2 | 92.8% | 14132.9 | 3.1% |
| | 5518.430107 | Rock Creek Reservoir | Butt Valley | **34.2** | 7.2% | 11351.2 | 0.3% |
| **Big Hill** | | | | | | | |
| | 5518.420402 | Swamp Creek | Bucks Lake | 39.9 | 67.3% | 9622.2 | 0.4% |
| | 5518.600104 | Crane Valley | undefined | 19.4 | 32.7% | 10269.9 | 0.2% |
| **Big--East** | | | | | | | |
| | 5518.420401 | Duffey Dome | Bucks Lake | 73.7 | 100.0% | 9782.2 | 0.8% |
| **Big--West** | | | | | | | |
| | 5509.140102 | Campbell Creek | Big Chico Creek | 1.6 | 100.0% | 13098.7 | 0.0% |
| **Breakneck** | | | | | | | |
| | 5518.600201 | Fall Creek | undefined | 35.2 | 4.6% | 10677.3 | 0.3% |
| | 5518.600204 | Big Kimshaw Creek | undefined | 736.0 | 95.4% | 6891.9 | 10.7% |
| **Camp** | | | | | | | |
| | 5518.110206 | Flea Valley Creek | Reservoir Drain | 1659.8 | 3.3% | 7573.9 | 21.9% |
| | 5518.420103 | Lower Bucks Creek | Bucks Lake | 1143.6 | 2.3% | 11358.2 | 10.1% |
| | 5518.420201 | Chambers Creek | Bucks Lake | 3347.9 | 6.7% | 8237.2 | 40.6% |
| | 5518.420202 | Milk Ranch Creek | Bucks Lake | 158.8 | 0.3% | 5218.4 | 3.0% |
| | 5518.420301 | North Valley Creek | Bucks Lake | 7156.8 | 14.4% | 10772.7 | 66.4% |
| | 5518.420302 | Flying Pan | Bucks Lake | 348.3 | 0.7% | 7238.8 | 4.8% |
| | 5518.420402 | Swamp Creek | Bucks Lake | 3764.9 | 7.6% | 9622.2 | 39.1% |
| | 5518.420501 | Dogwood Creek | Bucks Lake | 6298.2 | 12.7% | 12116.0 | 52.0% |
| | 5518.420502 | Lockerman Creek | Bucks Lake | 6561.9 | 13.2% | 11026.8 | 59.5% |
| | 5518.430107 | Rock Creek Reservoir | Butt Valley | 280.4 | 0.6% | 11351.2 | 2.5% |
| | 5518.600201 | Fall Creek | undefined | 1578.4 | 3.2% | 10677.3 | 14.8% |
| | 5518.600203 | Empire Creek | undefined | 4514.2 | 9.1% | 8140.1 | 55.5% |
| | 5518.600301 | Concow Creek | undefined | 3260.5 | 6.6% | 7995.7 | 40.8% |
| | 5518.600302 | Cirby Creek | undefined | 9569.1 | 19.3% | 9578.5 | 99.9% |
| **Camp-SpotFire** | | | | | | | |
| | 5518.600301 | Concow Creek | undefined | 6.6 | 100.0% | 7995.7 | **0.1%** |

## 2008 Butte Fires
## Watersheds Within Fire Perimeters

| Fire Name | CalWater # | Cal Fire Watershed Name | DWR Watershed Name | Acres Burned | Percent of Fire Acreage | Total Watershed Acreage | Percent of Watershed Burned |
|---|---|---|---|---|---|---|---|
| **Centerville** | | | | | | | |
| | 5521.300305 | Nimshew | undefined | 0.4 | 100.0% | 9464.3 | 0.0% |
| **Chino** | | | | | | | |
| | 5518.110201 | Chino Creek | Reservoir Drain | 158.7 | 100.0% | 6858.0 | 2.3% |
| **Cold** | | | | | | | |
| | 5518.320101 | East Nelson Creek | Hartman Bar | 819.7 | 14.9% | 6026.6 | 13.6% |
| | 5518.320103 | Dixon Creek | Hartman Bar | 2897.8 | 52.6% | 10474.2 | 27.7% |
| | 5518.320104 | Fells Flat | Hartman Bar | 1549.6 | 28.1% | 11706.8 | 13.2% |
| | 5518.330502 | Poplar Creek | Sloat | 65.1 | 1.2% | 6972.7 | 0.9% |
| | 5518.330503 | Little Long Valley Creek | Sloat | 180.7 | 3.3% | 10155.7 | 1.8% |
| **Craig** | | | | | | | |
| | 5518.110402 | Island Bar Hill | Reservoir Drain | 1960.0 | 98.0% | 2785.7 | 70.4% |
| | 5518.110403 | Oregon Gulch | Reservoir Drain | 32.7 | 1.6% | 3431.0 | 1.0% |
| | 5518.120000 | undefined | Reservoir Drain | 6.0 | 0.3% | 7634.8 | 0.1% |
| **Crest** | | | | | | | |
| | 5518.430107 | Rock Creek Reservoir | Butt Valley | 39.1 | 100.0% | 11351.2 | 0.3% |
| **Fields** | | | | | | | |
| | 5518.220203 | Lower Sucker Run | Lumpkin | 16.9 | 100.0% | 6433.3 | 0.3% |
| **Forbestown** | | | | | | | |
| | 5517.130102 | Costa Creek | Mildred Lake | 7.4 | 51.5% | 8482.5 | 0.1% |
| | 5518.220201 | Ponderosa Reservoir | Lumpkin | 7.0 | 48.5% | 7547.4 | 0.1% |
| **Four Mile** | | | | | | | |
| | 5518.110101 | Bush Creek | Reservoir Drain | 303.6 | 36.4% | 7950.0 | 3.8% |
| | 5518.110102 | Kelly Reservoir | Reservoir Drain | 531.7 | 63.6% | 7064.6 | 7.5% |
| **Fox** | | | | | | | |
| | 5518.110101 | Bush Creek | Reservoir Drain | 1301.7 | 69.7% | 7950.0 | 16.4% |
| | 5518.110102 | Kelly Reservoir | Reservoir Drain | 565.5 | 30.3% | 7064.6 | 8.0% |
| **French / Bear** | | | | | | | |
| | 5518.420402 | Swamp Creek | Bucks Lake | 574.4 | 53.9% | 9622.2 | 6.0% |
| | 5518.420502 | Lockerman Creek | Bucks Lake | 491.4 | 46.1% | 11026.8 | 4.5% |

## 2008 Butte Fires
## Watersheds Within Fire Perimeters

| Fire Name | CalWater # | Cal Fire Watershed Name | DWR Watershed Name | Acres Burned | Percent of Fire Acreage | Total Watershed Acreage | Percent of Watershed Burned |
|---|---|---|---|---|---|---|---|
| **Friend-Darnell** | | | | | | | |
| | 5518.110306 | Berry Creek | Reservoir Drain | 12.1 | 0.3% | 9497.3 | 0.1% |
| | 5518.110401 | Bean Creek | Reservoir Drain | 2179.9 | 56.7% | 4554.4 | 47.9% |
| | 5518.110406 | Frey Creek | Reservoir Drain | 1011.4 | 26.3% | 9614.2 | 10.5% |
| | 5518.120000 | undefined | Reservoir Drain | 14.1 | 0.4% | 7634.8 | 0.2% |
| | 5518.320701 | Bald Rock Canyon | Hartman Bar | 627.6 | 16.3% | 8203.7 | 7.7% |
| **Griz** | | | | | | | |
| | 5518.420401 | Duffey Dome | Bucks Lake | 0.1 | 100.0% | 9782.2 | 0.0% |
| **Hartman** | | | | | | | |
| | 5518.320402 | Willow Creek | Hartman Bar | 330.6 | 100.0% | 11144.5 | 3.0% |
| **Humboldt** | | | | | | | |
| | 5520.400001 | East Side | undefined | 10930.1 | 46.8% | 375314.0 | 2.9% |
| | 5521.100102 | Upper Knox Flat | undefined | 1898.3 | 8.1% | 3203.1 | 59.3% |
| | 5521.100103 | Stone Coal Creek | undefined | 1672.1 | 7.2% | 3721.2 | 44.9% |
| | 5521.100104 | West Branch | undefined | 2030.5 | 8.7% | 3304.6 | 61.4% |
| | 5521.100105 | Paradise | undefined | 2463.8 | 10.6% | 3050.3 | 80.8% |
| | 5521.100106 | Cat Hill | undefined | 256.4 | 1.1% | 4701.0 | 5.5% |
| | 5521.200001 | Middle Little Chico Creek | undefined | 16.1 | 0.1% | 5379.6 | 0.3% |
| | 5521.200002 | Lower Little Chico Creek | undefined | 1804.5 | 7.7% | 3274.6 | 55.1% |
| | 5521.200003 | Hole in Rock | undefined | 829.6 | 3.6% | 852.3 | 97.3% |
| | 5521.300301 | Toms Creek | undefined | 845.3 | 3.6% | 2117.1 | 39.9% |
| | 5521.300302 | Middle Butte Creek | undefined | 131.6 | 0.6% | 13417.6 | 1.0% |
| | 5521.300304 | Long Bell | undefined | 454.6 | 1.9% | 479.0 | 94.9% |
| **Hungary** | | | | | | | |
| | 5518.110206 | Flea Valley Creek | Reservoir Drain | 41.9 | 100.0% | 7573.9 | 0.6% |
| **Inskip** | | | | | | | |
| | 5518.600102 | Fish Creek | undefined | 103.5 | 100.0% | 8681.9 | 1.2% |
| **Lewis** | | | | | | | |
| | 5518.230001 | Lewis Flat | Lost Creek | 0.9 | 100.0% | 14517.7 | 0.0% |
| **Little** | | | | | | | |
| | 5518.320501 | Glazer Creek | Hartman Bar | 1384.3 | 100.0% | 10595.6 | 13.1% |
| **Musty Buck** | | | | | | | |
| | 5509.140102 | Campbell Creek | Big Chico Creek | 0.8 | 100.0% | 13098.7 | 0.0% |

## 2008 Butte Fires
## Watersheds Within Fire Perimeters

| Fire Name | CalWater # | Cal Fire Watershed Name | DWR Watershed Name | Acres Burned | Percent of Fire Acreage | Total Watershed Acreage | Percent of Watershed Burned |
|---|---|---|---|---|---|---|---|
| **Ophir** | | | | | | | |
| | 5515.400000 | undefined | undefined | 1000.6 | 100.0% | 125120.0 | 0.8% |
| **Rag Dump** | | | | | | | |
| | 5518.600204 | Big Kimshaw Creek | undefined | 21.8 | 100.0% | 6891.9 | 0.3% |
| **R-Line** | | | | | | | |
| | 5518.420301 | North Valley Creek | Bucks Lake | 4.2 | 100.0% | 10772.7 | 0.0% |
| **Rock2** | | | | | | | |
| | 5518.320502 | Marble Creek | Hartman Bar | 24.4 | 100.0% | 6372.7 | 0.4% |
| **Rody** | | | | | | | |
| | 5518.110104 | Coyote Gap | Reservoir Drain | 18.8 | 100.0% | 5152.2 | 0.4% |
| **Saddle** | | | | | | | |
| | 5518.420302 | Flying Pan | Bucks Lake | 34.2 | 100.0% | 7238.8 | 0.5% |
| **Scales** | | | | | | | |
| | 5517.520202 | Gold Run | Slate Creek | 2.3 | 100.0% | 10811.5 | 0.0% |
| Scotch | | | | | | | |
| | 5518.320301 | Kellog Ravine | Hartman Bar | 7136.3 | 76.3% | 10404.1 | 68.6% |
| | 5518.320302 | China Gulch | Hartman Bar | 1401.4 | 15.0% | 8830.3 | 15.9% |
| | 5518.320402 | Willow Creek | Hartman Bar | 49.6 | 0.5% | 11144.5 | 0.4% |
| | 5518.320501 | Glazer Creek | Hartman Bar | 58.8 | 0.6% | 10595.6 | 0.6% |
| | 5518.320502 | Marble Creek | Hartman Bar | 13.5 | 0.1% | 6372.7 | 0.2% |
| | 5518.320702 | Mtn. House Creek | Hartman Bar | 690.2 | 7.4% | 7101.3 | 9.7% |
| **Sly** | | | | | | | |
| | 5518.220101 | Rock Creek | Lumpkin | 0.0 | 8.7% | 11408.4 | 0.0% |
| | 5518.230001 | Lewis Flat | Lost Creek | 0.4 | 91.3% | 14517.7 | 0.0% |
| **Smokey** | | | | | | | |
| | 5509.140101 | Ninemile Creek | Big Chico Creek | 1323.6 | 100.0% | 7623.6 | 17.4% |
| **South Frey** | | | | | | | |
| | 5518.110406 | Frey Creek | Reservoir Drain | 1087.8 | 8.8% | 9614.2 | 11.3% |
| | 5518.120000 | undefined | Reservoir Drain | 5.6 | 0.0% | 7634.8 | 0.1% |
| | 5518.320401 | Pinchard Creek | Hartman Bar | 2646.5 | 21.4% | 9797.1 | 27.0% |
| | 5518.320601 | Middle Fall River | Hartman Bar | 9.2 | 0.1% | 7110.4 | 0.1% |
| | 5518.320602 | Lower Fall River | Hartman Bar | 5392.3 | 43.5% | 7269.7 | 74.2% |
| | 5518.320701 | Bald Rock Canyon | Hartman Bar | 2666.9 | 21.5% | 8203.7 | 32.5% |
| | 5518.320702 | Mtn. House Creek | Hartman Bar | 581.7 | 4.7% | 7101.3 | 8.2% |

**2008 Butte Fires**
**Watersheds Within Fire Perimeters**

| Fire Name | CalWater # | Cal Fire Watershed Name | DWR Watershed Name | Acres Burned | Percent of Fire Acreage | Total Watershed Acreage | Percent of Watershed Burned |
|---|---|---|---|---|---|---|---|
| **Sugar** | | | | | | | |
| | 5518.220101 | Rock Creek | Lumpkin | 2.1 | 100.0% | 11408.4 | 0.0% |
| **Transfer** | | | | | | | |
| | 5509.200304 | Transfer | undefined | 2.8 | 100.0% | 9497.2 | 0.0% |

# APPENDIX IV

# PHOTOS

2008 BUTTE FIRES –Site Assessment Photographs

Humboldt Fire: View looking northeast from Humboldt Road

Belden Fire: Highway 70- Bridge inlet to Little Indian Creek – B-1

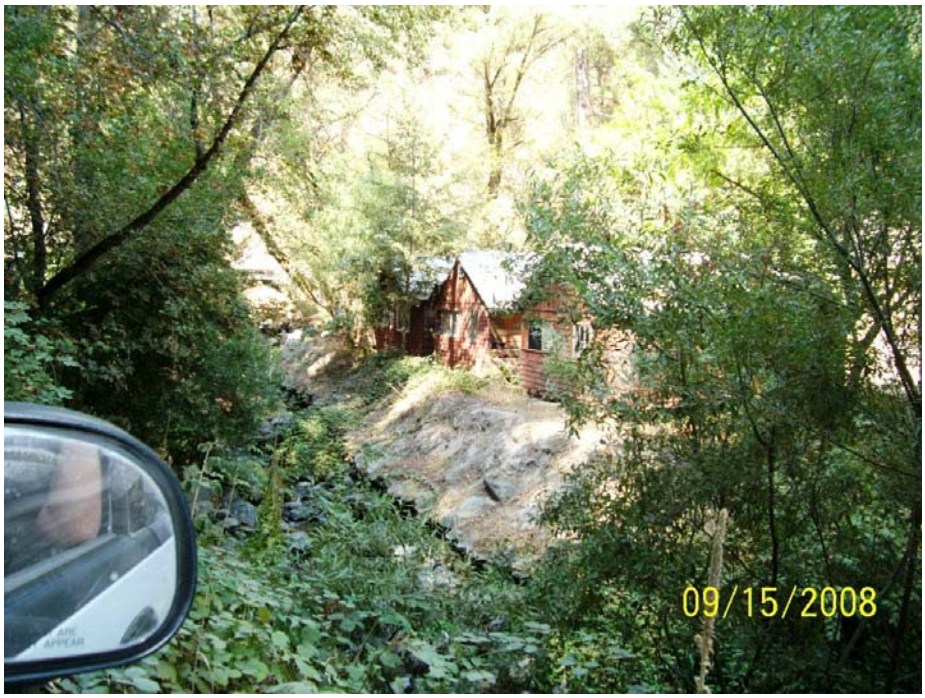
Belden Fire: Looking upstream from bridge at Little Indian Creek- B-1

Belden Fire: Chips Creek bridge across Highway 70- B-2

Belden Fire: Highway 70 view from Chips Creek bridge – BC-2

Camp Fire: Cabin-Mystic Valley Retreat at Flea Valley Creek – SC-1

Camp Fire: Flea Valley Creek above cabin's road crossing – SC-1




Camp Fire: Cabins adjacent to Flea Valley Creek – SC-2

Camp Fire: Cabins above undermined Creek – SC-2

Camp Fire: Union Pacific Railroad Bridge and access road – SC-3

Camp Fire: Concow Reservoir looking southeast from Lookout – SC-5

Camp Fire: Concrete Box Culvert looking upstream – SC-6

Friend-Darnell Fire – Upstream Bean Creek Road Crossing – FD-3

Friend-Darnell Fire – Downstream Bean Creek Road Crossing – FD-3

Friend-Darnell Fire – Downstream Bean Creek Road Crossing – FD-4

Friend-Darnell Fire – Bean Creek Road Crossing – FD-4