

## **Statistical Review**

### **A Brief Commentary: Floyd's Frustrations**

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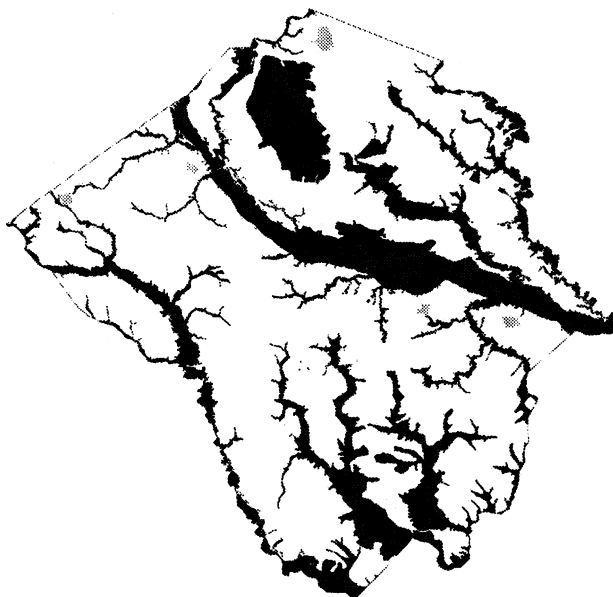
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Floyd. That one syllable sums up a multitude of activities and events associated with heavy rainfall in an already saturated eastern Carolina. For researchers, planners and a host of others, Hurricane Floyd has proven frustrating due to a lack of detailed information about the specific impacts of the storm. Even with swarms of satellites in the sky and hard drives crammed with data, two of our most basic questions about Floyd's floods remain unanswered: How bad was the flooding? How far and how deep were the waters?

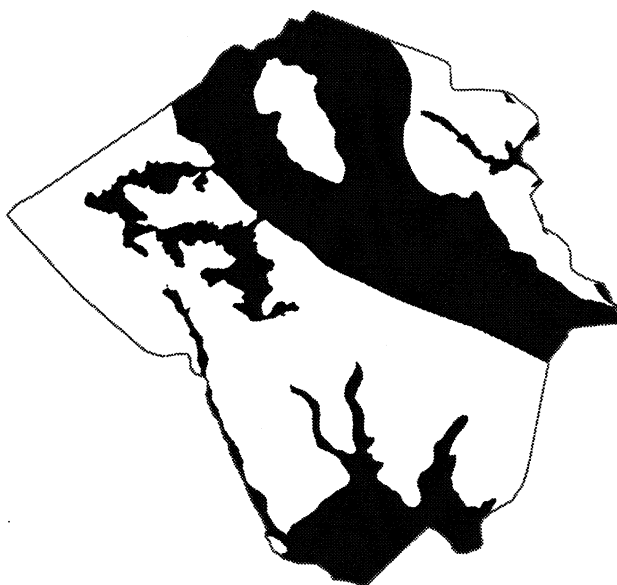
As a relative newcomer to North Carolina, I had assumed that it would be easy to access the necessary digital spatial data to answer these and other questions about the flood.

Like everyone else involved in this crisis, I set about trying to understand what had happened to the region. Little did I know that the Flood Insurance Rate Maps (FIRMs), from the Federal Emergency Management Agency (FEMA) were discordant with the post-flood needs of eastern Carolina.

The FEMA Q3 digital spatial database is the non-legally binding, digital version of the FIRMs. Pitt County Q3 data is shown in Figure 1. Given the expanse of 100 and 500-year flood zones, Pitt County was clearly in for a major flooding event when Floyd suanted up through eastern North Carolina. Both the Tar River basin, stretching northwest to east in the northern half of the county, and the Neuse



**Figure 1. FEMA Q3 map.**



**Figure 2.** Preliminary draft of actual flood extent derived from satellite imagery.

river basin, covering the southern half of the county, received heavy rainfall. There is a very basic problem with using this mapped data: it is inaccurate. In many places it dramatically underestimated flooding, and in other areas it overestimated the flooding.

Although the map was inadequate for efficient emergency planning, it was used in Pitt County as the basis for a revised estimate of the extent of the flooding, and for direction of relief operations. In the days after the hurricane, Ralph Forbes of the Pitt County MIS department estimated that the flood waters sloshing at the front door of his home were at least a quarter mile from the nearest delineated flood zone. For lack of a better view of the flooding, the Pitt County MIS department used the GIS spatial operation of buffering to extend the flooding extent of the Q3 data a quarter of a mile. Although we know that such an arbitrary spatial operation would not produce accurate flood extent information, it proved

a better fit in many areas.

So where exactly was the flood if not where predicted? Our next view came from Draft flood extent data based on 5 Radarsat images, from 9/23 and 9/25 (<http://radarsat.space.gc.ca>). These data were provided by FEMA from the Radarsat images and interpreted by a private firm. As seen in Figure 2, the extent of flooding looks extreme and is probably the source of estimates of 50% of Pitt County being flooded. This view of the flooding is very different from the designated zones in Figure 1. In fact, the area in the northern section of the county, which is zoned as 100 year flood in Figure 1, shows no flooding in Figure 2. Either an area predicted to flood did not, or more likely, there was too much vegetation present to permit proper interpretation of the flooded area; the radar sensor could not see the flood for the trees. The amount of detail here is also quite different. The radar data set shows a much smaller-scale

representation. One can conjecture about issues of satellite resolution and raster-to-vector conversion issues, but the basic questions remain: where exactly, and how deep, were the waters?

Maybe the USGS Digital Elevation Models (DEMs) can help. By pasting them together and modeling the flooding, perhaps we can reevaluate the other digital data sets. Maybe not. The North Carolina Center for Geographic Information and Analysis (NC CGIA) does not distribute combined state or county coverages of this digital terrain data. The U.S. Geological Survey data are inadequate for modeling the mildly undulating surface "Down East." We are pasting the DEMs together anyway to investigate the situation further.

So, we continue to search for detailed information about the extent and depth of

flooding brought on in the aftermath of Hurricane Floyd. This information is critical for moving people from the flood zones; improving or removing waste lagoons in the flood zones; updating FIRMs; understanding the influence of the built environment upon flooding intensity; screening for health related issues; and a wide range of other issues. Individual counties, cities and towns may have various information regarding flooding in their areas but how can it be utilized? Photos, surveys performed during the flood, anecdotal information, and data about condemned structures may all provide additional information. Whether this information will ever be combined, utilized, and archived for the entire region remains, however, an open question.