WILDFIRE AFTERMATH

Wildfires and Flooding – Facts and Best Practices

Source: Keenan & Associates

California is considered a high or even extreme risk from wildfires and the floods that often follow. That makes it the state with the highest wildfire risk. The wildfire season is starting earlier and lasting longer into the fall and winter. The following are some facts and best practices regarding the relationship between wildfires and flooding/debris flow.

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Flooding - Causes of flash flooding include heavy rain, ice or debris jams, levee or dam failure, and wildfire burn areas during heavy rain. These floods exhibit a rapid rise of water over low-lying areas. Rainfall that would normally be absorbed will run off extremely quickly after a wildfire. Burned soil can be as water repellant as pavement and as a result, much less rainfall is required to produce a flash flood. A good rule of thumb is: "If you can look uphill from where you are and see a burnt-out area, you are at risk." (www.weather.gov)

Debris Flow - Wildfire season in California 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. When a wildfire burns a slope, it increases the chance of debris flows for several years. Flash floods are exactly what the name suggests: floods that happen in a flash! Flash floods generally develop within 6 hours of the immediate cause.

How Much Rainfall Can Produce a Flash Flood After a Wildfire?
The time required for a flash flood to begin depends on how severe the fire was, how steep the terrain is, and the rate of precipitation. A general rule of thumb is that half an inch of rainfall in less than an hour is enough to cause flash flooding in a burn area. Light precipitation on steep terrain that was severely burned can cause flash flooding within minutes.

Areas less severely burned and flatter terrain can absorb more water leading to more time before flooding develops, even in heavier precipitation. The important point is that areas burned by wildfire take much less rainfall to cause flash flooding than before a wildfire. In fact, thunderstorms that develop over burn areas can produce flash flooding and debris flows nearly as fast as National Weather Service radar can detect the rainfall. If heavy rainfall is observed even for a very short time, there is the potential for flash flooding and/or debris flows. It's also important to understand that flood waters from burn areas can be dangerous and toxic.

How Can I Be Prepared?
In the event of moderate to heavy rainfall, do not wait for a flash flood warning to take steps to protect life and property. As mentioned, thunderstorms that develop over a burned area may begin to produce flash flooding and debris flows before a warning can be issued. If you are in an area exposed to flooding and debris flows, there may be very little time to react once the storms and rain starts. Have a plan and be prepared to move away from the area.

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Keenan

Here are the terms you need to know
If you are in an area that is threatened by flooding or mudslides following a wildfire, it's helpful to be familiar with the following terms:

Burn scar: When a wildfire burns away the vegetation, the barren soil that remains is called a burn scar. The charred soil repels water, preventing the earth from absorbing moisture. This can contribute to flooding.

Intense rain: A burst of rain at a fast rate, about half an inch in an hour. With debris flows, the rate matters more than total rainfall. Although some landslides require lengthy rain and saturated slopes, a debris flow can start on a dry slope after only a few minutes of intense rain.

Debris flow: A debris flow is a moving mass of mud, sand, soil, rock, and water that is carried down a slope. It can happen with little or no warning and travel at avalanche speeds, growing in size as it picks up trees, boulders, cars, and other objects in its path. Debris flows are also known as mudslides.

Flash flood: Most flood deaths are due to flash floods, which often occur with little or no warning, according to the National Weather Service. They can happen within a few minutes or hours of excessive rainfall or dam failures. Flash floods are powerful enough to move boulders, topple trees, or collapse homes. The rushing water can reach heights greater than 30 feet.

Mudflow: A mudflow is a river of liquid and flowing mud. The main ingredient is water. Mudflows don't carry large objects, such as trees or rocks, and they aren't covered by standard homeowner's insurance policies. They are covered by flood insurance policies.

How much time do I have to escape a flash flood?
When there has been severe burn damage, area residents may have very little time to evacuate to avoid a flash flood or mudslide. Authorities advise people in such communities to pay attention to weather reports.

Steep terrain combined with a burn scar and light precipitation can result in flash flooding within minutes of the start of rainfall. The length of time there will be an elevated risk of flash flooding and mudflows depends on the severity of the burn scar – that is, how badly the soil has eroded. Each area has unique risks for flash floods. These may include how close the burn scar is to population centers and the grade of the terrain.

How do I know when to evacuate?
It's important to evacuate promptly whenever public safety officials advise you to do so, but don't wait for an official order. A good rule of thumb is to evacuate whenever you feel that staff/student safety is threatened.

Don't be complacent. Evacuations one or more times in recent months without incident may become redundant and cause bad decisions such as not to leave when a new evacuation advisory is issued. Take every warning or advisory seriously!

How can I be prepared for flooding?
If you are in a burn scar area, there are things you can do to protect life and property from potential flash flooding, mudflows, and debris flows. The first step is to prepare for an evacuation. Don't wait until an evacuation advisory is issued - be ready to go.

Emergency Operations Plan
Preparedness includes having an updated District Emergency Operations Plan that outlines responsibilities and duties as well as procedures for staff responding to a flood near or on center grounds. Review procedures with staff as needed and disseminate incident information and follow-up actions such as relocation site and reunification procedures. Notify relocation centers and determine an alternate relocation centers if needed, and what to do if these areas would also be flooded. Make sure appropriate action is taken to safeguard property.

Another way to be prepared is to make sure that water can flow freely around your property or workplace. Regular maintenance programs (see **Attachment A**) for clearing debris from any culverts or ravines will help channel rainwater away from buildings and property into outside storm channels ensuring that diverted floodwater is not directed toward outside properties where damage may occur.

Other things you can do include:

- Making sure downspouts carry water away from your buildings to well-drained areas.
- Making sure water heaters are at least one foot above the floor.
- Securing fuel tanks on your property to make sure they aren't dislodged by floodwaters.
- Making sure electrical components, such as switches and circuit breakers, are at least a foot above the anticipated flood line.

Attachment A

FLOOD PREPARATION GUIDE

FLOOD PREPARATION GUIDE

The following may serve as a checklist when preparing for a flood. This checklist should be tailored to processes/ operations, flood protection equipment, and flood potential at your specific district. The time required to complete each item should be determined in advance to allow proper planning.

ACTION TO BE TAKEN BEFORE FLOOD SEASON

DISTRICT MANAGEMENT/EMERGENCY TEAM

- Develop a Flood Emergency Response Team as part of the District Emergency Organization.
- Review the Flood portion of the District Emergency Response plan and make any updates as required.
- Prepare and maintain a scaled plan or diagram of the facility which clearly shows the location of all fire protection equipment and other emergency equipment.
- Obtain and review applicable flood maps for each location and evaluate flood susceptibility of each building.
- Pre-qualify and pre-commit as many emergency and remedial service contractors as possible, including both local and national companies.
- Obtain multiple suppliers for critical building components, equipment and stock necessary to resume operations.
- Obtain telephone numbers of all committed contracting companies, utilities, and other services critical to resumption of operations.
- Establish Memorandum of Understanding and Agreements with service providers, suppliers, and contractors.
- Establish and maintain open communication and relationships with local police and fire departments.
- Understand your energy needs and make arrangements for backup utilities and fuel sources where possible. Consider emergency generators and alternative fuels.
- Identify alternative means of transportation and alternative routes for all critical personnel, services, suppliers, contractors, etc. and establish relationships with lease and rental companies.
- Develop a directory for critical suppliers, contractors, services, etc. and obtain phone books from surrounding major cities in the event you need to obtain services and supplies from surrounding areas.

BUILDING AND STRUCTURES

Review the structural integrity of each building and structure foundation including physical damage, etc. Check any flood doors, gates, shields, or barriers for proper operation and water tightness including latches and hardware. Where possible, brick up lower building openings susceptible to flooding. Evaluate the need for floodwalls, flood drains, and flood culverts.

- Inspect the following to ensure that they can withstand erosion and heavy water flow conditions:

  - Storm Drains/Culverts
  - Rain Gutters
  - Catch Basins
  - Driveways/Walkways
  - Grounds/Playgrounds
  - Other

EMERGENCY EQUIPMENT

Have sandbags and any other materials available to barricade floodwaters.
Make arrangements for several forms of emergency communications including cellular phones, two-way radios, ham radio operators, etc.

ACTION TO TAKE ONCE A FLOOD WARNING HAS BEEN ISSUED

DISTRICT MANAGEMENT/EMERGENCY TEAM

Assemble the District Emergency Organization and supplies and equipment at a designated safe location on site. Consider the following:

1. Emergency lighting
2. Emergency generators
3. Portable pumps and hoses
4. Lumber and nails
5. Tape for windows, doors, and other openings
6. Sandbags, K-rails available and ready
7. Squeegees and mops
8. Fans and dehumidifiers
9. Caulking compound
10. Tarps
11. Manual and power tools
12. Shovels, axes, etc.
13. Saws and chain saws
14. Emergency telephone list(s)
15. Ensure that the School Site Emergency Organization has the following:
    a) Nonperishable food
    b) First aid equipment
    c) Two-way communication equipment
    d) Stored drinking water
    e) Blankets
    f) Appropriate clothing including rain gear and boots

ESTABLISH EMERGENCY COMMUNICATION METHODS

A designated member of the District Emergency Organization should monitor weather and flood reports from National Sources. The Army Corps of Engineers can provide predictions of river levels and status of dams and levees. The National Weather Service (NWS) is a good source of weather information.

Monitor the River Flood Forecast using the National Ocean and Atmospheric Administration NOAA website http://www.weather.gov/ahps/forecasts.php

- Equipment repair and/or replacement suppliers are placed on alert.
- If necessary, shut down operations and processes safely in accordance with District EOP.
- Drain open tanks of combustible, flammable or hazardous liquids to approved, sealed containers.
- Evacuate students and non-essential staff, or direct to a designated reunification location.
- Turn off non-essential lighting and equipment. Anticipate power outages and surges; be prepared to shut down susceptible systems such as computers. De-energize equipment which may become submerged.
- Take care not to impair emergency equipment such as electric motor driven fire pumps or fire alarms.
- Back up important computer data and records and store backups in a safe, elevated location, or off-site locations not subject to flooding.

- Protect important paper records from flooding, rain, and debris and relocate to an elevated location not subject to flooding.
- When possible, move important equipment (including mobile equipment) and warehouse stock to higher elevations not subject to flooding. If possible, use past flood history to select "safe" areas. If equipment and stock cannot be relocated or elevated, sandbags, tarps, or waterproof coatings, such as grease, may be applied to help protect exposed metal surfaces.
- A trained Flood Emergency Team should remain on alert until the emergency has passed.

BUILDINGS AND STRUCTURES

- Close and secure any flood doors, gates, shields, or other flood barriers.
- Close any valves in building drains or plumbing to prevent backup into the buildings.
- Place sandbags at lower building openings such as doors and other openings susceptible to flooding, and around important outdoor equipment, to divert floodwaters.
- Ensure diverted floodwater is not directed toward outside properties where damage may occur, incurring liability to the District.
- Ensure preventative measures are in place to protect and prevent blockage to storm drains and culverts from playgrounds with woodchips or other debris.
- Check tanks for proper anchorage and extend vent lines above level of expected flooding. Anchor and secure all portable containers of flammable or combustible liquids.
- Anchor and tie down all small structures, equipment, and storage in the maintenance yard, trailers, etc. to prevent movement by floodwaters. Move smaller objects inside if possible.
- Barricade important outdoor equipment with sandbags to provide protection against floating debris. Move mobile equipment to higher elevations.
- Brace unsupported structural members and foundations for structures/buildings under construction.
- Secure electrical power to buildings in imminent danger of flooding

EMERGENCY EQUIPMENT

- Ensure emergency generators, water and sump pumps, etc. are operational and fuel tanks are full.
- Clean all catch basins, drains, and drainage culverts. Lower the levels of retention ponds. Ensure all sump pumps are operational and connected to emergency power.

FIRE PROTECTION

- Inspect all fire protection equipment and leave in service. All fire protection equipment should be adequately anchored and protected from flooding and floating debris.
- Recovery Action after a Flood.
- Repair and return to service as soon as possible all fire protection including sprinklers, water supplies, fire pumps, special extinguishing systems, alarms and supervisory service, etc.

- Ensure that all District Policy Programs are properly supervised and enforced during salvage and repair operations. If automatic protection is impaired, arrangements for special fire watches should be made and notice to the fire department and the insurance company should be made as soon as possible.

DISTRICT MANAGEMENT/EMERGENCY OPERATIONS

- The District Emergency Organization should be prepared and trained in recovery efforts specific for each location.
- The site should be secured, and a command center should be established to direct the recovery operation.
- Damage should be surveyed and, as soon as possible, notification of fire protection impairments should be reported to the local fire department. Damage should be reported to FEMA as appropriate.
- Professional emergency personnel should survey for safety hazards such as downed electrical wires, leaking gas or flammable liquids, poisonous gasses, etc. Look for undermining and damage to foundations or underground piping, etc. Notify appropriate utility companies of damage as soon as possible. Use care around downed power lines and leaking fuel lines and consider providing barriers or watches.
- Designated key personnel and emergency contractors should be called to coordinate and start repairs and salvage. Ensure that all contractors are always familiar with District Policy and Procedures and share responsibility for fire-safe conditions.
- Begin salvage as soon as possible to prevent further damage. Items to consider include:
    a. Relocating property to safe locations to prevent further damage.
    b. Cover building contents with tarps when exposed to rain and weather.
    c. Separate damaged goods from undamaged goods.
    d. Make temporary repairs to prevent further damage.
    e. Fill eroded land areas, especially around building and structure foundations.
    f. Remove standing water in buildings, ground areas, etc.**
    g. Clean and dry equipment with most critical objects receiving priority. **
    h. Consider dehumidification of most areas, especially moisture sensitive equipment. **
    i. Clean roof drains, storm drains, retention ponds, etc. and remove any debris.
    **Refer to Emergency Restoration Service professionals
- Inspect all electrical equipment including exposed insulators, bus bars, conductors, and motors before re-energizing electrical distribution systems and equipment. Electrical equipment may absorb large amounts of water even if not submerged which may reduce its insulation resistance to dangerously low levels. These operations may require professional electrical contractor services.
- Contents of tanks, piping, reservoirs, boilers, process equipment, cooling towers and the like should be tested for contamination before use.
- Mechanical equipment should be dried and cleaned, and casings inspected. Shafts should be checked for alignment and lubricating systems flushed.