The NHWC Transmission

October 2016

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NHWC 2015-17 Officers and Directors

Harris County Flood Warning System 2016 Flood Test – Passed!

Mark Moore, Steve Fitzgerald, Jeff Lindner, Harris County Flood Control

In 2009, the Harris County (Texas) Flood Control District (HCFCD) began a deliberate effort to restore the Harris County Flood Warning System into a reliable and accurate source of real-time hydrological data for the HCFCD, National Weather Service, local officials, and the public to rely on to make decisions before, during, and after storm events. All components of the system as well as the warning system staff and managers were carefully scrutinized and improvements identified and made. A goal established in 2009 was to begin conversion to an evolving technology - ALERT2. The April 17-18, 2016 (Tax Day) flood put the entire system and staff to the test.

In 2014, the four objectives for the final ALERT2 implementation phase were:

1. Deploy reliable and durable ALERT2 field transmitters and supporting equipment to improve data transmission efficiency.
2. Standardize gage station setups for maximum consistency and system simplification.
3. Improve the technical capabilities of technicians in all field equipment and data resilience.
4. Reduce reliance on consultants and vendors to a minimum.

By December 2015, the HCFCD had completely met these objectives. Gage sites were standardized, creating consistency and system simplification, and new gage equipment, including ALERT2 transmitters, were installed at 140 gage sites across Harris County. Solar panels were upgraded to provide more power, and new antennas were installed to allow better radio transmissions. The previously installed NEMA enclosures were inspected and sealed to prevent moisture from damaging the electronics. A multi-week training program provided instruction to technicians and management on proper system installation, operations, and trouble-shooting. Mastering the skills and knowledge was a requirement for technicians prior to installing and maintaining the ALERT2 gage sites and network components.

During the first preventative maintenance cycle of the newly upgraded equipment in the spring of 2016, the success of the implementation was noticeable. Rain calibration error was found to be on average 0.6% error, less than the HCFCD's 3% allowable. Tape down water level measurements were found to be 0.08 foot different on average than sensor measurements, better than the 0.10 foot allowable. The NEMA enclosures were found free of moisture with no corrosion to connectors. Compared to the cumbersome legacy canisters (see Figure 1), the back mounted

transmitters allowed technicians to efficiently perform thorough maintenance and calibration tasks (see Figure 2).

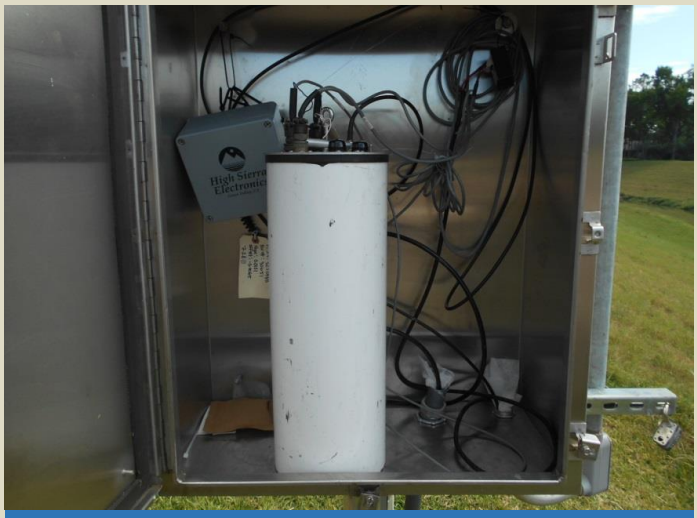


Figure 1 – The legacy ALERT configuration was cumbersome and caused unnecessary difficulty in maintenance. Included in the conversion effort was improvement to enclosure configuration.

Figure 2 – The ALERT2 back mounted configuration allows easy access to all components, reducing on site maintenance time.

The 2016 Tax Day flood fully tested the ALERT2 data collection resilience and durability. An exceptional high rainfall event occurred in a12-hour period with nearly half of the county receiving rainfall of 8" (2% exceedance probability, 50-yr) or higher, and the west and northwest portions of the county receiving up to 16 inches (0.1% exceedance probability, 1,000-yr) (see Figure 3). Over a 15-hour period, the HCFCD flood warning network reported nearly 40,000 data points on rain, water level, weather conditions, and site specific status.

Analysis of the collected data indicates that over 99% of the data reports transmitted were successfully received. Comparable events using the legacy ALERT protocol resulted in less than 65% successful radio transmissions in the HCFCD network.

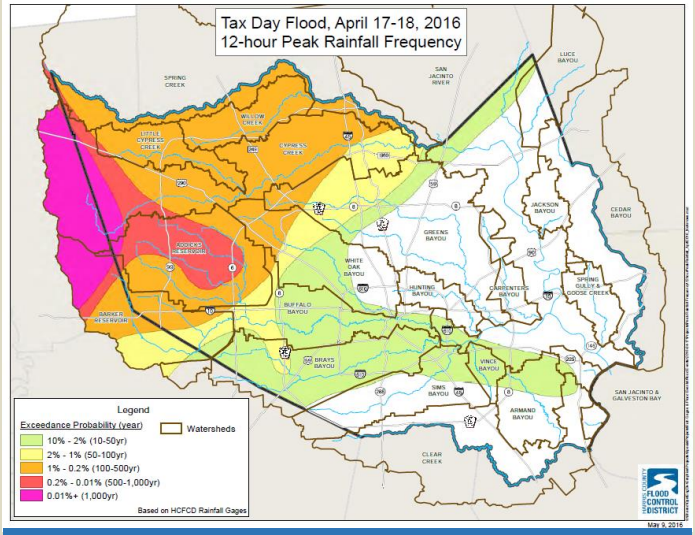
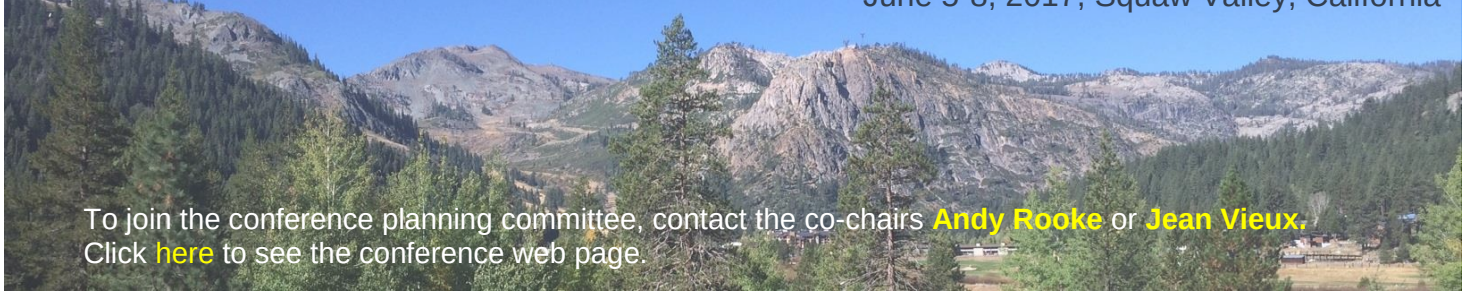


Figure 3 – 12-Hour Peak Rainfall Frequency for Tax Day Flood.

It is important for Flood Warning System owners, operators, and technicians to take all necessary steps to properly maintain, operate, and improve their networks. This includes careful planning and execution of system expansion and establishing standard operating procedures which have built-in accountability to ensure that remote stations, telemetry networks, base station servers and software are maintained for high availability. Finally, strategic funding and support by management and comprehensive skills training for technical team members are critical to the long term success of any flood warning program.

2017 National Hydrologic Warning Council Training Conference & Exposition

June 5-8, 2017, Squaw Valley, California



To join the conference planning committee, contact the co-chairs **Andy Rooke** or **Jean Vieux.**
Click here to see the conference web page.

The Journey Migrating Southern California's Flood Warning Systems to ALERT2

Ron Marotto P.H., Ventura County Watershed Protection District

As advancements were made in ALERT *(Automated Local Evaluation in Real Time)* agencies started to contemplate how they would be able to afford the cost in upgrading their existing flood warning systems from ALERT to ALERT2. Some of the Southern California Counties got their answer when the Department of Water Resources *(DWR)* offered a Flood Emergency Response Grant *(FERG)* in California. Ventura County Watershed Protection District took the lead with the DWR FERG which included five other County agencies and two National Weather Service *(NWS)* offices.

The first FERG awarded $839,356 to mainly cover the backbone of Southern California's ALERT networks *(SCAN)*, including repeaters and base stations.

A network study that covered all of Southern California was completed as part of the first FERG. This network study laid out options for making the transition as seamless as possible without losing large parts of the network for extended periods of time. The plan also laid out how to separate the dependencies on neighboring counties which, in the past, had to work in conjunction with each other in order to deliver the real-time data to the NWS via radio telemetry as required.

The transition to ALERT2 needed to be well coordinated as SCAN systems were entwined and lacked redundancy, leaving the network vulnerable to single point failures which could leave NWS offices without data feeds *(Figure 1)*.

An ALERT2 training paid for through the first FERG informed SCAN and other stakeholders of the new ALERT2 technology and how the transition to ALERT2 could occur for the SCAN stakeholders.

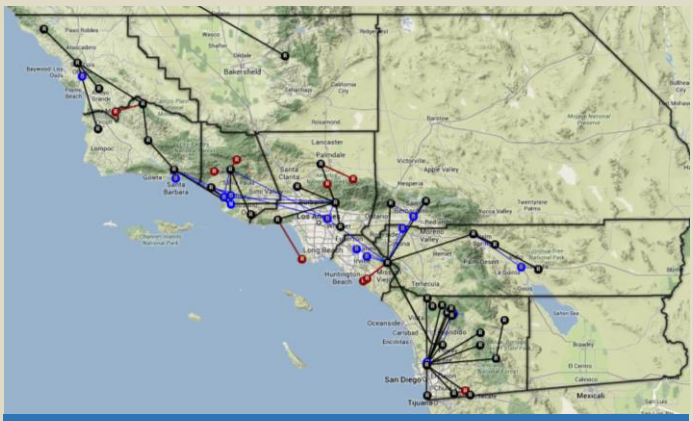


Figure 1: Southern California Legacy ALERT Network Backbone

With the network study and the training complete, it was time to move forward to simplify the systems by removing the interdependencies of the neighboring counties' telemetry networks. This was accomplished primarily by replacing the legacy ALERT base stations located at the NWS offices with a simple and reliable method of shipping standard hydro-meteorological exchange format (SHEF) data using FTP (File Transfer Protocol) over TCP/IP (the Internet).

In effect, the reliability attributed to a conventional off-grid legacy ALERT repeater backbone was traded for the reliability afforded by a simpler system which requires much less intervention by NWS personnel. This strategy also relieved Southern California NWS offices of the burden to purchase, install, learn and maintain ALERT2 infrastructure. An added benefit is a marked general decrease in flood warning radio telemetry traffic in Southern California and distributed, non-redundant management of sensor metadata.

Through the first FERG, agencies were able to purchase ALERT2 demodulators for their base stations along with repeaters, concentrators and a few field station transmitters. Later, the first FERG was amended to fund purchase of ALERT2 field demodulators for station setup and testing.

The second FERG award of $780,674 financed purchase of additional field station transmitters for the SCAN's to help the represented agencies transition their flood warning systems to ALERT2.

It appears likely that there will be a third DWR FERG. The SCAN counties that have been working together through the first two FERG's look to be joined by two more counties in applying for the third grant as they now see the progress made when projects are funded through outside sources like the DWR FERG's.

The new ALERT2 protocol, with its ability to deliver data at higher rates with less error and better reported radio propagation, coupled to TDMA *(Time Division Multiple Access)* technology, which prevents data packet collisions, has brought the future to the present.

California Investments in Modern Precipitation Monitoring Methods for Water Management

Michael Anderson, California State Climatologist

Extreme precipitation events and storms that make up the bulk of water year accumulations of both rain and snow in California have been tied to atmospheric river events (Dettinger et al., 2011). California is making investments to better monitor and track these important storms and use the information to help manage water resources.

Atmospheric rivers (AR) are relatively narrow bands (hundreds of kilometers wide) of atmospheric moisture with ties to the tropical region of the Pacific Ocean (thousands of kilometers long) as seen in Figure 1 below.

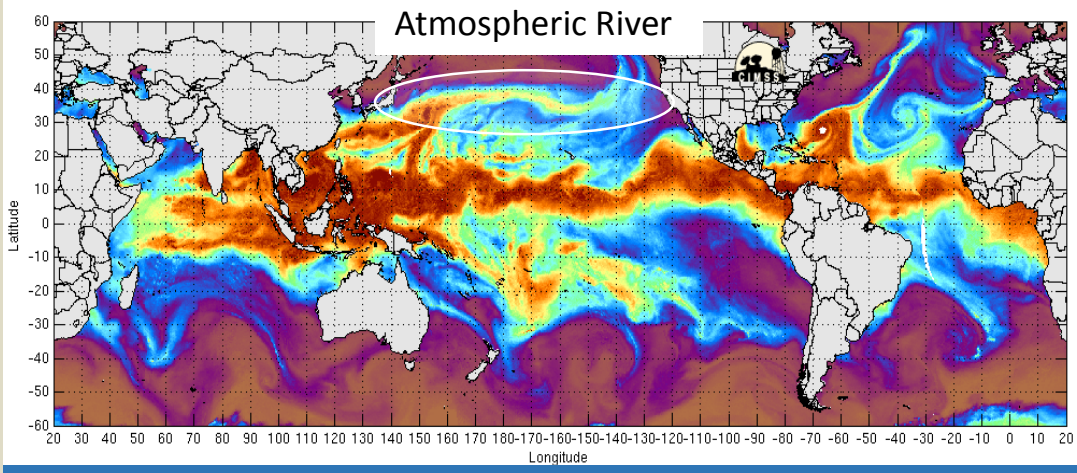


Figure 1. This image shows satellite detection of water vapor in atmospheric rivers over the oceans. An atmospheric river extending from the western Pacific towards North America is circled showing the relatively narrow width and long length of the high concentration water vapor.

The high moisture content air noted by the warmer colors is located in the lowest 15,000 feet of the atmosphere. That moisture combined with strong winds and California's topography can produce rainfall events that rival land-falling hurricanes of the Gulf States and East Coast. In the extreme case, they can produce significant flood events; in many other cases they provide beneficial rain and snow during California's limited rainy season. Ninety percent of California's annual precipitation falls between October and April with fifty percent, on average, falling between December and February. Only a handful of storms make up the bulk of California's wet season.

Two California Department of Water Resources (DWR) efforts have evolved from research conducted as a part of the National Oceanographic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) Hydro-meteorological Testbed (HMT) effort in Northern California. The first effort is the investment in instruments tested during HMT to create a statewide Extreme Precipitation Network. The second monitoring effort is part of the Bay Area Regional Integrated Water Management investment that will install a number of observing elements including a variety of radar instrumentation to facilitate water management in the San Francisco Bay Area. The broader program for the Bay Area is called the Advanced Quantitative Precipitation Information Project (AQPI). Each of these efforts is described in the following paragraphs.

The state-level Extreme Precipitation Network consists of three atmospheric monitoring elements:

- coastal atmospheric river observatories,
- atmospheric water vapor content, and
- snow level radar.

Figure 2 shows the Extreme Precipitation Network sensor locations.

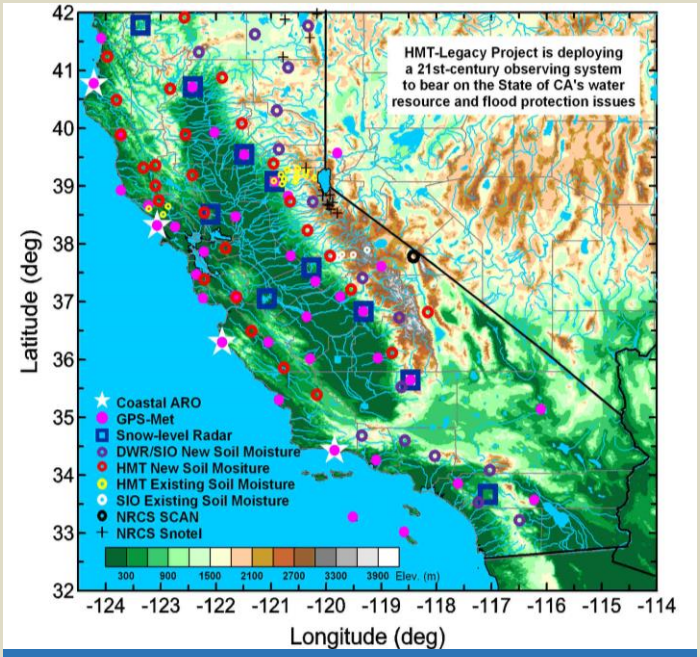


Figure 2. Map of 21st Century Extreme Precipitation Observing Network

There are four California **coastal atmospheric river observatories** located at McKinleyville, Bodega Bay, Point Sur, and Santa Barbara. Each observatory is made up of standard weather instrumentation (precipitation, temperature, and solar radiation) along with atmospheric water vapor sensors and a wind profiler. Figure 3 shows the Bodega Bay wind profiler. The wind profilers provide a detailed

Figure 3. Picture of the Bodega Bay wind profiler as part of the Bodega Bay Atmospheric River Observatory. Photo by Clark King, NOAA ESRL.

picture of the vertical structure of the winds which, when combined with the atmospheric water vapor sensor data, can provide information on how much water vapor flux is coming onshore with a given AR event.

The **atmospheric water vapor content** sensors are actually GPS sensors that, when combined with meteorological instrumentation, can provide the amount of water vapor in the atmosphere above the sensor. Prior to this effort, total column water vapor was visible by satellite only over open water. HMT research showed that different thresholds of atmospheric water vapor content have been tied to different levels of extreme precipitation. The GPS units are part of an observing network for tectonic activity in the State. The meteorological instrumentation not only provides the water vapor information but enables improved signal information for the tectonic monitoring. This component of the network is an evolving partnership between the Plate Boundary Observatory, ESRL, and DWR.

The **snow level radar** units are vertically pointing radars that can identify the freezing elevation during precipitation events. Freezing elevation is a key factor in determining the potential of the atmospheric river event to cause flooding or provide beneficial input to California's water resources. Figure 4 shows the snow level radar installations at Shasta Dam.

Figure 4. Snow Level Radar at Shasta Dam. Photo by Clark King, NOAA ESRL.

The second effort, AQPI, is a DWR investment in the Bay Area Integrated Regional Water Management Group (IRWM) that provides funds for the IRWM members to invest in a combination of new observing equipment, data assimilation, modelling, and decision support tools that will help inform a range of water management decisions from storm-water management to operation of recharge basins to reservoir management. The new observing equipment includes a variety of instruments including some new radar installations. The effort will also engage researchers from ESRL during the planning, construction, and installation of the new equipment. As the program evolves, efforts will be made to blend information from AQPI and the Extreme Precipitation Network. Further decision support tools and graphics will be developed with assistance from the Center for Western Weather and Water Extremes (CW3E) located at Scripps Institution of Oceanography. With these new monitoring methods, California is poised to bring the best science available to water management and flood forecasting.

NHWC Texas Workshop, November 2-3, 2016, San Antonio, Texas

There's still time to **register** for the Texas Workshop! The agenda includes presentations from local agencies, consultants, vendors, TWBD, TCEQ, USGS, NWS, and USACE. Topics include 2016 flood experiences, flood warning system performance and improvement ideas, effective public communication methods, flood risk reduction ideas, ants, weather outlook, dam safety and operations, and NOAA Atlas 14 status. We hope to see you there.

NWS Watch, Warning and Advisory Survey for Decision-makers

NOAA's National Weather Service (NWS) is conducting a survey to gauge how decision-makers, such as water managers, use NWS watches, warnings and advisories. Your feedback will play an important role in any decisions on how to improve NWS hazard messages.

This survey is part of the NWS Hazard Simplification Project, which is analyzing the use and effectiveness of NWS watches, warnings and advisories, and evaluating possible alternatives to these terms. The survey assesses the extent to which organizations (at all levels and in various sectors) have formally incorporated watches, warnings and advisories into their decision-making processes via policies, protocols, laws, etc. For instance, are there water management entities with a written policy that says if a Tornado Watch is issued, then XYZ needs to happen?

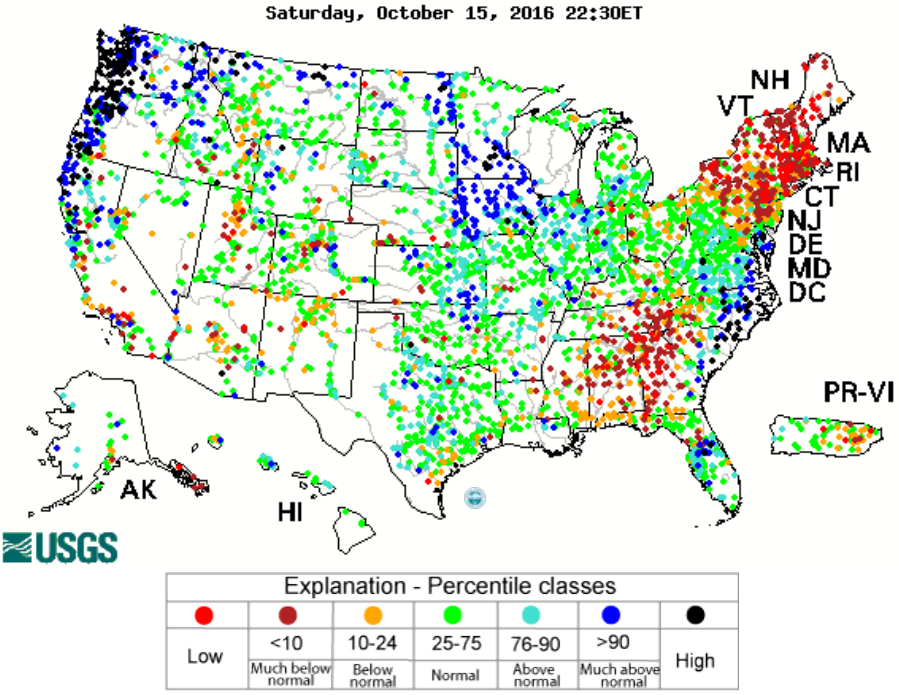
Survey answers will help the NWS understand the potential policy impact on various key partners if it significantly changes watches, warnings or advisories, such as altering the meaning or name of a particular watch, warning or advisory.

This survey will close after **October 31, 2016**. To take the survey, please visit **https://www.surveymonkey.com/r/62DX6TC**.

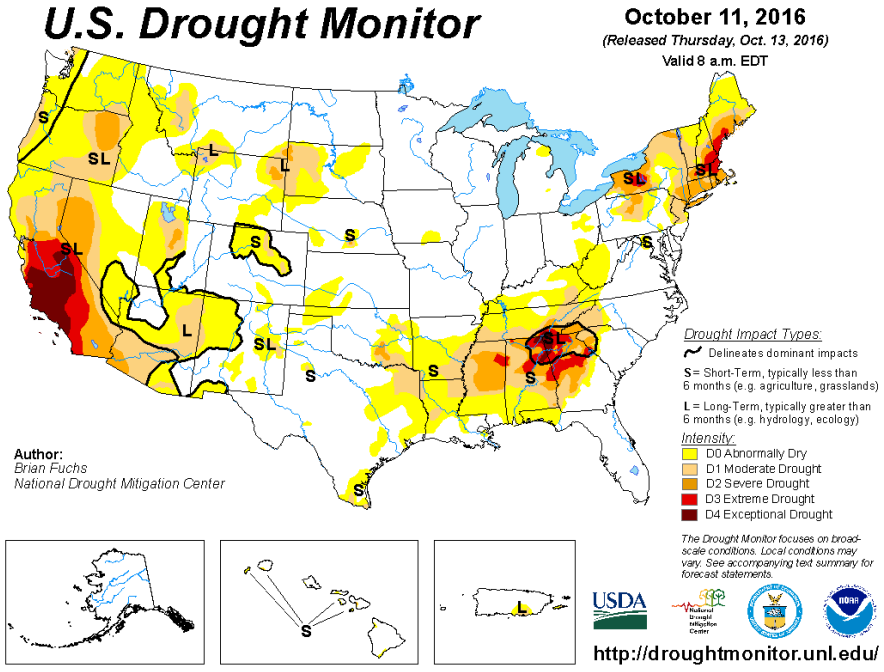
If you have any questions or comments, please email hazsimp@noaa.gov.

For more information about the overall Hazard Simplification Project, please visit **http://www.weather.gov/hazardsimplification**.

Hydrologic Conditions in the United States
Through October 11, 2016



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



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

November Newsletter Articles Focus:

Hydrology

The NHWC is requesting articles that focus on hydrology - the science behind the work we do.

Please consider preparing a short article about new methods, research, or discoveries in hydrology or a recent significant hydrologic event.

Submit your article to:

editor@hydrologicwarning.org

November 7th is the deadline for inclusion in the November issue.

Future Newsletter Articles Focus

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

Nov - Hydrology
Dec - Hazard Communication & Public Awareness
Jan - Modeling/Analysis
Feb - Data Collection

NHWC Calendar

November 2-3, 2016 - 8th Annual NHWC Texas Workshop, San Antonio, Texas

June 5-8, 2017 - NHWC 2017 Training Conference & Exposition, Squaw Valley, California

General Interest Calendar

October 20, 2016 - The ALERT Users Group Fall Training and Meeting, San Diego, California

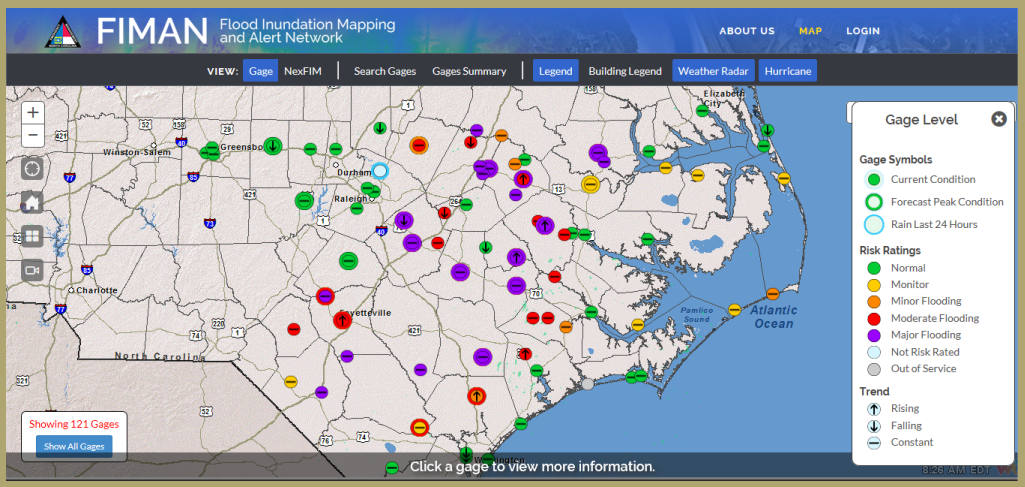
April 30 – May 5, 2016 - ASFPM 41st Annual National Conference, Kansas City, Missouri

May 21-25, 2017 - American Society of Civil Engineers, EWRI World Environmental & Water Resource Congress 2017, Sacramento, California

(See the event calendar on the NHWC website for more information.)

Parting Shot

Hurricane Matthew as seen on NC FIMAN



The effects of Hurricane Matthew were felt well inland. North Carolina's Flood Inundation Mapping and ALERT Network (FIMAN) website illustrates risk ratings as of 7:30 am EDT, October 10, 2016. The FIMAN website is at https://fiman.nc.gov/fiman/

Submitted by **David Haynes,** Distinctive AFWS Designs, Inc.

National Hydrologic Warning Council

Providing Timely, Quality Hydrologic Information to Protect Lives, Property, and the Environment

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