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BUREAU OF LAND MANAGEMENT
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EA Number: CA-180-10-23

Project Name: Wagner Ridge fuel break maintenance

Location: MDM, T 2 S, R 16 E, Sections 1, 2, 4, 5, 9, and 11
MDM, T 1 S, R 16 E, Sections 29, 30, 31, 32, and 33
Mariposa and Tuolumne counties, CA (see attached map)

1.0 Purpose of and Need for Action

1.1 Need for Action

This environmental assessment analyzes the effects of a specific set of fuel banks in Tuolumne and Mariposa counties. However the authors attempted to take an in-depth look at potential environmental effects of fuel bank construction/maintenance in the Sierra Nevada foothills, with the intention that some of the information would be useful in the analysis of similar projects.

The Bureau of Land Management's Mother Lode Field Office (BLM) manages scattered public lands the central Sierra Nevada foothills, especially in the chaparral belt and mixed conifer and mixed ponderosa pine forest. Due to decades of fire suppression, much of this area has not experienced wildfire in decades. Chaparral and other fuels have become decadent in some locales, increasing the possibility of a high-severity wildfire. At the same time, foothill communities such as Big Oak Flat and Greeley Hill have grown. There are now numerous private residences in the area, including houses adjacent to BLM-administered parcels containing dense fuels. Local residents are concerned about wildfire. The public lands around these communities are considered to be within the wildland urban interface (WUI) and the communities are considered "at risk." Some residents are anxious to see public land managers like the BLM take action to reduce fuels on public lands. Fuel breaks are needed to help give firefighters places to hold wildfire or launch suppression efforts. In the past, Cal Fire crews and others built a series of shaded fuel breaks on prominent ridges on public lands, now within the project area for the proposed action analyzed in this EA. These fuel breaks are located near the communities of Big Oak Flat and Greeley Hill. The fuel breaks were constructed to serve as a strategic holding point in the event of a wildfire. Because these fuel breaks are important strategically to fighting wildfire and protecting local communities, BLM would like to maintain them over the next 10 years. The fuel breaks discussed in this EA connect to other fuel break projects being planned by the Stanislaus National Forest, Yosemite Foothills Fire Safe Council, and Southwest Interface Team (SWIFT).

1.2 Conformance with Applicable Land Use Plans

The proposed action—to maintain a series of shaded fuel breaks on public land from Big Oak Flat to Greeley Hill/Stanislaus National Forest boundary—is consistent with the Sierra Resource Management Plan, approved in February 2008. The Sierra Resource Management Pan's Record of Decision (pages 15-16) gives BLM the goal of establishing a cost-efficient fire management program commensurate with threats to life, property, public safety, and environmental resources. BLM's objectives for meeting these goals are to 1) reduce the risk of wildfire in WUI communities; 2) reduce the risk of catastrophic wildfire through fuels management; 3) use prescribed fire, mechanical, and biological treatments to reduce fuels and promote ecosystem diversity and resilience, control invasive species, reduce fuel hazard, improve wildlife habitat, increase water yield, and enhance watersheds. The Folsom/Mother Lode Field Office Fire Management Plan, approved in March 2008 gives BLM various fire and fuels treatment objectives and strategies for specific lands under BLM's administration. Specific objectives and strategies for the fire management unit, in which the project area is located, are laid out in the plan. The proposed action is consistent with these objectives and strategies.

2.0 Proposed Action and Alternatives

2.1 Proposed Action

The proposed action is to maintain a series of shaded fuel breaks on BLM-administered land near the communities of Big Oak Flat and Greeley Hill. The fuel breaks would be 200 ft wide. The total area to be treated in approximately 235 acres.

Only maintenance, no new construction, would be authorized under this EA because the fuel breaks are already built (with a few very small exceptions). It is unclear when the fuel breaks were built and who built them; BLM fire program records are sketchy and incomplete. The fuel breaks were probably built or, at least greatly improved, by Cal Fire (formerly the California Department of Forestry and Fire Protection) crews over the last 25 years or so. It appears that these crews used mainly hand tools like chainsaws. Cut vegetation was piled for burning. The fuel breaks were built on prominent ridges like Wagner Ridge, Jackass Ridge, and others just south of Big Oak Flat. Some of the fuel breaks follow existing roads, including the Ponderosa Way fire break road built during the 1930s. It also seems likely that at some time in the past (probably after Ponderosa Way was put in and before Cal Fire began work), heavy equipment was used to clear brush on these ridges.

The fuel break maintenance proposed in this EA would be done by a hand crew (i.e., a BLM fuels crew, an inmate crew, a Hotshot crew, a BLM-selected contractor, etc.) under BLM supervision. In addition to using chainsaws and other hand tools, the crew would use any of the following methods:

1. The crew would feed cut vegetation into a rubber-tracked brush chipper staged on existing roads/trails. The chipped vegetation would be broadcasted over the project area.

2. The crew would pile and prep vegetation in 6 x 6 ft piles for burning at a later date in accordance with a BLM-approved burn plan and other BLM policy. Approximately 30-100 piles per acre would be constructed.

3. The crew would use a mechanical masticator to grind, chip, and chew vegetation. The masticated vegetation would be broadcasted across the project area, leaving an altered fuel type. Mastication does not reduce the quantity of fuels, but rearranges them so they are more manageable in the event of wildfire suppression. Equipment selected to carry out this task would be designed to minimize ground disturbance. Multiple cutting attachments would be used to adapt to the terrain and fuels.

The fuel breaks would tie into fuel breaks that are planned for portions of the ridge on private lands. These fuel breaks are being planned by various entities: Stanislaus National Forest, Yosemite Foothills Fire Safe Council, and the Southwest Interface Team (SWIFT).

Once completed the fuel break would be maintained at any time over the following 10 years. At the end of this 10-year period, fuel break maintenance would need to be reauthorized, perhaps with a "fresh" NEPA document. This EA would need to be reviewed by the relevant staff to determine whether it is adequate to use to reauthorize maintenance. During the 10-year period, maintenance would be done by a crew under BLM supervision. The fuel break would be maintained using any or all of the methods described above.

Any other form of fuels treatment work (i.e., broadcast prescribed burn) that BLM may propose in the future, or treatments affecting land outside the scope of the proposed action described above and/or outside of the area analyzed in this EA would be subject to BLM's full environmental review/decision-making process. In other words, a new NEPA document may be needed. Certainly, new cultural and biological recommendations would be needed.

2.2 Project Design Features

1. To minimize the potential for introduction or spread of invasive weeds, equipment used for the proposed action would be cleaned using best management practices prior to entering area and, where possible, would avoid operating within weed-infested areas, such as stands of Italian thistle or yellow starthistle. If a weed population is unavoidable, as the equipment leaves the weed perimeter, it will be inspected and cleaned of adhering soil and vegetation before it proceeds any further.

2. Also to minimize the potential for introduction or spread of invasive weeds, unnecessary roads and trails along fuel breaks will be blocked by barriers of cut brush and trees, or by rock and soil barriers where appropriate. This can have the additional environmental benefits including preventing some human-caused ignitions, erosion and dumping.

3. Limit operating season to the period July1 to March 1 (functionally October 1 to March 1 because of fire season) so as not to disrupt nests, dens and young animals during the spring breeding season of most wildlife.

4. In chaparral, to reduce habitat fragmentation by the long linear cleared zones that this project will maintain, a cross-strip of undisturbed vegetation (brush) will be retained at intervals along the fuel break. These bridges of habitat will be a minimum of 20' wide and be placed at an average spacing of 660' (i.e., 8 per mile). This measure will have its maximum impact in those areas with the most potential to be converted from chaparral to an herbaceous community by fuel bank construction/maintenance. Chaparral dominated by obligate seeding shrubs (e.g., white leaf manzanita) is the most vulnerable to conversion. These corridors of vegetation can act as additional barriers to vehicle movement along the fuel break (see design feature #2).

5. If a wildfire occurs affecting chaparral portions of the fuel bank, to maintain biodiversity and conserve seed reproducing fire-following shrub species, the fuel break will not be maintained for at least 10 years post-fire. A substantial post-fire interval is important to restore seed banks of fire adapted shrub species that reproduce from seed, because fire and the resulting germination of seeds in the seed bank can deplete a seed bank.

6. In chaparral, modify burn pile prescriptions to better simulate wildfire effects that fosters fire-adapted vegetation. By rearranging fuels or changing burn practices, pile burning can produce areas that experience less intense and prolonged soil heating than what occurs beneath brush piles. This can be done in two ways: 1) letting fires creep away from burn piles in the intervals between some sets of piles, and 2) feathering out the edges of brush piles by spreading some branches away from the brush pile core and allowing fire to move through this zone of moderate fuels. Burning would be done under an approved burn plan with a detailed prescription to assure safe firing operations.

7. For ponderosa pine or mixed conifer forest shaded fuel breaks, maintain heterogeneity of stands of retained trees, in terms of species, age, tree density (clumps and gaps). Without fuel ladders, clumping of mature trees is generally not thought to contribute to crown fires. Horizontal separation of trees of different age classes can avoid the creation of fuel ladders. Heterogeneity in the tree canopy promotes the development of diverse understory vegetation, as well as many forms of litter, duff and woody debris. Animal diversity can be maintained where there is a wide array of habitats. Fuels specialists would work with the forester and wildlife biologist to implement this measure.

8. In ponderosa pine or mixed conifer forest shaded fuel breaks, retain mature ponderosa pine and sugar pine for fuels characteristics (i.e., ability to tolerate repeated surface fires).

9. In shaded fuel breaks, retain mature oaks for wildlife. In live oak woodlands with multiple-stemmed oaks, favor reducing stems of trees (e.g., to a single bole and a typical tree-like appearance) to maintain canopy but reduce lower-level fuels.

10. In fuel break sections where previous fuel break construction removed more tree cover than appropriate for a shaded fuel break, small trees will be marked for retention before maintenance operations begin. Selection criteria will include avoiding the creation of fuel ladders. These trees will be flagged or otherwise made clearly visible for chainsaw crews or equipment operators. Pines and oaks will be prioritized for retention, but representatives of all native tree species will be conserved. Eventually these trees will provide additional tree canopy and wildlife habitat for the fuel break. Fuels specialists would work with the forester to implement this measure.

11. In shaded fuel breaks, retain large trees, defect trees, snags and downed logs for wildlife to the extent feasible. Large snags in particular provide hiding, denning, nesting, and food storage sites for a variety of wildlife. Retain all snags 24 inches and greater in diameter at breast height unless to do so would create an unusual unsafe concentration of fuels. Fuels specialists would work with the wildlife biologist to implement this measure.

12. In ponderosa pine or mixed conifer forest shaded fuel breaks, adjust prescriptions for tree retention to topography. Generally retain greater densities of mature trees in lower topographic positions, swales, riparian corridors, more mesic sites compared to more upland sites. Stream buffers for equipment work will be 150'for perennial streams, 75' for intermittent streams (partially dry in summer, but with scoured channel) and 75' for meadows. Generally no live material will be removed from the riparian zone, even using hand work. Most fuel breaks are on ridgetops. But when fuel breaks descend to other topographic positions, adjust the prescription accordingly. Fuels specialists would work with the forester to implement this measure.

13. Avoid wood rat nests and large woody debris when creating burn piles. If a potential nest cannot be avoided, check the pile for signs of wildlife before lighting. If nests or dens are found, leave the pile alone. If it must be burned, restack it nearby or give the animal a path to escape from the fire.

2.3 No Action
Under the no action alternative, BLM would not maintain the fuel breaks.

2.4 Alternatives Considered but Eliminated from Detailed Analysis
BLM did not consider any other alternatives in detailed analysis.

3.0 Affected Environment

The project area is located on BLM-administered parcels in the central Sierra Nevada foothills. Specifically, the project area is the tops of prominent ridges, from just south of Big Oak Flat to the Stanislaus National Forest boundary near Greely Hill. Elevations within the project area range from nearly 2500 ft to 3950 ft above sea level.

Vegetation in the project area varies depending on elevation, soils, exposure, soil moisture, microclimates, and other factors. The project transitions from chaparral dominated by white leaf manzanita and/or chamise to westside ponderosa pine forest. On some north facing slopes there is canyon live oak woodland. The easternmost portion of the fuel bank on Wagner Ridge itself is the highest elevation portion of the project. This part of the project is in ponderosa pine forest. For much of the rest of the project, the fuel bank straddles ridgetop transitions, with forest and woodland on north and east facing slopes, and chaparral on south and west facing slopes. Forest and woodland sites support ponderosa pine, sugar pine, incense cedar, black oak, canyon live oak, interior live oak, California buckeye, deer brush, buckbrush, white leaf Manzanita, Sierra gooseberry, toyon, holly leaf redberry, golden fleece, poison oak, mountain misery, trailing ceanothus. Chaparral sites support chamise, white leaf manzanita, mewukka manzanita, toyon, holly leaf redberry, golden fleece, poison oak, buckbrush, western mountain mahogany, California coffeeberry, keckiella, deeweed, pitcher sage, yerba santa, with scattered gray pine, ponderosa pine, sugar pine, black oak, interior live oak, canyon live oak, blue oak, California buckeye.

This mixed ponderosa pine-black oak forest provides habitat for a variety of wildlife including black bear, coyote, bobcat, grey fox, California quail, Steller's jay, raven, hawks, and eagles. The project area is near the boundary of the Stanislaus National Forest.

Recreational use of the project area is considered to be low. The existing road within the project area is used by walkers, joggers, bicyclists, off-highway vehicle riders. BLM manages this area in accordance with class III visual resource management (VRM) standards. BLM's objective for class III is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat basic elements found in the predominant natural features of the characteristic landscape.

4.0 Environmental Effects

The following critical elements have been considered in this environmental assessment, and unless specifically mentioned later in this EA, have been determined to be unaffected by the proposal: areas of critical environmental concern, prime/unique farmlands, floodplains, wetlands and riparian zones, wild and scenic rivers, wilderness, and environmental justice.

4.1 Impacts of the Proposed Action and Alternatives

4.1.0 Soil, water, air impacts

The proposed action would not impact atmospheric, water, or soil resources. There are small seasonal streams in the area. The project area is not located on a major stream. The area that would be treated is relatively small in size. Use of a masticator is expected to cause little soil disturbance. Because all vegetation would be cut above ground level, all root systems would remain intact functioning to anchor soils and prevent erosion. In addition litter and duff would remain in place to reduce raindrop impact and lessen soil particle displacement that might otherwise contribute to erosion. Masticated brush and other fuels would be dispersed throughout the project area. This layer of mulch would also help prevent erosion. The masticator would be staged on the existing road. Vehicle barriers such as cables, berms, and large boulders may be placed at strategic locations to prevent dirt bikes and other off-highway vehicles from driving within the treated area and causing erosion problems. Cutting and mastication of fuels, as proposed, would create some dust, but not enough to affect air quality.

4.1.1 Vegetation impacts

The BLM botanist conducted a botanical study of the project area. He conducted a field inventory during the appropriate time of year for plant identification within the project area. The study was designed to help BLM meet its obligations under the Endangered Species Act and other policies. The botanist recommended that the proposed action would not affect threatened and endangered plants or other BLM special status plants.

Maintenance activities for fuel breaks involve repeated entries to the same area. The initial cutting of the fuel break creates the most obvious impact to existing vegetation. However many plant communities will bounce back from a single disturbance and the previous plant community will restore itself with time. However multiple disturbances, like ongoing maintenance of a fuel break, can lead to long-term changes in vegetation often referred to as a type conversion. The ecological processes that lead to the restoration of the community after a single disturbance, may be altered by successive treatments, affecting how the new plant community develops.

Generally, fuel breaks on BLM managed lands in the Mother Lode Field Office area are created in one of three plant communities: 1) chaparral, 2) conifer forest (westside ponderosa pine forest or mixed conifer forest), and 3) live oak woodland (interior live oak woodland or canyon live oak woodland). Because of increased public concern about wildfire and structure protection in the wildland-urban interface, there has been an increase of funding for fuels reduction and more fuel breaks are being constructed. This prompted recent research to examine the effects of mastication and similar treatments on plant communities. These studies mostly address the effects of a single treatment, and most of these studies address forest sites.

In contrast to recent mastication research, the role of fire in chaparral and ponderosa pine forest has been much studied over a longer period. A portion of this research is relevant to the effects of shrub or tree cutting for fuel breaks, because, like these treatments, fire often removes above-ground portions of woody species. Some of these studies address multiple disturbances to the same site. However fire has many effects beyond those produced by the mechanical removal of woody plants, so drawing parallels must be done with caution. These studies of fire effects are also useful in combination with studies of mastication and similar treatments, because fuel breaks will eventually burn. Burning and brush clearing in succession may produce impacts that neither treatment would produce alone.

Another characteristic of fuel breaks makes their impacts unusual. As narrow linear features on the landscape, they have little interior area. But because of their length, they have a disproportionate impact on the surrounding ecosystem. Most studies of the effects of mastication and fire on ecosystems focus exclusively on the impacts of the disturbance on the area that was cut or burned. Fuel break maintenance impacts to the surrounding ecosystem (e.g., edge effects) may be as important as the impacts to the actual treatment area.

4.1.1.1 Chaparral

Chaparral fuel break projects have generally involved removing all shrubs and trees and leaving only the herbaceous layer. (Sometimes near homes or in high use areas, some trees or shrubs have been retained to address aesthetic concerns.) A tracked masticater or a hand crew with chainsaws usually does the work. Shrub regeneration is usually rapid, with some shrub species showing evidence of sprouting within weeks of canopy removal.

Chaparral vegetation is thought to be a fire climax community, i.e., a plant community with a developmental cycle that begins in the aftermath of a fire, and ends with a new fire consuming the existing vegetation. However for many chaparral communities the natural fire-return interval is thought to be long, possibly 100 years or more. Virtually every native species that is prominent in chaparral either has a long-lived seed bank that responds selectively to fire or post-fire conditions, or the plants have the ability to survive fire, (often by repsrouting from the base).

The cutting of plants for fuel break construction/maintenance simulates canopy removal by fire, but it does not simulate the conditions that seeds and seedlings experience during and after fire. Heating, smoke, charate, bare ground (resulting from litter and duff removal) and other factors that stimulate seed germination and seedling survival post-fire are all absent when fuels are mechanically removed. Many species that will resprout after fire, will resprout after being mechanically treated. But for many other species that need scarification or other germination cues, only a small proportion of the seed that would germinate after a typical fire will germinate after a cutting operation.

Retreatment can impact the non-sprouting shrub species in particular. Sprouting shrubs (e.g., chamise and toyon) exploit intact extensive root systems and reduced competition to put up vigorous new shoots after a fire. Many such species can produce seed by the second post-fire year. Thus, even short retreatment intervals of 5 to 10 years, will allow the regrowth of large canopies and some replenishment of the seed bank for a species like chamise. Compared to chamise, toyon is even more dependent on resprouting. It has short-lived seed that does not persist as a seed bank. Toyon relies on post-fire resprouting and occasional colonization of gaps aided by wildlife dissemination of fruits and seed.

In contract, for obligate seeding shrub species like whiteleaf manzanita, a substantial interval between disturbances is vital. During a typical chaparral fire, across whole stands virtually every white leaf manzanita plant is killed. The following growing season the area may be a carpet of whiteleaf manzanita seedlings, as most of the viable seed in the seed bank that was not killed by heating, germinates. But these seedlings will not reproduce and make a significant contribution to the restoration of the seed bank until about their tenth year. If a second fire runs through the stand before that time, the depleted seed bank will produce much fewer seedlings, resulting in a reduced whiteleaf manzanita component in the stand that develops.

Due to the fact that seed scarification generally does not take place during mastication or chainsaw clearing, few whiteleaf manzanita seedlings will germinate in the post-clearing environment, and white leaf manzanita will be less dense in the developing stand. The main difference between this scenario, and two fires in quick succession, is that because of differences in rate of germination, the whiteleaf manzanita seed bank is less depleted by mechanical clearing than by fire. After several mechanical clearing episodes, a viable seed bank may persist. However if fuel break clearing follows a fire, and the clearing comes before the whiteleaf manzanita has replenished its seed bank, it can have the same impact as a second fire in quick succession. Project design feature #5 will allow time for seed banks to be replenished.

Seed bank depletion caused by frequent disturbances is less likely for fire-following chaparral herbs, than for shrubs. Fire following herbs generally mature more quickly than shrubs and are reproductive by the first or second post-disturbance season. In fact, 5 years after a fire in chaparral, the woody cover starts to limit herbaceous cover (Keeley et al 2005), so seed bank replenishment has generally already occurred. Additionally, shrub clearing is less likely to directly affect these plants because they are not targeted for cutting. But like fire-following-shrubs, fire-following-herbaceous seedlings will be scarce after a cutting treatment. The seed bank will generally persist, but most seeds will not germinate until a fire with appropriate characteristics runs through the area. Pile burning can stimulate some seed germination. Project design feature #6 takes advantage of pile burning to gain the germination inducing ecological benefits of moderate intensity fire.

The reproduction of obligate seeding shrub species may be severely curtailed by brush clearing at short intervals. On the other hand, shrubs of sprouting species usually survive a cutting treatment and these sprouts generally return to seed production sooner than seedlings. Therefore, fuel break maintenance can shift the balance among shrub species. For instance, a mixed stand of chamise and whiteleaf manzanita may become dominated by chamise after repeated episodes of clearing. However if only obligate seeding shrubs are present (like the common large stands of white leaf manzanita often found in the transition zone at the lower edge of ponderosa pine forest), there may be a loss of shrub cover with each cycle of mechanical fuel bank clearing. Eventually the fuel bank may be converted to an herbaceous community, most likely annual grassland.

Disturbed areas in Sierra foothill chaparral are often occupied by exotic annual grass species, at least temporarily. In fact, in a survey of 24 existing California fuel breaks (Merriam et al 2006), the fuel breaks in chaparral had a higher cover of non-native species, especially non-native annual grasses, than fuel breaks in oak woodland or conifer forest. Annual grasses, when they dry, have very different fuel characteristics than the fuels of undisturbed chaparral. Fires in grass generally move fast and produce less heating of the soil and seeds in the soil. Such fires are likely to produce less germination cueing for seeds adapted to more typical hotter chaparral fires. Also, annual grasses dry earlier in the season and ignite more easily than chaparral. If the fuel break is near ignition sources (for instance if there is a road along the fuel break), more frequent ignitions are likely. These fires may shorten the fire return interval and lessen the opportunity for seed bank replenishment of native species. This results in a positive feedback loop, where the presence of grass favors ecosystem processes that favor grass.

A study of mastication, hand clearing and spring prescribed burning effects to a chaparral ecosystem was conducted at Whiskeytown National Recreation Area Bradley 2006). Cover for chaparral plots was dominated by toyon, both before the treatments were applied, and one year after mastication as well. Toyon is a sprouting species that recovers quickly after disturbance. The obligate seeding shrub whiteleaf manzanita that is killed by canopy removal was the species with the second highest cover in untreated plots. Unsurprisingly, one year after mastication it was not within the top five species in terms of cover. Long term monitoring would be necessary to assess whether this change will persist.

Masticated and hand cleared units resulted in increased cover and diversity of understory vegetation. The researchers attributed this trend to increased light and decreased competition after shrubs being cut. There was an increase of priority weed species (those in most need of control) where mastication occurred relative to untreated controls. Plots that were masticated and then prescribed burned had even higher weed densities.

Comparisons of masticated and hand cleared units found a greater diversity of both native and non-native species with hand clearing. This may be due in part to the removal of biomass with hand clearing (under the study protocol, cut branches were carried off site), which may have resulted in more light reaching the soil surface.

A Jackson County, Oregon study of buckbrush chaparral that specifically focused on differences between mastication, and "hand cut, pile, and burn" methods (Sikes and Muir 2009) found differences in the vegetation developing after the application of the two methods could be traced mostly to the fire rings that resulted from burning piles. After 2 years, "hand cut, pile, and burn" units had more non-native species, annual species and non-native weed species than masticated units. Fire rings were dominated by annuals. Many of the species the researchers found most closely associated with fire rings (indicator species) were non-native weeds. On the other hand, after 2 years "hand cut, pile, and burn" units also had more native species than masticated units. Some of these native species were only found in association with fire rings, presumably the result of fire associated germination cues.

In a study of spatial patterns of fire intensity and spatial patterns of chaparral development in the coast range of central California (Odion and Davis 2000), the density of fuels before the fire correlated with fire intensity. Fire intensity correlated with the survival of adults of sprouting species, and the survival and germination of seeds of seeding species. Various configurations of live fuels, standing dead fuels, downed fuels, and gaps can be found within a few feet of each other in natural brush stands. Many other factors influence fire intensity (e.g., terrain), so fire intensity will vary across the landscape. This small scale variation in fire intensity taken together with differences in species distribution and seed bank before the fire produced a complex mosaic of new growth in the post-fire stand. Some of this variation would be captured with prescribed burning. (The study itself was a prescribed burn, but some fuels were manipulated spatially.) Very little of this variation is simulated in most shrub cutting projects. Even when shrubs are piled and burned, fire intensity is functionally almost unimodal. Directly beneath piles, fire is so intense that it usually kills most of the seed bank, but fire cues are absent just a few feet from the pile. Only a narrow zone at the burn pile edge is heated to the degree that it simulates the germination cues provided by wildfires. Project design feature #6 better simulates wildfire by promoting a greater variety of fire intensities when piles are burned.

In a study of mastication and prescribed fire in chamise chaparral of the northern Coast Range (Potts and Stephens 2009), after 3 years mastication units were found to be more species rich than prescribed fire units. There were more native species and more non-native species in masticated units. If prescribed fire is assumed to be a reasonable simulation of natural processes, the increase of native species richness with mastication would be encouraging. However the authors note that the additional species in mastication units (not found in prescribed fire units) were widespread species that often occur in grasslands and disturbances. On the other hand the species found in prescribed fire units not found in mastication units were specialist species adapted to fire.

The authors found that the season of mastication (fall vs. spring) had little impact on the plant community 3 years after treatment. In fact, the amount of remaining tree canopy after the treatment had a larger effect on the developing vegetation. Deer browsing in the cleared units was extensive; much greater than in prescribed burn units of similar age where remaining shrub skeletons restricted movement for deer. Such browsing pressure could retard the recovery of the shrub or tree layers in some areas, or shift the balance of woody species. Seedlings or sprouts of species of brush or trees that are favored by browsing animals, might lose dominance relative to species that are less favored, following each repetition of brush clearing.

In summary, impacts can be separated into those that affect the footprint of the fuel break itself, and those that affect the wider ecosystem. The most obvious impacts to the ecosystem in general and vegetation in particular is the alteration of native plant communities within the fuel break itself. This impact occurs in a known limited area. In contrast, impacts to the surrounding ecosystem (including wildlife) generally affect a larger area and the geographic extent of the impacts may be unknown.

Results to be expected with long term maintenance of chaparral fuel breaks using mastication or hand clearing with chainsaws:

Affecting the fuel break itself:

1) Steep decline in density/cover of some non-sprouting shrub species like whiteleaf manzanita or buckbrush. Also, the seed bank of such a species can be rapidly depleted if fuel break maintenance occurs after a fire has crossed the fuel break and cues mass germination.
2) Relative increase of cover of sprouting shrub species when compared to obligate seeding shrub species.
3) Depletion of shrub cover over several cycles of mechanical maintenance in areas where obligate seeding shrubs form most or all of the shrub cover. Herbaceous cover dominated by annual grasses is likely to substitute for lost shrub cover. White leaf manzanita chaparral and buckbrush chaparral are susceptible to this type of conversion.
4) Depletion of native chaparral species over time with changes in the fire regime, fuels and fire severity. Relative to mastication, hand cutting and pile burning may slightly mitigate this impact by stimulating the germination of native chaparral species at the edge of burn piles.
5) Exotic annual grasses and other annuals increasing at the expense of perennials and woody species. This trend will be exacerbated by short interval between disturbances, especially fires. Often there will be an increase of invasive plant species. These impacts will be more pronounced with hand cutting and pile burning, relative to mastication. (The total exclusion of fire for a century or more could also lead to the loss of native chaparral species, but this is an unlikely outcome despite our fire control efforts.)
6) When wildfires occur, lower intensity wildfires will spread in the lighter fuels (e.g., grasses) of the fuel break. Such fires may not stimulate the germination of the seed of fire adapted chaparral species
7) Variable burning conditions during a wildfire that have a strong influence in creating a mosaic of post-fire vegetation. In chainsaw-cleared pile-burned areas, burn piles sites will respond differently than the unburned areas, creating one level of diversity. Project design feature #6 adds a second level of diversity but varying burn intensity. In contrast, there will be little micro-site diversity in the post-mastication stand.

Affecting the larger ecosystem as well as the fuel break:

8) Increased weed invasions of the fuel break and adjacent disturbances, relative to the surrounding plant communities.
9) Some degree of fragmentation of habitat of species, particularly species for which the cover or shade of brush is an important habitat element. Especially for areas with sprouting shrub species, this fragmentation effect will be greatest the year that maintenance is performed, before sprouting gradually restores brush cover. Chaparral with mostly obligate seeding shrubs may eventually be converted to an herbaceous community, in which case the fragmentation would be semi-permanent. (A fire, or the abandonment of fuel bank maintenance, could lead to restoration of chaparral.)
10) If there are potential ignition sources near the fuel break, possibly increased fire frequency.

4.1.1.2 Mixed conifer and westside ponderosa pine forest

Research including the examination of fire scars has produced evidence that ponderosa pine forest had a short fire return interval before European influence. Unlike chaparral fires which are almost always intense fires moving among shrub canopies, low intensity ground fires in ponderosa pine forest can be supported by litter and duff as fuels. Some ponderosa pine forest understory species like deer brush and Sierra gooseberry have seed that responds to germination cues from fire. Other understory vegetation resprouts in response to fire (e.g., mountain misery, poison oak). Fuel break construction by cutting of woody vegetation above the soil surface is likely to produce a sprouting response in those species that normally respond to fire by sprouting. However fuel break construction is unlikely to simulate fire for those species that normally reproduce from seed after a fire. Fuel break construction generally will not stimulate germination for seed that responds to fire cues like heat scarification, smoke or charate.

Unlike fire, fuel break construction by mastication or chainsaw clearing will not alter the seed bed by removing the duff and litter layer. On the other hand, mastication and hand clearing will affect the light regime at ground level. Many plant species are adapted to germinate only with some level of light and will not germinate beneath a deep layer of litter and duff. This may be adaptive because small seeds particularly may not have sufficient food reserves to permit a seedling to develop the height to emerge from beneath the litter and duff layers. And even if seedlings were to make it to the surface, generally where there is litter and duff, there is a live canopy reducing light, and there are established roots competing for water and nutrients. It might be more adaptive for the seed to remain dormant until the litter and duff are removed, most likely by fire, when there is likely to be reduced competition as well. Increased light or larger daily fluctuations in temperature can be cues to seeds to germinate under these conditions.

For germination, some seeds have a requirement that the light spectrum that reaches the seed have a red/far-red light ratio higher than some threshold. This is thought to be an adaptation to prevent seed from germinating in the competitive environment beneath leaf canopy. Leaves absorb heavily in the frequencies of red light, so the red/far-red ratio is reduced in light transmitted through a leaf canopy. Fuel break construction, by reducing the leaf canopy, changes the red/far red ratio and may stimulate the germination of some species. This germination stimulating effect will generally be reduced for shaded fuel breaks where some of the upper canopy is left intact. But it should be emphasized that germination cueing is only adaptive if the seedling develops at a time and place where it will be able to survive. Generally if a seed germinates on litter and duff in the Sierra foothills, it will experience desiccation, either before becoming successfully rooted, or later in the season because a portion of the root system is exposed to the dry environment of the litter and duff layers. So, if the altered light regime after fuel break construction causes seed of some species to germinate on the surface of layers of organic matter, it may actually lessen the viability of those species in that local environment.

A number of studies have looked at the impacts of mastication or other forms of clearing on the understory of forests. Many focus on species richness---simply the number of species present. The number of plant species present after a forestry/fuels treatments is compared to the number of species found before the treatment, or compared to the number of species after a different treatment. The emphasis on species richness, and especially native species richness, may be the result of critiques of common forestry practices that create even-aged stands of one or a few tree species and tend to simplify forest ecosystems (e.g., clear cutting).

Although species richness within a stand may be useful for some purposes, it does not capture ecosystem diversity and species diversity at larger scales. As an example, a forest may consist of three similar stands each containing 5 species, each stand supporting one unique species, and all three stands sharing the other 4 species. In contrast another forest may consist of three less-similar stands each containing 4 species, each stand supporting 2 unique species, and all three stands sharing the other 2 species.

Forest #1	Species	**Forest #2**	Species
Stand #1	ABCD,e	Stand#1	HI,jk
Stand #2	ABCD,f	Stand #2	HI,lm
Stand #3	ABCD,g	Stand #3	HI,no

Upper case letters indicate shared species. Lower case letters indicate unique species

Looking at stands individually, Forest #1 looks more diverse. Each of its stands has more species than any of the stands of Forest #2. But overall, Forest #1 has seven species, Forest #2 has eight. And comparing stands within a forest, the stands of Forest #2 are more diverse in terms of species, than the stands of Forest #1.

Generally for a land manager, biodiversity should be evaluated at the largest scale at which the manager will have an influence. If a stand is not biodiverse within itself, but it harbors unusual species and contributes to biodiversity on a larger scale, it is making an important contribution.

Species richness in small but linearly extensive stands like fuel breaks is probably most important if it includes species that are otherwise rare or absent in the larger ecosystem. If some exotic species are largely confined to fuel breaks, that aspect of species richness within the fuel bank becomes significant as a potential threat to the native plant community. For instance, along fuel breaks native vegetation can be displaced by exotic species with different fuel characteristics altering natural fire regimes. Early in fire season, a fire may propagate in a fuel break that has a non-native annual grass component that would not have been able to propagate in native forest. A fire that can move along the fuel break may move through a long swath of the forest and reach some stands that may also be flammable early in the season. Another example involves weed dispersal. If noxious weed dispersal is favored by fuel break maintenance, weeds that spread down the fuel break may reach new locations that may be conducive to weed proliferation away from the fuel break. So studies that separate native from non-native species responses to forestry/fuels treatments are particularly relevant to impacts to the larger ecosystem surrounding the fuel break.

In an extensive study comparing old growth units and 40 year old plantations in coastal British Columbia forest (Qian et al 1997), the old growth was much more diverse in terms of plant species diversity. Only 47 understory vascular plant species were found in plantations, versus 173 found in old growth stands (more old growth stands were examined). The authors attribute the difference at least in part to variation that develops in the forest canopy with age. Project design feature #7 promotes forest stand diversity.

A study of a southern Sierra Nevada old growth mixed conifer forest at Teakettle Experimental Forest (Wayman et al 2006) follows the effects of treatments that were applied to old growth stands. The study addresses "thinning from below" (i.e., cutting and removing smaller trees) rather than mastication, but some of the results may shed light on both treatments. Two prescriptions, 1) prescribed burning, and 2) thinning followed by prescribed burning, both produced increased understory species richness. Thinning alone did not produce such an increase. The authors ascribe this difference in effects to the removal of duff and litter by burning. Evidently the change in light regime and reduction of competition resulting from thinning alone were not capable of producing the kind of increase in the species richness in the herb layer produced by the burn treatments. However the authors also note four herb species that declined significantly with both thinning and prescribed burning. They suggest that to retain these and other old growth associated herbs, it may be necessary to conserve untreated old growth stands. Although few of the forest stands managed by the Mother Lode Field Office possess old growth character, the four herb species cited in the study do occur in our area.

A study at Blodgett Forest Research Station (Battles et al 2001), addresses the effects of forest management on the understory plant community. (Blodgett Forest Research Station is located near lands managed by Mother Lode Field Office, but the station is slightly higher in elevation.) The study only addresses silvicultural treatments rather than fuel control treatments. However some findings, for instance that canopy openings and bare ground were correlated with greater species richness, have relevance to fuels treatments as well. However the authors also note that as many as 11 late-seral (old growth associated) plant species might be lost if they were not conserved in untreated reserves.

Of particular relevance is the study of the old growth understory herb *Trillium* in the Siskiyou Mountains of Oregon (Jules 1998). The author found that *Trillium* plants were mostly eliminated from stands that were clearcut, broadcast burned and replanted. However a few *Trillium* plants did survive in the clear cuts, and these plants have not reproduced since the clear cuts, up to 30 years ago, while young forest has grown up around them. Additionally, the effects of the clear cuts extend well beyond the edge of the clear cuts. Although old *Trillium* plants are found at normal densities close to the clear cut edge, reproduction of plants in the remaining forest adjacent to the clear cuts, and up to 65 meters away from the clear cut, is depressed. Near the old clear cuts there are fewer *Trillium* of younger age classes than deeper in the forest. The author provides suggestive evidence that the clear cuts have affected microclimate in the adjacent forest stand, and wind may be the key factor.

These studies all point to the unique contribution of old growth forests to plant biodiversity. Although the Wagner Ridge fuel bank does not pass through old growth forest, the principle of protecting the most mature stands (adjacent to the fuel bank as well as within the fuel bank) is applicable.

Several studies from tropical rainforests echo one lesson of the *Trillium* study above, i.e., forest clearing produces an edge effect. A cleared zone in the forest produces impacts well beyond the clearing itself. In a study of a tropical rainforest in Amazonia, one researcher found increasing abundances of seedlings of mature-forest tree species as she sampled further from the edges of clear cuts, and these differences in seedling densities extended up to 100 meters from the clear cuts (Benitez-Malvido 1998). The canopy of the forest at the study site was only 30 meters to 37 meters in height; much less than the distance over which seedling abundance differences were detected.

Another study in the same area found that the recruitment of tree seedlings was nearly double in the edge of the forest, up to 100 m from the clear cut boundary, compared to the interior of the forest (Laurance et al 1998). In this outer zone of the uncut forest next to a clear cut, seedlings of early successional tree species that dominate forests that regenerate naturally in clear cuts, were more prevalent than in the interior of the uncut forest.

These studies all suggest that in forests, clear cuts can produce vegetation edge effects that can extend into the forest a distance equal to or exceeding the canopy height of the surrounding forest. Mechanisms that have been suggested include alterations of microclimate (wind, temperature and humidity often being suggested as key components) affecting young plants; gap production from wind damage to the edge of the remaining stand; changes in populations of pollinaters or herbivores including foliage feeders, seed predators or seed dispersers. Relative to clearcuts, shaded fuel breaks should produce less intense impacts and potentially a reduced area of impact. To what degree the impact will be mitigated will depend on the level of vegetation removal.

A study of young ponderosa pine stands (40-45 years old) at Challenge Experimental Forest (Kane et al 2007) found that mastication treatments alone led to decreased species richness in the understory. However combining mastication with prescribed burning or other treatments that reduced the cover of litter, duff and wood chips from mastication, resulted in increases in species richness. When the authors looked at environmental variables, a regression formula that used bare ground (positive correlation), shrub height (negative correlation), and canopy closure (negative correlation), best predicted species richness in the understory vegetation.

In 2009 the U.S. Forest Service issued a General Technical Report titled "An Ecosystem Management Strategy for Sierran Mixed Conifer Forests" (North et al 2009), that emphasizes fuels management and wildlife management. Although the report focused on stand level treatments with fuels reduction as one important goal, several principles from this report can be applied to fuel break construction/maintenance in westside ponderosa pine and mixed conifer forest:

1. Maintain heterogeneity of stands, in terms of species, age, tree density (clumps and gaps). Without fuel ladders, clumping of mature trees is generally not thought to contribute to crown fires. Horizontal separation of trees of different age classes can avoid the creation of fuel ladders. Heterogeneity in the tree canopy promotes the development of diverse understory vegetation, as well as many forms of litter, duff and woody debris. Animal diversity develops in response to the wide array of habitats.
2. Retain mature pines for fuels characteristics.
3. Retain mature oaks for wildlife.
4. Retain defect trees, snags and downed logs for wildlife. Prescriptions can be based on topographic position and fire intensity expectations. Generally retain greater densities of mature trees in lower topographic positions, swales, riparian corridors, more mesic sites compared to more upland sites. Most fuel breaks are on ridgetops. But when fuel breaks descend to other topographic positions, the prescription should be adjusted accordingly.
5. If prescribed burning can be used to maintain the fuel break, or if the fuel break can be used as a control line to broadcast burn an adjacent stand, this will reduce ground fuels and allow ecosystem processes to be restored. This is a highly desirable result both in terms of ecosystem restoration and fuels reduction.

In summary, results to be expected with long term maintenance of shaded fuel breaks in ponderosa pine forest using mastication or hand clearing with chainsaws include:

1. With hand cutting and pile burning, an increase of species richness relative to the surrounding forest. A portion of this increase is the result of increased density and cover of non-native and invasive species. Because of the retention of tree canopy with a shaded fuel break, the increase of annual and exotic species will be reduced. Because of project design feature #2, the potential for an increase of exotic species will be reduced.
2. With mastication, no similar increase in species richness would be anticipated. Cutting followed by chipping would produce impacts similar to mastication.
3. Because of project design features #8 and #9, an increase in relative density and cover of pines, relative to other conifers and an increase of relative density and cover of oaks, relative to all other tree species.
4. Because of project design feature #10, an increase in tree canopy within fuel breaks over time.
5. Little late successsional forest is affected by the Wagner Ridge fuel bank project. However in some areas late-successional forest plant and animal species may have the potential to occur in the adjacent forest. Canopy removal will generally negatively impact these species and this impact will extend into the adjacent forest. Because of the retention of tree canopy with a

shaded fuel break, and project design feature #10 which should produce additional tree canopy over time, this impact will be reduced.

6. In the event of wildfire, less mortality of mature conifers within the fuel break because of the absence of fuel ladders and the retention of more fire-adapted species, especially pines, (project design feature #8).

4.1.1.3 Interior live oak and canyon live oak woodland

The two most common oak woodland communities of the Sierra foothills are interior live oak woodland and canyon live oak woodland. (In general, blue oaks are more scattered on the landscape forming a savannah vegetation. Black oak usually associates with conifers and rarely dominates stands in the foothills.) Canyon live oak is generally found on more mesic sites including north facing slopes and canyons and often at higher elevations than interior live oak.

Both species sprout in response to fire and show a similar response to cutting treatments. The sprouting response is vigorous in both species. One study found that after the first year post-fire "canyon live oak sprouts formed dense, overlapping clumps averaging 3.3 feet (1 m) in height" (Tollefson 2008). Clearly in dense stands where this response occurs, to maintain fuel break effectiveness, fuel break maintenance needs to be frequent. The speed of initial height growth of interior live oak sprouts is reported to be generally somewhat slower.

Oak acorns display no adaptations to fire. Germination is not cued by fire effects. In fact there is evidence that canyon live oak acorns germinate best when covered by leaf litter, and seedlings grow best in shade. These conditions are very unlike post-fire conditions and might be better simulated by mastication, especially a shaded fuel break created by mastication.

Unlike the seeds of many other plant groups that grow in California's Mediterranean climate, oak acorns do not have the ability to remain viable if they do not germinate the first fall/winter after they mature. Acorns generally mature after fire season. If trees survive a summer fire and branch heating has not been severe, some current year acorns may survive. In any case, the year after the fire there is the opportunity for new trees to establish from acorns from surviving oak trees (if not all trees are top-killed), and from acorns transported by animals.

Oak habitat is important to a wide array of wildlife species. In fact, cycles of acorn production correlate with population densities of many wildlife species. Because they often develop cavities, oaks are particularly suitable for providing nest and denning sites. Retaining the oak component of the vegetation is a priority.

Mature oaks are rarely killed by cutting or fire, although top-kill is common. Younger oaks are sometimes killed by fire, and cutting may similarly produce some level of mortality. But overall there is little reason to expect oak density to decline with successive rounds of mastication or hand cutting. One trend that has been reported is for the growth form of oaks to become increasingly shrub-like with repeated burning. Repeated burning has produced a chaparral of canyon live oak in some areas. Presumably the result would be similar with repeated cutting, if all the oak stems were cut to the base. However with cutting, there is the opportunity to create tree-form oaks, by retaining one or a small number of stems of each tree when the other stems are cut. In this way lower lateral growth is inhibited and height growth is favored. Resulting oaks will be less likely to propagate fire from the ground to the canopy in a wildfire situation. Such trees can be appropriately retained in a shaded fuel break

A shaded fuel break where tree canopy is maintained should foster oak regeneration. Canyon live oak acorns germinate more consistently with leaf litter, its seedlings respond favorably to shade and canyon live oak has been found to have high germination rates beneath an existing canopy of the species. It is likely that the reproductive bottleneck for this species occurs at the transition from understory seedling to a sapling stage that requires more light and reduced competition. This transition may be rare unless the overstory is removed. Maintenance of a shaded fuel break may create some canopy gaps that would foster this transition. And the maintenance of tree canopy allows for ongoing acorn production on site.

In summary, results to be expected with long term maintenance of shaded fuel breaks in live oak woodland using mastication or hand clearing with chainsaws include:

1. Shaded fuel breaks in live oak woodland would probably maintain their characteristic dominant oak species through repeated maintenance cycles.
2. Because of project design feature #9, oaks would become more tree-form over time.

4.1.2 Wildlife impacts

The BLM wildlife biologist analyzed the impacts of the project on wildlife, especially on special status wildlife. Her analysis was designed to help BLM meet its obligations under the Endangered Species Act and other policies. The biologist recommended that the proposed action would not affect threatened and endangered wildlife or other BLM special status wildlife (refer to the study attached).

4.1.2.1 General Wildlife:

While mechanical fuels treatments can decrease the risk of catastrophic fire, they do not provide the ecosystem benefits of fire, and they alter habitat needed by wildlife.

In general, fire-dependent species, species preferring open habitats, and species that are associated with early successional vegetation or that consume seeds and fruit appear to benefit from mechanical fuel reduction activities. In contrast, species that prefer closed-canopy forests or dense understory, and species closely associated with those habitat elements that may be removed or consumed by fuel reductions, will likely be negatively affected by fuel reductions. Some habitat loss may persist for only a few months or a few years, such as the loss of shrubby understory vegetation which can recover quickly. The loss of large-diameter snags and down wood, which are important habitat elements for many wildlife and invertebrate species, may take decades to recover and thus represent some of the most important habitat elements to conserve during fuel reduction treatments. Project design feature #11 that addresses snag and down wood retention will reduce this impact.

Overall, direct mortality of wildlife owing to crushing from heavy equipment during fuel reduction is considered to be low, but this is mostly based on anecdotal information. It is believed that most species are able to find refuge microsites (for example, inside burrows or under surface objects) or move away from approaching equipment. However, spring-season thinning during the breeding season may result in mortality of ground- and shrub-nesting bird nestlings and species living within litter such as small mammals, reptiles, amphibians, and invertebrates. Project design feature #3 that establishes a limited operating period will reduce this impact.

4.1.2.2 Chaparral:

Rodents:

In a chaparral community in the San Bernardino Mountains in Riverside County, Quinn (1983) studied three different fuel treatments, including hand-cutting of all chaparral to ground level in a 35-meter swath along a ridgeline. Quinn found that there were significantly fewer captures of rodents in the hand cut area than in the untreated area in the year following treatment. Rodent species, such as California mouse and dusky-footed woodrat, that prefer shrub cover were most sensitive to treatments.

Birds:

Alexander et al (2007) found that fuel reduction treatments in southwest Oregon did not reduce shrub cover enough to have large effects on the oak woodland and chaparral bird community. Bewick's wren was less abundant at treated stations in the first year of the study, but occurred at similar abundances the second year of the study.

Reptiles:

James and M'Closkey (2003) found that the removal of dead trees (standing and prone) during fuels treatment on the Colorado Plateau may limit the local distribution, abundance, and diversity of lizards, which include dead trees in their microhabitat for shelter, perching, foraging, courting, and defending territories. Removal of dead trees could seriously affect the local abundance and diversity of lizard species, which spend substantial time in this microhabitat. Project design features #11 and #13 address the retention of snags and logs.

4.1.2.3 Mixed conifer and westside ponderosa pine forest:

Black bear:

By volume, about 25 percent of black bear diet can consist of insects (mainly ants and yellowjackets) obtained primarily from down logs. A decrease in down wood would result in fewer ants and yellowjacket nests available to black bears. Project design features #11 and #13 address the retention of logs.

Fuels reduction will likely increase the amount of grasses and berries used by black bears for foraging.

Deer:

Fuels reduction will increase forage quantity and quality for deer.

Small Mammals:

Shrubs, down wood, and snags provide important cover from predators thus the loss of these habitat elements may have negative consequences for some small mammal species. Project design feature #11 that addresses snag and down wood retention will reduce this impact. Small mammal species that need high shrub cover to avoid predators may be negatively affected by shrub removal. Project design feature #4 that allows for movement of small mammals through corridors of unfragmented shrub cover will reduce the impacts of shrub removal. However, other species prefer open habitat conditions and may benefit from the food resources provided by plentiful grasses and forbs that may establish after fuel reduction.

Bats:

Several species of bats roost under the bark of tall, large-diameter trees or in cavities of large snags. If large-diameter snags and trees are protected during fuel reduction as proposed, it is likely that fuels reduction may have minimal or even positive effects on bat populations. Project design features #11 addresses the retention of large trees and snags.

Birds:

Fuels reduction conducted during the nesting season is more likely to result in high mortality of nestlings, especially for species nesting on the ground and in shrubs and small trees. Project design feature #3 that establishes a limited operating period will reduce this impact. Fuels reduction prior to the nesting season is likely to reduce nesting habitat for ground- and shrub-nesting species. However, this impact is not substantial due to the percentage of mixed conifer habitat that will remain intact, compared to the amount of habitat removed during the fuels reduction.

Bird responses to fuels reduction are dependent on the species and other factors. Some bird species prefer early successional and open habitats, and these species are likely to increase in abundance after fuel reduction. In contrast, some bird species may be less abundant after fuel reduction. Removal of large trees or snags will likely affect species nesting in tree canopies and cavities of snags or live tree boles. Recruitment of large snags for cavity nesters may take decades or longer, depending on existing stand conditions. Project design feature #11 that addresses snag and down wood retention will reduce this impact.

Cavity-nesting birds:

If fuel treatments involve removing or eliminating snags, than a net loss of nesting habitat for primary and secondary cavity-nesting birds might be expected for many years. The majority of research studies report that fuel treatments, result in a decrease in populations of cavity nesters owing to loss of dead trees used for nesting and roosting. Project design feature #11 that addresses snag and down wood retention will reduce this impact, as well as project design feature #9 that conserves oaks.

Amphibians:

A few amphibians are strictly aquatic, but most use upland habitats at various times during the year, and a few species are strictly terrestrial. Upland habitat use by forest amphibians largely depends on the availability of moist duff and litter and rotting down wood. Amphibian response to reducing canopy cover will likely be unfavorable because of the warmer and drier conditions created in the understory vegetation, down wood, litter, and soil. Most terrestrial salamanders require moist soils or decomposing wood to maintain water balance, and dry conditions usually result in suppressed populations. Project design feature #11 that addresses retention of downed wood will reduce this impact. Anurans (frogs and toads) may be less affected by changes in environmental conditions associated with fuel reduction because of their tendency to travel at night and during rain events, their greater vagility than salamanders, and their close association with wetlands. Still, species that frequently occupy terrestrial habitats such as many salamanders, boreal toads, and tree frogs may be killed during fuel treatments or find post-treatment conditions unsuitable. These negative effects would be expected to be short-term. The direct mortality of amphibians during fuels reduction treatment is not anticipated to be high. Fuels reduction treatments may contribute fine sediment to streams because of increased surface runoff. Sedimentation causes reduced survivorship of eggs and tadpoles of some stream-breeding amphibians that lay their eggs and rear tadpoles under rocks or within interstitial spaces in the substratum. This project will cause little erosion and sedimentation because mechanical treatments cut vegetation above ground and leave root systems intact, and leave litter and duff in place that prevents soil displacement by raindrop impact. Project design feature #12 that establishes stream buffer zones will also reduce sedimentation.

Bark and Wood Boring Insects:

Species benefiting from stress or weakened defenses of living hosts, such as root and bark beetles and wood borers, are likely to respond positively in the short-term to site disturbance created by fuels reduction.

4.1.3 Fragmentation and corridors for animals and plants

Animal movement is notoriously difficult to study. It is even more difficult to quantify the regional effects of fuel breaks, and co-occurring fragmentation, on animal dispersal. Thus, despite the widespread use of fuel breaks as a management tool, scientific understanding of their landscape-scale impacts on animal movement is poor. Measures to address the potential for fuel break-caused fragmentation of habitats must be based on those studies that address related phenomena, and extrapolation from general principles that for the most part have not been tested in the fuel break context. Project design features incorporated in this EA attempt to address potential direct impacts and potential cumulative impacts of management actions.

Ecologically, fuel breaks disrupt native landscapes through direct habitat loss, changed spatial configuration of habitats, increased edge effects, fragmentation of habitats and, occasionally, creation of habitat islands. Creation of fuel breaks incorporates a new element into a landscape. The long, linear cleared area may impact the movement of animals across it. Fuel break creation fragments a landscape, though the degree of fragmentation is less than in landscapes with only remnant patches of intact habitat, where fragmentation research usually occurs. Scientific literature that addresses the impacts of barriers/filters such as highways or fields, habitat fragmentation, and benefits of native habitat corridors was reviewed for this analysis. There are not particular animal species of special concern in the project area. Project design features aim to mitigate the impacts of fuel breaks to native animals and plants in general.

Pollination services are one of the most visible examples of mutualism and codependence in ecosystems; disruption can have widespread impacts. Pollination is required for plant reproduction which in turn provides animal habitat and food sources. In a comprehensive review of experimental studies, Aguilar et al (2006) found a large negative effect of fragmentation on plant reproduction due to pollination limitation. However, an examination of cases that are superficially similar to fuel breaks reveal more resiliency in pollinators. Connectivity within a landscape is key. Corridors or smaller landscape elements, such as ditch banks and hedges, have been found to facilitate pollen dispersal in fragmented landscapes (Geert et al 2010; Townsend and Levey 2005). Medium-sized bees can fly 1-2km from nest to forage patches, and can adapt to changes in spatial configurations within flight paths (Cane 2001). However some insect pollinators do not fly, and their movements and services might be interrupted if the fuel break environment was inhospitable.

Some studies have recorded strongly positive effects for insects in fuel treatment areas. In fuel treatments in western United States forests, fuel breaks and prescribed burns had 13 and 2-3 times more butterfly species respectively than the untreated forest plot (Huntzinger 2003). Butterflies were attracted to host plants that only occur in forest gaps. Other studies show a more complicated management scenario. Highways may be especially detrimental to flightless insects. They are an absolutely barrier to gene flow in flightless ground beetles and Jerusalem crickets (Keller and Largiadèr 2003; Vandergast et al 2008). Experiments have shown that carabid beetles and wolf spiders movement may be blocked by roads 2.5 meters wide (Forman and Alexander 1998). Traffic intensity, substrate and other factors also influence insects movement, but clearly even a small break in native vegetation can change animal behavior and potentially ecosystem processes.

Chaparral-requiring birds in southern California, such as California Quail, Wrentit and California Thrasher, usually fly no higher than a meter above the vegetation and are extremely limited in their dispersal abilities. Wrentits (*Chamaea fasciata*), for example, prefer chaparral habitat, hold small one to two-and-a-half acre year-round territories, are monogamous and have short dispersal distances. In isolated canyon habitats in southern California, the studied bird species had a high degree of extinction in patches after just a few decades of separation (Soulé et al 1988). Fuel break creation in continuous chaparral habitat is a different process from the reviewed study; however, the study highlights the dispersal requirements of chaparral-requiring birds, and points to the need to limit separations in native habitat.

Studies have found that small vertebrates in fragmented habitats generally do less well than animals in connected areas. In Western Australia, 500 meters of type conversion (native vegetation to pasture or agricultural crops) in an otherwise connected habitat completely isolated gene flow between populations of geckos (Hoehn 2007). Gene flow within landscapes is not fully understood, but plays a key role in population health and is of particular importance to conservation-minded land managers. Decreased genetic health may affect population persistence in both the long and short terms, and there is increasing evidence of the key role of genetics in population extinctions. Fragmented landscapes are especially prone to situations that lead to inbreeding and loss of adaptive potential (Keyghobadi 2007). Studies in southern California chaparral provide some interesting examples.

Landscapes of native southern California chaparral perforated by roads have wildlife populations with substantially reduced gene flow. Suitable habitat surrounded by altered vegetation effectively strands four divergent and widespread vertebrates, on scattered little islands despite the fact that these species are common and widespread in their natural habitat (Delaney et al 2010). Movement into these scattered islands is reportedly negligible, if the development barrier is wider than 50 to 100 meters (Soulé et al 1988). These animals, the authors point out, have little effective movement through the matrix of nonnative vegetation; however, corridors have been shown to mitigate some of the negative effects. Birds have been observed taking advantage of strips of native habitat as narrow as 1 meter in width, other species seen in connectors less than 10 meters in width (Soulé et al 1988). Project design feature #4 which specifies 20' wide habitat connectors takes advantage of the ability of many species to use such narrow corridors.

Detrimental effects of fragmentation have also been documented in other chaparral wildlife. After isolating events such as urbanization, habitat islands do not retain native rodent or native birds for more than a few decades (Soulé et al 1992). This indicates there are high rates of localized extinction in 10-100 hectare patches of California chaparral. In their study, Bolger and collaborators (1997) also found fewer species of native rodents in fragmented habitat than in equivalently sized intact habitat. The longer the patch had been isolated, the more pronounced the effect (Bolger et al 1997; Delaney et al 2010). Fuel banks will rarely cause small habitat islands, although this could occur if the fuel bank were to cut through the edge of a population.

The ability of animals to move across landscapes is increasingly important because of climate change, which will bring new stressors such as changes in temperatures, precipitation and an increase in extreme weather events. To cope with rapid environmental change, species might evolve new physiological tolerances (if there is sufficient time and genetic diversity to allow for natural selection) or move spatially to maintain existing climatic niches (Tingley et al 2009). However, these adaptation strategies/options might be hindered by reduced genetic diversity caused by genetic drift and inbreeding within a small isolated population. Maintaining landscape connectivity is paramount for the continued health of wildlife species and ecosystem function.

In terms of the amount of area disturbed, fuel breaks are small on a landscape scale. A two hundred foot wide swath of converted habitat will, most likely, not noticeably change the amount of appropriate habitat for most wildlife species. It is the continuous linear nature of fuel breaks that makes them problematic. It has been documented that all roads serve as barriers or filters to some animal movement, and width (almost always less than 200') is one of the defining features (Forman and Alexander 1998). The Wagner Ridge fuel break is one of many local linear anthropogenic landscape features like power lines, roads, trails and other fuel breaks. If each of these features acts as a barrier that deters or slows movement of a species, the cumulative effects of all of these features combined could substantially affect the viability of an entire population.

The degree to which fuel banks will remain habitat barriers is largely dependent on the shrub species making up the chaparral. In chaparral with sprouting shrub species like chamise, the habitat fragmentation would be largely overcome after several years of shrub sprout growth post-treatment. In chaparral with only obligate seeding shrubs, the fragmentation will generally increase with each maintenance cycle, as less seed germinates each cycle without fire cues. The fragmentation in this case has the potential to become semi-permanent as the fuel bank trends increasingly toward grassland. Hand cutting and pile burning, especially with the incorporation of project design feature #6, can slow the loss of obligate seeding shrubs.

In summary, barriers as small as 50 meters wide (less than the width of fuel breaks discussed in this EA) have been shown to deter the movement of mobile species like some birds across vegetated but inappropriate habitat. Less mobile species like ground dwelling insects have been isolated by roads and other narrow linear barriers. Narrow corridors of habitat have been shown to provide connectivity between habitat patches for animal movement. Project design feature #4 which calls for the retention of habitat bridges 20' wide at an interval of 660' of length of fuel break in chaparral, will allow all species to travel across the fuel break without leaving chaparral habitat. Although it cannot be established at this time that this will be critical for any one given species, it is reasonable to posit that this measure will benefit one or more chaparral-dwelling species. The cumulative effects of many linear habitat disturbances like fuel banks on the landscape, and the hypothesized need for many species to migrate in response to climate change, increase the potential value of such habitat corridors.

4.1.4 Cultural resources impacts

The BLM archaeologist conducted a cultural resource study of the project area. The study included background records search, field inventory, and Native American consultation. The study was designed to help BLM meet its obligations under Section 106 of the Historic Preservation Act. The BLM archaeologist recommends that no significant cultural resources would be affected by the proposed action. This includes places of Native American religious and/or cultural significance (refer to the Section 106 compliance study attached).

4.1.5 Recreation and visual resources impacts

The proposed action could have negligible short-term impacts on recreational use. Walkers, joggers, bicyclists, and motorists might be inconvenienced temporarily during project implementation due to the noise and dust caused by cutting and masticating fuels. Recreationists would continue to use the project area after the project is implemented.

The project area is not known for its visual resources. The proposed project would have a negligible impact on visual resources. Some vegetation would be removed. The fuel break would not be visible, except by the air. It would not, for example, mar the scenic beauty of a river canyon. The proposed action is in line with BLM's VRM class III management objective which is to partially retain the existing character of the landscape.

4.2 Impacts of the No Action Alternative

There would be no impacts to environmental resources, such as water, soils, and wildlife. There could be impacts to firefighting efforts. If a wildfire occurred, firefighters would not have this strategic fuel break to stop the advance of the fire and attack the fire. The result could be a larger wildfire that impacts environmental resources well beyond the project area. There may also be impacts to private property.

4.3 Cumulative Impacts

Cumulative impacts are not anticipated. The proposed action would not impact significant biological and cultural resources. The proposed action would not impact water and soil resources. The proposed action would have some impacts on plants and wildlife but project design features have been included to address potential negative impacts. Project design feature #4 addresses the potential for fragmentation of animal habitat. As analyzed above (section 4.1.3), a fuel break of this size has some potential to impede the movement of some animal species. The Wagner Ridge fuel break is one of many habitat alterations in a complex landscape with many landowners. This landscape is already crisscrossed with linear features of disturbed habitat like power lines, roads, trails and other fuel breaks. If each of these features deters or slows movement of a species, the cumulative impacts of all of these features combined could substantially affect the viability of an entire population. By providing corridors of undisturbed habitat, project design feature #4 lessens the cumulative impacts of many linear anthropogenic habitat disturbances and the contribution of the Wagner Ridge fuel break to overall habitat fragmentation. The proposed action is expected to have a beneficial cumulative impact on wildfire suppression in the area as long as BLM maintains the fuel break.

5.0 Agencies and Persons Consulted

No outside agencies were consulted.

5.1 Authors

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Lauren Fety, Biological technician
James Barnes, BLM NEPA coordinator/Archaeologist
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5.2 Literature Cited

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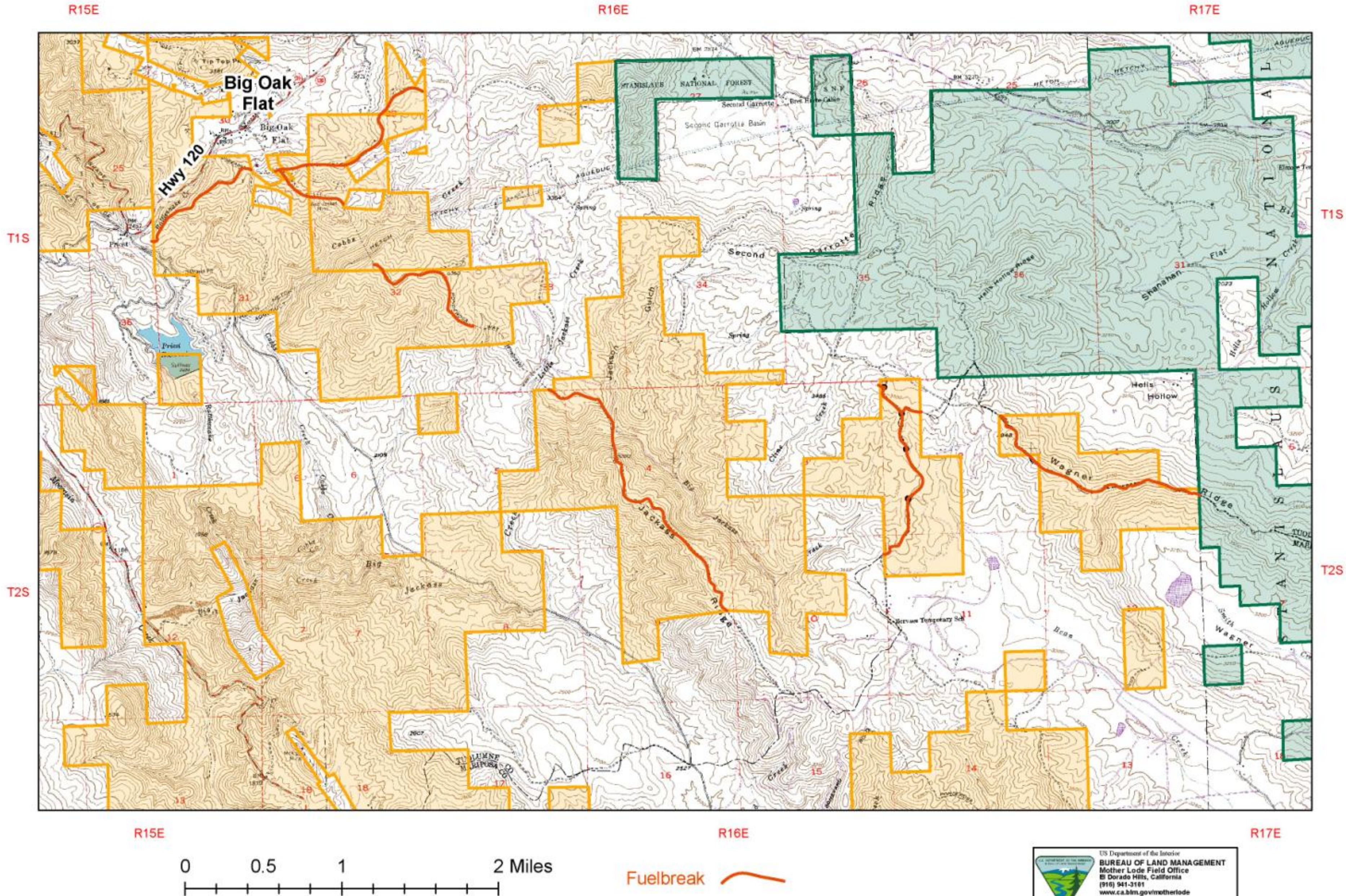
5.3 BLM Interdisciplinary Team/Reviewers:

/s/ James Barnes	*12/16/10*
NEPA coordinator/Archaeologist	Date
/s/ Brian Mulhollen	*12/16/10*
Fuels specialist	Date
/s/ Jeff Horn	*12/16/10*
Recreation	Date
/s/ Al Franklin	*12/16/10*
Botany	Date
/s/ Peggy Cranston	*12/16/10*
Wildlife/fisheries	Date

5.4 Availability of Document and Comment Procedures

This EA will be posted on Mother Lode Field Office's website (www.blm.gov/ca/motherlode) under NEPA and will be available for a 30-day public review period. The EA is also available by mail upon request during this 30-day public review period. Comments should be sent to James Barnes at Bureau of Land Management, Mother Lode Field Office, 5152 Hillsdale Circle, El Dorado Hills, California 95762 or emailed to James_Barnes@ca.blm.gov.

Wagner Ridge Fuelbreak



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