The Happy Camp Fire, on the Klamath National Forest, began in a flurry of lightening that ignited 18 small fires surrounding the community of Happy Camp, CA in the Mid-Klamath watershed. Many of these fires were easily contained and kept at minimal acreage. Three fires burning in separate watersheds — Frying Pan Fire, Man Fire and Faulkstein Fire — proved difficult to contain; the fires burned slowly in rugged, forested terrain until fire weather intensified and the fires grew into large conflagrations that continued to burn until the first fall rains. By seasons end on October 31, 2014 the
fires had merged, becoming the Happy Camp Complex. Combined, the fires burned across 134,056 acres, 98% of which was land administered by the Klamath National Forest.

Much of the Mid-Klamath watershed burned in the Happy Camp Complex, including over 28 miles of the Klamath River canyon, nearly 14 miles of the lower Scott River canyon, vast swaths of roadless terrain and large portions of the Marble Mountains Wilderness Area. The Mid-Klamath region is one of the most diverse and important wildland habitats on the West Coast of North America. The terrain is steep, rocky, rugged and generally inaccessible. Although large portions of the fire area have been subjected to industrial logging and road building, significant portions of the landscape support intact native forests, and many portions have adapted with the influence of relatively recent fire.

Significant Fire Weather and Events

The Happy Camp Fire was officially identified on the afternoon of August 12, 2014 after a localized summer thunderstorm swept north across the Mid-Klamath region. Ignition of the Happy Camp Fire Complex is closely associated with storm development triggered by pyrocumulus smoke plumes in adjacent wildfires. On the afternoon of August 11, 2014 massive pyrocumulus plumes built in the Salmon River as the Whites Fire made a large wind driven run towards Tanner’s Peak. Pyrocumulus smoke plumes were also evident in the Beaver Fire on the Klamath River and it is possible that lightening storm development was influenced by the merging of these two massive smoke columns filled with smoke, ash, and intense amounts of heat. Radar images clearly show the development of a large lightening storm on August 11, 2014. The storm track begins at the Whites Fire and extends north to Happy Camp and into southern Oregon.

Eighteen fires were started in the area due to this pyrocumulus influenced lightening storm, but only three fires burned for the following 81 days. The Frying Pan Fire began on a ridge directly south of Happy Camp and was burning both north towards town, and southwest towards Elk Creek, a major tributary of the Klamath River with its headwaters in the Marble Mountains Wilderness. The fire was growing fairly slow due to favorable weather conditions, heavy inversion layers and low lying smoke from adjacent wildfires, namely the Whites Fire in the Salmon River watershed and the Beaver Fire upstream on the Klamath River near the communities of Oak Knoll and Klamath River. The Happy Camp Fire quickly burned to the edge of Happy Camp itself, threatening the town within a few days of ignition. The fire then began spreading east toward Grider Ridge and south toward upper Elk Creek.
The Man Fire burned deep in the Marble Mountain Wilderness Area and was managed utilizing Minimum Impact Suppression Tactics (MIST). This picture taken, from the PCT near Cold Spring, shows the low severity fire effects in unmanaged, fire-adapted forest.

The Man Fire, deep in the Marble Mountains Wilderness, also started on August 12, 2014 in the Wooley Creek drainage. Wooley Creek is a large and wild tributary of the Salmon River and a very rugged and inaccessible area. The fire began in the canyon and burned slowly uphill towards Man Eaten Lake and Marble Mountain. The fire was originally managed as part of the July Complex in combination with the Log and Whites Fires, but later merged with the Happy Camp Fire in the Elk Creek watershed. The fire was managed utilizing Minimum Impact Suppression Tactics (MIST) due to its wilderness location. The Pacific Crest Trail, running across the ridgeline above, was utilized as fireline on the fire’s eastern border. The Man Fire burned extremely slow for the first twenty-five days, burning only 3,263 acres, mostly at low to very low severity.

The Faulkstein Fire, in the upper Grider Creek watershed, began in the same flurry of lightening and was burning in relatively remote and inaccessible terrain in the Grider Roadless Area. This fire was originally unstaffed and was also burning very slow in the old-growth forests of upper Grider Creek. For over two weeks the Faulkstein Fire burned slowly, burning only 5,225 acres in fifteen days in the upper Grider Creek watershed. The fire was burning at mostly low severity.
On August 27, wind conditions began to change, inversion layers lifted, and the Faulkstein Fire made a significant uphill and wind-driven run in the Fish Creek drainage, burning the canyon’s forests in high and moderate severity stand-replacing fire. On that same day the Frying Pan Fire overwhelmed firelines on lower Grider Ridge and burned over broad swaths of ridgeline doused in over 200,000 gallons of fire retardant on upper Grider Ridge; the fire retardant didn’t work. Pushed by steady winds, the fire then dropped into the Grider Creek watershed. By days end, 4,835 acres had burned, strategic fireline on prominent ridgetops had burned over, and fire behavior had significantly increased.

The following day, on August 28, the Faulkstein and Frying Pan Fires merged in the heavily forested and relatively inaccessible Grider Creek canyon. The fires had now picked up some steam and, pushed by heavy winds, burned 12,307 acres in what was by far the hottest section of the Happy Camp Fire. The fire made three to four mile runs east and northeast across Grider Creek towards the community of Seiad Valley and the Klamath River. Large pyrocumulus smoke columns billowed from the Grider Creek drainage, a sign of very active fire behavior. Tributary streams east of Grider Creek, including Rancheria Creek, Bark Shanty Creek, and No Name Creek burned, as did a large portion of Grider Ridge’s eastern slope and the area around Limestone Bluffs.

The next day, on August 29, the fire continued burning downstream on Grider Creek to the Klamath River corridor and east into the Walker Creek watershed, where it burned the entire watershed by day’s end. 13,310 acres burned and the now merged Faulkstein and Frying Pan Fires were steadily burning across the vast and rugged landscape of the Mid-Klamath watershed, threatening the communities of Hamburg and Scott Bar.

The fire burned steadily upstream along the Klamath River from September 1 to September 6, when the fires reached the Scott River canyon. Significant sections of moderate severity fire burned in the Tom Martin Roadless Area during this time period, making uphill runs on the steep and rocky slopes of Tom Martin Peak and Lake Mountain. By September 7, two outbuildings burned near Deep Creek in the Scott River Canyon. On September 8, two outbuildings and two residences were destroyed and two more outbuildings damaged on Scott River Road near McGuffy Creek. The fire also jumped Scott River Road and the Scott River on September 8, amid gusty northwest winds, prompting evacuations in the Mill Creek area east of Scott River. An inversion settled back into the area on September 9, and fire behavior calmed considerably.

On September 15, the Man Fire burned out of the Wooley Creek drainage and merged with the Happy Camp Fire in upper Elk Creek, officially becoming part of the Happy Camp Complex. On this same day a moderately sized wind-and slope-driven run also occurred in the extremely steep drainages below Man Eaten Lake at the eastern margin of the Man Fire. This run is the largest section of stand-replacing burn in the Man Fire, yet it came to a halt high on the slopes as they became rocky and devoid of continuous fuel. Significant precipitation fell across the fire area on September 24, (2.75 inches in Happy Camp), and within a week the fire was declared 100% contained.
Despite three days of extreme fire behavior, wind driven runs, and pyrocumulus smoke plume development from August 27-29, the Happy Camp Fire burned within the historical range of variability of fire severity in the Klamath Mountains. In fact, without these three exceptionally intense days, the fire would have burned at fire severity levels well below those considered “characteristic,” even with drought conditions, high temperatures, low fuel moisture, and low relative humidity of the 2014 fire season. The Happy Camp Fire burned at 10% very low severity, 67% low severity, 22% moderate severity, and only 1% high soil burn severity throughout the fire area.

The fire burned in a mosaic indicative of mixed severity fire, with large portions of the landscape burning in the understory, especially on north-facing slopes, the lower one-third of slopes, and in the canyon bottoms. The upper two-thirds of the slopes and the exposed ridgelines dividing watersheds sustained most of the moderate and high severity fire. Although found throughout the fire area, the watersheds that burned from August 27-September 6, experienced the majority of the moderate and high severity fire effects. Grider Creek and Walker Creek were particularly affected by higher severity fire and stand-replacing events. The ancient canyon bottom forest along Grider Creek and the Pacific Crest Trail was maintained by mostly low to moderate severity understory fire.

The watersheds between Seiad Valley and Hamburg, that flow north into the Klamath River, were also affected by high to moderate severity fire, mostly on the upper half of the slope. Numerous of these stand-replacing fires were lit by firefighting personnel during backfiring operations.
Within the Marble Mountains Wilderness, the Happy Camp Fire was predominately low to very low severity, including large areas of unburned habitat. The sparse and/or rocky ridgelines acted as firebreaks, slowing the spread of fire or allowing for containment. With the exception of the short period of time when fire behavior was driven by high winds, the Man Fire portion burned at mostly low severity, with small canopy openings created by fire induced thinning.

**Impact of Past Forest Management on Fire Behavior**

One of the most striking features of the Happy Camp Fire was the fire behavior on the western perimeter where it burned up against the 2008 Panther Fire. The fire footprints from past years moderate fire severity and rate of spread by creating areas with minimal ground fuels and dead fuels. Areas that experienced stand-replacing fire in 2008 and were allowed to recover naturally following the Panther Fire had very little fire-available-fuel; therefore, they tended to burn at low severity.

The effect of past forest management on Happy Camp Complex fire behavior is hard to quantify due to the extreme variability of weather conditions throughout the eighty-one days of active burning. Despite the variability, it is clear that forest management and fuel management treatments had little effect on the rate of spread or fire severity. Much of the acreage burned — and nearly all the acreage burned at moderate to high severity — was influenced by extreme weather conditions, including high and gusty wind, high temperatures, unusually dry conditions, pyrocumulus-plume-driven-fire, and discretionary backfires. By and large, it was weather and terrain that drove fire severity and effects in the Happy Camp Fire area. Based on observation of the Happy Camp Complex and other fires since 1987, it appears that in the Klamath Mountains weather and terrain are the main determinants of fire severity and fuel reduction projects ordinarily have limited influence on fire behavior.

When the weather and terrain lined up, vegetation and soil burn intensity increased. It is doubtful that any amount of fuel reduction would have stopped these runs. Fuel treatments in the Klamath Mountains are often not effective at controlling, moderating, or containing large wildland fires due to the steep slopes and complex, layered forest habitat. On the other hand, recent fire footprints did slow the fire and reduced its spread across the landscape. The unsalvaged portions of the 2008 Panther Fire was particularly helpful at slowing the fire on the western fire perimeter; in some cases severity was so low that fireline construction was not necessary to contain the fire.

**Recommendations**

Happy Camp Fire behavior, as described above, suggests that prescribed fire and wildland fire could be utilized to moderate and limit the spread of future fires. It also suggests that in order to have a chance of containing wildfires during wind and weather driven events Forest Service managers will need to maintain shaded fuelbreaks on major
ridges; firelines hastily constructed during wildfire events, on the other hand, are likely to prove ineffective.

As part of fire recovery, firelines on strategic ridgelines and along important road systems could be transformed into shaded fuelbreaks maintained through the use of prescribed fire. It is likely that such treatments would more effectively protect local communities in future fire events. Fires backing out of the mountains and toward forest communities of the Mid-Klamath can usually be contained at major river roads and prominent ridge systems. However, reducing understory fuel within ¼ mile of these communities and on major ridge systems would likely provide enhanced protection.

Natural wildfires should be managed to maximize the acreage burned at characteristic severity levels rather than to minimize the acres burned and achieve rapid containment. The use of wildland fire in this manner is the only practical way to restore fire on the scale necessary to moderate fire behavior and aid in the containment of future fires. Neither prescribed fire nor manual thinning can be implemented at the scale needed.

**Fire Suppression Impacts**

**Fireline Creation**

The sheer size of the Happy Camp Fire, 134,056 acres, impacted the scale at which fireline was created. Roughly 137 miles of fireline was built to contain the fire, including 67.9 miles of dozerline, 44 miles of which was newly developed dozerline. Crews also built 62 miles of handline. This total does not include the many miles of ineffective fireline that were overrun by the Happy Camp Fire; miles that are included within the fire perimeter, but not included as dozerline miles in the Happy Camp BAER report. The majority of the firelines were built on steep and erosive slopes in important fish bearing watersheds such as Elk Creek and Grider Creek on the Klamath River, as well as Tompkins, Middle and Kelsey Creeks in the Scott River watershed.

Large sections of dozerline were created in various parts of the fire, including Grider Ridge, the ridgeline dividing Grider Creek from Scott River tributaries, the lower flanks of Cayenne Ridge, adjacent to portions of the Highway 96 corridor, north of Seiad Valley on Grider Creek and the divide between Doolittle and Stanza Creek.

The fireline between Doolittle and Stanza Creek was built on particularly steep slopes in the Elk Creek watershed. The fireline was not only erosive and damaging, but it also negated the potential benefit of allowing the 2002 Stanza Fire and 2008 Panther Fire footprints to re-burn, reducing fuels and effecting stand development patterns.

The 2002 Stanza Fire had developed sufficient understory fuels from re-sprouting vegetation and downed trees and a fire would have been beneficial. Much of the Stanza watershed burned at low to moderate severity in 2002 and would have likely done the same if allowed to burn in the 2014 Happy Camp Fire. Likewise, the prolific regeneration
found in the unsalvaged stand-replacing portions of the 2008 Panther Fire would have benefitted from the thinning effects of wildfire. Downed wood from the last fire disturbance and shrubby understory growth would have likely burned in a mosaic, creating heterogeneity and resilience in these young and regenerating stands. It is also likely that fire severity would have been low to moderate in this section and the rate of fire spread would have been minimal as it burned through snag fields filled with supple green shoots of regenerating brush and young hardwoods. Some fire management professionals would recommend allowing this regenerating forest to burn in a patchy mosaic, figuring that it is better now than later, when more decadent woody fuels would have built up.

It is important to note that the fire did actually burn around the Doolittle Ridge Fireline and it was not effective at holding the fire north of Bear Creek. The fireline simply pushed the fire around the 2002 Stanza Fire and into the Marble Mountains Wilderness where it backed down to Elk Creek roughly four miles upstream. Like many firelines built during wildfires within the Klamath Mountains, the Doolittle Ridge Fireline expended many thousands of taxpayer dollars without aiding either suppression or control. The expense and the environmental impacts could have and should have been avoided. In this location the natural wildfire should have been allowed to burn.
uninhibited into the Stanza Fire and Panther Fire footprints and into the wilderness beyond. In fact, that is what the fire did in spite of the questionable Doolittle Ridge Fireline. Fireline could have been developed along Elk Creek Road instead, allowing the fire to back downhill into the Panther Fire area with positive results.

Other firelines built during suppression actions proved ineffective as well and were overrun by the Happy Camp Fire. These include dozerline on the ridge between Ottley Gulch and Frying Pan Creek, on the ridgeline above Happy Camp, the Klamath River, and Curley Jack Campground. These ineffective dozerlines, including the Doolittle Ridge fireline, amount to an estimated ten miles.

These dozerlines created long-term environmental impacts, cost large sums of taxpayer dollars, and served no purpose whatsoever in the containment of the fire. Constructing them also involved an opportunity cost. It is likely that the resources consumed building ineffective firelines on minor ridges and on mid-slope locations would have been better spent creating adequately shaded fuelbreaks on major ridges like Grider Ridge and in better preparing the areas around communities for the coming fire.

A large contingency line — estimated to be nearly ten miles long and entirely unnecessary for fire containment — was built from China Grade to Evans Mountain and over Grider Ridge to nearly Seiad Valley. This large contingency line, although never used, was one of the largest contiguous dozerlines built during the suppression efforts in the Happy Camp Fire Complex.

Another large section of contingency line was built within a small roadless area and late seral forest in the Johnny O’Neil LSR near Hicks Gulch. This roughly 6.5 mile long dozerline was constructed on steep and erosive slopes above the Klamath River, extending to the mouth of Horse Creek. Other large contingency lines were built east of Scott Bar near Mill Creek and across the spine of the Scott Bar Mountains.

It is likely that far more dozerline would have been built if the fire had not been driven by high and gusty winds, burning quickly across the landscape and requiring crews to pull back to defend communities on Highway 96 and Scott River Road. By and large firelines that actually contained the fire were located along major road systems deep within river/stream canyons, including Elk Creek Road, Highway 96 and Scott River Road. These were safe and highly effective firelines that allowed crews to protect homes and infrastructure, while creating minimal impact to the environment. In rugged regions like the Klamath River, the major road systems serve as the most effective and least damaging firelines and are often the most reasonable option for containment. These road systems should be maintained and utilized for fire control in the future.

Even firelines located on major ridge systems can be ineffective at containing a fire burning in the Klamath Mountains unless there has been pre-fire work to prepare a shaded fuelbreak for the next fire. Broad, well-shaded fuel-breaks maintained with prescribed fire, on the other hand, can be relied upon for fire containment under typical conditions.
Backburning

During the course of suppressing the Happy Camp Fire, firefighting crews conducted numerous backburns and burnout operations. The Forest Service has many vernacular terms that describe planned ignitions utilized to create “blackline” adjacent to firelines, including: backburning, back firing, burnout operations, line firing, tactical firing, tactical ignitions and blackline burning. These intentionally set fires are used to starve an approaching wildfire of fuel by burning flammable materials and fine fuels adjacent to a fireline to aid in containment of the fire. These fires can be ignited by hand using drip torches, or aerially utilizing heli-torches — giant drip torches attached to helicopters. Another ignition tactic involves the shooting of “ping pong balls” or “plastic sphere dispensing,” where small plastic balls that ignite on contact are shot from helicopters or by ground based crews to start backfires.

In this paper we use the term “burnout” to describe reducing fuels on the fire-side of a fireline to enhance the lines chance of stopping a fire; we use “backfire” to describe firefighters burning large areas – often from the bottom of the slope - in hopes of stopping a fast moving wildfire. Backfires are typically burned hot intentionally and in the Klamath Mountains they typically burn hotter and kill more trees as compared to natural wildfires.

Under favorable conditions and with responsible ignition tactics the burnouts can, at times, create characteristic fire effects that allow for safe and effective containment or confinement of a wildland fire. Under less favorable conditions, with irresponsible ignition tactics and careless implementation, discretionary backfires create high severity fire effects, including high levels of overstory tree mortality and high soil burn severity. It is these planned ignitions — best described as backfires — where suppression crews create extremely hot, fast moving fire fronts that evade control and hinder containment.

It is clear from the evidence on the ground and from agency documentation that such backfires were approved by forest managers and lit by firefighters on the Happy Camp Fire. Many of these backfires are now being proposed as timber salvage units in the Westside Fire Recovery Project, which would compound the substantial impact of backfiring operations on local watersheds.

Burning out to a well-placed fireline by “walking” the fire downhill in stages is an essential technique for responsible firefighting and tends to create low severity fire effects. Lighting backfires from the bottom of long and forested slopes, on the other hand, is usually irresponsible and tends to create high severity fire effects. Utilizing forms of ignition such as heli-torch and “ping pong ball” firing techniques can be difficult to control and have a tendency to light canopy fuels rather than fine fuels in the understory. This can also contribute to high severity fire effects. Poorly planned and poorly executed backfires do significant watershed and habitat damage and are often ineffective. They can also be difficult to control and/or contain as fire severity increases. Such poorly executed backfires do, at times, directly threaten communities and lead to
loss of life and property. Furthermore, helitorch and other aerial backfiring techniques are expensive and the cost of backfiring typically far exceeds the potential benefits. It is evident by looking at the landscape and reviewing agency documents that backfiring was used extensively during the Happy Camp Fire and can be associated with much of the high and moderate severity fire in the areas around Hamburg and the Scott River.

Freedom of Information Act (FOIA) documentation and agency news announcements identified many areas as ignition points for backburning operations, including, Cayenne Ridge, Slinkard Ridge, the ridges and slopes above Happy Camp and the area around Lake Mountain Lookout. Particularly high concentrations of aerial ignitions are noted on the ridgeline dividing the Scott River from the Klamath River in the vicinity of Tom Martin Peak, on the ridgelines dividing Tom Martin Creek and Muck-A-Muck Creek, and in the region of Elk Creek — between the East Fork of Elk Creek and Doolittle Creek — where helicopter ignitions lit nearly all spur ridges in the area north of the 2008 Panther Fire. Compared to most backburning conducted during the Happy Camp Fire, operations in the Elk Creek watershed were conducted fairly responsibly, as they were lit in a way that promoted mostly backing fires of low to moderate severity.

Questionable backfiring operations that included ignition sources at the bottom of steep slopes and drainages include ignitions at the bottom of Mitchell Creek, Jim Creek, Macks Creek, Tom Martin Creek, Muck-A-Muck Creek, along the Scott River near China Doctor Creek, George Allen Gulch, McGuffy Creek, near the mouth of Tompkins Creek, and near the confluence of Scott River and the Klamath River. These backfiring operations resulted in large sections of high and moderate severity fire, creating large runs that generated high levels of tree mortality. In fact, much of the higher severity fire on the fire’s eastern edge is centered in the area where these backfiring operations were conducted. The effect of these operations are clearly seen upslope of these ignitions on fire severity maps, constituting a significant portion of the fire’s high and moderate severity fire. Many of these areas are also now proposed for salvage logging.

In general, backburning operations were conducted during hot summer days and burned into the heat of the afternoon. It is likely that high severity fire effects could have been more effectively avoided if night burning had been utilized in an attempt to moderate fire behavior. Firing at the wrong time of day and the lack of night shift firefighting operations were mentioned in more than one of the post-fire community after action-review meetings conducted by KNF managers. The recommendation for night firing should be taken seriously; as more effective planned ignitions could significantly reduce fire severity and aid in the containment of future wildland fires.

It is possible that backfiring and burnout operations were partially responsible for the big runs and extreme fire behavior that led to the loss of several homes and outbuildings, as well as the long range spotting that facilitated the spread of fire across the Scott River between McGuffy and Mill Creek on September 8, 2014. On the evening of September 5, helicopters were igniting backfires between the head of the slowly backing wildfire and Scott River Road. On September 6, crews continued firing from
Scott River Road upstream of Scott Bar. By evening, news announcements reported big runs above Scott Bar and in the nearby Deep Creek drainage. On September 7, two outbuildings were lost on Deep Creek. On September 8, crews were firing along the Scott River Road from both the top and bottom of the slope between McGuffy Creek and Scott Bar. By afternoon northwest winds pushed the fire across Scott River, creating five spot fires near Mill Creek. Two homes and two outbuildings were lost, while two other outbuildings were damaged near McGuffy Creek.

Forest affected by backfiring operations in the McGuffy Creek watershed. Much of the area is now proposed for salvage logging in the Westside Fire Recovery Project.

**Riparian Impacts**

Impacts to riparian areas include the creation of bulldozed firelines within watersheds that support important salmon and steelhead fisheries. These firelines will likely result in sediment delivery to local streams such as Elk Creek, Grider Creek, Walker Creek, O’Neil Creek, Tompkins Creek, Kelsey Creek and many others. These streams represent thirty miles of federally listed Critical Habitat for the Coho salmon within the fire-effected area. The impact of backburning and its contribution to sedimentation in these streams is unknown; however, based on antidotal evidence from FOIA documentation, agency news reports and on-the-ground research, the impact of backburning to local watersheds could be quite high, covering many thousands of acres.
It is also clear from a video posted on August 26, 2014 on the KNF Facebook page that crews were “snagging,” (i.e. felling large, dead-standing trees) along Fish Creek in the Grider Creek watershed, a designated Late Successional Reserve, and the Grider Roadless Area. Snagging in riparian areas, particularly in relatively intact watersheds such as Fish Creek, should be avoided. Snagging during fire suppression activities has been documented throughout the Klamath-Siskiyou Mountains to impact wildlife habitat, riparian habitat, fisheries and late seral forest habitat.

The impact of sedimentation and debris flows to local watersheds that have highly erosive granitic soils and deep-seated landslides is also a concern. Excessive sedimentation is especially evident in the Grider Creek drainage where debris flows and erosion have created high levels of turbidity in the post-fire environment. During large rainstorms between October 23 and October 27, 2014, soil movement was evident in all stream courses and roadside ditches in the Grider Creek area. The stream ran turbid and thick with sediment due to both natural, fire-generated erosion and erosion from the estimated fifteen miles of bulldozed fireline built in the Grider Creek watershed.

**Future Cumulative Impacts- Westside Fire Recovery Project Project**

The impact to Grider Creek, due to natural fire-generated erosion and excessive sedimentation resulting from fire suppression activities, would be compounded if post-fire logging, as proposed by Klamath National Forest managers, in the Westside Fire Recovery Project were to be implemented. Based on existing science and historical observation, intensive salvage logging in this highly unstable watershed would drastically compound the effects of fire and fire-line sedimentation in terms of both quantity and duration, negatively impacting water quality for many years.

The soil and sediment impacts associated with salvage logging operations proposed in the Westside Fire Recovery Project could potentially thrust Grider Creek and other important watersheds above the threshold of concern for water quality and create chronic sources of sedimentation by triggering large scale soil erosion through logging, yarding operations, new road construction, landing construction and the removal of standing snags that provide an important source of coarse woody debris.

Additionally, the planting of dense conifer plantations and helicopter salvage logging, as proposed in the Westside Fire Recovery Project, will only serve to increase future fire risks and potential fire severities by creating logging slash “jackpots” (i.e. concentrations) and highly flammable tree plantations. Experience and science demonstrate that replacing natural forests with tree plantations encourages high severity re-burns, which will only further compound watershed impacts.

The fisheries of the Mid-Klamath River are world-class. The KNF should work towards strategies that will reduce watershed impacts to fire-effected watersheds by mitigating the impacts of fireline construction and allowing for natural fire recovery in
important salmon watersheds. The retention of large standing snags, coarse woody debris, and other important biological legacies should be emphasized in any proposed project.

Fire Retardant Use

Large quantities of fire retardant were used during suppression of the Happy Camp Fire. The use of fire retardant has the potential to contaminate watersheds, impacting water quality, aquatic organisms, and important fisheries in the Klamath River and its tributaries. Fish kills due to fire retardant use have been reported in the Klamath River region, including Clear Creek in 1987, when 500 Summer steelhead were killed by inappropriate fire retardant use.

Responsible use of fire retardant is necessary to ensure that impacts to waterways and fisheries are avoided, especially in salmon refugia such as the Mid-Klamath River and its tributary streams. The difficulty with targeted aerial application of fire retardant in the Klamath National Forest is associated with the region’s complex and dissected topography and wind patterns. This difficulty was demonstrated in the 1970s when Forest Service aerial herbicide spraying contaminated many of the region’s waterways causing dire consequences to aquatic life and humans living downstream. The aerial application of herbicides was banned on public land because of the repeated contamination of streams and water sources.

The largest quantity of fire retardant used during the Happy Camp Fire was dropped on Grider Ridge on August 26. Over 200,000 gallons were dropped across Grider Ridge and down a spur ridge leading to the Klamath River near Seiad Valley. These areas burned over the following day, as inversion layers lifted and wind pushed the fire to the east; therefore, the extensive and expensive use of fire retardant on Grider Ridge had no effect on fire containment. Other areas subjected to fire retardant drops include: the ridge dividing Doolittle and Buckhorn Creek on the western flank of Buckhorn Mountain; along ineffective dozerline above Ottley Gulch and East Fork Elk Creek; adjacent to the town of Happy Camp; on the slope over fire where the Happy Camp Fire jumped the Klamath River between Hamburg and Seiad Valley; near Beauty Flat on the Scott River where homes are located and on Cayenne Ridge.

On September 2nd, fire retardant was dropped directly into the Klamath River near the mouth of Kuntz Creek. This misapplication of fire retardant may have caused mortality in salmonids residing in the Klamath River. The specific fire retardant dropped in the Klamath River was Phos-Chek Grades 259-F, a retardant made by Israeli Chemicals Ltd. Performance Products (ICL Performance Products). The company lists diammonium phosphate as the main chemical component, but other proprietary ingredients are included as “performance additives.” Currently there is no way of knowing what these proprietary ingredients are, let alone their impacts, because the company refuses full disclosure.
In the Material Safety Data Sheet for Phos-Chek Grades 259-F it is stated, “ICL Performance Products LP has not conducted environmental toxicity studies on this product.” Despite this lack of detailed study the company also discloses on its Toxicology and Environmental Safety QA webpage, “the free ammonia present in all fire retardant solutions can be quite toxic to aquatic life when directly applied.” Phos-Chek Grades 259-F was directly applied to the Klamath River on September 2, 2014.

Aerial application of fire retardant is not appropriate adjacent to rivers and streams. Retardant drops should be avoided during high winds as they have the potential to drift into waterways, springs and away from targeted areas. The use of fire retardant should be avoided along the Klamath River and other important tributary streams; it is recommended that water drops be utilized instead. This important mitigation policy can ensure that waterways and fisheries are not impacted by fire retardant misapplication. This policy should be instituted across the Klamath National Forest.

Noxious Weeds

According to the Happy Camp Fire BAER Report, key concerns in regards to noxious weed management and spread in the fire area include the effects of fireline creation on weed infested private land that may spread to adjacent KNF lands, and the establishment of noxious weed species in the Marble Mountains Wilderness and Lake Mountain foxtail pine botanical area.

Spread of noxious weeds is particularly troublesome in large fire areas because of the vast road system within the fire area, areas of high overstory mortality, the widespread soil disturbance initiated from the fire and the extensive dozerlines built during suppression efforts. Noxious weed spread would be exacerbated by subsequent soil disturbance and hauling associated with proposed salvage logging operations.

The introduction of noxious weeds during fire suppression actions can be reduced if equipment coming from other locations is washed before use on a fire. This has been done in the past, but there is no indication that local managers required equipment brought in from other locations be washed prior to deployment on the 2014 fires.

A key issue of concern for noxious weed spread is the subsequent use of firelines constructed during fire suppression activities by Off-Highway Vehicles (OHVs). The problem is especially evident on dozerlines and could be mitigated by blocking access. Adequate closure of firelines would reduce noxious weed spread and would help control the erosion and stream sedimentation often caused by OHV use.

The presence of large wilderness and roadless habitats will make the identification of new weed infestations and their treatment difficult. The presence of relatively intact plant communities, including rare and/or uncommon species, make the potential of noxious weed spread that much more damaging. The Klamath National Forest should adopt post-fire management strategies that will not exacerbate noxious
weed spread within the fire area and reduce the widespread disturbance of fire-effected forest soils.

**Cost of Suppression**

Over the eighty-one days the Happy Camp Fire burned, fire suppression efforts cost the federal government $88 million dollars, amounting to over $1 million dollars a day. This cost includes all firefighting personal and their needs during the duration of suppression activities, including aerial support, ground support and logistics. Much of the tax dollars spent to contain the Happy Camp Fire were spent deep in the backcountry, keeping wildfire from burning lands that are adapted and dependent on fire for their health and proper function.

Millions of dollars were expended on futile attempts to keep wildfire from entering the footprint of a recent wildfires and out of wilderness and roadless areas. Those expenditures were potentially wasteful in two ways: they were ineffective, in that in most instances they did not stop the fire, and in instances where they were effective in stopping the fire, they kept fire from entering wild lands which are adapted to and would have benefitted from fire.

Ineffective firelines burned over by the Happy Camp Fire were also built at huge expense throughout the fire area. Snagging occurred in roadless, ecologically intact watersheds and large, sometimes stand-replacing backfires were set to deprive the fire of fuel. The sediment delivered to local salmon streams from these actions will last for decades. The financial cost to taxpayers was great, while the benefits were questionable. If large storm events occur before the forest has an opportunity to recover, the results of questionable suppression decisions could prove disastrous to water quality and fisheries.

Tax dollars spent to keep the fire out of the wilderness would be better focused on protecting homes, infrastructure and communities from wildfire impacts. One particularly damaging and wasteful expenditure was the creation of fireline on the ridge south of Doolittle Creek in the Elk Creek watershed, adjacent to the Marble Mountains Wilderness. The Doolittle Ridge fireline, built by bulldozer on very steep and erosive slopes, will likely become a source of turbidity impacting the fisheries habitat in Elk Creek for many years to come. Following fireline construction a helicopter utilizing “plastic sphere dispensing” lit a large backburn along the fireline that burned downhill into the Doolittle watershed. The backburn took numerous days to complete, and along with fireline construction, must have been implemented at great expense.

The main impetus for building this fireline appears to be the protection of young plantation stands created after salvage logging operations following the 2008 Panther Fire. Fire crews created dozerline, handline and utilized retardant drops to keep the fire from burning into the 2008 Panther Fire footprint in the vicinity of Sulfur Springs Campground and the Norcross Trailhead, a distance of four miles. The costly attempt to
save these young plantations demonstrates a very serious impediment to the restoration of natural fire regimes in the area. This impediment is the creation of new plantations that fire managers and National Forest officials strive to protect from fire. Much of the new plantation development in the area is associated with salvage logging that not only impacts future fire severity, but also complicates wildfire management and the restoration of natural fire regimes. The development of new plantation stands should be discontinued for these reasons.

On the other hand, unsalvaged stands in the area are recovering naturally from the now six-year-old stand-replacing fire and support dense, young regeneration. These areas would have benefited from the mosaic of fire, which would have reduced fuels and created heterogeneity in the regenerating forest. The fire severity would have likely been very low and the effects patchy. The Happy Camp Fire ended up burning around the Doolittle Ridge fireline and into the 2008 Panther Fire area. Fire severity in this area was generally low, due to existing fuel conditions within unsalvaged areas burned in the 2008 Panther Fire. None of the salvage logging units and newly created plantation stands burned in the Happy Camp Fire, but unsalvaged areas did burn, and they did so with predominantly low severity fire effects.

The area affected by the 2008 Panther Fire supports complex, early-seral stand conditions. Although understory shrub density is high, the regenerating forest lacks sufficient ground fuels and dead fuels to sustain high severity fire under most fire weather scenarios. Many in the fire management community believe this area should have been allowed to burn in the 2014 Happy Camp Fire, allowing for fire-adapted stand development patterns in this young forest.
Despite the huge expense trying to keep the fire from re-burning the 2008 Panther Fire footprint, when firelines were breeched, the area refused to burn and the fire crept around the margin of the unsalvaged portions of the 2008 fire footprint. Crews fell back to newly constructed firelines, some of which were never reached by the Happy Camp Fire. In other areas fire severity was so low that no firelines were created and the fire simply smoldered out at the edge of the 2008 stand-replacing fire area, which crews had worked so hard to protect.

This was also the case for the majority of the Happy Camp Fire’s western perimeter, from the Cuddihy basin to Huckleberry Mountain. Close inspection of the Daily Operations Map reveals that much of the western perimeter of the Happy Camp Complex Fire follows the margin of the 2008 Panther Fire quite closely, and throughout most of this area the fire was allowed to naturally smolder out without the creation of fireline.

A large amount of taxpayer dollars were spent and significant environmental impacts sustained building ineffective fireline above Doolittle Creek to keep the fire from burning large snag and brushfields that proved unburnable. Similar to historic fire conditions, the frequent fire regime of the Klamath Mountains moderates the severity and extent of subsequent fires. As demonstrated by the fire behavior and rate of spread on the western perimeter of the Happy Camp Fire, relatively recent fire footprints can create safe and effective fuel breaks for many years following a wildfire. The footprints of recent fires should be utilized to facilitate containment and reduce suppression costs. Opportunities to allow recent fire footprints to burn in a characteristic fashion should also be utilized to reduce fuels and encourage forest health. In light of these findings, a close examination of firefighting strategy, tactics and expenditures is needed.

**The Opportunity Cost of Ineffective Fire Suppression**

In this report we have documented the high direct cost to taxpayers of discretionary fire suppression actions, some of which were spectacularly ineffective at controlling, much less suppressing, the Happy Camp Complex fires. As is typically the case in the Klamath Mountains, it was not suppression actions by the Forest Service but the coming of fall rains which allowed for containment of Happy Camp Complex Fires. On September 24, 2014, 2.75 inches of rain was recorded at the town of Happy Camp; within a week, isolated smoldering snags were all that remained of the Happy Camp Complex fires.

Costly, wastefully, ineffective and environmentally damaging bulldozer firelines, retardant drops and backfires are not, however, the only costs of the Happy Camp Complex fires. Wasteful spending on ineffective and damaging suppression actions also means fewer funds available to conduct the prescribed fires our public forests need to restore them and the natural fire regimes with which they evolved.

The fire suppression bureaucracy and that bureaucracy’s strategy and tactics were created to eliminate fire from our public forests, and they were good tools for that
purpose. Fire suppression as currently practiced has, however, proven a poor tool for restoring fire to forest ecosystems that evolved with fire and forests are not allowed to burn as often as they should. A new approach is clearly needed but the fire suppression bureaucracy seems either unwilling or incapable of implementing what is needed.

A new generation of fire managers and fire fighters must be trained in a radically different approach, an approach which views fire as natural, as an essential restoration tool and as an opportunity to foster forest ecosystem health and resiliency.

**Restorative Fire Management**

Restorative Fire Management (RFM) utilizes MIST tactics, wildland fire use, and a realization that wildfire can be utilized for resource benefits if managed correctly. Restorative Fire Management seeks to restore the process of fire to as many acres as is responsible, necessary and beneficial in each fire event. Backburning and Fire use during suppression activities should be conducted with natural fire-generated patterns and mosaics in mind. Backfiring operations that include ignition from the bottom of steep slopes should be banned due to the propensity of such techniques to initiate high severity fire events and threaten nearby communities.

The concept of “loose herding” is especially useful to fire managers looking to utilize MIST and prescribed natural fire for resource benefit. A “confinement” strategy could also be useful in smaller roadless areas or in those that border private residential lands. Wildland fire use should be considered in fires burning in more remote, backcountry locations. This would free up resources to facilitate the protection of homes and communities, while encouraging fire adapted communities in backcountry areas and moderating the severity of future fires.

Fire management should focus on protecting communities and residences while incorporating the principals and objectives of forest restoration, fire restoration, and in many cases fuel reduction. Prescribed fire and prescribed natural fire should be encouraged and fire safety needs balanced with the need for characteristic fire effects on the landscape. Agency firefighting personnel should steer fire away from areas and resources likely to be negatively impacted by fire and encourage areas that may benefit from fire to burn at characteristic fire severity levels.

**Conclusions**

The Happy Camp Fire burned within characteristic patterns and fire severities. The fire, although at times weather or plume driven, was a natural disturbance with both short-term and long-term benefits and impacts. Environmental impacts associated with the wildfire can be characterized as typical for wildfire in the Klamath Mountains. The fire burned well within the range of historic variability, creating characteristic habitat conditions.
The impact of discretionary fire suppression tactics and actions, on the other hand, has created problematic and long-lasting landscape effects. Extensive bulldozer scars, snag deficits in important fishery habitats, the dumping of fire retardant directly into the Klamath River, large, stand-replacing backburns, and the spreading of noxious weeds are impacts that will be with us for decades. These impacts were sustained at great expense to the taxpayer. Much of this expense was associated with the high cost and extensive use of helicopters, air tankers and retardant drops in backcountry areas. The cost of expensive fire suppression actions likely far exceeded the benefits. Other significant expenditures include the creation of nearly seventy miles of bulldozer lines, including the scars of firelines that were never used and others that proved ineffective.

Much of the expense associated with fireline development on the western margin of the fire was spent to keep the fire out of a four-mile area that, in the end, refused to burn or burned at very low severity due to the 2008 Panther Fire footprint. It is likely that this four-mile section between Doolittle Ridge and Bear Creek would have burned at very low severity — if it had been allowed to burn — and could have created beneficial fire effects in the snag fields generated by the 2008 Panther Fire. Yet, Klamath National Forest officials and fire managers chose to protect the newly created plantation stands in the area, at the expense of healthy fuel conditions, stand development patterns, and biodiversity on the larger landscape of unsalvaged stands. The situation demonstrates the negative effect that creating highly flammable and fire intolerant plantation stands has on fire management.

Fire in the Klamath Mountains is particularly hard to contain given the steepness, the character of the vegetation, the folded nature of the terrain and the general inaccessibility of the area. Given this reality and the forest’s continuing evolution and dependency on wildland fire, a confinement strategy is recommended for most wildland fires in the area. Major river roads, strategic ridgelines, large streams and recent fire footprints make the most effective and least costly firelines. They also create significantly less environmental impacts than the current full suppression/direct attack approach, which aims to limit the extent of fire on the landscape and limit the costs associated with suppression by keeping fires to a minimal number of acres burned. In reality, this strategy rarely works in the Klamath Mountains, and large, landscape-scale fires burn unchecked despite the huge sums of money spent and long-term environmental impacts sustained.

Instead, an approach that utilizes Restorative Fire Management should be the core feature of fire management on the Klamath National Forest going forward. A “confinement” or “loose herding” strategy, along with wildland fire use in the backcountry, could restore fire to its historic role over time, while both moderating fire severity and limiting the spread of future wildfires. Research, confirmed by what actually took place on the Happy Camp Complex fires, demonstrates that wildland and prescribed fire footprints can limit or moderate the effects of wildfire for a period of over twenty years. These effects are evident in the Happy Camp Fire, especially on its western margin where it burned into and was contained in the unsalvaged footprint created by the 2008 Panther Fire. The effect is also evident in some portions of the forest that burned in 1987.
Prescribed and wildland fire should be utilized not only to protect natural resources and encourage a healthy fire regime, but also to protect communities in the Mid-Klamath area. If managed correctly, the large footprint of the Happy Camp Fire can now be utilized to moderate and contain future fires. Local communities and the Forest Service can also use this fire footprint as an anchor for future prescribed fire treatments that will maintain healthy forest and fuel conditions.

Fire managers should be utilizing fire for resource benefit wherever possible. The management of wildfire should be an essential tool in our forest restoration toolbox. Wildfire is a natural process with which the Klamath Mountains have evolved for millennium. It is not necessary for every wildfire to be seen as a catastrophic event to be suppressed. Wildfire can also be seen as a natural process that can be managed to increase fire resiliency and encourage fire safe communities. Such an approach is ecologically justifiable and economically far more responsible and sustainable when compared to current fire management practices and strategies.

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