



The NHWC Transmission

February 2016

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Modernization of the Harris County Flood Warning System

Mark Moore, Harris County Flood Control District

The goal of the Harris County flood warning system is to provide accurate real time rainfall and stage data to facilitate crucial decision making before, during, and after flood events. Starting in 1982, the Harris County Flood Control District (HCFCD) initiated their Flood Warning System (FWS) to accomplish this goal (Figure 1). While the system expanded after transfer to the Harris County Office of Emergency Management, aging equipment, uncontrolled system expansion, and poor maintenance practices resulted in unacceptable data loss and quality by 2007. After a multi-county departmental review of the system performance, HCFCD regained the FWS responsibilities and chose to restore and modernize it to better serve the needs of the District, local officials, NWS, and public. To achieve this effort, HCFCD staff underwent extensive training to detect, isolate, and correct field problems, excess transmissions were identified and reduced, a more robust repeater network was installed with ALERT2 concentration, and the entire FWS was modernized and portions rebuilt with ALERT2 technologies. At the start of 2016, the data collection capabilities of the modernized system and the FWS staff's

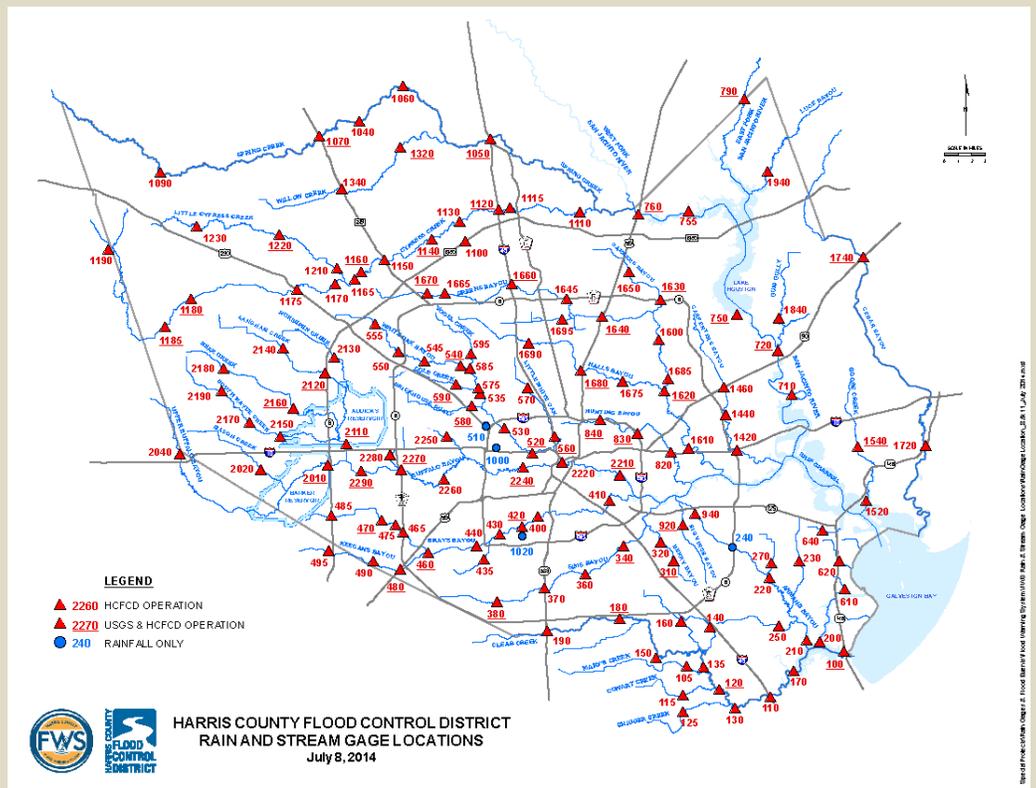


Figure 1: Map showing 139 Harris County ALERT/ALERT2 station locations. Click on the map above or follow this [link](#) to the interactive map.



commitment to delivering quality and accurate data have succeeded in achieving this goal.

Two ways to understand the data collection capabilities of the FWS are to study the gages during normal daily reporting and during large rainfall events. To analyze quiescent reporting success, examination of daily scheduled reports can be used to measure success rate. In 2012, only 82.0% of battery reports arrived as expected. Continued upgrades increased this percentage to 84.9% by 2014. The greatest change came with the full conversion to ALERT2, with current scheduled reports arriving 99.5% of the time (Figure 2).

While understanding the availability of the data during quiescent periods provides an important perspective of system performance, major rainfall events test the true reliability of the FWS. During major events, most ALERT data loss occurs from contention or collisions between messages generated at random times and at an increased rate. Steps to reduce this contention included reducing background radio interference, installing correctly functioning equipment, using ALERT2 concentrator repeaters, and more. Traffic loading in the ALERT system is a function of storm intensity and areal extent, with progressive deterioration in performance as the need for accurate data increases. The modernized FWS design assures a known and planned for upper limit to traffic loading with no performance degradation during events.

Prior to any system improvements, the overloading of the radio frequencies resulted in the loss of up to 60% of gage data during large events. On Memorial Day 2015, Harris County received excessive rainfall with many gages reporting over 7 inches of rain in less than three hours. Apart from one ALERT2 test site, the HCFCD system was still the legacy ALERT system. As designed, the test ALERT2 site reported 100% of its expected data reports during this rainfall event. A nearby ALERT gage successfully reported only 65% of expected reports during the entire event.

Rainfall events during the month of October

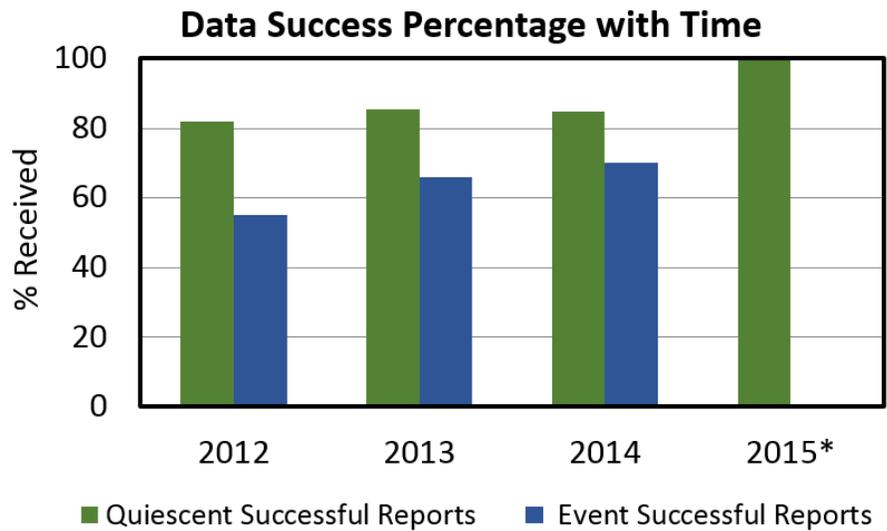


Figure 2: Demonstration of the increased ability of the FWS during both event and quiescent periods. *The quiescent data for 2015 is after the complete ALERT2 conversion, but a significant rainfall event has not occurred thus far with full ALERT2 implementation.

2015 provided a chance to observe the system during the ALERT2 field transition when 35% was ALERT and 65% ALERT2. Toward the end of the month, moisture from the remains of Hurricane Patricia precipitated 8 inches of widespread rain across Harris County over a 24 hour period. Less intense rainfall and the partial switch to ALERT2 implied that more reports should successfully arrive. Analysis agreed with this expectation, with 99.6% of ALERT2 data being received from 90 ALERT2 sites. Since ALERT2 gages reported on a separate radio channel, ALERT channel traffic loading was greatly reduced, resulting in 95% of transmitted ALERT data being received.

By December of 2015, all HCFCD sites had been converted to ALERT2. While there have been no major rain events, a 2.5 inch rain event over two days provided insight on the performance of the full ALERT2 conversion. An analysis of the 15,000 reports showed that 99.9% of expected reports arrived from all sites across Harris County during the two days. While no ALERT sites remain in the HCFCD system, 10 partner agency sites use the repeater network and are housed on a dedicated ALERT radio frequency. A sample of the partner sites showed 85% successful reports during this same interval.

Starting in 2016, the HCFCD and the FWS staff are confident in the real time, complete, and accurate rainfall and stage data provided to officials and the public to facilitate critical safety, life, and property damage reduction decisions. 🌧️

A simple, reliable automated river gauge

Brian Hahn, National Weather Service

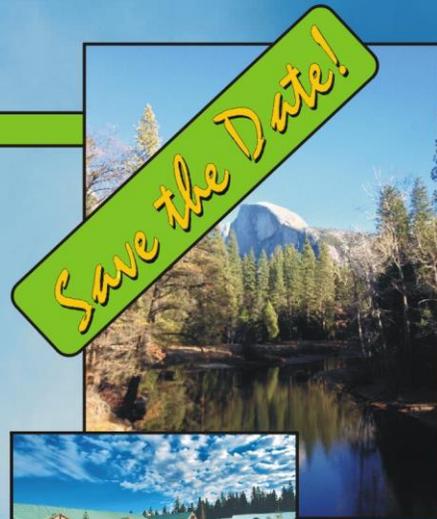
The National Weather Service in Milwaukee/Sullivan, WI has implemented 6 ultrasonic acoustic river gauging stations in southern Wisconsin since 2006. The gauges have proven to be accurate and reliable, year around, and have become part of our routine river monitoring and flood warning/prediction programs.

All the components cost \$5000-\$6000 plus the cost of a custom made bracket to be mounted on a bridge railing.

If good cellular phone service is available in the area, a new communications method utilizing an IP router and a data plan can be used. This method of communication costs about 1/3 the costs of a standard phone line.



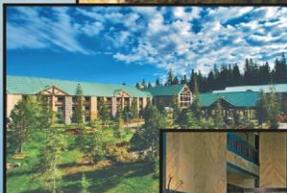
To see the current data from these 3 stations, follow these links:
[sakw3](#) [porw3](#) [pdvw3](#) [cusw3](#) [mazw3](#)



26th ALERT Users Group

Training Symposium & Preparedness Workshops

April 18-22, 2016



Tenaya Lodge at Yosemite
Fish Camp, CA

<http://www.alertsystems.org>

Save the Date

2017 National Hydrologic Warning Council Training Conference & Exposition

June 5-8, 2017
Squaw Valley, California

The 2017 NHWC Training Conference & Exposition will be held on June 5-8, 2017 at the Resort at Squaw Creek near Olympic Valley, California

Watch this [link](#) for more information and updates.

Membership Renewal

It's not too late to join or renew your Annual NHWC Membership. New members are welcome. Click [here](#) to join/renew your membership.

2016 Critical Infrastructure Symposium

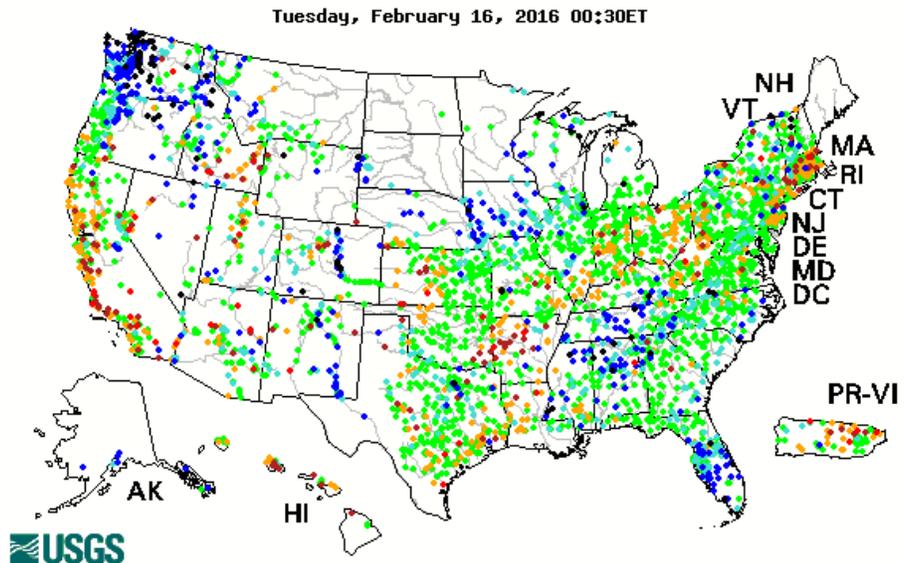
The 2016 Critical Infrastructure Symposium is sponsored by the Society of American Military Engineers (SAME) on April 3rd-5th, 2016 at the Charleston Marriott in Charleston, South Carolina.

www.same.org/tisp

Contact: Jacqueline Barrett
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Hydrologic Conditions in the United States Through February 16, 2016

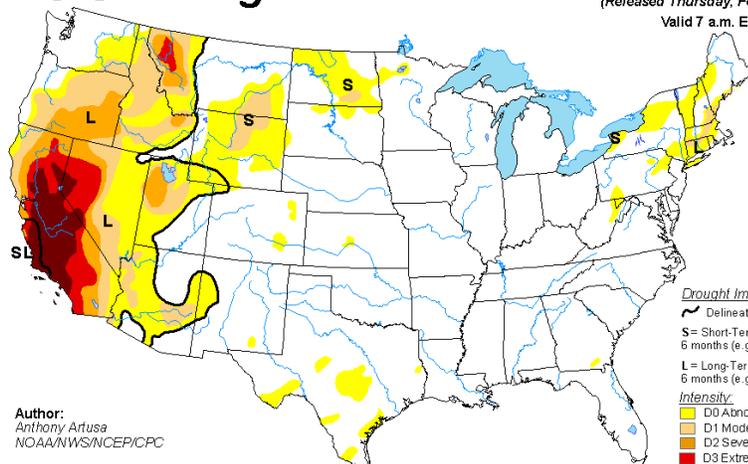


Explanation - Percentile classes						
Low	<10	10-24	25-75	76-90	>90	High
	Much below normal	Below normal	Normal	Above normal	Much above normal	

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

U.S. Drought Monitor

February 9, 2016
(Released Thursday, Feb. 11, 2016)
Valid 7 a.m. EST

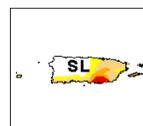
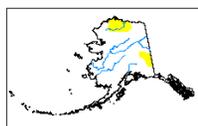


Author:
Anthony Artusa
NOAA/NWS/NCEP/CPC

Drought Impact Types:
~ Delineates dominant impacts
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



<http://droughtmonitor.unl.edu/>

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

March 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

March 10th is the deadline for inclusion in the March issue.

Future Newsletter Articles Focus

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

Mar - Hydrology

Apr - Hazard

**Communication &
Public Awareness**

May - Modeling/Analysis

Jun - Data Collection

NHWC Calendar

September 20-21, 2016 - [NHWC Northeast Regional Workshop](#), Albany, New York

June 5-8, 2017 – [NHWC 2017 Training Conference & Exposition](#), Squaw Valley, California

General Interest Calendar

March 9-11, 2016 - [2016 West Regional Conference, Association of Dam Safety Officials](#), Sacramento, California

April 3-5, 2016 - [2016 Critical Infrastructure Symposium](#), Charleston, South Carolina

April 18-22, 2016 - [ALERT Users Group Training Symposium and Preparedness Workshop](#), Tenaya Lodge at Yosemite National Park, California

June 19-24, 2016 - [ASFPM 2016 40th Annual National Conference](#), Grand Rapids, Michigan.

Parting Shot

Flow Measurement on Rock Creek at Highway 212, Carver, Oregon



Jeffery Budnick of River Measure performing a discharge measurement.

Photo Courtesy Lyman Petersen
River Measure

National Hydrologic Warning Council

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

<http://www.hydrologicwarning.org>