In Hindsight: What did local officials need to know before the September 2013 flood event?

Varda Blum, Boulder County Transportation Department
Ryan Carroll, Michael Baker International
Flood History

1894: All County watersheds affected (flood of record)
1921: St. Vrain Watershed
1941: St. Vrain Watershed
1969: Boulder, South Boulder, Lefthand
1976: Big Thompson River Flood

Floodplain Management History

1969: County floodplain regulations adopted
1979: Joined regular program of the NFIP
1984: Creation of Storm Drainage Criteria Manual
2006: CRS Class 7 Community
2012: Countywide DFIRM
Significant Precipitation from 9/9/13 to 9/15/13
We Make a Difference

**The Event**

- **People**
  - Deaths: 4
  - People evacuated by air: 1,102
  - People evacuated by road: 707

- **State Highways (CDOT)**
  - Approximately 200 miles – closed, damaged, or destroyed
  - 102 bridges damaged or requiring repair
  - Estimated damages of over $400 million

- **Boulder County Infrastructure Damages**
  - 31 public bridges/culverts damaged or destroyed
  - 118 private access crossings damaged or destroyed
  - 140 miles of road damaged or destroyed
  - Estimated damages to public infrastructure $128 million

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**Assistance/Claims Summary**

Table 4-1: IA Total of Applications and % Inside/Outside SFHA

<table>
<thead>
<tr>
<th>County</th>
<th>Total</th>
<th>% Inside SFHA</th>
<th>% Outside SFHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulder</td>
<td>10,446</td>
<td>13%</td>
<td>87%</td>
</tr>
<tr>
<td>Larimer</td>
<td>1,549</td>
<td>13%</td>
<td>87%</td>
</tr>
<tr>
<td>Weld</td>
<td>1,242</td>
<td>29%</td>
<td>71%</td>
</tr>
</tbody>
</table>

Table 4-2: SBA Total and % Inside/Outside SFHA

<table>
<thead>
<tr>
<th>County</th>
<th>Total</th>
<th>% Inside SFHA</th>
<th>% Outside SFHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulder</td>
<td>1,116</td>
<td>16%</td>
<td>84%</td>
</tr>
<tr>
<td>Larimer</td>
<td>476</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>Weld</td>
<td>240</td>
<td>32%</td>
<td>68%</td>
</tr>
</tbody>
</table>

Table 4-3: NFIP Claim Total of Applications, % Inside/Outside SFHA, and Average Loss

<table>
<thead>
<tr>
<th>County</th>
<th>Total</th>
<th>% Inside SFHA</th>
<th>% Outside SFHA</th>
<th>Average Loss per Claim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulder</td>
<td>1,416</td>
<td>55%</td>
<td>45%</td>
<td>$29,542</td>
</tr>
<tr>
<td>Larimer</td>
<td>268</td>
<td>57%</td>
<td>43%</td>
<td>$39,948</td>
</tr>
<tr>
<td>Weld</td>
<td>85</td>
<td>73%</td>
<td>27%</td>
<td>$46,572</td>
</tr>
</tbody>
</table>

Source: Reducing Losses Through Higher Regulatory Standards- 2013 Colorado Floods Case Study (March 30, 2015)
After Action Considerations

- What worked? What didn’t?
- What could we have done differently?
- What should we have thought of prior to the event?
- What lessons can we learn from this disaster to make us more resilient in the future?

**Flood Hazards**  
**Prioritizing recovery projects**

**Permitting**  
**Staffing**
Regulatory Floodplain Issues

Hazardous Hazards Exist Outside of SFHAs
Event consisted of highly erosive flows in the mountain canyons as well as on the plains.

Debris and sediment were also major causes of damage.
RIVERS COMPLETELY CHANGED COURSE
• Flood Recovery Mapping by CWCB
  • Provided a better representation of hazards
  • Captured dynamics of the event
  • Did not cover important and heavily-damaged areas of the county
1. Understand the state of Your Flood Hazards

- Post-flood: Be proactive and involved with any recovery modeling and mapping projects
- Get to know your problem areas/unmapped hazards
- Get involved with map updates
- Take advantage of the FEMA RiskMAP program when it comes to your watershed
Types of Recovery Projects

- Public Infrastructure
  - Access
  - Emergency, Winter, Final

- Protection of high-hazard homes
  - Prior to Spring runoff

- Debris Cleanup
  - Prior to Spring runoff

- Private Property & Infrastructure
  - Home Access, Bank Stabilization, & Repairs

- Stream Restoration Projects
  - Long-term stream planning
State Highways had a Governor-imposed deadline of 12/1/2013 for winter road completion.
Baker created a tool for tracking data and damage throughout the County

- Six community meetings, >650 residents attended
- Over 3,000 data points and damage reports to evaluate
- Over 90 miles of streams and drainages investigated by one person
Criteria for Determining Risk and Prioritization

- Woody debris is expected to dam or block culverts or bridges
- Deposition of sediment will cause flooding
- Culverts have been washed out and need replacement
- Bank erosion or avulsions will not handle creek flow and cause flooding
- If a home is in great danger of being affected by spring runoff

Spring Runoff Is Coming!!
Tool was augmented to assign priorities and track recovery projects
LONG-TERM RECOVERY & PLANNING: WATERSHED MASTER PLANS
1. Understand the state of Your Flood Hazards

2. Recognize that there are short-term and long-term goals, and develop a strategy for both

• From emergency projects to watershed master plans
• Develop a system to help prioritize and track recovery projects
• Reach out: community engagement can help with damage reporting, data collection, etc.
• Base your criteria for evaluating priority on access, threat levels and protection of life and property
Boulder County saw nearly a 2,000% increase in permits

- New process: Hazard Mitigation Review- a planning review process created for all permanent projects
  - Established additional rebuilding requirements
  - Geotechnical Analysis and considerations
  - Relocation on the property
  - Ensure compliance with Master Plan recommendations

- New process: Temporary Access Permit
  - Streamlined process for granting temporary access to property, emergency bank stabilization, etc.
Access

<table>
<thead>
<tr>
<th>Stream</th>
<th>Total Number of structures washed out in regulatory floodplain</th>
</tr>
</thead>
<tbody>
<tr>
<td>LITTLE THOMPSON RIVER</td>
<td>2</td>
</tr>
<tr>
<td>ST. VRAIN CREEK</td>
<td>39</td>
</tr>
<tr>
<td>LEFTHAND/JAMES CREEK</td>
<td>23</td>
</tr>
<tr>
<td>FOURMILE CANYON CREEK</td>
<td>5</td>
</tr>
<tr>
<td>FOURMILE CREEK</td>
<td>20</td>
</tr>
<tr>
<td>BOULDER CREEK</td>
<td>2</td>
</tr>
<tr>
<td>DRY CREEK NO.3</td>
<td>4</td>
</tr>
<tr>
<td>SOUTH BOULDER CREEK</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>97</strong></td>
</tr>
</tbody>
</table>
Access

- Existing standards are often impossible to meet in mountain canyons
- Impossible standards result in bridges built without permits
  - Storm Drainage Criteria Manual
    - Bridges: 100-year capacity/100-year structural stability/1 foot freeboard
  - Land Use Code
    - No Rise Certification or CLOMR
### SDCM Revisions

- County update to bridge design requirements

#### Diagram:
- Bridge design requirements
- Freeway or bridge approach causing erosion
- Excessive slope in bridge approach causing erosion
- Existing roadway
- Freeway = 1 foot
- Freeboard = 0.5 to 1.5 ft determined by equation dependent on depth

#### Table:

<table>
<thead>
<tr>
<th>Type of Crossing or Street Classification</th>
<th>Minimum Hydraulic Capacity</th>
<th>Stabilizing and Scour Design Flood Frequency</th>
<th>Stabilizing and Scour Check Flood (Scour Countermeasures Design Flood Frequency)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Driveways below 6000 ft elevation (Valleys and Lowlands)</td>
<td>5 Year</td>
<td>10 Year</td>
<td>25 Year</td>
</tr>
<tr>
<td>Private Driveways above 6000 ft elevation (Mountain Streams and Canyons)</td>
<td>10 Year</td>
<td>25 Year</td>
<td>50 Year</td>
</tr>
</tbody>
</table>
- County/CWCB/FEMA coordination
  - Replacement vs. Improvement
    - Replacement: requires engineers certify that project is restored to pre-flood conditions
    - Improvement (larger bridge): requires no-rise certification or CLOMR
  - No Rise Requirements
    - Not required for projects certified as restored to pre-flood conditions
    - May compare improved project to ‘Existing’ or ‘Pre-flood’ condition
What did we need to know?

1. Understand the state of your flood hazards
2. Recognize that there are short-term and long-term goals, and develop a strategy for both
3. Get your local code and regulations disaster-ready
   - Are temporary permits allowed or feasible under current code?
   - Does authority for permitting extend outside of regulatory SFHA?
   - Do current requirements make sense for flood scenarios in your community?
   - What can FEMA and your state agencies weigh-in on?
How do we accomplish everything?

- Hire staff, contractors
  - Floodplain Development staff: ½ FTE to 7 FTEs
  - Flood Recovery & Permit Information Center
  - Contractor support

- Training
  - Across all departments

- Cross training
  - Planning staff becomes Recovery Project Coordinator
  - Land Use staff becomes Community Outreach Lead

Make Emergency response a part of the culture…it’s everyone’s job
1. Understand the state of your flood hazards
2. Recognize that there are short-term and long-term goals, and develop a strategy for both
3. Get your local code and regulations disaster-ready
4. **Staffing needs are immediate and last for years**
   - Do official job descriptions include disaster-specific roles & responsibilities?
   - Include staffing plan in Emergency Operations Plan
   - Is your community set up for swift procurement of services?
   - Are credentials being issued for access to flood-damaged areas?