Responding to Disaster: Lessons Learned

By James McCluskey

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Overview

The Clarksville/ Montgomery County GIS Center (CMCGIS) was a fledgling organization in the fall of 1998. The Center was in its organizational phase with only minimal staff and funding when on January 22, 1999 a F3 tornado devastated the historic downtown district of the City of Clarksville, the campus of Austin Peay State University (APSU), and many business and homes in the community. The purpose of this article is to outline the events which led to the formation of the CMCGIS and its response to the disaster. Its value is that it provides insight into the lessons learned from the initial formation of integrated county/city GIS and the response of CMCGIS in gathering information and finalizing the post-disaster damage assessment.

As part of a pilot project to establish a uniform statewide parcel level GIS for Tennessee, the state selected the Tennessee Valley Authority (TVA) to manage the program. In 1996, TVA contracted with Fugro EarthData to acquire black and white imagery for Maury and Lewis Counties. Existing parcel boundaries were then fitted to the orthophotos. After the pilot project was successfully completed, three additional counties were selected for the statewide mapping program, including Montgomery County. All counties in the state were eventually mapped and in July 2007 Tennessee's Office for Information Resources, GIS services, launched TNMap. The TNMap portal is an online GIS application that provides users access to a statewide base map and datasets that can be used to solve several different types of problems.

Tennessee's uniform parcel mapping project was designed to provide county tax assessors a standard cadastral mapping application to track property records. Montgomery County and Clarksville officials soon realized that the orthophoto and parcel map deliverables could be used as the backbone of an enterprise GIS. Cooperation between the county and Clarksville, the only municipality in the county, had long been established through Clarksville-Montgomery County Regional Planning Commission. The Department of Geology and Geography became involved with conversations with members of the County Tax Assessor's Office and the Regional Planning Commission. A decision was made to establish the CMCGIS Center as an entity to be located at APSU because of the expertise the staff in GIS. The county, city, and university were to be equal partners in the Center with day to day operations to be administered by university personnel.

Several organizational meetings were held on the APSU campus to facilitate implantation of CMGIS. Officials from approximately twenty different county and city departments attended the meetings. Through the efforts of the APSU staff, the County Tax Assessor's Office, and the Regional Planning Commission an agreement was forged between the three entities for the formation of CMCGIS. The county, city and university contributed equally to provide in excess of one million dollars in funding for the first three years of Center's operation. The orthophotos and parcel maps delivered by the state were valued in excess of 1.25 million dollars. An oversight committee was formed consisting of people from the county, city, and university to oversee the operations and finances of CMCGIS. GIS training was provided to city and county employees over the course of the fall.

Tornado and Response

An F3 tornado touched down at 4:15 am on the morning of January 22, 1999 in Clarksville, TN (population of 89,000 people at the time of the tornado). The tornado was on the ground for approximately five minutes. Its path was 4.3 miles in length and it attained a maximum width of 880 yards. Five injuries and no fatalities resulted from the tornado. A total of 124 buildings were destroyed and another 562 buildings were damaged (Figure 1). The damage estimate attributed to the storm was 72.7 million dollars. The historic downtown district of Clarksville was heavily damaged with many government buildings destroyed or heavily damaged. Several of the buildings on the APSU campus were heavily damaged as were many commercial establishments and homes (Figures 2 and 3).

CMCGIS was tasked with the responsibility of conducting the post-disaster damage assessment and worked closely with members of the Regional Planning Commission and the County Tax Assessor's Office. Work on the post-disaster damage assessment began shortly eight o'clock in the morning, approximately four hours after the occurrence of the tornado. The first major problem encountered in the process of conducting the damage assessment was the need to set up a functioning GIS. The county's parcel database was stored at four different locations, including: the County Tax Assessor's Office, Montgomery County Data Center, Regional Planning Commission, and APSU. The first three of these locations were heavily damaged and not accessible because the Clarksville Police had secured the area and restricted access to these facilities. The CMSGIS Center was the only location from which the database could be acquired along with GIS software and needed hardware. The roof on the GIS Center had been compromised and there was six inches of standing water in the first floor GIS workroom. The needed database, software, and hardware was removed from the workroom despite the ground floor of the building was flooded.

The Emergency Management Center (EMC) at the Police Department would have normally been the location for the coordination of emergency services. It, like several other public buildings, was severely damaged and not safe to occupy. The alternate location selected for the EMC was the Emergency Responders building located on the grounds of Clarksville Memorial Hospital. The initial mapping of damaged

buildings was done by the Montgomery County Office of Emergency Management by using colored push-pins on a city map taped to the wall. This method was soon replaced by a functioning GIS. Caliper's Maptitude (Version 4.0) was the GIS software used to map and analyze data to derive the initial estimates for the total dollar damage that was attributed to the tornado. The damage assessment occurred previous to the delivery of the parcel maps from the state.

Fieldwork for the post-disaster damage assessment was begun by mid-morning. Four two-man teams made the field observations in different sections of the city. Each team consisted of a licensed property appraiser and a member of the staff of the Regional Planning Commission. The dollar damage for each structure was estimated on a percentage basis by the teams in the field and recorded on paper forms. Forms were continuously being returned to the EMC.

Maptitude's address match engine and street files were used to locate each of the destroyed or damaged structures. This procedure yielded better than a 98% address match for the location of the destroyed or damage structures. The value of damage to each structure was estimated by multiplying the observed percent damage to the structure by the value of the structure as recorded in the county's parcel database. The dollar loss for the content of structures was estimated by multiplying the percent damage to the structure by 50% of the value of the structure. The damage estimates and the dollar loss of each structure were joined to the matched addresses to compile a GIS database. The post-disaster damage assessment was completed within thirty six hours after the touchdown of the tornado. A senior member of the Tennessee Emergency Management Agency (TEMA) commented that the damage assessment was accomplished in the shortest period of time in Tennessee history.

Completion of the post-disaster damage assessment was of immediate importance. The assessment is required before any federal relief funds can be released. The damage assessment database also was used to verify the claims of residents for assistance from local organizations.

Conclusions

Several lessons can be learned by examination of the experiences of the fledgling CMCGIS Center both from an organizational standpoint and from the method used to conduct the post-disaster damage estimate. The inclusion of members of county and city departments in the planning process introduced the concept and need for a GIS for the community. It demonstrated to the public employees that GIS was an enabling technology and would make their work easier. It also established the fact that data sharing among departments would reduce the overall costs of their individual operations. Above all the rapport developed among the county, city, and university staff went a long way in creating the cooperation needed to successful complete the post-disaster damage assessment in such a short period of time.

The history of how the damage assessment was conducted is insightful. The need to have off-site data backups of GIS files is a mandatory requirement of any GIS maintained by government agencies. In the case of the CMCGIS three out of the four locations where data was stored were heavily damaged and not accessible. The fourth location, at the CMCGIS Center at the University, also had substantial damage but the required records were able to be retrieved. The use of field teams consisting of a licensed property appraiser and an employee of the Regional Planning Commission to perform the on-site inspection of the damage to structures speeded up data collection in the field. At the present time, paper forms would not be used to record data. Rather mobile communications would be employed to transmit data in a timely manner to the GIS conducting the analysis.

Most small communities have their GIS work done on a cooperative basis with County GIS Departments or Regional Planning Commissions. This arrangement has proven to be successful. However, it is also plausible for smaller municipalities to initiate their own GISs using software such as Maptitude (now Version 6.0) to complete in-house tasks like the fledgling CMCGIS Center did more than a decade ago. Data sharing agreements between a municipality and a County GIS Department can be established to provide the municipality with the GIS data that would be needed to run a local GIS operation. Common tasks such as crime mapping, stabling school zones, or locating social services for area residents can be readily accomplished.

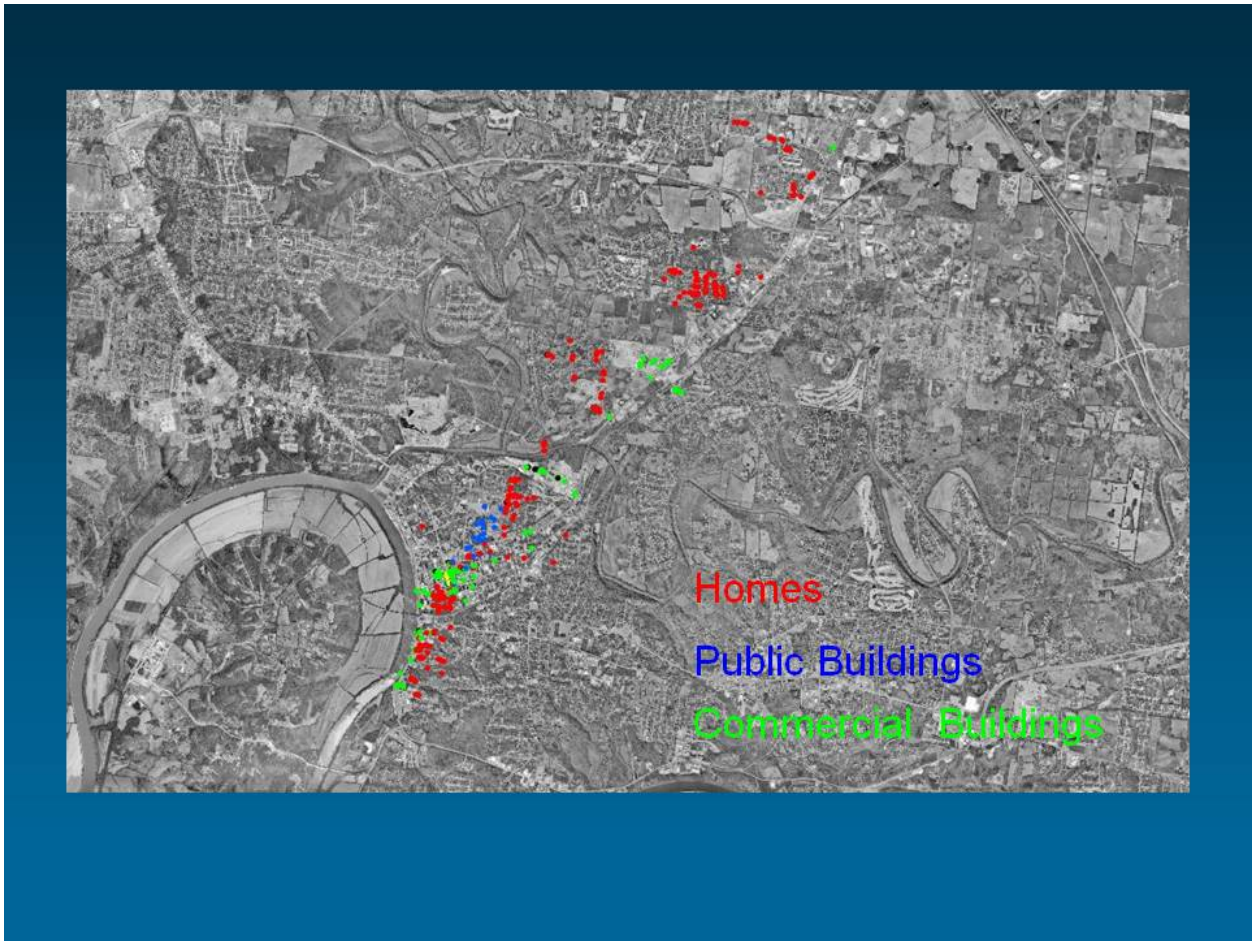

Figure 1. Path of the tornado and the location of homes, public buildings, and commercial buildings damaged or destroyed (map generated by Maptitude 4.0)

Figure 2. Damage to historic downtown church (photo downloaded from NOAA web site at http://www.srh.noaa.gov/ohx/?n=stormsurvey01221999)

Figure 3. Damage to historic downtown residence (photo downloaded from NOAA website at http://www.srh.noaa.gov/ohx/?n=stormsurvey01221999)