Progress with Recognizing Flood Threats

...since the September-to-Remember Floods of 2013

Kevin Stewart, P.E., Manager
Information Services & Flood Warning Program
Urban Drainage and Flood Control District, Denver, Colorado

ALERT Users Group 26th Flood Warning Systems Training Conference
Tenaya Lodge in Fish Camp, California
April 18-22, 2016
The Big Event

7-day totals exceeding average annual precip

"1,000-year Rainfall"
Urban Drainage and Flood Control District
Flood Warning Program
Serving the greater Denver/Boulder metropolitan area since 1979
in cooperation with NOAA’s National Weather Service
Provide local governments with early notifications of potential and imminent flood threats (primarily flash flood threats) in time to take appropriate defensive actions...
FWP Components

- Prediction & notification services (*F2P2*)
- Detection (*The ALERT System*)
- Radar-based decision support
- Models (*Meteorology & Hydrology*)
- E-notifications (*Text-Email-Twitter*)
Motivated by 2013 floods

Developing and maintaining a reliable and easy to use source of information...a never ending process

MORE DETECTION
WMS—Web Map Services
Build your own opportunities

231 ALERT Stations
198 Rain Gages
109 Stream Gages
25 Weather Stations
10 Repeaters
One Stop Shopping

http://alert5.udfcd.org

The ALERT System

REAL-TIME FLOOD DETECTION & FORECASTS

Welcome to UDFCD’s ALERT System. This website is designed to accommodate handheld devices such as smartphones, Apple iPads and Windows Tablets. Some webpages at this site still require Adobe Flash. Apple and Android users will not be able to view these pages. A few other pages designed primarily for desktop use also work with smaller devices. In time these tools will become more handheld-friendly.

Smartphone users can begin using this website by touching the menu icon in the upper right corner or simply touch the UDFCD logo to see the current real-time ALERT map. We hope you can easily find the information you are looking for. We welcome your questions, comments and suggestions.

This website was developed for our flood warning program partners. Public users should be directed to the Contrail® website supported by OneRain.

Follow us on Twitter
Relatively Simple Choices

The ALERT System
UDFCD's Real-Time Flood Detection & Current Conditions

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- UDFCD's Annual Newsletter
- CRS Flood Warning & Response Credits
- NHWC News Center

- ARCHIVES
- April 2016
- March 2016
Public website by OneRain
Before the next flood...

Understanding the risks, improving communications, organizing & integrating resources, having a plan, knowing what to do & practicing what to do.

FLOOD RISK MANAGEMENT
Flood Hazard Information Tool
Data Mining & Field Recon

**STRUCTURE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Highway Crossing/Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jurisdiction</td>
<td>Arvada</td>
</tr>
<tr>
<td>Owner</td>
<td>Arvada</td>
</tr>
<tr>
<td>Structure ID</td>
<td>Null</td>
</tr>
<tr>
<td>Access Priority</td>
<td>High</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Single box (3 ft high x 50 ft)</td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>4</td>
</tr>
<tr>
<td>Benchmark</td>
<td>Null</td>
</tr>
<tr>
<td>Low Chord Elevation</td>
<td>Null</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drainage Area (sq mi)</th>
<th>Null</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity (cfs)</td>
<td>750</td>
</tr>
<tr>
<td>2-Year Flow (cfs)</td>
<td>Null</td>
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<tr>
<td>10-Year Flow</td>
<td>2028</td>
</tr>
<tr>
<td>50-Year Flow</td>
<td>3762</td>
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<tr>
<td>100-Year Flow</td>
<td>4521</td>
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<tr>
<td>500-Year Flow</td>
<td>8125</td>
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<tr>
<td>Closure Criteria (stage ft)</td>
<td>Null</td>
</tr>
<tr>
<td>100-Year Velocity (fps)</td>
<td>8.4</td>
</tr>
<tr>
<td>Travel Time (minutes)</td>
<td>Null</td>
</tr>
<tr>
<td>Travel Time Methodology</td>
<td>Null</td>
</tr>
</tbody>
</table>

**COMMENTS**

This bridge did not overtop during the Sept 2013 flood, but came very close to overtopping.
Photo Documentation
Focus on Impact Prediction
Structures designed to fill and spill, but **not** fail, which do on occasions.

**UNDERSTANDING DAMS**
Emergency Action Plans

- 5363.5 (drop outlet submerged) - Emergency Level 3
- 5363.0 (overflow section active)
- 5362.0 (spillway active) - Emergency Level 2
- 5360.0 (3/4 full)
- 5358.4 (drop outlet active)
- 5356.7 (1/2 full) - Emergency Level 1
- 5352.0
A tad before the flood...

A better picture of heavy rainfall extents & potential impacts?

RADAR-RAINFALL (GARR) & HIGH-RES QPF
Testing Some New Possibilities

High resolution gridded forecasts

UDFCD Heavy Rainfall Guidance

Daily Summary: June 10, 2015
Updated: 12:05 PM

Quality Control: See Below for Meteorologist’s Note

Meteorologist’s Note: Highest threat appears to be between 3-6pm local time. Storms, already ongoing, will move into a favorable region southeast of Denver Metro where very heavy rainfall is possible. 1hr rates up to 2.4 inches are possible. After 7 pm, current indications are westerly low-level flow will drastically lower heavy rain threat.

Maximum 1-hour rainfall

<table>
<thead>
<tr>
<th>Zone</th>
<th>Threat</th>
<th>Primetime</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>LOW</td>
<td>14-16Wed</td>
</tr>
<tr>
<td>B</td>
<td>LOW</td>
<td>16-19Wed</td>
</tr>
<tr>
<td>C</td>
<td>MOD</td>
<td>12-19Wed</td>
</tr>
<tr>
<td>D</td>
<td>MOD</td>
<td>14-19Wed</td>
</tr>
<tr>
<td>E</td>
<td>HIGH</td>
<td>14-18Wed</td>
</tr>
<tr>
<td>F</td>
<td>HIGH</td>
<td>13-18Wed</td>
</tr>
</tbody>
</table>
Zone Forecasts

Zone F: Central Metro

<table>
<thead>
<tr>
<th>ZONE F: Overall Threat</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>% precipitation</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>% exceeding 1in. per 1hr</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>% exceeding 2.5in. per 3hr</td>
<td>25%</td>
</tr>
<tr>
<td>% exceeding 3.5in. per 6hr</td>
<td>25%</td>
</tr>
<tr>
<td>% exceeding 4.5in. per 24hr</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Primetime</td>
<td>13-18Wed</td>
</tr>
</tbody>
</table>

Zone F: Max 1-hour rainfall (inches)

Probability of exceeding 1 in/hr
Improvements Underway

1. **Model Weighting**: Is there evidence to move away from “every model is equally realistic?”

2. **Historically-based Bias Correction**: Post-process model output using historical observations over the 1980-2015 period (e.g. precipitable water)

3. **(2017) Sub-hourly guidance**: Use archived ALERT data to develop 5-, 15- and 30-minute guidance
Basin averaging (QPE & QPF)
GARR mapped to 1km grids
Coverage Extended
REAL-TIME HYDROMODELS
SSMA, VFLO, HEC-HMS
Streaming videos...1-minute stills...how about drones?

LIVE VIDEO—SEPTEMBER 12, 2013
Pushing The Push Notifications

SUBSCRIBE

Join the Front Range ALERT Users Group (FRAUG) subscription email list to receive information about system updates and new webpage features. Just click on the above link and send your request. After your request is approved you will begin receiving periodic information about the ALERT System. Subscribers may also send emails to the list. Please do not use 'Reply All' unless you intend everyone on the list to read your reply. An archive of the emails are posted to the Blog that is available to all users of this website (see topics listed under RECENT POSTS).

Notifications — Click here to sign up for ALERT rainfall and water level alarms; NWS warnings from EMWIN-Denver; and F2P2 flood threat messages and forecast products.
Tweeting in the Rain
Have a contingency plan for “THE BIG ONE”

Streamgage site on James Creek

Rod Stewart, 1971

EVERY PICTURE TELLS A STORY
SOME OTHER LESSONS

✓ Bad floods happen when we least expect at inconvenient times.
✓ Rainfall frequency never equals flood frequency.
✓ People ask difficult questions. Be ready with a good, short, simple answer.
✓ Do not underestimate the importance of streamgages & their flow ratings.
✓ Take the time to build relationships now.
✓ Be careful where you park.
WHAT YOU ALL DO TOGETHER SAVES LIVES—THANK YOU.