Emergency Management & GIS Integration at the City of Fort Worth
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Abstract
In emergency situations relating to safety and homeland security, spatial data becomes critical in developing responses, containment, and assessing damage. The Fort Worth – Tarrant County Emergency Operations Center (EOC) has been established with key members and equipment to help respond to any major emergency. Geographic Information Systems (GIS) and the spatial data they contain are critical tools that have been successfully integrated to augment the capabilities of our EOC. A fundamental part of this union of technology and response is selecting the correct tool for the job. The integration of GIS provides decision makers and first responders with supporting data to make efficient, informed decisions in natural, accidental, and intentional emergency situations.

Need
The last decade has provided the City of Fort Worth with extensive experience responding to a wide range of disasters: softball-sized hail fell on May 5, 1995, causing over $1 billion of damage; a tornado ripped through downtown Fort Worth high-rises on March 28, 2000; another tornado hit southeast Fort Worth on April 16, 2002; Lake Worth overflowed its banks in June of 2004; and coordination for Katrina and Rita shelters occurred in September 2005. Although GIS was a component in some of these incidents, its full integration as a part of the standard protocol of the Emergency Management Office was developed over time.

In 2002, discussions began at the City’s Homeland Security Planning Group meetings on ways to apply GIS to the needs of emergency preparedness and response. While it was evident that emergency responders had a limited view of GIS’s potential, it also became clear that GIS staff did not fully understand the procedures of the EOC and the potential data available. The initiation of this relationship was the catalyst to improving procedures and increasing information flow from both sides. What was identified as lacking ranged from simple things, such as a set of standardized maps for emergency response, to the complex applications of GIS for analysis. This began to set the wheels in motion for GIS integration into the Emergency Management Office (EMO).

The needs that were identified fell into several basic groups. GIS staff response for EOC activations, standardized maps, emergency planning, continuity in data gathering for damage assessment and reporting, and data analysis and visualization were all identified as critical applications of GIS needed for emergency operations. EOC and GIS staff began discussions of specific ways to address these broad categories and begin the process of creating solutions for the next emergency.
Implementation
The success of this concept of emergency management and GIS integration would require the cooperation of all interested parties. GIS is an enterprise endeavor at the City of Fort Worth. A central GIS group in the Information Technology Solutions Department supports the core infrastructure for GIS users in all departments throughout the City. Response to the EOC’s GIS needs followed much in the same manner. The City of Fort Worth Mapping Team was formed to enhance the City’s emergency planning process and response capabilities. The team consists of GIS professionals from the departments of Environmental Management, Fire, Information Technology Solutions, Police, Public Health and Transportation and Public Works. Members are committed to be available to respond on an as-needed basis to staff the EOC for the duration of any given event.

One of the easiest issues to address was the standardization of maps. By coordinating with the EMO, a standard set of symbolization and basic map composition elements were generated. This allowed the team to identify two mapping requirements, a standardized map set for planning and standardized map templates for incident response. The planning map set covers the entire city and extra-territorial jurisdiction (ETJ), which has been divided into a standardized grid. The digital PDF versions of these maps are updated every three months and distributed via CD to departments. A variety of plot sizes and alignments of the incident response map templates were developed by Mapping Team. This ensures that no matter which department is requesting a map the look and feel is always consistent.

Obviously, a large element of the success in emergency response is emergency planning. The City’s EMO and Homeland Security Planning Group created a list of prioritized targets, which has been loaded into the City’s Enterprise GIS SDE database. In coordination with federal entities, the mapping team has also assisted with potential locations for Biowatch and Metropolitan Medical Response System sites in the Fort Worth area. All of this critical spatial data is under additional security restrictions within our SDE database.

While targeted areas are an obvious requirement for homeland security planning, Fort Worth also has many weather related planning needs. In 2004 Lake Worth overflowed its banks, and illustrated the need to review flood prone areas for emergency planning. The city’s floodplain engineers were involved in an informal review of 100 year and 500-year floodplain boundaries using FEMA data. The team utilized this opportunity to perform an analysis of flood prone areas within the city. This analysis was completed using ArcInfo Workstation with supporting data from contour and hydrologic information, as well as field monitors and observation. Additionally, the City of Fort Worth Mapping Team has participated in tabletop exercises with the EMO, the City’s Homeland Security Planning Group, Tarrant County Public Health, Collin County, and the United States Department of Energy.

In response to the need for continuity of data during initial damage assessments, the City began a project to create a standard set of tools customized to the needs of the EOC. During an event, staff with differing levels of computer knowledge and skills will need to
enter data, run reports, and perform numerous other functions. A user-friendly web
interface to access and utilize the EOC toolset was needed to accommodate all user skill
levels. A main login provides time, date, and user name metadata to track and resolve
data entry problems. Standardized addressing and GIS validation ensures a better level of
accuracy from the resulting input. EOC staff can run summary reports on the data as well
as enter and update Situation Reports or SitReps. There is also an ability to summarize
events with the SitReps for post-event debriefing. This project is currently being
expanded to include field reporting and data collection through mobile data computers.

Although all aspects of GIS (data entry, manipulation, map production, etc.) can be
utilized in emergency preparedness and response, data analysis and visualization rank the
highest. This has been made apparent in the Local Integration of NARAC with Cities
(LINC) pilot program, which was brought to the City through Public Technology
Atmospheric Release Advisory Center (NARAC) iClient plume modeling software
provides tools to assess the consequences of atmospheric releases. These tools allow
users to enter release information and display model predictions with a GIS. The models
show the areas affected by a hazardous-material plume, and can aid in determining health
risks and recommending emergency actions.

Success
In the summer of 2005, the EMO extended State Homeland Security Grant Program
(SHSP) funding to purchase a storage device for high-resolution GIS imagery data. A
Disk Array Enclosure (DAE) is a storage device that will provide a terabyte of disk space
for the storage of digital and geographically referenced 6” aerial photography. Additionally, Pictometry data, which provides high-resolution, side-angled imagery, will
also be stored on this device. These two imagery products will be used to support
emergency preparedness and planning. Applications of the data include risk and threat
assessment, facility vulnerability assessment, police response, homeland security
planning, and damage assessment. These are only a few of the potential applications of
this data. This digital imagery will provide visual intelligence that has been unavailable
to the City until now and is a new means to support our homeland security initiatives.

In the late summer of 2004, the City of Fort Worth’s Homeland Security Planning Group
was introduced to the atmospheric plume modeling capabilities of the National
Atmospheric Release Advisory Center’s (NARAC) iClient. It was suggested that these
modeling tools be incorporated into a tabletop exercise to illustrate the potential of
improving the emergency planning and response. The exercise began by describing an
incident involving a major chlorine spill along a railroad that runs adjacent to the eastside
of Fort Worth’s Hospital District. Plume maps generated by iClient were used to show
the concentrations and extents of the chlorine release.

The first series of questions were how and where the information of the plume maps
would be disseminated. Both the Fire and Police departments recently implemented the
capability to obtain digital maps in the field. Previously, the information would have to
be given via phone and/or radio communications from the EOC to the field, or hard copy
maps and reports would have to be delivered. Since that time the Fire Department has enabled their HazMat trucks with laptops, which include a wireless network connection. The Police Department recently purchase a Mobile Command Unit, which is outfitted with a computer and printer so that it can receive digital documents. Future plans include the unit’s computer being loaded with ArcGIS software and data as well as NARAC’s iClient so that mapping can be done in the field. These improvements in technology for both the Police and Fire Departments allow for distribution of digital maps and reports to the field and provide a valuable resource to the first responders in the field.

The exercise continued with a list of impacted childcare centers, community centers, fire stations, hospitals, and schools was provided to the group. The mapper (iClient user) more than likely would be the first to come across this information and would need to know to whom to provide the information so that these facilities could be contacted. The first responders and other field personnel would already be dealing with situations on site. For that reason, it was decided that this information would be given to the designated Operations Chief of the EOC who would delegate a representative to handle the calls.

The group summarized the exercise information as extremely beneficial to the emergency response and planning of such a large-scale event. Moreover, it helped identify some components in our response and planning that need some improvement outside of this exercise. Items such as communication between EOC and first responders, disseminating information to the public, timely integration of NARAC system, scene evaluation, and synthesizing initial data into information that would help protect first responders as well as the public were identified areas for improvement.
The EOC was activated during the severe thunderstorm events of June 2004. A major concern was Lake Worth’s pool elevation reaching 598 feet due to heavy rainfall because business and residential areas around Lake Worth could have the potential of flooding. These areas were identified by extracting the 598-foot contour line from the elevation data layer and by then selecting all the parcels that intersected the potential flood elevation. The list of parcels was then given to Public Information Officers so that they could go door-to-door notifying people of the possible impacts.

Fort Worth had another opportunity to illustrate their use of GIS on July 28, 2005 when Valley Chemical and Solvent had caught fire. The fire caused several explosions to occur throughout the incident. The exact latitude and longitude of the site was determined through the GIS, and a listing of the chemicals on site with the tank locations was reviewed with Water Department staff. Based on this information an initial plume model was submitted through the iClient software. This worst-case scenario model was soon refined, based on additional site data about the mixture of chemicals involved and from first responder field observations. This allowed decision makers to make more educated choices on immediate shelter in place directives.

The Mapping Team staff provided a wide range of support for this incident in addition to the chemical plume and smoke plume maps. Street closure maps and traffic plan maps were provided to the Transportation and Public Works Department. These maps were continually changing as the event progressed and were produced several times. Mapping Team staff coordinated with EOC personnel on location to give distance information for the Fire Department. Maps were created for the shelter in place advisories that were issued to the public. Drainage areas surrounding the site were examined through GIS to determine potential runoff areas and containment. All of the City of Fort Worth staff involved responded quickly to fulfill all data requests using the array of GIS tools at their disposal.
Conclusion
The City of Fort Worth’s Mapping Team has successfully implemented geospatial technology into Fort Worth’s emergency response protocol. However, the success was not just the result of having proficient knowledge and skills in the GIS realm. To fully benefit from the EMO/GIS integration, the City went beyond the expertise of mapping professionals to include emergency planners as well as first responders. Finding the right GIS and EMO tools for the job through real world application and a team approach has benefited everyone involved. The mapping team continues to meet to run scenarios, fine-tune modeling procedures and discuss future applications. With this newly found relationship between EMO and GIS, if and when duty calls, the City will respond confidently with a well-designed and practiced plan of attack.