Post-fire erosion control

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Post-fire concerns

- Erosion control
- Removal of hazard trees
- Loss of income from timber harvest
- Road damage
- Regeneration (returning property to a forested condition)
- Degradation of wildlife habitat
- Increased wildfire hazard
- Invasive species management

Background

Post-fire erosion

- Results from severe loss of vegetation cover and alteration of soil conditions
- Highly variable in space and time
- Magnitude based on site conditions, wildfire severity, and the intensity of rain events prior to vegetation reestablishing
- Highest erosion rates during first year post-fire.
  - Decreasing with reestablishment of vegetation and mechanical processes in the soil (tree throw, bioturbation, etc.)

Hillslope erosion

- Caused by three processes:
  - Rain splash
  - Sheeting
  - Incision

Photo credit: USGS

Channel erosion

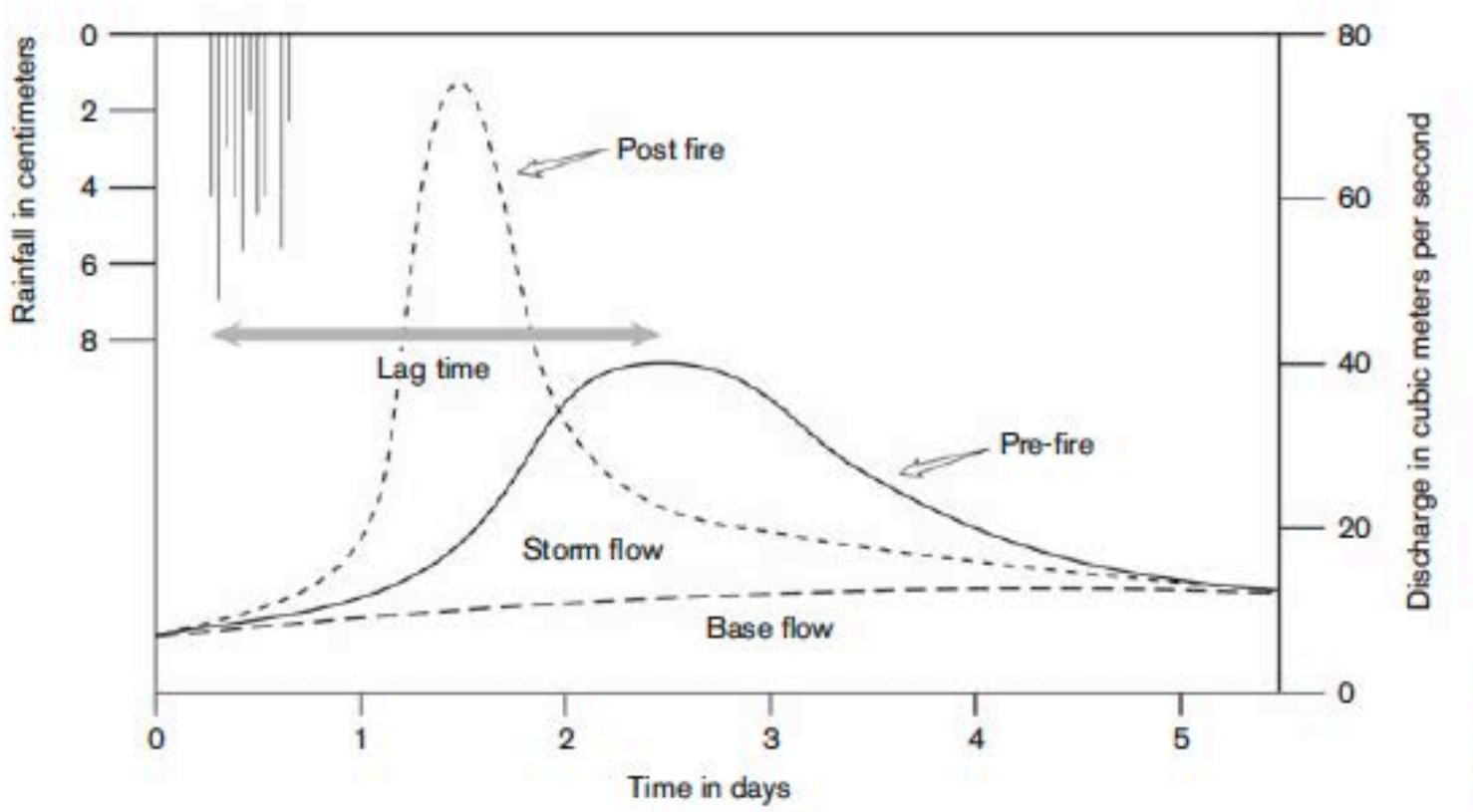
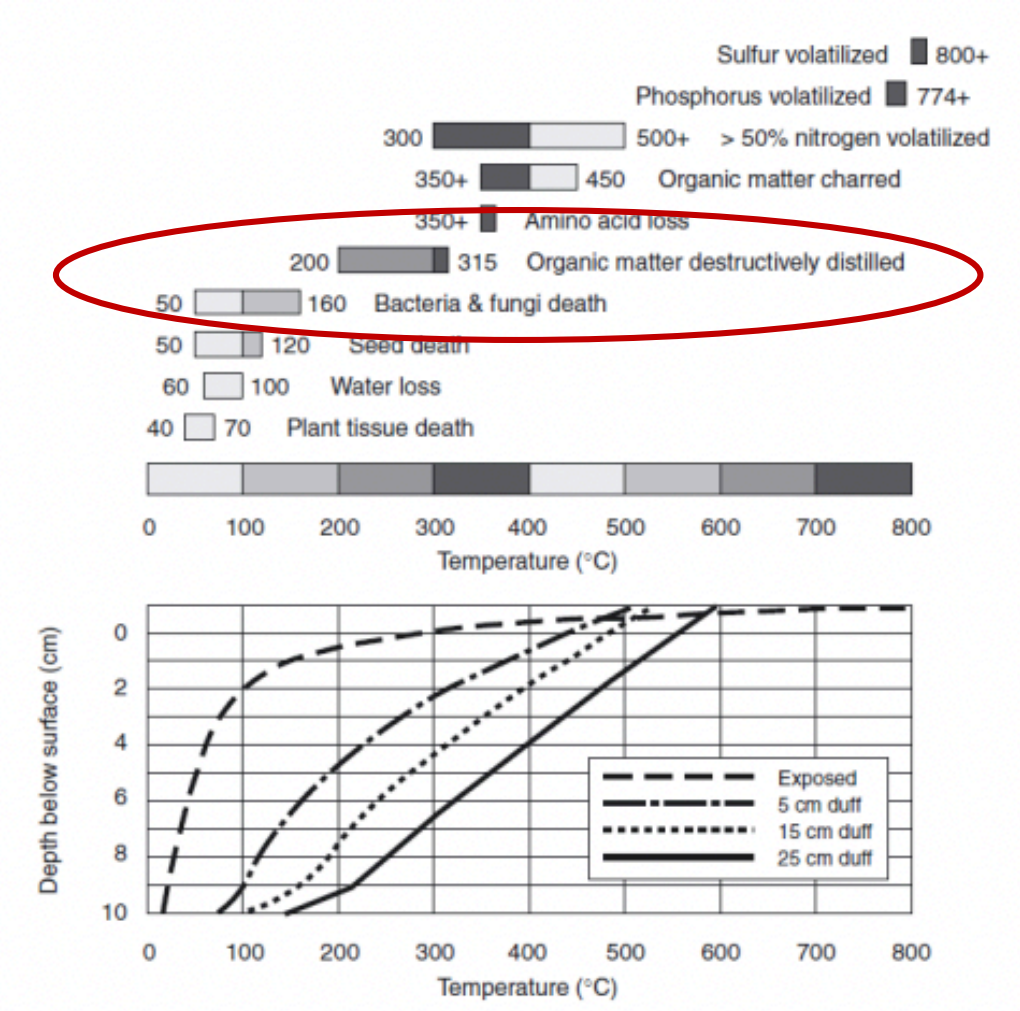


FIGURE 7.5 Streamflow hydrograph (discharge plotted against time) following a rainstorm showing lag time and peak flow changes with fire events.

Wohlgemuth et al., 2018

Fire impacts to soils



- Based on soil properties, plant community, and fire characteristics
- Fire may consume soil organic matter and fungi making the soil less resistant to soil detachment and erosion.

Excerpted from Ryan, 2002: "Temperature ranges associated with various fire effects (top) (from Hungerford *et al.*, 1991) compared to the depth of heat penetration into mineral soil (bottom) for a crown fire over exposed mineral soil (observed in jack pine *Pinus banksiana* in the Canadian Northwest Territories) or for ground fire burning in 5-, 15- and 25-cm (2-, 6- and 10-inches) of duff (predicted via Campbell *et al.*, 1994, 1995). Conditions are for coarse dry soil, which provides the best conduction (*i.e.*, a worst-case scenario)."

Hydrophobicity (water-repellent soils)

Photo credit: USGS

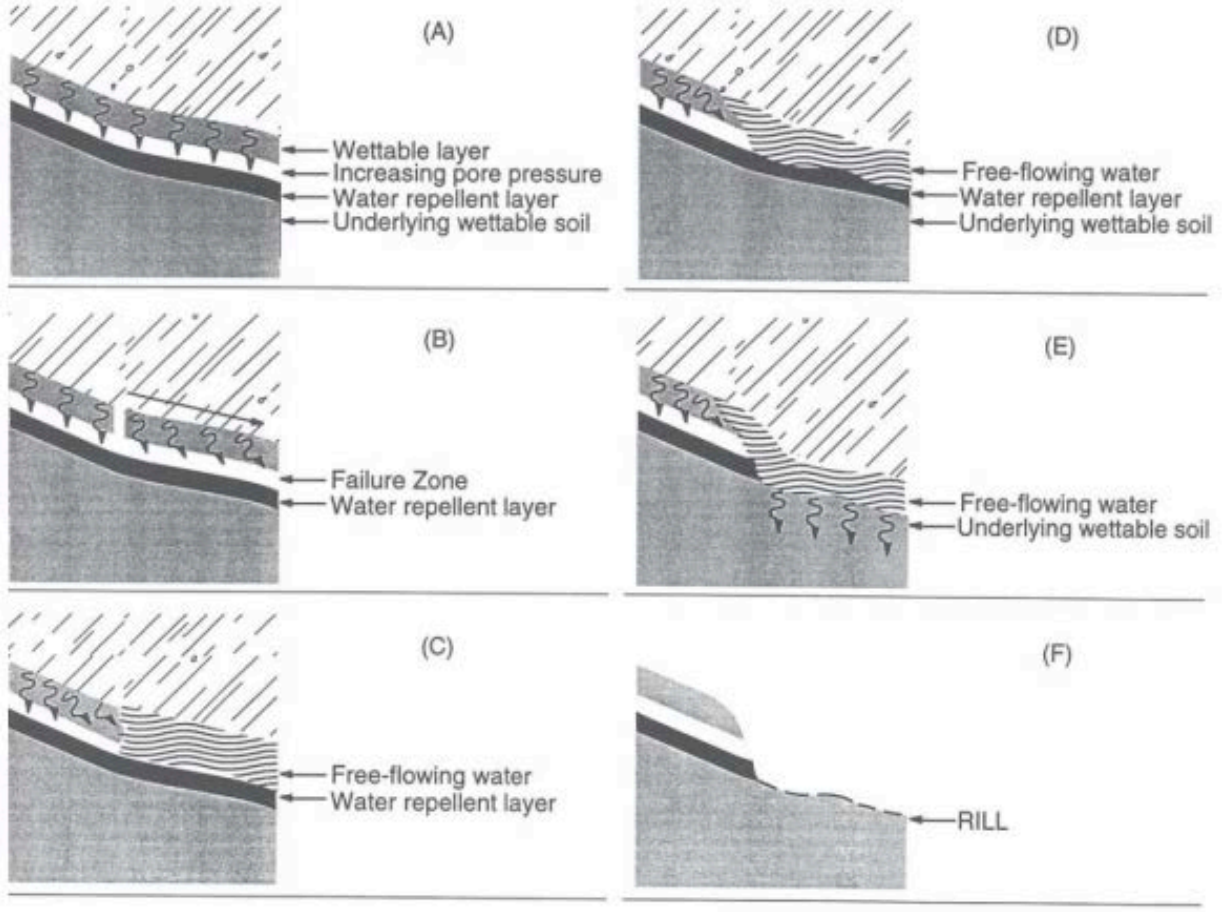


Figure 2. Excerpted from Neary *et al.* (2008): "Sequence of rill formation on a burned slope with a water-repellent layer includes (A) saturation of wettable surface area, (B) development of a failure zone in wettable surface layer, (C) free flowing water over the water-repellent layer, (D) erosion of the water-repellent layer, (E) removal of the water repellent layer and infiltration into underlying wettable soil, and (F) resultant rill. (From Wells,1987). The effects of fire on the generation of debris flows in southern California. Reviews in Engineering Geology. 7:105-114. Modified with permission of the publisher, the Geological Society of America, Boulder, Colorado U.S.A. Copyright © 1987 Geological Society of America.)"

Erosion control

- To reduce post-fire flooding and erosion caused by uncontrolled runoff on slopes that have become water repellent and denuded of vegetation.
- Decision on what treatments to implement based on costs, methods, and ecological impacts.
- Hillslope treatments
  - Create cover to absorb runoff
  - Act as a barrier to erosion
- Channel treatments
  - Stabilize channels or deflect large channel flows
- Road treatments


Preparing for
erosion

Survey the damage:

Identify areas of concern and values at risk

Steep and long hillslopes with bare or water repellent soils where overland flow could impact values at risk through erosion, flooding, or debris flows

Stream crossings or drainage features that could become clogged with debris

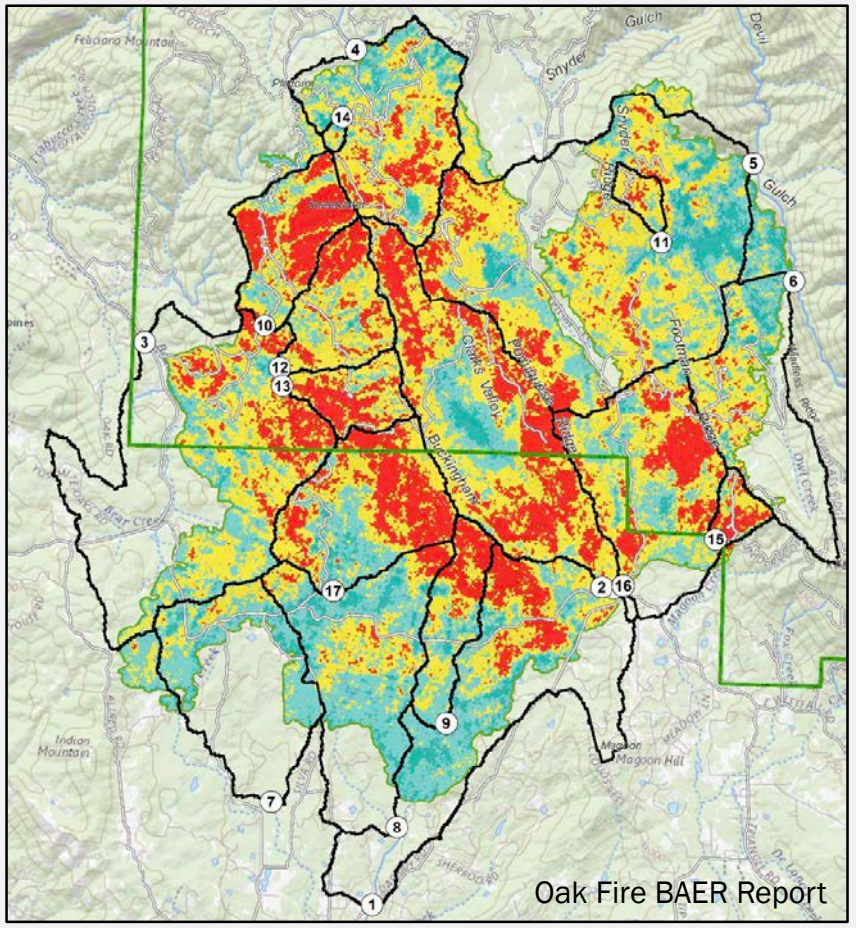
Assess the level of soil burn severity

Assessing soil repellency

Drop one water droplet on soil surface and start timer. Time how long it takes for the droplet to penetrate the soil surface. Repeat across multiple sites and soil depths.

<5 seconds	Wettable or non-water repellent
5-60 seconds	Slightly repellent
> 1 minute	Strongly to extremely repellent

Adapted from Dekker & Ritsema (1994)



Doing nothing may be best

Fire and erosion are natural processes

- Ash, leaf drop, downed trees, and remnant burned vegetation protect soil and slopes following wildfire

Avoid disturbing soils and slopes during the rainy season

Closing burned areas and allowing for natural recovery is appropriate in areas with

- low soil burn severity
- patchy moderate to high burn severity
- on low slopes
- in areas that do not pose risk to values.

Seeding is not recommended

- Largely ineffective for erosion control
- Limits native species recovery and conifer regeneration
- May introduce invasive species
- Consider seeding if you want to reintroduce more desirable species

Mulching

- Reduces erosion by
  - providing ground cover
  - increasing infiltration and soil moisture retention
  - shortening flow paths
  - trapping sediment
  - slowing development of concentrated flow
- Suitable for areas burned in moderate and high burn severity

Photo credit: Napper, 2006

	Wood shred mulch	Straw mulch	Seeding
Effectiveness high intensity rainfall	High	Moderate	Low
Effectiveness low intensity rainfall	High	High	Moderate-Low
Effectiveness on slopes (40-65%)	High	Moderate	Low
Function 0-1 year	High	High-Moderate	Low-Very Low
Function 1-3 years	High	Moderate	Depends on establishment
Function 3+ years	High	Low	Depends on establishment
Resistance to wind displacement	High	Low	Moderate
Resistance to water displacement	High	Moderate	Very low pre-germination
Implementation speed	Slow	Fast-Moderate	Fast
Risk of invasive species	Very low	High-Moderate	Moderate
Impact on native species	Positive-Neutral	Positive-Neutral	Negative/Unknown

Source: Grover, 2021

Erosion barriers

Contour log felling

(aka log erosion barriers or LEBs)

- Reduces erosion by
  - shortening slope length
  - trapping sediment
- Suitable for sites with slopes between 25 and 60%
- Considerations:
  - Less effective during high-intensity and large amounts of rainfall
  - Success is based on how well the logs are installed

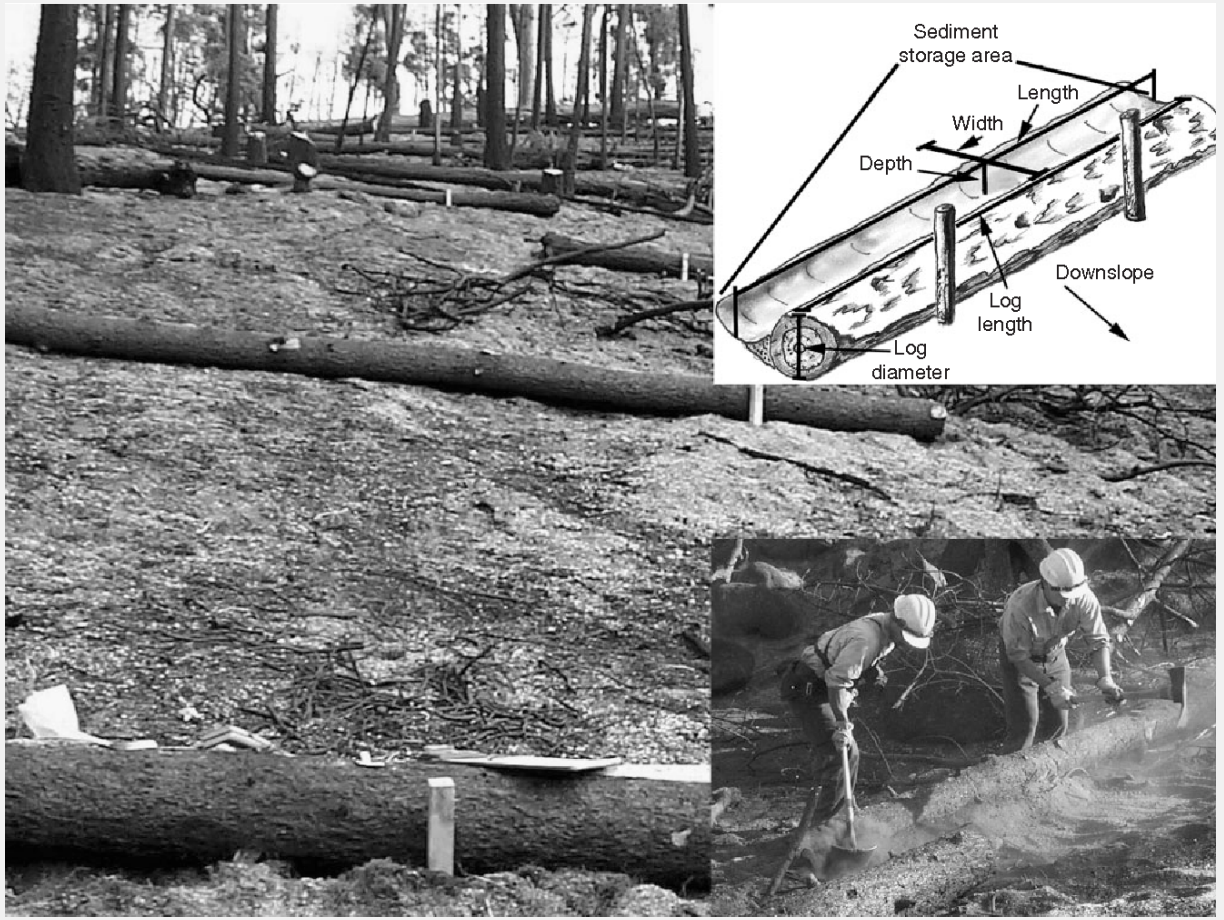


Photo credit: Robichaud et al. (2008)

Photo credit: Coalition for the Poudre River Watershed

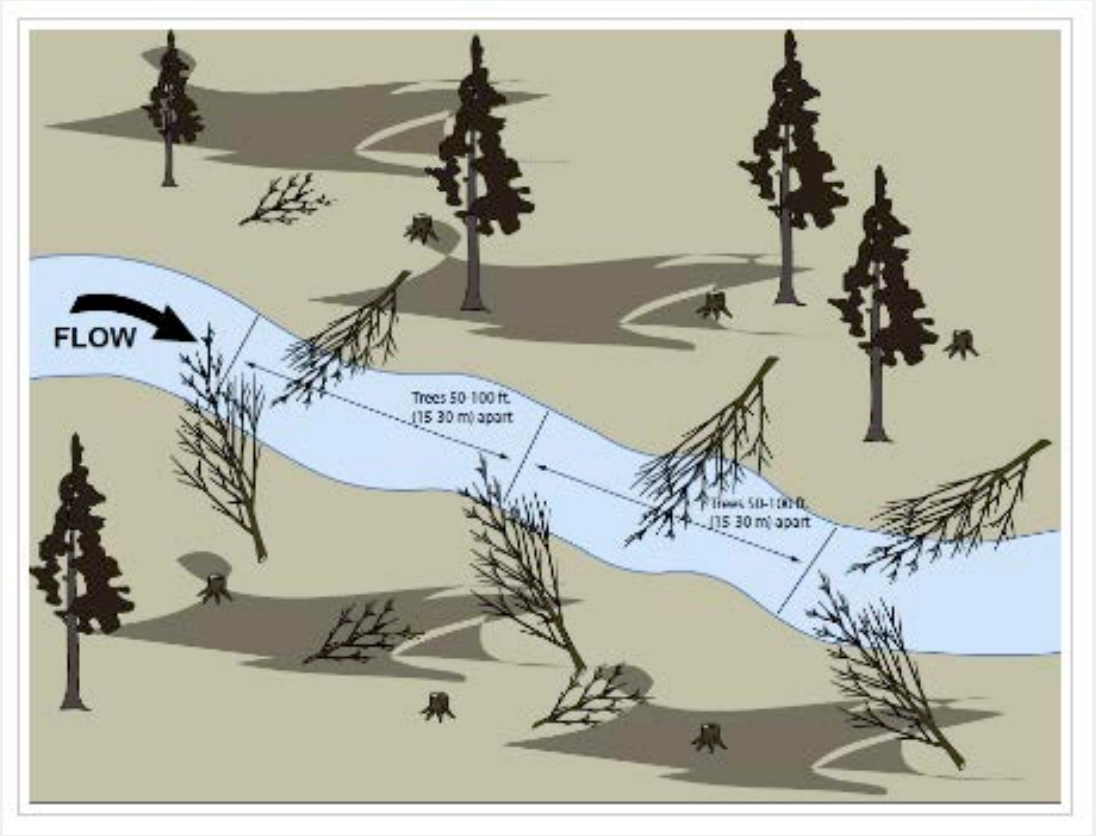
Erosion barriers

Fiber rolls/wattles

- Reduces erosion by
  - shortening slope length
  - trapping sediment
  - providing a seedbed for vegetative recovery
- Suitable for slopes < 40%
- Considerations
  - May contain noxious weeds
  - Less effective during high-intensity and large amounts of rainfall

In-channel tree felling

- Directionally felling trees with tops pointed upstream
- Reduces erosion by
  - Trapping floating debris and suspended sediment
  - Causing sediment deposition
  - Dissipating stream energy

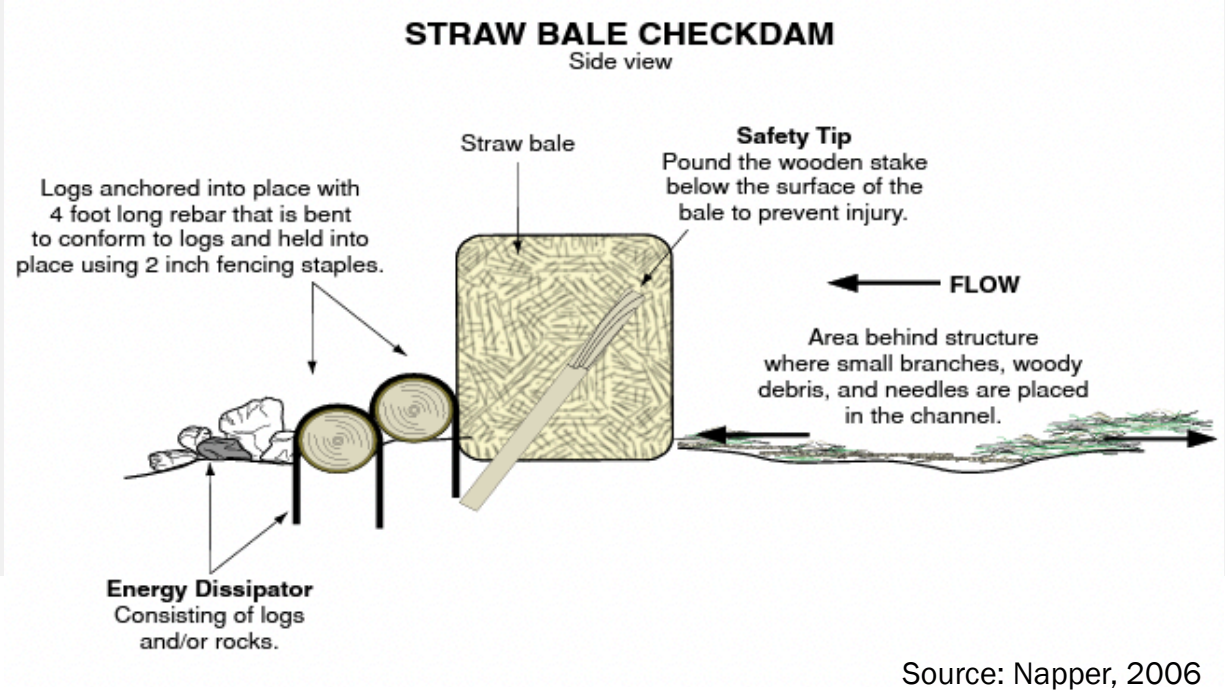


Source: Napper, 2006

Check dams

Photo credit: Coalition for the Poudre River Watershed

- Reduces channel erosion by
  - trapping and slowing sediment
  - Preventing downcutting
  - Slowing water
- Effective for low runoff
- High potential for failure
  - Effectiveness limited by storage capacity



Source: Napper, 2006

Road treatments

Photo credit: NPS

- Inspect roads frequently
- Drainage features may need to be replaced, relocated, or resized
- Patrol roads during significant rain events to clean out clogged ditches and culverts.
- Common treatments include:
  - Installing rolling dips or water bars
  - Upgrading to larger culverts
  - Ditch clearing and armoring

Seek a professional

- Seek professionals that are certified, registered, and/or licensed before selecting and installing treatment measures.
- Contact your local Natural Resources Conservation Service, Fire Safe Council, and Resource Conservation District offices to learn about available resources

Have an emergency evacuation plan

- Watch the weather forecast
- Know what you will do with pets and livestock during an evacuation
- Plan an alternative exit route
- Never stay in your home when it becomes unsafe


Thank you!
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