Make it Blue

POST–HURRICANE GIS SUPPORT

Spatial Relief Effort

ESRI – User Conference
Summer 2006

Table of Contents

Section 1: Abstract

The 2005 hurricane season was one of the worst seasons to date; climaxing with Hurricane Katrina was a devastation never known on the Mississippi Gulf Coast. The U.S. Army Corps of Engineers, while assisting FEMA, was tasked to accomplish several missions along the Coast. Specifically, the Corps of Engineers was required to track and repair damaged roofs with temporary blue tarps, or "Blue Roofs." GIS was used as the primary technology to support this mission.

Using GIS, The Corps of Engineers completed the Blue Roof Mission with more efficiency and success than ever before. GIS benefited the mission by:

a. Providing instantaneous analysis of mission spreadsheets
b. Providing location maps of damaged and repaired blue roofs for contractors, mission managers, and the public
c. Providing a easier method of maintaining and manipulating mission data

In all, more than 45,000 homes received temporary roofs in Mississippi from the late August 2005 to early December 2005.

Section 2: Introduction / Background

Hurricanes have been battering the Gulf Coast long before they were given names. Some of the most intense hurricanes of the past century have been:

- 1906 – From Pensacola, FL to Mississippi, 134 lives were lost and the tide was 9.9' above normal.

- 1947 – A Category 5 hurricane hits Florida, Louisiana and Mississippi. 51 lives were lost and the total damage was more than $700 million.
- 1957 – Hurricane Audrey was the cause of 390 deaths and a storm surge of over 12 feet, which went as far as 25 miles inland.
- 1965 – Hurricane Betsy caused major flooding in Florida before moving on to Mobile, AL. 62 people lost their lives to the hurricane with more than $7 billion dollars in damage.
- 1969 – Category 5 Hurricane Camille devastated the coast with over 256 lives lost and $5.2 billion in damage.
- 1979 – Hurricane Frederic created tides of 8 to 12 feet above normal. Due to the advanced preparedness and evacuation of 350,000 people only five lives were lost.
- 1985 – Hurricane Elena made landfall near Biloxi, MS. One million people were evacuated from Louisiana to Florida.
- 1992 – Hurricane Andrew devastated southern Florida and Louisiana. One of the terrible side effects of Andrew was the amount of tornadoes wrecking havoc in Mississippi and Alabama. Andrew is reported have caused more than $25 billion dollars of damage and is the most expensive hurricane in U.S. history.

Outside of the American Red Cross, the Federal Emergency Management Agency (FEMA) is one of the first to respond to hurricane impacted areas. FEMA has tasked the U.S. Army Corps of Engineers to help the Gulf Coast recover from its most recent hurricanes. Recent storms, including Andrew, 1995's Opal, 2004's Ivan and last year's Katrina, make recovery efforts on the Gulf Coast a top priority for the Corps.

Past Corps tasks during Hurricane Emergencies have included:

1. Fitting temporary roofs on qualifying homes
2. Providing temporary housing for public services
3. Identifying ‘red tag’ homes
4. Tracking FEMA trailers that are used as private temporary homes
5. Cleaning up debris

Due to the shear devastation of Hurricane Katrina, GIS is needed more than ever to expedite the recovery process and help people get their lives back in order.

As with every large operation, there are hiccups and issues that must be resolved while setting up a location and maintaining the location. The Regional Field Office, or RFO, is set up within days after a hurricane landfall. This is the center of operations for all of U.S. Army Corps of Engineers missions. It is considered the hub for all decision making and reporting within the Corps emergency structure. Typically, especially in the wake of such massive destruction, the Corps of Engineers will set up site offices that will help expedite the gathering and reporting of data back up to the RFO. When the GIS team arrived after Hurricane Katrina, the RFO was just getting set up. Typically, when the Corps of Engineers sets up an RFO, they need to look for a building to lease that will be able to house the number of workers coming in. This could be hundreds of workers, both in the office and field workers. In some cases, the building leased has not been used in this function; so network cables need to be run, computers and printers set up and running along with a multitude of other needs. The Corps of Engineers works through these problems

and still manages to be productive. One of the other large tasks still to conquer is the setting up of the temporary roofing database. This database will house all of the homes that required temporary roofs (blue tarps) that are designed to help block the rain from getting into damaged homes. There will be more on this later in the Temporary Roofing section.

Section 3: Problem Statement

The U.S. Army Corps of Engineers has only recently realized the potential ability of GIS to help with the relief efforts following a hurricane as well as any other disaster. As the GIS support for post-Hurricane relief efforts, we need to be prepared to educate relief workers and their supervisors of our ability to help with their objectives. We need to be prepared to give information out in a timely and easy to use manner. We also need to make sure that we include all data that would be of interest to our customers. Staying up to date with our information is essential to the success of this project. The GIS team also encounters numerous problems with geocoding data based on data collected in the field and given to them by other organizations.

Section 4: Objective

The main objective of this project is to provide GIS emergency support to the Mississippi Coast. Support includes, but is not limited to, mapping of temporary roofing efforts, temporary housing sites, red tag identification, trailer tracking and debris site selection and removal, as well as other relief efforts. For Hurricane Katrina the Corps' main focus was on temporary roofing and debris removal. The GIS team needs to be able to interact with database personnel as well as data

entry personnel in order to maintain a seamless integration between the environments. The receiving and delivering of information needs to be quick so the database used needs to fulfill all the needs that the database and the GIS functions require.

Section 5: Approach

The Corps of Engineers approach for disasters is to gather all basemap data together regarding the affected areas. After this is done, we are ready to add any other data that is relevant to the mission. We are provided with data collected by FEMA and other agencies. Our first mission is to put together a grid area of the affected counties, in this case Mississippi for Hurricane Katrina. We want our grid size to mimic a 11 x 17 printout to allow for ease of use while out in the field as well as showing a high degree of detail. Relief workers are able to come into the RFO and show us which areas they will need maps. We then are able to provide exactly what they need to complete their job. They in turn will gather additional field data and turn that data over to us. As more data comes in, our maps are continuously updated to reflect the most current information.

Section 5a: Temporary Roofing:

Temporary roofing, as stated before, is a big task for the Corps of Engineers. In Mississippi, there were over 70,000 homes that were in need of temporary roofing. Homes that qualify for temporary roofing is any home that passes the Corps of Engineers QA personnel inspection. QA personnel make sure the home qualifies for temporary roof and then has the Corps of Engineers contractors come and install a blue tarp to the home. To qualify for temporary roofing, the home must have less than 50% of the roof missing.

The process of receiving a temporary roof starts out with either the homeowners going to a Right of Entry sign up station or Data Collection employees going to their homes. A Right of Entry form states that the owner of the home gives permission for the Corps of Engineers to come onto their land and on their roof in the process of installing temporary roofs.

Homeowners are given a 30/60/90 day deadline for the temporary roof to go up. From the day the homeowners sign the Right of Entry form allowing the Corps of Engineers' contractors to install a temporary roof, the Corps has 30/60/90 days to install that roof before the form is void. Data entry is the key. In our Temporary roofing mission for Katrina, with over 70,000 records to enter, there were 10 - 15 people solely entering data at any given time. This data then had to be geocoded. Our percentage rate was typically 80% or more for a geocode match to data. While this is a great percentage depending on the dataset you are working with, that still left thousands of records that still need to be identified either manually or by using other software. Some records were never geocoded because of lack of data, i.e. missing zip code, city, street number or street name.

Through use of ArcGIS and other mapping software we were able to match around 95%. After the records were geocoded, GIS would then cluster the points into geographic groups. It would take twice as long to install temporary roofs if the contractors had to pick and choose where to go. During Hurricane Katrina recovery, we used ESRI's Mapbook extension to help create mapbooks that would display the home in need of roofs.

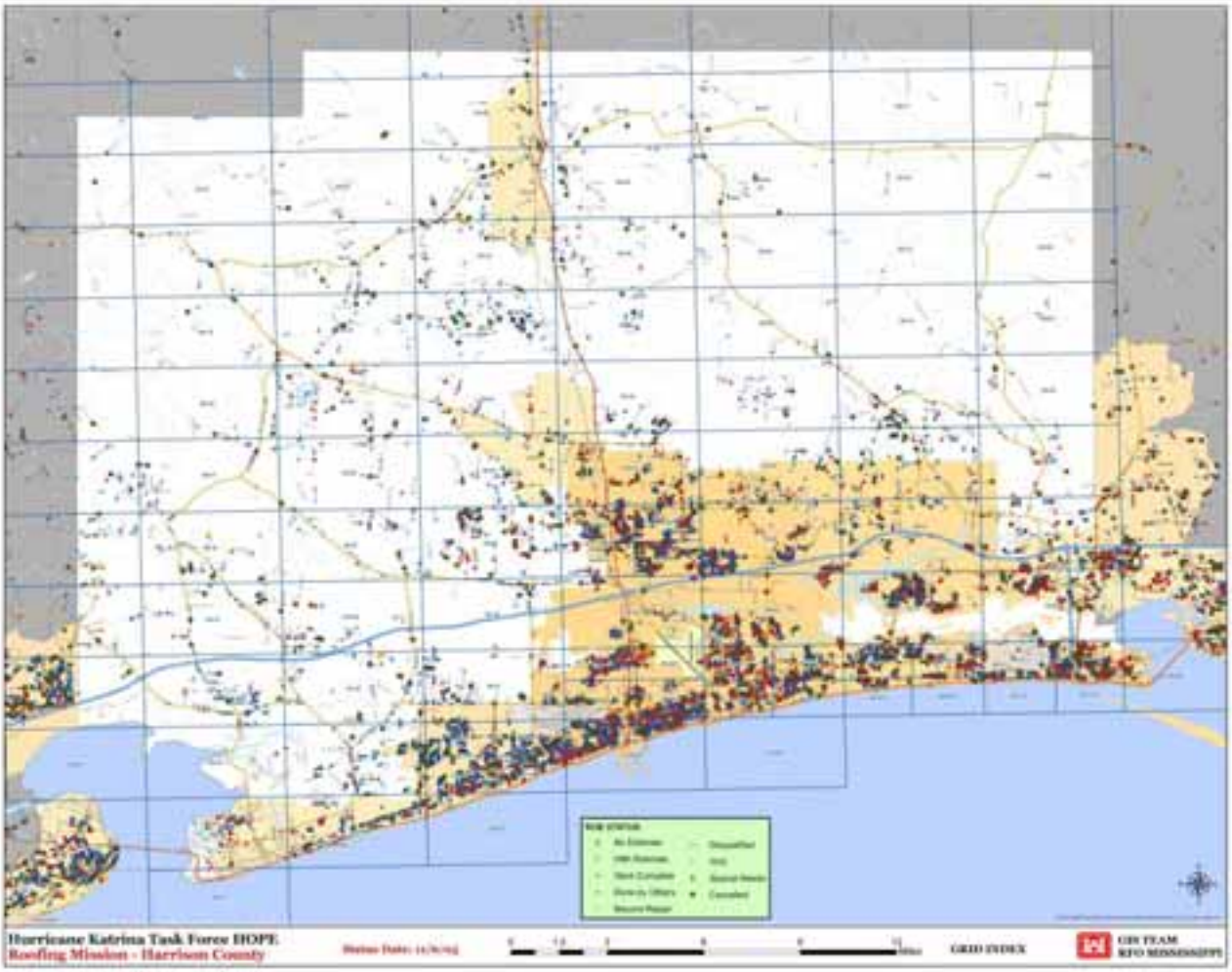
In this case, the maps were printed out in ½ mile radiuses. The maps would either show all homes in the system or they could show homes with no estimate, with estimate, work complete, done by others, beyond repair, disqualified, void, special needs or cancelled.

The mapbooks saved the GIS team a lot of time and effort; they also speed up temporary roof repairs by half. There was a dramatic difference between the counties that used this system and the counties that did not. The map lists the ROE numbers so the map can be put with the associated ROEs. The map also contains an inset of the grid that overlays the county. This grid was used to help locate the cluster in the county. There will be more regarding the grid and the ideas behind the grid later.

Throughout the mission, all Right of Entry data is continually updated as the statuses change. The lifecycle of a Right of Entry form is as follows: temporary roofs are approved or disqualified, if

approved they are then given estimates. Once given an estimate, they are given to contractors to put on the temporary roofs and given back as work completed.

Below is an example of a county's Right of Entry Status as of a certain date. The status is shown by using different symbols and colors to make using the map even easier. On this map the majority of Right of Entry statuses are Work Complete. This means that the Contractor has put the temporary roof on the house and the QA has signed off on the amount of material used.



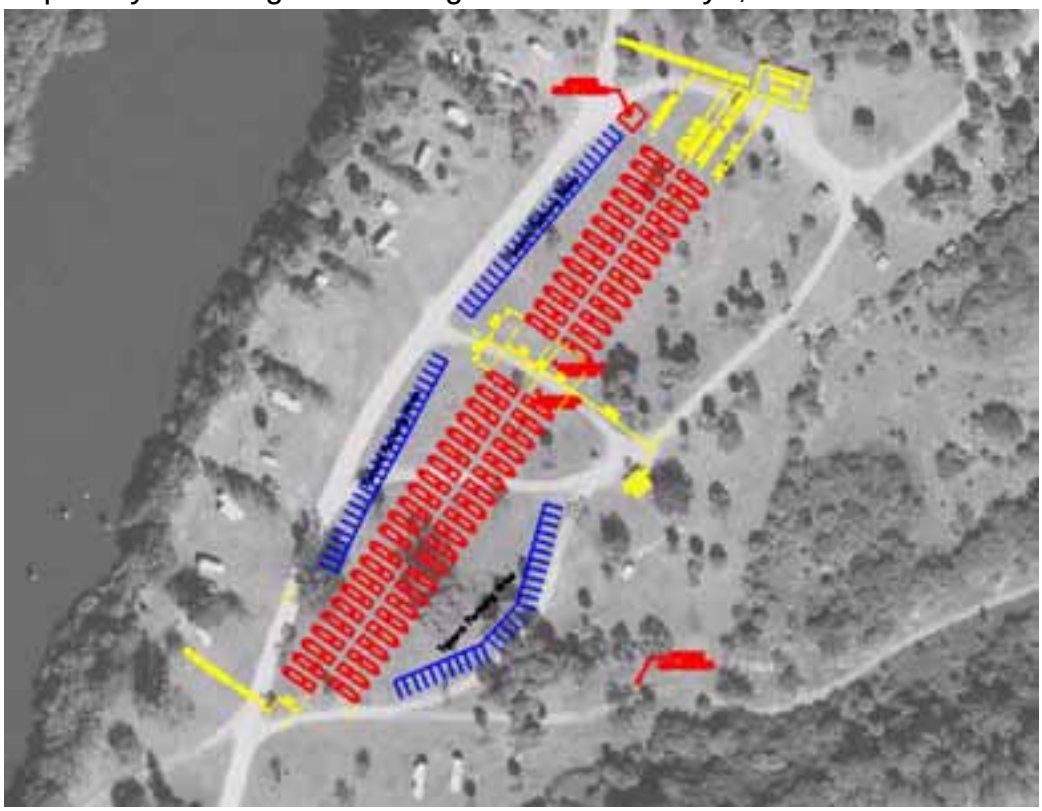
There are many aspects to tracking Right of Entry forms. The mission manager as well as the county temporary roof mangers tracks the stages of each of the Right of Entry forms. Are there some contractors that are not putting on enough roofs in a day? Are there some areas where we need to concentrate more of our efforts? Are homeowners signing more than one Right of Entry form for the same house? The latter has been part of a large undertaking. It is the GIS teams, as well as the Database management personnel's responsibility to make sure that duplicate Right of Entry forms are identified quickly. This is done for two purposes; the first is so that contractors do not waste their time going to homes that have already received their temporary roofs, this will increase production and get the job done quicker. Secondly, this will also prevent contractors from "completing" the house twice. Once contractors have completed a house the first time; they cannot claim to have completed the house again, therefore getting paid double for the same house. This task alone will keeps the GIS team and database personnel on their toes.

Section 5b: Temporary Housing:

Temporary housing has also been a big task for the GIS team in the past. Sites need to be located and evaluated to determine if the site is adequate for the temporary housing purpose. Temporary housing can mean many things: using an existing mobile home trailer park site to place FEMA trailers or RVs, using campgrounds for the same purpose, or even constructing totally new parks to house the many trailers needed. The first step is locating mobile home parks and campgrounds that already exist. The picture below shows some of the temporary housing sites that were located in

Indian River County, FL after the 2004 Hurricane Season. At this stage, the majority of the temporary housing sites has been FEMA approved and are ready to have trailers or RVs put on the existing sites. In central Florida, the area that had been hit three times by hurricanes in 2004, for temporary housing measures this means that the demand for existing sites are far outnumbered by the need than there would have been in the past.

This leads to having to create temporary housing sites. This is done through a number of methods. Aerial photography, site visits and through county officials. Typically the first thing our temporary housing managers look for is county or city land that can be used to park mobile homes. If the available areas are too few, then they look toward private landowners with vacant land that could reasonably house around 50 or more mobile homes. There are hundreds of people in need of temporary housing after their homes have been destroyed or otherwise unlivable. Most of these temporary housing sites are good for 120 days, in some cases even



longer. This is designed, of course, to help people get back to their jobs and allow time to rebuild or in some cases find a new home. In the picture above, CAD and GIS are used together to help layout sites, find and plan out utilities. The designated land that can be used for temporary trailer parks are highlighted in yellow. The trailers are shown in red and the parking is shown in blue. The trailers are based off of a CAD drawing that represents adequate spacing between the trailers. Many things must be taken in account when designing a trailer park from scratch. Where are the utilities? Is there enough room for the trailers and parking? Are there fences or other barriers that will have to be removed before placing the trailers?

Section 5c: Red Tag Identification:

Temporary housing goes through several phases especially when dealing with new temporary housing areas. First, several spots are highlighted as potential temporary housing areas. Next, the Corps of Engineers personnel must visit the site and determine if the site is feasible or if the site will be disqualified. Once the site is approved, plans similar to above are made and have to be approved by FEMA before temporary trailers are brought in. Changes are made and brought back for approval; more changes are requested, etc. Finally a plan is decided upon and the plans are then given to a contractor for the installation of utilities and the trailers. The main goal of this mission was to provide those in need with a travel trailer, a mobile home or move them to a temporary emergency group site until they can fix up their homes. In some cases, a travel trailer and the mobile home could be put directly onto the homeowner's site if room allows, otherwise they must

move to an Emergency group site. Homeowners that are accepted into the program sign a one-month lease that will allow them use of temporary housing. This allows hurricane victims the chance to live in a safe sanitary home rent free, the only catch is that homeowners must show that there are repairs being made to their existing houses in order to remain in temporary housing. Each county's emergency office designates each house as a red tag or non-red tag. The red tag symbolizes that the house is not fit for the occupants to live in. This could be due to overall damage to the house, mold or other sanitary conditions, etc. The first step is to get the data from each county. This data was provided to the Corps of Engineers in a spreadsheet. The Corps of Engineers then takes this spreadsheet and sends out field personnel to these sites to collect information about each site. Each site was given a unique Site ID which will allow us to link a certain house to a record. Some of the information gathered was: is this house an urgent need, is the site feasible for the set up of temporary housing on site, do they already have a FEMA number for temporary housing, and of course, name, number and address. One thing we couldn't stress enough to our field workers is the need to have a complete addresses when collecting data. We also need to make sure that the field workers talked directly to the homeowner to make sure the information that they have received is correct.

The GIS team first maps all of the urgent need sites. Urgent needs can be defined by many things, first the homeowner is elderly, has health problems, children, etc. The homes that were unsafe to live in and condemned by their counties were also put on the lists. Once a site was determined to be an urgent need, it was the Corps

of Engineers task to provide a site assessment of each site. The field workers draw out the placement of the temporary trailer or mobile home in relation to the existing house and other unmovable objects. Another major aspect of the Red Tag temporary housing mission is that we need to make sure that those with special needs were put in the right environment. For example, in a typically travel trailer, a wheelchair cannot fit in the doorway and there is not enough room for the person to move around the trailer. In this case, we need to be sure that this homeowner is provided a mobile home, which will allow for greater mobility.

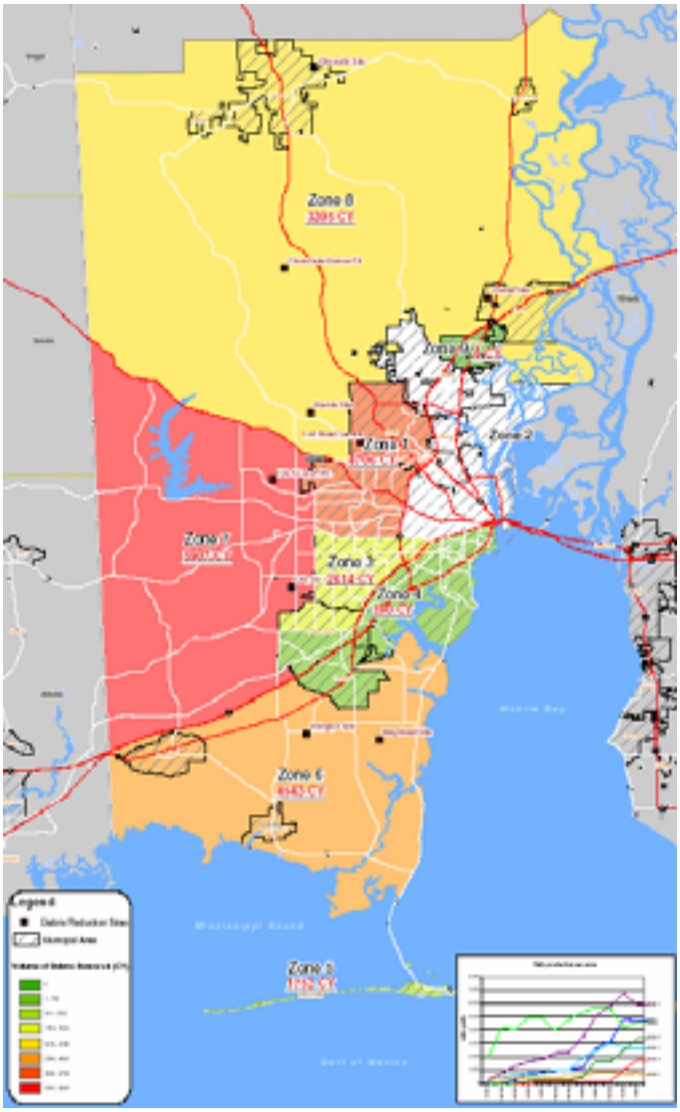
Section 5d: Trailer Tracking:

The trailer tracking mission is actually a subset of the Red Tag mission. FEMA tasked the Corps of Engineers with the tracking of each trailer. This means that the trailer assigned to a location, must actually be the trailer that was delivered. Corps of Engineers field workers also need to verify that all the hook-ups were made for the trailers. This mission started with FEMA supplying us with a spreadsheet of all the Bar Codes and Work Orders that matched each address. With this knowledge we can map the address to make finding the homes easier and allow the field workers to complete their tasks in the least amount of time possible.

Section 5e: Debris Management and Site Location:

Debris management and site location is a large undertaking for the Corps of Engineers. It takes contractors months and possibly years to clean up all the debris working 7 days a week, 12 hours a day. Before the debris can even be picked up, approved dumping sites must be established. To do this, Environmental personnel are

dispatched on site visits. While out, they take GPS points of each location to be sent back to the main office for use in the GIS. Armed with the GPS points, the GIS team is able to map the location out. Aerials as well as USGS Quad Sheets are used to help in the decision making process. The USGS Quad Sheets help tell them about elevation, low points and other important information. Aerial imagery is used to show how the land is positioned as well as to provide details on where to place debris, mulching machines, etc. This is also a great way to determine how large the property is and the boundaries of the property. There are a couple different ways debris is dealt with. Vegetation debris is typically mulched or cut up for firewood. Other miscellaneous debris is either burned or put into an existing dump. Regardless of which method is used, sites must be approved by environmental personnel to make sure that the land, water and wildlife is not adversely affected by the burning or dumping of this type of waste. The image shows that the debris team divided Mobile County, Alabama into nine zones for debris removal following Hurricane Ivan in 2004.



These zones were created using a dot density map to help show the population groupings in Mobile County. Also shown on the map are the cubic yards of debris collected in those zones. This was not the final amount of debris collected, but just a snap shot during the clean up efforts. The chart on the bottom right hand corner shows debris collections rates over a twelve day period. As you can see, the debris mission spikes up quickly then settles into a pattern over the coming weeks.

Section 5g: Ice & Water:

The distribution of Ice and Water is one of the first tasks put into place by the Corps of Engineers. This is also one of the first tasks

to end as well as one of the most important tasks in a disaster relief mission. After residents are hit with the force of a hurricane, many times they are left with little or nothing. Power is down and supplies are hard to come by. It is the job of the Corps of Engineers as well as other disaster agencies to step up and provide supplies and services. The picture above shows Ice and Water that

was tasked to be delivered and their respective percentages complete. This style of map is important to the Ice & Water crew; they use the map to accurately monitor deliveries being made to each of their distribution sites. This map also lets them know which areas are not complete and more supplies need to be sent.

Section 6: Outcomes

The Katrina mission was a success. Temporary roofs were placed on over 70,000 homes, temporary homes were provided to families in need, most of the debris has been cleaned up and disposed of and most important of all, the Corps of Engineers has proven that it is capable of handling emergency operations. The main goal of the mission was, of course, to answer the need for help, but also to be able to learn new things and be able to apply this new knowledge to other missions and disasters. With each event, the knowledge should grow making each recovery operation more seamless and efficient than the last.

Our recent GIS applications have proven to enhance the Corps' overall Emergency missions, providing the needed assistance in a more efficient and more effective manner, even within a highly stressful environment.

The Gulf Coast is on its way to recovering from two very active hurricane seasons. People will continue on and build again, hurricanes will continue to brew in the Atlantic and the U.S. Army Corps of Engineers will continue to provide assistance to those in need.

Section 9: Author Information

Author 1:

Name:
Cheryl Bosley

Title:
GIS Intermediate Analyst

Organization:
Bowhead Information Technology Services – U.S. Army Corps of
Engineers – Mobile District

Address:
109 St. Joseph St.
Mobile, AL 36602

Phone:
251-694-3774 (work)

Email:
Cheryl.L.Bosley@sam.usace.army.mil

Author 2:

Name:
G. Michael Renacker, RPA

Title:
Archeologist/GIS Supervisor

Organization:
U.S. Army Corps of Engineers, Vicksburg District

Address:
Attn:PP-PG
4155 East Clay St
Vicksburg, MS 39183

Phone:
601-631-5403(work)

Email:
Mike.Renacker@mvk02.usace.army.mil