sandstones have a similar distribution in both watersheds. Both sites have a relatively natural landscape except for an urban boundary along their upper perimeters. Drainage areas for each site were calculated above the lowest downstream check dam.

The CCRP watershed has a drainage area of 0.16 km^2. After the fire ~80% of the drainage area was treated with hydromulch and soil sealant. The vegetation is largely chaparral (predominantly *Baccharis pilularis*), northern coastal scrub (Ornduff 1974) and eucalyptus groves. A continuous gully emanating from road drains and extending through the entire watershed has deeply incised the intermittent channel (Fig. 2). In its upper reaches exposed bedrock indicated minimal sediment storage prior to bale installation. One dirt trail (~1 km) traverses the uppermost canyon below the urban boundary, but it has been abandoned since the early 1970's.

The NOSC watershed has a drainage area of 0.31 km^2. Treated soils covered ~95% of the drainage area. An extensive gully network has also formed in this watershed from problems associated with road runoff. The natural portion of the landscape is zig-zagged by ~2 km of dirt road that receives current use. Most of the vegetation is eucalyptus and to a lesser extent oak/bay woodland. In the central portion of the watershed

Figure 2. Photograph of gully in the CCRP site. The tape measure at the top of the gully indicates one of our cross sections.

Figure 3. Central portion of the NOSC site. Note erosion associated with the dirt road, which was not protected with erosion control measures, even though most of the watershed was aerial seeded, seeded with hydromulch (mixed with soil sealand) and straw bales were added to all the gullies and landslides.

most of the eucalyptus trees were cut (but not killed) about two years prior to the fire (Fig. 3). The NOSC site has a broad flat valley that was created by fill from the excavation of Caldecott Tunnel. At the upper end of the valley fill, at the apex where upland gullies are intersected, a new alluvial fan has developed over the last few decades. Six rows of straw bale barriers (n = 112 bales) were placed on the fan to enhance natural sediment deposition, limit its spread onto the sports green at the lower end of the valley fill, and reduce downstream sedimentation to Lake Temescal.

Results and Discussion: Performance of Straw Bale Dams

We evaluated the different applications of straw bales after each major rain storm during the 1991-92 wet season. Sediment was never removed from any of the dams or barriers in either watershed or throughout much of the total burn area. Likewise, decomposing bales were not removed from the wildlands, but they were removed along the urban roadsides.

Gullies

In total, the conditions of nearly 440 straw bale check dams situated in channels and over 100 straw bale barriers located on landslides and steep slopes were evaluated during the middle and end of the rainy season (mid February and end of March). At both times their condition was rated as: (1) side cut (water flowed around the dam thereby minimizing sediment storage); (2) undercut (water flowed beneath the dam also minimizing sediment storage); (3) filled but cut (dam may have partially or totally filled with sediment but stored sediment was subsequently cut and remobilized); (4) moved (dam was blown-out by high flows, no sediment storage); (5) filled (considered functioning but unable to store any additional sediment); and (6) unfilled (also considered functioning). The filled and unfilled dams were combined as 'functioning properly', the others were combined as 'failed' (Fig. 4).

The results of the check dam analysis are shown in Figure 5a and b. By the third month after the bales were installed only 43% of the straw bale dams in CCRP and 46% in the NOSC were functioning to reduce the

Figure 4. Photograph of straw bales in various conditions within the CCRP watershed.

erosion potential. About 60% (330 mm) of the total rainfall (since the bale installation) had already occurred. After 4.5 months (end of March) a respective 43% and 37% were functioning. The reason the number of functioning dams In CCRP did not change may have been due to the plugging of holes and repairing of dams by labor crews after the February storms. Repairs on other straw bale dams within gullies were not consistently observed In NOSC. Crews from the California Conservation Corps (CCC) inspected some of the bales in the gullies of NOSC in early February (David Jaramillo, CCC, personal communication) Some of the bales were replaced with sandbags at the dirt road crossings but repairs in gullies were minimal.

Alluvial fan

After 2.5 months the straw bale barriers on the alluvial fan showed significant deterioration. Others had been displaced by flows that exceeded the strength of the wooden stakes to hold them in place. They were

Figure 7. Check dam with two edge bales placed on end.

disproportionately large impacts to downstream resources and habitats by their direct supply and transport of large quantities of sediment. Likewise, their short-term sediment remediation with bales has accrued a disproportionately large amount of expense compared to resolving long-term sediment production. The 'ideal' solution is to fix the road runoff problems that are causing the erosion. But when such long-term solutions cannot be funded, rather than using bales for temporary sediment abatement, semi-permanent sediment basins (with access for clean-out) could provide a more cost-effective solution to deal with both long and short-term erosion associated with roads, fire, and post-fire construction.

Erosion from construction sites in the Lake Temescal watershed during the 1970's was reported as 46.0 mm per site (East Bay Regional Park District 1981). This implies that during the several years of post-fire reconstruction, erosion rates could be significantly greater than those just following fire. Clearly, intensive erosion control at construction sites is prudent, especially when hundreds of structures are being rebuilt within a single watershed and when these activities are permitted throughout the rainy season to hasten community recovery. We considered sediment production and downstream impacts to be more severe during the second winter from the combined effects of construction erosion and released sediment from thousands of decomposing bales.

Wildlands and Construction Sites: Where are Straw Bales Appropriate?

The standard use of straw bales has typically been for construction sites where they can effectively provide an inexpensive means to temporarily maintain sediment on site and restrict it from channels. Usually, access for supplying and cleaning-out bales at construction sites is easily accommodated, future landscaping is pending, and sediment retention basins are engineered to capture sediment missed by temporary measures. In wildland sites, however, access for supplying straw bales may be hampered by remoteness of the site, lack of roads, and steep rugged terrain. In Orange County for example, straw bales were dropped to ground crews by helicopter, because there was no other feasible access into the wildlands. The cost of