



# The NHWC Transmission

September 2014

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## Implementation of the Sacramento Soil Moisture Accounting Model for Douglas County, Colorado

Markus Ritsch, P.E., Water & Earth Technologies  
Garth Englund, P.E., Douglas County, Colorado

In 2014, Douglas County and the Urban Drainage and Flood Control District, with the help of Water & Earth Technologies, Inc. (WET), implemented the Sacramento Soil Moisture Accounting (SAC-SMA) rainfall-runoff model to provide operational forecasts of stream flow. The SAC-SMA was implemented for a basin coincident with an ALERT and USGS stream gage: East Plum Creek above Haskins Gulch near Castle Rock, Colorado.

The Sacramento model was implemented as a native component within the NovaStar5 data collection base station application which seamlessly integrates SAC-SMA. The ALERT monitoring network provides automated rainfall input to the model. NovaStar5 can be configured to run the SAC-SMA at different time steps ranging from 15 minutes to 6 hours.

The SAC-SMA is a conceptual, lumped parameter model that is a simplified representation of the physical runoff process. The fundamental concept in the SAC-SMA is that the soil column has two soil zones; an upper zone and a lower zone. The first represents the upper soil layer and interception storage while the lower zone represents the bulk of the soil column and ground-water storage. Within both zones there is tension water capacity and free water capacity. Tension water is held tightly to soil particles and can only be depleted as evapotranspiration. Free water can move both horizontally and vertically through the soil profile. Free water can be depleted by evapotranspiration or drained as surface runoff, interflow, percolation and ground-water base flow.

The SAC-SMA is used in conjunction with a unit hydrograph which converts runoff generated from the model into instantaneous discharges. Together the SAC-SMA and unit hydrograph models are used to simulate and forecast hydrologic stream conditions.

The SAC-SMA was selected for three reasons: 1). It is implemented at very low cost because it is native to the currently running NovaStar5 base station software, 2). It is a continuous model that tracks soil moisture conditions through time and 3). A calibrated parameter set was readily available from the National Weather Service (NWS). The NWS also uses the SAC-SMA to prepare river basin forecasts across the U.S.

In Colorado, the NWS runs the SAC-SMA for the South Platte River out of its Missouri Basin River Forecast Center (MBRFC). The NWS forecast point nearest the basins of interest to this project is Plum Creek at Sedalia (shown on the map below). The SAC-SMA parameter set utilized by the MBRFC for Plum Creek at Sedalia was obtained and used to implement the SAC-SMA for East Plum Creek above Haskins Gulch. For 2014, the

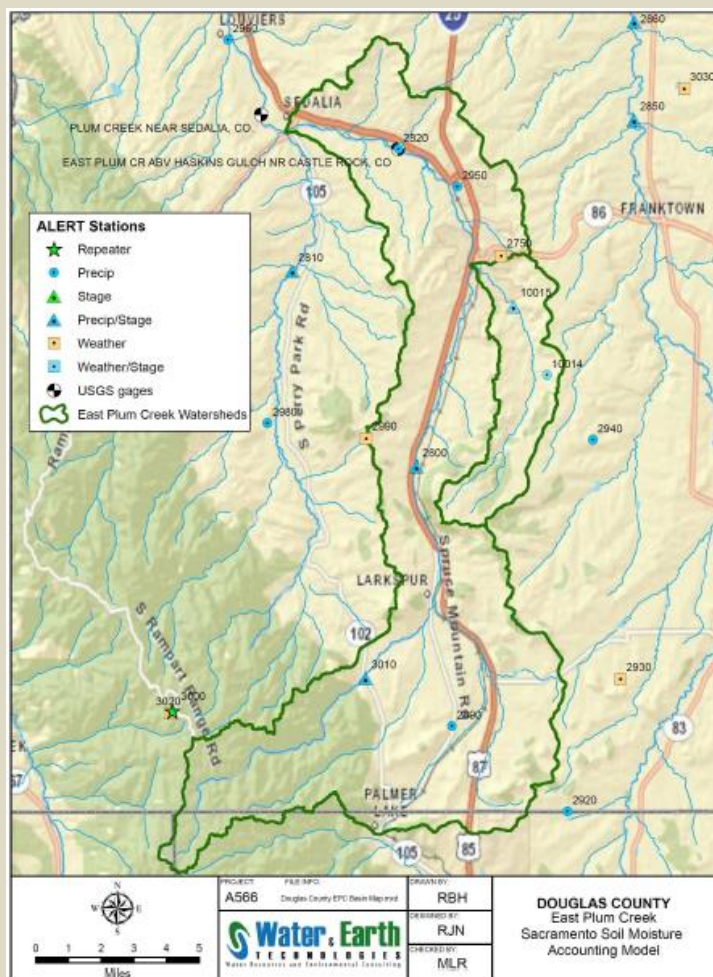
SAC-SMA parameter set obtained from the NWS was used as is.

East Plum Creek is a tributary to Plum Creek. Plum Creek at Sedalia, the MBRFC forecast point, has a tributary area of 275 square miles. East Plum Creek at Haskins Gulch has a tributary area of 116 square miles.

The primary input to the SAC-SMA is basin rainfall. Basin rainfall is derived from the real-time ALERT monitoring network using a predetermined set of station weights to generate a mean areal precipitation time series representative of each basin. The modeled basins along with the ALERT gages in the basin are shown on the map below. Station weights are assigned within NovaStar5 which then generates the basin rainfall time series and supplies this time series to the SAC-SMA.

The first real test of the SAC-SMA occurred on July 12, 2014. This day produced heavy rainfall in the late afternoon and into the evening during a 3-hour storm with rain totals exceeding two inches.

From a meteorological perspective, deep low level moisture was in place due to thunderstorm outflow boundaries that pushed through during the previous night. The resulting training thunderstorm cells prompted Flash Flood Warnings to be issued by the NWS in Douglas County.



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The USGS at East Plum Creek above Haskins Gulch recorded a peak discharge of 1,180 cfs at approximately 9:00 PM on July 12, 2014. The USGS station stopped recording data just before midnight on July 12.

NovaStar5 runs the SAC-SMA on a 15 minute time step producing forecasts that extend one and a half hours into the future. The model runs continuously every 15 minutes. The plot below shows the simulated flow

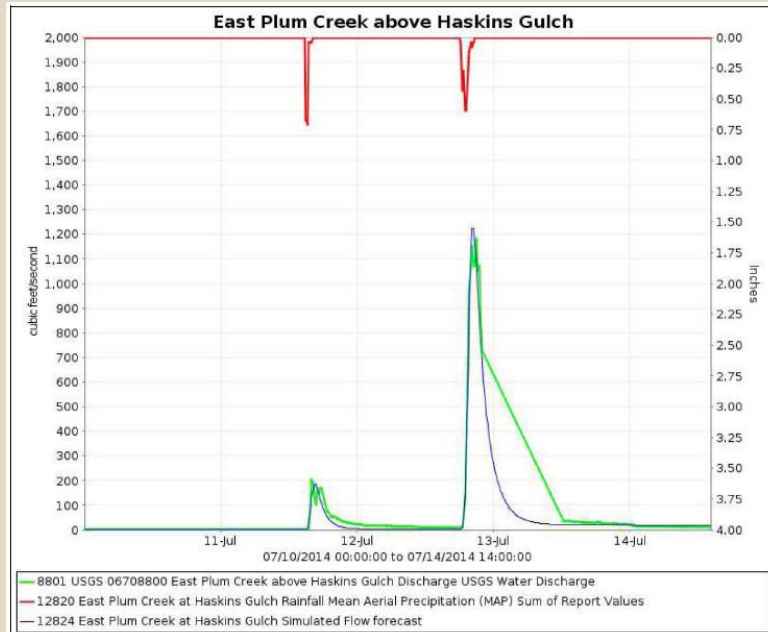


Figure 2: NovaStar5 Simulated Flow Forecast for July 12 Storm.

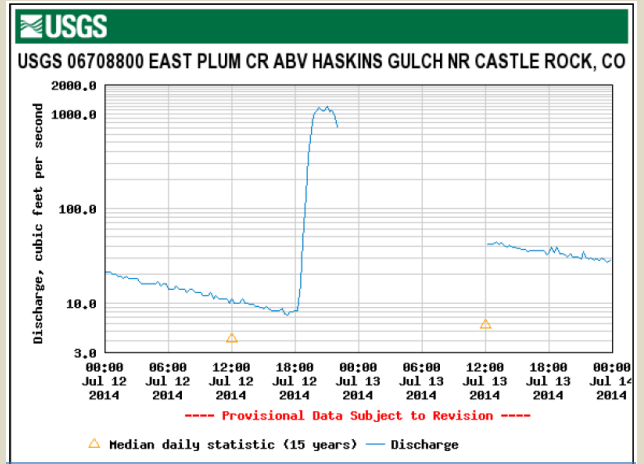


Figure 1: USGS Instantaneous Discharge for July 12, 2014

forecast (blue line) relative to the USGS discharge (green line) for the period July 11 through July 14, 2014. The basin rainfall (red line) is plotted vertically from the top of the plot. The observed data from the USGS below includes an artificial interpolation for the period of missing data. Overall, the NovaStar5 SAC-SMA flow forecast matches the discharge measured by the USGS very well. The County is encouraged by this preliminary result and hopes to add alarm and notification functionality to the simulated flow forecast to obtain additional lead time in the notification of emergency responders.

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WHEN MEASUREMENTS MATTER

## Evaluation of the Operational use of the KINEROS2 Model in Fish Creek near Anza Borrego, CA

Michael Schaffner, NWS, Western Region Headquarters  
Alexander Tardy, NWS, San Diego Weather Forecast Office  
Jayme Laber, NWS Oxnard Weather Forecast Office

In the May 2014 issue of the NHWC Transmission, the authors highlighted the publication of a NWS Western Region Technical Attachment on the application of the KINEROS2 model to the Fish Creek watershed near Borrego Springs, California. Fish Creek is an ungauged flash flood prone semi-arid basin within Anza Borrego Desert State Park. The model is a real-time event-based distributed model which was calibrated with rainfall events representing a full spectrum of flash flood events up to the flood of record. The model was first run operationally in real-time at the NWS San Diego Weather Forecast Office (WFO) this monsoon season. The purpose was to evaluate the performance of the model versus actual flash flood events for Fish Creek, compare its output to existing flash flood forecasting tools available to the NWS forecaster, and engage the State Park in enhanced Decision Support Services for this location. The model's output is a forecast hydrograph used to make categorical forecasts of the projected flash flood peak (i.e. no flooding, minor flooding, moderate flooding, or major flooding).

On the afternoon of August 3, 2014, heavy rain fell on the lowermost portions of Fish Creek. An areal average rainfall of 0.75 inches from the start of the rainfall event to the time of the simulated peak flow was noted. The simulated peak flow of 3,473 cubic feet per second (cfs) equated to a low-end moderate flood event. The authors conducted a field visit to Anza Borrego State Park on August 13<sup>th</sup>. State Park Ranger Steve Bier escorted the group through Fish Creek drainage. Roadway damage was observed at Split Mountain Road which is located a short distance downstream of the modeled point. Further upstream near the modeled location in Split Mountain, high water marks on sandstone indicated a peak flow 6 to 7 feet deep with rock and silt debris as high as 10 feet. Further upstream near the confluence of the mainstem Fish Creek and the North Fork, a State Park road sign was discovered. It had been removed from its original location by the flash flood and transported one mile downstream. Steve described the event as a moderate flood event based on what he had seen that day in the field and his long standing local knowledge as a park ranger. ➡

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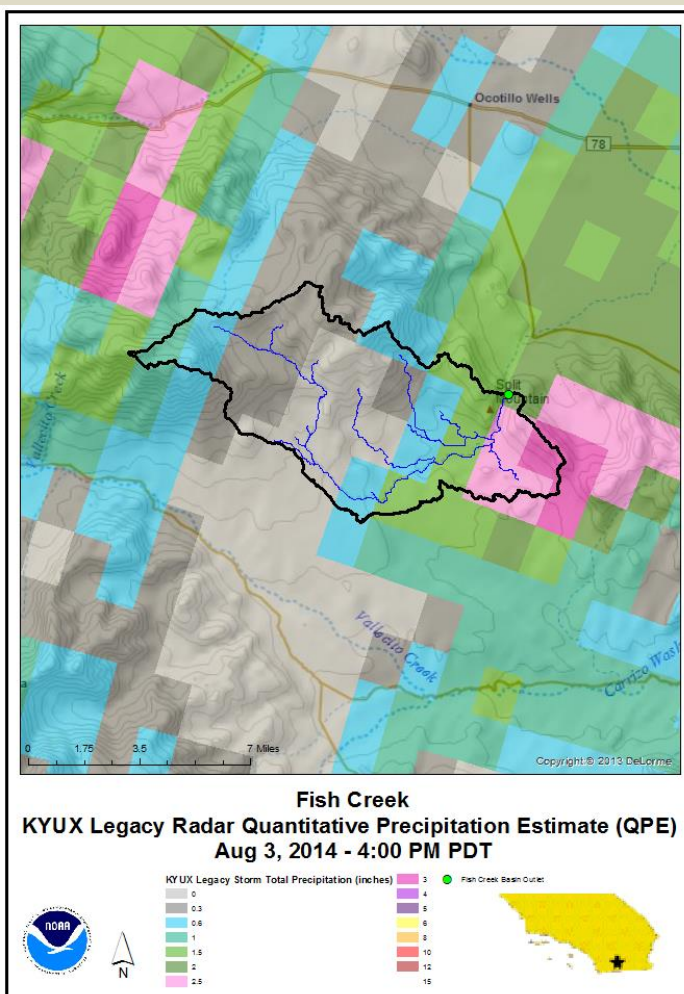
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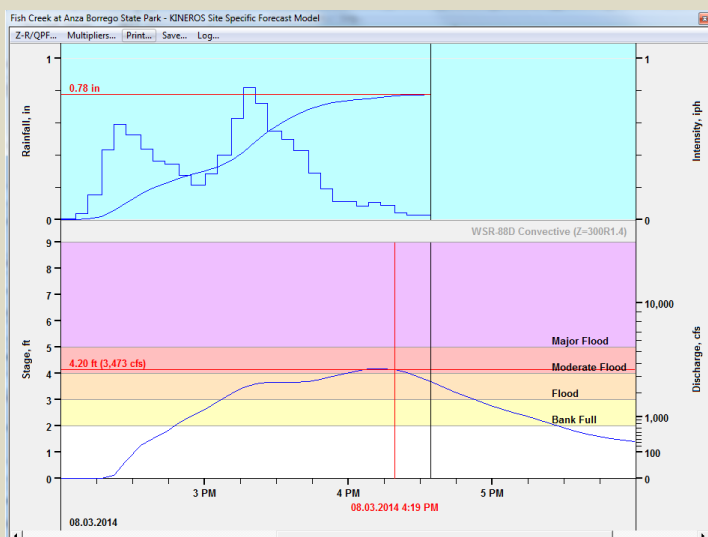
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Based on our field visit, the KINEROS2 model simulated a peak flow that fell into the appropriate flood category of moderate flooding. This is important since it not only verifies the model during an actual event, but demonstrates that categorical forecasting is possible in semi-arid ungaged canyon locations using a distributed model forced with real-time radar data being run at a WFO. In terms of lead time, the model provided approximately 1 hour and 30 minutes of lead time for minor flooding, and 30 minutes of lead time for moderate flooding. Lead time for minor flooding was well in excess of both national flash flood lead time metrics. Going forward, the WFO plans to see how best to use the output from the model, apply modeling to other flash flood drainages, as well as improving their Flash Flood Potential Index to provide added situational awareness to the State Park and its visitors.



Radar precipitation over the Fish Creek basin on August 3, 2014.

Screen capture from KINEROS2 model for Fish Creek run in real-time at NWS San Diego operations during the afternoon of Sunday, August 3, 2014.



Registration is open!

## Pacific Northwest Advanced Flood Warning System Workshop

Act now to receive free 2015 NHWC membership and to reserve discounted hotel rates!

Join the NHWC for a workshop on advanced flood warning system technologies and communication strategies. The workshop is scheduled for October 21-22, 2014 in Grand Mound, WA, on I-5 midway between Portland and Seattle.

The workshop will be held at the Great Wolf Lodge in Grand Mound, WA. For those intending to stay at the Great Wolf Lodge, you must make your reservation by September 20th in order to receive the special \$94 rate. Register on the NHWC [Pacific Northwest Workshop Website](#) before October 1<sup>st</sup> to receive free membership in the NHWC for 2015. (\$110 value)

The workshop is designed for floodplain managers, owners and operators of existing hydrologic warning systems, river authorities, emergency managers, flood control districts, public works officials, owners and operators of high hazard dams and levees, drainage and flood control engineers, and any others who have a need to better understand the benefits of hydrologic warning systems in managing flood risk. Certified Floodplain Managers who attend the workshop will be eligible to receive 12 core Continuing Education Credits.

Find out how to become a sponsor or exhibitor on the [Pacific Northwest Workshop Website](#). A copy of the preliminary agenda is also posted there. For more information, email: [workshop@hydrologicwarning.org](mailto:workshop@hydrologicwarning.org). To join or to learn more about the NHWC, please visit our website at [www.hydrologicwarning.org](http://www.hydrologicwarning.org)

# ASFPM National Flood Mitigation and Floodproofing Workshop

*Post-Disaster Mitigation,  
Flood Proofing and  
Watershed Restoration:  
Investing in Resiliency*

October 27 - 30, 2014  
Omni Interlocken Hotel  
Broomfield, Colorado

Flooding is the nation's #1 hazard. Add to that a lot of infrastructure and development that is either at moderate or high risk of flooding. How do we mitigate against this flood risk? How do we make sure what is being developed now isn't at risk in the future?

The National Flood Mitigation and Flood- Proofing Workshop focuses on these questions and you will learn tools and techniques that floodplain managers, emergency mangers, property owners, and others can use to reduce flood risk.

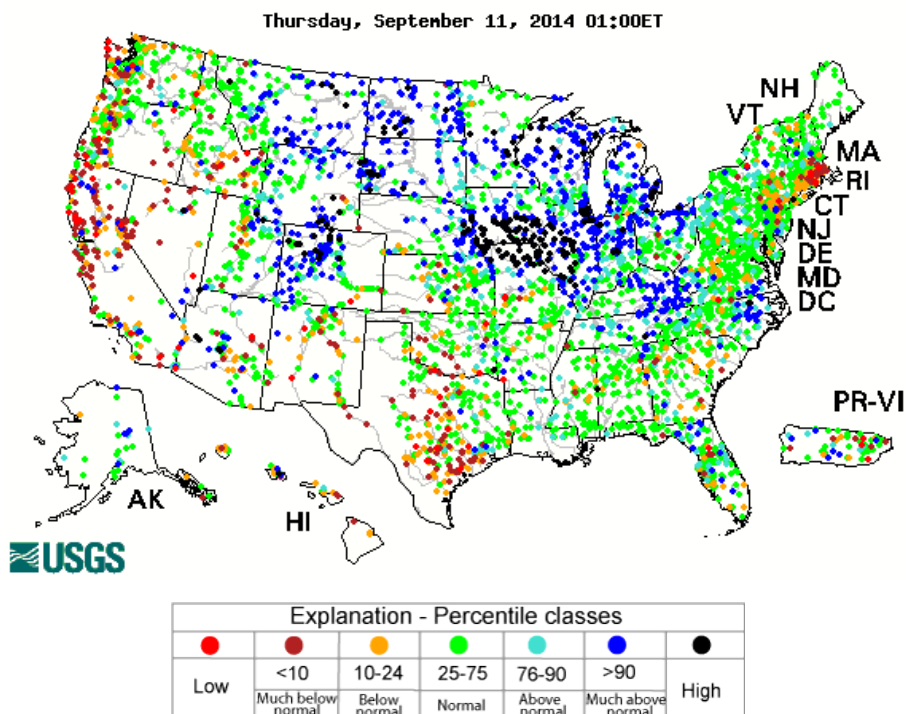
For full workshop details and the registration form please visit the workshop [webpage](#).

## September is National Preparedness Month

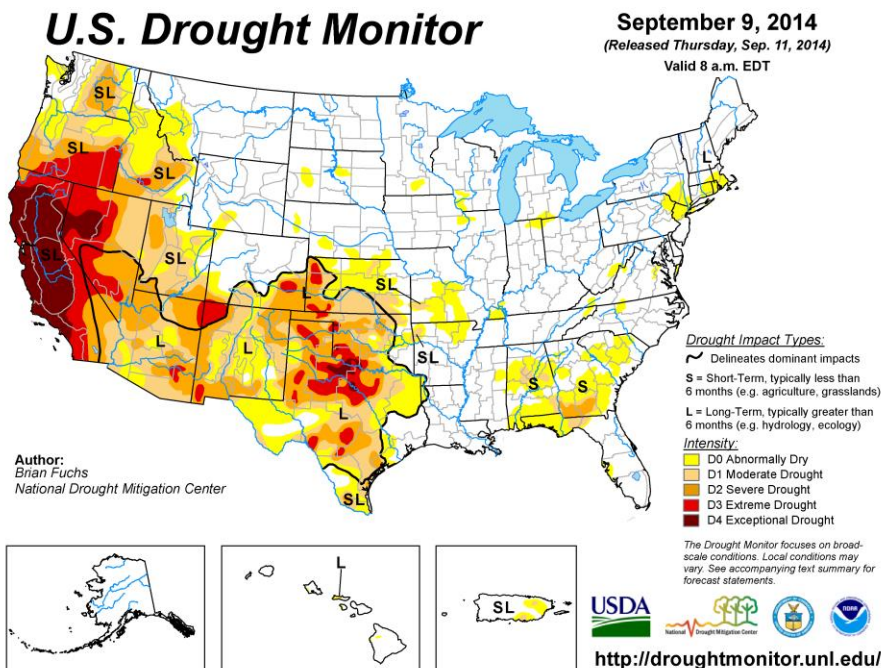
Click on the image below to find out how you can help your community become better disaster aware.



## Hydrologic Conditions in the United States Through August, 2014



Latest stream flow conditions in the United States. (courtesy USGS)



Latest drought conditions in the United States.  
(courtesy National Drought Mitigation Center)

## October Newsletter Articles Focus: Data Collection

The NHWC is requesting articles that focus on practices, technologies and tools used to gather and disseminate real-time hydro-meteorological data.

Please consider writing an article that highlights how your organization collects and disseminates real-time data.

Submit your article to:

[editor@hydrologicwarning.org](mailto:editor@hydrologicwarning.org)

October 3<sup>rd</sup> is the deadline for inclusion in the October issue.

## Future Newsletter Articles Focus

To give you more time to prepare articles, below is the article focus schedule for the next four months:

**Oct - Data Collection**

**Nov - Hydrology**

**Dec - Hazard**

**Communication &  
Public Awareness**

**Jan - Modeling/Analysis**

## NHWC Calendar

October 21-22, 2014 - [Pacific Northwest Advanced Flood Warning System Workshop](#), Great Wolf Lodge in Grand Mount, Washington

November 4-5, 2014 - 6<sup>th</sup> Annual Texas Flood Warning Workshop, Grand Prairie, Texas

June 15-18, 2015 - NHWC 2015 Training Conference & Exposition, Indianapolis, Indiana

## General Interest Calendar

September 21-25, 2014 - [Dam Safety National Conference](#), San Diego, California

October 16, 2014 – [ALERT User's Group 2014 Fall Workshop](#), Riverside County Flood Control and Water Conservation District, 1995 Market Street, Riverside, California 92501

October 27-30, 2014 – [ASFPM National Mitigation Flood Proofing Workshop](#), Broomfield, Colorado

(see the [event calendar](#) on the NHWC website for more information)

## Parting Shot



ALERT precipitation gauge on Somerset Dam, Queensland, Australia. August 26<sup>th</sup>, 2014.

Photo by David Curtis, WEST Consultants Inc., NHWC President

## National Hydrologic Warning Council

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Property, and the Environment*

<http://www.hydrologicwarning.org>