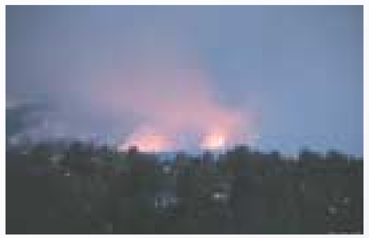
EES Contributions to Recovery from the Cerro Grande Fire



In May 2000 a wildfire swept into Los Alamos, destroying over 400 homes, a number of temporary Laboratory buildings, and more than 50,000 acres of vegetation. EES Division played a significant role in meeting the challenges of the Cerro Grande Fire, supporting the Laboratory's efforts to minimize the fire's impact and participating extensively in recovery activities of the Burned Area Emergency Rehabilitation (BAER) team and the Environmental Restoration (ER) Project.

Initially, we provided geological and geomorphological information to the BAER team, a task that transitioned to similar activities for the ER Project's fire-recovery efforts. For the ER Project, we undertook a variety of responsibilities, which we will continue over the long term. Soon after the fire, we evaluated and protected potential release sites within the heaviest burned areas of the Laboratory. To support flood mitigation, we surveyed the areas of concern and determined the post-flooding impacts on drainage, sediment transport, and contaminant migration. Using several remote-sensing techniques (including the collection of AVIRIS data on a 4-m grid), we helped determine the impact of the fire on vegetation, erosion, forest fuel loading, and soils. We led geochemical studies to understand the impact of the fire on the transport of metals and other contaminants.

We are continuing work with ESH Division to evaluate flooding potential, hillslope erosion, sediment transport, and contaminant movement from fire-affected areas. The issues we are evaluating include the impact of flooding on facilities and infrastructure; the impact of sediment on infrastructure and on the Rio Grande; and the changes in contaminant transport, given the higher expected stream flows following the fire.

An immense amount of data is being generated on the fire, and EES has set up a geographic information system (GIS) to show the time and spatial relationships of these data sets, allowing changes caused by the fire to be analyzed and visualized. The data are available to Laboratory and external users via a web interface. The GIS is designed to respond to queries for specific data sets and mapping functions, even if users don't have local GIS software. (For security and access control, data are stored in servers on an internal Laboratory computer net, and a subset of spatial data is placed on an external web site.) Using our new GIS, researchers can combine data in new ways to analyze patterns and trends not evident in databases that previously have been separated. This can lead to new predictive tools for hazards and effects such as storm runoff from burned areas and sediment transport in watersheds. Analytical results and models can also be stored and displayed, making the GIS a valuable planning and visualization tool for scientists, managers and other officials.

The fire burned a large land area west of the Laboratory, which resulted in the loss of vegetation and creation of hydrophobic soils. As a consequence, the dominant hydrologic runoff process in this area changed from *slow subsurface* runoff to *rapid surface* runoff. A comparison of the peak flows predicted before and after the fire is presented in Table 1. As can be seen in the table, the increase in the design peak flows following the fire ranged from a factor of 2 to a factor of 10. Activities are underway to check modeling predictions against these results using the nearly 50 surface-runoff gauging stations located across the Laboratory.

It is clear that higher runoff will increase soil erosion and sediment transport. Using remote sensing data, and an analysis of the soils' properties, we estimated the distribution of soil erosion for the fire area. A comparison of the pre- and post-fire erosion rates for the Pajarito Plateau is presented in Figure 1.

In addition to the predictive work described above regarding surface runoff, to support the Facilities and Waste Operations Division, we have established a sampling program to characterize and monitor the impacts of fire-related flooding. Large floods generated in the upper portions of burned watersheds have the potential to erode and transport contaminated sediments into the canyons. The samples collected should provide the data necessary to evaluate the impacts of post-fire floods on sediments, soils, surface and storm water, alluvial groundwater, and biota. Our results will be used to assess human health and ecological risks for areas that are affected by flooding. In addition, the data will be used to document changes in the spatial distribution of existing contaminant inventories and concentrations, as a function of erosion and deposition of sediments and changing hydrology within affected watersheds.

FIRETEC, the Los Alamos full-physics wildfire behavior simulation, is being used as a test-bed to begin to quantify uncertainties associated with wildfire predictions derived from the USDA Forest Service FARSITE model. FARSITE, based on an empirical approach, is known to have limitations when applied in the complex terrain and highly variable meteorological conditions such as the Pajarito Plateau, the location of the LANL site. At the present time, FARSITE is the model of choice for Laboratory planners, and it may present unknown hazards when it is used for the LANL site. Quantifying the uncertainties of FARSITE predictions will allow a priori mitigation of its hazards.

Table 1. Predicted flows for selected locations before and after the Cerro Grande Fire.

Location	100-yr Pre-Fire	100-yr Post-Fire
Los Alamos at Omega Bridge	532	2182
Los Alamos at Pueblo Canyon	589	912
Pajarito at NM 501	146	1533
Canon de Valle at NM 501	147	714
Water Canyon at NM 501	264	1849

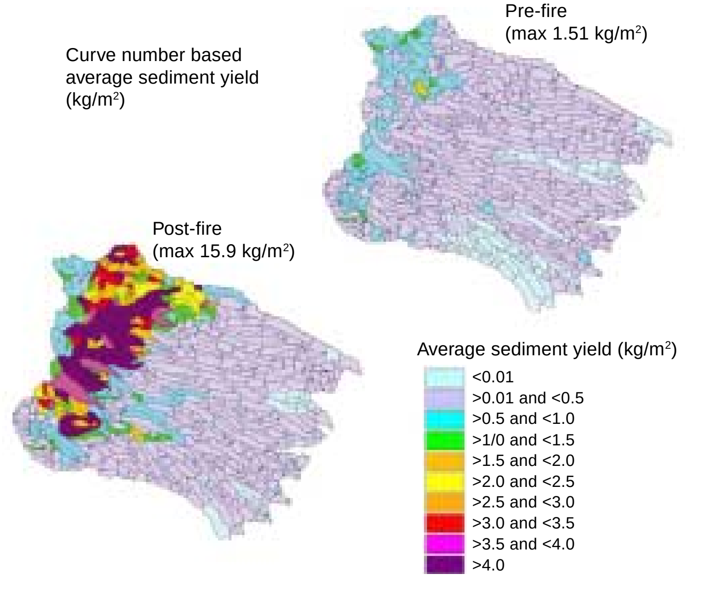


Figure 1. Comparison of erosion rates for the Pajarito Plateau before and after the Cerro Grande Fire.