

### CASE STUDY:

# Raleigh, NC Leverages Enhanced Rain Data and Hydrologic Modeling To Improve Flood Response



# Mitigating risk by better anticipating flood conditions

In recent years, the city of Raleigh, North Carolina has experienced a measurable increase in the frequency and severity of rainfall, which has translated to recurring severe floods. Additionally, Raleigh's urban creeks are prone to flash floods that can cause severe damage in very little time and with very little warning.

With the growing flood risk, Raleigh identified a need to take a more proactive approach to flood risk mitigation and response. The city partnered with AEM to implement its Flood Early Warning System (FEWS), "a program to forecast flooding conditions before and during a storm." One of the key objectives of the program was to help emergency managers, first responders, and other field personnel proactively anticipate when and where flooding would occur and where resources would be needed to save lives and mitigate damage.

### Overcoming operational limitations

Even before implementing FEWS, Raleigh had no shortage of field instrumentation, including cameras, flashing signs, stream gauges, and rain gauges. But even with all that data and technology, they were still limited in their ability to reliably anticipate when and where flooding was going to take place. Specifically, they were facing three key limitations:

### 1. LIMITED RAINFALL VISIBILITY

The city lacked visibility into how much rainfall was falling in communities between rain gauges.

### 2. SLOW DATA REFRESHES

The city received field updates only about once every hour; yet, a damaging flash flood could runits course in less than an hour.

### 3. LACK OF PREDICTIVE CAPABILITIES

Raleigh Stormwater staff needed a solution that could reliably predict the impact of rainfall on flooding throughout the city based on available forecasted information.

## FROM REACTIVE TO PROACTIVE FLOOD MANAGEMENT

In 2018, Raleigh experienced an historic rain event that produced a damaging flash flood. Although there were no rain gauges in the immediate vicinity of the flood, it's estimated that more than three inches fell in about an hour. The resulting flood took out an entire section of road and the underlying culvert. The frightening part was that city staff weren't aware of the event until it was already over.

This moment was a catalyst. Raleigh saw a need to proactively anticipate flood conditions before they happened, and in areas that had limited rain gauge coverage. They partnered with AEM's Vieux & Associates brand to help make that vision a reality.

We felt that the Vieux model...worked better than other proposals for urban areas and the flashy flood situations that we have. I think we made a wise choice because the watch points that we have in our system, it's amazing how accurate they are...on the timing and the height.

### - Kelly Daniel

Flood Early Warning System Engineer & Project Manager



# Solution: Gauge-Adjusted Radar Rainfall (GARR) and Vflo<sup>®</sup> hydrologic modeling

To overcome the limitations that were getting in the way of better anticipating flood conditions, Raleigh turned to AEM's Vieux & Associates brand for our GARR (which compensates for deficiencies in both rain gauge data and radar rainfall information by combining the two), and our proprietary Vflo hydrologic modeling (which reliably translates rainfall inputs into predictions of flood and runoff outputs).

### **EXPANDED VISIBILITY**



GARR data now enables Raleigh Stormwater to see exactly how much rain is coming down at any given point in the city – not just at rain gauges – making blind spots a thing of the past.

### MORE TIMELY INFORMATION



Raleigh's GARR data now refreshes every five minutes, and alerts go out when rainfall approaches critical thresholds. Raleigh Stormwater can now stay on top of unfolding flood events.

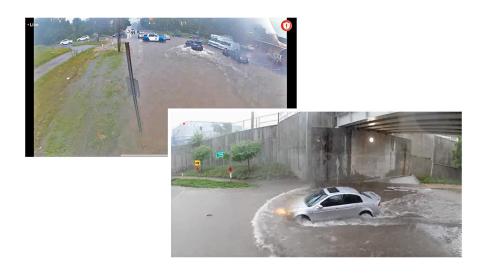
### IMPROVED PREDICTIVE CAPABILITIES

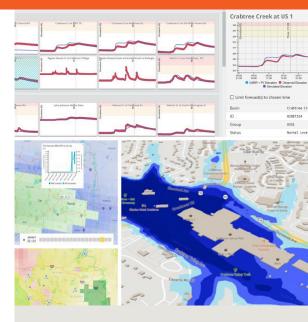


Both real-time GARR data and forecasted rainfall can serve as inputs into our predictive Vflo hydrologic model. This allows Raleigh Stormwater to reliably anticipate how actual and forecasted rainfall will impact flooding. Specific forecasts can even be amplified or reduced to minimize uncertainty and improve preemptive flood response..

# An evolving partnership

Strong partnerships tend to grow and evolve over time. That is especially true of the partnership between Raleigh and AEM. Raleigh is now entering the fourth phase of its FEWS program, which includes trying to anticipate the minimum amount of drawdown needed to keep reservoirs at safe levels during major rain events. They are leveraging AEM's hydrological modeling expertise to develop the predictive models that will underpin this phase of the program.





### WHY AEM?

AEM's purpose is to empower communities and organizations to survive – and thrive – in the face of escalating environmental risks. In the case of Raleigh, that means helping them better anticipate flood conditions before they happen, so they are better prepared to save lives and mitigate damage.

When it comes to anticipating flood conditions, clients like Raleigh tend to choose AEM for a wide variety of reasons. But these three reasons stand out:

# MORE ACCURATE RAINFALL MEASUREMENTS

Clients value the ability of AEM's GARR products to deliver rainfall measurements that are more accurate and actionable than they could get from either rain gauges or radar readings alone.

# HYRDOLOGIC MODELING EXPERTISE

Raleigh found our Vflo hydrologic model to be the best predictor for its urban creeks that are prone to flash flooding. The model can run and return results in the time frames required for decision making and emergency response.

### **RELIABLE FLOOD FORECASTING**

The sophistication of our hydrologic model means it incorporates multiple rainfall forecasts that extend as far as 72 hours into the future. The quality of the hydrologic model means confidence in the flood forecast continues to improve as the storm gets closer and as critical information updates in real time.