Post-Wildfire Hydrologic Concerns and Recommendations for Salvage Logging in the Southern Interior

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February 6, 2018

Wildfire and associated salvage logging can have a significant effect on hydrologic processes at both the stand and watershed scales. Loss of forest cover following wildfire generally results in:

- increased precipitation reaching the ground (rain and snow),
- decreased transpiration,
- the potential for increased soil moisture, and
- the potential for increased runoff.

In addition, depending on burn severity, soil properties, and vegetation type, a water repellent (hydrophobic) soil layer may form. Where this occurs, soil permeability will be reduced thereby increasing surface runoff as well as the potential for erosion.

Where the burned area is extensive, watershed-scale effects may include:

- increased streamflow (both annual yield and peak flows),
- advanced timing of snowmelt generated flows and prolonged low flows, and
- degraded water quality (physical, chemical, and biological).

The magnitude of post-fire hydrologic change is affected by:

- the timing and magnitude of post-fire rainfall and/or snowmelt,
- burn severity, extent, and distribution,
- watershed characteristics such as slope, aspect, forest cover, soils and geology,
- hydraulic connectivity,
- past forest disturbances, and
- recovery of vegetation, slopes and channels.

In general, where burn severity is low, measureable hydrologic response is unlikely. However, in areas with moderate to high burn severity, both local and downstream hydrologic changes can be significant in the years prior to vegetation recovery. The largest changes in streamflow timing and magnitude and in water quality are likely to occur:

- during intense rainstorms and during rapid melt of an above normal snowpack after a wet fall,
- in areas with high drainage densities, including streams and roads,
- in smaller watersheds where runoff concentration times are short,
- in watersheds without lakes or wetlands to attenuate flow,
- where runoff across the watershed becomes synchronized,
- in higher snowfall areas with mature spruce and subalpine fir dominated forest cover,
- where hydrophobic soil conditions occur,
- where runoff is concentrated from gentle onto steep slopes, and
- where surface runoff and erosion occurs along slopes and roads directly connected to streams.

Salvage logging, as well as pre-fire and fire-fighting related disturbance, may compound fire-related hydrologic change through:

- removal of remaining green vegetation,
- soil disturbance,
- alteration of natural flow paths,
- diversion of water along roads,
- riparian disturbance,
- poorly designed stream crossings,
- lack of road maintenance,
- removal of barriers that reduce cattle access to streams, and
- increased public access to slopes and streams.

Salvage plans should:

- focus on areas with little or no remaining green vegetation, maximize tree retention in areas where snowmelt dominates the hydrologic regime, and protect the understory,
- avoid riparian areas, whether black or green and regardless of stream classification, in order to protect channel banks and minimize cattle access to streams,
- avoid areas of erodible soil, hazardous terrain, and steep (>40%) slopes, and minimise soil disturbance,
- time harvest according to ground conditions, for example, in areas with hydrophobic soils consider harvesting during dry periods to break up the water repellent layer and in other areas schedule harvesting during snow-covered seasons to minimise soil disturbance,
- leave (or place) wood on the ground, thus increasing roughness which interrupts surface runoff and sediment delivery to streams and restricts cattle movement to and along streams,
- minimize stream crossings and maximize cross drains along roads,
- develop road monitoring/maintenance plans, including annual field reviews of all ditches and culverts to ensure they are fully functional prior to spring snowmelt, and
- decommission roads as soon as possible to reduce the potential for erosion and sediment generation, including damage caused by recreational access.

Moderate to high intensity wildfires can result in substantial hydrologic change at both the stand and watershed scales. These changes may be compounded by past disturbances and post-fire salvage logging. Both localised and watershed-wide hydrologic change can have a significant effect on downstream values such as water quality and quantity, stream channel stability, infrastructure, public safety, and aquatic ecosystem health. Watershed assessments should be undertaken prior to logging in order to understand the risks to downstream values and to identify the opportunities for minimizing risk, including the potential for runoff desynchronization in the design of salvage and leave areas, road and drainage management, access restrictions, riparian area protection and recovery of vegetation, slopes and channels.

Additional Reading:

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