TREATMENT EFFECTIVENESS MONITORING FOR SOUTHERN CALIFORNIA WILDFIRES: 2003 TO 2004

THE CEDAR, GRAND PRIX/OLD, PIRU, and PADUA FIRES

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Noxious weed reports:
Eliason, Scott; VinZant, Katie – Noxious weed monitoring results, Grand Prix/Old Fire
Dobrowolski, Wendy – Noxious weed monitoring results, Piru Fire

Vegetation recovery reports:
Dobrowolski, Wendy - Effects of hydromulch on vegetation recovery, Cedar Fire
Oriol, Valerie – Effects of aerial straw mulch on vegetation recovery, Old Fire
Heritage resource reports:
Roder, Susan – Heritage site collection monitoring, Cedar Fire
Vance, Darrell - Heritage site collection monitoring, Padua Fire

Acknowledgements

Rocky Mountain Research Station, USDA Forest Service: Pete Robichaud
USDA Forest Service, Region 4: Sherry Hazelhurst
Cleveland National Forest: Dan Ford, Kirsten Winter, Dave Bacon (CNF BAER Team Leader), Joe Leone, Mark Marquette, Alpine Ranger District fire crews Jerry Salazar
San Bernardino National Forest: Joe Johnson, Bob Ota, Mike Florey, Kerry Myers, John Taylor, Katie VinZant, Chelsea Vollmer, Chris Wagner, Annetta Mankins
Los Padres National Forest: Allen King, Al Hess, Kenny Shaw, Wendy Dobrowolski, Patrick Mingus, Steven Galbraith
Angeles National Forest: Darrell Vance
Pacific Southwest Research Station, Riverside: Valerie Oriol, Wes Christensen, Lynne Casal, Erin Kreutz, Pete Wohlgemuth, Jan Beyers, David Weise
San Dimas Technology Center: Carolyn Napper

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Summary table

Treatment & Page #	Fire Area	Monitoring Method	Summary of results
Aerial straw mulch	Grand Prix/Old Fire	Repeat photo points	For both hand-placed and helicopter applied straw mulch, wind was the main factor in determining final cover percentages. On the front range, most of the aerial straw mulch was blown off-site by Santa Ana winds, resulting in cover percentages from 0 to 10%. Treatment was determined to be unsuccessful. In the Lake Silverwood area, straw remained on the ground, but was prone to clump and formed mounds. Treatment cover in this area was <40%, and in this respect, was considered unsuccessful relative to total dollars spent. Clumping and mounding of straw was likely inhibiting plant regeneration.
Hand-placed straw	Grand Prix/Old Fire	Repeat photo points	See comments above for aerial straw mulch. Straw mulch was hand-placed on the front range near Devore and at Hook's Creek near Lake Arrowhead.
Aerial hydromulch	Cedar Fire - Viejas Mtn area	Silt fences	Aerial hydromulch reduced hillslope erosion in both the 50% strip and 100% cover treatments. Because of the decrease in surface erosion, it was assumed that the hydromulch also controlled the movement of water by allowing greater infiltration. The 50% strip hydromulch treatment reduced erosion by >50% in both the gabbro and granitic parent materials. The 100% hydromulch treatment reduced erosion by ~75% on granitic parent materials. The actual level of soil cover observed for the 50% treatment was 30 % and for the 100% treatment was 51%. However, the difference in sediment production between the two treatments was relatively small. Because of the small differences in erosion between treatment applications, it is recommended that the more economical 50% strip treatment be used, and increased implementation monitoring be added to ensure better treatment coverage It appeared that the intensity of the rain event was an important factor in determining overland flow, especially when antecedent soil moisture conditions were near or at storage capacity. Vegetation recovery (% cover) was not hindered by the hydromulch. It is unknown at this time whether any individual species were affected, or changes in plant succession occurred.

Straw-bale check dams	Grand Prix/Old Fire- above Deer Park Nudist Camp	Repeat photo points	The straw bale check dams were successful in storing sediment and breaking the energy of channel flows before the October, 2004 rain events. Vegetation became established through the Spring and Summer of 2004 and had somewhat stabilized portions of the stored sediment before the October, 2004 storms. Increased sediment bedloading of the channel allows for the increased possibility of a debris flow if a major storm event should occur, and if there is no required maintenance planned. During the October 2004 storm events, the majority of the check dams failed either by blowing out, overtopping, or by cutting around or below. It is recommended that straw bale check dams should not be placed in any channel where structures are at risk below (either situated in the drainage itself, on the alluvial fan, or dangerously close to the edge of the channel).
Fiber rolls (straw wattles)	Cedar Fire - San Diego Country Estates	Observations and photo points	Because of low precipitation during the winter, there was very little movement of sediment on the treated hillslopes. Therefore, it was difficult to determine if the treatment was successful or cost effective before the October, 2004 storm events. Following the higher than normal October rain events, movement of sediment on the hillslopes continued to remain relatively low. With no comparable control area, it remained difficult to determine if the treatment was cost effective or not. Implementation monitoring of the fiber roll treatment is needed. The fiber rolls successfully remained in place but many failed when placed incorrectly in drainage landscape positions. The incorrect downward turning at the end of the fiber roll contributed to the few rills noticed on the site. Vertical spacing of the fiber rolls needs to be investigated. If the purpose of the fiber roll is to break up slope length and slow overland flow, it seems that thirty foot spacing on 5-15% slopes is overkill (Fig. 2.22). More scientific data is needed to support and recommend the spacing criteria used, especially when considering the extra costs incurred. Channel release of stored sediments occurred after the 12/25 storm. By reducing flow to the channel, fiber rolls likely reduced the amounts of sediment transported because of increased hillslope infiltration.

Log check dams	Piru Fire - Dominguez Canyon	Observations and photo	The lower drainage section of log check dams immediately filled with sediment following the 2003 Christmas Day storm, because of the high rate of production of material from the drainages of this watershed. The log check dams began to fail during the February rain events. The check dams that failed at the sides resulted in further cutting of the bank resulting in bank erosion and more sediment contributed to the channel. Because of this, the check dam treatment has promoted greater erosion in the channel, and in places, has put the road in danger to undercutting. The entire set of channel treatments should not have been done because (1) the high production rate of material (dry ravel) in these steep (>55% watersheds) that provide high bedloads, (2) steep gradients in the upper drainages, (3) redirection of new channels as fresh flows cut into the newly deposited sediment because of lessening of the gradient, and (4) questionable values at risk (Lake Piru Reservoir, some believed that sedimentation posed no problem here).
Vegetation recovery	Cedar Fire - Viejas Mtn area Grand Prix/Old Fire- City Creek area	Transects, 1 m^2 plots, and photo points	Cedar Fire (Viejas Mountain): Hydromulch had no impact on vegetation cover or species diversity, however, it is likely that the differences were not detected due to too small of a sample size. Short-term vegetation recovery in terms of both cover and diversity in the immediate post-fire growing season seems successful regardless of treatment. Since Viejas Mountain is such refuge for native plant diversity, it recommended that this project be continued for the next couple years to determine long-term, post-fire vegetation establishment. Old Fire – City Creek: At city Cr., it appeared that aerial straw mulch had little effect on vegetation recovery. In the Hooks Cr and Mojave areas, clumping and piling of straw appeard to be inhibiting plant recovery.
Noxious weeds	Grand Prix/Old, Piru Fires	NRIS-Terra standard protocol, observation	Grand Prix/Old: Infestations of the target weed species *Ailanthus altissma*, *Centaurea melitensis*, *Cirsium vulgare*, *Helianthus annuus*, *Nicotania glauca*, and *Spartium junceum* seemed to be the most prevalent in the areas surveyed. *Foeniculum vulgare*, *Riccinus communis* and *Tamarix ramosissima* were also detected in several areas and occupied a small enough area to warrant efficient removal. There were also large infestations with dense canopy covers of the other non-native species, most especially *Brassica nigra*, *Bromus diandrus*, *Bromus madritensis*, *Bromus*

			tectorum and *Erodium cicutarium.* The greatest concentrations of weed species seemed to be associated with roadsides, bulldozer lines and drainages near human habitation. It was difficult to distinguish whether the weed infestations were in place prior to the fires or if they were new occurrences. It was highly probable that the weed species were already present in most of the areas seed banks, but were released from competition following the fire. Iit was obvious that *Centaurea melitensis*, *Brassica nigra*, *Bromus diandrus*, *Bromus madritensis*, and *Bromus tectorum* population sizes had expanded beyond the pre-fire levels. The perennial target weed species, such as *Nicotania glauca*, also seemed to respond well to the fire associated disturbances. Piru Fire: Infestations of the target weed species *Centaurea melitensis* was the most prevalent in the areas surveyed. This species seemed to occur mostly along roads and trails but has begun to spread. The removal of this species should focus on the areas where it is actively escaping into otherwise undisturbed habitat. *Foeniculum vulgare* (fennel) was detected in several areas, had patchy distribution, and occupied a small enough acreage to warrant efficient removal. *Spartium junceum* was found to occur along road ditches and drainages and was spreading into the stream systems. *Tamarix ramosissima* (tamarisk) is known to occur along the Sespe Creek and needs to be mapped. Efforts to control *Tamarix ramosissima* by hand pulling are being conducted by a volunteer group and mapping of these infestations is needed as part of effectiveness monitoring. The non-native grass species *Avena barbata, Bromus diandrus, Bromus madritensis,* and *Bromus tectorum* were also recorded as commonly occurring within both the Wolf and Piru burn areas.
Road and trail treatments	Cedar, Paradise, Grand Prix/Old, Piru Fires	Photos, observation, completion of forms	Cedar Fire: A number of overside drains failed after both the April 2 thunderstorm and the unusually heavy (>9 inches) October, 2004 rain events After reviewing the road forms, it appeared that overside drains failed more than any other treatment. Upsizing of overside drains appeared to be effective as of mid-July, but conditions were unknown following the October, 2004 rain events. Rolling dips with lead-offs were successful in removing water from the road.

			The OHV removable pipe barriers were successful in deterring OHV activity in areas where they have been placed. Barbed wire fencing was less successful in deterring both mountain bike and OHV activity. The fencing was cut in a number of areas and literally knocked down in others. It is recommended that patrols be added along with barriers or fencing as an added deterrent. Piru Fre: *Storm patrol* - The storm patrol was contracted out by the Los Padres National Forest to one individual. Distance, time, and road failures prevented access to all sites during storm events. Thus, it was rare for failures to be prevented by the storm patrol. For the most part, the storm patrol was only able to identify where treatments had failed or new failures had occurred. *Low water crossings with K-rails* - Out of the7 total LWC's with K-rails installed, 4 were originally placed too high and failed, and 3 were placed low enough and were successful. In many cases, repairs had to be repeated numerous times (further lowering of K-rail) until treatment was deemed successful. Further monitoring of this treatment is needed to access the value of this treatment. *Overside drains* - Both overside drains with metal outlets and overside drains with either Little Macs or Big Macs worked. *Culvert cleanout and culvert replacement* - Existing culverts needed to cleaned out following most storm events. Most culverts that were replaced were upsized and appeared to be working. *Road grading* - Because of the constant deposition of dry ravel and fluvial sediments, road grading was a continuous and successful treatment application through late Fall 2003 and Winter 2004. Berms worked well where outsloping of the road was not wanted. *Rolling dip with lead-off* - This treatment was successful in keeping the roads from rilling and gullying. Overall, the money spent on road treatments, (especially that spent in the Sespe unit) was worth the cost. The roads here have remained open and have provided important access to both the oil fields nad the Sespe Wilderness area.
Heritage resources	Cedar, Grand Prix/Old, Padua Fires	Photos, observation	At all locations, treatments (fencing, gates, or barriers) were effective. There was no evidence of looting or other impacts.

Chapter 1:
Introduction

The Southern California wildfires that began in late October 2003 consumed more than 750,000 acres (~ 40% occurring on Federal lands) (Fig. 1). Burned Area Emergency Response (BAER) teams assessed the burned areas to determine if treatments were necessary to protect life and property; water quality; roads and trails; heritage resources; and threatened or endangered plant and animal species.

Fig. 1.1. False-color infrared MODIS scene showing fire locations, acquired November 5, 2003 (Clark et al. 2003).

After BAER assessment, funds were requested for treatments specific to the individual fires, including monitoring. However, a GAO report found that current monitoring practices need improvement in consistency, coordination, and information reporting. Consequently, the Pacific Southwest Research Station (PSW) developed a monitoring plan to address common treatments applied across the fires.

A variety of BAER treatments were implemented at each fire to protect specific values at risk, most of which were monitored for effectiveness. Effectiveness of four land treatments was monitored: (1) aerial hydromulching (Cedar Fire) was monitored using silt fences and vegetation plots, (2) fiber rolls (straw wattles) were monitored using photo points, (3) aerial straw mulching and (4) hand-placed straw mulching (Grand Prix/Old Fire) were monitored using photo points and repeat photography. Two channel treatments were monitored: (1) straw bale check dams were monitored using photo points combined with repeat photography (Grand Prix/Old Fire), and (2) log check dams (log erosion barriers) were monitored using photo points on the Piru Fire. Noxious weed populations were monitored by local forests for expansion and new invasion (Cedar, Old/Grand Prix, and Piru Fires). Effectiveness of road treatments including signs and fencing were monitored by storm patrols and road engineers after storm events when possible, and at the end of the rainy season (Cedar, Grand Prix/Old, and Piru Fires). Heritage resources were inspected as determined by the local Forests (Cedar, Grand Prix/Old, Piru, and Padua Fires). Soil quality was identified as an issue, but was not included in the final monitoring proposal. However, a protocol addressing soil quality is included in this report as Appendix F.

In this report, established and published monitoring protocols were used when possible. For those treatments where no protocols existed, professional expertise was used to devise the appropriate method. Effectiveness monitoring strategies were:

1. Land treatments and plant cover/diversity) – to measure the effectiveness of the treatment in reducing erosion, and its effect on vegetation recovery.
2. Channel treatments – to monitor the effectiveness of treatments on sediment delivery and water movement in ephemeral and intermittent drainages.
3. Road treatments – to monitor the effectiveness of treatments in reducing road failures
4. Noxious weeds – to monitor the expansion of known infestations and identify introductions of new species.
5. Heritage site protection – to monitor treatments that were implemented to protect the cultural resource at risk.

Treatments varied between fires according to the values at risk. Every fire was different and treatments were planned accordingly. The rapidly expanding wildland /urban interface in San Diego County, for example, called for hillslope treatments to protect communities at risk from erosion processes following the Cedar Fire. In the Piru Fire, treatments focused on road repair because access into the Sespe oil fields and Sespe wilderness condor refuge were major at risk priorities. In respect to the Grand Prix/Old Fire, watersheds above Silverwood Lake were treated to prevent sedimentation of the reservoir and to protect water quality.

Chapter 2:

Cedar Fire - Cleveland National Forest

Introduction

The Cedar, Otay and Paradise Fires of October and November, 2003 burned a total of ~380,000 acres, destroyed approximately 2,700 residences, and claimed 16 lives. Of this total, the Cedar Fire burned 284,790 acres of public and private lands. The fire consumed most of the effective cover within the burned perimeter, however, existing rock cover in places was up to 30% of the ground surface. Most riparian areas were completely consumed, except for those located in lower and moister drainages.

Chaparral shrub skeletons were left chiefly intact following the fire. Shrub re-sprouting should result in effective cover within a 3 to 5 year recovery period. Soil burn severity and water repellency is included in Table 2.1. The majority of shrub species registered moderate burn intensity, while trees and high duff layers had high burn intensity levels.

Table 2.1. Soil burn severity and water repellency

Burn severity	Acres
Low	4,232
Moderate	52,386
High	6,864
Water repellency	none

Because of loss of plant cover, watershed response to precipitation events was mapped as high over most of the fire area and runoff and sediment yield was expected to increase substantially. The BAER team identified several watershed locations at risk, including Peutz Valley, San Diego Country Estates, and El Capitan Reservoir. Aerial hydromulch was prescribed for the watersheds above Puetz Valley. Fiber rolls (straw wattles) were prescribed for the watershed above San Diego Country Estates. No treatments were prescribed for the El Capitan Reservoir, although there were debris flow hazards from Forest Service slopes above the reservoir's parking lot and boat ramp. The BAER geologists concluded that no slope stabilizations measures could be taken to mitigate the hazard, therefore, road closures into the area were recommended. Numerous road treatments were prescribed, along with gates and barriers to prevent OHV access. In addition, monitoring of noxious weeds was prescribed.

Monitoring status, modifications, and operational problems encountered

The monitoring proposal was modified at San Diego Country Estates. It was originally planned to use silt fences to monitor the fiber rolls. After field review, this was changed to field observation and photo points. Road monitoring was delayed because repairs were not completed because of disputes between private landowners and the National Forest (specifically Anderson Truck Trail). Road storm patrol was contracted out and was not available to record and complete the road survey forms. We acquired post-storm information on road repairs from Mark Marquette and Joe Leone (Engineers – Cleveland N.F.). It will be important to monitor second year recovery and erosion response to winter storm events. Precipitation during the 2003/2004 season was below normal and followed 5 years of drought.

Hillslope treatments

Aerial hydromulch, Puetz Valley - Viejas Mountain

Background

Many hillslope erosion treatments that are in current use have been under-studied. The application of hydromulch as a post-fire hillslope treatment will increase and so will the costs, especially when applied by helicopter. Effectiveness monitoring was conducted to determine if the treatment was effective in preventing erosion, and also if it was cost effective when compared to the values at risk.

The aerial hydromulch was a wood and paper mulch matrix with a non water-soluble binder. The mulch is mixed as a slurry and applied by helicopter (Fig. 2.1, 2.2). It was applied at 100 % cover and laid on a contour at 30 m intervals to both Forest Service and Capitan Grande Indian Reservation land in the upper portion of the Peutz Valley watershed (Fig. 2.3, 2.4). It is important to note that the average hydromulch cover area was below the planned 100 and 50% cover targets. Mean values for actual coverage after application were 51% for the "100% treatment and 30% for the "50% strip treatment". The purpose of the treatment was to provide immediate ground cover to help reduce flood peaks and sediment yield downstream in the community of Peutz Valley where there were high values at risk. Aerial straw mulch, though less costly than aerial hydromulching, was considered but discounted because it would not likely remain in place due to winds in the area. Additional views of hydromulch application can be viewed in Appendix E.

Fig. 2.1. View of hydromulch being applied in 30 m wide strips.

Fig. 2.2. View of strip hydromulch applied to west side of Viejas Mountain near Alpine, CA.

Fig. 2.3. Hydromulch strip treatment that was applied at 30 m intervals on the contour.

Many concerns were addressed by the community before, during, and after the hydromulch treatment application. Primary concern focused on the mulch suppressing native seed germination, thus increasing long-term rates of erosion as more bare soil would be exposed to rainfall once the mulch decomposed. Additionally, there was concern that post-fire mulch treatment would encourage the spread of non-native invasive species and disrupt processes of native plant succession. And third, many believed the project unnecessary because of the rapid post-fire recovery of chaparral systems that naturally resprout and reseed without human intervention.

There were also concerns addressed by the Forest over the installation of silt fences for monitoring purposes. Concerns focused on ground disturbance caused by frequent traversing of the area (footpaths), trenching, and removal of soil. In addition, the Forest did not believe that they could supply an adequate work force to help monitor and maintain the silt fences, because of too many competing post-fire priority projects.

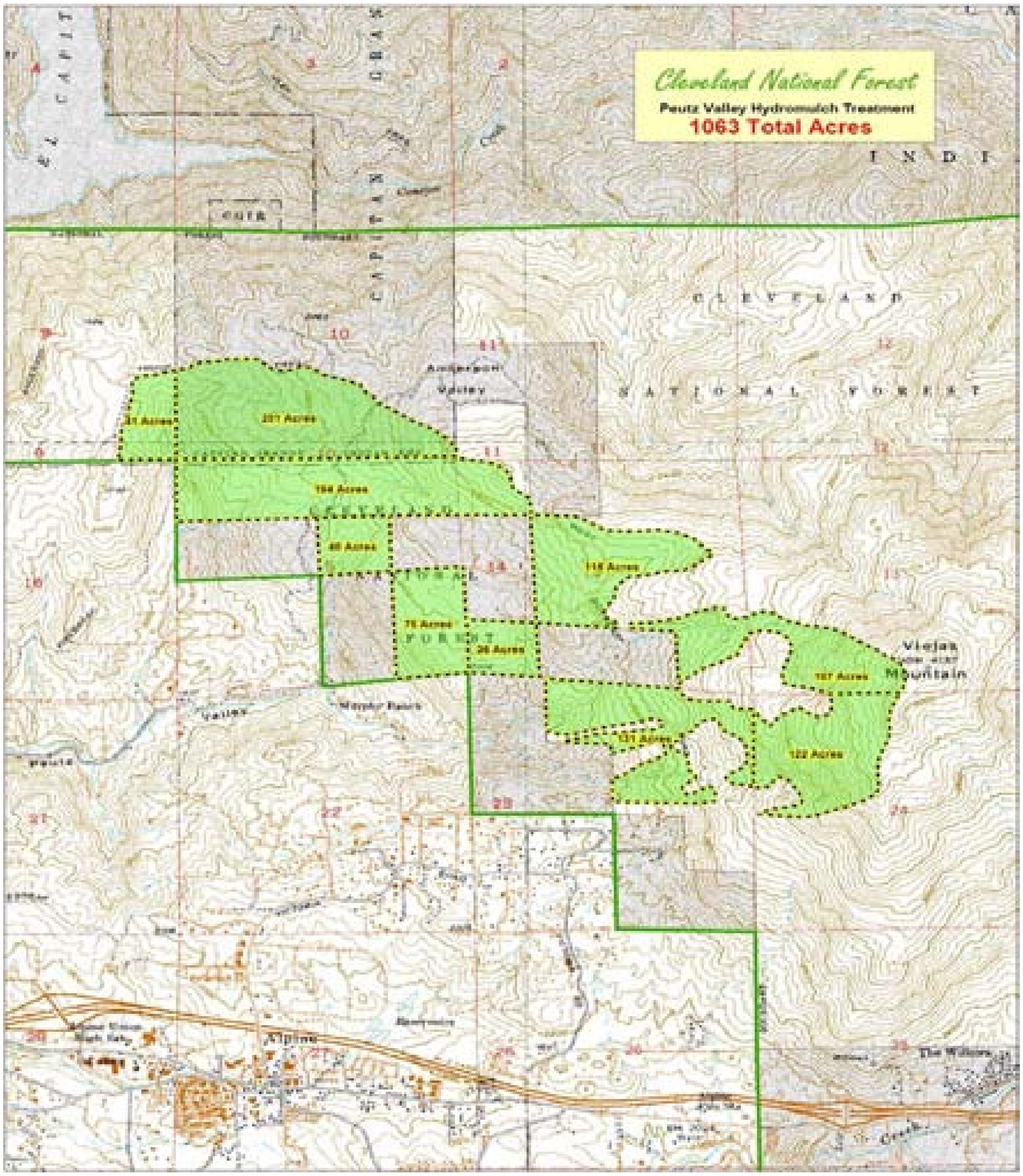

Fig. 2.4. Land treatment effectiveness monitoring sites for Cedar Fire located above Puetz Valley. Sites were located on both Capitan Grande Indian Reservation and FS responsibility lands. The 201 acres on the Capitan Grande Reservation were treated with 100% aerial hydromulching, and the Forest Service lands were treated with strip aerial hydromulching to provide 50% coverage.

Silt fence installation

Monitoring sites need to be installed on relatively uniform hillslope facets that avoid swales and interfluves. This proved difficult in our site selection due to the highly dissected terrain. Sites also need to be representative of the overall landscape category that is being treated and should be reasonably accessible by highways or Forest roads (Robichaud and Brown, 2002). Silt fences form a barrier to trap and retain hillslope erosion from the treated areas and their associated controls. For a more detailed discussion of silt fence theory, construction, cleanout, and data analysis see UDSA Forest Service General Technical Report RMRS-GTR-94 (Robichaud and Brown, 2002).

In brief, a silt fence is constructed of synthetic woven geotextile fabric that passes water but not sediment. Silt fences were oriented across the contour perpendicular to the lines of potential runoff (Fig. 2.5). Silt fence construction began with digging a 20 ft long trench that is curved slightly uphill to hold the collected sediment. The bottom 6 inches of the 4-foot wide fabric was placed in the trench and buried under compacted soil. Five metal posts were driven into the ground at a 3- to 5-foot spacing just downhill of the trench, and the fabric was then secured to the posts with wire.

The approximate 5-foot collecting area upslope of the silt fence was smoothed of any rocks or uneven spots, and a layer of red construction chalk was then applied to mark the boundary of the natural soil and any subsequent accumulated sediment. The upslope contributing area was limited to 100 feet so the structure is not overwhelmed or does not overtop. An uphill boundary in the form of an inverted ‘V’ was trenched with a Pulaski. In cases where we encountered a natural boundary, the measured length to the obstruction was used.

Fig. 2.5. Representative silt fence construction viewed from contributing area. Note red chalk placed at base of silt fence designating the surface boundary.

With the help of the Alpine Ranger District fire crew, we installed a total of 54 silt fences at the site. We monitored both the 100% hydromulch and the 50% strip hydromulch treatments. In addition, we compared the treatments on two different parent materials, granite bedrock and gabbro bedrock. Silt fences were distributed as follows: gabbro control = 13; gabbro strip 50% cover = 11; granitic control = 10; granitic strip 50% cover = 10; and 100% cover granitic = 10. Controls were placed in areas with comparable characteristics of geology, soils, topography, burn severity and pre-fire vegetation.
Each silt fence contributing area was inventoried for the following site attributes: (1) slope, (2) aspect, (3) hillslope position, and (4) soil texture. Silt fence GPS locations are given in Appendix H.
Silt fence construction was completed in late January. Late construction of the silt fences was a result of delays in funding for the project which did not get final approval until late December. We missed the

Christmas Day storm event of 1.37 in and also a 1.14 in November rain event (Table 2.2). Fortunately, neither one of these storms produced much in the way of hillslope erosion (personal communication Dan Ford).

Rainfall intensity, duration, and amounts controlled much of the hillslope and watershed hydrologic response. Two rain gages were installed within the site perimeter at the end of January. We also used precipitation data that was downloaded from the RAWS station located in Alpine, CA (Table 2.2). Site descriptions for both granitic and gabbro parent materials are included in Appendix C.

Sediment and debris measurement

We attempted to visit the silt fences after each rain event, but found it impossible due to closely spaced rain events in February that did not allow us the time to empty the stored sediment. We were able to empty the silt fences of sediment on Mar 2, Apr 13, and May 16, 2004. Sediment was shoveled and scraped down to the chalk marker boundary and placed in 5-gallon buckets. The buckets were weighed in the field with a scale, and the data recorded on datasheets. A sub-sample was taken from each bucket to be taken to lab for moisture content determination and particle size distribution. After sediment removal, the collecting area was smoothed and new chalk was laid down. The silt fences are to remain in place for a three-year period.

Sediment data analysis

The first rain event (Feb 2, 3) to occur after gage and silt fence installation recorded 1.2 inches. We observed little movement of soil on the hillslopes, and little or no sediment accumulation behind the silt fences at either the treated or control sites. However, three check dams constructed by Pete Robichaud as part of an ongoing “small watershed scale monitoring” project accumulated a substantial amount of sediment (personal communication Pete Wohlgemuth). This indicated that there was a high hydrologic response in the channels that released and moved stored sediment.

Our first collection of stored sediment occurred on Mar 2 following a series of storms that occurred in February 2004 (Fig. 2.6). Total rainfall amounts for the period were 5.7 in. All treatments exhibited lower sediment totals than did the controls (Fig. 2.6). For the control/granitic treatment, we noticed that rills entered into the contributing area from outside the contributing area boundary for silt fence numbers 42 and 43. By ocular estimate, we corrected by 30% the sediment totals of these sites (i.e. we subtracted 30% from the final weight). The control plots on the granitic parent material produced more sediment than on the control plots on the gabbro. This may have reflected the difference in rock cover between the sites, gabbro rock cover = 23% and granitic rock cover = 3% (Fig. 11), but this was not totally clear as seen in Fig. 2.7.

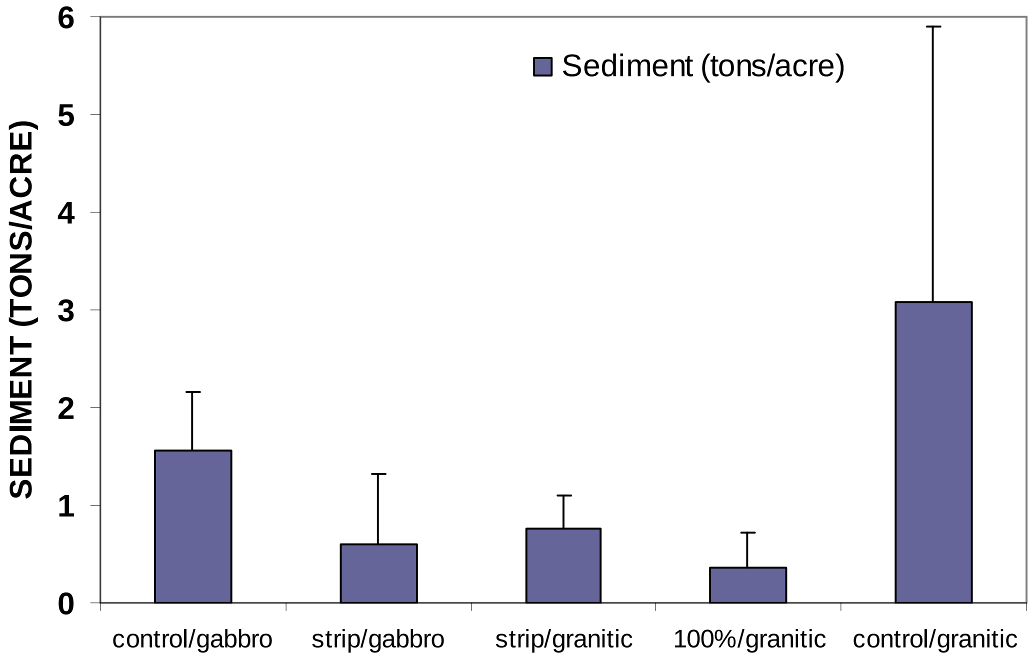

Fig. 2.6. Mean values of sediment collected Mar 2, 3 following Feb and Mar precipitation of 5.7 in. Sampling size: Control/gabbro n = 13; strip/gabbro n = 11; strip/granitic n = 10; 100% granitic n = 10; control/granitic n = 10.
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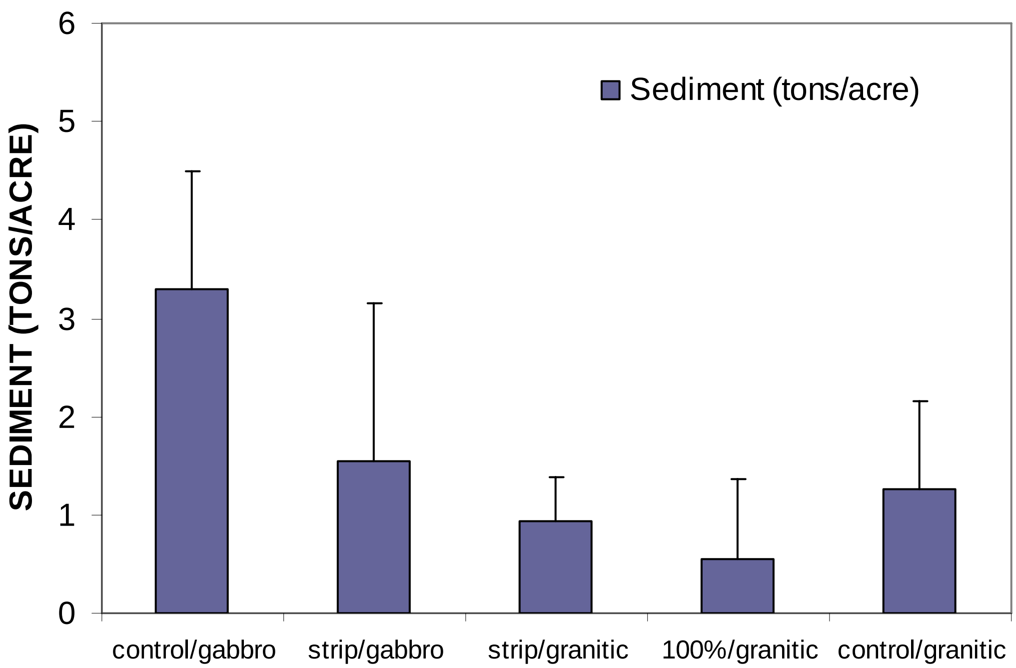

Fig. 2.7. Mean values of sediment collected Apr 13, 14 following March and April precipitation of 0.85 in.

Precipitation between Mar 3 and Apr 13 totaled 0.69 in of, 0.62 in falling on Apr 2, 2004 during a thunderstorm event. Much of the erosion was produced during one afternoon thunderstorm event that occurred on Apr 2. There was an increase in sediment production in both the control and treated gabbro plots (Fig. 2.7), which was opposite of what is seen in Fig. 2.6. The reversal in sediment production may have reflected differences in infiltration rates between the two soils. The gabbro soils have lower infiltration rates than the granitic soils (Soil survey, Cleveland N.F.). If the gabbro soils had lower storage capacity than the granitic soils, then antecedent moisture conditions may have been such that overland flow was increased as infiltration rates were overcome. Steeper slopes in the gabbro terrain likely contributed to the higher sediment amounts (Fig. 20). It appeared that rock cover (Fig. 2.10) was contributing to sediment production, which was opposite to results seen in Fig. 2.6. This may be explained by the greater intensity of the thunderstorm. During intense rain events, rock provides cover but also deflects water to its downward side. The force of the water initiates rill formation below the rock and sediment production is greatly increased. Rilling was observed in the gabbro plots below a number of individual rocks. Additional graphs showing sediment accumulation in relation to rainfall intensity at the gabbro control site are included in Appendix B.

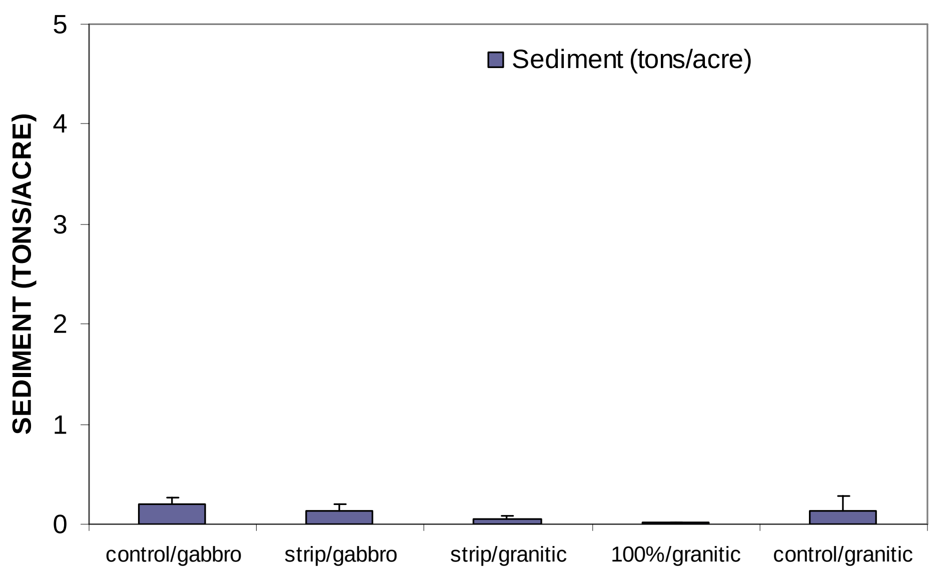

Fig. 2.8. Comparison between treatments of mean values of sediment collected on May 16 following April and May precipitation totals of 0.41 in**.**

The lower sediment totals across all treatments were attributed to low precipitation, low rainfall intensity, and the increase of vegetation cover (Figs. 2.8, 2.10). Additionally, the increased vegetation cover increased transpiration on the sites, thus removing water stored in the soil. Therefore, the soil had more storage capacity than in February and March.

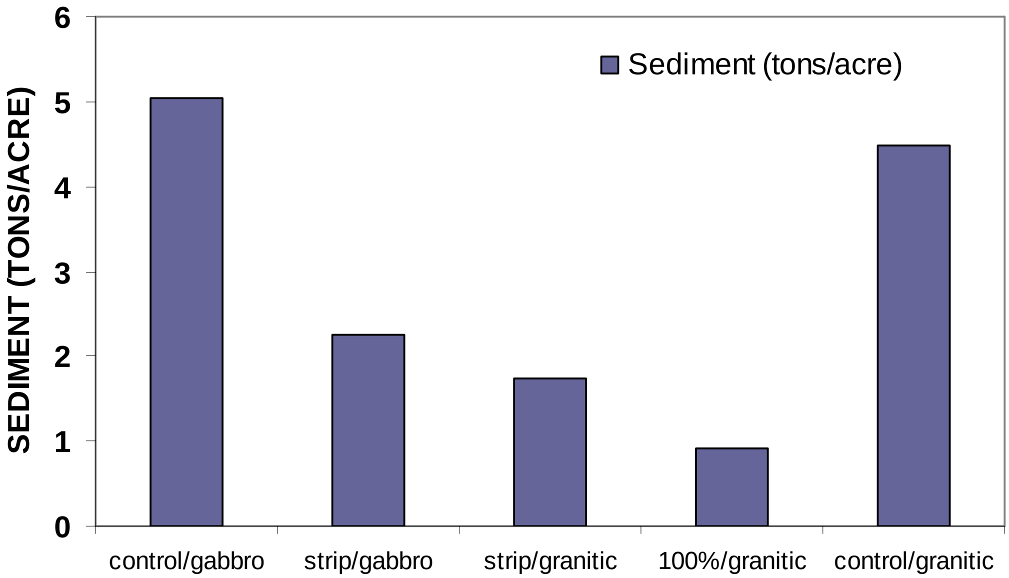

Fig. 2.9. Comparison between treatments of all accumulated sediment collected from Mar 2 through May 16, 2004.

Aerial hydromulch reduced erosion in both the 50% strip and 100% cover treatments. The 50% strip hydromulch treatment reduced erosion by >50% in both the gabbro and granitic parent materials. The 100% hydromulch treatment reduced erosion by ~75% on granitic parent materials. However, the below normal rainfall amounts resulted in erosion totals in the control plots that were below BAER erosion potential predicted amounts of 7.6 tons/acre (Frazier, 2003). It appeared that the "100% cover treatment reduced erosion better than the "50% strip treatment" (0.91 tons/acre as compared to 1.74 tons/acre) (Fig. 2.9). However, it was previously noted that values for actual coverage after application were 51% for the "100% treatment and 30% for the "50% strip treatment. Considering the minimal erosion protection gained by the "100% treatment, difference in treatment costs in relation to values at risk must be weighed carefully before final treatment decisions are made.

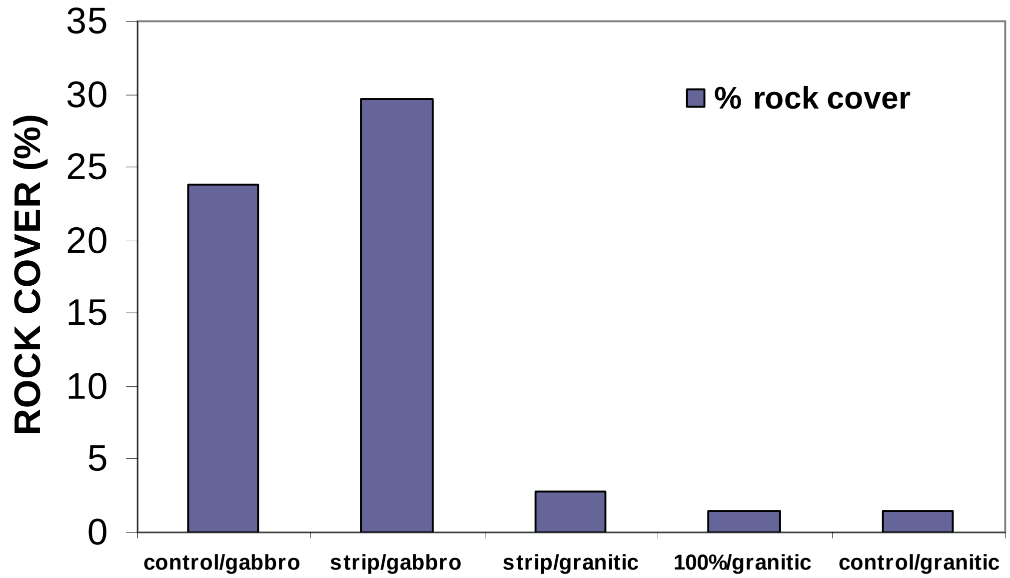

Fig. 2.10. Comparison of percent rock cover between gabbro and granitic parent material under all treatment conditions.

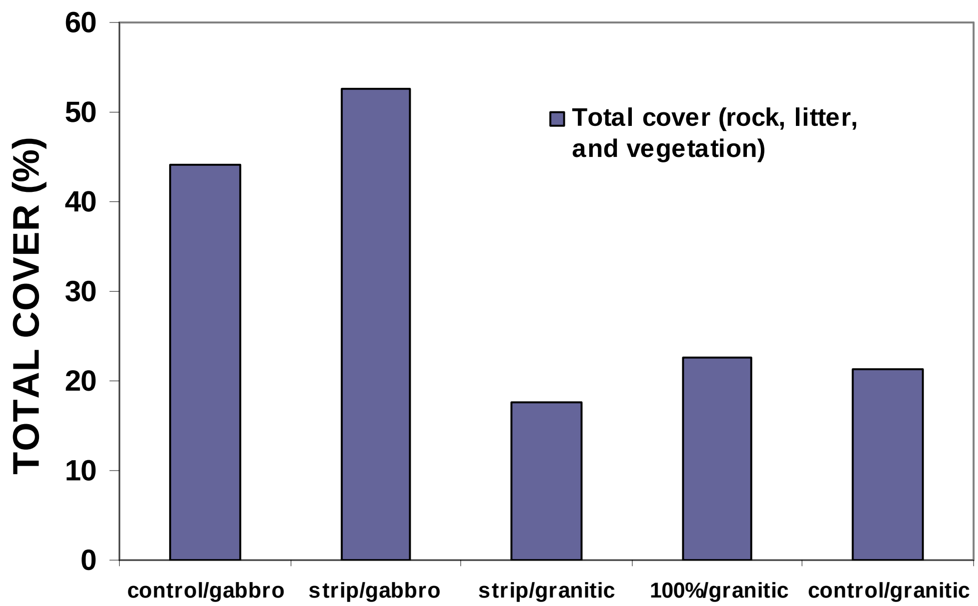

Fig. 2.11. Comparison of total cover (rock, litter, and vegetation) between gabbro and granitic parent material under all treatment conditions.

Table 2.2. Precipitation measured at RAWS Alpine, CA weather station

Month	Day						Monthly total
Nov, 2003	Nov 2 0.01	Nov 3 0.04	Nov 4 0.03	Nov 12 1.14	Nov 16 0.12		1.34
Dec	Dec 7 0.07	Dec 8 0.13	Dec 11 0.01	Dec 25 1.37	Dec 26 0.06	Dec 28 0.02	1.66
Jan, 2004	Jan 2 0.33	Jan 3 0.28	Jan 25 0.14	Jan 27 0.01	Jan 28 0.06		0.82
Feb	Feb 3, 4 0.96	Feb 18 0.47	Feb 21-23 2.35	Feb 26 0.67	Feb 27 0.20	Feb 28 0.02	4.67
Mar	Mar 2 0.5	Mar 3 0.03	Mar 26 0.01	Mar 28 0.03			0.57
Apr	Apr 2 0.62	Apr 3 0.07	Apr 4 0.09	Apr 17 0.41			1.19
May through Sep							0.0
Oct	Oct 17 0.96	Oct 18 0.52	Oct 19 2.18	Oct 20, 21 2.91	Oct 27 2.13	Oct 28 0.74	9.44
Nov to Oct totals							19.69

Vegetation recovery monitoring in conjunction with silt fences (Viejas Mtn area)

Vegetation recovery monitoring was done in conjunction with sediment monitoring. We used the contributing boundaries that extended up from the silt fences for 100 ft on both sides as transects. On the right side looking up from the silt fence, we sampled at 5 m, 15 m, and 25 m. On the left side boundary, we sampled at 10 and 20 m. At each sampling point, we placed a 1 m square frame on the surface that was separated into one hundred 10 cm^2 grids. The following criteria was established to record the type of cover within each grid: rock <3 in, rock > 3 in, bare soil, grass, forb, stump, shrub, downed wood >2, downed wood <2, litter, and treatment. We sampled 5 plots at 54 silt fences for a total of 270 individual sampling sites.

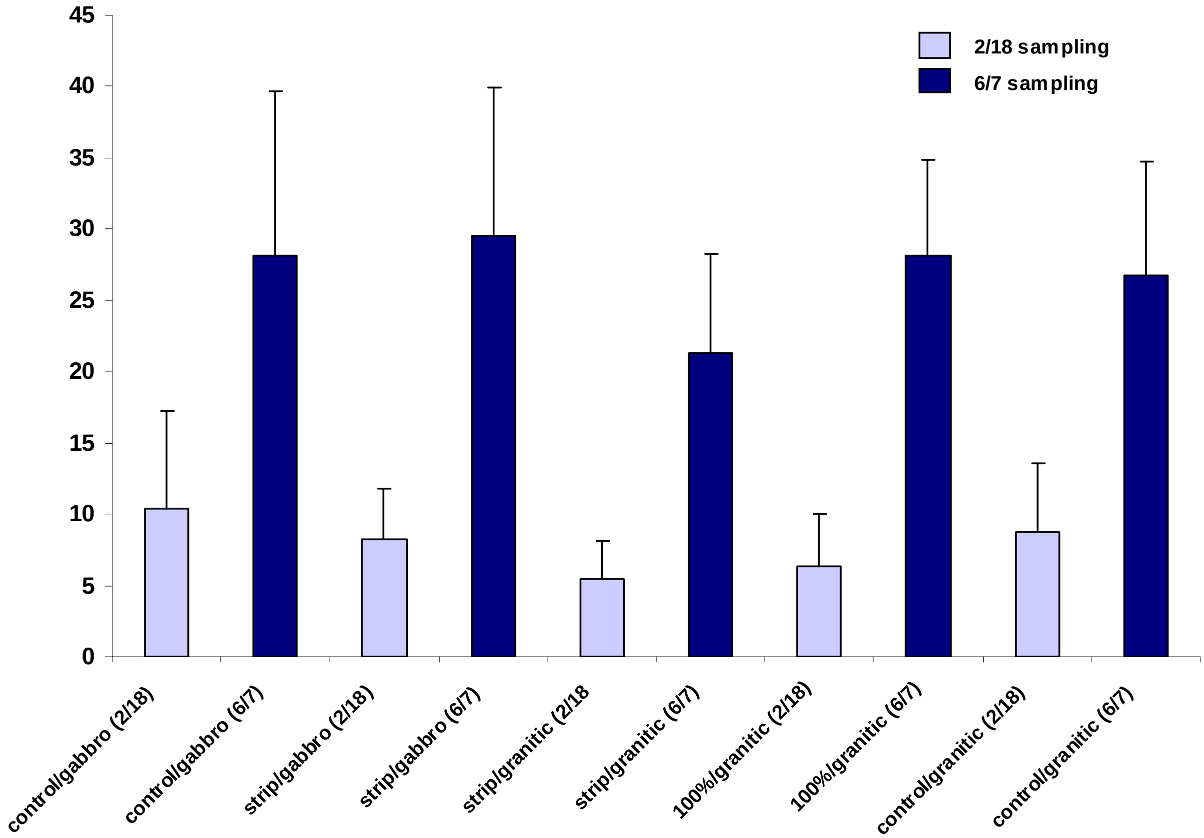

Fig. 2.12. Mean values of percent vegetation cover sampled on Feb 18 and on Jun 7 for all treatments. Cover included vegetation, litter, and reprouting and non-resprouting stumps. In this case, rock and treatment cover were not included to help in identifying any effects hydromulch treatments had on vegetation recovery. Sampling size: Control/gabbro n=65; strip/gabbro n=55; strip/granitic n=50; 100% granitic n=50; control/granitic n= 50

There was substantial vegetation recovery at both the control and treatment sites, even allowing for very low rainfall following 5 years of drought (Fig. 2.12). Figures 2.13, 2.14, and 2.15 showed recovery over a 5-month period. Litter was included here to account for any herbaceous or grass species that had germinated and died. In most cases, it appeared that the hydromulch did not affect the recovery of either forb/grasses or shrub resprouters (Fig. 2.16). Lowest percent recovery occurred in the 50% strip hydromulch treatment on the granitic parent material (Fig. 2.12). This may have been due to distribution problems in application of the hydromulch. In some areas of the hydromulch strip, the hydromulch was up to 2 inches thick. Distribution of the hydromulch in the 30 m strips tended from thin at the boundaries to thick in the middle. Shrub resprouters were prevalent at all plots and were not inhibited by any of the hydromulch treatments. By the June 6 sampling date, it was observed that nearly 100 percent of resprouting shrubs had resprouted. In Fig. 2.16, there was greater response by forbs/grasses in the strip treatments on both granitic and gabbro parent materials. More moisture was probably stored at the soil surface because of the hydromulch, which, in turn would benefit species with shallow rooting systems.

Fig. 2.13. Photo of the burned area underlain by granitic parent material taken in December 2004. There were few signs of vegetation recovery at this time.

Fig. 2.14. View of contributing area of silt fence 39 (100% treatment-granitic) showing vegetation recovery on 2/19/2004. Chamise skeletons were just beginning to resprout.

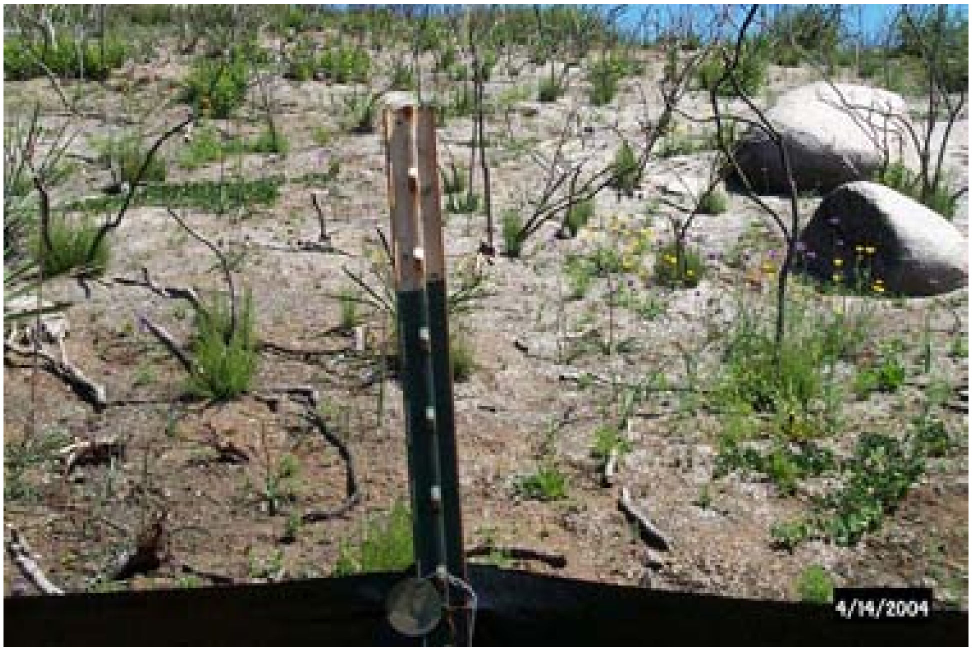

Fig. 2.15. Same view of contributing area of silt fence 39 (100% treatment-granitic) showing vegetation recovery on 4/14/2004. chamise were vigorously resprouting.

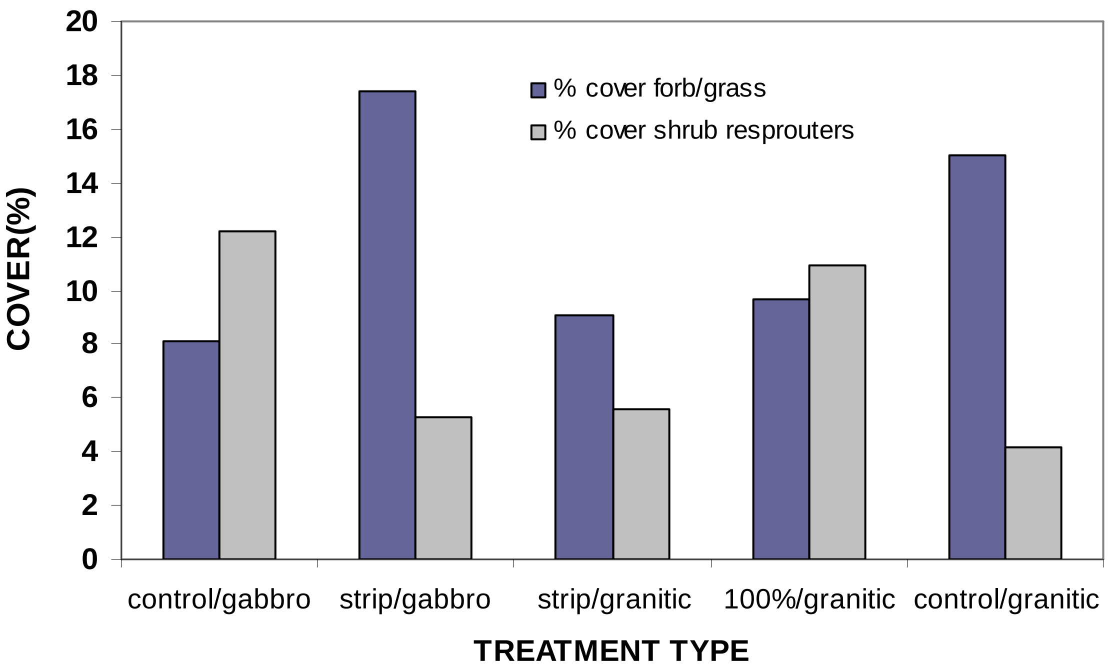

Fig. 2.16. Comparison of percent cover between forb/grass and shrub resprouter species sampled on June 7, 2004. Forbs/grasses showed a higher response to the strip treatment on gabbro which may be a result of greater moisture stored at the surface due to the hydromulch.

Fig. 2.17. Photo of resprouting chamise taken on 2/19/2004.

Chamise was the dominant chaparral species on both the gabbro and granitic plots. Almost all chamise skeletons were resprouting, but at 2/19/2004 it was not providing much cover (Fig. 2.17**)**

Fig. 2.18. Photo of resprouting scrub oak taken on 2/19/2004.

Scrub oak resprouters were located in depression areas and near drainages, but were not nearly as abundant as chamise. However, the resprouting was vigorous and early cover was established where they were located (Fig. 2.18). Compare percent ground area covered with individual cover provided by chamise (Fig. 2.17).

Fig. 2.19. Photo of wild cucumber taken on 2/19/2004.

Wild cucumber was one of the first herbaceous fire followers to become established after the fire (Fig. 2.19). In locations where it became established, it spread rapidly across the surface soil to provide cover. It progressed to the seed stage rapidly, but still provided litter cover after die-off.

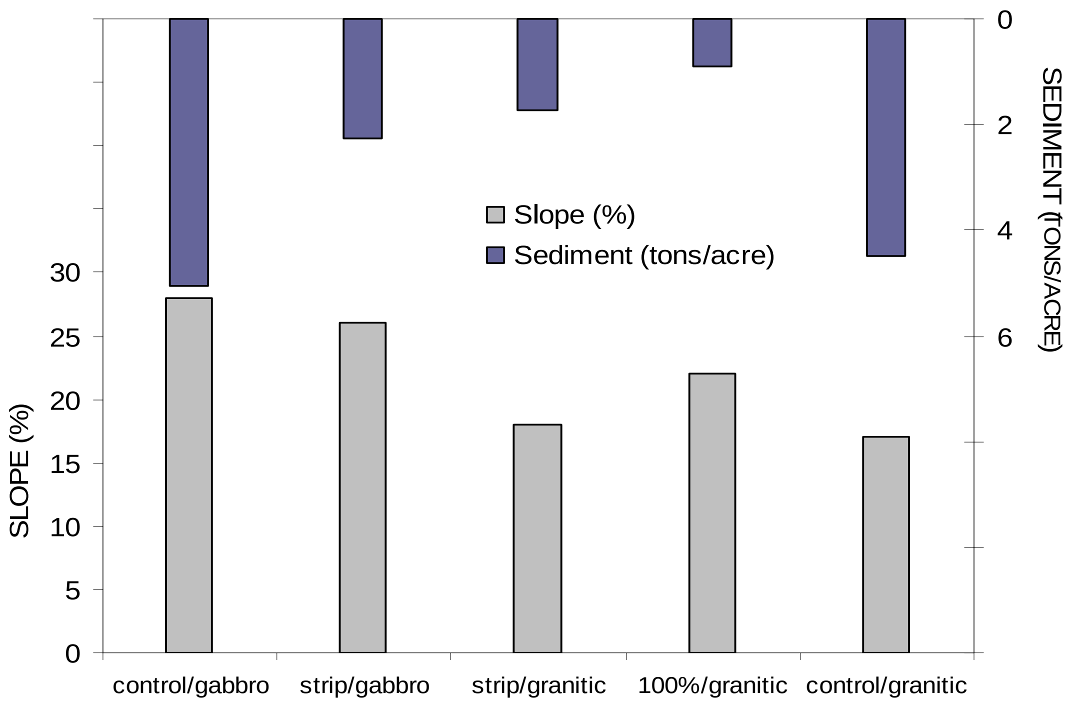

Fig. 2.20. Comparison of percent slope and sediment production between treatments and controls.

Table 2.3. Mean plant cover and frequency (in parentheses) per species for 0, 50 and 100% hydromulch treatments.

Species			**May**			**June**		
Scientific Name	**Common Name**	**Life Form**	**0**	**50**	**100**	**0**	**50**	**100**
Adenostoma fasciculatum	chamise	shrub	1.36 (4)	1.54 (5)	0.56 (4)	2.54 (4)	2.16 (5)	1.80 (5)
Allium haematochiton	red-skinned onion	forb	0.68 (3)	1.10 (3)	0.48 (3)	0.14 (2)	0.68 (3)	0.82 (2)
Antirrhinum coulterianum	Coulter's snapdragon	forb	----	----	----	0.20 (2)	0.22 (4)	----
Arctostaphylus sp.	manzanita	shrub	0.78 (3)	0.38 (3)	1.50 (3)	1.48 (3)	1.36 (2)	1.82 (3)
Baccharis salicifolia	mule-fat	forb	0.08 (1)	0.22 (1)	----	----	----	----
Calochortus albus	white globe lily	forb	0.16 (2)	0.04 (1)	0.34 (3)	0.22 (2)	0.88 (5)	0.46 (3)
Calystegia macrostegia	morning glory	vine	2.70 (3)	1.10 (2)	1.64 (2)	4.56 (2)	3.24 (2)	2.22 (2)
Ceonothus sp.	lilac	shrub	0.16 (2)	0.20 (3)	0.18 (2)	0.28 (5)	0.12 (2)	0.54 (3)
Chlorogalum parviflorum	wavyleaf soap plant	forb	1.92 (4)	2.48 (4)	0.98 (4)	1.54 (4)	0.72 (3)	1.98 (5)
Clematis pauciflora	ropevine clematis	vine	0.02 (1)	----	----	0.40 (1)	0.40 (1)	0.06 (1)
Dichelostemma capitatum	bluedicks	forb	0.5 (5)	0.46 (4)	0.28 (3)	----	----	----
Emmenanthe penduliflora	whispering bells	forb	----	----	0.04 (2)	0.62 (2)	----	----
Eriophyllum confertiflorum	golden yarrow	forb	0.14 (2)	----	----	0.14 (2)	0.10 (1)	0.22 (1)
Galium aparine	bedstraw	forb	0.04 (1)	0.16 (2)	----	----	0.02 (1)	----
Hazardia squarrosa	sawtooth goldenbrush	forb	0.20 (1)	----	0.14 (1)	0.20 (1)	----	----
Heteromeles arbutifolia	toyon	shrub	----	----	----	----	----	----
Lomatium lucidum	shiny biscuitroot	forb	0.40 (1)	----	0.32 (2)	----	----	----
Lotus scoparius	deer weed	forb	0.10 (1)	0.18 (1)	----	0.80 (1)	0.4 (1)	2.62 (2)
Lotus sp.	lotus	forb	----	0.10 (1)	----	----	----	----
Monardella hypoleuca	thickleaf monardella	forb	0.10 (2)	----	0.06 (1)	----	----	----
Phacelia parryi	Parry's phacelia	forb	0.22 (1)	0.40 (1)	0.04 (1)	1.06 (2)	0.6 (1)	0.60 (2)
Prunus ilicifolia	hollyleaf cherry	shrub	----	----	3.16 (2)	----	----	----
Quercus berberidifolia	scrub oak	shrub	0.86 (1)	0.60 (2)	0.08 (1)	1.16 (2)	2.00 (2)	2.70 (3)
Rhamnus ilicifolia	holllyleaf redberry	shrub	----	----	----	----		1.26 (1)
Rhus trilobata	skunkbrush sumac	shrub	----	----	----	----	1.20 (1)	0.40 (1)
Ribes indecorum	whiteflower currant	shrub	0.04 (2)	----	----	----	----	----
Salvia columbariae	chia	forb	----	----	----	----	----	0.04 (1)
Salvia sonomensis	creeping sage	forb	----	0.40 (1)	----	----	----	----
Sidalcea malviflora ssp. *sparsifolia*	dwarf checkerbloom	forb	----	----	----	0.10 (1)	----	----
Solanum douglasii	greenspot nightshade	forb	----	0.08 (1)	----	----	0.60 (1)	0.06 (1)
Tauschia arguta	southern umbrellawort	forb	----	----	----	0.30 (1)	0.34 (1)	0.16 (2)
Yucca whipplei	chaparral yucca	forb	----	----	0.40 (1)	----	----	----
Zigadenus fremontii	Fremont's deathcamus	forb	0.20 (3)	0.42 (4)	0.76 (3)	0.62 (3)	0.92 (4)	0.64 (3)

In Table 2.3, chamise increased in mean cover percentage for all treatments (0, 50, and 100% hydromulch) between May and June 2004. However, cover was lower overall in the 50 and 100 % treatment when compared to the control zero % cover. The same increase in cover % from May to June was seen for scrub oak also. But overall scrub oak June cover % was greater in the 50 and 100% treatment when compared with May. This suggested that the recovery of the resprouting species chamise may be inhibited by the 50 and 100% mulch treatments, whereas scrub oak benefited from both treatments.

A complete list of species identified on both granitic and gabbro parent materials at Viejas Mountain (Cedar Fire) is included in Appendix M.

Fig. 2.21. Rilling of “100% cover hydro-mulch applied on steep (>55% slope) roadcut in the Devore area.

Rilling of both the 50% strips and 100% cover hydromulch treatments was minimal on the Viejas silt fence plots (most slopes were 30% or less). Rilling was observed on some of the steeper slopes at Viejas, mainly on the Gabbro parent material. On slopes >50% (Fig. 2.21 above) where water is flowing with greater energy, rills can form and cut through the hydromulch. After the 2003 Christmas Day storm and the February 2004 rain events, heavy rilling was commonly observed on the hydromulch treated roadcut banks (predominantly along highways).

Conclusions

- Aerial hydromulch reduced hillslope erosion in both the 50% strip and 100% cover treatments. Because of the decrease in surface erosion, it was assumed that the hydro-mulch also controlled the movement of water by allowing greater infiltration.

- Less erosion was witnessed on the 100% cover treatments as compared to the 50% strip treatments. The actual level of soil cover observed for the 50% treatment was 30 % and for the 100% treatment was 51%. The 50% strip hydromulch treatment reduced erosion by >50% in both the gabbro and granitic parent materials. The 100% hydromulch treatment reduced erosion by ~75% on granitic parent materials. However, the difference in sediment production between the two treatments was relatively small. Because of the small differences in erosion between treatment applications, it is recommended that the more economical 50% strip treatment be used.

- It appeared that the intensity of the rain event was an important factor in determining overland flow, especially when antecedent soil moisture conditions were near or at storage capacity.

• The large difference between actual cover and predicted cover suggested that monitoring of treatment implementation is necessary.

• It was difficult to determine if hydromulching was cost effective because of the continuing drought and the low precipitation amounts recorded before the October, 2004 rain events. After observing the relatively minor hillslope erosion that followed the unusually high precipitation amounts of 9.44 inches in October, 2004 (Table 2.2), it appeared that the treatment was not cost effective. Although, it was very difficult to determine what,, if any, values (homes) were at risk along the main channel into Puetz Valley, even after walking and observing the area.

• Vegetation recovery (% cover) was not hindered by the hydromulch. It is unknown at this time whether any individual species were affected, or changes in plant succession occurred.

• Both resprouting shrubs and forbs have recovered rapidly despite the below normal rainfall amounts.

• Although rock cover was much greater on gabbro parent material, it may have promoted erosion under high intensity rain events.

• From observations alone, it appeared that rilling can occur quite readily on hydromulch treated roadcut banks where slopes are >50%.

Fiber rolls (straw wattles) San Diego Country Estates – Cedar Fire

Introduction

The 36 acre treatment area was located on Forest Service land within the San Vicente watershed situated immediately above the southeast portion of San Diego County Estates (Fig. 2.21, 2.32). The area was treated with fiber rolls to protect homes which abut upslope Forest Service land. The treatment was implemented using hand crews. The major concern was increased flows from San Vicente Canyon and sediment loading of small tributaries and small drainages from the hillslopes.

Fig. 2.22. View of fiber rolls and San Diego Country Estates in background. Photo was taken in January following the 2003 Christmas Day storm.

Background

Fiber rolls are permeable barriers used to slow overland flow velocity, improve infiltration, and to a lesser degree capture and keep sediment on the slopes (Robichaud et al. 2000) (Fig. 2.22). Their primary purpose is to break up slope length. Fiber rolls are prefabricated from rice straw wrapped in tubular plastic netting. The rolls are about 9 inches in diameter, and are manufactured in lengths up to 25 ft. They are labor intensive with a 25 ft long fiber roll weighing approximately 35 pounds. They are designed for low surface flows, and should not be placed in drainages, gullies, or depression areas subject to high water flow.

Fiber roll installation

Correct installation of straw wattles is important to their effectiveness. Fiber rolls need to have good ground contact and be anchored. Trenching and backfilling help anchor the fiber rolls to the ground and plus improve their ground contact. See Appendix E for photos showing installation of the fiber rolls.

Fiber rolls are installed along the contour with slight upward angle at the lowest end of the fiber roll to promote ponding and infiltration at the mid-section of the fiber roll. Vertical spacing was dependent on the slope gradient: 30 ft spacing for slopes 5 to 15%, 25 ft spacing for slopes 15 to 25%, 20 ft spacing for slopes 25 to 50%, and 15 ft spacing for slopes >50%. Most slopes treated were between 30 to 40%, ranging from <15 to 60%. Fiber rolls were installed in staggered rolls (checkerboard pattern) with an ~18 in overlap (Figs. 2.23, 2.24). The fiber rolls were placed in trenches 3-5 in deep, backfilled on the upslope side, and staked using 6 stakes for a 25 ft roll.

Fig. 2.23. View of fiber rolls placed in checkerboard fashion upslope to the top.

Fig. 2.24. Another view of fiber roll placement. Note close spacings.

Fiber roll monitoring

The original plan was to monitor the fiber rolls using silt fences. We surveyed the site and could not find suitable control sites. It was decided to use observation and photo points to document the site. Locations of photo points (GPS) are included in Appendix E. The first series of photos were taken on Mar 24 and the second series on July 8, 2004.

The fiber rolls were inspected after significant weather events to identify failures. The 2003 Christmas Day storm event resulted in ~ 1" of rain and many fiber rolls failed as they were undercut (personal communication Dave Bacon). This was a result of locating the fiber rolls in natural drainages and swales, and can be seen in Figs. 2.24 and 2.25. After the Dec 25 rain event, repairs were made to the failed fiber rolls. However, fibers rolls were not removed from incorrect drainage locations, but were repaired by packing soil into undercut areas. Subsequently, many fiber rolls placed incorrectly failed again during February rain events. More repairs were made adding to the cost of the treatment.

Fig. 2.24. Fiber rolls incorrectly placed across drainage.

Fig. 2.25. Another view showing fiber rolls placed incorrectly. The fiber roll seen in the foreground was undercut during the Christmas Day storm. Note backfill repairs.

Fig. 2.26. Fiber roll incorrectly down-turned at end. A rill is beginning to form at the end where water is being channeled.

In Fig. 2.26, the fiber roll was correctly placed on the contour perpendicular to the hillslope, but was incorrectly down-turned at the ends. This resulted in water being concentrated and directed towards the end where rill formation commenced. This was observed at a number of fiber roll locations. The implementation team had recommended the down-turning as a way to reduce ponding. However, this is counter to the purpose of the fiber roll of increasing water infiltration into the hillslope.

There was little accumulation of soil material on the uphill side of the fiber rolls after the 2003 Christmas Day storm (Fig. 2.22). Additionally, there was little or no signs of rilling at adjacent untreated sites. This suggested that there was little hillslope movement of sediment. However, movement of sediment in the channels was observed and a small debris flow crossed onto Cathedral St. at the end of the main drainage (Fig. 2.27).

Fig. 2.27. Sediment and debris in channel that emptied onto Cathedral St.

San Diego County Public Works supervised the clean up of mud and debris on Cathedral St. after the12/25/03 storm, and they removed 35-40 yards of material from the street and private land. Following the rain events totaling 9.44 inches of October, 2004, there was evidence of sediment accumulation behind fiber rolls that were placed on the steeper slopes. The volume of sediment accumulated behind the fiber rolls was small, though, and represented normal redistribution of soil material downward on the hillslope. Under no treatment conditions, it is suspected that only a small amount of soil would have made it to the channel.

Photo points

We monitored the site using field observation and selected photo points. We chose several locations for photo points. The first location looked down at San Diego Country Estates with the upslope side of the fiber rolls in view (Fig. 2.28). Slopes at the first location were less than 15%. The second location was located above the water tank on slopes >30%. Photo points and GPS locations are listed in Appendix G. Plant cover has increased considerably in both photo sequences.

Fig. 2.28. Looking down at San Diego Country Estates. The photo was taken on Mar 24, 2004. (photo # 100-0030). Note little or no sediment buildup behind rolls.

Fig. 2.29. Same view as Fig. 2.28 taken on July 8, 2004. Note vegetation recovery and size of chamise resprouters.

Fig. 2.30. View looking downslope to water tank of main channel. Photo # 100-0032 taken on Mar 24, 2004.


Fig. 2.31. Same view as Fig. 2.30 taken on July 8, 2004.

Conclusions

- Because of low precipitation during the winter, there was very little movement of sediment on the treated hillslopes. Therefore, it was difficult to determine if the treatment was successful or cost effective before the October, 2004 storm events. Following the higher than normal October rain events, movement of sediment on the hillslopes continued to remain relatively low. With no comparable control area, it remained difficult to determine if the treatment was cost effective or not.

- Implementation monitoring of the fiber roll treatment is needed.

- The fiber rolls successfully remained in place but many failed when placed incorrectly in drainage landscape positions.

- The incorrect downward turning at the end of the fiber roll contributed to the few rills noticed on the site.

- Vertical spacing of the fiber rolls needs to be investigated. If the purpose of the fiber roll is to break up slope length and slow overland flow, it seems that thirty foot spacing on 5-15% slopes is overkill (Fig. 2.22). More scientific data is needed to support and recommend the spacing criteria used, especially when considering the extra costs incurred.

- Channel release of stored sediments occurred after the 12/25 storm. By reducing flow to the channel, fiber rolls likely reduced the amounts of sediment transported because of increased hillslope infiltration.

- Drainage structures are needed where the channel enters Cathedral St..

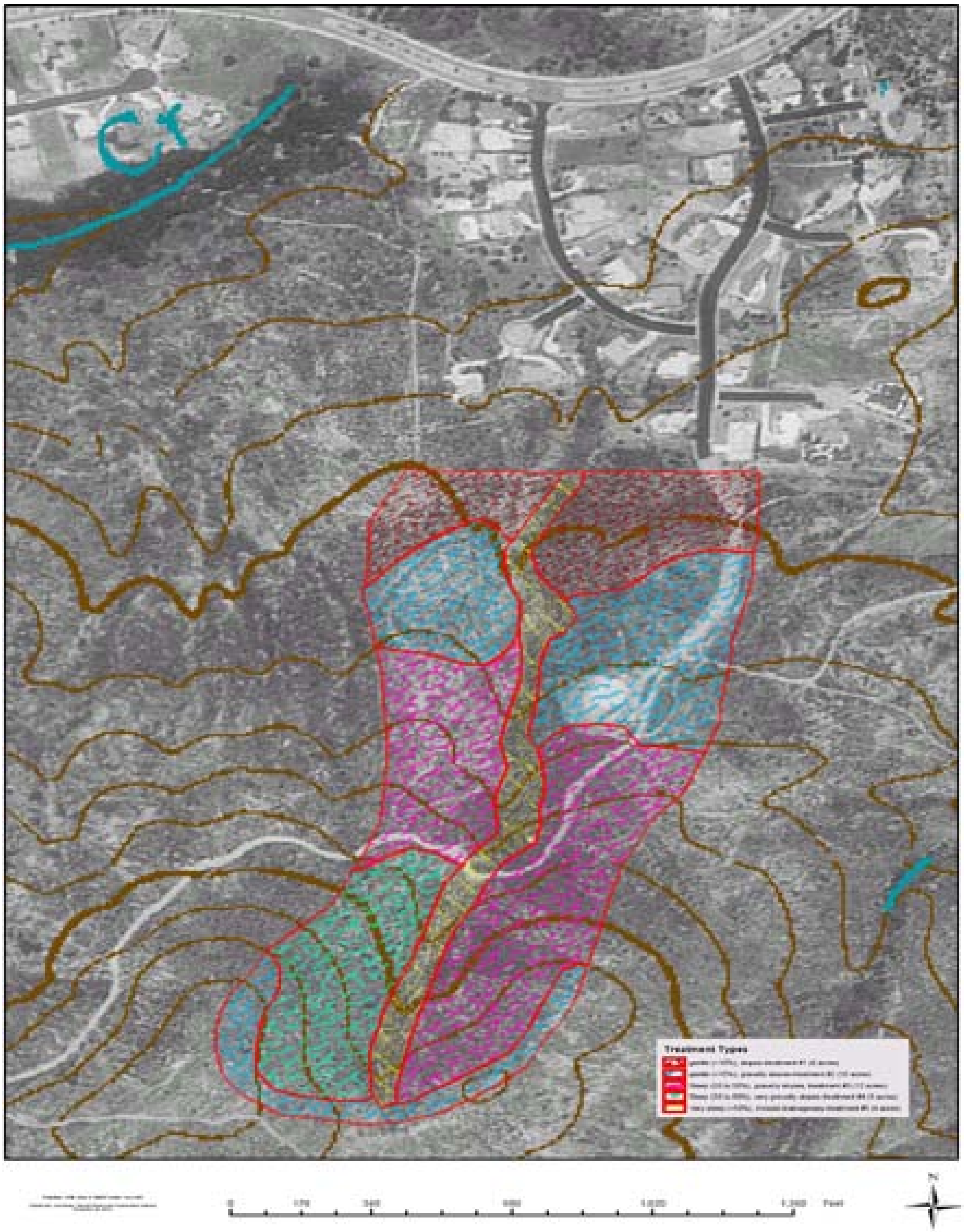

Fig. 2.32. View of 38 acre fiber roll treatment site at San Diego County Estates (Cedar Fire) in the San Vincente watershed.

Road treatments

Background

Approximately 40 miles of Forest Service system roads were affected by the Cedar Fire. Most were single lane, native surface roads, with simple drainage features. Private in-holdings, tribal lands, lack of rights-of-way, and locked gates limited access and delayed implementation of the prescribed road treatments.

Because of deferred maintenance and loss of vegetation cover on the hillslopes, the Forest Service roads were expected to fail when and if increased runoff occurred. Many drainage features were expected to be inadequate for increased post-burn runoff. Without treatments, erosion was expected from road surfaces, gully erosion in road side channels from runoff, hill-slope and stream bank erosion, and road washouts.

Emergency treatments prescribed

Recommended treatments on National Forest land focused mainly on restoring drainage function, constructing overside drains, rip rap, storm patrol, and BAER warning signs. The following treatments were prescribed:

- rolling dips
- rolling dips with lead-off ditches
- overside drains
- drivable waterbars
- rip rap on existing overside drains
- flared (metal) end sections
- remove/replace culverts (36 in and 48 in)
- drainage armor
- hardened crossings
- road grading and fill sections

Effectiveness monitoring

Because of delays in road treatment implementation, there was no treatment effectiveness monitoring conducted during the winter months and into Mar 2004. Repairs were not completed because of disputes occurring between private landowners and the National Forest (specifically Anderson Truck Trail). Survey forms were distributed to the road engineers. Samples of the road forms are included in Appendix J. Road logs (Tables 2.4, 2.5, 2.6, 2.7, 2.8, and 2.9) identifying treatment location (mile point and GPS) and treatment status were prepared using survey data and onsite observation with the road engineer. A treatment was successful if the repair column in the road log was not marked with a "y for yes)". If marked with a "y", the treatment had failed and was repaired. No road treatments were included for the Paradise Fire because it consumed mostly private, Indian reservation, and County of San Diego Park land.

Anderson Truck Trail and West Side Truck Trail (road treatments)

This road accessed the Anderson Valley area, and was divided up into a mix of Forest Service and private land ownership. Road segments on private lands have not been maintained to Forest Service standards for the last several years, and following the fire, the road has deteriorated further and needs restoration. The private landowners did not construct rolling dips and have left the road flat with no insloping or outsloping. This has resulted in major gullying at the side of the road in a number of areas (Fig. 2.35). Recommended treatments included restoring drainage function, constructing dips and overside drains, placing rip rap at the end of existing overside drain flumes, storm patrol, and BAER warning signs.

Road damage occurred during storm events on Apr 2, 2004 and also during the series of heavy rain events totally >9 inches occurring in October, 2004. The April 2 event was an afternoon thunderstorm that caused flash flooding on and near the Anderson Truck Trail with road damage. The following photos were taken along Anderson Truck Trail 5-d after the flash flood event that occurred during the Apr 2 thunderstorm. Some of the failures seen in the photos occurred on private land and were not repaired by the Forest Service.

The following photos correspond with the mile points and treatments noted in the road log. The photo number can be located in the photo # column of the road log.

Fig. 2.33. New overside drain with extension at mile point 0.6, photo #100-0008.

The overside drain in Fig. 2.33 failed during the October, 2004 storms as the bank eroded and cut 8 foot down at side of drain. After the October storms, the overside drain was removed and a new 24 inch culvert with extension was installed.

Fig. 2.34. Riprap added to existing drainage features (rolling dip and lead-off (crowing) at mile point 1.1, photo #100-0013.

Fig. 2.35. Gully formed on side of Anderson Truck Road.

Gully forming in Fig. 2.35 was located on one of the private sections of Anderson Truck Trail. Private landowner has incorrectly sloped the road while grading. There is also too long a run before water is taken off of the road. After the series of October, 2004 storm events, the gully had cut down to bedrock, and has continued to cut through the exposed granitic rock.

Fig. 2.36. Old overside drain located on private section of Anderson Truck Trail. Mile Point 1.7, photo #100-0018.

In Fig 2.36, back-cutting below the drain is visible. The private landowners have unsuccessfully placed an assortment of riprap including tires to prevent further gullying. However, the source of the problem is on the road. The length of run is too long, allowing for water to increase in energy. This area failed after the October, 2004 storm events that totaled >9 inches (Table 2.2).

Fig. 2.37. Failure of overside drain at mile point 1.4 on Anderson Truck Trail. Photo taken on Apr 7, 2004.

Fig. 2.38. Failure of overside drain at mile point 1.9 on Anderson Truck Trail. Photo taken on Apr 7, 2004. Note riprap below overside drain.

Both of these failures occurred during the Apr 2 thunderstorm. The intensity of the rain event coupled with the length of run resulted in failure. In addition, cutting of the lower side of the road occurred in poorly compacted fill material.


Fig. 2.39. Failure of overside drain at mile point 1.49. This failure occurred during the October, 2004 rain events.


Fig. 2.40. Rolling dip with lead off installed. Dip is hard to see in photo. Mile point 0.9, photo #100-0020.


Fig. 2.41. New overside drain with extension and riprap installed on West Side Truck Trail. Mile point 0.6, photo #100-0038.

Warning signs, fencing, and OHV barriers

Because of close proximity to the highly populated San Diego area, there was a high risk of unauthorized OHV activity following the fire. Past history has shown that administrative closures are ineffective in this area.

Fig. 2.42. Warning sign placed at the beginning of Anderson Truck Trail. (Photo # 100-0005).

Fig. 2.43. Barbed-wire fencing installed along Anderson Truck Trail. (Photo # 100-0006).

Fig. 2.44. Removable pipe barrier (OHV barriers) placed along Anderson Truck Trail. (Photo # 100-0015).

Fences and barriers were installed at sites highly vulnerable to intrusions by OHV's, human traffic, or cattle drifting onto Forest land from adjacent ownerships (Figs. 2.42, 2.43, 2.44). Physical barriers plus signage and OHV regulation enforcement by patrol personnel were the only proven effective methods of reducing unauthorized OHV activity. These treatments were also necessary to protect T&E plant populations and to reduce other land damage caused by unauthorized entry.

Conclusions and summary

- A number of overside drains failed after both the April 2 thunderstorm and the unusually heavy (>9 inches) October, 2004 rain events (Figs. 2.37, 2.38, 2.39). After reviewing the road forms, it appeared that overside drains failed more than any other treatment. However, this was the number one treatment in numbers done. Reasons for failure included (1) size too small, (2), length of run along road too long, and (3) lower side of road not reinforced. The treatment is less expensive than replacing with a culvert. Even though this treatment has a good chance of failure during intense and large storms, it can be termed successful in that it removed water energy from the road and prevented much greater road damage.

- On Miner's Road, the main treatment was upping-in-size the existing overside drains from 12 to 18 inches. The upsizing appeared to be effective as of mid-July, but conditions were unknown following the October, 2004 rain events.

- Rolling dips with lead-offs were successful in removing water from the road. Because of gullying on the lower side of Anderson Truck Trail below a number of overside drains, more and larger riprap material was suggested.

- The OHV removable pipe barriers were successful in deterring OHV activity in areas where they have been placed.

- Barbed wire fencing was less successful in deterring both mountain bike and OHV activity. The fencing was cut in a number of areas and literally knocked down in others. It appeared that fencing alone did not act as a deterrent. It is recommended that patrols be added along with barriers or fencing as an added deterrent.

- The pipe barriers worked fine, but were limited in use due to their expense. Some fencing was placed in areas that were already inaccessible due to topography. It is also recommended that better planning and identification of sites would lower the treatment cost. There was also unnecessary overlapping of the fence and barrier treatments. Again, improved planning would have saved the additional treatment costs.

Cedar Fire Road Logs

7/8/04 Alpine area

Table 2.4. ANDERSON TRUCK TRAIL - Mileage begins from gate at water tank where pavement turns to gravel.

Mileage	Treatment	GPS pt	Photo #	Repair	Notes
0.0	Gate at water tank				Reference only
0.1	Warning sign		100-0005		At start of road. This road is graded during the spring of every year. This was not done this year because of fire.
0.1	Reset drains				
0.2	Overside drain				
0.3	Fencing	32º51.708' 116º44.535'	100-0006 100-0007	y	Wire fencing has been cut. Fencing was placed on both sides of the road from 0.1 to 1.3 miles.
0.6	Overside drain	32º51.649' 116º44.662'	100-0008 100-0009	y	Bank eroded and cut 8 foot down at side of drain. New 24 inch culvert with extension installed after Oct storms.
0.7	Lead-off	32º51.742' 116º44.684'	100-0010		(PRIVATE land)
0.8	Pipes	32º51.781' 116º44.766'	100-0011 100-0012		(on PRIVATE land)
0.9	Lead-off on both sides				Both seem to be working
0.9-1.1	Series of 12 rolling dips with lead-offs		100-0020		Photo of 3 lead-offs between 0.9 and 1.1 but closer to 1.1. 12 lead-offs include the 2 previously mentioned.
	Brow ditch on inslope				
1.1	Lead-off reinforced with rock				There was much rock added to drainage features (i.e. riprap to lead-offs).
1.1	Crowing		100-0013 100-0014		Riprap added to existing drain features
1.3	OHV pipe barriers	32º52.093' 116º44.763'	100-0015 100-0016		100-0017; representative photos taken. GPS point taken at middle of barrier.
1.4	Overside drain	32º52.137' 116º44.836'		y	Also reinforced berm, added material (after thunderstorm). Nearby old overside drain. New one after thunderstorm had to be fixed (probably not compacted properly).
1.4	Overside drain				With riprap below.
1.4(9)	Overside drain			y	Held after thunderstorm, but failed after Oct storms
1.5	Overside drain			y	Riprap below
1.7	Old overside drain	32º52.272' 116º45.123'	100-0018 100-0019		With riprap (and tires). Private land, 6" spestic concrete pipe. Too long a run on road and water not dissipating.

1.8	New overside drain				Short run, riprap below. Sand ahead on road appeared after fire.
1.9	Overside drain			y	Reinstalled with a lot of fill.
1.9	Overside drain			y	Riprap below
1.9(9)	Overside drain				
2.0					Crossing onto Viejas land; overside drain at sign.
2.1	Overside drain				Functioning quite well
2.4				y	End of road work. Grading up to this point. Lightly graded flat like private owners wanted. When rolling dips were installed, land owners destroyed them.

Table 2.5. WILDWOOD GLEN LANE/LOS TERENITOS (Old Highway 80)

Mileage	Treatment	GPS pt	Photo #	Repair	Notes
0	Gate and sign	32º50.476’ 116º37.888’	100-0021		

Table 2.6. MINER’S ROAD - Off of Pine Creek Road. Mileage started at gate.

Mileage	Treatment	GPS pt	Photo #	Repair	Notes
0.0		32º52.122’ 116º30.999’			
0.1	Overside drain	32º52.130’ 116º30.995’	100-0022 100-0023		
0.1	Overside drain				
0.2	Lead off				This was improved.
0.3	12” overside drain	32º52.376’ 116º30.999’	100-0024 100-0025		This was improved after the fire. Photo 100-0025 shows wildfire on left side and prescribed burn right side.
0.3-0.42	5 overside drain				Total includes one mentioned above. At 0.4, overside drain is in the dip.
0.5	Opened up rolling dip				
0.5	Lead off				With riprap
0.5	Lead off				2 improved
0.5	Lead off				
0.6	Lead off				
0.7	Lead off				In low spot.
0.7	Lead off				
0.7-0.8	Outsloping road				
0.8	Riprap added				With 2-3 year old drain.
0.9	Riprap				Existing 12” overside drain with riprap at bottom of flume.
0.9	New 18” overside drain				
1.0	Newly added riprap				Existing 12” overside drain with riprap at bottom of flume.
1.0	New 18” overside drain				

	installation				
1.1	New 18" overside drain installation				
1.1	Rolling dip and lead off				
1.2	New 18" overside drain installation				
1.3	New 18" overside drain installation				
1.3	New 18" overside drain installation				
1.4	Water bar with riprap				
1.4	Water bar with riprap				
1.4	Water bar with riprap				
1.5	New 18" overside drain installation				With rolling dip
1.5	New riprap at bottom				Existing 18" overside drain
1.6	Riprap above and below				Existing 18" overside drain. Riprap added above not thought to do anything (MM). Expect water and sediment to wash through because not tight enough.
1.6-1.7	Outsloped road				
1.7	New 18" overside drain installation				
1.7	Little rock added below				Existing 12" overside drain
1.7	Riprap below moved around				Existing 12" overside drain
1.8-1.9	Series of 3 dips				This section is steep, not a whole lot can be done here.
1.8	New 18" overside drain installation				No riprap added.
1.8	New 18" overside drain installation				No riprap
1.9	New 18" overside drain installation				No riprap
2.0					Road ends. Rest of road blocked by rocks.

Table 2.7. DEER PARK ROAD – Off of Pine Creek Road. Mileage from gate.

Mileage	Treatment	GPS pt	Photo #	Repair	Notes
0.0		32º53.669’ 116º30.296’			Road maintained annually.
0.1	Lead off				
0.1	Lead off				With riprap added, existing rolling dip.
0.2	New 18” overside drain installation				
0.4	Lead off improved				
0.4	Lead off				
0.5	New 18” overside drain installation				
0.6	Lead off improved				Appears to be silted in already.
0.7	Lead off				Looks like it is going uphill.
0.8	Lead off				
0.8	Lead off				Probably some touchups
0.9	Riprap added			y	Low water crossing with riprap added to both sides of road.
0.9	New 18” overside drain installation.				
1.0	Lead off				

Ramona Area

7/9/04

Table 2.8. WEST SIDE TRUCK TRAIL - Section: Thornbush to Barona Mesa. Mileage started from gate

Mileage	Treatment	GPS pt	Photo #	Repair	Notes
					Plans to pave this road
0.0(5)					Existing drain feature.
0.0(8/9)					Existing drain feature.
0.1					Existing overside drain.
0.1(5)					Existing overside drain.
0.1(7)	New riprap below				Existing overside drain.
0.1(9)	New riprap below				Overside drain
0.2	New riprap below				Overside drain
0.2(4)					Existing overside drain.
0.2(8)	New riprap below				Existing overside drain.
0.3	New overside drain with 10				

	ft flume				
0.3(3)	Riprap added below	32º59.588' 116º45.627'	100-0037(?)		Existing overside drain with rilling below. Added rock to prevent erosion.
0.3(7)	New riprap				Existing drain
0.3(8/9)	New overside drain				With riprap below.
0.4	New overside drain				Extension with riprap below. Also rolling dip
0.4(3)	Possibly improved dip			y	Existing overside drain, might have improved the dip.
0.4(6/7)	Added riprap				Removed overside drain?
0.5	New overside drain				
0.5(1/2)	New overside drain				With riprap
0.5(3/4)	New riprap				Existing overside drain.
0.5(7)	New riprap				Existing overside drain.
0.5(8)	New riprap				Existing overside drain.
0.6	New riprap				Existing overside drain.
0.6(3)	New overside drain	32º59.389' 116º45.775'	100-0038		With extension and riprap. Old motorcycle's trail above road, rilling towards…
0.6(7)	New overside drain				With riprap
0.7	overside drain				With riprap
0.8	New riprap				Existing overside drain.
0.8(5)	New riprap				Existing overside drain.
0.9	New riprap				Existing overside drain.
1.5					Gate at Barona Mesa with horse gate and OHV gate).

Table 2.9. WEST SIDE TRUCK TRAIL - Ramona Oaks to Mount Tom. Mileage started at gate.

Mileage	Treatment	GPS pt	Photo #	Repair	Notes
0.0		33º00.157' 116º45.239'	100-0039		Photo of area with straw wattles (fiber rolls).
0.0(1)	Riprap				
0.0(5)	New overside drain				With riprap, dip.
0.1	New overside drain				With riprap, dip.
0.1(3)	New riprap, improved dip				Existing overside drain
0.1(6)	2 overside drains				
0.1(8)	New riprap				Existing overside drain. Berm improved in parts along road (where new overside drain installed).
0.2	New overside drain				With new riprap.

0.2(5)	Added fill & riprap above and below				Existing overside drain.
0.2(7)	New overside drain				With riprap
0.2(9)	New riprap				Existing overside drain.
0.3	New riprap				Existing overside drain.
0.3(3)	New overside drain				New riprap
0.3(7)	New overside drain				New riprap
0.4	New overside drain				New riprap
0.4(3)	New overside drain				New riprap, reinforced berm.
0.4(4)	New overside drain				New riprap
0.4(7)	New overside drain				New and existing drain. Added new one believed removing old one would cause more disturbance.
0.5	New overside drain				With riprap
0.5(4)	New riprap				Existing overside drain
0.6	Overside drain				With riprap
0.6(4)	New overside drain				With riprap
0.6(8)	New overside drain				With riprap
0.7	Large rock in channel				
0.8	Lead off				
0.9	New riprap				In channel
1.2	New riprap				In small channel
1.4	Lead out				
1.4(6)	Lead out				
1.4(8)	Lead out				
1.5					End, turn around point

Vegetation recovery

Effects of Hydromulch on Vegetation
Descanso Ranger District, Cleveland National Forest, Cedar Fire

Author: Wendy Dobrowolski, Plant Ecologist and Resource Assistant, Los Padres National Forest, Ojai Ranger Station
Surveyors: Wendy Dobrowolski and Patrick Mingus

I. Introduction

In 2004, the Cleveland National Forest used Burned Area Emergency Rehabilitation (BAER) funds in a contract to the Pacific Southwest Research Station (Riverside Fire Lab) to determine the effectiveness of an experimental, post-fire treatment of hydromulch on several environmental factors, including vegetation recovery. This document describes the short-term vegetation recovery observed in the spring and early summer immediately following the Cedar Fire event. The Cedar Fire that burned over 273,000 acres in San Diego County and the Cleveland National Forest occurred October 25-30, 2003. Vegetation monitoring transects are located in Fig. 2.45.

II. Methodology

The objective was to determine whether the aerial hydromulch, applied for erosion control, had an impact of plant cover and species diversity. The survey was conducted between 2,800 and 3,000 feet elevation on the western slope of the Viejas Mountain, on the Descanso Ranger District of the Cleveland National Forest. Post-fire vegetation recovery on Viejas Mountain is of concern because this area supports seven rare plant species, including the federally listed San Diego thornmint, and four plant communities: gabbroic chamise chaparral, scrub oak woodland, southern mixed chaparral and some coast live oak woodlands.

One hundred and fifty quadrats (0.25 m^2) were sampled along 15 transects (30 m), which ran perpendicular to the slope with five transects of each of the following treatment types: 0, 50, and 100% hydromulch. Species cover, which is the percentage of quadrat area beneath the canopy of a given species, was determined by visual estimate. Frequency was determined as the number of transects of each treatment that contained an individual of a given species. Hydromulch percentage was ascertained by a visual estimated of soil cover. This was possible because stripes of hydromulch treatment remained visible on the landscape until late June of 2003.

The program PC-ORD, version 4.0 was used to create the results tables and PC-ORD in conjunction with Microsoft Excel 2000 data analysis extension program was used to determine significance among treatments.

III. Results

No significant differences in individual species cover or frequency was found among hydromulch treatments or survey dates. Certain shrub and fire-following species such as *Adenostoma fasiciulatum, Allium haematochiton, Arctostaphylus* sp., *Calochortus albus, Calystegia macrostegia Chlorogalum parviflorum, Quercus berberidifolia* and *Zigadenus fremontii* were most common throughout transects (Table 2.10). Table 2.10 is included in Appendix A at end of report.

In May, species richness was significantly greater in the control than in the 50% or 100% hydromulch treatments. By June, however, no differences in species richness were detected among treatments. Likewise, the Shannon-Weiner Diversity Index indicated that transects in 100% hydromulch areas were significantly less diverse than in the control or 50% treatments, but this difference also leaves as the season progresses (Table 2.11). Mean vegetation cover was 0.60, 0.62, and 0.72 by June 14, 2004 for the 0, 50 and 100% hydromulch treatment, respectively (Table 2.11).

Table 2.11. Summary data for two survey dates by hydromulch cover (%).

	% Hydromulch	**Mean Cover**	**Species Richness[1]**	**Species Evenness[2]**	**Shannon's Diversity Index[3]**	**Simpson's Diversity Index[4]**
May	0	0.34	9.6a	0.76	1.72a	0.75
	50	0.34	8.8b	0.83	1.79a	0.78
	100	0.41	8.6b	0.77	1.60b	0.73

	0	0.60	9.0	0.79	1.72	0.77
June	50	0.62	9.0	0.80	1.74	0.78
	100	0.72	9.2	0.79	1.76	0.78

[1] Number of species per unit area
[2] Distribution of individuals among species
[3] Weights rare species
[4] Weights dominant species

IV. Conclusions

It is possible that the aerial hydromulch applications for erosion control had no impact on vegetation cover or species diversity, however, it is more likely that effects on species diversity were not detected because of sample size and one-year length of study. Short-term vegetation recovery in terms of both cover and diversity in the immediate post-fire growing season seems successful regardless of treatment. Since Viejas Mountain is such refuge for native plant diversity, it recommended that this project be continued for the next couple years to determine long-term, post-fire vegetation establishment.

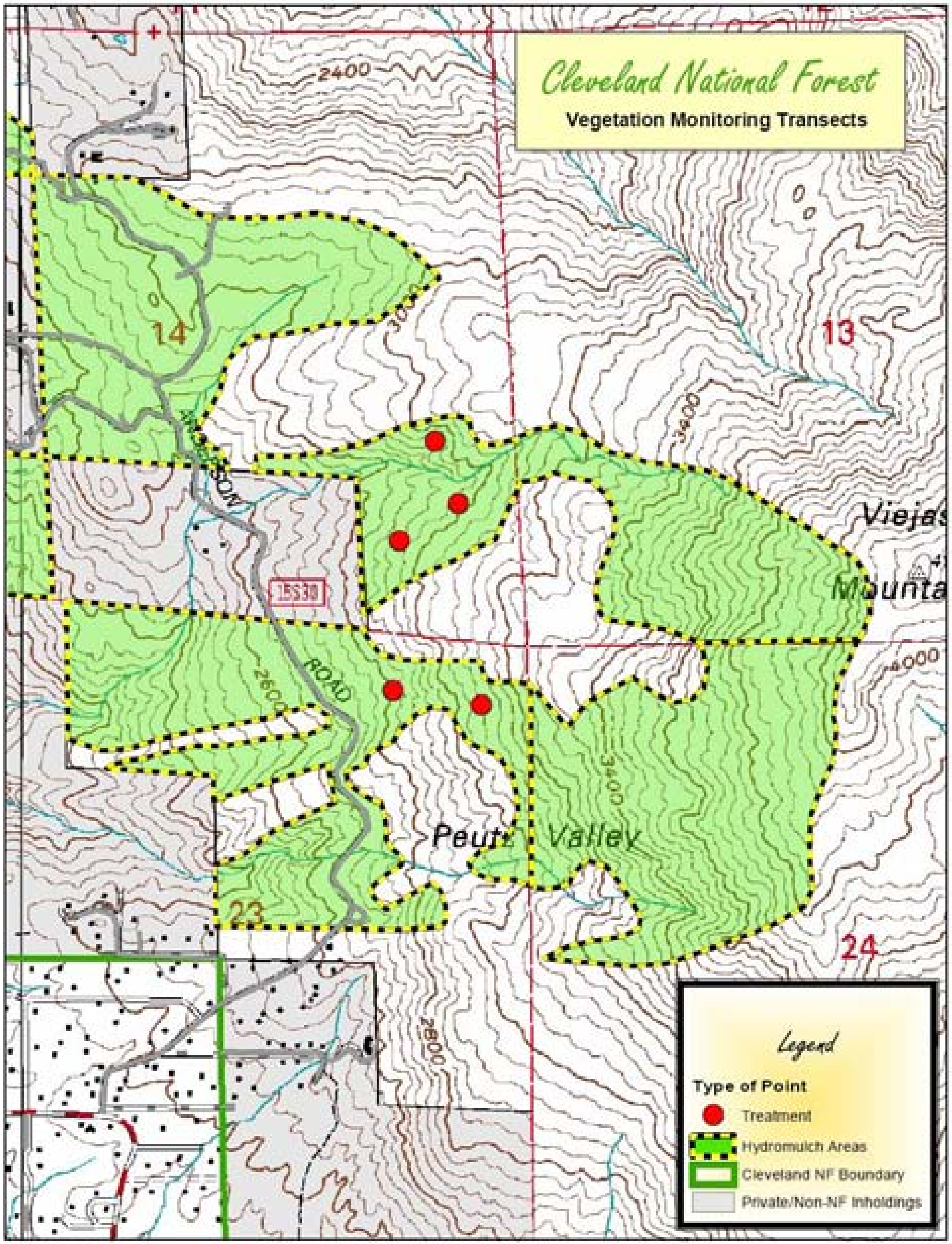

Fig. 2.45. Map showing general location of vegetation monitoring transects. Red circles designated treatment in legend are transect locations.

Noxious weed monitoring

Background

Reducing the spread and introduction of non-native species is a primary goal of the Forest Service. A three year monitoring plan was proposed for Cleveland National Forest lands impacted by the Cedar and Paradise Fires. Noxious weed populations were monitored for expansion and new invasion. Of particular concern were invasive plant populations that affected the recovery of federally threatened or endangered native species. Within the Cedar Fire, identified native species habitat, riparian corridors, and ground disturbance were areas of concern.

Effectiveness monitoring

Noxious weed monitoring was conducted by each Forest individually as an independent project separate from this proposal. The project is ongoing and is planned for 3 years. At the time of this report, first year monitoring results of noxious weeds were not available and are not included in this report. For more information, contact Kirsten Winter at the Cleveland National Forest.

Table 2.12. Invasive species designated as posing a threat to ecological communities.

Non-Native Species	**Resource at Risk**	**Proposed Monitoring**	**Fire**
Alianthus altissima (Tree of Heaven)	Riparian corridor recovery in King Creek.	Monitor expansion of known population.	Cedar
Arundo donax (Giant Reed)	Riparian corridor recovery in San Diego River Valley.	Monitor expansion of known population and potential impacts to Least Bells Vireo habitat.	Cedar
Centaurea calitrapa (Purple Starthistle)	Listed species habitat on Viejas Mountain.	Monitor expansion of known population and potential impacts to *Acanthomintia ilicifolia* populations.	Cedar
Centaurea melitensis (Tocolote)	Listed species habitat on Viejas Mountain.	Monitor expansion of known population and potential impacts to *Acanthomintia ilicifolia* populations.	Cedar
Robinia pseudoacacia (Black Locust)	Listed species habitat within the San Luis Rey River Riparian corridor, establishment in areas utilized for suppression around the Mesa Grande Indian Reservation.	Monitor expansion of known population and potential impacts to Southwest Willow flycatcher populations.	Paradise
Spartium junceum (Spanish Broom)	Riparian corridor recovery in Sweetwater River, native chaparral.	Monitor expansion of known population.	Cedar
Tamarix spp. (Tamarisk)	Riparian corridor recovery in San Diego River Valley, Least Bells Vireo habitat.	Monitor expansion of known population and potential impacts to Least Bells Vireo habitat.	Cedar

Heritage site protection monitoring

Author - Susan Roder, Cleveland National Forest

Background

The Cedar fire exposed large areas of the Cleveland National Forest. As a result numerous cultural resources such as prehistoric and historic archeological sites were at risk from erosion and illegal pot-hunting. Treatments were recommended for three sites affected by the fire (SDi-5842, SDi-8586H, and SDi-10768). These sites as well as others have been monitored for adverse effects over the last year.

Effectiveness monitoring

Site SDi-5842 (FS 05025400192)

The site is located adjacent to Lucas Creek on the south slope of a hill (Figs. 2.46, 2.47, 2.48). Vegetation is pine, oak, chaparral and grasses. Soil is deep sandy loam and powdery in texture. The fire was intense in the area. All vegetation was burned including trees and ground cover.

BAER recommendations originally included erosion control. However, erosion control measures were subsequently deemed unnecessary by the forest soils specialist due to the topography of the site. An additional BAER recommendation was regular site monitoring to prevent looting. The site was deemed at risk from pot-hunting because of the lack of vegetation and proximity to a well-traveled forest road. The road was closed for months after the fire which reduced the number of people in the area. Site monitoring was done on November 7, 2003, December 17, 2003, January 15, 2004, and October 15, 2004. No evidence of looting was noted.

Findings: The site shows little signs of erosion. Ground cover is returning slowly. Some partially burned pine trees have new growth. There is no evidence of looting or other impacts to the site. Further monitoring is recommended especially in light of the recent heavy rains.

Fig. 2.46. SDi-5842 October 15, 2004


Fig. 2.47. SDi-5842 November 7, 2003


Fig. 2.48. SDi-5842 October 15, 2004

Site SDi-8586H (FS 05025400275)

The site is a historic mine (Figs. 2.49, 2.50). It is unknown whether all associated mining features have been recorded. The site is adjacent to the Noble Canyon Trail, a highly used hiking and biking trail, and may be at risk from looters.

The BAER recommendation was to install a gate on an exposed adit. Also recommended was a resurvey of the site to identify associated features and evaluate additional risks. The alleged adit was subsequently identified as a large tree hole where the trunk and roots had been completed destroyed by the fire. The stump hole was filled in using materials on site. The site still needs to be resurveyed. Site monitoring was done on November 8, 2003, December 17, 2003, and October 15, 2004.

Findings: The site shows no signs of erosion. There is no evidence of looting or other impacts. Regular monitoring is recommended until vegetation is restored.


Fig. 2.49. SDi-8586H October 15, 2004 (Note tailings pile in center of frame)


Fig. 2.50. SDi-8586H November 8, 2003 (Note tailings pile in center of frame)

Site SDi-9197 (FS 05025400076)

The site is located within a “Penny Pines” plantation adjacent to State Route 1, Sunrise Highway, and consists of numerous lithics (Figs. 2.51, 2.52). All vegetation was burned making the artifacts very visible. Due to the proximity to the highway and the lack of vegetation the site is at risk from looting. A high-use trail is also located adjacent to the site and there are multiple small “social” trails going through the site. Erosion was not considered to be a problem on the site.

BAER recommendations included re-surveying the site to establish boundaries. Also recommended was the installation of a fence along the high-use trail as it passes through the site. It was further recommended that all “social” trails in the vicinity of the site be rehabbed and that signs be posted warning the public to keep off the site. None of these recommendations were acted upon although a range fence was installed sometime in 2004 which serves to protect the site. Site monitoring was done on November 8, 2003, January 15, 2004, and October 15, 2004.

Findings: The site is not at risk from erosion. Ground cover is returning and obscuring the surface artifacts. There is no evidence of looting or other impacts to the site. Further monitoring is needed until vegetation is restored.

Fig. 2.51. SDi-9197 October 15, 2004

Fig. 2.52. SDi-9197 November 8, 2003

Site SDi-8571 (FS 05025400244)

The site consists of bedrock milling features, pottery sherds and lithics (Figs. 2.52, 2.53). The intensity of the fire was very high in the area. All vegetation was burned except for a large oak tree which has fallen across the bedrock milling features. There was little potential for erosion. The site is adjacent to a Forest Service road and may be subject to looting.

BAER recommendations included removal of the dead oak tree from the site. A downed barb wire fence within the site boundary was also recommended for removal. These recommendations have not yet been implemented. Site monitoring was done on November 8, 2003, and October 15, 2004.

Findings: Although the vegetation is slowly returning, surface artifacts are still apparent. The dead tree should be removed because it could damage the site if it burns (i.e., causing bedrock to spall).

Fig. 2.53. SDi-8571 October 15, 2004

Fig. 2.54. SDi-8571 November 8, 2003

<u>Site SDi-10768 (FS 05025400561)</u>

The site consists of lithics, sherds, and midden soil (Figs 2.55, 2.56). Vegetation was completely destroyed by fire. Soil is a sandy loam which may be subject to erosion. The site is adjacent to a large meadow. The site was driven on by emergency vehicles during the fire (i.e., used as a turn-around point).

BAER recommendations included installation of metal pipe barriers to prevent vehicles from driving on the site. Monitoring for erosion was also recommended initially. However, the forest soils specialist found little potential for erosion. Reseeding the area was considered as an erosion control measure but was not implemented due to the lack of erosion potential. The metal pipe barriers were installed on

December 19, 2003. Site monitoring was done on November 8, 2003, December 17, 2003, January 15, 2004, and October 15, 2004.

Findings: The metal pipe barriers are effective and the ground cover has returned. There is no sign of erosion. There is no evidence of looting or other impacts. Further monitoring is recommended due to the proximity of the site to the road.

Fig. 2.55. SDi-10768 October 15, 2004 (Site is to the right of the barriers; private property gate is apparent behind vehicle)

Fig. 2.56. SDi-10768 November 8, 2003 (Private property fence with "No Trespassing" sign can be seen)

Chapter 3:

Grand Prix/Old Fire
San Bernardino National Forest

Introduction

The Grand Prix/ Old Fire burned or damaged over 1000 structures. The fire consumed a total of 139,446 acres of which 90,561 acres were on National Forest Service land. The Grand Prix /Old Fires areas were located within the steep-sloped San Bernardino and San Gabriel Mountain Ranges, part of the Transverse Range. (Figs. 3.1, 3.2). The fires started in the lower elevations of the front-range (southern slopes) and spread into the upper elevation mountain areas near Silverwood Lake (a reservoir for the California aqueduct) and Lake Arrowhead. Elevations ranged from 1,600 to 8,800 ft. in the burn area, with much of the terrain being steep and rocky. Watersheds of the front range drain into the Santa Ana River, while backside drainages near Silverwood Lake and Lake Arrowhead drain into the Mojave River.

Fig. 3.1. View of steep, incised canyons of the front range of the San Bernardino Mountains.

Chaparral species dominate the lower elevations and are well-adapted to fire. Mixed hardwood conifers are found at the upper elevations, and are also adapted to periodic fire. Chaparral shrub skeletons were left chiefly intact following the fire. Due to steep topography and rough landscapes, fire intensities varied across the landscape creating a mosaic pattern. Because of the resprouting nature of the chaparral species, burned areas at lower elevation were expected to recover in 2-5 years and provide vegetation cover.

Soil burn severity and water repellency is included in Table 3.1. Approximately 38% of the burn area was impacted by high burn intensities; 33% burned with moderate intensity; and 22% burned with low intensity. The BAER team estimated erosion potential of 112 tons/acre within the steep-sloped burn area. In the steep front country watersheds, erosion rates for high and moderate burn areas ranged from 60 to 260 tons per acre. In contrast, erosion rates for less extreme sloped ranged from 16 to 22 tons per acre. About 50% of the chaparral shrublands were water repellent, and approximately 30% of the hardwood/conifer sites exhibited water repellency.

Table 3.1. Soil burn severity and water repellency

Burn severity	Acres
Low	38,620
Moderate	47,394
High	53,177
Water repellency	49,400

The mountainous burned area is underlain with granitic, metamorphic bedrock, unconsolidated deposits, and small areas of sedimentary rock. There is past evidence of channel generated debris flows occurring throughout the fire area. Soils described in the front-range include: Trigo Family-Lithic Xerumbrepts (shrub dominated landscapes) and Springdale Family-Lithic Xerortents-Rock outcrop (hardwood/conifer sites above 4,000 ft). Morical-Wind River Preston soil families are mapped in the Lake Arrowhead area. On the backside of the mountains near Silverwood Lake, Sorboba-Avawatz-Morical, Dry families are present.

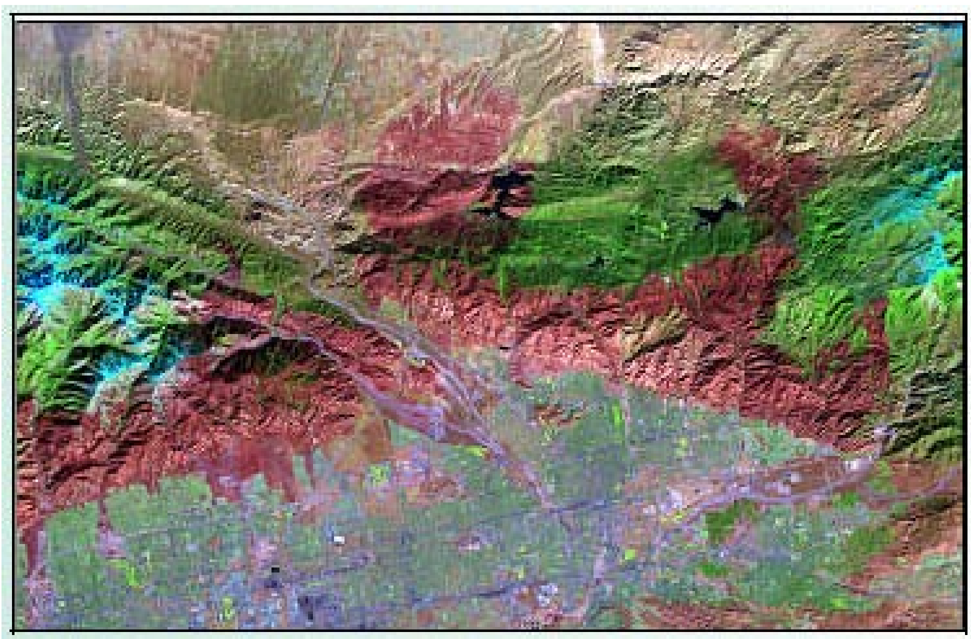

Fig. 3.2. ASTER imagery of the Grand Prix and Old Fires, acquired on November 18, 2003. The city of San Bernardino is south of the fires (Clark et al. 2003)

Deposits of dry ravel were observed at the base of virtually all slopes steeper than 55% and was accumulating at the toes of slopes in the drainage bottoms and road surfaces (Fig. 3.3). Precipitation ranged from 25 to 35 in on the front side of the mountains, and 15 to 25 in on the backside.

The primary hillslope treatment proposed was aerial straw mulching treatment using helicopters. Channel treatments included strawbale check dams that were installed in steep drainages above the Deer Park Resort in the Devore area. Figure 3.6 shows proposed treatments locations.

No hillslope treatments were proposed on slopes steeper than 50%, as such, most of the front country was deemed untreatable. However, the interim BAER 2500-8 report requested approval of an additional 1000 acres of aerial straw mulch for placement on the front range above area of high value at risk (houses, roads, and public water supply) (Fig. 3.4). In this request, application rate was one ton per acre and the slope limit was raised to 60%.

Fig. 3.3. Dry ravel accumulated at the base of steep slopes.

Fig. 3.4. View of homes at risk.

Monitoring status, modifications, and operational problems encountered

It was planned to continue photo point monitoring for the next two years. Changes made to the original monitoring plan included: (1) photo point monitoring of hillslope treatments in replacement of silt fences, and (2) a delay of road treatment monitoring until the second year. It will be important to monitor second year recovery and erosion response to winter storm events, especially in the case of the straw bale check dams placed behind the Deer Park Resort. Large storm events in 2004/2005 could result in failure of these dams. Precipitation during the 2003/2004 season was below normal and followed 5 years of drought. Unfortunately, the opportunity to measure hillslope sediment production after the unusually large Christmas Day storm was lost due to delays in funding approval of the proposal.

Hillslope treatments

<u>Aerial straw mulching (strawbale heli-mulching)</u>

Background

Aerial straw mulch is recognized as an expedient and highly effective means of providing groundcover on high-severity burn hillslopes (Janicki 2002). The mulch protects the topsoil against soil particle detachment during rain events and disperses runoff through microtopographic roughness, retarding the formation of rills (Janicki 2002). Mulch also helps retain soil moisture, and by retaining water, allows for greater infiltration.


Fig. 3.5. Aerial view of Silverwood Lake (copyright California State Parks)

Aerial straw mulch was identified as the preferred treatment to prevent hillslope erosion, but its use was severely limited because the majority of the burned watershed was too steep (>55%). Aerial straw mulch specifications are given in Appendix I.

Values at risk

Aerial straw mulching was proposed in the Silverwood Lake watershed high burn severity area to protect water quality (Fig. 3.5). Silverwood Lake is a holding reservoir operated by the California Department of Water Resources that brings water from Northern California through the California aqueduct. The water brought into the lake provides about 25% of the total supply of water available to the district and serves 10-12 million customers. The major concern involved the impact of eroded ash and sediment on water quality in the lake. It was indicated that if turbidity exceeded about 100 NTU's the water treatment plants would need to be taken off line affecting millions of customers. In addition, the State Park administrative facilities and a campground on the West Fork of the Mojave River above Silverwood Lake would be at risk. The headquarters complex lies in the floodplain.

On the front range, runoff and sediment delivery would be high in most watersheds that drain to the front country. Life and property values most at risk were private residences located at the base of the burned slopes (Fig. 3.4), and those structures located within, adjacent, and at the mouth of major drainages of the front range.

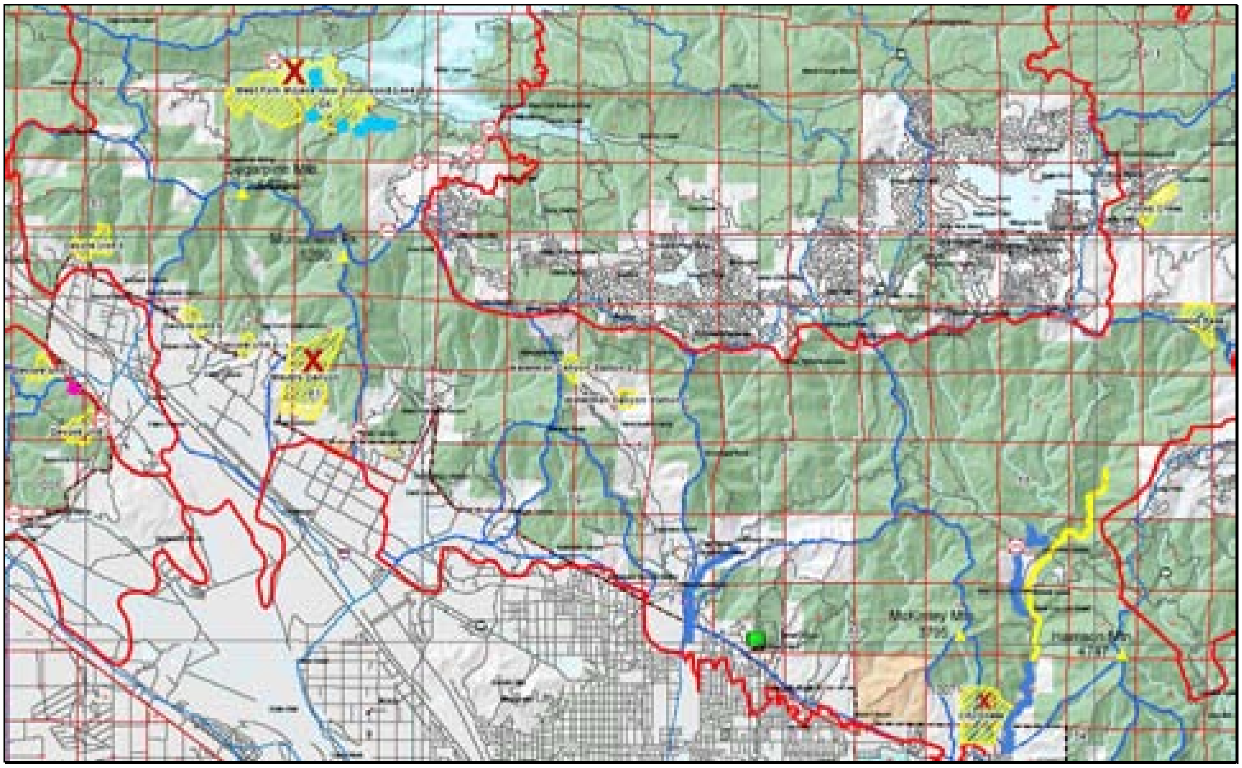

Fig. 3.6. Proposed locations of land treatment effectiveness monitoring sites for Grand Prix /Old Fire (red X's). Sites monitored were West Fork Mojave (Lake Silverwood), City Creek, and two sites in the Devore area.

Aerial hydromulch application

Straw was dropped by helicopter using specified nets and rigging (Fig. 3.7). Drop sites were determined utilizing GPS, line of sight, and round observers during application. The helicopter was capable of carrying 2,200 lbs. of straw per load. The large nets were 20ft. x 20ft. and could carry 20 small bales or one large bale. Drop boundaries were set using flagging (Fig. 3.8).

Fig. 3.7. Straw bales breaking up as they are dropped from helicopter (Janicki 2002).

Fig. 3.8. Targets were positioned on the ground as drop zone boundaries.

Aerial straw mulch treatment prescribed for the Silverwood Lake area encompassed a portion of the West Fork of the Mojave River watershed (Fig. 3.9). The certified weed-free straw was applied at the rate of 1.5 tons per acre with ground cover expected at 70-90%. The cost including helicopter, personnel, straw, trucking, salary and per diem was $750 per acre.

Fig. 3.9. View of West Fork Mojave River aerial straw mulch unit pre- treatment.

Effectiveness monitoring (photo points)

The initial plan was to use silt fences to monitor aerial and hand applied straw mulch on both the front-range and the West Fork Mojave (Lake Silverwood) area. We were prepared to construct the silt fences early in December, but due to delays in final approval of the monitoring project we were unable to do so. Unfortunately, we missed an excellent opportunity to monitor hillslope erosion that occurred after the Christmas Day storm 2003. Because of the magnitude of the storm in the San Bernardino Mountains, it was decided not to employ silt fences. Fortunately, we had access to photo point data that was prepared by Vicki Sjoberg and Anneta Mankins. Appendix C contains detailed photo point site descriptions for aerial straw mulch, hand-applied mulch, and straw bale check dam sites. Precipitation (Rock Creek RAWS station – Lake Silverwood area) is included in Appendix D.

Straw was dropped by helicopter on the West and East Fork Mojave watersheds (Figs. 3.10, 3.11), and also on the front range of the San Bernardino Mountains (Fig. 3.6). Straw mulch was hand-applied in the Devore area and also at Hook's Creek near Lake Arrowhead (Fig. 3.6).

Fig. 3.10. Strawmulch applied on the West Fork Mojave by helicopter

Fig. 3.11. View of West Fork Mojave watershed above Silverwood Lake before straw mulch application. Note rocky surface and chamise skeletons.

Photo points were used to monitor both the hand and aerial applied straw mulch. Photos were taken in November/December of 2003 immediately after treatment, and again in March 2004, and again in May 2004.

Photo points were established at the following locations (treatment):

- Devore-Grand Prix (strawbale check dams)
- Devore-Grand Prix (hand-applied straw mulch)
- Hook Creek (hand-applied straw mulch)
- East Fork Mojave (aerial straw mulch)
- West Fork Mojave (aerial straw mulch)

The first series of photos were taken at various dates between November and the first week of December. The second series were taken between Mar 9 and Mar 12, 2004. The third and final series were taken between May 3 and May 6, 2004.

Fig. 3.12. Grand Prix/Devore hand mulch site PP2c viewed on 11-15-2003. Note sparse straw coverage

Fig. 3.13. Grand Prix/Devore hand mulch site PP2c viewed on 3-13-2004. Chamise is resprouting. There is little straw left on the ground.

Fig. 3.14. Grand Prix/Devore hand mulch site PP2c viewed on 5-7-2003.

Fig. 3.15. Grand Prix/Devore hand mulch site PP3a viewed on 11-15-2003. Note sparse cover of straw and straw wrapping around the base of chamise skeletons.

Fig. 3.16. Grand Prix/Devore hand mulch site PP3a viewed on 3-13-2004.

Fig. 3.17. Grand Prix/Devore hand mulch site PP3a viewed on 5-3-2004. Note recovery of resprouters.

Fig. 3.18. Grand Prix/Devore hand mulch site PP4c viewed on 11-15-2003.

Fig. 3.19. Grand Prix/Devore hand mulch site PP4c viewed on 3-13-2004. Note the decrease in straw cover.

Fig. 3.20. Grand Prix/Devore hand mulch site PP4c viewed on 5-3-2004. Note the recovery of the chamise resprouters.

Fig. 3.21. Hooks Creek hand mulch site PP1East viewed on 12-3-2003. Note the high cover percent because of low wind conditions in area.

Fig. 3.22. Hooks Creek hand mulch site PP1East viewed on 3-12-2004.

Fig. 3.23. Hooks Creek hand mulch site PP1East viewed on 5-5-2004. Note lack of vegetation recovery in this area of high straw coverage.

Fig. 3.24. Hooks Creek hand mulch site PP4 West viewed on 12-6-2003. Note high cover density.

Fig. 3.25. Hooks Creek hand mulch site PP4 West viewed on 3-12-2004. Cover density has decreased.

Fig. 3.26. Hooks Creek hand mulch site PP4 West viewed on 5-5-2004. Some plant recovery beginning.

Fig. 3.27. Hooks Creek hand mulch site PP6 West viewed on 12-3-2003. Note cover density.

Fig. 3.28. Hooks Creek hand mulch site PP6 West viewed on 3-12-2004. Cover density has decreased.

Fig. 3.29. Hooks Creek hand mulch site PP6 West viewed on 5-5-2004. There is excellent plant recovery where there is no straw cover.

Fig. 3.30. West Fork Mojave aerial straw mulch PP1 South viewed on 12-3-2003. Note clumping and rock.

Fig. 3.31. West Fork Mojave aerial straw mulch PP1 South viewed on 3-13-2004. Note clumping of straw.

Fig. 3.32. West Fork Mojave aerial straw mulch PP1 South viewed on 5-5-2004. Vegetation returning is good in areas free of straw.

Fig. 3.33. West Fork Mojave aerial straw mulch PP2 West viewed on 12-3-2003. Note that straw has moved into drainage landscape position.

Fig. 3.34. West Fork Mojave aerial straw mulch PP2 West viewed on 3-13-2004.

Fig. 3.35. West Fork Mojave aerial straw mulch PP2 West viewed on 5-5-2004. Vegetation recovery is good in areas free of straw.

Fig. 3.36. West Fork Mojave aerial straw mulch PP4 West viewed on 12-3-2003. Note clumping and piling of straw.

Fig. 3.37. West Fork Mojave aerial straw mulch PP4 West viewed on 5-5-2004. Only vegetation recovery is chamise resprouting.

Fig. 3.38. East Fork Mojave aerial straw mulch PP5 West viewed on 12-3-2003. Straw is clumped.

Fig. 3.39. East Fork Mojave aerial straw mulch PP5 West viewed on 3-13-2004.

Fig. 3.40. East Fork Mojave aerial straw mulch PP5 West viewed on 5-5-2004. Vegetation recovering is good in areas free of straw.

Fig. 3.41. East Fork Mojave aerial straw mulch PP7 West viewed on 12-8-2004. Straw is clumped.

Fig. 3.42. East Fork Mojave aerial straw mulch PP7 West viewed on 3-13-2004.

Fig. 3.43. East Fork Mojave aerial straw mulch PP7 West viewed on 5-4-2004. Vegetation recovery is good in areas free of straw.

Results of straw bale mulching

Figures 3.12 through 3.20 show the Grand Prix/Devore hand-applied mulch sites. In most cases, hand-applied mulch is distributed uniformly across the landscape, and is one of the advantages of this type application. However, high Santa Ana winds immediately followed the application and the straw was either blown into piles (windrows), or completely blown offsite (Figs. 3.18, 3.19). Most of the straw was blown off the crest or summit landscape positions (Figs. 3.15, 3.16). In many cases, the straw was wrapped tightly around the basal portions of the chamise skeletons (Fig. 3.15). Even accounting for a winter of below average rainfall following 5 years of drought, vegetation recovery was dramatic between December 2003 and May 2004 (Figs. 3.17, 3.20).

An additional 1,000 acres of straw (>$700,000) was applied on the front range of the San Bernardinos. Because the heli-mulching implemented on the front-range was approved after the initial Silverwood Lake treatments were approved, no photo points were planned at these front range locations. This was unfortunate because most of the 1,000 acres of straw that was dropped by helicopter was blown of the site by strong Santa Ana winds. High winds are historically known to occur in this region (Cajon Pass and front-range canyons) during November and December of the year. Therefore, topography and weather conditions need to be considered before applying straw by helicopter or by hand. In this situation, there was not a good chance of successful implementation of the treatment. Straw mulch did not prevent water movement off the slopes. Infiltration may have been increased, but this would only increase subsurface flows in the saturated soils. Debris flows after the Christmas Day storm indicated that significant amounts of water were entering the channels from the hillslopes.

Figures 3.21 through 3.29 show straw mulch that was hand-applied at Hooks Creek near Lake Arrowhead. Because this area was less windy than the GrandPrix/Devore location, most of the straw mulch remained in place. This was most evident in Figs. 3.21, 3.22, and 3.23. The photos cover a time period of almost 5 months, and most of the straw remained where it was placed. However, we do not see much vegetation recovery in this photo sequence. In Figs. 3.27, 3.28, and 3.29, where cover is not as dense, there was excellent vegetation recovery. This suggests that the depth of mulch applied may affect the germination of the natural post-fire vegetation.

Figures 3.30 through 3.37 represent straw mulch dropped by helicopter on the West Fork Mojave River watershed above Silverwood Lake. These sites were very rocky (percent rock cover ranging from 10 to 20%) and were situated on slopes generally not greater that 30% (Appendix C). This area was subject to high winds, but maximum wind speeds were much less that experienced in the GrandPrix/Devore location (RAWS data). The winds that did occur resulted in the clumping of the straw into mounds (Figs 3.30 and 3.36). Burn severity was high at these locations, but by May, 2004 the chaparral species were beginning to resprout (Figs. 3.32, 3.35, and 3.37). In most areas, it appeared that straw cover was below 40%, thus the treatment should not be considered successful.

Figures 3.38 through 3.43 represent straw mulch dropped by helicopter on the East Fork Mojave River watershed above Silverwood Lake. As on the West Mojave, there was clumping of straw into piles caused by the wind. There was very little to no vegetation growth in locations where the straw had clumped together into piles. This further suggests that depth of mulch is affecting plant regeneration.

Detailed descriptions of photo point site characteristics are included in Appendix C.

Conclusions

- For both hand-placed and helicopter applied straw mulch, wind was the main factor in determining final cover percentages.

- On the front range, most of the straw was blown off-site by Santa Ana winds, resulting in cover percentages from 0 to 10%. Treatment was determined to be unsuccessful.

- High winds are historically known to occur in this region during the months of November and December. Therefore, it was an unwise decision to recommend straw mulch as a treatment in this circumstance.

- In the Lake Silverwood area, straw remained on the ground, but was prone to clump and formed mounds. Treatment cover in this area was <40%, and in this respect, was considered unsuccessful for the dollars spent.

- Clumping and mounding of straw was likely inhibiting plant regeneration.

Channel treatments

Straw bale check dams

Background

Straw bale check dams are prescribed to stabilize in-channel sediments, trap suspended sediments, and control down-cutting for 1 to 3 years. Stored sediments by design are slowly released over time as the straw check dam materials deteriorate. The breakdown of the straw dam takes place over a period of 1 to 3 years, allowing sediments to be released after the watershed has recovered from the effects of a wildfire. In most cases, the treatment offers first year effectiveness for sediment control.

Two steep watersheds were located immediately behind the Deer Park Nudist Resort. The resort was built on an alluvial fan immediately below the canyons. The upper two-thirds of the southern watershed, which contributes to this alluvial fan, was located on National Forest land. Numerous side drainages entered the channel and have steep colluvial deposits on their side slopes. Dry ravel deposits were present in the channel and have contributed to the channel sediment bedload. The headwalls of the canyon were very steep (150 – 200%). Because the channel gradient below the headwall is approximately 20%, there was high debris flow susceptibility.

Values at risk

The main values at risk were life and property at the Deer Park nudist resort located at 1924 Glen Helen Road in Devore (Fig. 3.44). There were a number of residences and buildings that were at risk from flooding and debris flows. The BAER team mapped the watersheds with high burn severity. Adding in steep slopes and an accumulation of debris in the channels, there was a high probability of debris flows occurring in the watershed. It was recognized that the greatest risk was in small watersheds (<250 acres) during the earliest post firestorms and the risk diminishes as the rainy season progresses (Cannon 2002).

Fig. 3.44. Entrance to Deer Park Nudist Resort. Note two steep canyons immediately behind camp. Buildings of the camp extend beyond the trees to the National Forest border.

Effectiveness monitoring (photo points)

Photo points were established in the southern watershed behind the Deer Park Nudist Resort and were divided between the upper and lower portions of the channel, with additional points located in the side channels. The first series of photos were taken between November and the first week of December. The second series were taken between Mar 9 and Mar 12, 2004. The third and final series were taken between May 3 and May 6, 2004.

Fig. 3.45. Deer Park/Devore straw dam 2a viewed on 12-3-2003 immediately after installation in main channel.

Fig. 3.46. Deer Park/Devore straw dam 2a viewed on 3-10-2004**.** Note large build-up of sediment behind dam.

Fig. 3.47. Deer Park/Devore straw dam 2a viewed on 5-3-2004**.** Note vegetation growth on stored sediment.

Fig. 3.48. Park/Devore straw dam 2b viewed on 12-3-2003 immediately after installation in main channel.

Fig. 3.49. Deer Park/Devore straw dam 2b viewed on 3-10-2004**.** Note sediment stored behind check dam.

Fig. 3.50. Deer Park/Devore straw dam 2b viewed on 5-3-2004**.** Note vegetation growth on stored sediment.

Fig. 3.51. Deer Park/Devore straw dam 3b viewed on 12-3-2003 immediately after installation in main channel.

Fig. 3.52. Deer Park/Devore straw dam 3b viewed on 3-10-2004**.** Note sediment stored behind check dam.

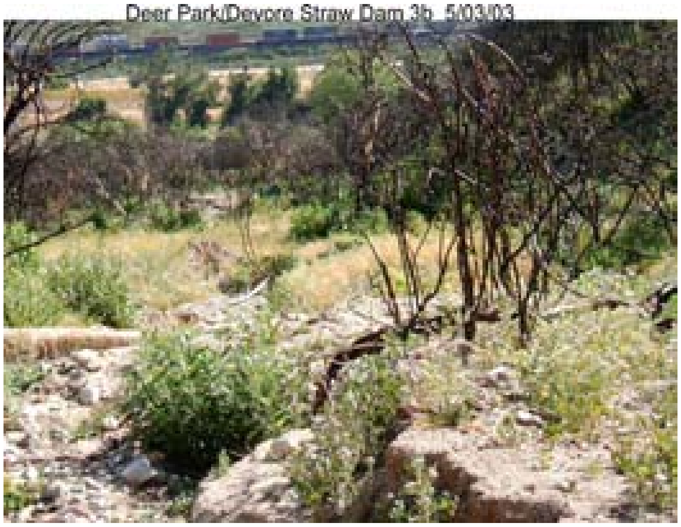

Fig. 3.53. Deer Park/Devore straw dam 3b viewed on 5-3-2004**.** Note vegetation growth on stored sediment.

Fig. 3.54. Deer Park/Devore straw dam 3d viewed on 12-3-2003 installed in upper main channel. Note riprap below dam.

Fig. 3.55. Deer Park/Devore straw dam 3d viewed on 3-10-2003**.** Note incising of channel below dam.

Fig. 3.56. Deer Park/Devore straw dam 3d viewed on 5-3-2004**.** Note vegetation above dam.

Fig. 3.57. Blowout of strawbale check dam located in lower channel (view looking up channel). This the check dam viewed in Figs. 3.48 to 3.50.

Fig. 3.58. Blowout of strawbale check dam located in lower channel (view looking down channel).

Fig. 3.59. Sediment was stored to the level of the cut banks. Sediment storage can be seen in Figs. 3.52 and 3.53. All of this material was released during the October, 2004 storm events when the check dam failed.

Fig. 3.60. Blowouts of side channel check dams also occurred in the October, 2004 storm events.

Table 3.2. Precipitation recorded at the RAWS station located at Devore, CA.

Month	Day						Monthly total
Nov, 2003	Nov 1	Nov 3	Nov 12	Nov 15	Nov 16		
	0.18	0.21	0.60	0.13	0.03		1.15
Dec	Dec 7	Dec 11	Dec 14,15	Dec 21, 23	Dec 24	Dec 25	
	0.35	0.10	0.05	0.03	0.20	4.19	4.92
Jan, 2004	Jan 2	Jan 21	Jan 24	Jan 25	Jan 31		1.33
	1.10	0.07	0.06	0.03	0.07		
Feb	Feb 2, 3	Feb 18	Feb 20	Feb 21, 22	Feb 25	Feb 26	
	0.89	0.33	0.23	2.40	0.56	2.20	6.80
Mar	Mar 1	Mar 2	Mar 24				
	0.67	0.32	0.01				1.00
Apr	Apr 2	Apr 3	Apr 4	Apr 17, 18			
	0.06	0.12	0.01	0.42			0.61
Oct	Oct 16	Oct 17	Oct 18	Oct 19	Oct 26	Oct 27	3.62
	0.03	0.60	0.31	0.74	0.64	1.30	
Nov to Oct totals							19.45

Results - Straw bale check dam effectiveness

The selection of the sites followed some of the criteria for locating grade control structures. The channels were first and second order with sediment loading instream and on sideslopes, and contained gravel substrates (in accordance with BAER guidelines) Gradients in the upper portion of the main channel (>20% in some locations) and side channels (>30%) were greater than the 6% BAER guidelines. Aditionally, channels had a high potential for threatening dwellings and other structures if the dams were to fail, rather than low potential as mentioned in the BAER guidelines.

Straw bale check dam widths and number of bales used varied with landscape location and size and steepness of the channel. Overall, the straw bale check dams were well-constructed in both the main channel and side drainages. Rock riprap was used below the check dams as an energy dissipater. The Dec 3 photos were taken soon after the treatments were installed, and before the Christmas Day storm. The Dec 25 storm resulted in approximately >4 in. of rain (Table 3.2). Over eight more inches of rain fell in January and February (Table 3.2). Consequently, the photos taken on Mar 10 reflect the aftermath of 12 in of precipitation.

Figures 3.45 through 3.50 showed straw bale check dams that were located in the lower drainage. Slope gradients here were less than 6 % and the channel was beginning to widen out before it met the alluvial fan deposits. In both photo sequences (Figs. 3.45-3.47 and 3.48-3.509), we witnessed sediment completely filling the storage capacity of the dams, and beginning to overtop them. But in photos (Figs.3.47 and 3.50), vegetation has "stabilized" the stored sediment. There was still concern that a large 2nd year storm event would result in the release of the sediment as the straw bales weakened and deteriorate.

Figures 3.51 through 3.56 showed straw bale check dams that were located in the upper drainage. Channel gradients at these check dams were >6 %. In Fig. 3.54, we can see the rock riprap placed below the check dam. In Fig. 3.55, the rock has completely disintegrated. When storage capacity of the check dam was filled, there was no further obstruction to water flow, and the resulting energy of the flow resulted in significant incising below the dam. As in the previous photos of the lower drainage, new vegetation growth in the stored sediment is now providing some surface stability. However, because of the steepness of the slope and gradual deterioration of the check dams, there was a good chance of dam failure and movement of sediment down the drainage. Historically over time, the sediments have been deposited naturally in the alluvial fan at the base of the channel. It was unknown how far beyond the fan and how near to the buildings the flow would reach if there was a failure.

In terms of success or failure for the first year of monitoring, the straw bale check dams were successful in storing sediment and breaking the energy of channel flows before the October, 2004 rain events. Additionally, vegetation had somewhat stabilized portions of the stored sediment before the October storms (Fig. 3.50), one of the primary goals of straw bale installation. On the other hand, the storage of large amounts of bedload materials in steep channels added future risk to structures situated below if a major storm event occurred.

In October 2004, a series of rain events occurred over a two week period. Following this series of rain events totaling 3.62 inches (Table 3.2), all of the straw bale check dams in the main channel and side channels failed (Figs. 3.57, 3.58, 3.59, 3.60), releasing stored sediment into the lower channel and onto the alluvial fan situated above the Deer Park nudist camp. A large amount of sediment traveled into the camp perimeter causing minor damage. Sediment removal from the Deer Park property has been ongoing since the October, 2004 storm events. It is recommended that straw bale check dams should not be placed in any channel where structures are at risk below (either situated in the drainage itself, on the alluvial fan, or dangerously close to the edge of the channel). The increased sediment bedloading of the channel allows for the increased possibility of a debris flow if a major storm event should occur. In this case, the rain event was not even major. When compared to nearby Lytle Creek precipitation amounts (15.47 inches), the 3.62 inches of precipitation at Devore seems relatively minor. The damage to the camp may have been much worse if these numbers were reversed.

Conclusions

- The straw bale check dams were successful in storing sediment and breaking the energy of channel flows before the October, 2004 rain events.

- Vegetation became established through the Spring and Summer of 2004 and had somewhat stabilized portions of the stored sediment before the October, 2004 storms.

- Increased sediment bedloading of the channel allows for the increased possibility of a debris flow if a major storm event should occur, and if there is no required maintenance planned.

- During the October, 2004 storm events, the majority of the check dams failed either by blowing out, overtopping, or by cutting around or below.

- It is recommended that straw bale check dams should not be placed in any channel where structures are at risk below (either situated in the drainage itself, on the alluvial fan, or dangerously close to the edge of the channel).

Road treatments

Background

Post-fire field review of roads and trails was performed from 10/31/2003 through 11/05/2003. Road logs were prepared by Bob Ota on 11/18/2003 and these are shown in Tables 3.4 and 3.5. Road drainage designs consisted primarily of rolling dips and various forms of overside drains and lead-off ditches. Treatments also included gates, warning signs, and storm patrols. It was decided that existing drainage structures and maintenance strategies would be able to minimize potential debris flow and provide an adequate level of flood flow protection.

The majority of treatments recommended were the installation of gates to limit public access (Table 3.3, Fig. 3.57). Unauthorized off-highway-vehicle (OHV) is a large scale resource problem and results in significant resource impacts. Because of the close proximity of 20 million people and 80 miles of urban interface, the Forest, thousands of acres have been degraded from past OHV use. "Angeles" gates were planned at locations where public access would be attempted. A total of 15 gates were planned as BAER treatments, seven of which using Forest service funds. It was planned to repair damage to drainage in Road 3N34 to divert runoff away from a cultural Site east of T-6 Crossing.

Work on the approved treatments was not begun until mid-summer after the rainy season had ended because of delays in the contract process. Therefore, monitoring of these treatments was not completed. Monitoring of road treatment effectiveness is planned for 2004/2005.

Table 3.3. Road number and road name of locations of gates proposed under BAER.

			Gate Responsibility		
Road No.	Road Name	ML	Forest	BAER	Comments/Remarks
1N09	City Creek	2	*	1	At Bear Creek (Angeles Gate)
1N22	Daley	2		1	Public Safety – Gate at City Creek
1N32	Edison Rd Section 3	3		1	Public Safety – Gate near Lytle Creek
1N36	Bullocks Spur	2	*		Public Safety
2N03	Burnt Mill	2		2	Both ends
2N49	Bailey Truck Trail	2		2	Public Safety – both ends

2N52	BP&L	2		1	Public Safety – at 2N53
2N57	Old CCC Spur	2		3	Public Safety – off Lytle Creek Road
2W01	(Motorcycle Tr)	N/A		1	(Angeles Gate)
3N31	Lower Lytle Crk Divide	3		2	Public Safety – both ends

Fig. 3.61. View of new gate and warning sign located at Lower Lytle Creed Divide.

Fig. 3.62. Failure of rolling dip and overside drain along Big Tree Cucamonga #1N34. This occurred following October, 2004 storm events. Treatment was planned here but not completed before the October, 2004 rain events. Milepoint was unknown.

Old/Grand Prix Fire Road Logs

Table 3.4. BAILEY CANYON ROAD #2N49 - Mileage begins at intersection of Palm Ave and 2N49.

Mileage	Treatment	GPS pt	Photo #	Repair	Notes
0.0	Reference pt.				Intersection of of Palm Ave and 2N49
0.02	Reference pt.				Gate
0.07	Overside drain				Remove and install 2-12 inch metal spillway with 30 ft flume extension
0.09	Overside drain				Remove and install 2-12 inch metal spillway with 30 ft flume extension
0.17	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 30 ft flume extension
0.55	Remove material				Remove stockpiled material on cutback
0.73	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension / add riprap
1.03	Overside drain				Remove and install 2-12 inch metal spillway with 60 ft flume extension
1.11	Overside drain				Remove and install 2-12 inch metal spillway with 60 ft flume extension
1.18	Overside drain				Remove and install 2-12 inch metal spillway with 40 ft flume extension
1.21	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 20 ft flume extension / riprap
1.23	Little Mac				Riprap added for outlet protection
1.3	Overside drain				Remove and install 2-12 inch metal spillway with 60 ft flume extension / riprap
1.4	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 30 ft flume extension / riprap
1.42	Overside drain				Remove and install 2-12 inch metal spillway with 40 ft flume extension / riprap
1.49	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 20 ft flume extension / riprap
1.84	Overside drain				Remove and install 2-12 inch metal spillway with 20 ft flume extension / riprap
2.5	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 20 ft flume extension / riprap

2.52	Double Big Mac				Repair damaged inlet and starter sections by jacking open and installing stakes or bars to support inlet section.
2.74	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 20 ft flume extension / riprap
3.44	Little Mac				Remove and reinstall outlet structure
3.84	Grouted rock spillway				Removed stockpiled material on bank
4.38	Overside drain				Remove and install 2-12 inch metal spillway with 30 ft flume extension
4.43	Overside drain				Remove and install 2-12 inch metal spillway with 30 ft flume extension
4.71	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension
4.78	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 10 ft flume extension / riprap
4.96	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 20 ft flume extension / riprap
5.04	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 10 ft flume extension / riprap
5.11	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 20 ft flume extension / riprap
5.47	Reference				Road to left
5.52	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 30 ft flume extension / riprap
5.96	Intersect 2N45				End work

Table 3.5. BIG TREE CUCAMONGA #1N34 Mileage begins at intersection of Lytle Cr Road and 1N34

Mileage	Treatment	GPS pt	Photo #	Repair	Notes
0.0	Intersection of Lytle Cr. Rd and 1N34				Reference
0.02	Gate				Reference
0.09	End pavement				Reference
1.04	Intersect 2N57				Reference
1.15	Little Mac overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension / riprap
1.24	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension
1.45	Little Mac overside drain				Remove and install 2-12 inch metal spillway with 15 ft flume extension / riprap

1.47	Overside drain				Remove and install 2-12 inch metal spillway with 15 ft flume extension / riprap
2.38	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 10 ft flume extension
2.45	Overside drain				Remove and install 2-12 inch metal spillway with 20 ft flume extension / riprap
2.49	Switchback				Reference
2.60	Overside drain				Remove and install 2-12 inch metal spillway with 20 ft flume extension
2.63	Overside drain				Remove and install 2-12 inch metal spillway with 20 ft flume extension
3.0	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 10 ft flume extension / riprap
3.05	Overside drain				Remove and install 2-12 inch metal spillway with 20 ft flume extension
3.15	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension
3.17	Overside drain				Remove and install 2-12 inch metal spillway with 20 ft flume extension
3.39	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension
3.45	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension / riprap
3.47	Overside drain				Remove and install 2-12 inch metal spillway with 20 ft flume extension
3.69	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension
4.02	Overside drain				Remove and install 2-12 inch metal spillway with 20 ft flume extension
4.17	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension
4.4	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension
4.61	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 20 ft flume extension / riprap
5.13	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension / riprap
5.22	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension / riprap
5.32	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 20 ft flume extension / riprap
5.58	Intersect 1N36				Reference
5.75	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension
6.44	Overside drain				Remove and install 2-12 inch metal spillway with 10 ft flume extension

6.46	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 10 ft flume extension / riprap
6.73	Rolling dip w. overside drain				Construct rolling dip and install overside drain w. 10 ft flume extension
7.58	Intersect 1N34B				End work

Noxious Weed Monitoring

(Grand Prix and Old Fires, including Bridge and Lytle Fires)

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I. Introduction

In 2004, BAER funds were used to perform weed monitoring of the Bridge, Lytle, Grand Prix and Old Fires on the San Bernardino National Forest. This document describes the survey results and provides recommendations for continued monitoring and weed removal within the burned areas.

The goals of the invasive species monitoring included detecting the expansion of known weed infestations in burned areas and other sites disturbed by fire suppression activities (i.e. dozer lines, hand lines, safety zones and graded roads) and identifying the introduction of new weed species.

II. Background

These fires occurred on the Front Country District of the San Bernardino National Forest during the fall of 2003. The Bridge Fire occurred from September 5th to the 10th on steep slopes with chaparral and conifer vegetation at an elevation range of 2200-4800 feet. The Lytle Fire occurred between October 1st to the 5th in chaparral, oak and sage scrub vegetation on steep slopes with an elevation range of 3800-5200 feet. The Grand Prix/Old Fire occurred between October 21 to November 14th, 2003 in coastal sage, chaparral, oak and mixed conifer vegetation on primarily steep slopes at an elevation range of 1500-6500 feet.

III. Methods

The NRIS-Terra standard protocol was used to define the methods for data documentation and GIS mapping. A combination of general and intuitive controlled survey types were used most often when looking for the targeted weed species. In other words, the surveyors attempted to cover as much ground as possible (on average 60% of total area), but focused on those areas that were most likely to harbor or promote the spread of invasive species (i.e. riparian, roadsides, trails, areas adjacent to private land).

Twenty highly invasive weed species were identified as the greatest threats to the successful restoration of native vegetation following these fires (Table 3.6). These 20 target species were mapped to provide baseline information, and allow for continued monitoring to detect the expansion of infestations. In addition to mapping the target species, the presence of all other non-native species were recorded for each

site, to provide a qualitative representation of all the weed species infestations post-fire. A limited amount of hand removal of isolated occurrences of tamarisk seedlings was also performed.
The surveys were conducted from May to early August and focused primarily on BAER sites (treated with aerial application of straw mulch) and roadsides. Other fire suppression treatment areas that were surveyed included dozer and hand lines created to contain the fires.

IV. Results and Conclusions

Table 3.7 lists completed sites. Approximately one year after the Bridge, Lytle and Grand Prix/Old Fires infestations of the target weed species *Ailanthus altissma, Centaurea melitensis, Cirsium vulgare, Helianthus annuus, Nicotania glauca,* and *Spartium junceum* seem to be the most prevalent in the areas surveyed. *Centaurea melitensis* and *Spartium junceum* often cover large acreages, but the other species are typically found to occupy less area and may be more easily eradicated. *Foeniculum vulgare, Riccinus communis* and *Tamarix ramosissima* were also detected in several areas and occupy a small enough area to warrant efficient removal. In addition, in almost all of the sites surveyed there were large infestations with dense canopy covers of the other non-native species, most especially *Brassica nigra, Bromus diandrus, Bromus madritensis, Bromus tectorum* and *Erodium cicutarium.*
The greatest concentrations of weed species seemed to be associated with roadsides, bulldozer lines and drainages near human habitation. This is intuitively due to their conduciveness to seed dispersal and disturbance.

In most instances it was difficult to distinguish whether the weed infestations were in place prior to the fires or if they were new occurrences. It is highly probable that the weed species were already present in most of the areas seed banks, but were released from competition following the fire and it's associated disturbances. For example, in the case of most infestations of *Centaurea melitensis, Brassica nigra, Bromus diandrus, Bromus madritensis,* and *Bromus tectorum* it was obvious that their population sizes had expanded beyond the pre-fire levels. The perennial target weed species, such as *Nicotania glauca,* also seemed to respond well to the fire associated disturbances, since they were often found to be recolonizing previous populations.

When surveying the areas with straw mulch cover in the BAER sites a pattern was noticed that areas with a significant layer of straw (>1 inch) had decreased infestations of weed species. The applications of straw were very patchy however, leading to a mosaic of weed colonization. Dozer and hand lines rehabilitated with brush thrown across the disturbed soil also showed a decrease in weed colonization compared to uncovered areas.

Table 3.6. Target Species

ARDO-Arundo donax	CIVU- Cirsium vulgare	PESE- Pennisetum setaceum
ACRE-Acropitilon repens	DISI- Dimorphatheca sinuata	POBU- Poa bulbosa
AGAD- Ageratina adenophora	FOVU-Foeniculum vulgare	RICO- Riccinus communis
AIAL- Ailanthus altissma	HEAN- Helianthus annuus	TARA- Tamarix ramosissima
CEMA- Centaurea maculosa	LIGE- Linaria genistifolia	SPJU- Spartium junceum
CEME- Centaurea melitensis	MEOF-Melilotus officinalis	SEMI- Senecio mikanioides
CESO- Centaurea solstitialis	NIGL- Nicotania glauca	
Other Non-native Species recorded Recorded		
AVBA-Avena barbata	BRTE- Bromus tectorum	VUMY- Vulpia myuros
BRNI- Brassica nigra	CHSP- Chenopodium sp.	
BRDI- Bromus diandrus	ERCI- Erodium cicutarium	

BRHO- Bromus hordeaceus	LASE- Lactuca seriola	

Table 3.7. Completed Sites:

Quad	Treatment	**Town ship**	Range	Section	Date	**Target Sp.**	**Other Non-native Sp.**	Comments
Cucamonga	Demons Canyon dozer line				5/11/04		BRNI	
Devore	Nude camp BAER area	2N	5W	29	5/10/04	**CEME NIGL**	AVBA BRMA ERCI CHSP	
Devore	BAER area	2N	5W	21	7/21/04	**HEAN AIAL, ARDO CEME**	BRNI, BRMA BRTE, BRDI, BRHO, ERCI, LASE, AVBA	Unknown thistle also gps'd. AIAL, ARDO found right along property boundary along Middleman Creek, seem to have spread from private. HEAN is located occasionally along Middleman Cr. CEME pretty much consistently located on more gradual ridges and slopes of area.
Devore	BAER area	1N	5W	33, 32	7/27/04	**AIAL HEAN NIGL**	BRTE, BRDI	All listed weeds found in drainage which starts near the middle of sec 32 and heads SE to 3N31
Devore	3N31: Graded road				7/27/04	**CEME CIVU HEAN**		All found scattered along road
Devore	Dozer line	1N	5W	7	7/27/04	**CEME HEAN**		Both found in patches along ridgeline
Devore	Dozer Line: along closed 1N36	1N	6W	11	7/27/04			No target weeds found
Devore/	1N34A				5/07/04		BRDI,	Road reclaimed

Cucamonga							BRMA BRTE	
Devore/ Cucamonga	1N34/1N36 Safe zone and turn out				5/07/04		BRMA BRTE, BRDI AVBA ERCI	
Devore/ Cucamonga	1N34 N dozer line				5/07/04		BRNI, BRDI	
Devore/ Cucamonga	1N34 S dozer line				5/07/04		BRDI BRNI CHSP	
Devore/ Cucamonga	1N34 W of graded road				5/07/04	**CIVU**	BRNI AVBA CHSP	
Devore/ Cucamonga	2N57 S from 1N34	1N	6W	1	5/07/04	**CEME**		No access. CEME at gate
Devore/ Cucamonga	2N57 N from 1N34				5/07/04		BRNI BRDI	
Devore/ Cucamonga	1N34 E of 2N57				5/07/04			No target weeds found
Forest Falls	Mountain Home Creek Road up to gate				5/10/04	**SPJU**		
Harrison Mtn	BAER area	1N	3W	28	7/12/04	**CEME HEAN NIGL, TARA**	BRNI BRMA BRTE BRDI BRHO ERCI LASE AVBA	Only one known individual of TARA found in main drainage. Individual pulled up and removed. CEME found all over ridges and slopes. HEAN in southern half of far western drainage. NIGL all along road at southern end and on southern ridge to west of far western drainage
Harrison Mtn	City Creek Rd 1N09	1N	3W		8/03/04	**CEME CIVU SPJU Area did not burn. Previous infestations**	BRNI BRMA BRTE BRDI BRHO ERCI LASE AVBA VUMY	CEME scattered along entire stretch of road. CIVU near beginning of road (near Highway 330), approximately 1-2 acres. SPJU consistent along road, until end where peters out
Harrison Mtn	Del Rosa:	1N	3W	SE	8/03/04	**CEME**	AVBA	CEME and

	E.side of Forest Service compound			corner 13		**HEAN NIGL, RICO**	BRDI BRMA BRTE LASE	HEAN scattered throughout area to the N. and E. of buildings. NIGL and RICO in drainage to the E. of buildings, approximately 2 acres
Harrison Mtn	Heaps Peak BAER Site	2N	3W	NE corner sec 25	8/03/04		BRNI BRTE	Some heavy infestations of BROTEC found, including areas with straw
Harrison Mtn	Highway 330	1N	3W	15	8/03/04	FOVU		Small patch of about 10 plants
Keller Peak	1N16				5/06/04		AVBA BRDI BRMA	
Lake Arrowhead	Hooks Creek BAER site	2N	3W	13	8/03/04		BRDI BRTE LASE	
San Bern. North	Meyers Canyon BAER site	2N	5W	SW 25, NW 36	7/29/04	CEME CIVU, HEAN NIGL	BRNI BRMA BRTE BRDI BRHO ERCI LASE AVBA	CEME found along most ridge-lines on southern end. CIVU at southern end of Meyers Canyon, small patch (15m) in drainage. HEAN small patches (1-2 plants) scattered throughout southern end. NIGL in drainages at southern end, especially Meyers Canyon
San Bern. North	2N49				5/11/04	CIVU SPJU CEME HEAN	BRNI BRTE BRDI CHSP	
San Bern. North	2N49 erosion control area				5/11/04			No target species found
Silverwood Lake	Cottonwood Station BAER site	2N	5W	1,2,11, 12	8/01/04	HEAN TARA	BRNI BRMA BRTE BRDI BRHO ERCI LASE	HEAN found scattered throughout 2 drainages running north into the West Fork Mojave

							AVBA VUMY	River. TARA is uncertainly identified in 2 drainages of this area, due to the small stature of the specimens found. Large infestations of BROTEC and BRODIA found in patches
Telegraph	Dozer line	3N	6W	SW corner 33	6/22/04		BRNI BRMA BRTE BRDI BRHO ERCI,L ASE AVBA	
Telegraph	Dozer line	2N	6W	8,9	6/22/04		BRTE AVBA LASE BRMA	
Telegraph	Dozer line by Lytle Creek	2N	6W	NE 16	6/22/04	AIAL	BRNI BRMA BRTE BRDI BRHO LASE AVBA VUMY	Area near houses has AIAL that is spreading into burned area.
Yucaipa	1N16				5/06/04	PESE, TARA NIGL, SPJU, CIVU, CEME	BRNI AVBA BRDI	

V. Recommendations

Continue survey along City Creek and Plunge Creek to document if seedlings of Spanish broom are present and have become established within the riparian areas. These are important locations to survey due to the presence of one of the only two locations of mountain yellow legged frog on the Forest. If seedlings are present and could be hand pulled, this area is priority for control.

The fennel and castor bean occurrences are small enough at this time to be controlled by hand removal. This should also be a priority**.**

Continue monitoring the locations where tamarisk seedlings were found and removed. Remove as new seedlings become established so as to the reduce potential for expansion and need for herbicide use in the future.

Weed monitoring data will need to be entered into NRIS when the system is available on the Forest. Maps of the weeds will need to be entered into the Forest weed GIS database.

Forest botanists need to review the data to identify species and locations of weeds that have the greatest effect on habitat and could be effectively eradicated. Completion of NEPA is needed to begin treatments. Funding is available from 2003 National Fire Plan funds to complete NEPA and begin eradication, therefore an additional request of BAER funds is not needed.

Effects of strawbale heli-mulching on vegetation recovery

San Bernardino National Forest, Old Fire

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Introduction

In 2004, the San Bernardino National Forest used Burned Area Emergency Rehabilitation (BAER) funds in a contract to the Pacific Southwest Research Station (Riverside Fire Lab) to determine the effectiveness of strawbale heli-mulching on vegetation recovery. This document describes the short-term vegetation recovery observed in the spring and early summer immediately following the Old Fire. The objective was to determine the effects of straw heli-mulching on vegetation recovery and species diversity. There are concerns that straw mulching will negatively affect vegetation recovery because of the clumping and formation of straw during winds.

Methodology

The survey was conducted at an elevation of 2,200 ft on the front range of the San Bernardino Mountains in the City Creek area off of Highway 330. Locations of transects and site are given by GPS points in Appendix L.

Vegetative sampling transects were set up and sampled based on FIREMON guidelines. Baseline transects extended 25 meters and ended near the top of the ridge. For plots 1T, 2T, 4C, and 5C baselines tended to run N, with transects running E. For Plots 3T and 6C, baselines ran S, with transects running W. Transects were located along the baseline using a random numbers table, and were required to be ≥ 2 m apart. Length of baselines were 25 m and the transect length was 26 m. Further plot information is included in Appendix L.

For vegetation sampling, a pin was dropped at every 0.5 m along the transect starting at 0.5 m and ending at 25.5 (end of transect line was at 26 m). For each pin drop, a ground cover (less than .5 m height) was recorded along with any vegetation that hit the pin below 1 m. The angle of the sampling pole was used for vertical placement. If a plant was hit basally, this was recorded as such. Plants were identified down to species level where possible. In addition, average height of a plant species and live/dead plant status were recorded along the transect. The live/dead plant status referred to the entire plant rather than the portion of the plant the pin hit.

Results

Table 3.8 is a list of species present at the site identified as to Genus and species, Family, lifeform, and code. Table 3.9 lists unknown species found at the site that were later identified. Table 4.0 is a comparison of mean percent species cover and treatment cover between the straw mulch treatment and untreated control from March to June of 2004.

Table. 3.8. List of species present at site.

Genus	Specific Epithet	Family	Lifeform	Code
Acourtia	microcephala			ACMI
Adenostoma	fasciculatum	Rosaceae	Shrub	ADFA
Artemisia	californica			ARCA
Avena	sp	Poaceae	Grass	AVENsp
Bromus	diandrus	Poaceae	Grass	BRDI
Bromus	hordeaceus	Poaceae	Grass	BRHO
Bromus	rubens	Poaceae	Grass	BRMA
Calystegia	macrostegia	Convolvulaceae	Forb	CAMA
Camissonia	californica		Forb	CACA
Ceanothus	crassifolia	Rhamnaceae	Shrub	CECR
Centaurea	melitensis			CEME
Cryptantha	muricata		Forb	CRMU
Emmenanthe	penduliflora	Hydrophyllaceae	Forb	EMPE
Encelia	farinosa			ENFA
Erodium	cicutarium	Geraniaceae	Forb	ERCI
Eucrypta	chrysanthemifolia	Hydropyllaceae	Forb	EUCH
Helianthus	gracilentus	Asteraceae		HEGR
Hirschfeldia	incana	Brassicaceae	Forb	HIIN
Marah	macrocarpa	Cucurbiaceae	Forb	MAMA
Mentzelia	micrantha		Forb	MEMI
Mirabilis	laevis	Nyctaginaceae	Forb	MILA
Phacelia	minor	Hydrophyllaceae	Forb	PHMI
Phacelia	sp	Hydrophyllaceae	Forb	PHACsp
Quercus	berberidifolia	Fagaceae		QUBE
Salvia	columbariae	Lamiaceae		SACO
Salvia	mellifera	Lamiaceae		SAME
Solanum	xanti	Solanaceae		SOXA
Stephanomeria	virgata		Forb	STVI
Vulpia	myuros	Poaceae	Grass	VUMY
Cercocarpus	betuloides	Rosaceae		CEBE
Lonicera	subspicata			LOSU

Table 3.9 . List of unknown species sampled at site and later identified.

Date	Location	Unknown	Code	Genus	Specific Epiphet	Verifier
6/3/2004	City Cr.	Phacelia minor	PHMI	Phacelia	minor	A. Sanders
6/3/2004	City Cr.	BRHO	BRHO	Bromus	hordeaceus	A. Sanders
6/3/2004	City Cr.	EUCH	EUCH	Eucrypta	chrysanthemifolia	A. Sanders
6/3/2004	City Cr.	ACMI	ACMI	Acourtia	microcephala	A. Sanders
6/3/2004	City Cr.	MENTsp	MEMI	Mentzelia	micrantha	A. Sanders
6/3/2004	City Cr.	oak?	QUBE	Quercus	berberidifolia	A. Sanders
6/3/2004	City Cr.	CAMA	CAMA	Calystegia	macrostegia	A. Sanders
6/3/2004	City Cr.	STVI	STVI	Stephanomeria	virgata	A. Sanders
6/3/2004	City Cr.	CEME	CEME	Centaurea	melitensis	A. Sanders
3/24/2004	City Cr.	BRMO	BRHO	Bromus	hordeaceus	A. Sanders
3/24/2004	City Cr.	Unk 5	CRMU	Cryptantha	muricata	A. Sanders
3/24/2004	City Cr.	Solanum #10	SOXA	Solanum	xanti	A. Sanders
3/24/2004	City Cr.	Camissonia #9	CACA	Camissonia	californica	A. Sanders
3/24/2004	City Cr.	Unk 2	EUCH	Eucrypta	chrysanthemifolia	A. Sanders
3/24/2004	City Cr.	oak	QUBE	Quercus	berberidifolia	A. Sanders
3/24/2004	City Cr.	Unk 1	CEME	Centaurea	melitensis	A. Sanders
3/24/2004	City Cr.	Unk 4	VUMY	Festuca	myuros	A. Sanders
3/24/2004	City Cr.	BRCA #7	BRDI	Bromus	diandrus	A. Sanders
3/24/2004	City Cr.	Unk 3	HEGR	Helianthus	gracilentus	A. Sanders
3/24/2004	City Cr.	Unk 6	ACMI	Acourtia	microcephala	A. Sanders
3/24/2004	City Cr.	Mirabilis	MILA	Mirabilis	laevis	A. Sanders
3/24/2004	City Cr.	Phacelia	PHMI	Phacelia	minor	A. Sanders

Table 4.0. Comparison of mean percent species cover and treatment cover between the straw mulch treatment and untreated control from March to June of 2004.

Species and treatment		3/1/2004 Cover %		6/1/2004 Cover %	
Scientific name	Code	control	treated	control	treated
	Straw treatment	**2**	**20.8**	**0**	**22.2**
Centaurea melitensis	CEME	12.8	3.7	8.9	14.7
Erodium cicutarium	ERCI	2.4	1.3	0.7	1.4
Bromus hordeaceus	BRHO	0	0.9	0	0.3
Eucrypta chrysanthemifolia	EUCH	0.1	0.9	0.1	3
Quercus berberidifolia	QUBE	0.1	0.3	2.3	0.3
Bromus rubens	BRMA	7.9	6.7	6.1	10.4
Helianthus gracilentus	HEGR	0	0.1	0	0.53
Calystegia macrostegia	CAMA	1.9	2.4	13.8	10.9
Marah macrocarpa	MAMA	0.1	0.1	0	0
Bromus diandrus	BRDI	0	0.1	0	0
Hirschfeldia incana	HIIN	9	4.7	10.2	13.2
Vulpia myuros	VUMY	0	0.4	0.1	2
Solanum xanti	SOXA	0	0.1	0	0.3
Salvia mellifera	SAME	0.3	0.1	0.3	0
Phacelia minor	PHMI	1.2	6.9	1.6	0
Mirabilis laevis	MILA	0	0.5	0	0.4
Camissonia californica	CACA	0.3	0.5	0.1	0.4
Encilia farinosa	ENFA	0	0.1	0	0.1
Acourtia microcephala	ACMI	0.4	0	0.3	0
Artemisia californica	ARCA	0.3	0	0	0
Adenostoma fasciculatum	ADFA	0.3	0	0.78	0.1
Cryptantha muricata	CRMU	0	0	0.4	0
Mentzelia micrantha	MEMI	0	0	0	0.3
Stephanomeria virgata	STVI	0	0	0	0.1
Emmenanthe penduliflora	EMPE	0	0	0	0.1
Ceanothus crassifolia	CECR	0	0	0.4	0
Lonicera subspicata	LOSU	0	0	0.1	0
Phacelia spp.	PHACsp	0	0	0.1	0
Avena spp.	AVENsp	0	0	0.5	0

Conclusions

It appeared that the straw heli-mulch applications for erosion control had little impact on vegetation cover or species diversity. Short-term vegetation recovery in terms of both cover and diversity in the immediate post-fire growing season seemed successful in both the treated and control areas. The species *Phacelia minor* was the only one showing a showing a positive response to the treatment early in the season. The three Ceanothus seedlings that germinated in the Spring were found only in the control area and not in the treated area.

Heritage Resources

Background

Conditions resulting from the Cedar Fire placed heritage resources at risk due to erosion, storm runoff, debris flows, looting, and suppression/rehabilitation efforts. BAER teams visited each cultural site and determined if it was at risk and if treatment was necessary. It is important that physical stabilization of the site be implemented before damaging storms occur.

Effectiveness monitoring

The following seven sites were monitored for treatment effectiveness:

- CA-SBr-485: evaluate effectiveness of water diversions and cover for site protection
- CA-SBr-1595: evaluate effectiveness of area closure and fences
- CA-SBr-3003: evaluate effectiveness of area closure.
- CA-SBr-3866: evaluate effectiveness of area closure and fences
- CA-SBr-5683: evaluate effectiveness of area closure and fences
- CA-SBr-10569: evaluate effectiveness of area closure.

Conclusions

- Treatment of the areas at risk have proven successful to this point.

Chapter 4:

Piru Fire

Los Padres National Forest

Introduction

The Piru Fire began on Oct 23, 2003 along the west shore of Lake Piru and grew quickly due to the hot and dry and Santa Ana wind conditions. The fire burned a total of 63,991 acres of which 32,534 acres were on National Forest land (Fig. 4.5). Access to the fire was difficult and was limited on the east side to private roads off of Lake Piru Road, and on the west side to Squaw Flat Road that provides passage to the Sespe Wilderness condor refuge. Major values of risk were the Lake Piru Reservoir (Fig 4.1), and in the Sespe area, oil fields (Fig. 4.2) and the condor refuge in the wilderness area.

Fig. 4.1. In this view of the Lake Piru Reservoir, a plume of sediment can be seen entering at the upper end.

Fig. 4.2. Oil pipelines suspended across drainage in the Sespe area. The fire uncovered a vast array of functioning and non-functioning pipelines in the area. It was suggested that the pipelines be mapped and noted as working or not.

Very steep slopes are common to the Monterey and Sisquoc geologic formations and much of the terrain is inaccessible (Fig. 4.3). Soils were classified as Lithic Xerochrepts-Lithic Haploxeralfs-Rock Outcrop complex (Soil Survey, Los Padres N.F.). Because of the steep slopes and numerous drainages, the fire left a mosaic pattern of scattered islands of vegetation that did not burn. In the Sespe area, a large amount of dry ravel was deposited on the road surfaces during and immediately following the fire. Dry ravel continued to accumulate on road surfaces and in drainages through the winter.

Fig. 4.3. View of steep terrain common to the Monterey and Sisquoc geologic formations found in the Piru Fire area.

Soil burn severity and water repellency is included in Table 4.1. Burn severity is mapped in Figure 4.4. Erosion potential was estimated at 12 tons/acre. Sediment potential was estimated at 7,680 tons/square mile. Because of the relatively light fuel loads, soil damage in the context of water repellency and infiltration rate was minor (Fitzerald, Napper 2003). Water repellency occurred on 30,335 acres (Table 4.1), with the depth of repellency not going below 2 inches. Vegetation within the fire perimeter was a combination of mixed chaparral, California sagebrush, riparian woodland, canyon live oak, and big cone Douglas fir.

Table 4.1. Soil burn severity and water repellency.

Burn severity	Acres
Low	19,713
Moderate	28,839
High	1596
Unburned	13,843
Water repellency	30,335

Monitoring status, modifications, and operational problems encountered

The monitoring proposal was modified to include the log check dams (log erosion barriers) that were prescribed later in a BAER supplemental report and implemented in Dominquez Canyon. This created no problem as monitoring of the treatment was already being done by Allen King (see channel treatments). Road storm patrol was contracted out and was not available to record and complete the road survey forms. We acquired post-storm information on road repairs from Kenny Shaw (Engineer -Ojai Ranger District), Allen King, and from our own personal visits to complete the forms. It will be important to continue to monitor the channel treatments during the second year following the fire, because of the stored sediment now in the drainage.

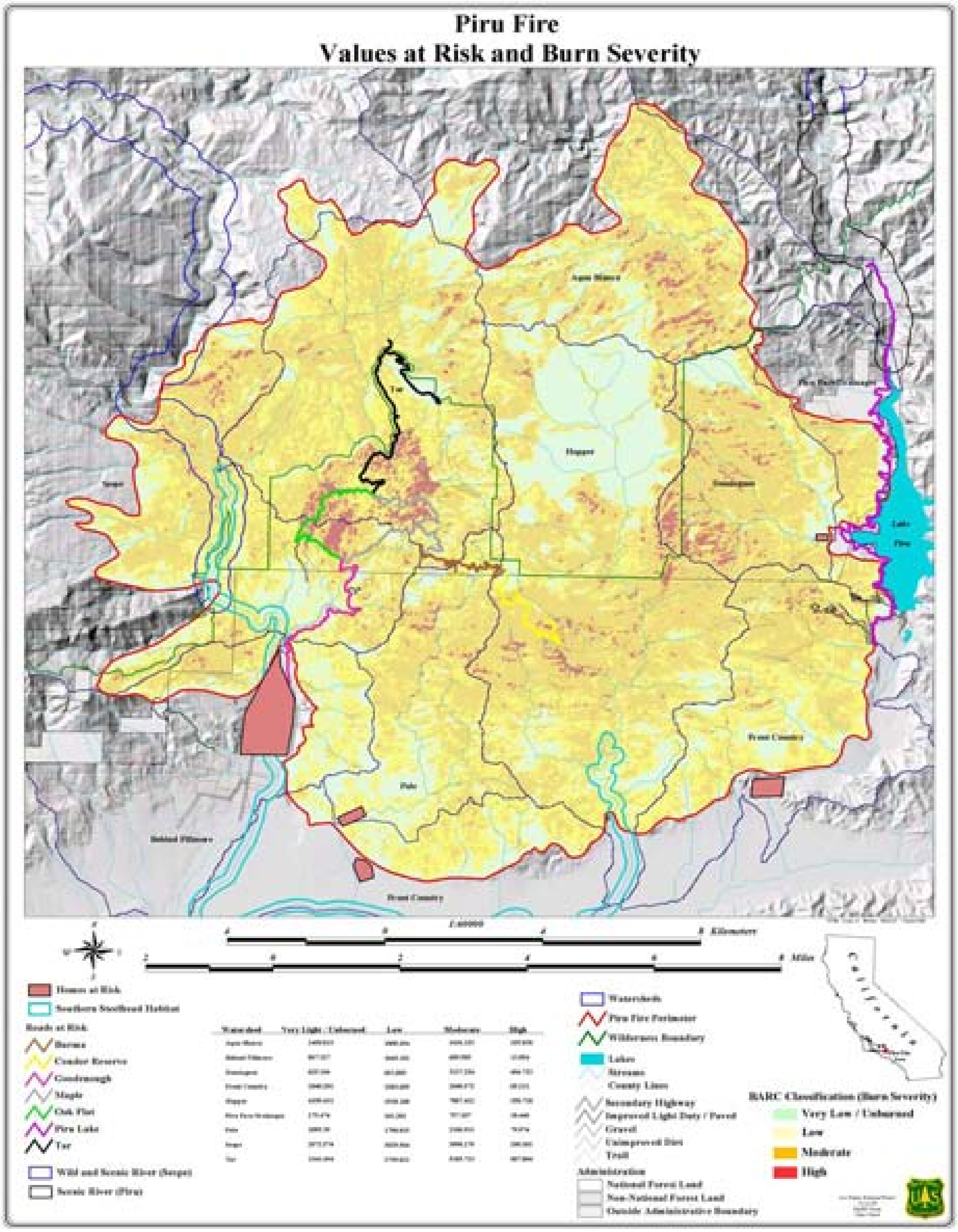

Fig. 4.4. Burn severity map of the Piru burn area.

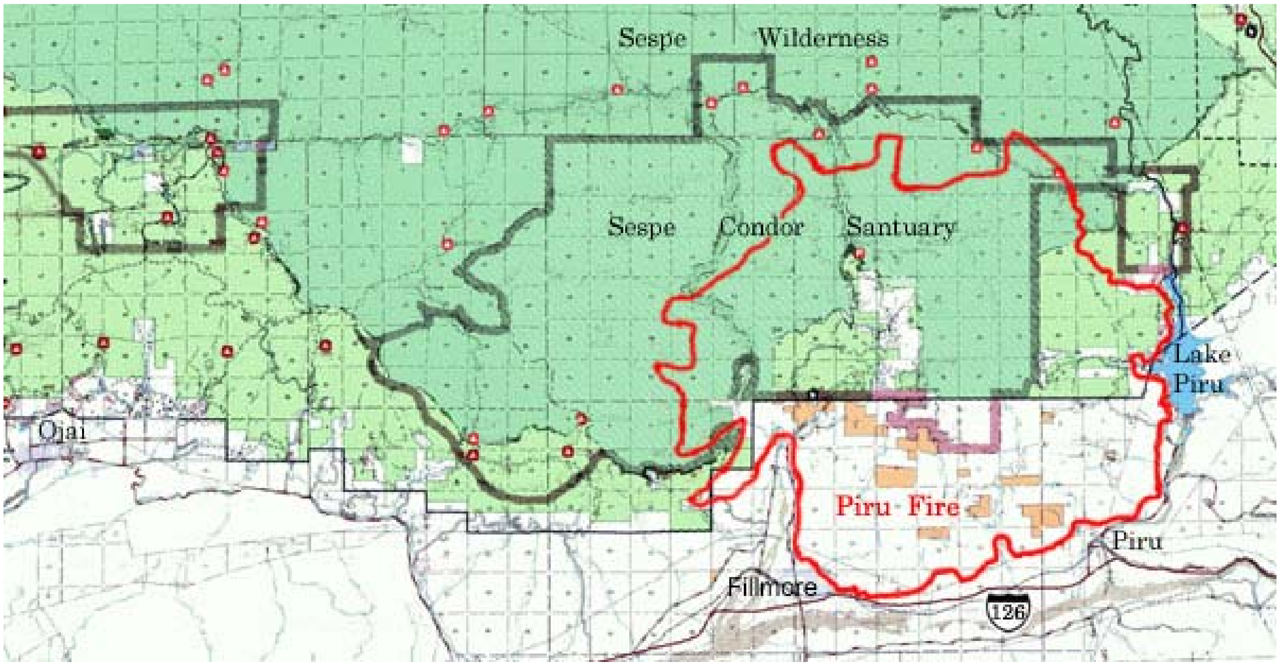

Fig. 4.5. Boundary of Piru Fire lined in red.

Hillslope treatments

Because most of the slopes were >60% within the fire boundary, no hillslope treatments were prescribed. The fire area has natural background erosion rates that are high due to the unstable lithology, structure, and steep topography. It was predicted that surface erosion rates would increase during the first two years because of the removal of vegetation cover. Vegetation recovery was expected in three years. Recovery on some of the slopes was already evident only a few weeks after the fire (Fig. 4.6). Remarkably, almost all of the oaks were showing signs of resprouting by mid-June, 2004, many of which were presumed dead by some (Figs. 4.7, 4.8).

There is a definite need to monitor post-fires areas where no treatments are prescribed. The following statement was contributed by Carolyn Napper (BAER team leader for the Piru Fire.

Why Monitor the "No Treatment" Areas within a Wildland Fire?

The 2003 Piru Fire burned areas at a moderate to high burn severity. The BAER assessment team did not propose any hillslope treatments for the following reasons:

- Existing direction in FSM 2523.03 states "undertake stabilization treatments only when an analysis shows that planned actions are likely to substantially reduce risks and are compatible with land and resource management plans and wilderness management objectives." The team felt hillslopes treatments within the burn were not compatible with the FSM direction, and treatments would not reduce the risks.
- Current information on effectiveness of hillslope treatments in Southern California demonstrates reduced effectiveness due to the following:
    - high winds that remove cover treatments
    - steep slopes with dry ravel
    - large quantities of stored sediment in channels
    - and limited ground access to sites.

In the 2500-8 Part III- Watershed Condition- asks for the erosion potential in tons per acre. “The estimate should be a weighted average for all soils and should be based on the next 24-month time period without treatment.” (2500-8 Part III, D.)
Monitoring untreated hillslopes will validate if the erosion potential, determined by the team, was accurate. Both erosion and sediment potential define the emergency, based on the values at risk. In addition, soil scientist benefit from site specific erosion monitoring data. The monitoring data is useful for determining the accuracy of the initial erosion potential estimate.

Hydrologic design factors (2500-8) require an estimate of vegetative recovery period. This is defined;”the period of time, in years, that is required for the burned area to develop vegetation sufficient to reduce runoff and erosion potential to essentially pre-fire conditions. This is a best estimate of natural regeneration, supplemented by the treatment prescribed.”(2500-8 instructions) A BAER assessment team unfamiliar with recovery periods would benefit from monitoring information that documents the recovery. Both team members and management benefit from understanding the vegetative recovery process, resulting in better decisions on emergency determination and subsequent treatment selection.

There is current direction in FSM 2500 (2523.3 Monitoring) that states; “Monitoring of recovery may be done in certain cases to evaluate if subsequent treatments are warranted where values at risk were identified, but no treatment measures were implemented, due to concerns regarding effectiveness or practicality.”

Fig. 4.6. Grass and herbaceous vegetation recovery witnessed within weeks following the Piru Fire. Photo taken on 11-21-2003.

Fig. 4.7. A photo of Canyon live oaks taken immediately following
The Piru Fire. Photo taken on 11-21-2003.

Fig. 4.8. A photo showing the vigorous aerial and basal reprouting of the Canyon live oaks.
Photo taken 6-22-2004.

Channel treatments

<u>Log check dams</u>

Background

Check dams are used as grade control structures to prevent downcutting, headcutting and gully action, which in theory also effectively prevents the generation of new sediments in burned-area channels. Structures are designed with no defined spillway and attempt to match the morphology as the original channel (BAER manual). The dam is designed such that it will pass a design flood. In theory, sediments are permanently stabilized on a level gradient above the spillway, and are temporarily stabilized on a gradient equal to the original channel gradient.

Treatment installation

A total of 35 log check dams were installed in channels along Dominquez Canyon. Canyon live oaks growing along the channel were cut down and the logs used to build the dams. The trees were thought to be dead (but most were resprouting by the spring of 2004). Logs ranged in size from approximately 6 to 18 in. Most of the log check dams were about 3-4 ft in height. Width of the barriers ranged from 6 to 45 ft. The logs were "keyed in" 1 to 2 ft into the channel side banks (Fig. 4.9). Logs were pinned together using wooden pegs. Geo-textile fabric was placed over the dams and fabric netting was laid out below the dams to act as an energy dissipater (Fig. 4.10). Figure 4.11 shows finished log check dams (see Dominquez road log mile pt. 3.1-3.3). BAER criteria for constructing log check dams states that they should not be built in channels where the gradient exceeds 6%. Dominquez Creek gradient was 10-12% in the lower section, and 12-16% in the upper drainage section.

Fig. 4.9. Installation of log check dams begins.

Fig. 4.10. Geo-textile fabric being spread over log check dam and fabric laid out below dam to act as an energy dissipater.

Fig. 4.11. Finished log erosion barriers viewed up channel.

Values at risk

Values at risk included: (1) large amounts of sediment entering Lake Piru Reservoir and reducing its storage capacity and its water quality, (2) threats to Dominquez Canyon Road from bank failure (used as a fire road and as access to privately owned ranches), and (3) threats to Matthew's cabin (see Dominquez road log, mile pt. 0.98-1.0).

Effectiveness monitoring

The log check dam treatment was approved and implemented after the original treatments were approved and prescribed. Consequently, this treatment was not planned for in the original effectiveness monitoring proposal. We were fortunate in that Allen King (Southern California Province Geologist, Los Padres N.F.) had began taking photos soon after the treatment was implemented. A detailed implementation map was used to locate treatments during the survey (4.12). Storm patrol was contracted out to the private sector and was not available for recording surveys. A survey form is included in Appendix J. However, we were able to make numerous visits to the site after storm events. Visual surveys and photo documentation were used to monitor channel treatment effectiveness. Precipitation was determined using data from the Piru RAWS weather station (Table 4.2).

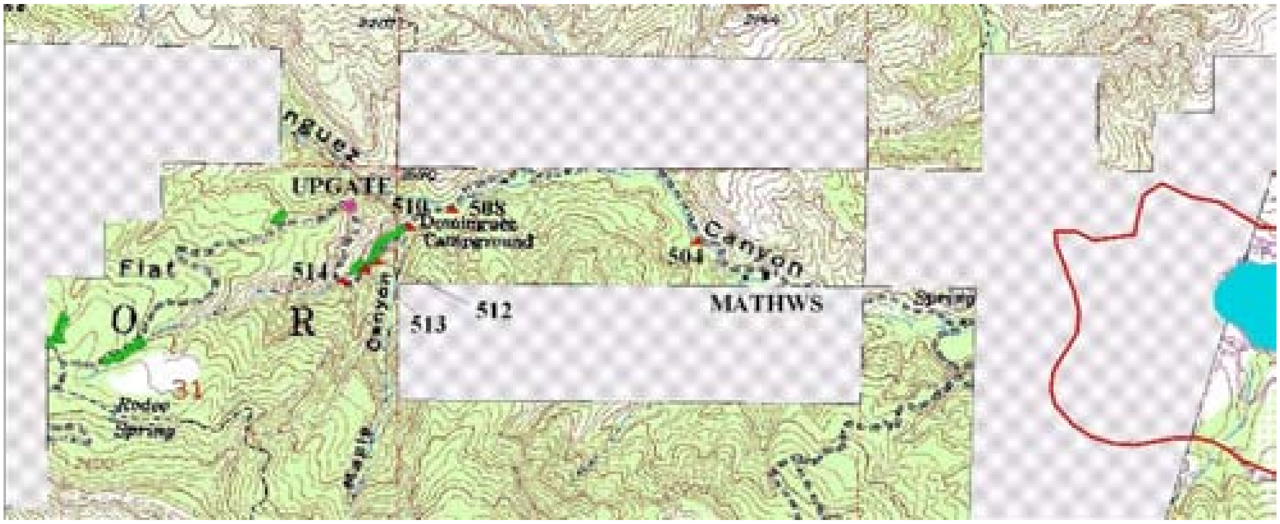

Fig. 4.12. Dominguez Canyon log check dam treatment sites. Treatment sites are marked as green triangles.

Table 4.2. Precipitation measured at the RAWS station located in Piru, California

Month	**Day**						**Monthly total**
Nov, 2003	**Nov 1,3**	**Nov 8,9**	**Nov 15**				
	0.06	**0.04**	**0.05**				**0.15**
Dec	**Dec 7**	**Dec 14**	**Dec 23**	**Dec 24**	**Dec 25**		
	0.10	**0.14**	**0.14**	**0.47**	**1.26**		**2.14**
Jan, 2004	**Jan 2**	**Jan 20**	**Jan 27**				
	0.79	**0.02**	**0.02**				**0.83**
Feb	**Feb 2**	**Feb 18**	**Feb 20, 21**	**Feb 22**	**Feb 25**	**Feb 27**	
	0.62	**0.38**	**0.50**	**0.65**	**2.66**	**0.04**	**4.85**
Mar	**Mar1**	**Mar 2**	**Mar 25**				
	0.40	**0.02**	**0.01**				**0.43**
Apr to Sep							**0.13**
Oct	**Oct 16**	**Oct 17**	**Oct 18**	**Oct 19**	**Oct 26**	**Oct 27**	**4.67**
	0.05	**0.64**	**0.36**	**2.30**	**1.21**	**0.11**	
Nov to Sep total							**13.20**

Results

Following the Christmas Day storm of 1.26 in (Table 4.2), the storage area of the lower drainage check dams were filled to capacity by sediment (Fig. 4.13). This resulted in water flowing unimpeded over the top of the dams. Note the denuded channel below the dam in figure 4.13. The increased energy of the flows caused cutting back (incising) of the channel below the dam (Fig. 4.14, 4.19).

Fig. 4.13. Storage area behind dams filled to capacity.

Fig. 4.14. Cutting back under the log check Dam.

With increased energy, flowing water began creating new channels in the stored sediment. These newly formed channels in the recently deposited bedload meander to the channel sides (banks) because of less resistance, cut into banks and contibute end failures of the check dams (Fig. 4.15).

Fig. 4.15. New channel formed in newly deposited sediment causing check dam to fail at end.

The log check dams began to fail during the February rain events. A series of storms occurred in February totaling 4.85 in. (Table 4.2). In Fig. 4.16, water was flowing beneath the structure threatening to undermine both the structure and the bank. In the same Fig. 4.16 and also in Fig. 4.17, sediment has overtopped the check dam and is also passing around it. Below the upper check dam in Fig. 4.17, there was gully formation. The storage area behind the check dam in Fig. 4.17 was filed coarse rock and sediment infill. The creek gradient here is >20% and the gradient of the surface of infilled material was 12%. Height of hiking pole was 4' (Fig. 4.17). The photo in Fig. 4.17 was taken before the Feb 26 rain event of 2.66 in. (Table 4.2). The next photo (Fig. 4.18) was taken from the same location after the Feb 26 rain event. The failure of the dam has resulted in the release of the sediment that was stored behind the dam. The flow of water was now cutting into the bank and causing the banks to fail and add more sediment to the channel (Fig. 4.18). The “keying in” of the check dam into the slope was questionable in many of the structures, as was witnessed in Fig. 4.18.

Fig. 4.16. Water flowing under structure in foreground and sediment overtopping and going around structure.

Fig. 4.17. Sediment passing over and around check dam. Photo taken before the Feb 26, 2004 rain event.

Fig. 4.18. Photo taken from same location but after the Feb 26 rain event.

Fig. 4.19. View of log check dam being undercut. With the check dam filled to capacity with sediment, there is nothing reducing the energy of the water flow.

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Canyon live oaks were cut down to construct the check dams (Fig. 4.20). The crews thought the oak dead, however, most of the oaks had resrpouted aerially on the limbs by June, 2004. The oaks growing on the side banks were old and had deep, well established rooting systems that provided stability to the steep banks. If the roots now die, bank stability would deteriorate over time and may fail eventually.

Fig. 4.20. Remaing canyon live oak stump.

No repairs have been made to the lower drainage check dams. In the upper drainage, some log erosion barriers have been removed and others have been notched. This is detailed in the road log. Figure 4.21 shows notching or removal of middle portion of check dam to allow sediment and water to pass through. Additional photos of the log check dams are included in appendix E.

Fig. 4.21. To remediate the check dam installation, notching or removal of middle portion of some check dams was initiated.

Conclusions

- The lower drainage section of log check dams (Group A – 12 dams) immediately filled with sediment following the 2003 Christmas Day storm, because of the high rate of production of material from the drainages of this watershed.

- The log check dams began to fail during the February rain events.

- Those that failed at the sides resulted in further cutting of the bank resulting in bank erosion and more sediment contributed to the channel.

- Because of the above, the check dam treatment has promoted greater erosion in the channel, and in places, has put the road in danger to undercutting.

- The entire set of channel treatments should not have been done because (1) the high production rate of material (dry ravel) in these steep (>55% watersheds) that provide high bedloads, (2) steep gradients in the upper drainages, (3) redirection of new channels as fresh flows cut into the newly deposited sediment because of lessening of the gradient, and (4) questionable values at risk (Lake Piru Reservoir, some believed that sedimentation posed no problem here).

Road treatments

Background

Approximately 52 miles of Forest Service system roads were affected by the Piru Fire. Post-fire repair of roads was the primary focus of BAER treatments prescribed. Over two million dollars were spent on road treatments. Road treatments were concentrated in two separate areas of the Piru Fire, the Sespe unit (comprised of the Sespe oil fields and the Sespe Condor Sanctuary) and the Dominquez Canyon unit (located above Lake Piru) (Fig. 4.5). Because of the loss of plant cover on the steep slopes in both units, drainage features were expected to be inadequate for increased post-burn runoff.

Values at risk

Initial implementation work began with road protection and culvert treatments along Squaw Flat Road in the Sespe unit. Access to the Sespe oil fields was the number one priority. There were environmental concerns over pipeline failures (Fig. 4.2). Access to the Sespe condor refuge was another primary concern. In the Dominquez Canyon unit, major concerns focused on maintaining access to private ranches, and access to remote area for fire control (i.e. fire road).

Effectiveness monitoring

There were no delays in road treatment implementation, contracts were approved and funded with promptness. Survey forms were distributed to the road engineers. Samples of the road forms are included in Appendix J. Road logs (Tables 4.3 through 4.8) identifying treatment location (mile point and GPS) and treatment status were prepared using survey data and onsite observation with the road engineer. A treatment was successful if the repair column in the road log was not marked with a “y = yes”. If marked with a “y”, the treatment had failed and was repaired. The number of “y’s” signified the how many times the treatment was repaired. The road logs also contain narratives describing the treatment.

The following emergency road treatments were prescribed:

- Storm patrol
- Gates and warning signs
- Culvert enlargement, replacement, or removal
- Installation of trash racks
- Installation of culvert risers
- Overside drains
- Cleanout of culvert sediment traps
- Armoring of culvert inlets (riprap)

- Rolling dips/low water crossings
- Removal or addition of berms
- Ditch construction or enlargement
- Construction of cross drains or waterbars
- Low water crossing with K-rails
- Road grading, outsloping road surfaces
- Installation of gabions to stabilize fill slopes
- geo-textile netting for slope control

The following photos correspond with the treatments noted in the road log. The photo number can be located in the photo # column of the road log. Photo section and road logs have been separated into two units, the Dominquez Canyon unit and the Sespe unit.

<u>Dominquez Canyon unit</u>

Major road types were graded gravel and dirt. Adjacent vegetation type was oak woodland. Five culverts were upgraded or installed. Seven low water crossings were armored with K-rails (concrete barriers). Twenty-five rolling dips were constructed, and five overside drains were installed. Road grading and culvert clean-outs were completed on 3.2 miles of road.

Rolling dips with lead-offs

A number of rolling dips with lead-offs were placed on Dominquez Canyon Road from milepoints 2.2 to 3.1. This treatment shortens the length of run water has along a road. The rolling dip is placed such that water is carried off the road and into the lead-off. This lowers the energy of the flowing water, thus preventing the road from rilling and gullying.

K-rail channel vein structures

Repair treatment used 5 K-rails placed as "vein structures". They were placed within the channel such that they stuck out into channel tilting downward. The purpose of this treatment was to slow the energy of the water through the curve, helping to prevent further erosion of the bank below the road.

Fig. 4.22. Vein structure of K-rails set in channel at angles to lessen water energy and prevent additional eroding of bank. Mile point 0.78. See road log for narrative.

Low water crossings with K-rails

In some cases, low water crossings are considered more desirable than a culvert pipe because of its ability to pass a large amount of debris without "plugging". Low water crossing can become flooded and cause delays, so are often used on low traffic roads. Figure 4.23 shows a recently constructed low water crossing with K-rail (mile point 1.2,). A 36" culvert was removed here The K-rail was

Fig. 4.23. Low water crossing with K-rail covered with filter cloth (mile point 1.2).

first placed too high, and had to be lowered. Maintenance team came out and lowered K-rail in May 2004, also lowered the vertical curve of the road.

The following series of photos represent road repair work done at mile point 1.4 (Figs. 4.24, 4.25, 4.26, 4.27). K-rails were originally placed too high here with no spillway or low point. At this location, there is a confluence of 2 different streams. During one of the earlier flows after a storm event, water worked itself around the k-rails. This was repaired by adding 2 more k-rails. The next storm resulted in further erosion around the newly placed k-rails, introducing up to 3-4 ft of new sediment (Fig. 4.26). This was repaired in May by lowering and moving k-rails further nearer the bank, and creating a spillway toward the center. The site has been repaired a total of 3-4 times. There is a large amount of sediment perched above the road, this remaining after road grading has created a man-made nick point where the drainage meets the road (low point) and sediment remaining in channel (high point). The downstream side of the road has been armored with rocks and boulders.

Most of the K-rails were placed to high in the initial treatments. This resulted in many failures and repeated repairs. The solution was to lower the K-rail at the lower side of the road.

Fig. 4.24. K-rails installed at mile point 1.4.


Fig. 4.25. Drainage entering the road


Fig. 4.26. Water worked itself around the K-rails.


Fig. 4.27. Further erosion and 3-4 ft of new sediment

Culvert installation

At Maple Creek crossing, a 12" culvert was replaced with a 48" culvert (Fig. 4.28). Riprap was added to inlet and outlet. A rolling dip was maintained and upgraded here just below 48" culvert to keep Maple Cr. overflow from flowing down road. Large rocks were added to keep creek from eroding fill. Ther was no berm installed at the rolling dip. In Fig. 4.29, an old 48" concrete pipe culvert was replaced with a new 60" culvert. Culvert was 80% plugged after fire and Christmas Day storm. Old concrete culvert was broken up and used as riprap. Inlet of culvert was not placed at the correct angle in relation to the direction of the drainage.

Fig. 4.28. New culvert with rock armoring at inlet (mile point 1.97)

Fig. 4.29. Old culvert replaced with new 60” culvert (mile point 2.1). Culvert was off-center when placed as seen in photo. Additional rock riprap was added to the right of the culvert openingto channel flow into culvert drain.

Fig. 4.30. Geo-textile fabric with jute was added on slope bordering road located above the 60 in. culvert (mile point 2.1).

Sespe unit

Culvert cleanout and replacement

After the Feb 25 storm of 2.66 in, many of the culverts needed cleaned out and some failed altogether (Fig. 4.31). Figures 4.30 and 4.31 show culvert failure followed by culvert repair.

Fig. 4,31. Culvert that has failed located at mile point 0.4 on Squaw Flat Rd.

Fig. 4.32. Culvert being replaced.

Fig.4.33. Road grading completed and approximately 280 cu. yds of mud, rock, and debris was removed at mile point 1.9.

Overside drains

Overside drains are necessary when the concentrated water from a drainage or ditch runs water down a fill slope or unstable, eroding slope. Overside drains can be Big Macs (concreted rock spillway), Little Macs, or down-drain pipes (Figs. 4.35, 4.36).

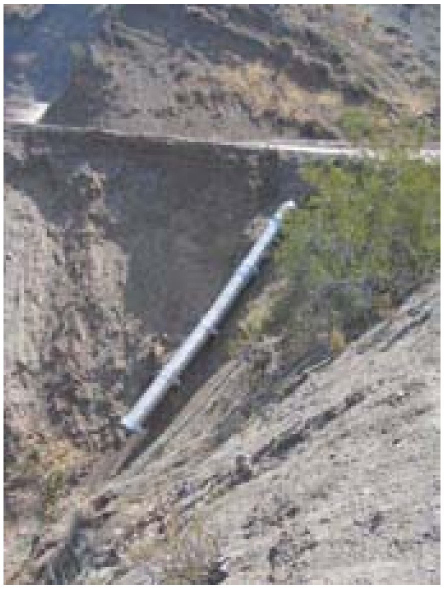

Fig. 4.34. Overside drain with extension (mile point 2.62 Squaw Flat Rd)

Fig. 4.35. Low water crossing with Big Mac (mile point 0.6 – Ranger Stn to Dough Flat.

Fig. 4.36. Inlet side of overside drain (mile point 4.1 – Ranger Station to Dough flat)

Conclusions and summary

• ***Storm patrol -*** The storm patrol was contracted out by the Los Padres National Forest to one individual. Distance, time, and road failures prevented access to all sites during storm events. Thus, it was rare for failures to be prevented by the storm patrol. For the most part, the storm patrol was only able to identify where treatments had failed or new failures had occurred.

• ***Low water crossings with K-rails -*** Out of the7 total LWC's with K-rails installed, 4 were originally placed too high and failed, and 3 were placed low enough and were successful. In many cases, repairs had to be repeated numerous times (further lowering of K-rail) until treatment was deemed successful. Further monitoring of this treatment is needed to access the value of this treatment.

• ***Overside drains –*** Overside drains are prone to failure if road grading is poor. In the case of the Sespe unit, road grading was excellent and added to the success of this treatment. Both overside drains with metal outlets and overside drains with either Little Macs or Big Macs worked. In one case, a Big Mac was enlarged.

• ***Culvert cleanout and culvert replacement –*** Existing culverts needed to cleaned out following most storm events. Most culverts that were replaced were upsized and appeared to be working.

• ***Road grading –*** Because of the constant deposition of dry ravel and fluvial sediments, road grading was a continuous and successful treatment application through late Fall 2003 and Winter 2004. Road grading was implemented to smooth out the road. Graded material was piled on channel side of road as a protective berm, or removed by truck. Berms worked well where outsloping of the road was not wanted.

• ***Rolling dip with lead-off –*** This treatment was successful in keeping the roads from rilling and gullying.

• ***K-rail channel vein structures*** - Because this treatment was not completed until November, 2004 after the October, 2004 storm events, it is still unclear on its success or failure in slowing the energy of the water through the curve, thus preventing further erosion of the bank below the road.

• Overall, the money spent on road treatments, especially that spent in the Sespe unit, was worth the cost. The roads here have remained open and have provided important access to both the oil fields nad the Sespe Wilderness area.

<u>Piru Fire Road Logs</u>

Dominquez unit

Table 4.3. Dominquez Canyon (Dominquez Canyon Road) road log

Mile pt	Treatment	Photo #	GPS point	Repair	Work and repair description
<u>0.0</u>	Reference				Locked gate at junction of Piru Cyn Rd and Dominquez Cyn Rd.
0.2	Low water crossing (LWC) w/ K-rail #1	103-0396 103-0397 (38, 39)	N 34°28.693 W 118° 46.464		Treatment was successful. K-rail placed at correct level (not too high or low) allowing for free flow of water across the road but still maintaining a decent grade for the road.
0.3	Road	103-0398	N 34°		Road grading implemented to smooth out road.

	grading	(40)	28.708 W 118° 46.597		Graded material piled on channel side of road as a protective berm. A berm is appropriate where one does not want outsloping of road, especially where the road borders a drainage that is on an outside curve of high energy stream.
0.41	Reference				Junction of Dominquez and Lime Canyon Road
0.7	Riprap armoring below culvert	103-0399 (41)	N 34° 28.709 W 118° 46.914		Catch basin below culvert outlet armored with rock, and inlet armored also. At this location, road was narrowing due to cutting back of road. Riprap will help cut energy of water flow.
0.78	Riprap armoring	103-0400 (42)	N 34° 28.725 W 118° 46.954	y	Original maintenance effort dumped a load of rock at site, but was inefficient in amount and also was poorly placed.
0.78	Re-treatment with K-rail vein structures			y	Repair treatment used 5 K-rails placed as “vein structures”. They were placed within the channel such that they stuck out into channel tilting downward. The purpose of this treatment was to slow the energy of the water through the curve. Treatment was completed in November 2004. It was planned to place erosion pins here to monitor bank erosion. See Fig. 4.22.
0.98 to 1.0	Matthew’s Ranch (cabin)		N 34° 28.756 W 118° 47.146		BAER implementation team designed a K-rail retaining structure to help protect the road past Matthew’s cabin. Allen King argued that the treatment addressed the road problem, but did not address the acceleration of the stream into the bank during storm events, that was a potential future threat to Matthew’s cabin. This resulted in the construction stoppage of the K-rail retaining structure. Road engineer and Allen King both agreed and stopped construction of K-rail retaining wall. The new design structure for the stream curve has been left to United Water District and the NRCS, since a land survey needs to be done. If on private lands, it was decided to leave work to the above mentioned, and not involve the US Forest Service. Erosion pins have been placed into the bank below Matthew’ cabin to monitor the stream bank erosion here.
1.0	Road widening				Road cutback on inside to widen road approximately 2 feet.
1.1	Armoring (rip-rap)		N 34° 28.796 W 118° 47.193		Improved armoring to east-side inlet of 36” culvert. Riprap also added to outside curb of stream to stabilize road hillslope.
1.13	Riprap	103-0401 (43)			Riprap added to outside curve of channel bordering road to stabilize road fill-slope
1.2	LWC #2 w/ K-rail. 36” culvert replaced.	104-0402 104-0403 (44,45)	N 34° 28.802’ W 118° 47.248’	yy	Removed a 36” culvert. Caretaker (rancher) of land originally paid for culvert to be built, so he wanted it replaced and not have an LWC. K-rail was first placed too high, had to be lowered. Maintenance team came out and lowered K-rail in May 2004, also lowered the vertical curve of

					the road. Further monitoring needed.
1.23	LWC w/ K-rail #3		N 34° 28.859' W 118° 47.280'		Treatment working, some sediment being deposited on road. K-rail placed very deep, so working. Gradient of stream is slight.
1.26	LWC w/ K -rail #4		N 34° 28.888' W 118° 47.304'	y,y	K-rail lowered in May, originally placed too high.
1.3	LWC w/ K -rail #5		N 34° 28.919' W 118° 47.333'		Treatment working. Most of flow here is underground. K-rail placed low enough. Area has infilled about a foot of sediment since fire. Vertical curve of road was also raised here to prevent water from running down the road. Armored downstream side of road.
1.4	LWC w/ K -rail #6	104-0404 104-0405 (46, 47)	N 34° 28.945' W 118° 47.441'	yyyy	K-rails were originally placed too high here with no spillway or low point. After storm events, they were eroding away at toe (undercutting). There was no low-point in the middle to act as a spillway (fairly flat across). At this location, there is a confluence of 2 different streams. During one of the earlier flows after a storm event, water worked itself around the K-rails. This was repaired by adding 2 more K-rails. The next storm resulted in further erosion around the newly placed K-rails, introducing up to 3-4 ft of new sediment. This was repaired in May by lowering and moving the K-rails further nearer the bank, and creating a spillway toward the center. Large boulders were re-arranged to further protect the bank. This area has been repaired a total of 4 times. There is a large amount of sediment perched above the road, in the lower channel across from the K-rails. The bedloaded sediment was left because road grading has created a man-made nick point between the road (low point) and sediment remaining in channel (high point). Downstream side of road was armored. Further monitoring is needed here. (Height of stream elevation raised too much, relative to roadway. Need to increase height of road (crest curve/vertical curve) about one foot so that high flows don't flow down road – Allen King 1-29-04). (1-29-04 – increased crest curve just before entering LWC)
1.5	LWC w/ K-rail #7	104-0406 (48)	N 34° 28.929' W 118° 47.577'	y	K-rails placed low enough at edge of concrete "spillways". Large amount of rock armoring, originally had just been dumped, so came back in and did specific placement of rock. Armored downstream side of road. (1-29-04 – open space between K-rail and concrete needed to be grouted to eliminate scour and cavitation. Site with pipe diverting water to rancher)
1.6	Riprap/rolling dip			y	Riprap placed at side-slope of road to break the energy of water flows. Early placement of rock at

					edge of rolling dip did not protect slope. 1-29-04 replaced rock on fill where it would be more effective.
1.7	Riprap/rolling dip				
1.8	LWC w/ K-rail #8. Culvert replaced.		N 34° 28.851' W 118° 47.807'	yy	36" culvert removed. Surfacing was added at first but was being gullied by creek flow (1-29-04). It would also probably wash away during next storm because it was placed too high, LWC placed too high (~1 ft) above level of K-rail. K-rail placed too high at first, then lowered with spillway added. Riprap was added in May.
1.97	Culvert replaced	104-0407 (49)	N 34° 28.818' W 118° 47.911'		Maple Creek crossing – 12" culvert replaced with 48" culvert. Riprap added to inlet and outlet. Rolling dip maintained and upgraded here just below 48" culvert to keep Maple Cr. overflow from flowing down road. Added large rocks to keep Dominquez Cr. from eroding fill. No berm installed at rolling dip.
1.98 to 2.1	Channel check dams		N 34° 28.760' W 118° 47.976'		Start of LEB's in channel. Group A consisted of 12 check dams. No remediation or repair has been done to this lower section of LEB's.
2.0	Rolling dip with lead-off drain	104-0408 (50)			Riprap armoring added below outflow drain.
2.0	"Debris"				Also located at other similar places. Tree branches and other log debris piled in gullies. Debris material should be cleared out and disposed of properly. Debris will not reduce erosion, but will be floated downstream during high flows.
2.05	Culvert replaced				Culvert replaced and enlarged to 36" and riprap added with armoring at inlet and outlet.
2.1	Geo-textile fabric w. jute	(51) 104-0410			Geo-textile fabric with jute was added on slope bordering road located above the culvert.
2.1	Culvert replaced	(52) 104-0409	N 34° 28.713' W 118° 48.055'		Old 48" concrete pipe culvert replaced with new 60" culvert. Culvert was 80% plugged after fire and 2003 Christmas Day storm. Old concrete culvert broken up and used as riprap. Inlet of culvert was not placed at the correct angle in relation to the direction of the drainage. See Fig. 4.29..
2.1	Road grading				Major grading was completed on road above culvert. Roadway was channeling water. Road dips were installed and road was built up in places.
2.2	Rolling dips				
2.3	Up gate				Gate with combination lock
2.35	Rolling dip				Rolling dip with lead off drain installed (Little Mac w/ 60' drop).
2.4	Rolling dip				
2.4 to 2.5	3 channel check dams				Group B of 3 LEB's placed above the up gate. No remediation done to these.

2.5	Rolling dip				Rolling dips from 2.5 to 3.1 all with lead-off drains. Rolling dips were modified (steeper and taller).
2.6	Rolling dip				
2.66	Rolling dip				
2.72	Rolling dip				
2.79	Rolling dip				
2.82	Rolling dip				
2.88	Rolling dip				
2.92	Rolling dip				
3.01	Rolling dip				
3.1	Rolling dip				
3.1 to 3.25	Channel check dams	104-0411 104-0412 (53,54)	LEB), 025 (#10 LEB) N 34° 28.603’ W 118° 48.503’ N 34° 28.568’ W 118° 48.585’	y	Group C set of 10 LEB’s. Remediation done. LEB C-10 removed completely, C-9 (photo 53) notched, C-7 (photo 54) notched at side, C-6 removed completely, C-5 removed east-side 2/3’s, C-4 removed completely, C-3 removed west 1/3, C-2 nothing done, and C-1 removed west ½.
3.19	Rolling dip				
3.25	Road Junction				Junction to Dominquez Ranch and to Ridge Top
3.2 to 3.3	Channel check dams		N 34° 28.606’ W 118° 48.707’ N 34° 28.615’ W 118° 48.688’	y	Group of 9 LEB’s (2 in side draw, and 7 in other side drainage. Some have been notched in middle. LEB D-1 removed, D-3 notched spillway middle about 10” notched, D-4, D-5, D-6, D-7, D-8, and D-9 nothing done.
3.3	LWC			y,y	Previously was a LWC. Backhole was brought in to install LEB’s, caused some damage to the drainage. Storms caused excessive damage to road here. Road was repaired partially by bringing in rock to build up spillway. Rock was added to channel for armoring where LEB’s were notched or removed. More rock armoring was planned here.
3.4	Rolling dip				Junction, bear to left for beginning of Ridge Top Road, bear right for private ranch property.
3.48	Fence-line (Reference only)				No gate
3.6				y	Need rolling dips constructed here to prevent gullying. Gullies from 1 to 1.5 ft deep are forming down road, center and side. Need to get drainage off road. Rolling dips added here in Nov 2004.

Sespe unit

Table 4.4. Entrance to Oak Flat (Intersection of Goodenough Rd and Squaw Flat Road) to Old Ranger Station

Mile pt	Treatment	Photo #	GPS point	Repair	Work and repair description
0.0	Reference				Intersection of County route (Goodenough Road), and Forest Service Road (Squaw Flat Road).
0.7	Cleaned culvert		N 34° 27.265' W 118° 50.000'	y,y	The 24" culvert was 80% plugged, cleaned out after late Feb 2004 storm . Repair work also done 06/22/04.
0.725	Cleaned culvert			y	The 24" culvert was plugged, cleaned out after late Feb 2004 storm. Repair work done.
0.9	Cleaned culvert		N 34° 27.311' W 118° 54.879'	y	The 24" culvert was plugged, cleaned out after late Feb 2004 storm. Repair work done.
0.925	Cleaned culvert			y	The 24" culvert was plugged, cleaned out after late Feb 2004 storm. Repair work done. (6 inches in 6 hrs)
1.0	Road grading			y	Grading to remove mud slide (280 cu. yds.). Late Feb 2004 storms. Repair work done.
1.1	Road grading			y	Grading to remove mud slide (20 cu. yds.) Late Feb 2004 storms. Repair work done.
1.7	Grade repair		N 34° 27.542' W 118° 54.195'	y	Eroded gully on inside of roadway (100 ft long, 1.5 ft wide, and 1 ft deep. Late Feb 2004 storms. Repair work done Mar 6.
1.9	Road grading/LWC		N 34° 27.566' W 118° 54.158'	y	Removed approximately 280 cu. yds of mud, rock, and debris from paved LWC. Late Feb 2004 storms. Repair work done Mar 6.
2.3	Road grading to raise rolling dip	104-0413 (55)			Road was graded at this location.
2.0 to 2.5	Dry ravel deposition	104-0414 104-0416 (55,56,57)	N 34° 27.821' W 118° 54.403'		Dry ravel material still being deposited. **See Fig. ?.**
2.5	Rolling dip with lead out		N 34° 27.943' W 118° 54.400'		No repair needed here.
2.62	Rolling dip with lead out	104-0416 104-0417 104-0418 (58,59,60)	N 34° 27.970' W 118° 54.322'		
2.62	Cleaned culvert				36" culvert cleaned out, concrete-filled sand bags used as armoring at inlet.
2.8	Rolling dip with lead out		N 34° 28.126' W 118° 54.231'		

2.9	Cleaned culvert	104-0419 (61)	N 34° 28.166’ W 118° 54.282’		36” culvert cleaned out and armored with concrete-filled sandbags.
3.1	Culvert extension	104-0420 (62)	N 34° 28.124’ W 118° 54.409’		
3.3	Rolling dip with lead out				

Table 4.5. Ranger Station to Dough Flat

Mile pt	Treatment	Photo #	GPS point	Repair	Work and repair description
0.0	Reference				Old ranger station
0.19	Rolling dip with lead out	104-0421 (63)	N 34° 28.326’ W 118° 54.631’		
0.21	Road grading				
0.4	48” culvert	104-0422 104-0423 (64,65)	N 34° 28.452’ W 118° 54.817’		Replaced old culvert with new 48” culvert
0.5	Cleaned culvert		N 34° 28.493’ W 118° 54.866’	y,y	24” culvert cleaned out. Plugged after late Feb storm (6 inches in 6 hrs). Also removed 30 cu. yds mud, sand, and rock.
0.6	Big Mac	104-0424 104-0425 (66, 67)	N 34° 28.538’ W 118° 54.932’	y,y	Low water crossing with Big Mack (concreted rock spillway). Washed out in late Feb storm (6 inches in 6 hrs).
0.65	Rolling dip with lead out				Metal overside drain added.
0.7	Rolling dip with lead out (overside drain)				New metal overside drain installed here
0.8	Big Mac	104-0426 (68)	N 34° 28.600’ W 118° 55.061’	y	Big Mac with LWC was installed. Washed out in late Feb storm (6 inches in 6 hrs).
1.3	Cleaned culvert		N 34° 28.706’ W 118° 55.146’		Old culvert cleaned out.
1.6	Rolling dip with lead out				Overside drain added.
1.75	Cleaned culvert	104-0427 (69)	N 34° 28.706’ W 118° 55.146’	y	24” culvert with sandbag armoring cleaned out after late Feb storm (6 inches in 6 hrs). Work completed in Mar 2004.
1.8	Rolling dip with lead out				
1.84	Riprap added at culvert		N 34° 28.943’ W 118° 54.833’		Riprap added at outlet of 24” culvert, extended overside drain.

2.0	Cleaned culvert	104-0428 (70)	N 34° 28.985' W 118° 54.812'	y	Old 36" culvert cleaned out.
2.1	Rolling dip with lead out				
2.3	Cleaned culvert/ LWC				Old 36" culvert armored with cement-filled sand bags and cleaned out.
2.5	Cleaned culvert				Old 36" culvert cleaned out
2.58	Rolling dip with lead out (overside drain)				
2.6	Road grading and debris removal			y	Mud slide of 100 cu. yds on entire width of roadway after late Feb storm (6 inches in 6 hrs). Repair work done in Mar 2004.
2.75	LWC				
2.8	Flood gate/oil catcher			y	Flood gate/oil catcher silted to top after late Feb storm (6 inches in 6 hrs), removed 200 cu. yds material here in Mar 2004.
3.0 to 3.1	Flood gate/oil catcher, LWC	104-0429 (71)	N 34° 29.179' W 118° 53.996'	5	Maple Cr. Landing. Flood gate/oil catcher silted to top after late Feb storm (6 inches in 6 hrs), removed 300 cu. yds material in Mar 2004.
3.18	Cleaned culvert				Old 24" culvert cleaned out
3.21	Cleaned culvert				Old 18" culvert cleaned out
3.3	Culvert extension				Culvert extension placed on 36" culvert
3.4	Cleaned culverts	104-0430 104-0431 (72,73)	N 34° 29.372' W 118° 53.827'	y	2- 30" culverts plugged after late Feb storm (6 inches in 6 hrs), removed 100 cu. yds of debris in Mar 2004.
3.51	Cleaned culvert				Old 24" culvert cleaned
3.63	Cleaned culvert				Old 24" culvert cleaned
3.66	Cleaned culvert				Old 18" culvert cleaned
3.72	Cleaned culvert				Old 24" culvert cleaned
3.81	Lead off (overside drain)				
3.9	Rolling dip with lead off				Lead off flume structure added to lead off.
3.98	Rolling dip with lead off				
4.1	Little Mac	104-0432	N 34° 29.553'	y	Washed out Little Mack overside drain.

		(74)	W 118° 54.126’		
4.23	Cleaned culvert	104-0433 (75)	N 34° 29.693’ W 118° 54.042’		Photo of riser placed at inlet to culvert.
4.31	Cleaned culvert				Old 18” culvert cleaned out.
4.4	Rolling dip with lead off				
4.5	Cleaned culvert				Old 24” culvert cleaned out.
4.6	Reference				Junction of Tar Creek and Dough Flat Road
4.61	New bridge	104-0434 (76)	N 34° 29.702’ W 118° 53.780’		New 15 by ft arch “bridge” construction. This was not part of BAER.
4.62	Flood gate/oil catcher			y	Flood gate/oil catcher silted to top after late Feb storm (6 inches in 6 hrs), removed 75 cu. yds material in Mar 2004.
4.73	Riprap				
7.0	Stream crossing (Reference only)				Stream crossing. Entrance to Dough Flat trail head

Table 4.6. Maple Road

Mile pt	Treatment	Photo #	GPS point	Repair	Work and repair description
0.05	Cleaned culvert		N 34° 29.159’ W 118° 53.874’	y	24” culvert half-plugged after late Feb storm (6 inches in 6 hrs), cleaned out in Mar 2004).
0.2	Cleaned culvert	104-0435 (77)	N 34° 29.116’ W 118° 53.743’	y	24” culvert plugged after late Feb storm (6 inches in 6 hrs), cleaned out in Mar 2004).
0.3		104-0436 104-0437 (78,79)	N 34° 29.134’ W 118° 53.675’	y	24” culvert plugged after late Feb storm (6 inches in 6 hrs), cleaned out in Mar 2004).
0.4	Cleaned culvert		N 34° 29.156’ W 118° 53.578’	y	30” culvert plugged after late Feb storm (6 inches in 6 hrs), cleaned out in Mar 2004).
0.7	Cleaned culvert		N 34° 29.035’ W 118° 53.462’	y	24” culvert plugged after late Feb storm (6 inches in 6 hrs), cleaned out in Mar 2004).
0.95	Cleaned culvert			y	24” culvert plugged after late Feb storm (6 inches in 6 hrs), cleaned out in Mar 2004).
1.0	LWC				
1.09	Rolling dip with lead off	104-0438 (80)	N 34° 28.318’ W 118° 54.303’		

Table 4.7. Shale Ridge Road

Mile pt	Treatment	Photo #	GPS point	Repair	Work and repair description
0.1	Repaired lead-off ditch				2 cu. yds of riprap added at outlet.
0.3	Installed new culvert pipe	104-0441 (83)		y	60" arch culvert pipe washed out after late Feb storm (6 inches in 6 hrs). Installed new pipe. Added 5 cu. yds riprap at outlet. Reconstructed roadway ditch 100 ft. Reconstructed fill at pipe outlet with ~150 cu yds of material.
0.4	Replaced culvert				Removed and replaced existing 30" culvert with 60" culvert. Installed 100 cu. yds riprap at inlet and outlet face.

Table 4.8. Burma/Hopper Road

Mile pt	Treatment	Photo #	GPS point	Repair	Work and repair description
0.0	Reference				Junction of Burma Road and Tar Road
0.05	Cleaned and repaired culvert				
0.05	Installed rolling dip				Installed rolling dip below existing culvert and repaved. Cleaned out culvert and inlet basin. Installed 15 cu. yds riprap at inlet face and 6 cu. yds riprap at outlet.
0.29	Added riprap at culvert				Installed 20 cu. yds riprap at inlet.
0.33	Added riprap at culvert				Installed 20 cu. yds riprap at inlet.
0.8	Raised rolling dip				Reconstructed and raised existing modified paved dip 1 ft.
0.9	Reshaped rolling dip				15 ft and 50 ft each side of dip
1.0	Paved and raised dip				Reconstruct and raise existing road dip 1 ft.

Noxious Weed Monitoring Results
Ojai Ranger District, Los Padres National Forest
Piru and Wolf Fires

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I. Introduction

In 2004, the Los Padres National Forest used Burned Area Emergency Rehabilitation (BAER) funds to perform weed monitoring and removal in the Piru Fire area and weed removal in the Wolf Fire area. This document describes the methodology that was used for survey and removal of weeds and the results of the survey and control efforts. This document also provides recommendations for continued monitoring and weed removal within the burned areas.

The goals of the invasive species monitoring included detecting the expansion of known weed infestations in burned areas and identifying the introduction of new weed species.

II. Background

The Wolf Fire occurred June 1-15, 2002 on the Ojai District of the Los Padres National Forest. The Wolf Fire burned 21,512 acres of mainly mixed chaparral and California sagebrush, but also affected stands of canyon live oak, riparian woodland, pinyon pine woodland, Big cone Douglas Fir, mixed-conifer forest, and Jeffery pine forest. The Piru Fire occurred on the Ojai District of the Los Padres National Forest October 23 through November 6, 2003. The Piru Fire burned 63,720 acres of mainly mixed chaparral and California sagebrush, also affected stands of canyon live oak, riparian woodland, Big-cone Douglas Fir, and pine woodland. Both the Piru and Wolf Fires burned within sections of the Sespe Wilderness Area and the Sespe Creek, which is both a Wild and Scenic River and is habitat for the endangered steelhead and arroyo toad.

III. Methods

The NRIS-Terra standard protocol was used to define the methods for data documentation and GIS mapping. A combination of general and intuitive controlled survey types were used most often when looking for the targeted weed species. In other words, the surveyors attempted to cover as much ground as possible, but focused on those areas that were most likely to harbor or promote the spread of invasive species (i.e. riparian, roadsides, trails, and areas adjacent to private land). The surveyors monitored over 1,777 acres of the Piru Fire for invasive plant species.

Six highly invasive weed species were identified as the greatest threats to the successful restoration of native vegetation following these fires. These target species were mapped to provide baseline information, to detect the expansion of infestations due to fire disturbance, and to plan removal efforts for next year and the years to come. In addition to mapping the target species, the presence of all other non-native species were recorded for each fire, to provide a qualitative representation of all the weed species infestations post-fire (Fig. 1).

The botany field crew removed a population of *Spartium junceum* (Spanish broom) adjacent to the Wolf Fire in September 2004 using a combination of weed wrenches, hand pulling and a truck winch (depending on the stem diameter) to remove the entire individual, including the root. This required digging around the base of the plant to get a strong hold on the root directly below the ground surface. Though outside the fire boundary, this area was used during staging in the Wolf Fire and became a priority for eradication because vehicle access was being eliminated due to the decommissioning of Lion Campground to protect arroyo toad habitat. This is a priority habitat that should be not be compromised by invasive weeds.

Centaurea melitensis (tocalote) were removed by hand pulling in May and June 2004. Money was allocated to the Concerned Resource and Environmental Workers CREW for tocalote removal in the Wolf Fire along the Piedra Blanca Trail in June of 2004. The plant material was left on-site. The City Corp and the California Conservation Corp (CCC) also did hand pulling of tocalote in the Pire Fire area along Squaw Flat Road to Dough Flat and along the Alder Creek Trail. This removal effort occurred in May and June 2004. Plant material was piled and removed from site in June by the botany field crew.

IV. Target Species

CEME- Centaurea melitensis
CESO- Centaurea solstitialis
FOVU- Foeniculum vulgare
TARA- Tamarix ramosissima
SPJU- Spartium junceum
MAVU- Marrubium vulgare

V. Tables

Table 4.9. Piru Fire—Weeds located and treated

Species	Acres of Weeds	Acres of Treatment
CEME	109	116*
CESO	10	0
FOVU	2	0
Total	121	116

Approximately 50 acres of CEME were treated prior to monitoring.

Table 4.10. Piru Fire—Weeds located by site

Site	Quad	Township	Range	Section	Survey Month-2004	Species	Acres
Alder Creek Trail	Devils Heart Peak	T5N	R19W	17,8,PB41	August	CEME	1
Blue Point Road	Cobblestone Mt., Piru	T5N	R18W	15,22,27	August	CEME	2
Dominguez Canyon	Piru	T5N	R18W	31,32,33	July	CESO	10
Dough Flat	Devils Heart Peak	T5N	R19W	17	July	CEME	23
Oak Flat	Fillmore	T5N	R19W	31	July-August	CEME FOVU	6
Sespe Oil Fields	Fillmore	T5N	R19W	28,29,32,33	July-August	CEME FOVU	10
Squaw Flat Rd	Devils Heart Peak, Fillmore	T5N	R19W	17, 20, 29, 31, PB56, PB63	July	CEME FOVU	56
Tar Creek	Fillmore	T5N	R19W	31, PB48	July	CEME FOVU	14

Table 4.11. Wolf Fire—Weeds treated

Species	Acres of Treatment
CEME	13
SPJU	6
Total	19

VI. Conclusions

Approximately one year after the Piru Fire, 1,777 acres were monitored for weeds, weeds were located on 121 acres, and weed removal efforts took place on 116 acres. In the second year after the Wolf Fire intensive eradication efforts took place on 19 acres of the burn area. Infestations of the target weed species *Centaurea melitensis* was the most prevalent in the areas surveyed and was often evenly distributed over large areas. This species seemed to occur mostly along roads and trails but has begun to spread away from these ruderal habitats due to fire disturbance. The removal of this species should focus on the areas where it is actively escaping into otherwise undisturbed habitat. *Foeniculum vulgare* (fennel) was detected in several areas, had patchy distribution, and occupies a small enough acreage to warrant efficient removal. *Spartium junceum* was found to occur along road ditches and drainages and is spreading into the stream systems. Though the extent of this species is quite large on the district, its extent in the burned areas is small enough to warrant removal in the burn areas in order to prevent further population expansion. *Tamarix ramosissima* (tamarisk) is known to occur along the Sespe Creek and needs to be mapped. Efforts to control *Tamarix ramosissima* by hand pulling are being conducted by a volunteer group and mapping of these infestations is needed as part of effectiveness monitoring. In addition to target species that were mapped the non-native grass species *Avena barbata*, *Bromus diandrus*, *Bromus madritensis*, and *Bromus tectorum* were recorded as commonly occurring within both the Wolf and Piru burn areas.

The greatest concentrations of weed species seemed to be associated with roadsides, trails, and drainages near heavily used recreation areas. This is intuitively due to their conduciveness to seed dispersal and disturbance.

In most instances it was difficult to distinguish whether the weed infestations were in place prior to the fires or if they were new occurrences. It is highly probable that the weed species were already present in most of the area's seed banks, but were released from competition following the fire and its associated disturbances. For example, in the case of most infestations of *Brassica nigra*, *Bromus diandrus*, *Bromus madritensis*, and *Bromus tectorum* it was obvious that their population sizes had expanded beyond the pre-fire levels. The target weed species *Centaurea melitensis* and *Centaurea solstitialis* (yellow star thistle) seemed to respond favorably to the associated fire disturbances, since their populations were often found to be spreading into areas where they were previously out-competed by native vegetation.

VII. Recommendations

Continue to survey along the Sespe Creek Wild and Scenic River to determine the extent of the *Spartium junceum*, *Centaurea solstitialis*, and *Tamarix ramosissima*. This is an important location to survey due the Wild and Scenic River status of this creek and the presence of the endangered arroyo toad and steelhead. This area is priority for control (Fig. 4.39). If seedlings are present they should be hand pulled.

It is critical that we revisit Squaw Flat Road, Alder Creek Trail, and the Piedra Blanca Trail where hand pulling occurred last year and continue eradication efforts to remove *Centaurea melitensis* and *Centaurea solstitialis*. Though last years eradication effort was useful, seeds from these species remain viable for several years in the soil. It is important, therefore, to continue revisiting these treatment sites and to hand pull in April prior to flowering and fruiting in order to prevent further seed production (Fig. 4.38).

Revisit the *Spartium junceum* infestation that was eradicated near Lion campground and Sespe Creek in the spring to remove any seedlings that may germinate from the seed bank (Fig. 4.39).

The *Foeniculum vulgare* occurrences in the Piru Fire are small enough at this time to be effectively controlled by hand removal. This should be done using weed wrenching to ensure removal of the root system. This should also be a priority (Fig 4.37).
Weed monitoring data will need to be entered into the Natural Resources Information System (NRIS) database when the system is available on the Forest.

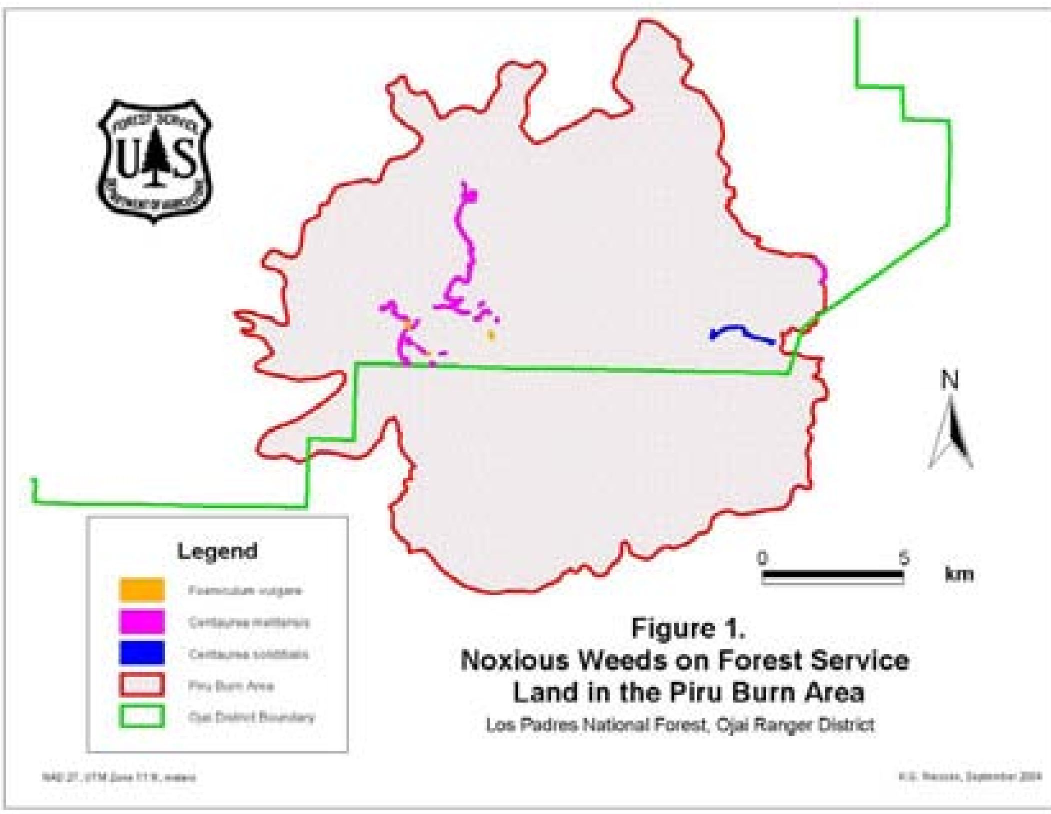

Fig. 4.37. Noxious weeds on Forest Service Land in the Piru Fire area.

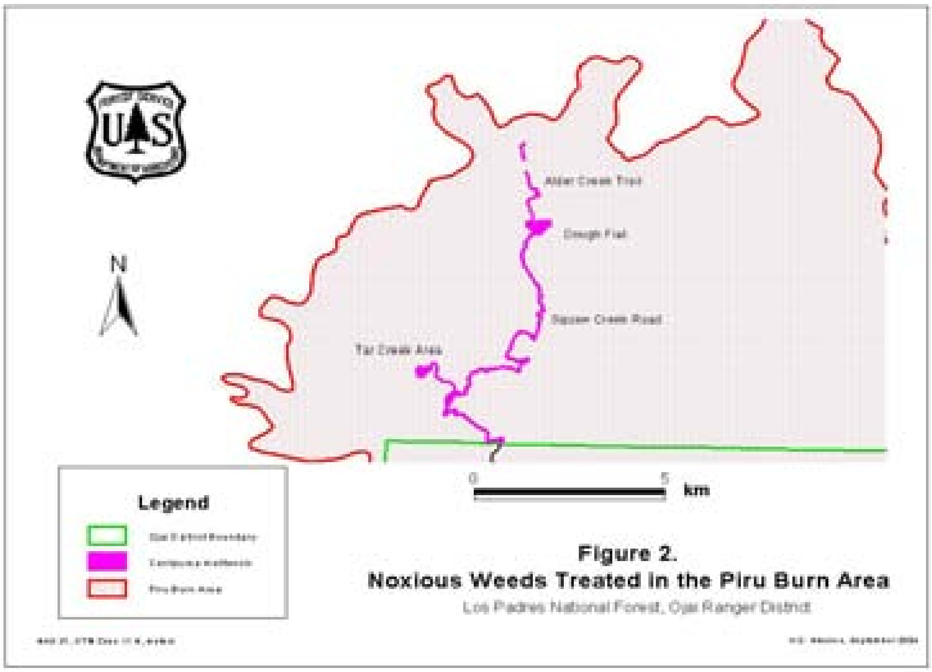

Fig. 4.38. Noxious weeds treated in the Piru Fire area.

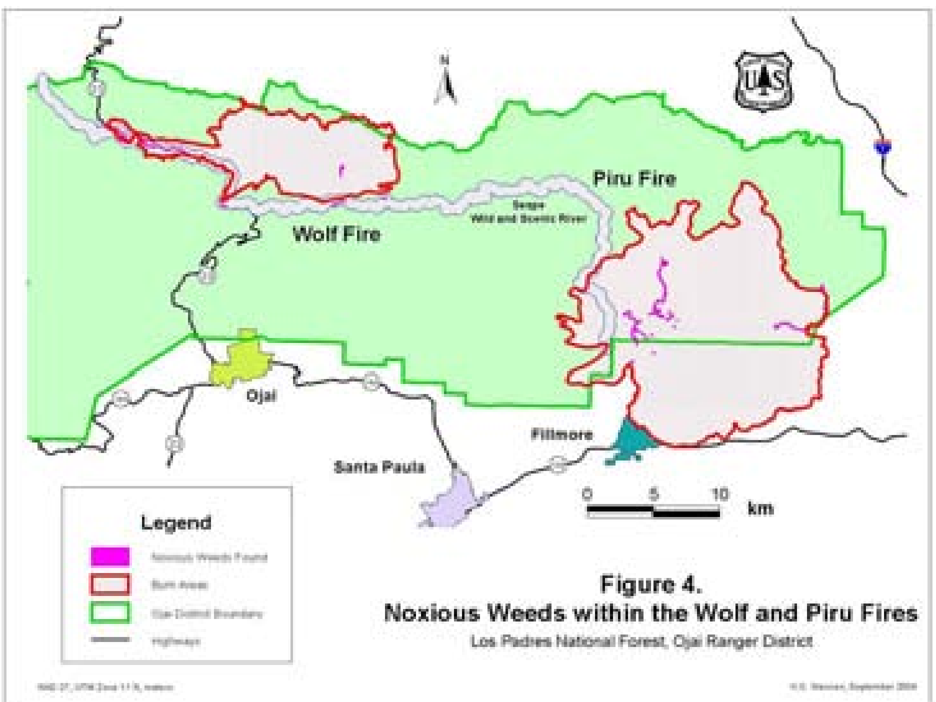

Fig. 4.39. Noxious weeds within the Wolf and Piru Fire areas.

Heritage Resources

Background

Minimal survey coverage for cultural properties existed within the burn area of the Forest due to land allocations of the Sespe Wilderness and Condor Sanctuary as well as the rugged terrain. Fourteen recorded cultural properties existed within the burn area, 8 of which were situated on forest Service land. The archaeological surveys focused on rock outcroppings and terraces adjacent to watercourses in the vicinity of Squaw Flat Road between Oak Flat and Squaw Flat, Tar and Maple creeks, and Devil's Potrero. It was proposed that cultural properties within the burn area would be patrolled by volunteers under trained supervisory archaeologists to discourage any looting or vandalism activities.
Known heritage sites designated for inspection are included in Table 4.12.

Table 4.12. Heritage sites designated for inspection

Forest Service No.	Landowner	Description
0507-55-002	USFS	Prehistoric
0507-55-008	USFS	Cemetery
0507-55-028	Private	Historic
0507-55-094	Ventura County	Prehistoric
0507-55-131	USFS	Rock Art
0507-55-158	USFS	Prehistoric
0507-55-159	USFS	Historic
0507-55-161	USFS	Prehistoric

After initial assessment, monitoring of the sites was to continue for a one-year period or until vegetative recovery insured site protection. The sites also were inspected for fire impacts and potential risks resulting from winter storm events. Signs with rock art elements (condor like figures) were placed at three trailheads that lead to areas of archaeological sensitivity in the Sespe Wilderness. These signs carried an educational message about the heritage resources within the wilderness, particularly the rock art, and the importance of not touching. The signs also informed the public that antiquity violations are a federal offense. Signs were placed at the Forest Boundary along Squaw Flat Road (6N16) at Oak Flat, the trailhead for Pothole Trail (18W04) along Piru Canyon Road, and at the Agua Blanca Trail (19W10) trailhead. Initial monitoring of the sites have shown treatments to be successful. Further monitoring results will be included in the 2004/2005 report.

Chapter 5:

Padua Fire
Angeles National Forest

Introduction

The Padua Fire consumed 10,446 acres of predominately chaparral vegetation, of which 4,909 acres were on National Forest land. The Padua Fire was an extension of the western portions of the larger Grand Prix Fire. The Padua Fire burned vegetation across the San Antonio Canyon watershed and destroyed a number of structures not on Forest land (Vance 2003).

Burned severity ratings and acreage are listed in Table 5.1. Water repellency was found on 176 acres. Hillslope erosion potential was estimated at 117 tons/acre. Sediment potential equaled 7488 cubic yards/square mile. The majority of the fire burned with moderate to low severity. In all sample locations, fibrous root material was intact.

The City of Upland indicated that they were concerned about their water supply from a dam on San Antonio Creek. There were also concerns about flood flows into San Antonio Heights because of the lack of storm drains.

Table 5.1. Soil burn severity and water repellency

Burn severity	Acres
Low	1,888
Moderate	2,563
High	177
Unburned	281
Water repellency	176

Hillslope treatments

No treatment option

No treatments were prescribed for either hillslope or channels. The “no treatment option” was chosen because of the steep slopes and also because of the known rapid recovery of the chaparral species. Monitoring of natural recovery was not proposed because funding of this type project was not funded by BAER. It is suggested that future monitoring of the “no treatment option” be covered by BAER. Monitoring of treatment and no treatment sites will provide knowledge that can be used to educate the public on how natural systems recover following fire. It will also help remove pressures to recommend treatments that will either not be effective or harm the environment.

Heritage Resources
Darrell W. Vance, ANF Archaeologist

Records search and field inspection of the Padua Fire APE identified a total of nine Class I and Class II heritage resource sites. Eight of the sites were previously recorded and one additional site was detected during the current BAER-related fieldwork. Descriptions of the heritage resources and emergency points of damage are summarized below:

Proposed prescriptions

No Action Treatments

The “no action” BAER treatment was proposed at six heritage resource sites in the Padua Fire APE due to low probability of effects from the deteriorated watershed, ineffectiveness of any practical treatments, or because the sites do not represent Class I properties. No action prescriptions were proposed for the following sites:

FS #05-01-52-006 - *San Antonio Light and Power Co. Pomona Powerplant System.*

FS #05-01-52-15 - Jacob Shinner’s Grave.

FS #05-01-52-17 - Hog Back Mine C..

FS #05-01-52-19 - Kerckhoff Wagon Road.

FS #05-01-52-101 - Sunset Ridge Fire Road.

FS #05-01-52-112 - Shinn Road Bridge.

Protection Treatments

The following BAER treatments were proposed at three Class I and Class II sites that have high potential for effects from the deteriorated watershed.

FS #05-01-52-050 - Sunset Lookout Site (Fig. 5.1. Due to potential impacts from sediment/debris flows, for which there are no practical preventive treatments, it is recommended that an updated site record be prepared to document the layout of site components. Updated survey and inventory was completed in January 2004. Mapping of locations of any significant features/artifacts will be completed for purposes of future relocation. December and January rain events had no effect on the site (Fig. 5.2).

Fig. 5.1. Burned components of the Sunset Peak Lookout site, looking southwest. Site visited in November following fire.

Fig. 5.2. Photo taken of Sunset Peak Lookout site on January 20, 2004.

FS #05-01-52-115 - Camp Baldy Road (Fig. 5.2)

Since some segments of the newly detected trail may be obliterated, it is recommended that a site record be prepared to document the linear feature (Fig. 5.3).

Fig. 5.3. Camp Baldy Road, from the west side of the canyon, looking southeast.

FS #05-01-52-42 - *Lower San Antonio Ranger Station*. This site is already slated for protection in other facets of BAER. Heritage Resource concerns will be satisfied in providing support of those protection treatments.

The installation of a trash rack was proposed to capture large sediment and material upstream to minimize any effect to Stoddard Bridge on Mountain Avenue at the canyon mouth (Fig. 5.4).

Fig. 5.4. Installation of a trash rack in Stoddard Canyon.

During field inspection, six new heritage resources were identified. These historic sites include San Antonio Road (05-01-52-115), San Antonio Road Can Dump (05-01-52-116), Grandpa's Secret Can Dump (05-01-52-117), Eucalyptus Grove Foundation (05-01-52-118), Stoddard's Camp (05-01-52-119), and the San Antonio Road Complex (05-01-52-120).

- *FS #05-01-52-115 - San Antonio Road.* This site consists of a former primary route into San Antonio Canyon, dating to 1922. In 1955, the access road was moved to higher ground, replacing this route. The route is an overgrown, intermittently paved surface that had washed out several times. Sections of the road had been burned over by the fire. It is expected that watershed processes will not adversely affect historic characteristics of the road. In any case, there are no practical or cost-effective treatments that can be applied over sufficient areas of the watersheds to treat the route.
- *FS #05-01-52-116 – San Antonio Road Can Dump*. This historic site is tied to the former road, consisting of a large can dump with elements dating to between the 1930s and 1970s. The site was burned over in the Padua Fire, and may have lost some flammable materials. The site is not expected to be extensively affected by slope movement, as it sites on a relatively flat terrace, and has nearby channel features to prevent much sediment flow.
- *FS #05-01-52-117 - Grandpa's Secret Can Dump*. This historic site consists of an isolated can dump of 100+ elements, dating to circa 1930s. The site is not expected to be extensively affected by slope movement, as it sites on a relatively flat terrace.
- *FS #05-01-52-118 – Eucalyptus Grove Foundation*. This historic site consists of a large structure terrace of rubble masonry with plaster facing. It likely dates to between the late 1870s and 1930s. This site was burned over by the fire, but will not be greatly affected by natural processes. However, the site has been clipped by road maintenance activities, and is threatened by further mechanical damage.
- *FS #05-01-52-119 – Stoddard's Camp*. This is a historic resort camp site dating to the 1890s. The site consists of a series of foundations, an old road bed, and some water catchment features. This site was only partially burned over by the fire and received some suppression fire retardant, but will not be greatly affected by natural processes. Vandalism and mechanical equipment damage are the major threats.

- *FS #05-01-52-120 – San Antonio Road Complex.* This is a historic site, associated with San Antonio Road, consisting of a complex of very elaborate masonry buildings and foundations. The site likely dates to the turn-of-the century water and power ventures in San Antonio Canyon. The site is not expected to be extensively affected by slope movement, as it sites on a relatively flat terrace, and has nearby channel features to prevent much sediment flow.

Effectiveness Monitoring Plan
The objective of monitoring is to assess the effectiveness of prescriptions proposed for specific heritage resource values potentially at-risk from the deteriorated watershed related to the Padua Fire. Due to the fragile nature of heritage resource values, it is imperative that if selected treatments do not achieve the desired results, then other measures must be developed and implemented at once. Monitoring was required at FS #05-01-52-050 (Sunset Lookout Site) and FS #05-01-52-115 (Camp Baldy Road).

The basis of the monitoring plan will be three verification visits utilizing a photo-monitoring program. The first visit will be as soon as possible prior to the onset of the winter rainy season.

Photographs will be taken from designated points to establish a baseline condition. The next visit will occur after the first measurable precipitation event that is sufficient to potentially affect at-risk values and a third visit will be conducted within two months after the first measurable event. During these visits, photographs will be taken from the same points, and essentially duplicating, the first set of photographs. Again, due to sensitivity of the resource, there cannot be any deviation in site condition due to effects of the deteriorated watershed. If the prescription is inadequate to protect the values at risk, additional measures must be implemented.

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Chapter 6:

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Appendix A. Vegetation recovery – Cedar Fire.

Table 1. Cedar Fire - Effects of Hydromulch on Vegetation 6/14/2004

TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			cover class	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
1	0	dirt	50		90		50		90		60	
		rock	50		10		50		10		40	
		CHPA			10				10		5	
		CLPA					20					
		ADFA							20	15		
		ZIFR							10			
		unk ceanothus										
		EMPE										
1	50	dirt	90		50		60		60		90	
		rock	10		50		40		40		10	
		unk manzanita										
		CHPA	10						5		10	
		CAAL									5	
		ERCO										
		ANCO										
		unk ceanothus							0.5	1		
		ADFA										
		ALHA										

TRANSECT	% hydro mulch	item/species										
1	0	dirt	QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
		rock	coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
		CHPA	85		70				10		90	
		CLPA	15		30		100		90		10	
		ADFA	5		5						5	
		ZIFR										
		unk ceanothus										
		EMPE							3			
									3	4		
1	50	dirt	100		95		80		90		80	
		rock			5		20		10		20	
		unk manzanita	25	9								
		CHPA	2		3		5		3			
		CAAL	3		2				3			
		ERCO	5									
		ANCO	2									

		unk ceanothus			0.5	1			5	5	3	4
		ADFA			0.5	1					1	2
		ALHA									3	

TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
1	100	dirt	90		80		90		80		95	
		rock	10		20		10		20		5	
		CAAL	3									
		CHPA			10		10				5	
		ADFA										
		unk ceanothus	0.5	1								
		ERCO					5				5	
		LOSC										
		QUBE										
		CLPA	3									
		unk manzanita							20	17		
		RHTR									20	90

TRANSECT	% hydro mulch	item/species	QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
1	100	dirt	60		80		50		95		95	
		rock	40		20		50		5		5	
		CAAL	5				2				5	
		CHPA	5				2		5			
		ADFA	25	70								
		unk ceanothus			0.5	1	7	4				
		ERCO			1							
		LOSC							10		100	300
		QUBE										
		CLPA										
		unk manzanita										
		RHTR										

TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
2	0	dirt	100		50		100		95		100	
		rock			50				5			
		LOSC					5				10	
		PHPA			5		5					
		ADFA	1	2	10	8	10	10			5	4
		EMPE			5		10				10	
		SIMA										
		unk ceanothus										
		ALHA										
		ERCO			5							
		ANCO									5	

			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty
2	0	dirt	95		90		95		85		60	
		rock	5		10		5		15		40	
		LOSC	15		10							
		PHPA	20		10						3	
		ADFA	5	5	20	11	5	100	10	50	5	7
		EMPE	3									
		SIMA			5							
		unk ceanothus					1	1				
		ALHA					1					
		ERCO										
		ANCO										

TRANS ECT	% hydro mulch	item/speci es	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty
2	50	dirt	100		90		90		80		50	
		rock			10		10		20		50	
		SODO										
		PHPA										
		LOSC									5	
		ADFA			0.5	1	10	6			3	2
		ANCO										
		ZIFR			10							
		CAAL			1							
		ALHA					3					

			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty
2	50	dirt	40		95		100		90		100	
		rock	60		5				10			
		SODO	10		20							
		PHPA	20								10	
		LOSC	5						10			
		ADFA			30	50			10	60		
		ANCO					5					
		ZIFR										
		CAAL										
		ALHA										

			QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
TRANS ECT	% hydro mulch	item/speci es	covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty	covercl ass	densi ty
2	100	dirt	90		40		80		70		80	
		rock	10		60		20		30		20	
		LOSC			3				2		3	
		ZIFR										
		ADFA									15	25

		PHPA										
		TAAR	5									
		CHPA			10							
		unk manzanita							0.5	1		
		CAAL									3	
			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
2	100	dirt	90		80		80		100		100	
		rock	10		20		20					
		LOSC	10				1		2			
		ZIFR			10							
		ADFA							30	50		
		PHPA									20	
		TAAR										
		CHPA										
		unk manzanita										
		CAAL										
TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
3	0	dirt	90		60		100		95		90	
		rock	10		40				5		10	
		TAAR	3				5					
		unk ceanothus	0.5	1			1	3				
		ADFA	5	15	10	15	3	12	7	11		
		CAAL					10					
		ERCO					2					
		CHPA							1		3	
		ALHA									1	
		ZIFR										
		unk manzanita										
		QUBE										
			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
3	0	dirt	95		100		80		50		60	
		rock	5				20		50		40	
		TAAR	7									
		unk ceanothus					2	1	1	2		
		ADFA	5	6			1	5				
		CAAL										
		ERCO										
		CHPA	3		3				7		3	
		ALHA			2				3			

		ZIFR	3									
		unk manzanita									15	25
		QUBE									3	7

TRANSECT	% hydro mulch	item/species	QUAD 1 coverclass	density	QUAD 2 coverclass	density	QUAD 3 coverclass	density	QUAD 4 coverclass	density	QUAD 5 coverclass	density
3	50	dirt	75		70		90		90		100	
		rock	25		30		10		10			
		ALHA							5		10	
		CHPA							5			
		TAAR			3		5					
		ADFA	10	12					3	6		
		ZIFR										
		unk ceanothus										
		CAAL										
		RHTR									60	50
			QUAD 6 coverclass	density	QUAD 7 coverclass	density	QUAD 8 coverclass	density	QUAD 9 coverclass	density	QUAD 10 coverclass	density
3	50	dirt	100		60		85		95		95	
		rock			40		15		5		5	
		ALHA	3		5				5			
		CHPA	5		10		3		5			
		TAAR	2				5		2			
		ADFA	3	8	1	2						
		ZIFR			5							
		unk ceanothus			0.5	1			3	6	0.5	1
		CAAL					3					
		RHTR										

TRANSECT	% hydro mulch	item/species	QUAD 1 coverclass	density	QUAD 2 coverclass	density	QUAD 3 coverclass	density	QUAD 4 coverclass	density	QUAD 5 coverclass	density
3	100	dirt	70		70		90		90		5	
		rock	30		30		10		10		95	
		CHPA	3		5		5		5			
		ALHA					10		10			
		QUBE										
		ADFA							3	6		
		unk ceanothus	0.5	1								
		TAAR			2				1			
			QUAD 6 coverclass	density	QUAD 7 coverclass	density	QUAD 8 coverclass	density	QUAD 9 coverclass	density	QUAD 10 coverclass	density
3	100	dirt	85		100		90		95		100	
		rock	51				10		5			
		CHPA	5				5					
		ALHA	5				10					

		QUBE			100	50						
		ADFA									5	15
		unk ceanothus									5	1
		TAAR										

TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
4	0	dirt	90		60		60		40		70	
		rock	10		40		40		60		30	
		unk ceanothus	1	2					1	1		
		CAMA	10		10		10		20		30	
		CHPA			1		1		10			
		ZIFR			5							
		CAAL			1							
		unk manzanita										
		ANCO										
		PHPA										
			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
4	0	dirt	50		50		50		80		50	
		rock	50		50		50		20		50	
		unk ceanothus										
		CAMA	10		5				20		10	
		CHPA										
		ZIFR	10									
		CAAL										
		unk manzanita	1	15			30	35				
		ANCO			5							
		PHPA			10							

TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
4	50	dirt	40		90		50		50		50	
		rock	60		10		50		50		50	
		CAMA	20				3				10	
		unk manzanita			15	8					5	3
		ADFA										
		ZIFR	1				10					
		CHPA										
		ANCO	3									
		CAAL	3				3		1			
		QUBE							50	20		
		CLPA									20	
			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density

4	50	dirt	40		40		50		50		50	
		rock	60		60		50		50		50	
		CAMA	5								15	
		unk manzanita	20	30							3	5
		ADFA			10	15						
		ZIFR									5	
		CHPA									5	
		ANCO										
		CAAL										
		QUBE										
		CLPA										

TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
4	100	dirt	60		80		30		50		90	
		rock	40		20		70		50		10	
		CHPA										
		ALHA							3			
		CAMA	25		3		10		10		3	
		ZIFR			10							
		PHPA										
		RHIL	3	2			60	15				
		QUBE			5	100						
		HEAR										
		ADFA							10	10		

			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
4	100	dirt	30		90		90		50		50	
		rock	60		10		10		50		50	
		CHPA	15		3							
		ALHA			3							
		CAMA			5		10		15			
		ZIFR							5			
		PHPA									10	
		RHIL										
		QUBE										
		HEAR										
		ADFA										

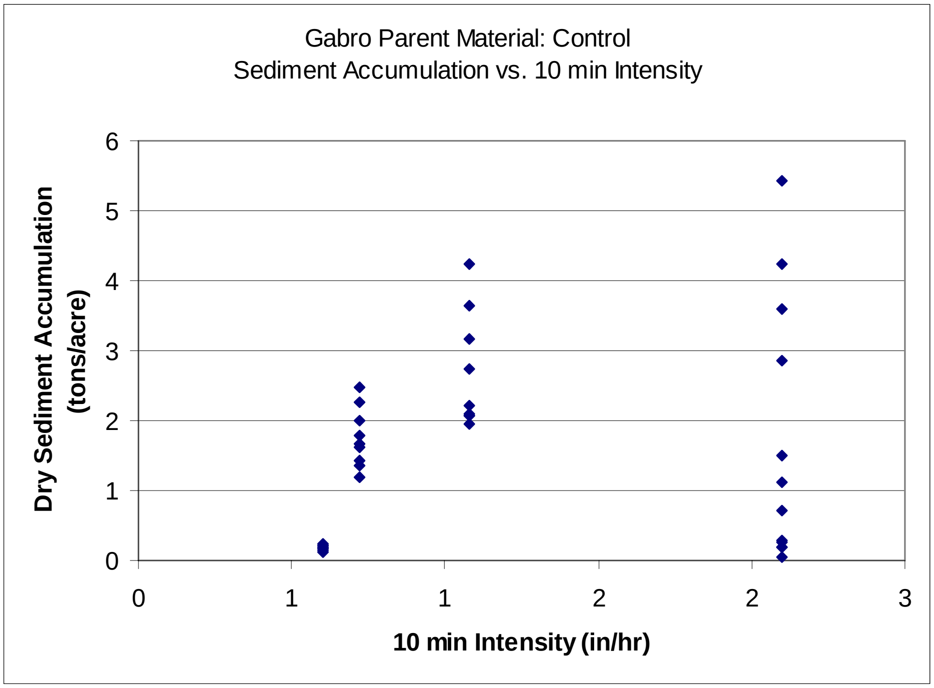
TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
5	0	dirt	80		40		90		90		50	
		rock	20		60		10		10		50	
		QUBE										
		CAMA	25				5		20		20	
		unk manzanita					1	20				

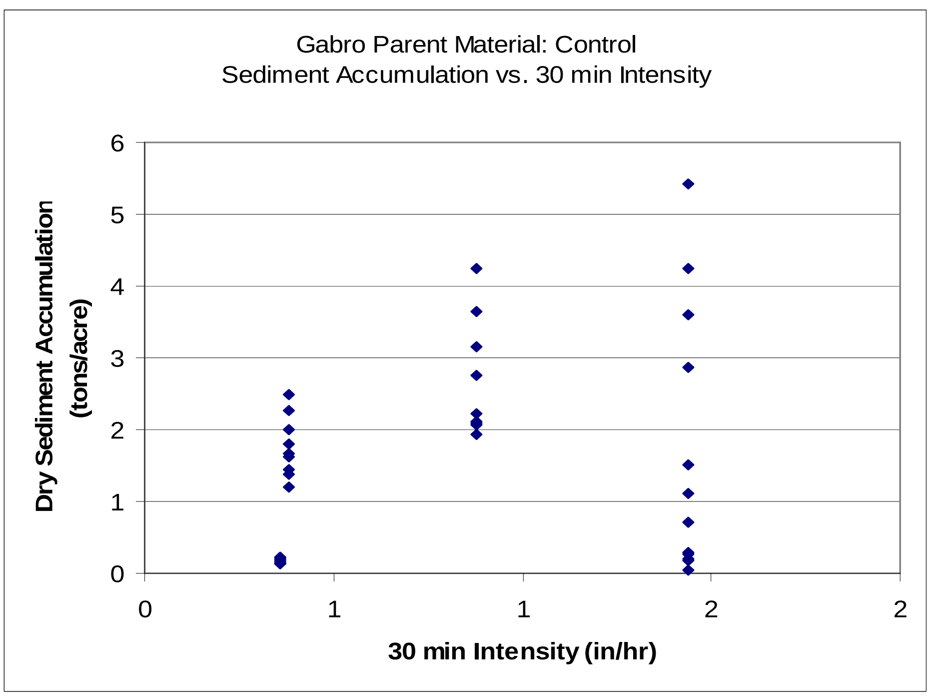
		CHPA										
		HASQ										
		unk ceanothus					1	2			1	30
		ADFA	5	10								
			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
5	0	dirt	80		80		70		80		60	
		rock	20		20		30		20		40	
		QUBE	30	50					25	100		
		CAMA	3				10		10		10	
		unk manzanita			7	15	20	15				
		CHPA							5			
		HASQ									10	
		unk ceanothus									1	1
		ADFA										
TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
5	50	dirt	70		80		70		60		80	
		rock	30		20		30		40		20	
		unk ceanothus					1	1				
		GAAP										
		QUBE										
		CAAL			5						5	
		ADFA							15	15		
		CAMA	80		5		1		10		1	
		ANCO										
		ZIFR									15	
		CHPA									3	
			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
5	50	dirt	30		100		80		50		90	
		rock	70				20		50		10	
		unk ceanothus	1	1								
		GAAP	1									
		QUBE			50	25						
		CAAL					10					
		ADFA					10	25				
		CAMA							2		10	
		ANCO							1			
		ZIFR										
		CHPA										
TRANSECT	% hydro mulch	item/species	QUAD 1		QUAD 2		QUAD 3		QUAD 4		QUAD 5	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density

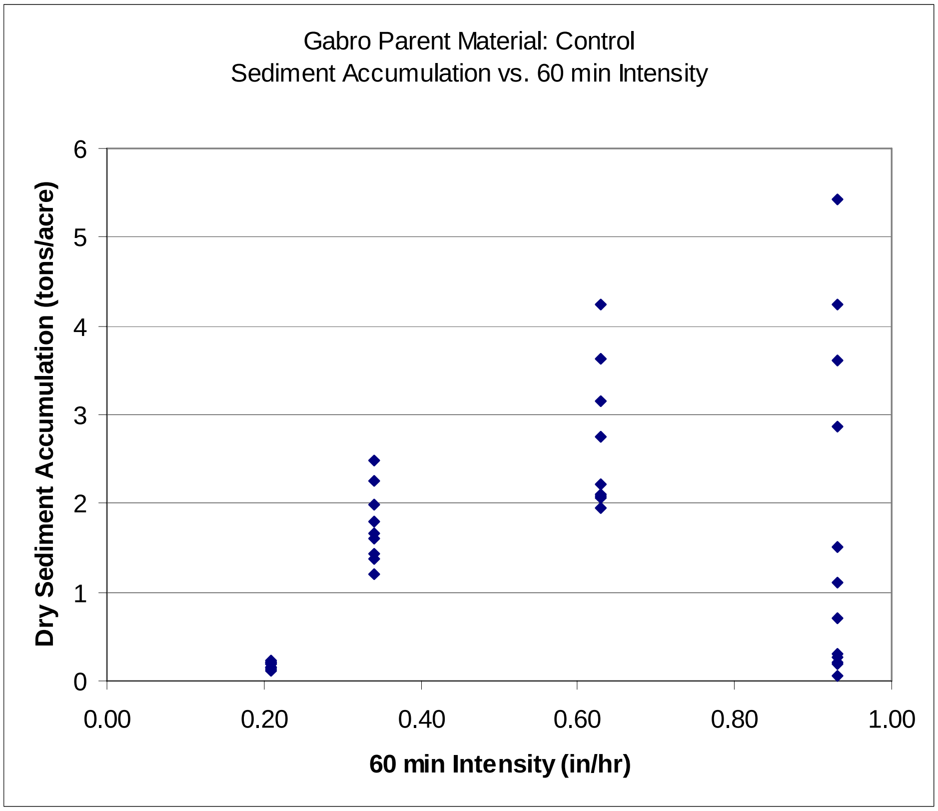
			ass	ty	ass	ty	ass	ty	ass	ty	ass	ty
5	100	dirt	80		80		60		60		80	
		rock	20		20		40		40		20	
		unk ceanothus					10					
		ZIFR										
		ADFA										
		SACO										
		CAMA	10		5						5	
		unk manzanita	50	50								
		QUBE										
		SODO			3							
		CHPA					5		1			
		CAAL					5					
		ZIFR					5					

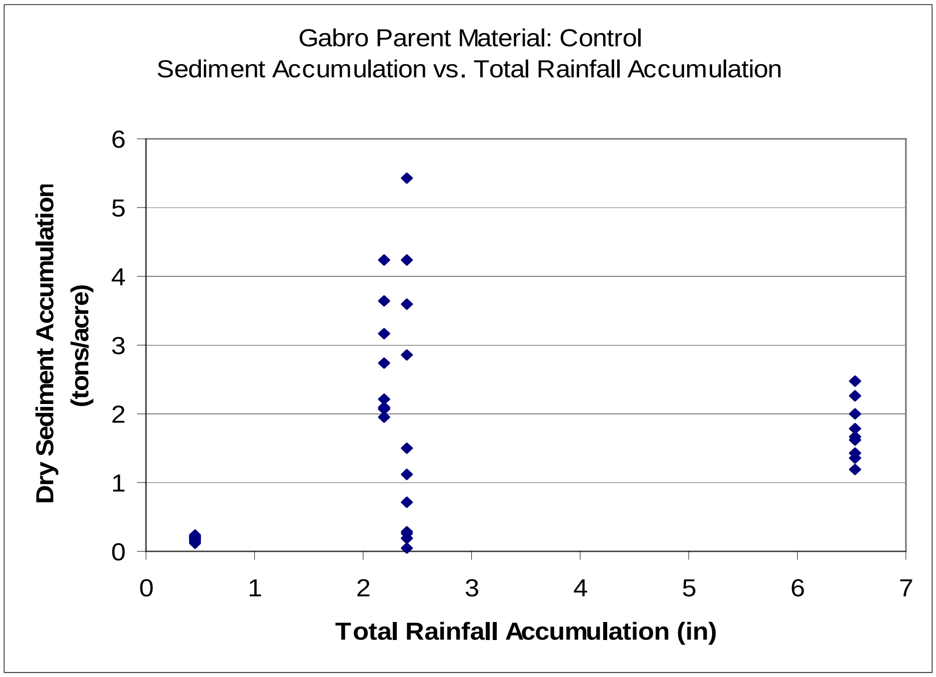
			QUAD 6		QUAD 7		QUAD 8		QUAD 9		QUAD 10	
			coverclass	density	coverclass	density	coverclass	density	coverclass	density	coverclass	density
5	100	dirt		50		80		50		80		
		rock		50		20		50		20		
		unk ceanothus	1	1	1	1	1					
		ZIFR		7								
		ADFA		2	6							
		SACO				2						
		CAMA						10				
		unk manzanita								20	10	
		QUBE								30	20	
		SODO										
		CHPA										
		CAAL										
		ZIFR										

Appendix B – Cedar Fire silt fence graphs showing relationship between sediment production and rainfall intensity.






Gabro Parent Material: Control
Sediment Accumulation vs. 60 min Intensity
Dry Sediment Accumulation (tons/acre)
0
1
2
3
4
5
6
0.00
0.20
0.40
0.60
0.80
1.00
60 min Intensity (in/hr)


Gabro Parent Material: Control
Sediment Accumulation vs. Total Rainfall Accumulation
Dry Sediment Accumulation (tons/acre)
0
1
2
3
4
5
6
0
1
2
3
4
5
6
7
Total Rainfall Accumulation (in)

Appendix C - Photo point site descriptions (SBNF and Cleveland)

Landscape and soil descriptions – photo points San Bernardino National Forest

Photo points/site description

Site #	1	Date: 3/11/2004	Treatment type:		straw heli-mulching	
Location (name)		Mojave West	Estimated Cover %:		40-60%	
GPS site location – see photo in report						
Soil family:		Trigo Family (map unit 6)				
Taxonomic class:		loamy, mixed, nonacid, thermic, shallow Typic Xerorthents				
Precipitation: 10-20 inches						
Surface morphometry			**Geomorphic location**			
Elevation:	4,600- 5,300 ft		Landform:		backslope	
slope %	37% 20°		Microfeatures:			
aspect	NE		Slope shape:		Down slope	Across
slope length:		400 ft crest to channel			convex	convex
Parent material		metamorphic	**vegetation**			
Depth to bedrock		50-60 cm	% cover	channel	side-slope	
Soil texture		ls to sl (sandy loam)				Species:
Surface rock:		50-70% gravels, cobble, stones	grass	0		Mixed chaparral
		some large rock 2 to 3 ft in size	forb	0		
Erosion			shrub	5%		chamise, scrub oak
rill	none		tree	0		(no resprouting)
gully	none					
sheet	none		Photo point direction			
bedload	none	fines flushed out	Time of day		10:45	

Notes: No resprouting nor any signs of grasses or forbes. Scrub oak skeletons thick near drainage.

Photo points/site description

Site #	2	Date:	3/11/2004	Treatment type:	straw heli-mulching	
Location (name)	Mojave West			Estimated Cover %:	40-50% in swale	
GPS (site location)				40-60%		

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents Typic Xerorthents

Precipitation: 10-20 inches

Surface morphometry		**Geomorphic location**		
Elevation:	4,600- 5,300 ft	Landform:	large swale (bowl) sideslope	
slope %	36%, 14% sideslope of swale (140° SE)	Microfeatures		
aspect	260° W down drainage 320° NW	Slope shape	Down slope	Across
slope length:			concave	concave

Parent material	metamorphic (gneiss?)	**vegetation**			
Depth to bedrock	50-60 cm	% cover	channel	side-slope	
Soil texture	ls to sl (sandy loam)				species
Surface rock:	50-60% cobble to stone size rocks	grass	0		
	few stone size	forb	5		
Erosion		shrub			chamise, scrub oak
rill	none	tree			(resprouting)
gully	none				
sheet	none	Photo point direction			
bedload	none	Time of day		10:15	

Notes:

Photo points/site description

Site #	3	Date:	3/11/2004	Treatment type:	Straw heli-mulch
Location (name)	Mojave West			Estimated Cover %:	range 10 to 60%,
GPS (site location)					majority <30%

Soil family: Trigo Family (map unit 6)
Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 inches

Surface morphometry

Elevation:	4,600- 5,300 ft	
slope %	28	sideslopes 22% W, 31% E
aspect	channel 0° N	sideslopes 280° W, 100° E
slope length:	unknown	
Parent material	metamorphic	
Depth to bedrock	50 cm	
Soil texture	ls (loamy sand) to sl (sandy loam)	
Surface rock:	50-80% cobble size rocks	
	few gravel and stone size	

Geomorphic location

Landform:	footslope at channel	
Microfeatures	linear drainage	
Slope shape	Down slope	Across
	(up channel - convex to concave)	

vegetation

% cover	channel	side-slope	species
	0	60	
grass	0		
forb	0		
shrub	15%		chamise, scrub oak
tree			(not resprouting)

Erosion

rill	none
gully	none
sheet	none
bedload	Stone-size rocks in channel

Photo point direction: 0° N

Time of day: 11:50

Notes: Evidence of water moving thru channel, fines flushed out material settling out last). Site surface was very rocky with cover 50% or greather in areas. There was no signs of erosion either where treatment was >60% or where treatment was <30%

Photo points/site description

Site #	5	Date: 3/11/04	Treatment type:		straw heli-mulching	
Location (name)		West Fork Mojave E-side	Estimated Cover %:		40%	
GPS (site location)						

Soil family: Trigo Family (map unit 6)
Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 inches

Surface morphometry			**Geomorphic location**			
Elevation:	4,600- 5,300 ft		Landform:		Lower backslope	
slope %	14		Microfeatures			
aspect	60° NE		Slope shape		Down slope	Across
slope length:		>1,000 ft			linear	convex and concave
Parent material		metamorphic	**vegetation**			
Depth to bedrock		?	% cover	channel	side-slope	
Soil texture		sl (sandy loam)				species
Surface rock:		rock outcrops	grass	5		
			forb	10		
Erosion			shrub	5%		chamise, scrub oak
rill	none		tree			manjanita (resprouting)
gully	none					
sheet	none		Photo point direction			
bedload	none		Time of day			

Notes: Wind-blown straw is clumping in piles. (see photo)

Photo points/site description

Site #	6	Date:	3/11/2004	Treatment type:	Straw heli-mulch
Location (name)	Mojave East			Estimated Cover %:	10 to 15%
GPS (site location)					

Soil family: Trigo Family (map unit 6)
Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 inches

Surface morphometry			**Geomorphic location**			
Elevation:	4,600- 5,300 ft		Landform:		lower backslope	
slope %	39		Microfeatures			
aspect	20° NE		Slope shape		Down slope	Across
slope length:		>1,000 ft			concave	concave
Parent material		metamorphic (gneiss?)	**vegetation**			
Depth to bedrock		?	% cover	channel	side-slope	
Soil texture		sl (sandy loam)		0		species
Surface rock:		60-80% cobble to stone size rocks	grass	0		
			forb	0		
Erosion			shrub	10%		manjanita, oak
rill	none		tree			thick stand of oak
gully	none					(not resprouting)
sheet	none		Photo point direction			
bedload	6-12 inch accumulation in bowl formation		Time of day		11:30	

Notes: Very rocky surface, no grasses or forbes. Oaks are not yet resprouting.

Photo points/site description

Site #	7	Date:	3/11/2004	Treatment type:	Straw heli-mulch
Location (name)	Mojave East			Estimated Cover %:	range 20 to 30%
GPS (site location)					

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 inches

Surface morphometry		**Geomorphic location**			
Elevation:	4,600- 5,300 ft	Landform:	upper backslope, shoulder		
slope %	23	Microfeatures			
aspect	90° E	Slope shape	Down slope		Across
slope length:	120 ft				
Parent material	metamorphic	**vegetation**			
Depth to bedrock	?	% cover	channel	side-slope	
Soil texture	sl (sandy loam)		0		species
Surface rock:	40-45% gravel tocobble size rocks	grass	0		
	few stone size	forb	5		
Erosion		shrub	5%		chamise, manjanita
rill	none	tree			(not resprouting)
gully	none				
sheet	none	Photo point direction			0° N
bedload	channel has partially been cut and loose sediment removed	Time of day	12:00		

Notes:

Photo points/site description

Site #	8	Date:	3/11/2004	Treatment type:	no treatment
Location (name)	Mojave East			Estimated Cover %:	0%
GPS (site location)					

Soil family: Trigo Family (map unit 6)
Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 inches

Surface morphometry		**Geomorphic location**		
Elevation:	4,600- 5,300 ft	Landform:	convergence of two drainage systems forming bowl	
slope %	26% upslope drainage, 22% sideslope	Microfeatures		
aspect	0° down drainage (90° E up drain, 240° SW side)	Slope shape	Down slope	Across
slope length:	120 ft		concave	concave

Parent material	metamorphic	**vegetation**			
Depth to bedrock	<50 cm	% cover	channel	side-slope	
Soil texture	ls to sl (sandy loam)		0		species
Surface rock:	30-40% gravel tocobble size rocks	grass	0		
	few stone size	forb	0		
Erosion		shrub	10%		chamise, manjanita
rill	minor	tree	5		oak
gully	none				(not resprouting)
sheet	none	Photo point direction			0° N
bedload	6-12 inch accumulation in bowl formation	Time of day		12:45	

Notes: Area where fire severity was high. At this time no evidence of resprouting

Photo points/site description

Site #	1 to 6	Date: 3/11/04	Treatment type:	Straw hand-mulch
Location (name)	Hooks Creek		Estimated Cover %:	40-60%, on summit only 10-20%
GPS (site location)				cover, more exposed to wind, wrapped around chamise skeletons

Soil family: Morical (map unit 4)
Taxonomic class: fine-loamy, mixed, mesic Mollic Haploxeralfs.

Precipitation: 20-35 inches

Surface morphometry			**Geomorphic location**			
Elevation:	6,000 ft		Landform:		summit or ridge top and shoulder	
slope %	46-55%	ridge 10% steepens to 30% (220° S)	Microfeatures			
aspect	300° NW		Slope shape		Down slope	Across
slope length:		>1000 ft			linear	convex
Parent material		?	**vegetation**			
Depth to bedrock		unknown	% cover	channel	side-slope	
Soil texture		sl (sandy loam)		0		species
Surface rock:		50% gravel	grass	0		
			forb	0		
Erosion			shrub	0%		
rill	<5% of crest minor		tree	Ponderosa pine, black oak (resprouting delayed by elevation (>6,000 ft).		
gully	none					
sheet	none		Photo point direction			
bedload	none		Time of day		10:30	

Notes: Hazard trees (pines) felled and used as LEB's. At risk, burned and unburned homes at bottom of slope. Only cover is straw mulch. No surface rock and little organic material. Soil is of very loose consistency.

Photo points/site description

Site #	1	Date:	3/11/2004	Treatment type:	Straw hand-mulch

Photo points/site description

Site #			
Location (name)	Grand Prix/Devore	Estimated Cover %:	<5%
GPS (site location)			

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 in

Surface morphometry			**Geomorphic location**			
Elevation:	2,000 - 2,800 ft		Landform:		crest	
slope %	55		Microfeatures			
aspect	60° NE		Slope shape		Down slope	Across
slope length:		150 ft				
Parent material		metamorphic	**vegetation**			
Depth to bedrock		unknown	% cover	channel	side-slope	
Soil texture		ls (loamy sand)		0		species
Surface rock:		60% gravel	grass	5		
			forb	5		
Erosion			shrub	10%		chamise resprouting,
rill	<5% minor		tree			scrub oak
gully	none					
sheet	none		Photo point direction			
bedload	none		Time of day		15:30	

Notes: Hand-mulched straw blown of-site by strong winds. It has accumulated and clumped beneath chamise skeletons. It may hamper resprouting by shading out light.

Photo points/site description

Site # 3	Date: 3/11/04	Treatment type:	Straw hand-mulch
Location (name)	Grand Prix/Devore	Estimated Cover %:	< 5%, blown off by high winds,
GPS (site location)			only small clumps left wrapped around chamise skeletons

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents

Precipitation: 10-20 in

Surface morphometry		**Geomorphic location**	
Elevation:	2,000 - 2,800 ft	Landform:	spur ridge crest
slope %	28	Microfeatures	
aspect	180° S	Slope shape	Down slope: linear; Across: convex
slope length:	>1000 ft		

Parent material	metamorphic	**vegetation**			
Depth to bedrock	unknown	% cover	channel	side-slope	
Soil texture	ls (loamy sand)		0	60	species
Surface rock:	50% gravel	grass	0		
		forb	<5%		
Erosion		shrub	20%		chamise, scrub oak (resprouting strongly)
rill	<5% of crest minor	tree			
gully	none				
sheet	none	Photo point direction			
bedload	none	Time of day		14:30	

Notes: Chamise dominated hillslopes, all resprouting strongly on S-facing slopes. Observation - chamise with straw wrapped tightly around basal trunk not resprouting as strongly as those without straw.

Photo points/site description

Site #	5	Date:	3/11/2004	Treatment type:	Straw hand-mulch
Location (name)	Grand Prix/Devore			Estimated Cover %:	<5%
GPS (site location)					

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 in

Surface morphometry			**Geomorphic location**			
Elevation:	2,000 - 2,800 ft		Landform:		shoulder	
slope %	26% shoulder, 46% backslope		Microfeatures			
aspect	160° S		Slope shape		Down slope	Across
slope length:		150 ft			convex	convex
Parent material		metamorphic	**vegetation**			
Depth to bedrock		unknown	% cover	channel	side-slope	
Soil texture		ls (loamy sand)		0		species
Surface rock:		80% gravel	grass	5		
			forb	5		
Erosion			shrub	10%		chamise resprouting
rill	<5% minor		tree			
gully	none					
sheet	none		Photo point direction			
bedload	none		Time of day		15:00	

Notes: Hand-mulched straw blown of-site by strong winds. It has accumulated and clumped beneath chamise skeletons. It may hamper resprouting by shading out light.

Photo points/site description

Site #	6	Date: 3/11/04	Treatment type:	Straw hand-mulch	
Location (name)	Grand Prix/Devore		Estimated Cover %:	<5%	
GPS (site location)					

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 in

Surface morphometry		**Geomorphic location**			
Elevation:	2,000 - 2,800 ft	Landform:		shoulder	
slope %	46	Microfeatures			
aspect	280° W	Slope shape		Down slope	Across
slope length:	100 ft			linear	
Parent material	?	**vegetation**			
Depth to bedrock	unknown	% cover	channel	side-slope	
Soil texture	ls (loamy sand)		0		species
Surface rock:	10-15%	grass			
		forb	35		wild cucumber
Erosion		shrub	5%		scrub oak
rill	none	tree			
gully	none				
sheet	none	Photo point direction			
bedload	none	Time of day		14:00	

Notes: Hand-mulched straw blown of-site by strong winds. Road blow out need culvert
Side drainage off road cutting back into road (see photos)

Photo points/site description

Site #	3 Date: 3/11/2004	Treatment type:	Straw heli-mulch
Location (name)	Mojave West Silverwood 1,2,3,4	Estimated Cover %:	range 30 to 80%
GPS (site location)			

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 in

Surface morphometry		**Geomorphic location**			
Elevation:	[illegible]	Landform:	spur ridge (trending 40° NE)		
slope %	38% W, 48% E	Microfeatures			
aspect	320° NW, 140° SE to Mojave River	Slope shape		Down slope	Across
slope length:	500 ft NW, 240 ft SE				
Parent material	metamorphic	**vegetation**			
Depth to bedrock	50 cm	% cover	channel	side-slope	
Soil texture:	ls (loamy sand) to sl (sandy loam)		0	60	species
Surface rock:	50-70% gravel to cobble	grass	0		
	size rocks	forb	5-10 %		
Erosion		shrub	15%		scrub oak
rill	none	tree			bay
gully	none			(resprouting slow)	
sheet	none	Photo point direction			
bedload		Time of day		9:30	

Notes:
Wind blown straw was clumping, in places it had gathered to depths of >1 ft.

Photo points/site description

Site #	2	Date:	3/10/2004	Treatment type:	Straw bale check dam
Location (name)	Deer Park Resort./Devore			Estimated Cover %	
GPS (site location)					

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow
Typic Xerorthents
Precipitation: 10-20 in

Surface morphometry			**Geomorphic location**			
Elevation:	1100-1500 ft		Landform:		main channel	
slope %	24		Microfeatures		new deposition recut by recent storms	
aspect	0° N		Slope shape		Down slope	Across
slope length:	side slopes, 150 ft N-facing, 300 ft S-facing			(up channel - convex to concave)		
Parent material	metamorphic		**vegetation**			
Depth to bedrock	30-50 cm on sideslopes		% cover	channel	side-slope	
Soil texture	ls (loamy sand)			50,30*		species
Surface rock:	in channel		grass	0		
	100%	stones (8-10 in)	forb	wild cucumber		
Erosion			shrub	elderberry, poison oak		
rill	none		tree			
gully	yes, recutting out new deposition in channel					
sheet	none		Photo point direction		0° N	
bedload	3 to 4 ft cut (incising)into bedoad below check dam.		Time of day		11:19	

Notes: * 50% cover below ck dam, 30% cover above ck dam. First major storm (Christmas Day) filled up storage area behind check dams to capacity. Flow from subsequent storms flow over the dams, thus there is no energy abatement. Unabated flow cuts deeply into stored channel sediment on the lower side of check dam. At some flows go around check dams cutting into the bank ,dams fail at the sides when flows cut into around the check gullies. New deposition is being cut by newly formed gullies

Photo points/site description

Site # 2	Date: 3/10/2004	Treatment type:	Straw bale check dam
Location (name)	Deer Park Resort./Devore	Estimated Cover %	
GPS (site location)			

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 in

Surface morphometry		**Geomorphic location**			
Elevation:	1100-1500 ft	Landform:		main channel	
slope %		Microfeatures		new deposition recut by recent storms	
aspect	180° S up channel	Slope shape		Down slope	Across
slope length:	150 ft to change in slope gradient		(up channel - convex to concave)		
Parent material	metamorphic, alluvium	**vegetation**			
Depth to bedrock	30-50 cm on sideslopes	% cover	channel	side-slope	
Soil texture	ls (loamy sand)		0	60	species
Surface rock:	in channel 100%	grass	0		
	stones (8-10 in)	forb		wild cucumber	
Erosion		shrub		elderberry, poison oak	
rill	yes, on side-slope SE facing	tree			
gully	on side-slope S-facing below ck dam				
sheet	none	Photo point direction		0° N	
bedload	3 to 5 ft cut (incising) into bedoad 2-3 ft deep where breaching side of dam (failure).	Time of day		11:48	

Notes: * 50 % cover below ck dam, 30 % cover above ck dam. First major storm (Christmas Day) filled up storage area behind check dams to capacity. Flow from subsequent storms flow over the dams, thus there is no energy abatement. Unabated flow cuts deeply into stored channel sediment on the lower side of checkdam. At some check dams, dams fail at the sides when flows cut into the banks a flow around the check dam.

Photo points/site description

Site # 3 Date: 3/10/2004 Treatment type: Straw bale check dam

Location (name) Deer Park Resort./Devore Estimated Cover %

GPS (site location)

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow
Typic Xerorthents
Precipitation: 10-20 in

Surface morphometry			**Geomorphic location**			
Elevation:	1100-1500 ft		Landform:		main channel	
slope %	30-40% upper channel		Microfeatures		new deposition recut by recent storms	
aspect	180° S up channel		Slope shape		Down slope	Across
slope length:	150 ft to change in slope gradient		(up channel - convex to concave)			
Parent material	metamorphic, alluvium		**vegetation**			
Depth to bedrock	30-50 cm on sideslopes		% cover	channel	side-slope	
Soil texture	ls (loamy sand)			0	60	species
Surface rock:	in channel	100%	grass	0		
	stones (8-10 in)		forb	Same a site 2		
Erosion			shrub	Same a site 2		
rill	yes, on side-slope S-facing below ck dam		tree			
gully	yes, on side-slope S-facing below ck dam					
sheet	none		Photo point direction		0° N	
bedload	3 ft of new deposition deposited over original 3-4 ft bedload (total 7 ft) cut (incising) into bedoad 2-3 ft deep		Time of day	11:50		

Notes: NW facing side slope very steep. There is evidence of ravel movement (cone shaped depsition at bottom with coarse-grained material settling out last).

Photo points/site description

Site #	4a, 4b		Date: 3/10/2004	Treatment type:	Straw bale check dam	
Location (name)		Deer Park Resort.Devore		Estimated Cover %		
GPS (site location)						

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 in

Surface morphometry				**Geomorphic location**			
Elevation	1100-1500 ft			Landform:		side channel	
slope %	28			Microfeatures			
aspect	320° NW		140° SE up channel	Slope shape		Down slope	Across
slope length		unknown **ck**					
Parent material		alluvium		**vegetation**			
Depth to bedrock		unknown		% cover	30-40 %	species	
Soil texture		ls (loamy sand)		grass	yes		
Surface rock		in channel	100%	forb	yes		
				shrub	yes		
Erosion				tree	yes		
rill	on side slopes						
gully	on side slopes						
sheet				Photo point direction			
bedload	4 to 5 ft of bedoad behind check dams			Time of day	12:15		

Notes: Grass and forb vegetation cover all in channel growing in new sediment deposited behind check dam. New deposition is being cut by newly formed gull 1-2 ft deep.

Photo points/site description

Site #	6a, 6b, 6c		Date: 3/10/2004	Treatment type:		Straw bale check dam
Location (name)		Deer Park Resort,.Devore		Cover %	61%	
GPS (site location)						

Soil family: Trigo Family (map unit 6)

Taxonomic class: loamy, mixed, nonacid, thermic, shallow Typic Xerorthents
Precipitation: 10-20 in

Surface morphometry				**Geomorphic location**			
Elevation	1100-1500 ft			Landform:		side channel	
slope				Microfeatures			
aspect	40°		260°	Slope shape		Down slope	Across
slope length		255 ft					
Parent material		alluvium		**vegetation**			
Depth to bedrock		unknown		% cover	15	species	
Soil texture		ls (loamy sand)		grass			
Surface rock		in channel		forb		wild cucumber	
				shrub		posion oak, scrub oak	
Erosion				tree			
rill							
gully							
sheet				Photo point direction			
bedload				Time of day		12:11	

Notes: Steep side channel. All check dams failed. Incising below check dam.

Site descriptions: Cedar Fire (Alpine area-granitic)

Photo points/site description

Site #	Date: Jun 2004	Treatment type:		Aerial hydromulch	
Location (name) Viejas Mountain		Cover %	n.a.		
GPS (site location)					

Soil family:
Fallbrook Sandy Loam; Cieneba-Fallbrook rocky Sandy Loam
Taxonomic class:
Precipitation: 12-15 inches

Surface morphometry		**Geomorphic location**			
Elevation	2,300 - 2800 ft	Landform:		backslope	
Slope (%)	15-30	Microfeatures			
aspect	varies	Slope shape		downslope	Across
slope length	100 ft			linear	linear
Parent material	Granitic bedrock	**vegetation**			
Depth to bedrock	60 – 120 cm	% cover	15-30	species	
Soil texture	sl	grass	See report	See report	
Surface rock	<5 %	forb	See report	See report	
		shrub		Chamise dominant spp.	
Erosion		tree	no		
rill	no				
gully	no				
sheet	yes	Photo point direction		n.a.	
bedload		Time of day		n.a	

Notes:

Site descriptions: Cedar Fire (Alpine area-gabbro)

Photo points/site description

Site #	Date:	Treatment type:	Aerial hydromulch
Location (name) Viejas Mountain		Cover %	
GPS (site location)			

Soil family:
Los Posas Stoney Fine Sandy Loam
Taxonomic class:
Precipitation: 12-15 inches

Surface morphometry		**Geomorphic location**		
Elevation	2,300 - 2800 ft	Landform:	backslope	
Slope (%)	25-50	Microfeatures		
aspect	varies	Slope shape	Down slope	Across
slope length	100 ft		linear	linear
Parent material	Gabbro bedrock			
Depth to bedrock	30-100 cm			
Soil texture	sl			
Surface rock	20-35%			

vegetation

% cover	20-35		species
grass	See report		See report
forb	See report	See report	
shrub		Assorted chaparral resprouters, see report	
tree	oak		

Erosion

rill	yes
gully	no
sheet	no
bedload	yes

Photo point direction	n.a.
Time of day	n.a.

Notes:

Site descriptions: Cedar Fire (San Diego Country Estates)

Photo points/site description

Site #	Date:	Treatment type:	Straw wattles (fiber rolls)
Location (name)	San Diego Country Estates	Cover %	
GPS (site location)			

Soil family: Fallbrook Sandy Loam; Ramona Sandy Loam

Taxonomic class:
Precipitation: 10-15 inches

Surface morphometry		**Geomorphic location**		
Elevation		Landform:	backslope	
slope	5- >50%	Microfeatures		
aspect	varies	Slope shape	Down slope	Across
slope length	varies		linear	linear
Parent material	Granitic, metamorphic	**vegetation**		
Depth to bedrock	30 - 110 cm	% cover		species
Soil texture	sl	grass	yes	
Surface rock	20-30%	forb	yes	
		shrub	Chaparral resprouters	
Erosion		tree	no	
rill	yes			
gully	no			
sheet	no	Photo point direction		n.a.
bedload	In channel	Time of day		n.a.

Notes: Rills forming below down-turned corners of fiber rolls

Appendix D – Precipitation data collected from RAWS that were near to treatment locations

Alpine California Precipitation

Month	Day						Monthly total
Nov, 2003	Nov 2 0.01	Nov 3 0.04	Nov 4 0.03	Nov 12 1.14	Nov 16 0.12		1.34
Dec	Dec 7 0.07	Dec 8 0.13	Dec 11 0.01	Dec 25 1.37	Dec 26 0.06	Dec 28 0.02	1.66
Jan, 2004	Jan 2 0.33	Jan 3 0.28	Jan 25 0.14	Jan 27 0.01	Jan 28 0.06		0.82
Feb	Feb 3, 4 0.96	Feb 18 0.47	Feb 21-23 2.35	Feb 26 0.67	Feb 27 0.20	Feb 28 0.02	4.67
Mar	Mar 2 0.5	Mar 3 0.03	Mar 26 0.01	Mar 28 0.03			0.57
Apr	Apr 2 0.62	Apr 3 0.07	Apr 4 0.09	Apr 17 0.41			
May - Sep							0.0
Oct	Oct 17 0.96	Oct 18 0.52	Oct 19 2.18	Oct 20, 21 2.91	Oct 27 2.13	Oct 28 0.74	9.44
Nov to Oct totals							19.69

Lytle Creek Precipitation

Month	Day						Monthly total
Nov, 2003	Nov 1	Nov 3	Nov 12	Nov 15			1.86
	0.23	0.38	1.04	0.21			
Dec	Dec 6,7	Dec 11	Dec 14	Dec 23	Dec 24	Dec 25	
	0.19	0.07	0.02	0.04	0.38	8.21	8.91
Jan, 2004	Jan 2	Jan 21	Jan 31				
	1.22	0.08	0.05				1.35
Feb	Feb 2	Feb 18	Feb 20,21	Feb 22,23	Feb 25	Feb 26	
	1.63	0.54	0.76	4.07	1.62	3.82	12.44
Mar	Mar 1	Mar 2					
	0.72	1.38					2.10
Apr	Apr 1	Apr 2	Apr 3	Apr 17			
	0.34	0.05	0.11	0.32			0.82
May - Sep							0.00
Oct	Oct 16	Oct 17	Oct 18	Oct 19,20	Oct 26	Oct 27	15.47
	0.11	1.75	0.85	3.78	3.25	5.73	
Nov to Oct totals							43.95

Fawnskin Precipitation

Month	Day						Monthly total
Nov, 2003	**Nov 1,2**	**Nov 12**	**Nov 13**	**Nov 14**	**Nov 15,16**		**1.43**
	0.18	**0.38**	**0.54**	**0.20**	**0.13**		
Dec	**Dec 7**	**Dec 23**	**Dec 24**	**Dec 25**	**Dec 30**	**Dec 31**	
	0.01	**0.13**	**0.12**	**1.85**	**0.04**	**0.01**	**2.17**
Jan, 2004	**Jan 2**	**Jan 4**	**Jan 19**	**Jan 21,22**	**Jan 23**		
	0.11	**0.01**	**0.02**	**0.03**	**0.14**		**0.31**
Feb	**Feb 3,4**	**Feb 5,6**	**Feb 18**	**Feb 20, 21**	**Feb 22,23**	**Feb 25**	
	0.04	**0.05**	**0.49**	**0.17**	**0.55**	**0.12**	**1.42**
Mar	**Mar 2**	**Mar 3**	**Mar 4**	**Mar 5**			
	0.25	**0.43**	**0.32**	**0.05**			**0.54**
Apr	**Apr 2**	**Apr 2**	**Apr 17**	**Apr 18**			
	0.14	**0.04**	**0.05**	**0.08**			**0.31**
May - Jul							**0.0**
Aug	**Aug 13**	**Aug 14**	**Aug 15**				**1.10**
	0.60	**0.49**	**0.01**				
Sep	**Sep 9**						**0.06**
	0.06						
Oct	**Oct 12**	**Oct 17**	**Oct 18**	**Oct 26, 27**	**Oct 28**	**Oct 30**	**1.39**
	0.02	**0.35**	**0.21**	**0.23**	**0.37**	**0.21**	
Nov to Sep total							**8.73**

Rock Camp Precipitation

Month	Day						Monthly total
Nov, 2003	Nov 1,3	Nov 8,9	Nov 15				
	n.a.	n.a.	n.a.				n.a.
Dec	Dec 6,7	Dec 11	Dec 20	Dec 23, 24	Dec 25		
	0.04	0.15	0.01	0.14	5.04		5.38
Jan, 2004	Jan 2	Jan 3	Jan 18	Jan 21			
	0.13	0.03	0.01	0.06			0.23
Feb	Feb 18	Feb 20	Feb 21	Feb 22, 23	Feb 25	Feb 26,	
	0.67	0.78	0.40	1.63	0.86	2.75	7.09
Mar	Mar1	Mar 3	Mar 25				
	0.07	0.47	0.01				0.54
Apr	Apr 1	Apr 2	Apr 3	Apr 17	Apr 18		
	0.11	0.21	0.03	0.26	0.01		0.62
May - Jul							0.0
Sep	Sep 9						0.06
	0.06						
Oct	Oct 25	Oct 26	Oct 27				2.03
	1.92	0.02	0.09				
Nov to Sep total							15.95

Piru California Precipitation

Month	Day						Monthly total
Nov, 2003	Nov 1,3	Nov 8,9	Nov 15				
	0.06	0.04	0.05				0.15
Dec	Dec 7	Dec 14	Dec 23	Dec 24	Dec 25		
	0.10	0.14	0.14	0.47	1.26		2.14
Jan, 2004	Jan 2	Jan 20	Jan 27				
	0.79	0.02	0.02				0.83
Feb	Feb 2	Feb 18	Feb 20, 21	Feb 22	Feb 25	Feb 27	
	0.62	0.38	0.50	0.65	2.66	0.04	4.85
Mar	Mar1	Mar 2	Mar 25				
	0.40	0.02	0.01				0.43
Apr				Apr 17			
				0.13			0.13
May - Sep							0.0
Oct	Oct 16	Oct 17	Oct 18	Oct 19	Oct 26	Oct 27	4.67
	0.05	0.64	0.36	2.30	1.21	0.11	
Nov to Sep total							13.20

Appendix E. Additional photos

Cedar Fire

Fig. A.1. View of Anderson Truck Trail
immediately following fire.

Fig. A.2. View of 6 inch deep trench taken before placement
of fiber roll at San Diego Country Estates.

Fig. A.3. Fiber roll being placed into trench.

Fig. A.4. Fiber roll being staked into the ground.

Fig. A.5. Picking up hydromulch mixture from mixing container.

Fig. A.6. Helicopter applying hydromulch.


Fig. A.7. Check dams, Dominquez Canyon.


Fig. A.8. Check dams, Dominquez Canyon.


Fig. A.9. Check dams, Dominquez Canyon.


Fig. A.10. Water ponding behind check dam.

Fig. A.11. Outlet of culvert looking into drainage

Fig. A. 13. Culvert cleanout 104_0419a

Appendix F. Proposal submitted for monitoring of soil quality

<u>Monitoring post-fire soil quality in southern California with regard to burned area emergency rehabilitation treatments</u>

The USDA Natural Resources Conservation Service defines soil quality as: "The capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation". Soil provides a medium for plant growth and animal habitat, and plays a primary role in biological transformations, breakdown of organic materials, and the cycling of water and chemical elements (including carbon, nitrogen and phosphorus) through the biosphere. In southern California wildlands, both soils and bedrock provide physical support, nutrients, water, and gas exchange necessary for the post-fire recovery of the native biota.

Physical, chemical, and biological soil attributes determine the status of soil quality. The importance of these characteristics in determining a healthy soil can vary, being dependent upon human value judgments concerning the primary function of a particular soil in a specific location. Following wildfire, soil quality should be evaluated to assess the extent of soil degradation and to maintain the condition of the soil. The question that should be asked is, “How will the construction of, and nature of BAER prescribed treatments affect the short- and long-term soil quality of the treated site?”

Physical soil indicators of importance in soil quality include those related to water storage capacity and movement, soil structure, and soil aggregate stability. Chemical indicators include soil nutrient status and the presence of toxic and growth inhibiting substances. Biological indicators include amounts, types, diversity, and community structure of the soil organisms. In most cases, soil biological activity is the most important indicator of soil health, but is the most difficult to interpret.

Hillslope Treatments

1. **Straw mulch, hydromulch, and fiber rolls** – aerial and hand-applied mulch; hydromulching both strip and 100% cover (wet); fiber rolls (straw wattles)

Primary factors involved in determining a monitoring protocol for soil quality under these treatments include: soil moisture content, soil temperature, total C, total N, carbon/nitrogen ratio, and microbial populations. With these treatments, the main issue of concern is whether the added mulch material changes the carbon/nitrogen ratio, thus altering microbial populations and reducing soil productivity.

Study design

- Use silt fences that have previously been installed to monitor hillslope erosion at both control and treated sites.
- Describe site.
- Determine the contributing area above silt fence (should be previously documented).
- Note location of silt fence and contributing area as to hillslope position (toeslope, footslope, backslope, shoulder, crest).
- Note the aspect, percent slope, and slope length.
- Estimate treatment coverage within contributing area and natural coverage on control contributing areas. (should be previously documented)

Sampling protocols

- Soil moisture - water content measurements will be made gravimetrically after oven drying of soil moisture tins (Gardner, 1986). Three samples per contributing area will be taken (total samples = 9). Oven dry samples for 24 hrs at 105° C.

- Soil temperature - use any common soil thermometer. Measure temperature at surface, 4 cm, and 15 cm depths.

- Total N, total carbon, carbon/nitrogen ratio - Using a soil sampler, three sub-samples will be taken from fine-textured sediment collected behind 3 silt fences installed to monitor hillslope erosion at both control and treated sites. The 3 samples from each silt fence will be mixed and treated as one composite sample (total sites sampled = 6, total samples = 6). Three randomly selected samples will also be taken at two depths (0-5 cm and 10-15 cm) within the contributing areas at both the control and treated sites. These samples will also be mixed for each site and for each depth and be treated as one composite sample (total sites sampled = 6, total samples = 12). Place samples in labeled field storage bags. To prepare samples for analysis, sieve with a 2 mm sieve and air dry. A minimum of 5 grams of sieved soil is needed for analysis if not pre-ground. For mailing to a lab (the preferred lab is at the USDA-FS Rocky Mountain Research Station in Flagstaff), soils can be packed in small whirl-paks or small plastic vials.

- Soil microbial populations - using wooden decomposition stakes, the difference in rates of decomposition among different treatments will be measured. Stakes are (type wood, size of stake). Stakes will be placed at 3 depths (2 cm, 5 cm, and 15 cm) at 3 locations (same sites as for chemical samples) within the contributing area (total sites sampled = 6, total stakes placed = 54). Contact Debbie Page-Dumroese at the Rocky Mountain Research Station, Moscow, ID (e-mail, ddumroese@fs.fed.us) for further methodogy. Further metods need to be investigated.

Time frame

- At least 3 samplings following different rain events should be conducted per year. This should continue over a 5-yr-period. Data will be analyzed and reported upon on a yearly basis.

2. Hydroaxe mulching

- Use the same methods designed for mulching treatments, except that soil compaction monitoring needs to be added. With this treatment, the weight of the hydroaxe machinery could contribute to soil compaction.

Sampling protocol

Soil compaction – use core sampler to measure soil bulk density or a recording penetrometer to measure soil strength if available (otherwise too expensive). The recording penetrometer is preferred because of the number of replication it enables. Sampling procedures for use of the core sampler can be found in: Blake, G.R., and K.H. Hartge. 1986. Bulk density, p. 363-375. *In* A. Klute (ed.) Methods of soil analysis.

3. **Access barriers to unauthorized OHV access.** Preventive measures include: wire fencing, gates, pipe rail barriers, and patrols.

Sampling protocol

- Monitoring different access barrier treatments will include photo points and survey questionnaires. The time frame for site visits will depend on the amount of unauthorized activity that occurs, and the timing of activity (e.g. peak holiday periods). The survey or questionnaire will detail the nature of the treatment failure, an estimate of area disturbed, and any significant erosion (e.g. rutting or initiation of rilling). Photo points will allow an ongoing assessment of failure or success of the treatment. Additional photos of specific failures and subsequent erosion can augment the written survey. Further monitoring can include soil strength testing of OHV disturbed areas. These measurements can be compared with soil strength testing of undisturbed control sites. In this case, a self-recording penetrometer is recommended. This instrument allows the user to take a large number of samples over a large area in a short period of time.

Structure number/identifier, drainage area above road crossing
Sampling concerns

- Variability may be high within the contributing area. Concerns would include the location of depression or swale areas, convex and concave topography, inter-rill and rill positions, and fluve and interfluve locations. These locations could affect soil moisture content and carbon concentrations.

Region 5 USDA Forest Service soil quality standards (Appendix F Sierra Nevada Forest Plan Amendment)

Detrimental soil compaction

- Bulk density increase of 15% in the surface horizon.
- Reduction of ≥10% soil porosity.
- An increase in soil strength of >500 kPa between disturbed and undisturbed sites.

Detrimental soil displacement / organic matter

- Loss of 2.5 cm of any surface horizon, usually the A horizon.
- Loss of either 5 cm or 1/2 of the humus-enriched topsoil, whichever is less.
- Loss of 50% of the A horizon.

Soil buffering capacity

- Do not add materials to the soil in amounts sufficient to alter microbial populations to the degree that significantly impairs soil productivity.

References

Blake, G.R., and K.H. Hartge. 1986. Bulk density, p. 363-375. *In* A. Klute (ed.) Methods of soil analysis, part 1, physical and mineralogical properties. 2nd ed., American Society of Agronomy, Madison, WI.

Gardner, W.H. 1986. Water content. *In* Methods of soil analysis. Part 1. 2nd edition. Agron. Monogr. 9. *Edited by* A. Klute. ASA and SSSA, Madison, WI, pp. 493-541.

Appendix G. San Diego Country Estates photo points

Photo points established in San Diego Country Estates.

Point #	**Photo Subject**	**GPS pt**	**Photo # 1**	**Photo # 2**	Notes
	Trail gate	32º59.709’ 116º45.380’	100-0026		Gate across trail to Cedar Creek Falls
	36” culvert on trail near trail gate	Same as above	100-0027	100-0028	
	Gate at West Side Truck Trail	32º59.703’ 116º45.390’	100-0029		Near straw waddles
1		32º59.710’ 116º45.402’	100-0030		
2	Road above tank looking uphill (S/SW)	32º59.639’ 116º45.436’	100-0031		Doesn’t have earlier picture?
3	On rd above tank looking at houses	32º59.602’ 116º45.465’	100-0032		
4	On road above tank looking uphill	32º59.602’ 116º45.471’	100-0033		
5	On road above tank looking uphill	32º59.604’ 116º45.473’	100-0034		
6	On road above tank	32º59.604’ 116º45.473’	100-0035		Mistake?
7	Road above tank	32º59.647’ 116º45.432’	100-0036		
8 & 9	Looking towards San Diego Country Estates	32º59.721’ 116º45.385’	100-0040	100-0041	
	General reference – recovery	32º59.730’ 116º45.394’	100-0042	100-0043	
	Looking upslope	32º59.787’ 116º45.396’	100-0044	100-0045	100-0046
10	Looking upslope	32º59.767’ 116º45.398’	100-0047		
11		116º45.380’	100-0048		

Appendix H. Silt fence locations (GPS points)

Silt Fence Number	Land Ownership	N	W
01	USFS	32º51.202’	116º44.480’
02	USFS	32º51.202’	116º44.484’
03	USFS	32º51.262’	116º44.512’
04	USFS	32º51.301’	116º44.469’
05	USFS	32º51.338’	116º44.428’
06	USFS	32º51.376’	116º44.492’
07	USFS	32º51.386’	116º44.503’
08	USFS	32º51.451’	116º44.492’
09	USFS	32º51.473’	116º44.570
10	USFS	32º51.480’	116º44.515’
11	USFS	32º51.505’	116º44.507’
12	USFS	32º51.506’	116º44.497
13	USFS	32º51.339’	116º44.425’
14	USFS	32º51.525’	116º44.552’
15	USFS	32º51.541’	116º44.545’
16	USFS	32º51.548’	116º454.583’
17	USFS	32º51.552’	116º44.583’
18	USFS	32º51.597’	116º44.580’
19	USFS	32º51.609’	116º44.584’
20	USFS	32º51.624’	116º44.593’
21	USFS	32º51.629’	116º44.587’
22	USFS	32º51.617’	116º44.580’
23	USFS	32º51.958’	116º44.683’
24	USFS	32º51.968’	116º44.675’
25	USFS	32º51.980’	116º44.667’
26	USFS	32º51.995’	116º44.652’
27	USFS	32º52.386’	116º45.775’
28	USFS	32º52.393’	116º45.769’
29	USFS	32º52.393’	116º45.755’
31	USFS	32º52.386’	116º45.707’
32	USFS	32º52.383’	116º45.704’
33	USFS	32º52.237’	116º45.775’
34	USFS	32º52.219’	116º45.788’
35	USFS	32º52.202’	116º45.787’
36	USFS	32º52.197’	116º45.774’
40	USFS	32º52.774’	116º46.465’
41	USFS	32º52.787’	116º46.444’
42	USFS	32º52.808’	116º46.432’
43	USFS	32º52.812’	116º46.427’
44	BIA	32º52.828’	116º46.232’
45	BIA	32º52.830’	116º46.210’
46	BIA	32º52.836’	116º46.201’
47	BIA	32º52.831’	116º46.096’
48	BIA	32º52.826’	116º46.087’
49	BIA	32º52.828’	116º46.084’

Appendix I. Specifications for aerial straw mulching (BAER report Grand Prix/Old Fire)

SPECIFICATION TITLE:	Aerial Straw Mulching- Old / Grand Prix Fire	JURISDICTIONS:	USFS
PART E: LINE ITEM:	DRAFT DRAFT DRAFT	FISCAL YEAR(S) (list each year):	FY 2004

I. WORK TO BE DONE

Number and Describe Each Task:

A. General Description: Straw mulch is applied where ground cover was consumed by the fire and the expected soil erosion and runoff is expected to degrade soil productivity and water quality. Aerial straw mulching will be completed with contract helicopter and pilots. Implementation monitoring will be done by the Forest Service.

Location (Suitable) Sites: The unit boundary will be flagged on the ground with 2 foot wide plastic flagging and GPS data will establish latitude and longitude.

B. Design/Construction Specifications:

1. Helicopter and Nets: Helicopter shall be R5 red carded and meet all FS safety requirements. The helicopter shall be capable of carrying 2,200 lbs. of straw per load. A four-hook carousal and multiple size nets are required. The nets shall be square cargo nets (not round), with a flat bottom. Large nets are 20ft. x 20ft. and carry 20 small bales. Medium nets are 15 ft. x 15 ft. and carry 10 bales. Small nets are 12 ft. x 12 ft. and carry 5 bales. The nets, rigging, and helicopter shall have a capability of spreading approximately xx tons of straw per flight hour.
2. Straw: Straw shall be rice straw. Rice straw shall be processed in a manner that releases from cargo nets and spreads evenly. Straw must be dry and baled loosely to facilitate spread once it is released. Straw moisture level shall be less than 13%. Small bails weigh 60 to 75 lbs. Straw is chopped to a 2 to 5 inch length.
3. Straw Delivery and Staging Area: Straw shall be delivered to the staging area (yet to be determined). The contractor shall supply a squeeze or forklift and operator to unload and stack straw. On site stored straw must be protected from rain. If necessary, staging area will be _watered for dust abatement_ (*Ask about engine availability for both dust abatement and crash rescue?).*
4. Loading Crew: Loading crew will place straw into cargo nets. Crew will load straw and remove binding string. (*trash receptacles shall be provided by xx for loose string etc., don't want it flying around helipad*). A crew (15 people) will carry and place bales onto cargo net. Crews will wear Nomex and leather gloves.
5. Application rate: Straw shall be applied at the rate of 1.5 tons per acre. Test areas will be setup for calibration purposes.
6. Application Method: Straw shall be dropped by helicopter using specified nets and rigging. Pilot will utilize GPS, line of sight, and direction from forward observers during application.
7. Contract inspection: Forward observers will monitor application rate. The COR and forward observers will communicate results of test strip application and any needs related to calibration.
8. Helicopter Manager: Manager will provide safety briefing to all personnel. Helicopter manager will also provide oversight and spot check of load calculations and weight balance.

C. Purpose of Treatment: The basic purpose of straw mulch is to replace only the natural ground cover that was consumed by the fire. Straw can effectively control overland runoff due to bare soil, hydrophobic soils and compacted soils.

II. LABOR, MATERIALS AND OTHER COST:

PERSONAL SERVICES (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): **Do not include contract personnel costs here (see contractor services below).**	COST/ITEM
Contracting Officer Contract Development GS-11 @ $250/day for 2-5 days	500-1,250

Helicopter Manager GS-9/ step 5 @ $200/day for 10 days	2,000
15 person helicopter/loading crew @ $2250/day for 10 days (100 hours/person@ $15/hour)	22,500
Project coordinator GS-11 @ $ 250/day for 10 days	2,500
TOTAL PERSONNEL SERVICE COST	28,250
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X # Fiscal Years = Cost/Item):	COST/IT EM
1020 tons of rice straw, delivered and stacked at staging area ($36/ton for straw; $150/ ton trucking)	**189,720$**
TOTAL MATERIALS AND SUPPLY COST	**189,720**
CONTRACT COST (Labor or Equipment @ Cost/Hour X # Hours X # Fiscal Years = Cost/Item):	COST/IT EM
1 helicopter @ $1200 per hr. for 60 hours, plus fuel truck (included)	**72,000$**
TOTAL COST ($750/acre X 800 acres)	**600,000$**

Appendix J. Fiber Roll Treatment Specifications (BAER report Cedar Fire)

General Description:

Treatment area is located on Forest Service land south of southeast portion of San Diego County Estates within the San Vicente watershed (T13S, R2E, Section 34, southeast quarter, southeast quarter). Fiber rolls (straw wattles) will be used on slopes to prevent slope erosion and facilitate plant establishment. Fiber rolls are prefabricated rolls typically manufactured from rice straw wrapped in tubular plastic netting. Their primary purpose is to break up slope length to reduce both flow velocity and surface erosion. Fiber rolls are about 9 inches in diameter, and can be any length up to 25 feet. A 25 foot long fiber roll weighs approximately 35 pounds. They are designed for low surface flows not to exceed 1 cfs, and will not be placed in stream channels or gullies, or in the path of high water flow (see Table 1 for estimated costs).

Treatment areas 3 and 4 are high priority areas.
Treatment areas 1 and 2 are excellent for volunteer installation.

Purpose of Treatment Specifications:

Fiber rolls are intended to slow overland flow velocity, capture and keep sediment on slopes, and to improve infiltration. They will also be used to temporarily stabilize slopes by reducing soil creep, and sheet and rill erosion until native vegetation can establish. Pin flags and flagging have been located on 50 percent of treatment area, as possible locations for fiber rolls, displaying spacing and arrangement.

Design/Construction Specifications:

Fiber rolls will be installed along the contour with slight downward angle at the lowest end of the fiber roll to prevent ponding at the mid-section of the fiber roll. A line or carpenter's level will be used to help achieve the slight downward angle during trenching of the fiber roll. No overall slope preparation is needed prior to installation; however fiber rolls will always be staked securely to the ground and installed in shallow trenches according to the guidelines below.

a. Spacing Down-slope: Locate fiber rolls on level contours in a checkerboard pattern to the extent possible. Vertical spacing is dependent on slope gradient, quantity and size of surface rock fragments and local vegetation patterns. Some general guidelines for spacing fiber rolls down slope are listed below. If in doubt use closer spacing.

Gentle slopes inclination: **20:1 to 6.5:1 (5 % to 15 %)**: Fiber rolls will be placed at a maximum interval of 30 **ft.**

Moderately steep slopes inclination: **6.5:1 to 4:1 (15 % to 25 %)**: Fiber rolls will be placed at a maximum Interval of **25 ft**.

Steep slopes inclination: **4:1 to 2:1** (**25 % to 50 %**): Fiber Rolls will be placed at a maximum interval of **20 ft**.

Very steep slopes inclination: **2:1 or greater (> 50 %)**: Fiber Rolls will be placed at a maximum interval of **15 ft**.

b. Spacing laterally: Fiber rolls will be installed in staggered rows with 12 to 18 inches of overlap (checkerboard pattern, see attached diagram), so drainage off of one tier of fiber rolls is captured by the next tier of fiber rolls.

c. Trenching: Use a hand tool such as a Pulaski or pick to score the ground. Stake fiber rolls into a 3 to 5 in. deep trench for soft, loamy soils and 2 to 3 inch deep trench for hard rocky soils with a width equal to the diameter of the fiber roll.

d. Installation: Lay the first fiber roll snugly in the trench. No daylight should be seen under the wattle. Pack soil from trenching against the wattle on the uphill side using a tamping tool. It's preferable to install wattles from the top of the slope and work down slope.

Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center. It may be necessary to use the pick end of a Pulaski in order to get the stake through the straw. Stakes should protrude about 2 – 3 inches above the fiber roll. A 25 foot fiber roll uses 6 stakes, a 20 foot fiber roll uses 5 stakes, and a 12 foot fiber roll uses 4 stakes.

Use wood stakes with a minimal nominal classification of 1 inch by 1 inch and minimum length of 24 inches. For hard, rocky soils, 18 inch stakes are a good length, while for soft loamy soils 30 inch long stakes are preferable if they can be relatively easily driven into the soil.

If it's necessary to install two fiber rolls on a contour side-by-side, butt the second fiber roll very tightly against the first; this will be done only where absolutely necessary.

Treatment Effectiveness Monitoring:
Inspect wattles after significant weather events for failures and make necessary repairs.

Slope Treatment Area # 1:

Slope: <10%
Burn Severity: low
Soil Surface: sandy loam (2% gravel)
Slope shape: linear to slightly convex, little dissection
Vegetation: 80% burned many skeletons
Concerns: prevent surface water runoff from flowing directly into incised channels and along roadway and trails

Fiber rolls spacing: 25 to 30 feet
West of incised channels: 100 % 25' fiber rolls, estimated treatment area is 50 %.
East of incised channels: 85 % 25' fiber rolls, and 15 % 20' fiber rolls, estimated treatment is 100 %.

Slope Treatment Area # 2:

Slope: <15%
Burn Severity: moderate
Soil Surface: sandy loam (10% gravel)
Slope shape: linear to slightly convex, some dissection
Vegetation: 100% burned many skeletons
Concerns: prevent surface water runoff from flowing directly into incised channels and along roadway and trails

Fiber rolls spacing: 25 to 30 feet
West of incised channels: 80 % 25' fiber rolls, and 20 % 20' fiber rolls estimated treatment area is 75%.
East of incised channels: 85 % 25' fiber rolls, and 15 % 20' fiber rolls, estimated treatment is 70%.

Slope Treatment Area # 3:

Slope: 20 to 50%
Burn Severity: moderate
Soil Surface: gravelly sandy loam (15% gravel, 2% cobble, 1% stone)
Slope shape: slightly concave to slightly convex, moderate dissection
Vegetation: 100% burned many skeletons
Concerns: prevent surface water runoff from flowing directly into incised channels and along roadway and trails

Fiber rolls spacing: 15 to 20 feet
West of incised channels: 50 % 20' fiber rolls, 25 % 15', and, 25 % 25' fiber rolls estimated treatment area is 80 to 90%.

East of incised channels: 60 % 20’ fiber rolls, 40 % 15 foot fiber rolls estimated treatment is 85 %. Exclude areas with greater than 50% rock fragments

Slope Treatment Area # 4:

Slope: 30 to 60%
Burn Severity: moderate
Soil Surface: very gravelly sandy loam (35% gravel, 10% cobble, 3% stone)
Slope shape: slightly concave to slightly convex, slight dissection
Vegetation: 100% burned many skeletons
Concerns: prevent surface water runoff from flowing directly into incised channels and along roadway and trails

Fiber rolls spacing: 15 to 20 feet
West of drainage: 60 % 15’ fiber rolls and 40 % 20’ fiber rolls, estimated treatment area is 50 %. %. Exclude areas with greater than 50% rock fragments

Slope Treatment # 5:

Slope: >50%
Burn Severity: moderate
Soil Surface: very gravelly sandy loam
Slope shape: slightly concave to slightly convex, deeply dissection
Vegetation: 100% burned many skeletons
Concerns: debris flow, flash flood events affecting downhill home (portion of San Diego Country Estates)

No fiber roll treatments, hydro mulching is more appropriate.

Table 1. Fiber roll estimated costs.

Treatment Type & Area	Acres	25' rolls	20' rolls	15' rolls	Total linear ft	Fiber roll cost* ($)	Stakes	Stake cost^	Total cost
1 west	2	60	0	0	1500	1125	375	67.50	1192.50
1 east	4	30	240	0	5550	4162.5	1400	252	4414.50
2 west	3	60	0	0	1500	1125	375	67.5	1192.50
2 east	5	30	240	0	5550	4162.5	1400	252	4414.50
2 headwaters	2	60	0	0	1500	1125	375	67.5	1192.50
3 west	4	110	210	150	9200	6900	2300	414	7314
3 east	8	0	470	430	15850	11887.5	4100	738	12625.5
4	5	0	140	280	7000	5250	1800	324	5574
5	4	0	0	0	0	0	0	0	0
Totals	37	350	1300	860	47650	35737.5	12125	2182.50	37920

*Estimate cost per linear foot is 75 cents
^Estimate cost per stake 18 cents

Shrink wrap is 5 cents per linear foot (transportation and weather protection)

Appendix K. Road survey forms

Initial Assessment/Installation Survey

Road

Geographic/fire name ______________________________

Sector ____________ **Date** ____________ **Time survey start:** ____________

Culvert

Road number	Mileage marker	Culvert or other structure ID	GPS ID or Lat	Long	photo #	Soil type and texture	Vegetation type	Road Slope	Profile (insloped/out sloped)	Drainage area above structure	Did size change? from-to	Were downspouts or culvert extensions added?	Was entrance or exit armored? If so with what?	

Initial Assessment/Installation Survey

Road

Geographic/fire name ______________________________

Sector ____________ **Date** ____________ **Time survey start:** ____________

Trash Racks

			GPS											
Road number	Mileage marker	Culvert or other structure ID	Lat	Long	photo #	Soil type and texture	Vegetation type	Road Slope	Profile (insloped/out sloped)	Drainage area above structure	Channel slope	construction materials	Width of channel?	height of structure?

Initial Assessment/Installation Survey

Road

Geographic/fire name ______________________________

Sector ____________ **Date** ____________ **Time survey start:** ____________

K-Rails

			GPS											
Road number	Mileage marker	Culvert or other structure ID	Lat	Long	photo #	Soil type and texture	Vegetation type	Road Slope	Profile (insloped/out sloped)	Drainage area above structure	Were structures added or removed?	Construction materials?	height of structure?	

Initial Assessment/Installation Survey

Road

Geographic/fire name ____

Sector ______________ **Date** ______________ **Time survey start:** ______________

Rolling Dip

			GPS											
Road number	Mileage marker	Culvert or other structure ID	Lat	Long	photo #	Soil type and texture	Vegetation type	Road Slope	Profile (insloped/out sloped)	Drainage area above structure	Armored? What material?			

Initial Assessment/Installation Survey

Road

Geographic/fire name ____

Sector ______________ **Date** ______________ **Time survey start:** ______________

Surface Treatments

			GPS											
Road number	Mileage marker	Culvert or other structure ID	Lat	Long	photo #	Road Slope	Profile (insloped/out sloped)	type and grade of material						

Initial Assessment/Installation Survey

Road

Geographic/fire name ____________________

Sector __________ **Date** __________ **Time survey start:** __________

Slope Gradient Changes

			GPS											
Road number	Mileage marker	Culvert or other structure ID	Lat	Long	photo #	Soil type and texture	Vegetation type	Road Slope	Profile (insloped/out sloped)	Drainage area above structure				

Initial Assessment/Installation Survey

Road

Geographic/fire name ____________________

Sector __________ **Date** __________ **Time survey start:** __________

Gates and Signs

			GPS											
Road number	Mileage marker	Culvert or other structure ID	Lat	Long	photo #	Gate Type	Key or combination	New or replacement	New sign?	Sign wording?				

Road Storm Patrol Monitoring (Circle response)

Geographic/fire name ______________________

Sector ____________ Date ____________ Time survey start: ____________

Treatment

		GPS			Culvert		Culvert Armoring		Trash rack			Krail		Rolling Dip		Surface Treatment.		Outsloping		Gates/Locks	
Road number	Culvert or other structure ID	Lat	Long	Flow Event?	Cleaned Out	Failed?	Armoring still in place	Failed?	Cleaned Out	Failed?	%Full	Cleaned Out	Failed?	Armoring still in place?	Failed?	Armoring still in place?	Failed?	Ruts?	Failed?	Failed?	Reason for Failure/notes
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	
				Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N		Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	

Appendix L. Vegetation recovery – City Creek (Old Fire) GPS pts and cover data.

San Bernardino National Forest Vegetation
Sampling Transects (Firemon protocol)
Plots established on 3/23/04 and 3/24/04 by Ken Hubbert, Valerie Oriol, and Erin Kreutz.
Directions: 215N to 30E(Mtn Resorts) to 330N(Mtn Resorts). First turnout on west side (after first turnout going N on 330- east side; turnout before 35 mph sign and red sign just past mph sign). Follow old road S.

GPS Points: Taken at end of baseline transect. (GPS pts recorded 3/24/04)

Plot	N	W	Elevation (ft)	# of points	Accuracy(ft)	Notes
1T	34º09.105’	117º11.604’	2302	122		
2T	34º09.108’	117º11.568’	2289	100	20	
3T	34º09.106’	117º11.558’	2275	120	20	
4C	34º09.111’	117º11.519’	2277	100	20	
5C	34º09.113’	117º11.508’	2215	100	21	
6C	34º09.173’	117º11.446’	2086	115	15	

Plot 1T – Baseline 174º; Transects at 264º	
Transect 1 – 24 m	
Transect 2 – 16 m	
Transect 3 – 11 m	
Transect 4 – 9 m	
Transect 5 – 7 m	
Aspect 358°	
Plot 2T – Baseline 187º; Transects at 277º	
Transect 1 – 22 m	
Transect 2 – 16 m	
Transect 3 – 11 m	
Transect 4 – 6 m	
Transect 5 – 2 m	
Aspect 158° (probably should be 338°)	
Plot 3T – Baseline 314º; Transects at 224º	
Transect 1 – 22 m	
Transect 2 – 20 m	
Transect 3 – 15 m	
Transect 4 – 10 m	
Transect 5 – 4 m	
Aspect 154°	
Plot 4C – Baseline 165º; Transects at 255º	

Transect 1 – 19 m	
Transect 2 – 15 m	
Transect 3 – 7 m	
Transect 4 – 3 m	
Transect 5 – 1 m	
Aspect 356°	
Plot 5C – Baseline 153º; Transects at 243º	Plot 5C extends into 4C approximately 5m. Transect 2 of Plot 5C is approximately 1.5 m from that of Transect 1 on Plot 4C.
Transect 1 – 23 m	
Transect 2 – 21 m	
Transect 3 – 18 m	
Transect 4 – 13 m	
Transect 5 – 6 m	
Aspect 342°	
Plot 6C – Baseline 337º; Transects at 247º	Plot 6C located off of another ridge. Standing at Plots 4C and 5C, 6C is visible on the opposing slope (also a drop in elevation).
Transect 1 – 22 m	
Transect 2 – 19 m	
Transect 3 – 17 m	
Transect 4 – 12 m	
Transect 5 – 10 m	
Aspect 150°	

Percent cover data at City Cr. For March and June 2004

Date by Month	Plot	Transect	TBL VisitInfo_VisitID	Date	VisitCovID	Cov	GC %	VC %
3/1/2004								
	1T	1	1	3/24/2004	61	Gravel	1.96%	1.96%
	1T	1	1	3/24/2004	117	Straw	11.76%	11.76%
	1T	1	1	3/24/2004	207	BRHO	0.00%	3.92%
	1T	1	1	3/24/2004	300	CEME	1.96%	11.76%
	1T	1	1	3/24/2004	346	ERCI	1.96%	9.80%
	1T	1	1	3/24/2004	1	Bare	82.35%	82.35%
	1T	2	2	3/24/2004	360	EUCH	0.00%	5.88%
	1T	2	2	3/24/2004	426	QUBE	0.00%	3.92%
	1T	2	2	3/24/2004	348	ERCI	0.00%	3.92%
	1T	2	2	3/24/2004	304	CEME	0.00%	1.96%
	1T	2	2	3/24/2004	209	BRHO	0.00%	5.88%
	1T	2	2	3/24/2004	125	Straw	35.29%	35.29%
	1T	2	2	3/24/2004	2	Bare	60.78%	60.78%
	1T	2	2	3/24/2004	72	Gravel	3.92%	3.92%
	1T	2	2	3/24/2004	218	BRMA	0.00%	1.96%
	1T	3	3	3/24/2004	310	CEME	0.00%	2.00%
	1T	3	3	3/24/2004	3	Bare	64.00%	64.00%
	1T	3	3	3/24/2004	362	EUCH	0.00%	2.00%
	1T	3	3	3/24/2004	129	Straw	28.00%	28.00%
	1T	3	3	3/24/2004	83	Gravel	8.00%	8.00%

1T	3	3	3/24/2004	465	HEGR	0.00%	2.00%
1T	4	4	3/24/2004	4	Bare	58.00%	58.00%
1T	4	4	3/24/2004	92	Gravel	4.00%	4.00%
1T	4	4	3/24/2004	139	Straw	38.00%	38.00%
1T	4	4	3/24/2004	268	CEME	0.00%	4.00%
1T	4	4	3/24/2004	321	CAMA	0.00%	4.00%
1T	5	5	3/24/2004	327	CEME	0.00%	2.00%
1T	5	5	3/24/2004	103	Gravel	4.00%	4.00%
1T	5	5	3/24/2004	370	EUCH	0.00%	2.00%
1T	5	5	3/24/2004	146	Straw	32.00%	32.00%
1T	5	5	3/24/2004	5	Bare	64.00%	64.00%
1T	5	5	3/24/2004	240	BRMA	0.00%	2.00%
2T	1	6	3/24/2004	6	Bare	82.00%	82.00%
2T	1	6	3/24/2004	113	Gravel	12.00%	12.00%
2T	1	6	3/24/2004	147	Straw	2.00%	2.00%
2T	1	6	3/24/2004	285	CAMA	4.00%	8.00%
2T	1	6	3/24/2004	333	CEME	0.00%	2.00%
2T	1	6	3/24/2004	464	MAMA	0.00%	2.00%
2T	2	7	3/24/2004	357	ERCI	0.00%	4.00%
2T	2	7	3/24/2004	471	BRDI	0.00%	2.00%
2T	2	7	3/24/2004	372	EUCH	0.00%	2.00%
2T	2	7	3/24/2004	211	BRHO	0.00%	2.00%
2T	2	7	3/24/2004	148	Straw	6.00%	6.00%
2T	2	7	3/24/2004	7	Bare	94.00%	94.00%
2T	2	7	3/24/2004	406	HIIN	0.00%	2.00%
2T	2	7	3/24/2004	335	CEME	0.00%	8.00%
2T	3	8	3/24/2004	149	Straw	47.06%	47.06%
2T	3	8	3/24/2004	452	VUMY	1.96%	1.96%
2T	3	8	3/24/2004	358	ERCI	0.00%	1.96%
2T	3	8	3/24/2004	191	Wood	1.96%	1.96%
2T	3	8	3/24/2004	115	Gravel	1.96%	1.96%
2T	3	8	3/24/2004	8	Bare	47.06%	47.06%
2T	3	8	3/24/2004	336	CEME	0.00%	3.92%
2T	4	9	3/24/2004	337	CEME	0.00%	6.00%
2T	4	9	3/24/2004	453	VUMY	0.00%	4.00%
2T	4	9	3/24/2004	456	SOXA	0.00%	2.00%
2T	4	9	3/24/2004	373	EUCH	0.00%	4.00%
2T	4	9	3/24/2004	150	Straw	38.00%	38.00%
2T	4	9	3/24/2004	116	Gravel	4.00%	4.00%
2T	4	9	3/24/2004	9	Bare	58.00%	58.00%
2T	4	9	3/24/2004	287	CAMA	0.00%	4.00%
2T	5	10	3/24/2004	10	Bare	70.00%	70.00%
2T	5	10	3/24/2004	62	Gravel	6.00%	6.00%
2T	5	10	3/24/2004	118	Straw	24.00%	24.00%
2T	5	10	3/24/2004	248	CAMA	0.00%	4.00%
2T	5	10	3/24/2004	359	EUCH	0.00%	2.00%
2T	5	10	3/24/2004	438	SAME	0.00%	2.00%
3T	1	11	3/24/2004	374	HIIN	0.00%	6.00%

3T	1	11	3/24/2004	411	PHMI	0.00%	2.00%
3T	1	11	3/24/2004	301	CEME	0.00%	6.00%
3T	1	11	3/24/2004	212	BRMA	2.00%	14.00%
3T	1	11	3/24/2004	119	Straw	14.00%	14.00%
3T	1	11	3/24/2004	11	Bare	28.00%	28.00%
3T	1	11	3/24/2004	63	Gravel	56.00%	56.00%
3T	1	11	3/24/2004	457	SACO	0.00%	6.00%
3T	1	11	3/24/2004	208	BRHO	0.00%	2.00%
3T	2	12	3/24/2004	249	CAMA	1.92%	5.77%
3T	2	12	3/24/2004	412	PHMI	1.92%	7.69%
3T	2	12	3/24/2004	407	MILA	1.92%	5.77%
3T	2	12	3/24/2004	375	HIIN	1.92%	7.69%
3T	2	12	3/24/2004	302	CEME	0.00%	9.62%
3T	2	12	3/24/2004	213	BRMA	3.85%	17.31%
3T	2	12	3/24/2004	120	Straw	11.54%	11.54%
3T	2	12	3/24/2004	64	Gravel	40.38%	40.38%
3T	2	12	3/24/2004	12	Bare	34.62%	34.62%
3T	2	12	3/24/2004	338	CRMU	1.92%	5.77%
3T	3	13	3/24/2004	288	CACA	0.00%	2.04%
3T	3	13	3/24/2004	376	HIIN	2.04%	18.37%
3T	3	13	3/24/2004	65	Gravel	57.14%	57.14%
3T	3	13	3/24/2004	344	ENFA	0.00%	2.04%
3T	3	13	3/24/2004	413	PHMI	4.08%	20.41%
3T	3	13	3/24/2004	121	Straw	6.12%	6.12%
3T	3	13	3/24/2004	13	Bare	26.53%	26.53%
3T	3	13	3/24/2004	214	BRMA	4.08%	16.33%
3T	3	13	3/24/2004	250	CAMA	0.00%	2.04%
3T	4	14	3/24/2004	251	CAMA	0.00%	8.00%
3T	4	14	3/24/2004	408	MILA	0.00%	2.00%
3T	4	14	3/24/2004	377	HIIN	2.00%	8.00%
3T	4	14	3/24/2004	289	CACA	2.00%	4.00%
3T	4	14	3/24/2004	414	PHMI	4.00%	28.00%
3T	4	14	3/24/2004	215	BRMA	6.00%	24.00%
3T	4	14	3/24/2004	122	Straw	2.00%	2.00%
3T	4	14	3/24/2004	66	Gravel	44.00%	44.00%
3T	4	14	3/24/2004	14	Bare	38.00%	38.00%
3T	4	14	3/24/2004	347	ERCI	2.00%	4.00%
3T	5	15	3/24/2004	252	CAMA	2.08%	6.25%
3T	5	15	3/24/2004	378	HIIN	6.25%	29.17%
3T	5	15	3/24/2004	415	PHMI	6.25%	45.83%
3T	5	15	3/24/2004	290	CACA	0.00%	4.17%
3T	5	15	3/24/2004	216	BRMA	4.17%	25.00%
3T	5	15	3/24/2004	123	Straw	16.67%	16.67%
3T	5	15	3/24/2004	15	Bare	35.42%	35.42%
3T	5	15	3/24/2004	67	Gravel	29.17%	29.17%
4C	1	16	3/24/2004	16	Bare	46.00%	46.00%
4C	1	16	3/24/2004	68	Gravel	54.00%	54.00%
4C	1	16	3/24/2004	253	CAMA	0.00%	2.00%
4C	2	17	3/24/2004	69	Gravel	82.00%	82.00%

4C	2	17	3/24/2004	439	SAME	2.00%	4.00%
4C	2	17	3/24/2004	303	CEME	0.00%	2.00%
4C	2	17	3/24/2004	254	CAMA	0.00%	2.00%
4C	2	17	3/24/2004	124	Straw	2.00%	2.00%
4C	2	17	3/24/2004	17	Bare	14.00%	14.00%
4C	2	17	3/24/2004	217	BRMA	0.00%	2.00%
4C	3	18	3/24/2004	255	CAMA	0.00%	4.00%
4C	3	18	3/24/2004	18	Bare	36.00%	36.00%
4C	3	18	3/24/2004	70	Gravel	62.00%	62.00%
4C	3	18	3/24/2004	179	Wood	2.00%	2.00%
4C	3	18	3/24/2004	192	ACMI	0.00%	2.00%
4C	4	19	3/24/2004	425	QUBE	0.00%	2.04%
4C	4	19	3/24/2004	256	CAMA	2.04%	4.08%
4C	4	19	3/24/2004	180	Wood	2.04%	2.04%
4C	4	19	3/24/2004	19	Bare	38.78%	38.78%
4C	4	19	3/24/2004	71	Gravel	57.14%	57.14%
4C	5	20	3/24/2004	193	ACMI	1.96%	3.92%
4C	5	20	3/24/2004	20	Bare	39.22%	39.22%
4C	5	20	3/24/2004	305	CEME	0.00%	1.96%
4C	5	20	3/24/2004	73	Gravel	54.90%	54.90%
4C	5	20	3/24/2004	181	Wood	3.92%	3.92%
5C	1	21	3/24/2004	21	Bare	78.00%	78.00%
5C	1	21	3/24/2004	74	Gravel	20.00%	20.00%
5C	1	21	3/24/2004	126	Straw	2.00%	2.00%
5C	1	21	3/24/2004	257	CAMA	0.00%	6.00%
5C	1	21	3/24/2004	379	HIIN	0.00%	2.00%
5C	1	21	3/24/2004	463	MAMA	0.00%	2.00%
5C	2	22	3/24/2004	22	Bare	60.00%	60.00%
5C	2	22	3/24/2004	75	Gravel	38.00%	38.00%
5C	2	22	3/24/2004	178	Stump	2.00%	2.00%
5C	3	23	3/24/2004	219	BRMA	2.00%	2.00%
5C	3	23	3/24/2004	76	Gravel	50.00%	50.00%
5C	3	23	3/24/2004	23	Bare	48.00%	48.00%
5C	4	24	3/24/2004	77	Gravel	42.00%	42.00%
5C	4	24	3/24/2004	127	Straw	4.00%	4.00%
5C	4	24	3/24/2004	220	BRMA	0.00%	2.00%
5C	4	24	3/24/2004	24	Bare	54.00%	54.00%
5C	5	25	3/24/2004	25	Bare	60.00%	60.00%
5C	5	25	3/24/2004	78	Gravel	32.00%	32.00%
5C	5	25	3/24/2004	128	Straw	2.00%	2.00%
5C	5	25	3/24/2004	152	Litter	4.00%	4.00%
5C	5	25	3/24/2004	182	Wood	0.00%	2.00%
5C	5	25	3/24/2004	361	EUCH	2.00%	2.00%
6C	1	26	3/24/2004	221	BRMA	3.92%	17.65%
6C	1	26	3/24/2004	380	HIIN	3.92%	13.73%
6C	1	26	3/24/2004	349	ERCI	1.96%	11.76%
6C	1	26	3/24/2004	291	CACA	0.00%	1.96%
6C	1	26	3/24/2004	204	ARCA	1.96%	3.92%

	6C	1	26	3/24/2004	79	Gravel	7.84%	7.84%
	6C	1	26	3/24/2004	26	Bare	66.67%	66.67%
	6C	1	26	3/24/2004	306	CEME	13.73%	47.06%
	6C	2	27	3/24/2004	27	Bare	30.00%	30.00%
	6C	2	27	3/24/2004	80	Gravel	34.00%	34.00%
	6C	2	27	3/24/2004	222	BRMA	4.00%	20.00%
	6C	2	27	3/24/2004	307	CEME	22.00%	58.00%
	6C	2	27	3/24/2004	350	ERCI	2.00%	10.00%
	6C	2	27	3/24/2004	381	HIIN	6.00%	30.00%
	6C	2	27	3/24/2004	416	PHMI	2.00%	10.00%
	6C	3	28	3/24/2004	197	ADFA	2.08%	4.17%
	6C	3	28	3/24/2004	382	HIIN	4.17%	27.08%
	6C	3	28	3/24/2004	351	ERCI	4.17%	10.42%
	6C	3	28	3/24/2004	417	PHMI	0.00%	4.17%
	6C	3	28	3/24/2004	81	Gravel	22.92%	22.92%
	6C	3	28	3/24/2004	28	Bare	60.42%	60.42%
	6C	3	28	3/24/2004	308	CEME	2.08%	16.67%
	6C	3	28	3/24/2004	223	BRMA	4.17%	25.00%
	6C	4	29	3/24/2004	258	CAMA	2.17%	6.52%
	6C	4	29	3/24/2004	418	PHMI	0.00%	2.17%
	6C	4	29	3/24/2004	309	CEME	13.04%	30.43%
	6C	4	29	3/24/2004	224	BRMA	4.35%	28.26%
	6C	4	29	3/24/2004	82	Gravel	8.70%	8.70%
	6C	4	29	3/24/2004	29	Bare	65.22%	65.22%
	6C	4	29	3/24/2004	383	HIIN	6.52%	36.96%
	6C	5	30	3/24/2004	30	Bare	64.00%	64.00%
	6C	5	30	3/24/2004	311	CEME	10.00%	36.00%
	6C	5	30	3/24/2004	419	PHMI	0.00%	2.00%
	6C	5	30	3/24/2004	384	HIIN	4.00%	26.00%
	6C	5	30	3/24/2004	352	ERCI	2.00%	4.00%
	6C	5	30	3/24/2004	292	CACA	0.00%	2.00%
	6C	5	30	3/24/2004	259	CAMA	2.00%	4.00%
	6C	5	30	3/24/2004	84	Gravel	12.00%	12.00%
	6C	5	30	3/24/2004	225	BRMA	6.00%	22.00%
6/1/2004								
	1T	1	31	6/3/2004 0:00	312	CEME	6.00%	22.00%
	1T	1	31	6/3/2004 0:00	444	VUMY	0.00%	4.00%
	1T	1	31	6/3/2004 0:00	385	HIIN	0.00%	10.00%
	1T	1	31	6/3/2004 0:00	353	ERCI	4.00%	10.00%
	1T	1	31	6/3/2004 0:00	210	BRHO	0.00%	4.00%
	1T	1	31	6/3/2004 0:00	153	Litter	10.00%	10.00%
	1T	1	31	6/3/2004 0:00	130	Straw	14.00%	14.00%
	1T	1	31	6/3/2004 0:00	31	Bare	66.00%	66.00%
	1T	1	31	6/3/2004 0:00	226	BRMA	0.00%	4.00%
	1T	2	32	6/3/2004 0:00	427	QUBE	0.00%	6.00%
	1T	2	32	6/3/2004 0:00	32	Bare	56.00%	56.00%
	1T	2	32	6/3/2004 0:00	445	VUMY	0.00%	2.00%
	1T	2	32	6/3/2004 0:00	386	HIIN	0.00%	4.00%

1T	2	32	6/3/2004 0:00	363	EUCH	0.00%	2.00%
1T	2	32	6/3/2004 0:00	354	ERCI	0.00%	10.00%
1T	2	32	6/3/2004 0:00	313	CEME	4.00%	16.00%
1T	2	32	6/3/2004 0:00	260	CAMA	0.00%	14.00%
1T	2	32	6/3/2004 0:00	227	BRMA	0.00%	8.00%
1T	2	32	6/3/2004 0:00	154	Litter	2.00%	2.00%
1T	2	32	6/3/2004 0:00	131	Straw	38.00%	38.00%
1T	2	32	6/3/2004 0:00	466	HEGR	0.00%	2.00%
1T	2	32	6/3/2004 0:00	339	CRMU	0.00%	2.00%
1T	3	33	6/3/2004 0:00	228	BRMA	0.00%	6.00%
1T	3	33	6/3/2004 0:00	446	VUMY	0.00%	2.00%
1T	3	33	6/3/2004 0:00	387	HIIN	0.00%	2.00%
1T	3	33	6/3/2004 0:00	364	EUCH	0.00%	6.00%
1T	3	33	6/3/2004 0:00	261	CAMA	0.00%	6.00%
1T	3	33	6/3/2004 0:00	132	Straw	22.00%	22.00%
1T	3	33	6/3/2004 0:00	85	Gravel	6.00%	6.00%
1T	3	33	6/3/2004 0:00	33	Bare	70.00%	70.00%
1T	3	33	6/3/2004 0:00	314	CEME	2.00%	22.00%
1T	4	34	6/3/2004 0:00	388	HIIN	0.00%	4.00%
1T	4	34	6/3/2004 0:00	34	Bare	60.00%	60.00%
1T	4	34	6/3/2004 0:00	86	Gravel	2.00%	2.00%
1T	4	34	6/3/2004 0:00	133	Straw	38.00%	38.00%
1T	4	34	6/3/2004 0:00	262	CAMA	0.00%	8.00%
1T	4	34	6/3/2004 0:00	315	CEME	0.00%	24.00%
1T	4	34	6/3/2004 0:00	365	EUCH	0.00%	8.00%
1T	4	34	6/3/2004 0:00	467	HEGR	0.00%	2.00%
1T	4	34	6/3/2004 0:00	340	CRMU	0.00%	2.00%
1T	5	35	6/3/2004 0:00	263	CAMA	2.00%	12.00%
1T	5	35	6/3/2004 0:00	460	MEMI	0.00%	2.00%
1T	5	35	6/3/2004 0:00	440	SAME	0.00%	2.00%
1T	5	35	6/3/2004 0:00	316	CEME	0.00%	16.00%
1T	5	35	6/3/2004 0:00	468	HEGR	0.00%	6.00%
1T	5	35	6/3/2004 0:00	229	BRMA	0.00%	2.00%
1T	5	35	6/3/2004 0:00	134	Straw	28.00%	28.00%
1T	5	35	6/3/2004 0:00	87	Gravel	4.00%	4.00%
1T	5	35	6/3/2004 0:00	35	Bare	66.00%	66.00%
1T	5	35	6/3/2004 0:00	366	EUCH	0.00%	2.00%
2T	1	36	6/3/2004 0:00	264	CAMA	0.00%	37.25%
2T	1	36	6/3/2004 0:00	428	QUBE	1.96%	1.96%
2T	1	36	6/3/2004 0:00	389	HIIN	0.00%	7.84%
2T	1	36	6/3/2004 0:00	317	CEME	3.92%	15.69%
2T	1	36	6/3/2004 0:00	230	BRMA	0.00%	11.76%
2T	1	36	6/3/2004 0:00	155	Litter	1.96%	1.96%
2T	1	36	6/3/2004 0:00	135	Straw	5.88%	5.88%
2T	1	36	6/3/2004 0:00	36	Bare	66.67%	66.67%
2T	1	36	6/3/2004 0:00	88	Gravel	19.61%	19.61%
2T	2	37	6/3/2004 0:00	231	BRMA	0.00%	7.84%
2T	2	37	6/3/2004 0:00	318	CEME	1.96%	33.33%

2T	2	37	6/3/2004 0:00	390	HIIN	0.00%	19.61%
2T	2	37	6/3/2004 0:00	265	CAMA	1.96%	7.84%
2T	2	37	6/3/2004 0:00	156	Litter	15.69%	15.69%
2T	2	37	6/3/2004 0:00	136	Straw	7.84%	7.84%
2T	2	37	6/3/2004 0:00	37	Bare	47.06%	47.06%
2T	2	37	6/3/2004 0:00	89	Gravel	23.53%	23.53%
2T	2	37	6/3/2004 0:00	447	VUMY	1.96%	9.80%
2T	2	37	6/3/2004 0:00	198	ADFA	0.00%	1.96%
2T	3	38	6/3/2004 0:00	448	VUMY	2.00%	6.00%
2T	3	38	6/3/2004 0:00	454	STVI	0.00%	2.00%
2T	3	38	6/3/2004 0:00	429	QUBE	0.00%	4.00%
2T	3	38	6/3/2004 0:00	391	HIIN	0.00%	8.00%
2T	3	38	6/3/2004 0:00	367	EUCH	0.00%	6.00%
2T	3	38	6/3/2004 0:00	319	CEME	4.00%	22.00%
2T	3	38	6/3/2004 0:00	232	BRMA	0.00%	8.00%
2T	3	38	6/3/2004 0:00	157	Litter	8.00%	8.00%
2T	3	38	6/3/2004 0:00	137	Straw	44.00%	44.00%
2T	3	38	6/3/2004 0:00	90	Gravel	12.00%	12.00%
2T	3	38	6/3/2004 0:00	38	Bare	30.00%	30.00%
2T	3	38	6/3/2004 0:00	266	CAMA	0.00%	10.00%
2T	4	39	6/3/2004 0:00	233	BRMA	0.00%	6.00%
2T	4	39	6/3/2004 0:00	455	SOXA	0.00%	4.00%
2T	4	39	6/3/2004 0:00	449	VUMY	0.00%	4.00%
2T	4	39	6/3/2004 0:00	430	QUBE	0.00%	2.00%
2T	4	39	6/3/2004 0:00	392	HIIN	4.00%	24.00%
2T	4	39	6/3/2004 0:00	368	EUCH	0.00%	8.00%
2T	4	39	6/3/2004 0:00	39	Bare	40.00%	40.00%
2T	4	39	6/3/2004 0:00	267	CAMA	2.00%	22.00%
2T	4	39	6/3/2004 0:00	158	Litter	14.00%	14.00%
2T	4	39	6/3/2004 0:00	138	Straw	36.00%	36.00%
2T	4	39	6/3/2004 0:00	91	Gravel	4.00%	4.00%
2T	4	39	6/3/2004 0:00	320	CEME	0.00%	18.00%
2T	5	40	6/3/2004 0:00	322	CEME	0.00%	3.92%
2T	5	40	6/3/2004 0:00	93	Gravel	23.53%	23.53%
2T	5	40	6/3/2004 0:00	469	EMPE	0.00%	1.96%
2T	5	40	6/3/2004 0:00	393	HIIN	0.00%	9.80%
2T	5	40	6/3/2004 0:00	369	EUCH	0.00%	13.73%
2T	5	40	6/3/2004 0:00	40	Bare	43.14%	43.14%
2T	5	40	6/3/2004 0:00	140	Straw	27.45%	27.45%
2T	5	40	6/3/2004 0:00	159	Litter	5.88%	5.88%
2T	5	40	6/3/2004 0:00	269	CAMA	0.00%	21.57%
3T	1	41	6/3/2004 0:00	293	CACA	0.00%	3.92%
3T	1	41	6/3/2004 0:00	458	SACO	0.00%	5.88%
3T	1	41	6/3/2004 0:00	450	VUMY	1.96%	1.96%
3T	1	41	6/3/2004 0:00	394	HIIN	1.96%	17.65%
3T	1	41	6/3/2004 0:00	323	CEME	1.96%	13.73%
3T	1	41	6/3/2004 0:00	234	BRMA	1.96%	17.65%
3T	1	41	6/3/2004 0:00	183	Wood	1.96%	1.96%
3T	1	41	6/3/2004 0:00	160	Litter	25.49%	25.49%

3T	1	41	6/3/2004 0:00	141	Straw	11.76%	11.76%
3T	1	41	6/3/2004 0:00	94	Gravel	13.73%	13.73%
3T	1	41	6/3/2004 0:00	41	Bare	39.22%	39.22%
3T	1	41	6/3/2004 0:00	341	CRMU	0.00%	1.96%
3T	2	42	6/3/2004 0:00	461	MEMI	0.00%	2.00%
3T	2	42	6/3/2004 0:00	294	CACA	0.00%	4.00%
3T	2	42	6/3/2004 0:00	472	HIIN	0.00%	20.00%
3T	2	42	6/3/2004 0:00	420	PHMI	2.00%	8.00%
3T	2	42	6/3/2004 0:00	342	CRMU	0.00%	2.00%
3T	2	42	6/3/2004 0:00	324	CEME	0.00%	6.00%
3T	2	42	6/3/2004 0:00	235	BRMA	6.00%	22.00%
3T	2	42	6/3/2004 0:00	161	Litter	18.00%	18.00%
3T	2	42	6/3/2004 0:00	142	Straw	16.00%	16.00%
3T	2	42	6/3/2004 0:00	95	Gravel	10.00%	10.00%
3T	2	42	6/3/2004 0:00	42	Bare	48.00%	48.00%
3T	2	42	6/3/2004 0:00	270	CAMA	0.00%	8.00%
3T	3	43	6/3/2004 0:00	395	HIIN	2.00%	24.00%
3T	3	43	6/3/2004 0:00	43	Bare	52.00%	52.00%
3T	3	43	6/3/2004 0:00	421	PHMI	2.00%	6.00%
3T	3	43	6/3/2004 0:00	345	ENFA	0.00%	2.00%
3T	3	43	6/3/2004 0:00	325	CEME	0.00%	6.00%
3T	3	43	6/3/2004 0:00	271	CAMA	2.00%	12.00%
3T	3	43	6/3/2004 0:00	184	Wood	0.00%	2.00%
3T	3	43	6/3/2004 0:00	162	Litter	14.00%	14.00%
3T	3	43	6/3/2004 0:00	143	Straw	10.00%	10.00%
3T	3	43	6/3/2004 0:00	96	Gravel	10.00%	10.00%
3T	3	43	6/3/2004 0:00	236	BRMA	8.00%	16.00%
3T	3	43	6/3/2004 0:00	462	MEMI	0.00%	2.00%
3T	4	44	6/3/2004 0:00	163	Litter	12.00%	12.00%
3T	4	44	6/3/2004 0:00	422	PHMI	6.00%	14.00%
3T	4	44	6/3/2004 0:00	409	MILA	0.00%	2.00%
3T	4	44	6/3/2004 0:00	396	HIIN	2.00%	14.00%
3T	4	44	6/3/2004 0:00	326	CEME	0.00%	2.00%
3T	4	44	6/3/2004 0:00	295	CACA	2.00%	2.00%
3T	4	44	6/3/2004 0:00	237	BRMA	6.00%	22.00%
3T	4	44	6/3/2004 0:00	144	Straw	12.00%	12.00%
3T	4	44	6/3/2004 0:00	97	Gravel	10.00%	10.00%
3T	4	44	6/3/2004 0:00	44	Bare	50.00%	50.00%
3T	4	44	6/3/2004 0:00	272	CAMA	0.00%	4.00%
3T	5	45	6/3/2004 0:00	273	CAMA	0.00%	2.00%
3T	5	45	6/3/2004 0:00	238	BRMA	4.00%	26.00%
3T	5	45	6/3/2004 0:00	397	HIIN	0.00%	34.00%
3T	5	45	6/3/2004 0:00	423	PHMI	2.00%	10.00%
3T	5	45	6/3/2004 0:00	145	Straw	14.00%	14.00%
3T	5	45	6/3/2004 0:00	98	Gravel	4.00%	4.00%
3T	5	45	6/3/2004 0:00	45	Bare	58.00%	58.00%
3T	5	45	6/3/2004 0:00	164	Litter	18.00%	18.00%

3T	5	45	6/3/2004 0:00	410	MILA	0.00%	4.00%
4C	1	46	6/3/2004 0:00	46	Bare	32.08%	32.08%
4C	1	46	6/3/2004 0:00	99	Gravel	60.38%	60.38%
4C	1	46	6/3/2004 0:00	185	Wood	3.77%	3.77%
4C	1	46	6/3/2004 0:00	199	ADFA	1.89%	1.89%
4C	1	46	6/3/2004 0:00	274	CAMA	0.00%	18.87%
4C	1	46	6/3/2004 0:00	431	QUBE	0.00%	3.77%
4C	1	46	6/3/2004 0:00	441	SAME	1.89%	1.89%
4C	2	47	6/3/2004 0:00	100	Gravel	54.90%	54.90%
4C	2	47	6/3/2004 0:00	432	QUBE	1.96%	1.96%
4C	2	47	6/3/2004 0:00	275	CAMA	1.96%	21.57%
4C	2	47	6/3/2004 0:00	165	Litter	3.92%	3.92%
4C	2	47	6/3/2004 0:00	47	Bare	37.25%	37.25%
4C	2	47	6/3/2004 0:00	200	ADFA	0.00%	1.96%
4C	3	48	6/3/2004 0:00	48	Bare	34.00%	34.00%
4C	3	48	6/3/2004 0:00	101	Gravel	62.00%	62.00%
4C	3	48	6/3/2004 0:00	166	Litter	2.00%	2.00%
4C	3	48	6/3/2004 0:00	186	Wood	2.00%	2.00%
4C	3	48	6/3/2004 0:00	195	ACMI	0.00%	2.00%
4C	3	48	6/3/2004 0:00	276	CAMA	0.00%	12.00%
4C	3	48	6/3/2004 0:00	433	QUBE	0.00%	4.00%
4C	4	49	6/3/2004 0:00	239	BRMA	3.77%	5.66%
4C	4	49	6/3/2004 0:00	277	CAMA	0.00%	16.98%
4C	4	49	6/3/2004 0:00	451	VUMY	1.89%	1.89%
4C	4	49	6/3/2004 0:00	297	CECR	1.89%	1.89%
4C	4	49	6/3/2004 0:00	434	QUBE	0.00%	7.55%
4C	4	49	6/3/2004 0:00	167	Litter	1.89%	1.89%
4C	4	49	6/3/2004 0:00	102	Gravel	41.51%	41.51%
4C	4	49	6/3/2004 0:00	49	Bare	47.17%	47.17%
4C	4	49	6/3/2004 0:00	187	Wood	1.89%	1.89%
4C	5	50	6/3/2004 0:00	196	ACMI	1.96%	1.96%
4C	5	50	6/3/2004 0:00	473	LOSU	0.00%	1.96%
4C	5	50	6/3/2004 0:00	442	SAME	0.00%	1.96%
4C	5	50	6/3/2004 0:00	435	QUBE	3.92%	13.73%
4C	5	50	6/3/2004 0:00	278	CAMA	3.92%	7.84%
4C	5	50	6/3/2004 0:00	188	Wood	1.96%	1.96%
4C	5	50	6/3/2004 0:00	168	Litter	1.96%	1.96%
4C	5	50	6/3/2004 0:00	104	Gravel	33.33%	33.33%
4C	5	50	6/3/2004 0:00	50	Bare	50.98%	50.98%
4C	5	50	6/3/2004 0:00	298	CECR	1.96%	1.96%
5C	1	51	6/3/2004 0:00	51	Bare	50.00%	50.00%
5C	1	51	6/3/2004 0:00	279	CAMA	1.92%	34.62%
5C	1	51	6/3/2004 0:00	398	HIIN	0.00%	9.62%
5C	1	51	6/3/2004 0:00	436	QUBE	0.00%	1.92%
5C	1	51	6/3/2004 0:00	328	CEME	0.00%	5.77%
5C	1	51	6/3/2004 0:00	241	BRMA	0.00%	1.92%
5C	1	51	6/3/2004 0:00	201	ADFA	0.00%	3.85%
5C	1	51	6/3/2004 0:00	189	Wood	1.92%	1.92%
5C	1	51	6/3/2004 0:00	105	Gravel	38.46%	38.46%
5C	1	51	6/3/2004 0:00	169	Litter	7.69%	7.69%

5C	2	52	6/3/2004 0:00	443	SAME	1.96%	1.96%
5C	2	52	6/3/2004 0:00	52	Bare	50.98%	50.98%
5C	2	52	6/3/2004 0:00	106	Gravel	43.14%	43.14%
5C	2	52	6/3/2004 0:00	190	Wood	1.96%	1.96%
5C	2	52	6/3/2004 0:00	280	CAMA	0.00%	21.57%
5C	2	52	6/3/2004 0:00	399	HIIN	1.96%	7.84%
5C	3	53	6/3/2004 0:00	281	CAMA	2.00%	28.00%
5C	3	53	6/3/2004 0:00	170	Litter	6.00%	6.00%
5C	3	53	6/3/2004 0:00	107	Gravel	50.00%	50.00%
5C	3	53	6/3/2004 0:00	53	Bare	42.00%	42.00%
5C	4	54	6/3/2004 0:00	54	Bare	48.00%	48.00%
5C	4	54	6/3/2004 0:00	108	Gravel	40.00%	40.00%
5C	4	54	6/3/2004 0:00	171	Litter	4.00%	4.00%
5C	4	54	6/3/2004 0:00	202	ADFA	0.00%	2.00%
5C	4	54	6/3/2004 0:00	242	BRMA	0.00%	2.00%
5C	4	54	6/3/2004 0:00	282	CAMA	6.00%	20.00%
5C	4	54	6/3/2004 0:00	299	CECR	2.00%	2.00%
5C	5	55	6/3/2004 0:00	437	QUBE	0.00%	2.00%
5C	5	55	6/3/2004 0:00	474	CEBE	0.00%	2.00%
5C	5	55	6/3/2004 0:00	400	HIIN	0.00%	8.00%
5C	5	55	6/3/2004 0:00	371	EUCH	0.00%	2.00%
5C	5	55	6/3/2004 0:00	172	Litter	2.00%	2.00%
5C	5	55	6/3/2004 0:00	55	Bare	88.00%	88.00%
5C	5	55	6/3/2004 0:00	109	Gravel	10.00%	10.00%
5C	5	55	6/3/2004 0:00	283	CAMA	0.00%	8.00%
6C	1	56	6/3/2004 0:00	243	BRMA	10.00%	12.00%
6C	1	56	6/3/2004 0:00	459	PHACsp	0.00%	2.00%
6C	1	56	6/3/2004 0:00	401	HIIN	2.00%	24.00%
6C	1	56	6/3/2004 0:00	355	ERCI	0.00%	2.00%
6C	1	56	6/3/2004 0:00	56	Bare	62.00%	62.00%
6C	1	56	6/3/2004 0:00	329	CEME	4.00%	22.00%
6C	1	56	6/3/2004 0:00	173	Litter	14.00%	14.00%
6C	1	56	6/3/2004 0:00	151	Rock	2.00%	2.00%
6C	1	56	6/3/2004 0:00	110	Gravel	6.00%	6.00%
6C	1	56	6/3/2004 0:00	343	CRMU	0.00%	2.00%
6C	2	57	6/3/2004 0:00	330	CEME	4.00%	30.00%
6C	2	57	6/3/2004 0:00	402	HIIN	0.00%	22.00%
6C	2	57	6/3/2004 0:00	111	Gravel	8.00%	8.00%
6C	2	57	6/3/2004 0:00	356	ERCI	2.00%	8.00%
6C	2	57	6/3/2004 0:00	424	PHMI	0.00%	2.00%
6C	2	57	6/3/2004 0:00	174	Litter	26.00%	26.00%
6C	2	57	6/3/2004 0:00	57	Bare	56.00%	56.00%
6C	2	57	6/3/2004 0:00	244	BRMA	2.00%	16.00%
6C	2	57	6/3/2004 0:00	205	AVENsp	2.00%	6.00%
6C	3	58	6/3/2004 0:00	58	Bare	58.00%	58.00%
6C	3	58	6/3/2004 0:00	112	Gravel	4.00%	4.00%
6C	3	58	6/3/2004 0:00	175	Litter	24.00%	24.00%
6C	3	58	6/3/2004 0:00	203	ADFA	2.00%	2.00%

6C	3	58	6/3/2004 0:00	245	BRMA	6.00%	16.00%
6C	3	58	6/3/2004 0:00	331	CEME	6.00%	24.00%
6C	3	58	6/3/2004 0:00	403	HIIN	0.00%	24.00%
6C	4	59	6/3/2004 0:00	176	Litter	26.00%	26.00%
6C	4	59	6/3/2004 0:00	470	BRDI	0.00%	2.00%
6C	4	59	6/3/2004 0:00	404	HIIN	2.00%	30.00%
6C	4	59	6/3/2004 0:00	332	CEME	6.00%	28.00%
6C	4	59	6/3/2004 0:00	246	BRMA	10.00%	22.00%
6C	4	59	6/3/2004 0:00	59	Bare	52.00%	52.00%
6C	4	59	6/3/2004 0:00	284	CAMA	4.00%	8.00%
6C	5	60	6/3/2004 0:00	405	HIIN	0.00%	28.00%
6C	5	60	6/3/2004 0:00	60	Bare	60.00%	60.00%
6C	5	60	6/3/2004 0:00	114	Gravel	8.00%	8.00%
6C	5	60	6/3/2004 0:00	177	Litter	16.00%	16.00%
6C	5	60	6/3/2004 0:00	206	AVENsp	0.00%	2.00%
6C	5	60	6/3/2004 0:00	247	BRMA	6.00%	16.00%
6C	5	60	6/3/2004 0:00	286	CAMA	2.00%	10.00%
6C	5	60	6/3/2004 0:00	296	CACA	0.00%	2.00%
6C	5	60	6/3/2004 0:00	334	CEME	8.00%	24.00%

Appendix M. Complete list of species identified on both granitic and gabbro parent materials at Viejas Mountain (Cedar Fire)

Species list

CoverCategory	Genus	SpecEpi	Family	Genus2	SpecEpi2	Code2	CommonName
YUCCsp	Yucca	sp	Agavaceae				
ADFA	Adenostoma	fasciculatum	Rosaceae				Chamise
ALHA	Allium	haematochiton	Liliaceae	Allium	marvinii		Redskin onion
ALLIsp	Allium	sp	Liliaceae				
ALLOsp	Allophyllum	sp	Polemoniaceae				False gilyflower, falsegilia
ANAR	Anagallis	arvensis	Primulaceae				Scarlet pimpernel
SACOul	Sairocarpus	coulterianus	Scrophulariaceae	Antirrhinum	coulterianum	ANCO	Coulter's snapdragon
NEST	Neogaerrhinum	strictum	Scrophulariaceae	Neogaerrhinum	strictum	ANKE	Kellog snapdragon
SANU	Sairocarpus	nuttalianus	Scrophulariaceae	Antirrhinum	nuttalianum	ANNU	Violet snapdragon/toad's-mouth
ANTIsp	Antirrhinum	sp	Scrophulariaceae				
APAN	Apiastrum	angustifolium	Apiaceae				
ARGL	Arctostaphylos	glandulosa	Ericaceae				Eastwood's manzanita
AVENsp	Avena	sp	Poaceae				Oat(s)
BRMA	Bromus	rubens	Poaceae	Bromus	madritensis	BRMA	Foxtail/red brome
CACA	Camissonia	californica	Onagraceae				
CAHI	Camissonia	hirtella	Onagraceae				Santa Cruz Island suncup
CAKO	Calamagrostis	koelerioides	Poaceae	Calamagrostis	densa	CADE	Fire reedgrass
CAMA	Calystegia	macrostegia	Convolvulaceae				Island false bindweed
CAWE	Calochortus	weedii	Liliaceae				Weed's mariposa lily

CECR	Ceanothus	crassifolius	Rhamnaceae				Hoaryleaf ceanothus
CEOL	Ceanothus	oliganthus	Rhamnaceae				Hairy ceanothus
CHAR	Chaenactis	artemisiifolia	Asteraceae				White pincushion
CHFI	Choricanthe	fimbriata					
CHPO	Chlorogalum	pomeridianum	Liliaceae				Wavyleaf soap plant
CLPE	Claytonia	perfoliata	Portulaceae				Miner's lettuce
CNDU	Cneoridium	dumosum	Rutaceae	Pitavia	dumosa	PIDU	Bush rue
CRIN	Cryptantha	intermedia	Boraginaceae				Clearwater catseye/cryptantha, common cryptantha
CRMU	Cryptantha	muricata	Boraginaceae				Pointed catseye/cryptantha, prickly cryptantha
CRYPsp	Cryptantha	sp	Boraginaceae				Cryptantha
DECA	Delphinium	cardinale	Ranunculaceae				Scarlet larkspur
DELPsp	Delphinium	sp	Ranunculaceae				Larkspur
EHCH	Ehrendorferia	chrysantha	Fumariaceae	Dicentra	chrysantha	DICH	Golden eardrops
DICHsp	Dicholostemma	sp					
ERCO	Eriophyllum	confertiflorum	Asteraceae				Golden/yellow yarrow
ERCR	Eriodictyon	crassifolia	Hydrophyllaceae				Thickleaf yerba santa
ERFO	Erigeron	foliosus	Asteraceae				Leafy fleabane
EUCH	Eucrypta	chrysanthemifolia	Hydrophyllaceae				Common Eucrypta, spotted hideseed
LOGA	Logfia	gallica	Asteraceae	Filago	gallica	FIGA	Narrowleaf cottonrose
GAVE	Garrya	veatchii	Garryaceae				Canyon silktassel
PSCA	Pseudognaphalium	californicum	Asteraceae	Gnaphalium	californicum	GNCA	Ladies' tobacco
HASQsq	Hazardia	squarrosa	Asteraceae	Haplopappus	squarrosus	HASQ	Sawtooth goldenbush
HEAR	Heteromeles	arbutifolia	Rosaceae				Toyon
HEFA	Hemizonia	fasciculata	Asteraceae	Hemizonia	ramosissima	HERA	Clustered tarweed
HEGR	Helianthus	gracilentus	Asteraceae				Slender sunflower
HEMI	Hesperolinon	micranthum	Linaceae				Smallflower dwarf-flax
HESC	Helianthemum	scoparium	Cistaceae				Bisbee Peak rushrose
HIIN	Hirschfeldia	incana	Brassicaceae	Brassica	geniculata	BRGE	Shortpod mustard
HYGL	Hypochoeris	glabra					
LOFO	Lomatium	foeniculaceum	Apiaceae				(Desert) biscuit root, carrot-leaf desert-parsley
LOSC	Lotus	scoparius	Fabaceae				Common deerweed
LOST	Lotus	strigosus	Fabaceae				Strigose bird's foot trefoil, Bishop's lotus
LOSU	Lonicera	subspicata	Caprifoliaceae				Southern honeysuckle
MALA	Malosma	laurina	Anacardiaceae	Rhus	laurina	RHLA	Laurel sumac
MALAsp	Malacothamnus	sp	Malvaceae				Bush mallow
MIDI	Mimulus	diffusus	Scrophulariaceae	Mimulus	grantianus	MIGR	Palomar monkeyflower
NAAT	Navarretia	actractyloides	Polemoniaceae				Hollyleaf pincushionplant
NAVAsp	Navarretia	sp	Polemoniaceae				Navarretia, pincushionplant
PACA	Papaver	californicum	Papaveraceae	Papaver	lemmonii	PALE	Fire/western poppy
PHBR	Phacelia	brachyloba	Hydrophyllaceae				Shortlobe phacelia
PHCI	Phacelia	cicutaria	Hydrophyllaceae				Caterpillar phacelia
PHMI	Phacelia	minor	Hydrophyllaceae	Phacelia	whitlavia	PHWH	Wild Canterbury bells

PLAGsp	Plagiobothrys	sp	Boraginaceae				Popcorn flower
PLCO	Plagiobothrys	collinus	Boraginaceae				Cooper's popcorn flower
PTDR	Pterostegia	drymarioides	Polygonaceae				Woodland pterostegia/threadstem
QUBE	Quercus	berberidifolia	Fagaceae				Scrub oak
RHCR	Rhamnus	crocea	Rhamnaceae				Hollyleaf/redberry buckthorn
RHOV	Rhus	ovata	Rhamnaceae				Sugar sumac
SAAP	Salvia	apiana	Lamiaceae				White sage
SACO	Salvia	columbariae	Lamiaceae				Chia
SAME	Salvia	mellifera	Lamiaceae				Black sage
SANIca	Sambucus	nigra ssp canadensis	Caprifoliaceae	Sambucus	mexicana	SAMEx	Mexican/common elderberry
SCTU	Scutellaria	tuberosa	Lamiaceae				Danny's skullcap
SIMU	Silene	multinervia	Caryophyllaceae				Manynerve catchfly
SOLAsp	Solanum	sp	Solanaceae				Nightshade
NALE	Nassella	lepida	Poaceae	Stipa	lepida	STLE	Smallflower tussockgrass
TRPA	Trichostema	parishii	Lamiaceae				Parish's bluecurls
UnkForb							
VUMY	Vulpia	myuros	Poaceae	Festuca	myuros	FEMY	Foxtail/rattail fescue
XYBI	Xylococcus	bicolor	Ericaceae	Arctostaphylos	bicolor	ARBI	Mission manzanita
ZIFR	Zigadenus	fremontii	Liliaceae				Fremont's deathcamas