

# An Overview of NOAA's National Weather Service Burn Hydrology Efforts

## Results of An Informal Survey

NOAA NWS Western Region Hydrology Science Meeting  
October 4-6, 2005  
Park City, Utah



Unique Hydrological Forecasting Component



# Unique Geo-Hazard Forecasting Component



# ABSTRACT

- A **diverse** compliment of burn hydrology **efforts** has been realized nationwide throughout the NWS in response to the unique hydrological and geo-hazard forecasting concerns presented by these impacted areas. In general these techniques have been developed **ad hoc** and in isolation from each other.
- A **survey** of offices has been conducted by the authors; and an **overview** of known current and planned techniques utilized by the NWS is provided.

# RESPONDING OFFICES

- Colorado Basin RFC
- WFO Tucson, AZ
- WFO Rapid City, SD
- California-Nevada RFC
- WFO Sacramento, CA
- Missouri Basin RFC
- WFO San Diego, CA
- WFO Salt Lake City, UT
- WFO Boise, ID
- WFO Missoula, MT
- WFO Los Angeles / Oxnard, CA
- WFO Spokane, WA

# COOPERATING AGENCIES

- USDA Forest Service
- U.S. Geological Survey
- Other U.S. Department of Interior (NPS, BLM)
- Utah Geologic Survey
- Arizona Geologic Survey
- County Emergency Managers

# FIRE SIZE

## Small to Medium

1. Flash Floods
2. Landslides
3. Debris Flows
4. Hyperconcentrated Flows

## Medium to Large

1. Flash Floods
2. Landslides
3. Debris Flows
4. Hyperconcentrated Flows
5. River Forecasting
6. Water Supply Forecasting

# BURN SEVERITY

## Low

- No Additional Risk

## Moderate to High

- Increased Risk

# OTHER FACTORS

## Where it happens

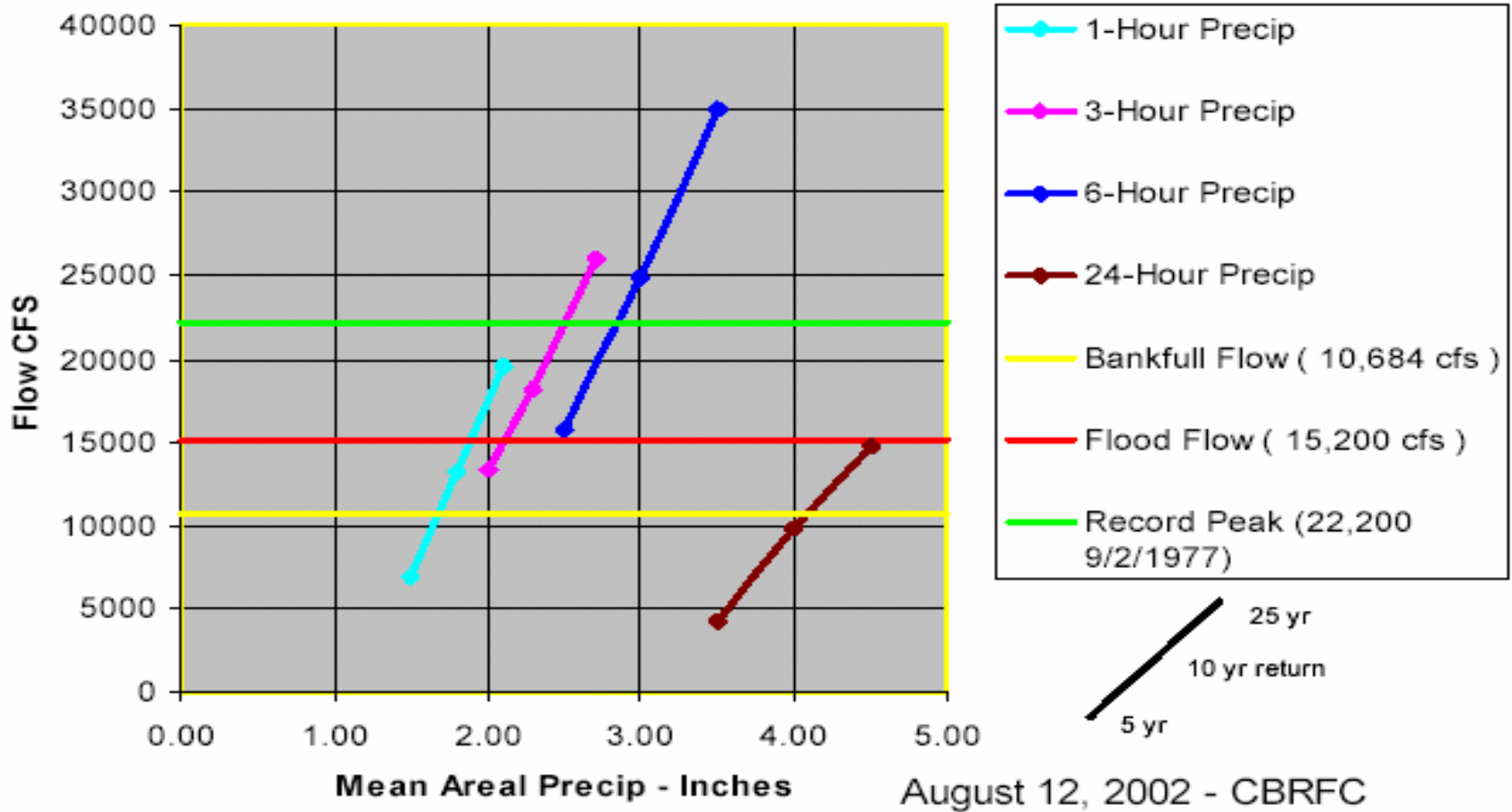
- Geology
- Fluvial  
Geomorphology
- Basin Topography
- Climate

## What happens next

- Rainfall Intensity
- Rainfall Duration
- Rapid Snowmelt
- Timing - Watershed  
Recovery



**Estimated Peak Flows at Cibecue Ck Near Chrysolite  
CBQA3 (old gage)  
For Various Mean Areal Precipitation Amounts  
(Computed from NWSRFS - Adapted to Burn Area)**



August 12, 2002 - CBRFC

# TECHNIQUES

- Dynamic - Event Layers for CBRFC GIS Flash Flood Potential - Greg Smith
- NWSRFS Segment Definition Modification (e.g., reduce upper SMA tank up to 50%; added a little more impervious area) - Terri Hogue
- NOAA-USGS Debris Flow Warning System - Pedro Restrepo

## Static Layers



Soil Type



Forest Cover



Land Use

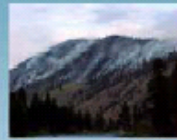


Slope



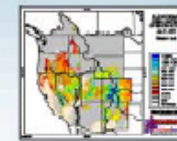
Vegetation Type

## Dynamic - Event Layers

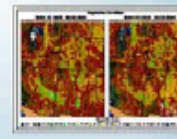


Fire

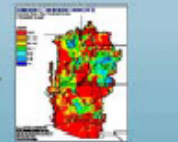
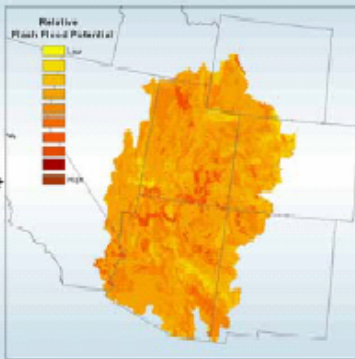
## Dynamic - Seasonal Layers



Snow Cover - Frozen Ground



Vegetation State



Precipitation  
(Grid API Model from MPE Output)

API  
Antecedent Precipitation Index  
A measure of soil moisture based on recent precipitation and a time based recession constant

MPE  
Mesoscale Precipitation Estimator  
Generates hourly gridded precipitation field by creating a multi-scale mosaic, mean field bias adjustment, and merging this information with gage observations

## Dynamic - Daily or Hourly Layers

## TECHNIQUES (cont.)




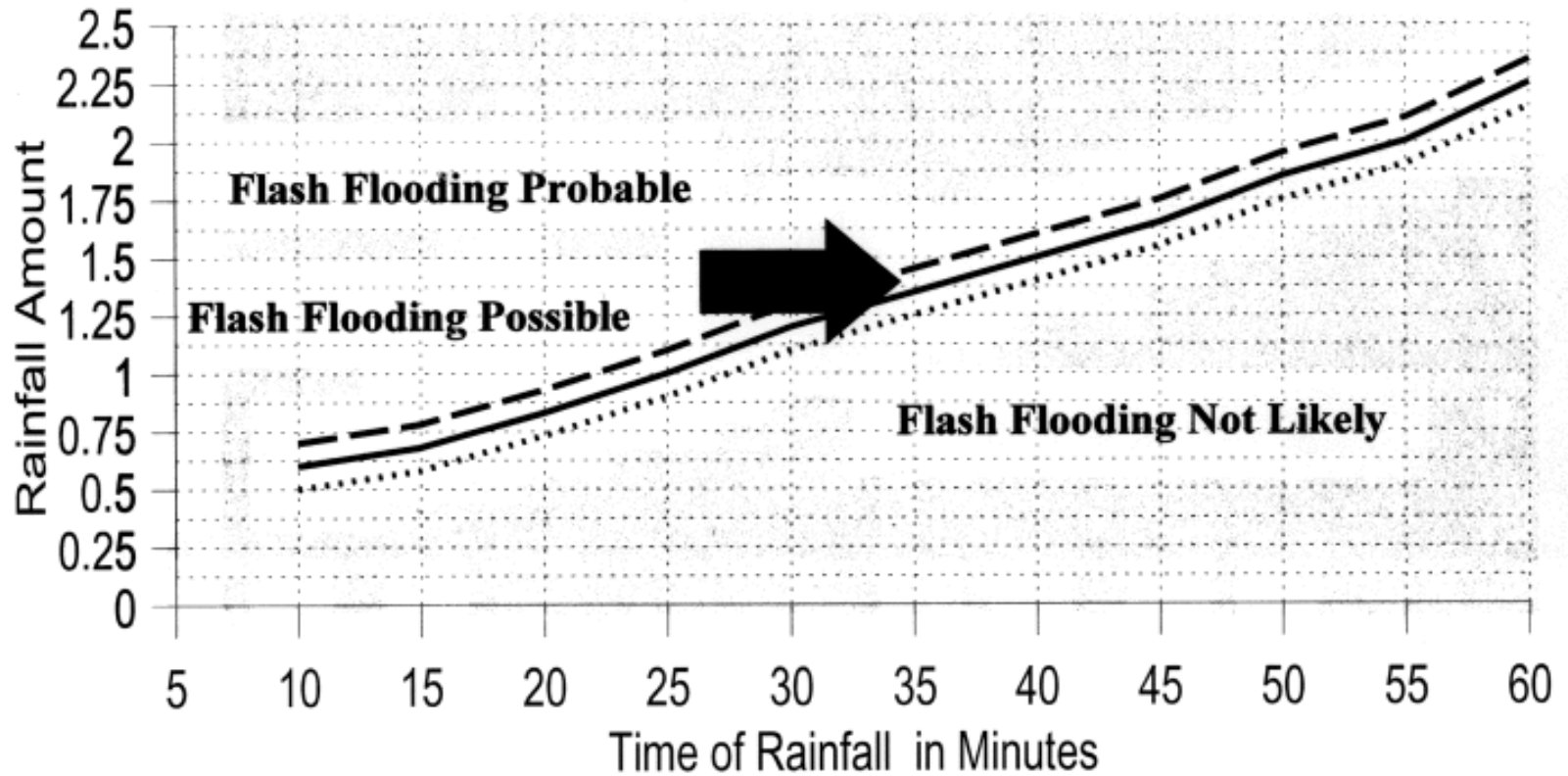
- Rapid-Deployment Data-Collection Networks
- Rainulator Experiment (Boise) 
- Burn Specific  Fixed (Soil Moisture Independent)  NWSRFS FFG Values
- Different Thresholds for Ash Covered (1st Year), Post Ash (1st Year), and 2nd Year

Fig. 1




# Boise Foothills Flash Flood Guidance




— Warning Line



## TECHNIQUES (cont.)

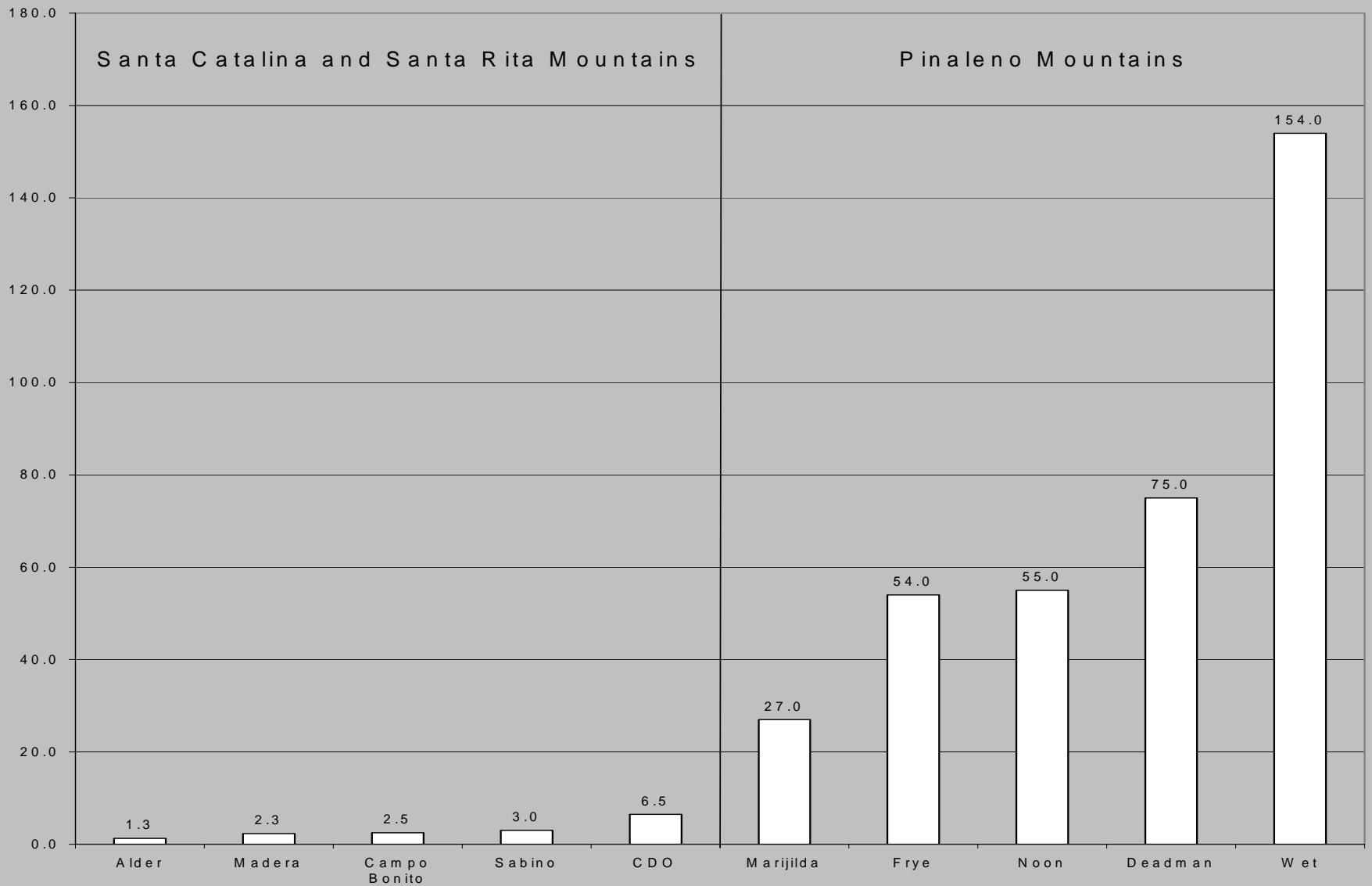
- WFO Sacramento Debris Flow Guidance (Thresholds, Intensities, and Weather Scenarios)
- Boise Foothills Flash Flood Plan 
- Burn Area Emergency Rehabilitation (BAER) Team Involvement 
- Community Awareness / Outreach 

# TECHNIQUES (cont.)

- **Post Burn Studies / Field Trips** 
- 1. **Rainfall Events And Their Effect On Severely Burned Areas Of Western Montana Following The Forest Fires Of 2000, Ray Nickless, Eric Boldt and Craig Neesvig, WFO Missoula, MT**
- 2. **Analysis of Rainfall Triggered Fire-Related Debris Flows at Santaquin, Utah, Brian McInerney, WFO Salt Lake City, UT and Richard Giraud, Utah Geological Survey**
- 3. **Activities of the CBRFC: Support of the Burn Area in Arizona, Dave Brandon, CBRFC (Presentation for WFO-FLG, White Mountain Apache Tribe and Others, August 21, 2002)**
- 4. **Effects of Wildfire in the Mountainous Terrain of Southeastern Arizona: Post Burn Hydrologic Response in Nine Watersheds, Mike Schaffner, WFO Tucson, AZ and William B. Reed, CBRFC**

# Basin Response

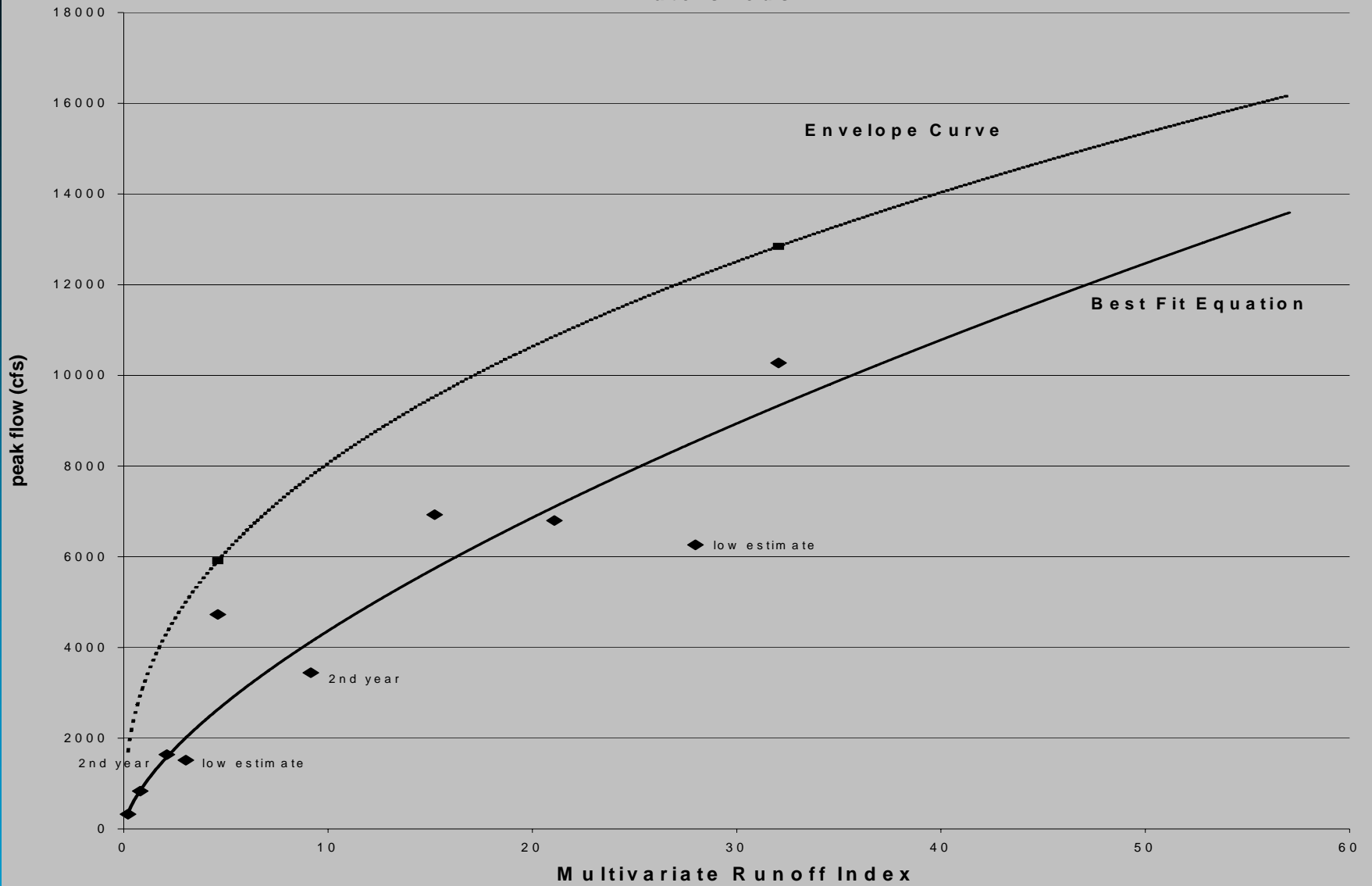
Ratio for 5-Year Events (Post-Burn vs Pre-Burn Flow)



## TECHNIQUES (cont.)

- Analyzed the Effects of High Intensity-Short Duration Rains Vs. Longer Duration Rains on the Burn Areas - Sue Cannon
- Analyzed Increased Runoff from Burn Areas for Various Return Intervals
- For Flash Floods / Water Supply Can Develop Empirical Equations and Regional Regressions...

# An Empirical Equation for 5-Year Post-Burn Runoff from Southern Arizona Watersheds





## TECHNIQUES (cont.)

- Can Also Develop Hydro-Physiographic Discharge Relationships for Ungaged Watersheds
- For Debris-Flow Hazard Analyses Can Be Inferential, Statistical, Process-Based
- NWS WR Hydrology Program Manager's Guide. Chapter 16: Post Wildfire Operational Hydrology (9/2005)

# NEEDS

- National Data Repository
- National Cohesive Program
- Reserved Stock of Gages (including stream) for Rapid Deployment (in addition to the 2,200 RAWS stations)
- Additional Rainulator Experiments ?
- Simplified Fluvial Geomorphologic Classification System ?

# Contributors

- Bill Reed, CBRFC
- Dave Brandon, CBRFC
- Greg Smith, CBRFC
- Mike Schaffner, WFO Tucson
- Teresa Murphy, WFO Rapid City
- Eric Strem, CNRFC
- Elizabeth Morse, WFO Sacramento
- Cindy Matthews, WFO Sacramento
- Bob Cox, MBRFC (since retired)
- Sue Cannon, USGS
- Jim Purpura, WFO San Diego
- Brian McInerney, WFO Salt lake City
- John Jannuzzi, WFO Boise
- Jay Breidenbach, WFO Boise
- Ray Nickless, WFO Missoula
- Jayme Laber, WFO Los Angles/Oxnard
- Charles Ross, WFO Spokane
- Michelle Schmidt, WRH
- Kevin Werner, WRH
- Andy Edman, WRH
- Melissa Smith, WRH
- Terry A Kaplan-Henry, USDA Forest Service



**8:50 Pedro Restrepo (NWS/OHD) The joint NOAA/NWS – USGS Debris Flow Warning System**

**9:10 Sue Cannon (USGS) Post-wildfire debris flows from a Geologic perspective and Rainfall Intensity-Duration Thresholds as the Basis for Post-Wildfire Flash Flood and Debris Flow Warnings**

**9:30 Jay Breidenbach (NWS/WFO – Boise): Science issues associated with the Hot Creek Burn Scar in Central Idaho - a case study.**

**9:50 Terri Hogue (UCLA): Improving the understanding and prediction of post-fire hydrology**

**10:10 Discussion of Session 4: Where can research most help NWS operations? Are there particular areas where collaboration would most benefit both?**