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Title

Progress Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities

Status of Burned Area Rehabilitation Two Years Postfire

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Credit: Cerro Grande BAER Monitoring, USDA Forest Service

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Cover photo: October 2002, watershed divide between Pueblo and Quemazon Canyons three growing seasons after the Cerro Grande Fire. Area in foreground was treated by aerial seeding only while the background received aerial seeding and a straw mulch application.

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CONTENTS

LIST OF ACRONYMS

ANOVA	analysis of variance between groups
BART	Burned Area Rehabilitation Tracking
CGRP	Cerro Grande Rehabilitation Project
DOE	Department of Energy
FWO-IP	Facility & Waste Operations Division – Infrastructure Projects
GIS	geographic information system
GPS	global positioning system
LANL	Los Alamos National Laboratory
PRS	potential release site
RRES-DO	Risk Reduction and Environmental Stewardship Division – Division Office
RRES-ECO	Risk Reduction and Environmental Stewardship Division – Ecology Group
RRES-WQH	Risk Reduction and Environmental Stewardship Division – Water Quality and Hydrology Group
RUSLE	Revised Universal Soil Loss Equation

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SUMMARY

This is the second report on the annual monitoring conducted on the rehabilitation treatments installed to mitigate the effects of the Cerro Grande Fire of 2000. The Cerro Grande Fire had an enormous adverse impact on forests on and around Los Alamos National Laboratory (LANL). Immediately there were concerns about increased erosion and flooding and the potential impacts on contaminated soil and sediment. Seventy-seven contaminant potential release sites (PRSs) and two nuclear facilities at LANL that contain hazardous and radioactively contaminated soils and materials were located within floodplain areas. Without Department of Energy (DOE) action, these PRSs and nuclear facilities could potentially have released contaminants and materials downstream during rainfall events. Numerous cultural resource sites and traditional cultural properties were located in canyons or along drainage areas. These were now at increased risk of flood damage.

An Emergency Rehabilitation Plan was created to evaluate and estimate the impacts of the Cerro Grande Fire on LANL property, design appropriate mitigation methods for erosion and increased runoff, and implement these methods to prevent further damage to people, property, and the environment.

The Laboratory conducted assessments and implemented all on-the-ground rehabilitation efforts. Under the DOE Special Environmental Analysis, the Laboratory was to conduct mitigation methods and monitor annually the condition of the burned area. In all, LANL treated over 728 ha (1,800 ac) with techniques similar to those used by the Burned Area Emergency Rehabilitation team (BAER 2000). Results from the first year (2001) indicated that the project was successful; increasing vegetative cover on the severely burned units from around 0% to almost 45%. Most of the straw wattles that were installed have held sediment on site and allowed vegetation to grow. Out of 40 rehabilitation units only five required additional work in FY 2002. During the second year (2002), the drought and other factors decreased vegetative cover to around 38%.

This work was funded through emergency funds provided to DOE and LANL to remediate damage and address demonstrated vulnerabilities associated with the Cerro Grande Fire. Two separate initiatives were responsible for implementation of this work: the Emergency Rehabilitation Team addressed emergency and urgent actions to recover from the fire and the Cerro Grande Rehabilitation Project addressed near- and long-term activities required for LANL to fully recover from the Cerro Grande Fire.

1.0 INTRODUCTION

The Cerro Grande Fire of May 2000 burned approximately 2,830 ha (7,000 ac) of Los Alamos National Laboratory (LANL) property. Shortly after the fire an Emergency Rehabilitation Plan was created to evaluate and estimate the impacts of the Cerro Grande Fire on LANL property, design appropriate mitigation methods for erosion and increased runoff, and implement these methods to prevent further damage to people, property, and the environment. Since that time the Cerro Grande Rehabilitation Project (CGRP) has assumed the role of the Emergency Rehabilitation Team. Extensive background information, including impacts of the fire on vegetation and soils, and initial rehabilitation treatments, are discussed in Buckley et al. (2002). In all, 385 ha (950 ac) of LANL property were treated by hand following the Cerro Grande Fire. Of these 385 ha (950 ac), 240 ha (599 ac) are monitored under the Burned Area Rehabilitation Tracking (BART) system. Four surveys, spring and fall 2001 and spring and fall 2002, have been conducted over the past two years.

This report details monitoring results of the Emergency Rehabilitation Team and the CGRP over the last two years (2001-2002). The Laboratory has been directed by the Department of Energy through the Special Environmental Analysis (DOE 2000) to conduct assessments, implement mitigation measures, and monitor annually the condition of the rehabilitated areas. Burned area assessments and treatment implementation were accomplished within months after the fire. The BART system was developed to monitor soil and vegetation conditions on rehabilitated sites. The BART system is a geographic information system (GIS)-based tracking and monitoring system designed to organize the monitoring data to more efficiently generate reports needed to evaluate the status and trend of treatment units.

2.0 METHODS

Postfire rehabilitation treatments were designed to stabilize soils, decrease runoff and sediment transport, increase infiltration of precipitation, and provide a suitable microhabitat for plant growth. Rehabilitation treatments included contour felling, raking, wattles and rock and log check dams. Specific rehabilitation treatments are described in Buckley et al. (2002).

2.1 Burned Area Rehabilitation Tracking (BART) System

The BART system was developed as a GIS-based tracking and monitoring data management system. BART provides easy access to information used to generate reports on treatment area status and trend. In addition, in-field recommendations for additional work are recorded and tracked.

A global positioning system (GPS) unit was used to document and map the burned area boundaries and the associated treatments. Treatment areas were broken into units and the boundaries were mapped (Fig. 1). Additional information was collected on the treatment types, amounts of materials used, and crew identification.

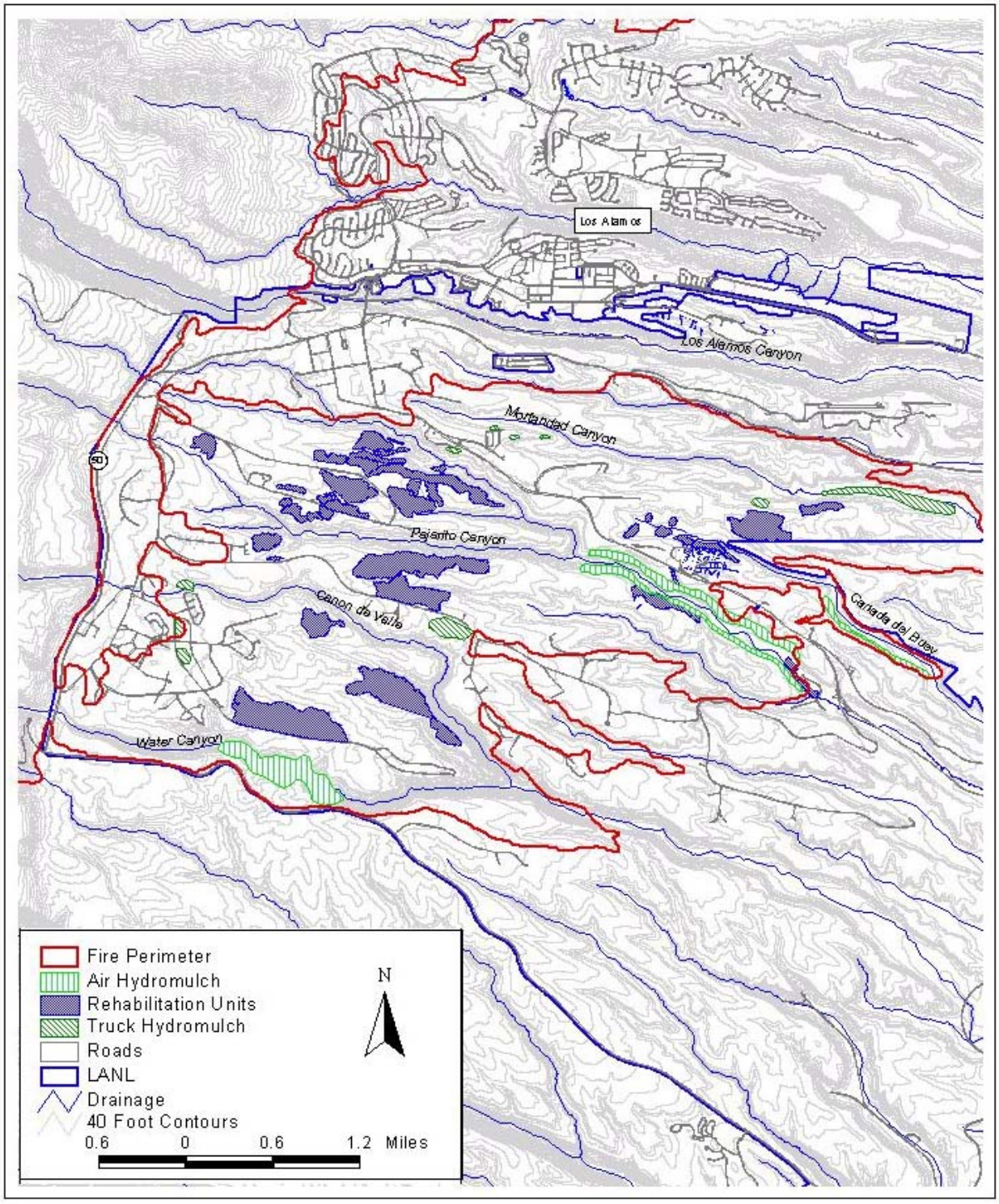


Figure 1. Rehabilitation units at LANL.

A field form was developed to standardize the type of information collected when monitoring and assessing the treatment units (Buckley et al. 2002). Percent total ground cover (vegetation, litter, straw, wattles, logs, etc.) and percent vegetation cover are estimated in each rehabilitation unit. Observers walk throughout the unit estimating these two measurements using a square meter as a point of reference. Percentages are averaged for the entire unit and recorded on the data sheet.

Additional information collected includes condition of treatment unit, estimated percent of ground cover, additional work required, maintenance requirements, etc. Completed monitoring forms were entered into a database, and maintenance reports were generated based on the type of repair or additional treatment needed in the rehabilitation area. In addition, photo points were established within each treatment unit to document the dominant landscape vegetation. Digital photos were taken during each assessment. Comparison of photos of the same site over time will provide visual evidence of vegetation changes and site recovery.

Areas needing treatment that were not treated previously were identified and the locations were recorded with GPS. Based on the findings of the BART surveys, areas needing additional work will be prioritized and rehabilitation work will be completed.

BART data are analyzed for statistical significance using analysis of variance (ANOVA) and independent samples t-test procedures on SPSS 11.0. The univariate ANOVA procedure is used instead of a repeated-measures ANOVA because of problems with missing data.

2.2 Revised Universal Soil Loss Equation

Potential surface erosion rate from thinned and unthinned BART units were calculated using the Revised Universal Soil Loss Equation (RUSLE) (Renard et al. 1997). The RUSLE estimates potential surface erosion from a site in tons/acre/year based upon the soil type, amount of ground cover, slope, slope length, and rainfall intensity. The traditional Universal Soil Loss Equation was developed for agricultural areas (row crops) in the east and midwest, and contains a cropping factor (C) and erosion control factor (P) not applicable to rangeland conditions. The RUSLE has been modified for use on western range by replacing the C and P values with a vegetation management (VM) factor that accounts for vegetative cover such as canopy cover, effects of low-growing vegetation with mulch and litter, and bare ground on rangelands.

The RUSLE was conducted on three BART units, a unit that received postfire thinning treatments (Unit 1), an unthinned unit (Unit 2), and a Control unit to determine the potential surface erosion rates based upon our field conditions. Soil type for the calculations was obtained from LANL soil survey maps (Nyhan et al. 1978), ground cover was obtained from BART survey data, slope and slope length were measured on randomly selected transects in the field, and the rainfall intensity was obtained from Natural Resource Conservation Service maps.

2.3. Photo Point Monitoring

In addition to collecting information about the condition of the rehabilitation treatments, 44 photo points were created in or near the BART units to track landscape changes in vegetation over time. Photo point monitoring allows for quick inexpensive documentation of vegetative change over time. Photo point locations were selected to capture a view of the BART unit that included rehabilitation techniques. Stumps from felled trees were most often chosen for a landmark to take the photos from. At most photo points, two photos were taken. For each photo, a compass was used to determine the direction that the photo was taken. The location of the photo point was recorded with GPS and an aluminum tag recording the photo point number and compass direction. GPS locations were saved as waypoints in the GPS so that each photo point could be navigated to and photos retaken. Example photo point photos are reproduced in Section 3.3.

3.0 RESULTS

3.1 BART

Previous BART survey results show that there were no significant changes in percent total ground cover and percent vegetative cover on the rehabilitation units between summer 2001 and fall 2001 (Buckley et al. 2002). Between fall 2001 and summer 2002 percent total cover increased while percent vegetation cover decreased (Fig. 2). Neither change was significant. This trend might be expected as green vegetation dies over the winter and contributes to the litter cover. However, both ground cover and vegetation cover decreased between summer 2002 and fall 2002. Again, neither change was statistically significant, but this reduction was unexpected. There are two likely explanations for this observed response. One, the summer/fall of 2002 was very dry and little precipitation was recorded before October, leaving little time for herbaceous vegetation response. Obviously, the lack of rain should have less effect on total cover than vegetation cover. Secondly, there have been extensive thinning activities on some of the rehabilitation units. Thinning has occurred on 125 ha (310 acres) of the 242 ha (599 acres), or 51%, of the total area that received rehabilitation treatments. In most cases trees were cut on the site and chipped or skidded off site. In some cases all of the ground cover, including the rehabilitation treatments, was removed from the site. Figure 3 shows significant differences in total and vegetation cover between thinned and unthinned rehabilitation units. Total cover was approximately 25% less and vegetation cover was approximately 15% less on thinned sites. Much of these differences may be due to the timing of the thinning activities and the rehabilitation surveys. Surveys may have been conducted before the thinning crews had a chance to implement secondary rehabilitation treatments. At this time, the CGRP plans to complete all thinning and rehabilitation activities by September 30, 2003. Monitoring and maintenance will continue as a component of long-term management of these sites.

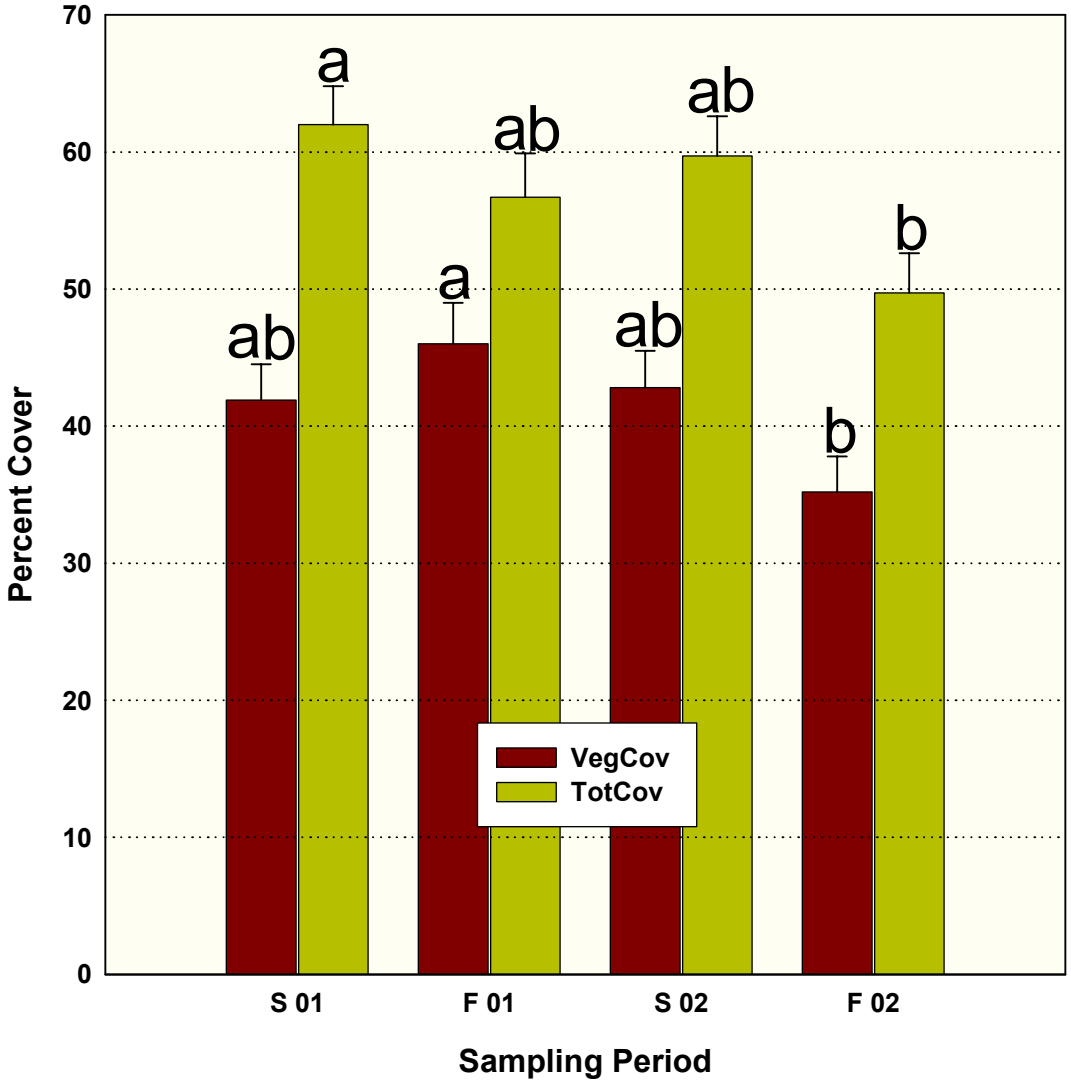


Figure 2. Changes in total and vegetation cover (%) on LANL rehabilitation units. Columns topped with the same letter (within a cover type) are not significantly different ($p \leq 0.05$). According to the ANOVA test, the only significant difference between samples was summer 2001 (S 01) and fall 2002 (F 02) for total cover and fall 2001 (F 01) and fall 2002 (F 02) for vegetative cover. Sampling periods are summer 2001 (S 01), fall 2001 (F 01), summer 2002 (S 02), and fall 2002 (F 02).

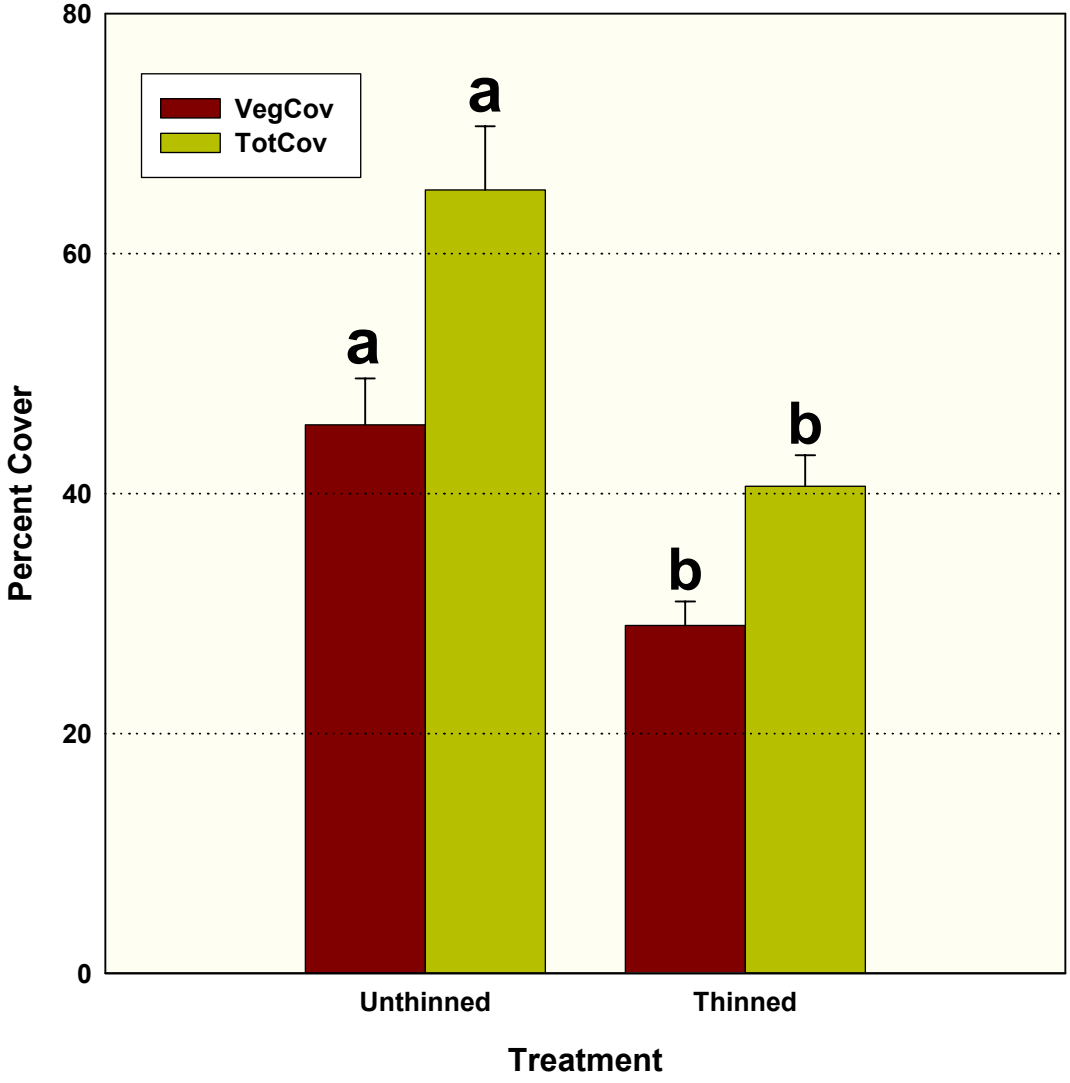


Figure 3. Differences in total cover and vegetation cover between thinned and unthinned BART units. Samples (within a cover type) were significantly different ($p \leq 0.05$) between unthinned and thinned areas.

3.2 Revised Universal Soil Loss Equation

The RUSLE was conducted on three BART units to determine the potential surface erosion rates based upon our field conditions. All three units are located in ponderosa pine forest at an elevation of approximately 2,100 m (7000 ft). Units 1 and 2 received Burned Area Emergency Rehabilitation treatments immediately after the fire; the Control unit was left untreated. In 2002, Unit 1 and the Control unit were thinned and skidded using equipment with rubber tires. Unit 2 was not thinned due to steep slopes preventing access.

	Unit 1	**Unit 2**	**Control Unit**
RUSLE	0.7 *Tons/Acre/Year*	0.2 *Tons/Acre/Year*	4.6 *Tons/Acre/Year*
Ground Cover	40%	60%	20%
Veg. Cover	35%	45%	6 %
Slope	12%	22%	17%

Erosion rates estimated by RUSLE are below the maximum soil loss tolerance of less than 5 tons/acre/year by the Natural Resources Conservation Service (Pimentel, 1993). However, this value of soil loss tolerance is normally applied to rangeland and cropland situations and may not be applicable to the forest setting of the BART units. Additional RUSLE surveys were not conducted because the three units surveyed were judged to be representative of conditions found on other BART units. Ground cover established by post fire rehabilitation activities at LANL appears to be sufficient for erosion control at this time.

3.3 Photo Point Monitoring

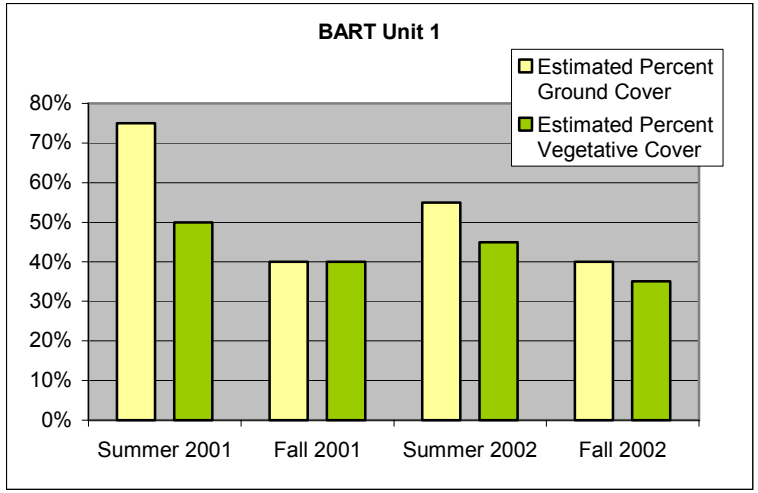
The following pages illustrate some of the postfire changes in vegetation on BART units over the past two years. BART Units 1, 2, 22, and 33 were chosen as a representative sample of the rehabilitation units. Changes in vegetation are apparent in the photos. Units 1, 22, and 33 were located in areas that the CGRP thinned for fire protection. The figures in the bottom right corners show results of BART vegetation and total cover sampling. There are no cover data for the summer 2000 photos.

Changes in Vegetation Over Two Years on BART Unit 1, LANL TA-06

BART Unit 1, July 2000

BART Unit 1, June 2001

BART Unit 1, October 2002

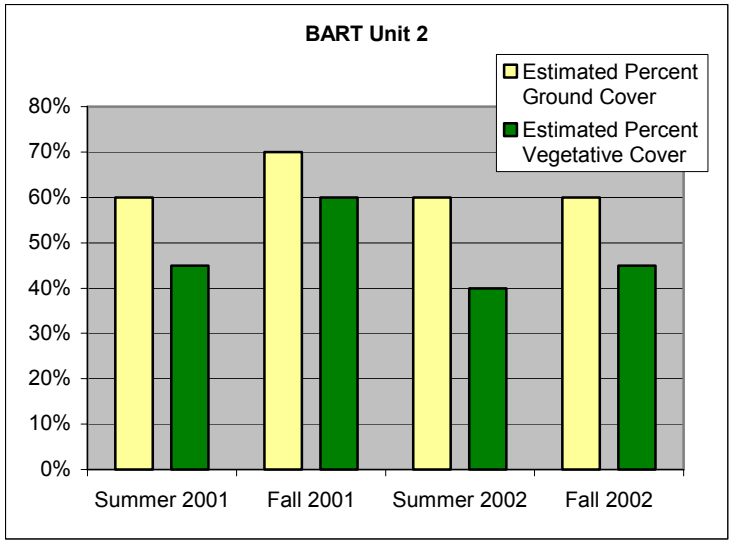


Changes in Vegetation Over Two Years on BART Unit 2, LANL TA-06

BART Unit 2, July 2000

BART Unit 2, June 2001

BART Unit 2, October 2002

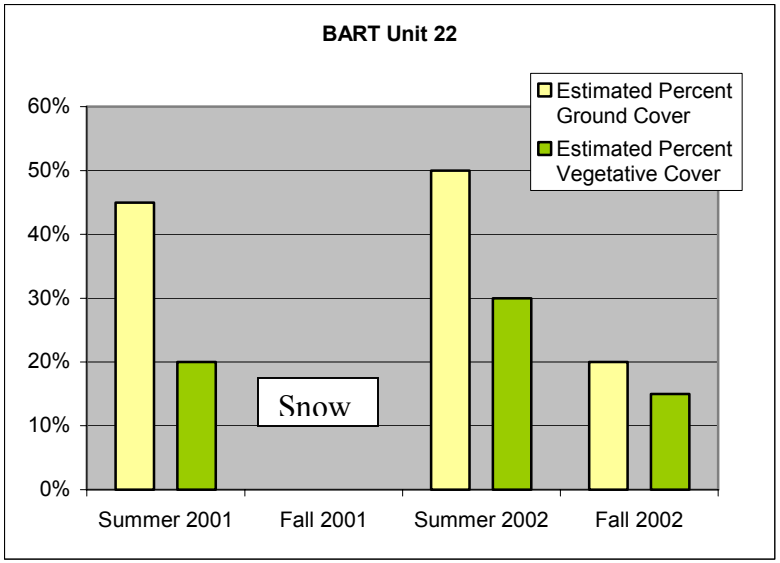


Changes in Vegetation Over Two Years on BART Unit 22, LANL TA-46

BART Unit 22, September 2000

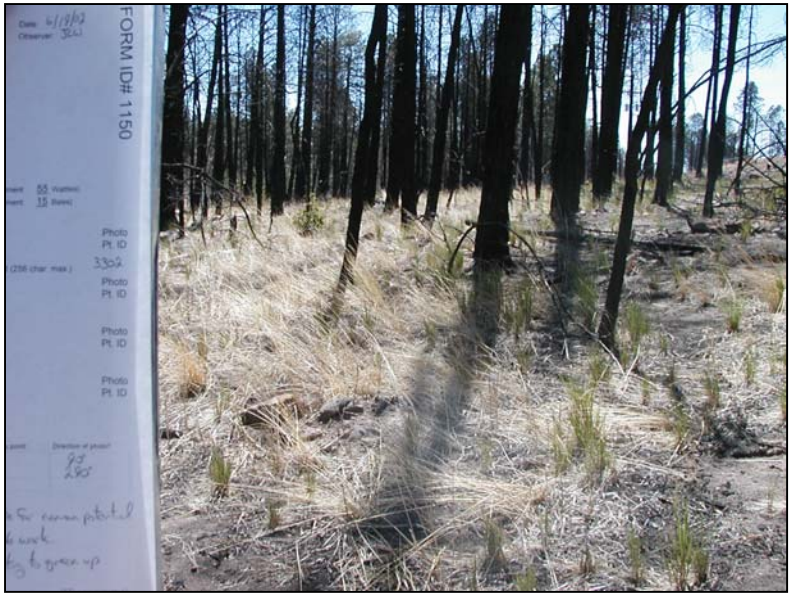
BART Unit 22, July 2001

BART Unit 22, October 2002



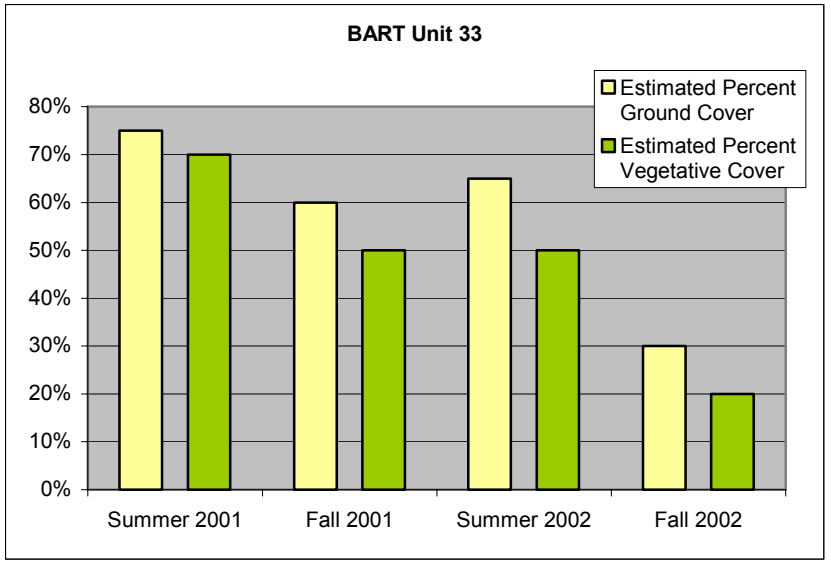
Changes in Vegetation Over Two Years on BART Unit 33, LANL TA-22

BART Unit 33, June 2001



BART Unit 33, June 2002

BART Unit 33, November 2002



4.0 CONCLUSIONS

Following the Cerro Grande Fire of 2000, over 40 BART sampling points were established to monitor changes in total cover and vegetation cover on approximately 240 ha (600 ac) of rehabilitation units. Rehabilitation units were sampled in summer 2001, fall 2001, summer 2002, and fall 2002. Total and vegetation cover have remained relatively stable. Declines in fall 2002 are likely due to a combination of drought and disturbance. RUSLE estimates of soil erosion, given current total ground cover, are within acceptable soil loss values. Additional rehabilitation treatments will be implemented to improve cover and protect soils where necessary.

5.0 ACKNOWLEDGMENTS

This work was funded through emergency funds provided to DOE and LANL to remediate damage and address demonstrated vulnerabilities associated with the Cerro Grande Fire. Past work has been conducted by LANL through two initiatives: the Emergency Rehabilitation Team to address emergency and urgent actions to recover from the fire and the CGRP to address near- and long-term activities required for LANL to fully recover from the Cerro Grande Fire. The 2002 work was conducted as part of the erosion control task of the CGRP.

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