MUDSLIDES AND DEBRIS FLOWS ASSOCIATED WITH WILDFIRES

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Overview

Every year, wildfires burn millions of acres of land across North America. With the severity, occurrence and cost of wildfires increasing every year, the aftermath of these catastrophes — which can include devastating impacts to soils and vegetation — is resulting in an evolving environmental disaster. In this paper, we will discuss mudslides and debris flows caused by wildfires, impacts of mudslides and debris flows on structures, and outline what can be done to control and mitigate soil erosion and other environmental issues after wildfires.

Highlights

- Enviromental Effects After a Wildfire
- Debris Flow
- Areas Affected by Wildfires to Debris Flow
- Soil Erosion Control After Wildfires

Environmental Effects After a Wildfire

Wildfires result in widespread loss of forest and undergrowth, which greatly changes the look and nature of the landscape. Typically referred to as the burn scar, the burned land surfaces caused by a wildfire are partially to completely devoid of vegetation. Extreme heat exposure from wildfires can kill microbes, alter soil texture and sterilize the soil several inches deep, although recolonization is generally rapid and can actually increase after a wildfire due to the flush of nutrients. This rapid change in landscape greatly affects the ground cover and erodibility of the ground. Since it takes several years for vegetative stands to recover, it is not unusual for mud and debris flows to form during the first few wet seasons after a wildfire.

Debris Flow

The United States Geological Survey (USGS) defines a debris flow as a form of rapid mass movement in which loose soil, rock and sometimes organic matter combine with water to form a slurry that flows downslope. They have been informally and inappropriately called “mudslides” due to the large quantity of fine material that may be present in the flow. When debris flows are thin and watery they are often referred to as mudslides or mudflows. In many cases though, thick sediment, rocks and other debris, including vehicles and buildings, combine to be what are typically referred to as debris flows. Debris flows following wildfire are typically

triggered by heavy precipitation or snowmelt. They are a problem due to their rapid onset, high speed of movement and high level of energy as they move downslope and into more confined valleys. Debris flows can inundate and damage structures, infrastructure and foundations in their path and have the potential to move objects as large as cars and houses.

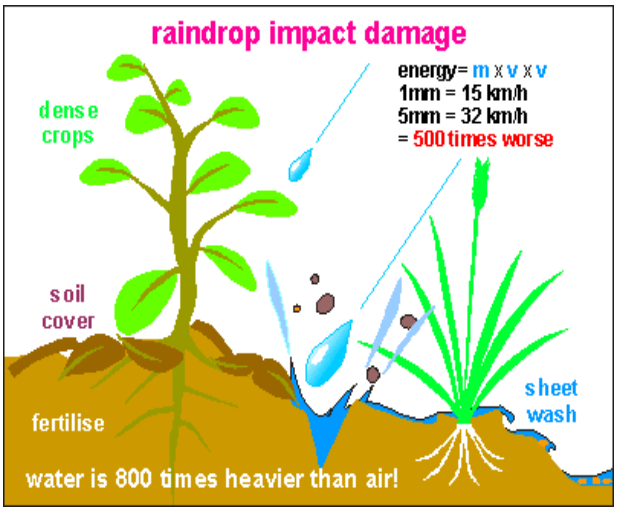
The Susceptibility of Areas Affected By Wildfires to Debris Flow

The Universal Soil Loss Equation (USLE) is a mathmatical model that derives the process of soil erosion. It is used to predict the long-term average annual rate of erosion on a field slope, based on characteristics such as rainfall patterns, soil types, topography, crop systems and management practices.

The USLE is defined as :
A=KR(LS)C(P)

Where A=Estimate of Soil loss (in rate tons/Hectare/year); K=Soil erodibility factor (In place versus exposed); LS=Slope Factor (Normal versus man-made changes); C=Crop Management Factor (Cover) with the P factor being the man induced reduction in rate of erosion.

After a wildfire, most of the factors in the USLE are not impacted, except for the Crop Management Factor (C). The Crop Management Factor for a forest area prior to a wildfire is 0.005 whereas clear land after wildfire would be 1.6, as diagramed in the image to the right. This equates to an increase of more than 300 times in soil loss potential after a fire. In addition, as the figure to the right depicts, the energy impact of raindrops on exposed soils is 500 times worse than on vegetative environments where there is ground cover, plants and large trees. Moreover, in burn scar areas, the material on the surface contains very loose ash, as well as soils that may have undergone altered soil texture due to the intensity of the wildfires. These surface conditions are more susceptible to erosion.



"Chaudhuri, Subrata & Raja, R. & Meena, Babu. (2008). Soil and Water Conservation Measures in Broad Bed and Furrow System."

In addition to the heightened potential for erosion after a fire, there is also a corresponding increase in water runoff from the burn scar area, which adds concern for downstream flooding.

Soil Erosion Control After Wildfires

One of the most immediate consequences after wildfires is the increased potential for soil erosion. Newly exposed soils are susceptible for a few years after wildfires, and in particular the first rainy season after the fire. Getting appropriate vegetation planted to stabilize the area is critical. Some of the other interim measures that can be taken are:

- Contour log terraces
- Drainage system modifications
- Erosion control blankets and other geosynthetics netting
- Leaving existing burned vegetation in place if there is no threat to personal safety or property
- Mulching
- Reseeding the burn scar with temporary to permanent grass
- Silt fences
- Steeper slopes may need terracing
- Straw bales
- Straw wattles
- Surface roughening

CONCLUSION

The severity, occurrence and economic impacts of wildfires is increasing every year. This increase brings substantial risks for mudslides and debris flows in affected areas. Following a wildfire or mudslide/debris flow, it is important to seek advice from geotechnical, civil and structural engineers who can evaluate soil conditions and assess affected foundations, structures and infrastructure, in addition to recommending corrective techniques to reduce future risks. Experts specializing in groundwater, vegetation and biology should also be consulted.

References

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