River Restoration to ALERT System Optimization - Assisting a Small Mountain Town Recover from a Major Flood and be Better Prepared for the Next
Located in Boulder County, Colorado about 12 miles northwest of the City of Boulder

Population of approximately 300 people

Gold discovered near James Creek in the 1870s

Several abandoned mines in the area with renewed interest in mining in the past few years

Incorporated into Boulder County in 1883

Homes built up around the narrow valleys of James and Little James Creeks during the mining period, and many homes are still next to the creeks and in the floodplain
2013 Front Range Flood

September 9-15th, 2013
"Almost a year's worth of rain in a week"

Jamestown, CO
• 1 fatality
• $30+ million financial toll
• 90% of the town's population displaced
Jamestown Impacts

- Heavy rains for a week wreck havoc
- Debris flow on Howlett’s gulch hits town patriarch’s home on Sept 12 resulting in fatality
- Damage resulted in
  - 17 homes destroyed
  - 21 damaged
  - Water distribution system inoperable
  - Fire Hall inoperable
  - Three bridges washed out
  - 2 side streets became stream beds
Flood and Debris Flow Impacts
Flood and Debris Flow Aftermath
Town Evacuation
Field Data Collection

Survey

Investigations

Flood Indicators
Community Involvement

Site Assessments

Input from Affected

Tours and Meetings
Clearwater vs Debris Flows

FEMA Assumption

Homes Outside Floodplain

100-year Flood Surface

Normal Water Level

Material Built Up During Event

Higher Flood Surface

Water Surface Raises Due to Material Aggradation

Channel Moves to New Location Due to Scour

Areas of New Scour

Avulsed Bank

Channel Shape and Location Changes Due to Avulsion
Erosion Hazard Zone Concepts

Diagram showing various zones such as Bedrock Outcrop, AHZ, HMZ, DMA, EHA, and Erosion Hazard Area (Erosion Setback + Geotechnical Setback). The diagram includes timelines for active channels from 1930 to 2000 and Historical Migration Zone. Dashed lines represent Final CMZ Delineation.
Jamestown Flood Relief Project

Large Wood Structure Stability Analysis

TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors of Safety and Design Constants</td>
<td>2</td>
</tr>
<tr>
<td>Hydrologic and Hydraulic Inputs</td>
<td>3</td>
</tr>
<tr>
<td>Stream Bed Substrate Properties</td>
<td>4</td>
</tr>
<tr>
<td>Bank Soil Properties</td>
<td>5</td>
</tr>
<tr>
<td>Wood Properties</td>
<td>6</td>
</tr>
<tr>
<td>Rootwad with Ballast - Stability Analysis</td>
<td>7 - 8</td>
</tr>
<tr>
<td>Rootwad with Boulder - Stability Analysis</td>
<td>9 - 10</td>
</tr>
<tr>
<td>Rootwad with Anchor - Stability Analysis</td>
<td>11 - 12</td>
</tr>
<tr>
<td>Floodplain Log + Boulder - Stability Analysis</td>
<td>13 - 14</td>
</tr>
<tr>
<td>Notation and List of Symbols</td>
<td>15 - 16</td>
</tr>
</tbody>
</table>

Date of Last Revision: February 18, 2014
Implementation of Channel Design
AFWS Project Objectives

1. Evaluate need for additional AFWS gauge(s) and provide gauge installation recommendations
2. Generate refined rainfall thresholds tailored to Jamestown’s early warning flood alert needs
3. Provide guidance/input for an updated flood alert emergency monitoring and response plan between Boulder OEM and Jamestown
4. Evaluate the potential application of the National Water Model as a hydrologic forecasting tool for the James Creek basin
Impacts in Jamestown

Timeline of the September 2013 Flood

James Creek @ Jamestown Main St Bridge

- Numerous Rainfall Pulses & Debris Flows
- Rapidly Deteriorating Conditions
- Porphyry Mtn Debris Flow
- NWS Storm Report of Damages
- Gauge Destroyed
- Numerous Additional Rainfall Pulses

Timeline:
- 6pm
- 12am

James Creek Inst Streamflow (CFS)

0 500 1000 1500 2000 2500 3000 3500

- Major
- Moderate
- Minor
- Bankfull
- Ideal Alert Window

LYNKER TECHNOLOGIES
Jamestown Flood Warning System

Jamestown FWS

Rain/Stream Gauge Alerts
- Automated threshold exceedance tracking
- Conditional exceedance alerts

Boulder OEM Monitoring
- Situational awareness monitoring
- Radar/rainfall storm tracking and projection
- NWS forecast communication & hazard warnings

James Creek Forecasts
- High-resolution rainfall, snowmelt, & runoff forecast
- Advanced lead time forecasts for James Creek stream segments

Alert Lead Time
Spatial data products + Esri tools = Engaging End Product

**Esri Story Map**

**Jamestown Automated Flood Warning System - AUG Presentation**

1. Project Inspiration

2. James Creek Watershed

   The James Creek watershed is situated in the mountainous foothills in central Boulder County. The Jamestown community sits at the confluence of James Creek and Little James Creek. The following series of map tabs provide a summary of the comprehensive data analysis used to evaluate current and future rainfall monitoring options to help safeguard the Jamestown community from future flooding & debris flow threats.

   **Key Map Layers:**
   1. James Creek watershed boundary
   2. James Creek & Little James Creek stream reaches
   3. Current Alert gauge network (rain & stream gauges)

   **Important features within the watershed:**

   [Map of James Creek Watershed with markers and layers]

**LYNKER TECHNOLOGIES**
Emergency Management
Rain Gauge Network

James Creek Rainfall Alert Gauge Network:

- Ward C-1 (Hills Mills): WRDC2
- Fling’s: FLIC2
- Gold Lake: GLLC2
- Cannon Mountain: CMTC2
- Cal-Wood Ranch: CALC2
- Porphyry Mountain: PPHC2
- Slaughterhouse: SLGC2
# Rainfall Alert Thresholds

<table>
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<tr>
<th>Time Duration</th>
<th>Default Rainfall Accumulation Alert (inches)</th>
<th>Modified Rainfall Accumulation Alert (inches)</th>
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<td>2-hours (120)</td>
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<td>24-hours (1440)</td>
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<tr>
<td>72-hours (4320)</td>
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Historical analysis (1999-2016) tested several iterations of modified rainfall values to evaluate optimal lead time and minimal false alarm rate.
Current Default Rainfall Alerts – Sep 2013

James Creek Inst Streamflow (CFS) w/ Rainfall Alert Flags (UDFCD) 2013-09-11–2013-09-13

- Missing early warning rainfall alerts
- Standard 10min-2hr Alerts
- Standard 1-3 day Alerts

Streamflow (CFS)

- Major
- Moderate
- Minor
- Bankfull

Date

2013-09-11 12:00 to 2013-09-13 18:00

120-min Static Alert
60-min Static Alert
30-min Static Alert
Obs - Streamflow

4320-min Static Alert
1440-min Static Alert
Obs - Streamflow
Proposed Rainfall Alert Tracking

Standard Alert

- 2-Hour Gauge Accumulation Data
  - Rainfall Exceeds Standard Threshold?
    - No: No Alert
    - Yes: Multiple Gauges Exceed Threshold?
      - Yes: Alert
      - No: Standby

Conditional (Saturated) Alert

- 24 & 72-Hour Gauge Accumulation Data
  - 24 or 72-hour Rainfall Exceeds Saturated Threshold?
    - Yes: No Alert
    - No: 2-Hour Conditional (Reduced) Threshold Exceeded?
      - Yes: Multiple Gauges Exceed Saturated Threshold?
        - Yes: Alert
        - No: Standby
      - No: No Alert
## Proposed Thresholds Refinements

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Historical analysis (1999-2016) tested several iterations of modified rainfall values to evaluate optimal lead time and minimal false alarm rate.
Sep 2013 Event with New Alerts

James Creek Inst Streamflow (CFS) w/ Rainfall Alert Flags (Modified) 2013-09-11–2013-09-13

- Saturated 10min-2hr Alerts
- Standard 10min-2hr Alerts

Alert Window Target

Initial alert instance: 7:55pm

Initial alert instance: 10:50pm

Initial alert instance: 10:50pm
Action Plan

- Provide input for an updated/augmented **Flood Emergency Response Plan** operated by the Jamestown Volunteer Fire Department
- Configure guidance for rain gauge automated alerts for JVFD messaging
What is the National Water Model?

• Continental-scale water resources model developed and maintained by the NWS
• Hourly short-range forecasts out to 18-hours, medium-range forecasts out to 10-days, and long-range ensemble forecasts out to 30-days
• Forecast products include streamflow, soil moisture, snow melt etc.
NWM Analysis

- 6 Boulder County (UDFCD) gauge locations
- Instantaneous flow data aggregated to mean hourly data
- Limited interpolation between missing points
Summary/Recommendations

- Flow magnitude/timing forecast skill still needs refinement – active development ongoing
- Current NWM forecasts have the potential to provide extended monitoring lead-time for tracking flash flood conditions for the James Creek basin
- Consider options for incorporating the NWM forecast as a component of the Boulder County OEM daily flash flood outlook toolset

Online Forecast Viewer: http://water.noaa.gov/map
Questions?

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