

Understanding Debris Flows and Flooding

Debris Flows and Flooding

Debris flows pose a risk in hilly or sloped areas following large fires. Residents within and below the CZU Lightning Complex burn area should be aware that the dangers to life and property from these hazards are significant and have a higher likelihood of occurring for several rainy seasons following a fire. County geologists are working with state and federal partners to assess debris flow risks in neighborhoods throughout the burn area. Residents should be prepared to evacuate and may not locate temporary housing on their properties until approved by the County.

In many natural disasters, debris flows can cause more fatalities and injuries than wildfires.

Understanding Wildfires and Flood Risk

The wildfire season of 2020 has some lasting effects on the landscape, both in the immediate area and locations that may be several miles away. Locations downhill and downstream from burned areas are very susceptible to Flash Flooding and Debris Flows, especially near steep terrain. Rainfall that would normally be absorbed will run off extremely quickly after a wildfire, as burned soil can be as water repellant as pavement. As a result much less rainfall is required to produce a flash flood.

The time required for a flash flood to begin depends on how severe the fire was and how steep the terrain is, combined with the rate of precipitation. Steep terrain combined with a severe burn scar and light precipitation can result in flash flooding within minutes of precipitation beginning. Areas of less severe burn damage and flatter terrain will be able to absorb more water leading to more time before flooding develops even in heavier precipitation.

Rule of Thumb:

- **If you can look uphill from where you are and see a burnt-out area, you are at risk.**
- **Half an inch of rainfall in less than an hour is sufficient to cause Flash Flooding in a burn area.**
- **If the rain is coming down, get to high ground.**

The soils in a burn scar are highly erodible so flood waters can contain significant amounts of mud, boulders, and vegetation. The powerful force of rushing water, soil, and rock, both within the burned area and downstream, can destroy culverts, bridges, roadways, and structures, and can cause injury or death if care is not taken.

Post-Fire Flooding Hazards and Flash Flooding

How Wildfires Cause Flooding

BEFORE FIRE



DURING FIRE



AFTER FIRE



Flooding

Flooding occurs when water accumulates and submerges land that is normally dry, and flash floods are exactly what the name suggests: floods that happen in a flash! In burned areas, flash floods occur most often when rainfall rates reach half an inch per hour. When it rains in a burn area, debris flows started by flash floods can travel many miles downslope from the burn area, where it may not even be raining.

- **Heavy Rains:** Excessive amounts of rainfall can happen throughout the year, putting your property at risk. Properties directly affected by fires and those located below or downstream of burn areas are most at risk for flooding.
- **Flash Floods:** A flash flood is a rapid flooding of low-lying areas in less than 6 hours, which can be caused by intense rainfall. Flash floods are known to roll boulders, tear out trees, and destroy buildings and bridges.

Remember: it takes much less rainfall to cause flash flooding in a burn area than it would have taken before the wildfire occurred. In fact, thunderstorms that develop over burn areas can produce flash flooding and debris flows nearly as fast as National Weather Service (NWS) radar can detect the rainfall.

Wildfire Increases the Risk

You may be at an even greater risk of flooding due to recent wildfires that have burned across the region. Large-scale wildfires dramatically alter the terrain and ground conditions. Normally, vegetation absorbs rainfall, reducing runoff. However, wildfires leave the ground charred, barren, and unable to absorb water, creating conditions ripe for flash flooding and mudflow. Flood risk remains significantly higher until vegetation is restored—up to 5 years after a wildfire.

As a result, properties located below or downstream of the burn areas are at an increased risk for flooding and debris flows.

- **Mudflows:** Mudflows are rivers of liquid and flowing mud on the surface of normally dry land, often caused by a combination of brush loss and subsequent heavy rains. Mudflows can develop when water saturates the ground, such as from rapid snowmelt or heavy or long periods of rainfall, causing a thick, liquid, downhill flow of earth. Mudflows are covered by flood insurance but are different from other non-covered earth movements where there is not a flowing characteristic—such as landslides or slope failures.
- **Debris Flows:** As water runs downhill through burned areas, it can create major erosion and pick up large amounts of ash, sand, silt, rocks, boulders, and burned vegetation (trees, shrubs, or plants), generating a debris flow (also commonly termed “mudflow”). These fast-moving, highly destructive debris flows are one of the most dangerous post-fire hazards because they tend to occur with little warning. They block drainages, damage structures, travel in unpredictable directions, and can endanger human life even miles away from the burned area.
 - **Before fire and rain:** Soil is trapped on steep rocky hills by vegetation.
 - **After fire:** During summer’s fire season, vegetation is burned, causing sediment to roll down steep hills. Within a few hours or days, channel bottoms are loaded with loose sediment.
 - **Rain and runoff:** During an intense rain, the water and runoff move sediment in the steep channels, producing debris flows.

- **Rock Fall:** Rockfall is a natural process where rock fragments on steep slopes fall, bounce, or roll downhill. After a fire, this process may become more frequent because wildfires can burn hot enough to crack rocks (making them less stable and more likely to fall) and destroy trees, stumps, logs, woody debris, and roots that normally hold loose rocks in place. Rockfalls can be especially hazardous to life and property along roads, trails, and steep slopes near residential, industrial, and farm buildings.
- **Infrastructure and Roadway Erosion:** Increased runoff from rain in a burn area may cause sediment buildup on and erosion of roadways. Thick cones and piles of sediment can build up on roadways and in drainage ditches. The latter may clog culverts, block flows beneath bridges, and cause erosion of embankments supporting roads. In heavy storms, this may lead to partially or completely collapsed roadways. These hazards make traveling in burn areas or in areas downslope of burn areas especially dangerous at night.
- **Burned and Distressed Trees:** Burned and distressed trees may fall at any time, with or without wind. Fallen trees may also get hung up in the branches of other trees and break away later.

Flooding after fire is often more severe, as debris and ash left from the fire can form mudflows. As rainwater moves across charred and denuded ground, it can also pick up soil and sediment and carry it in a stream of floodwaters. These mudflows can cause significant damage.

Early Warning: Watches and Warnings

The National Oceanic and Atmospheric Administration (NOAA) and the United States Geological Survey (USGS) have established a demonstration flash-flood and debris-flow early-warning system for recently burned areas across the state in California. The National Weather Service (NWS) employs multiple forecasting and monitoring tools that identify when both flash floods and debris flows are likely to occur based on comparisons between radar precipitation estimates and/or real-time rain gage accumulations and established rainfall intensity-duration.

Monitor

The County of San Mateo Office of Emergency Services, and the National Weather Service (NWS) work closely together throughout the winter to monitor precipitation rates on the burn scars to ensure that early warnings are issues to communities at risk.

Issuance

When there is a threat or potential threat of flash flooding or debris flows, the NWS may issue Flood Advisories, Flash Flood Watches, or Flash Flood Warnings. Emergency alerts, such as flash flood warnings, are issued initially by the National Weather Service and amplified through SMCAAlert. Residents should register for emergency alerts to receive notifications about debris flows and flash floods near or on the burn scar:

- **Register for SMCAAlert**

Terminology

Understanding NWS watches, warnings, and advisories can help you keep your family and community safe when it rains after a wildfire.

- *Flash Flood Advisory: Be aware and continue monitoring conditions when the NWS issues a Flood Advisory.*

A Flood Advisory is issued when a forecasted weather event may cause trouble and require action. You should continue monitoring local news outlets and your local NWS office for updates as conditions develop. A Flood Advisory is issued when flooding is not expected to be bad enough to issue a warning. Take appropriate actions to safeguard your family and property, and consider modifying travel plans.

- *Flash Flood Watch: Be prepared for a flash flood when the NWS issues a Flash Flood Watch.*

A Flash Flood Watch is issued to indicate that current or developing conditions may result in flash flooding. However, flash flooding or debris flows are not imminent, and there may be some uncertainty about the location or timing. In areas where ground conditions have been changed by wildfire, a watch is typically issued within several hours to days ahead of forecasted thunderstorms and rain events that could possibly generate flash flooding or debris flows. An example of this is the rainfall that occurred in the Thomas Fire burn area, which led to flash flooding and debris flows downslope of the burn area in Montecito, California, on January 9, 2018.

- *Flash Flood Warning: Take action to keep your family and community safe when the NWS issues a Flash Flood Warning.*

A Flash Flood Warning is issued when a flash flood or debris flow is imminent or occurring. If you are in the warning area, take action immediately, as these conditions are often life threatening. Debris flows result from short duration, high intensity rain events over ground that has been altered by a wildfire. Impacts from flash flooding and debris flows can occur many miles away from the burn area.

Even if you were not directly affected by the wildfire, it does not mean you are safe from the possibility of flash flooding or debris flows after it.

Burn Scar Debris Flow Precipitation Thresholds (ALL)

<i>Time</i>	<i>Quantity</i>
<i>15 Minutes</i>	<i>0.3 Inches</i>
<i>30 Minutes</i>	<i>0.5 Inches</i>
<i>60 Minutes</i>	<i>0.7 Inches</i>

Links

- CalFire’s Watershed Emergency Response Team (WERT) has prepared a detailed report outlining potential risks from debris flows and hazard trees in the fire burn area and impacted watersheds.
- San Mateo County Office of Emergency Services CZU Debris Flow Plan Webinar
- National Weather Service Debris Flow Guide
- CA Department of Conservation Debris Flow Facts
- USGS Riding the Storm Landslide Danger in the San Francisco Bay Area
- Debris flows explained
- Debris flows in Montecito
- USDA Post Fire Assistance