# Water Quality and Quantity Risks of High-Severity Fire For Drinking Water Reservoirs

Steve Hallgren, Forest Ecology

Chris Zou, Ecohydrology

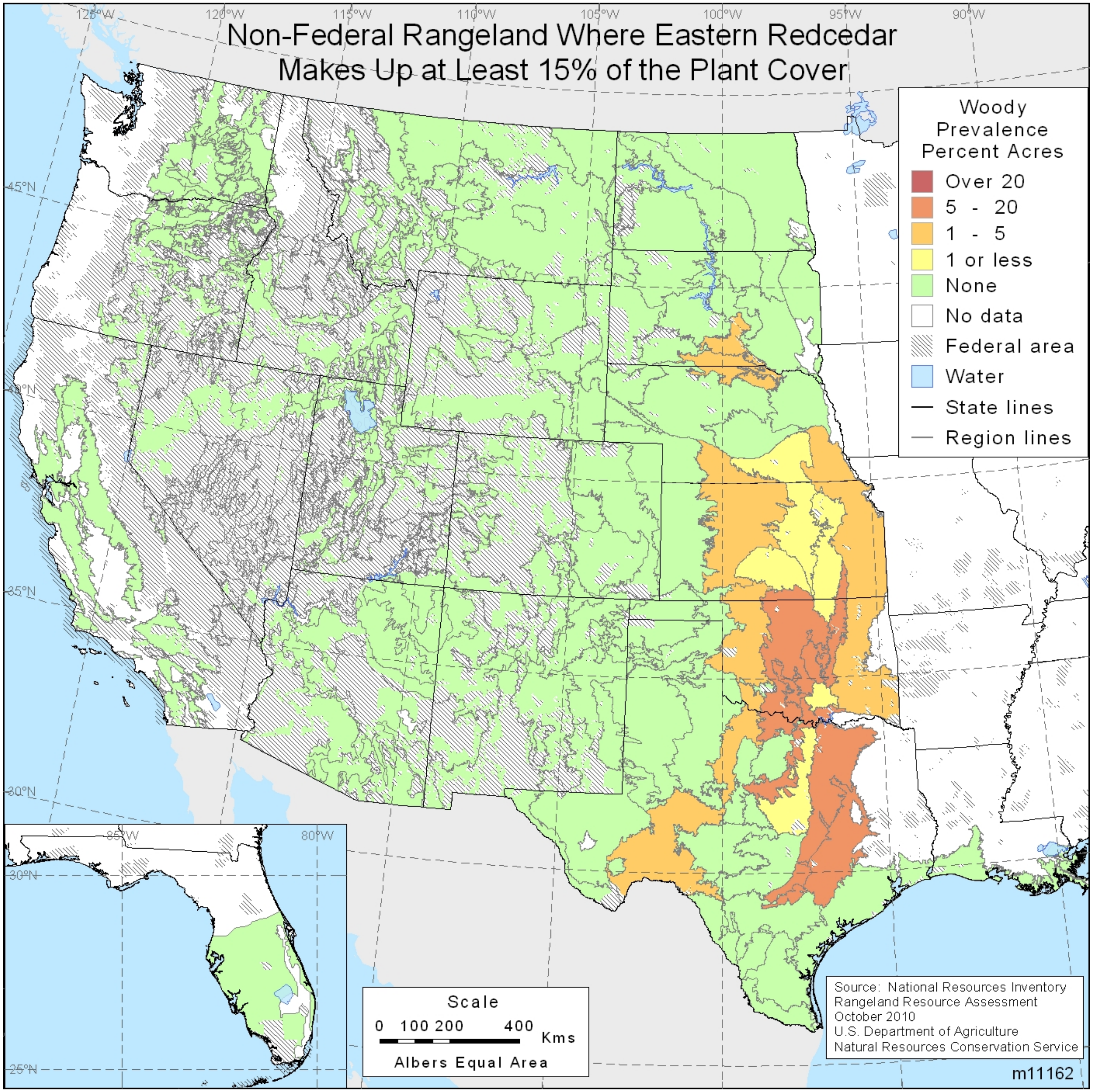
Dan Shoup, Fisheries

# High-Severity Fire and Drinking Water

## Wildland fire severity has increased

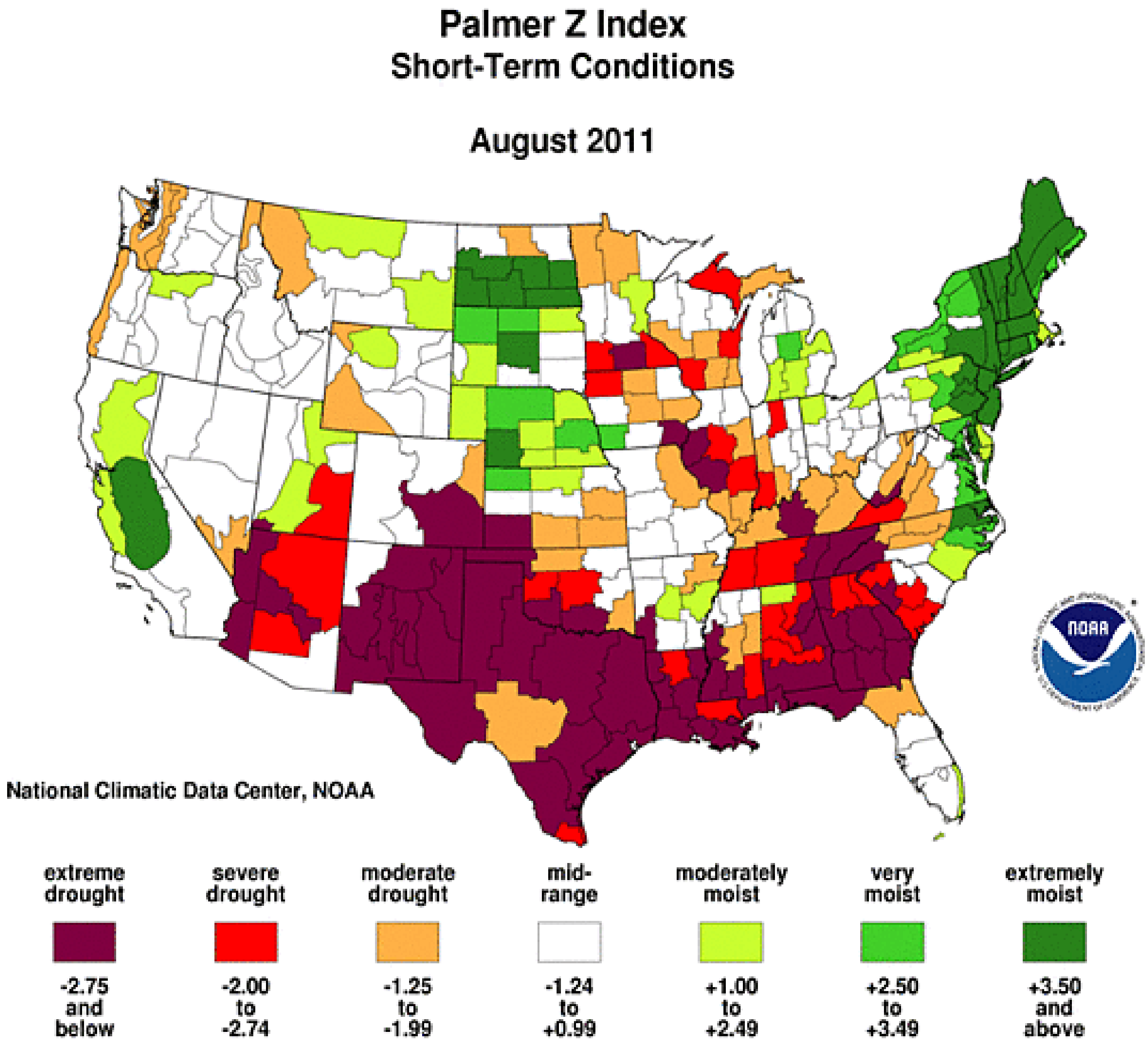
- Woody encroachment has produced greater fuel loads and novel fuel complexes – eastern redcedar

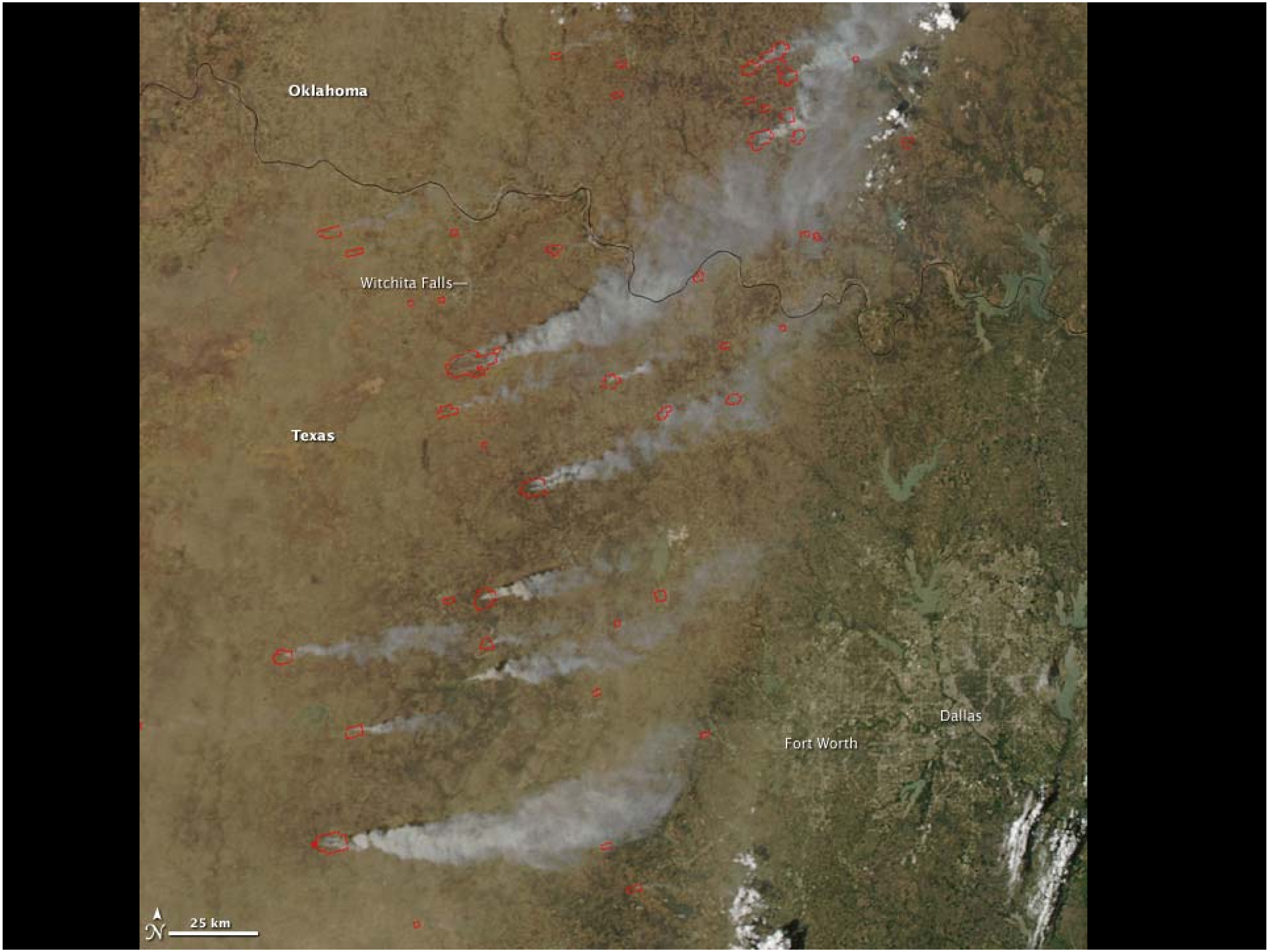
- Recent severe droughts have reduced fuel moisture resulting in extreme fire occurrences



Non-Federal Rangeland Where Eastern Redcedar Makes Up at Least 15% of the Plant Cover
125°W
120°W
115°W
110°W
105°W
100°W
95°W
90°W
45°N
40°N
35°N
30°N
85°W
80°W
30°N
25°N
Woody Prevalence Percent Acres
Over 20
5 - 20
1 - 5
1 or less
None
No data
Federal area
Water
State lines
Region lines
Scale
0 100 200 400 Kms
Albers Equal Area
Source: National Resources Inventory
Rangeland Resource Assessment
October 2010
U.S. Department of Agriculture
Natural Resources Conservation Service
m11162

# Keystone Lake



Palmer Z Index
Short-Term Conditions
August 2011
National Climatic Data Center, NOAA
NOAA
extreme drought
-2.75 and below
severe drought
-2.00 to -2.74
moderate drought
-1.25 to -1.99
mid-range
-1.24 to +0.99
moderately moist
+1.00 to +2.49
very moist
+2.50 to +3.49
extremely moist
+3.50 and above



Oklahoma
Witchita Falls—
Texas
Dallas
Fort Worth
N
25 km

# High-Severity Fire and Drinking Water

Increased fire severity causes greater effects on soil and water:

- Greater runoff
- Increased erosion

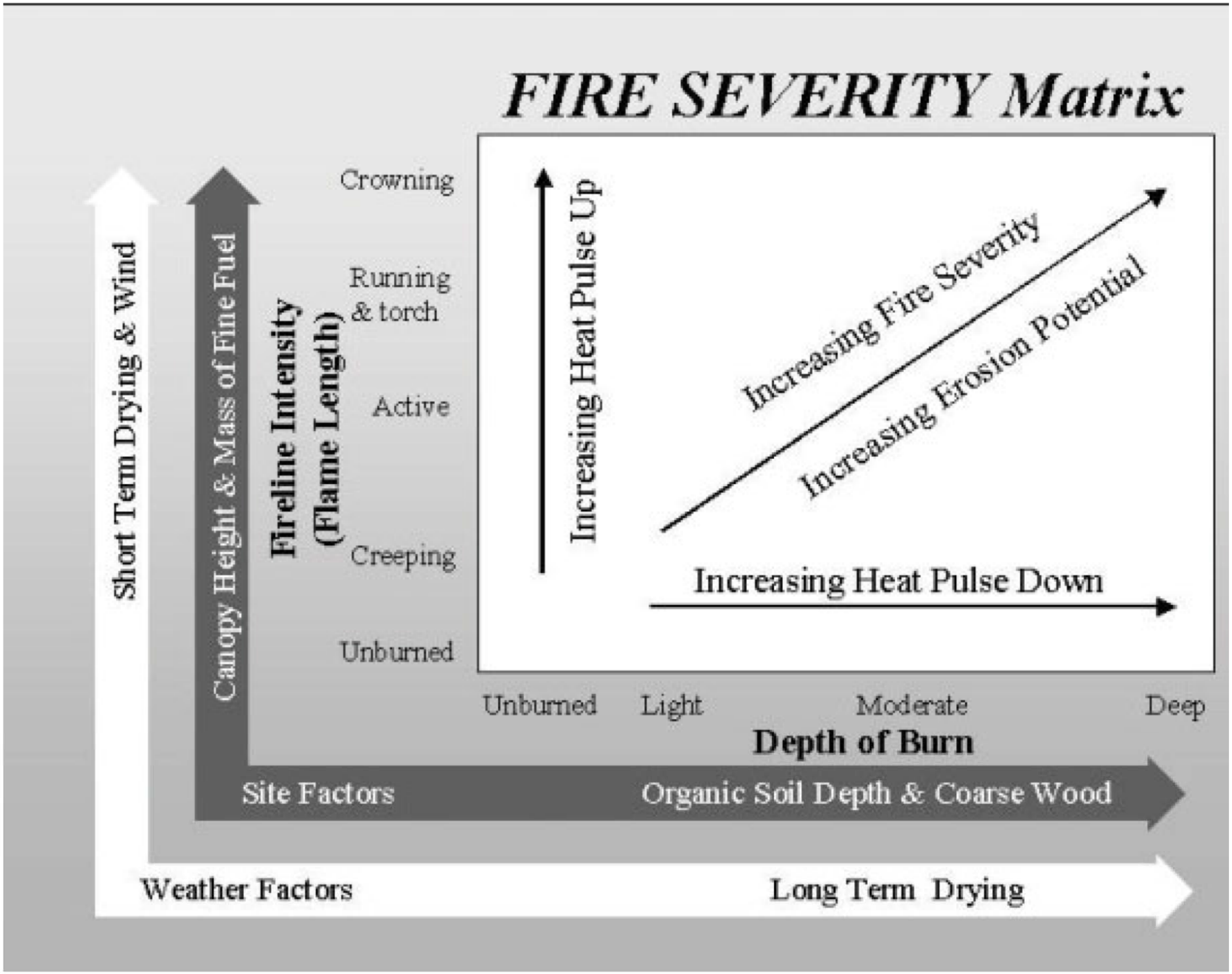



**Figure 1.8**—Site and weather factors associated with increasing fire severity and erosion potential. **(Neary et al. 1985)**

## Summary of changes in hydrologic processes following wildland fires

| Hydrologic process | Type of change | Specific effect |
|---|---|---|
| 1. Interception | Reduced | Moisture storage smaller, greater runoff in small storms, increased water yield |
| 2. Litter storage of water | Reduced | Less water stored, overland flow increased |
| 3. Transpiration | Temporary elimination | Streamflow increased, soil moisture increased |
| 4. Infiltration | Reduced | Overland flow increased, stormflow increased |
| 5. Streamflow | Changed | Increased in most ecosystems |
| 6. Baseflow | Changed | Decreased (less infiltration)<br>Increased (less evapotranspiration)<br>Summer low flows (+ and -) |
| 7. Stormflow | Increased | Volume greater, peakflows larger, time to pleakflow shorter, more flashfloods, flood levels higher, erosive power increased |

(Neary et al. 2005)

# High-Severity Fire and Drinking Water

## Effect of surface condition on infiltration rate

| Surface condition | Rate description |
|---|---|
| Intact forest floor | Very rapid |
| Vegetation only | Slow to moderate |
| Bare soil | Very to moderately slow |
| Water repellent soil | Very slow to none |

(Hewlett 1982)

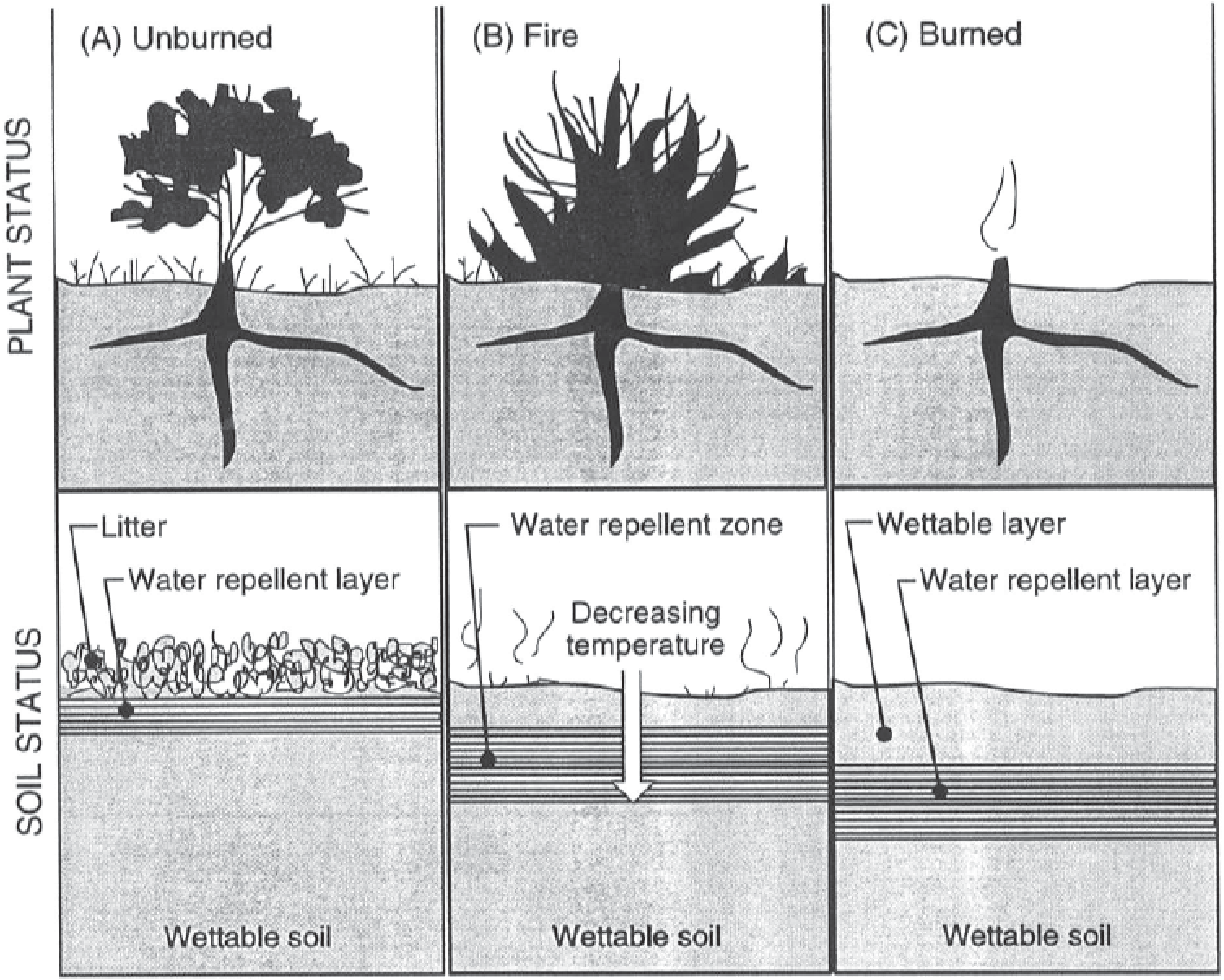



**Figure 2.10**—Formation of fire-induced water repellency. Water repellency before (A), during (B), and following (C) fire. (After DeBano 1981).

# High-Severity Fire and Drinking Water

| Surface condition | Infiltration | Runoff | Erosion |
|---|---|---|---|
| Litter charred | High | Low | Low |
| Litter consumed | Medium | Medium | Medium |
| Bare soil | Low | High | High |
| Water repellent layer | Very low | Very high | Severe |

(DeBano et al. 2005)

Alluvial Fan. The Buffalo Creek Fire in May 1996 burned 4,690 hectares in the mountains southwest of Denver, Colorado. This wildfire lowered the erosion threshold of the watershed. As a consequence of this wildfire, a 100-year rainstorm in July 1996 caused erosion upstream and deposition of this alluvial fan at the mouth of a tributary to Buffalo Creek. Buffalo Creek is flowing to the right at the bottom of the photograph. Photo by R. H. Meade

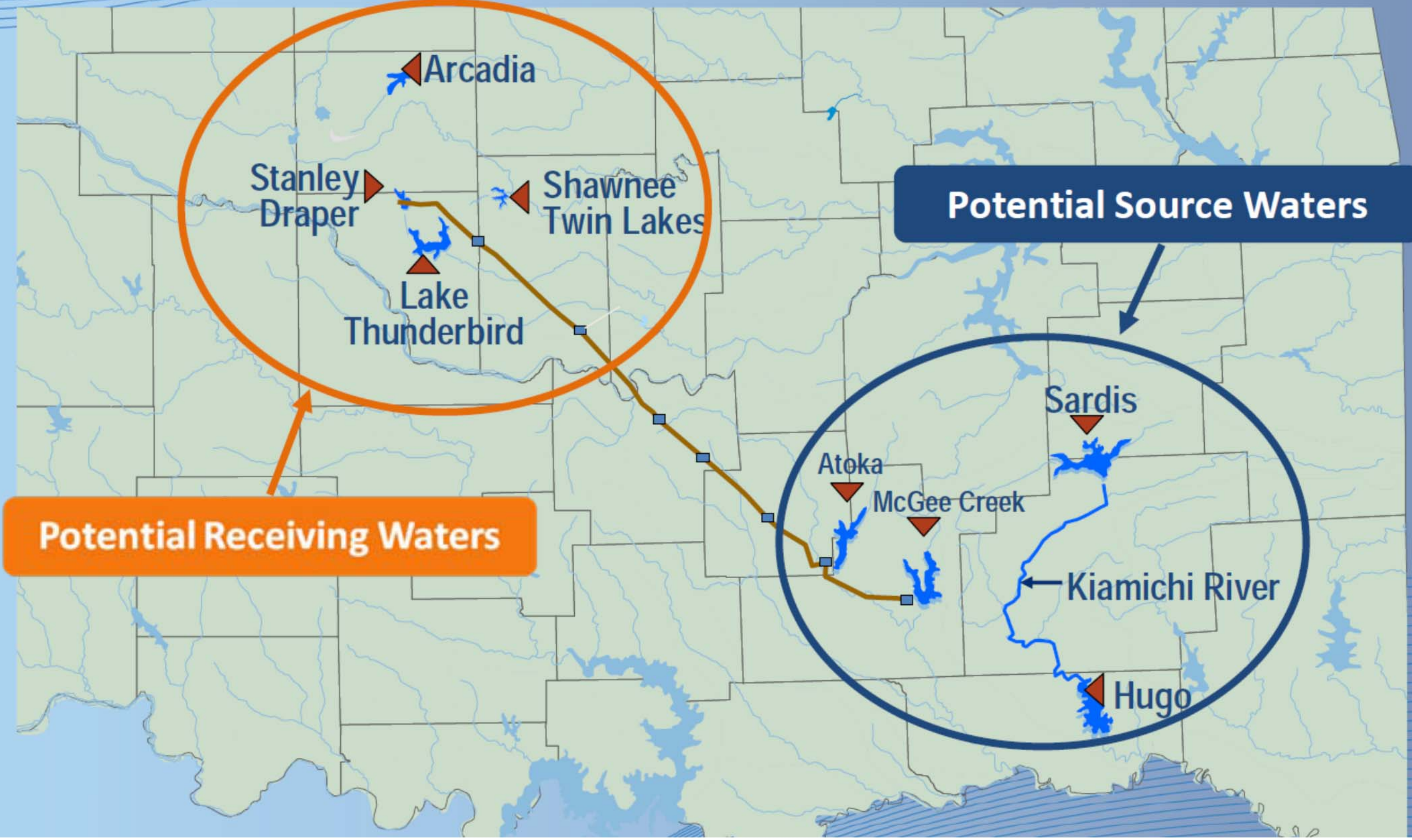
Trail Creek severely burned flood plain

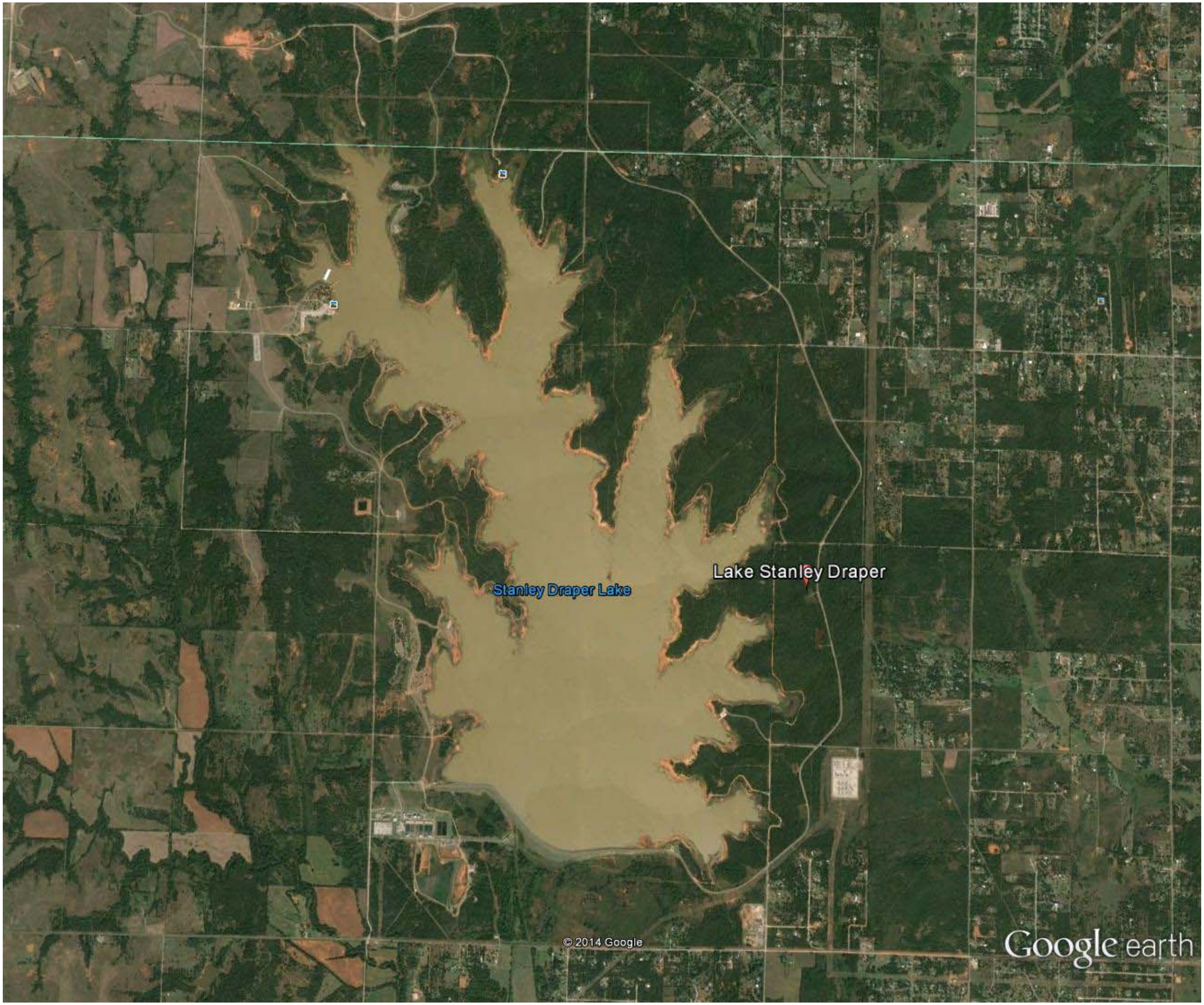
Black water event Yuba River 45 grams/liter

Hillslope hollow above the Yuba River

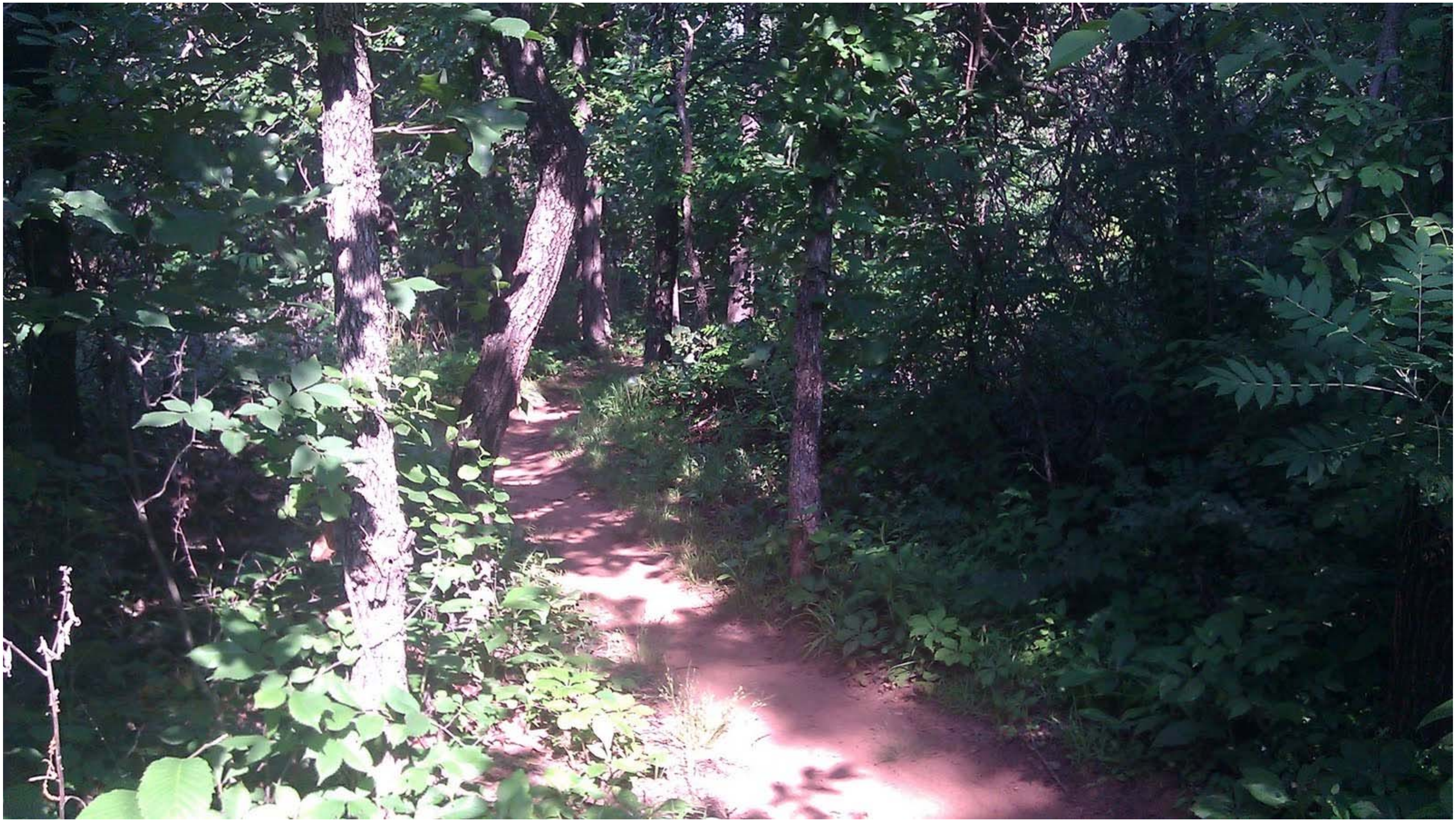
# Water Quality

- **OWRB provided water quality data for all potential source waters and receiving waters**





Lake Stanley Draper
Stanley Draper Lake
© 2014 Google
Google earth



Atoka Reservoir, Oklahoma 74525, USA
Stringtown
Atoka
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Sardis Lake
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# High-Severity Fire and Drinking Water

Research to determine effect of high-severity wildfire on:

- Streamflow
- Wind-driven ash and sediment production
- Sediment yield
- Nutrient load

# High-Severity Fire and Drinking Water

Expected results:

- Determine risks of high-severity wildfire for drinking-water reservoir water quality and quantity

- Develop management tool for land management to minimize risks of damage from high-intensity wildfire to drinking-water reservoirs

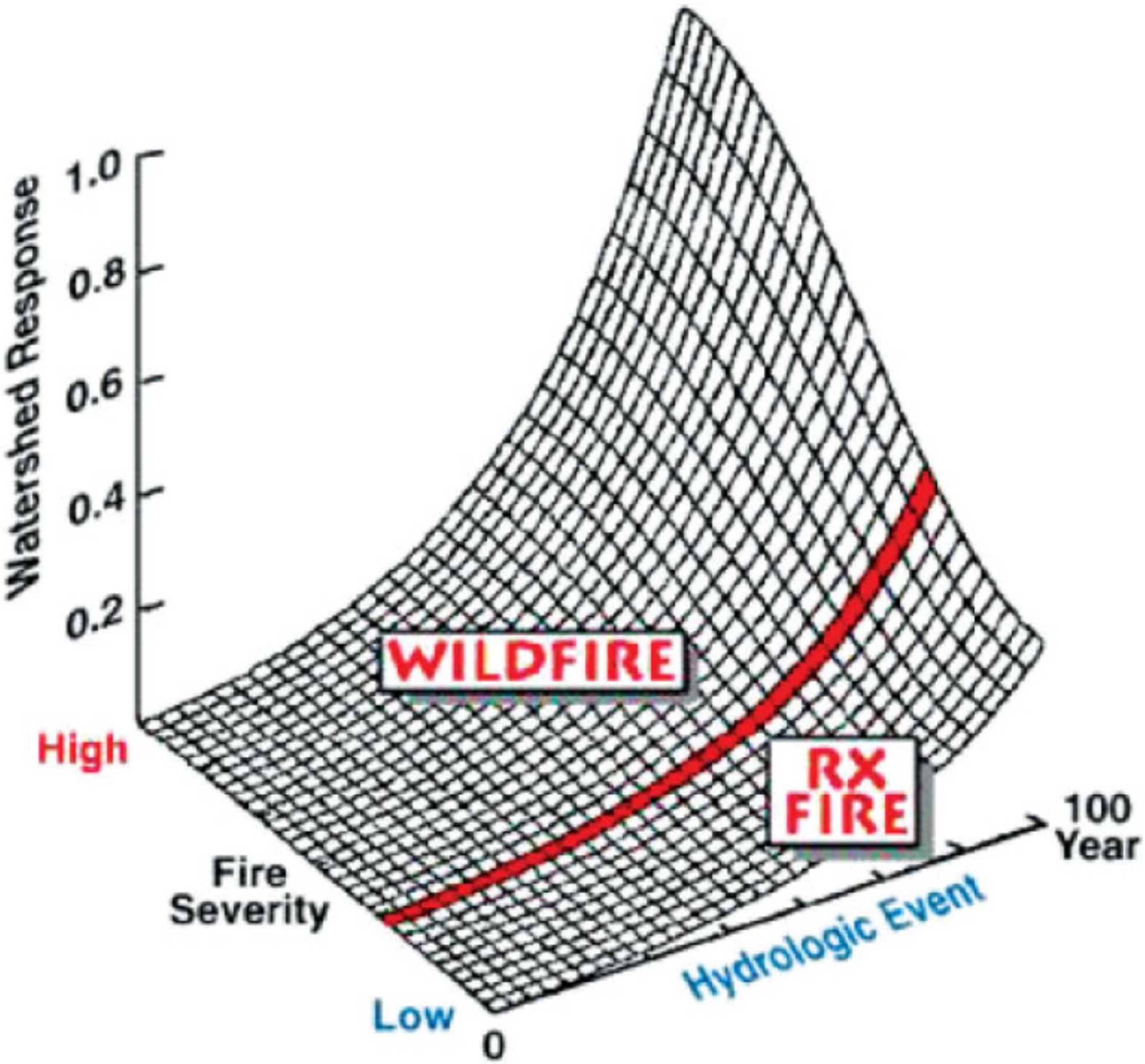
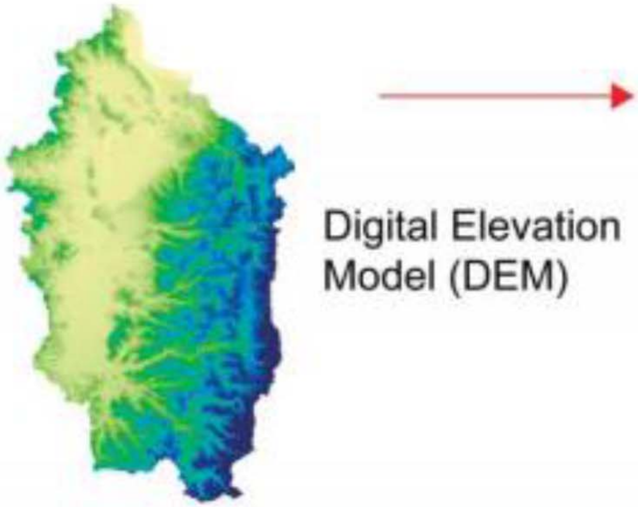
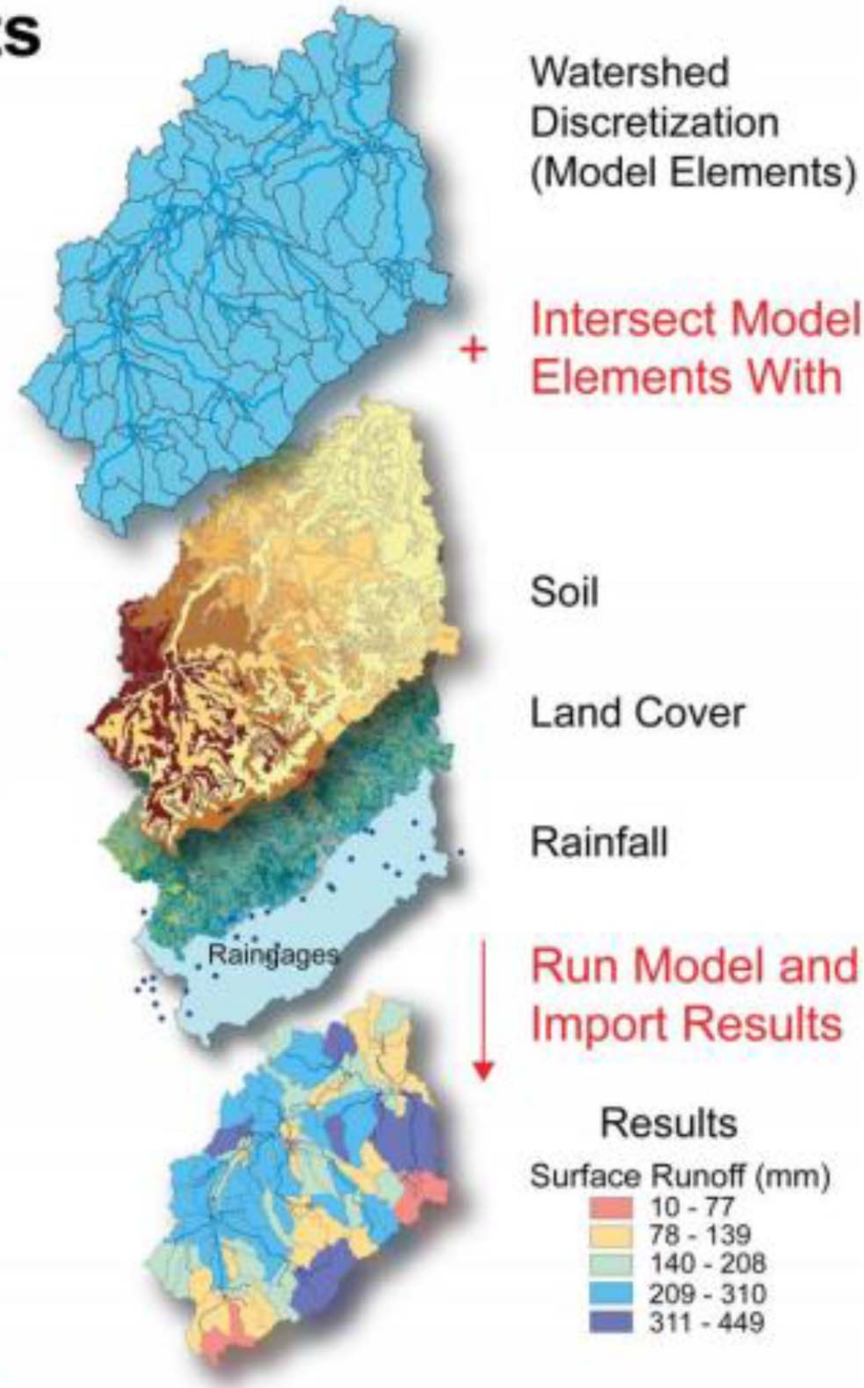



**Figure 1.9**—A conceptual model of watershed responses to fire severity. **(Neary et al. 1985)**

# AGWA Inputs and Outputs




| KINEROS Outputs | SWAT Outputs |
|---|---|
| Channel Infiltration ($m^3$/km) | Precipitation (mm) |
| Plane Infiltration (mm) | ET (mm) |
| Runoff (mm or $m^3$) | Percolation (mm) |
| Sediment Yield (kg) | Surface Runoff (mm) |
| Peak Flow ($m^3$/s or mm/hr) | Transmission Losses (mm) |
| Channel Scour (mm) | Water Yield (mm) |
| Sediment Discharge (kg/s) | Sediment Yield (t/ha) |
| | Nitrate in Surface Runoff (kg N/ha) |
| | Phosphorous in Surface Runoff (kg P/ha) |