Using GIS and Google Earth to Report Flood Damage to FEMA

By Lisa Harris

Barton County saved hundreds of hours, thousands of dollars in hard copies, and was reimbursed a quarter of a million dollars.

Barton County
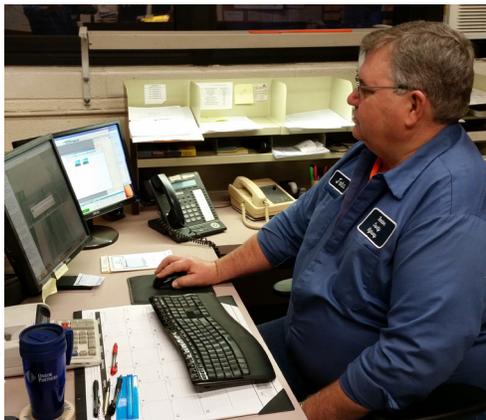
Remmert at work at the County's "file cabinet."

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John Remmert is a self-described "old guy." A few years ago he would not have imagined himself using a GIS system to track road work, maintenance-related receipts and other road and bridge documentation. But seeing geo-referencing and Google Earth in action, and using it himself, has changed all that. He's a convert. Remmert is saving the county a lot of time and money as a result.

When we asked Remmert to describe how these technologies are benefiting his county, he said "Wow... where to start?" (See the sidebar on page 2 for a few applications.) He said what really brought home the power of GIS, though, was using it to organize documentation for flood remediation in 2013.

Challenge: Managing and tracking paperwork

After a period of particularly heavy rains and subsequent flooding, the county qualified for FEMA funds for clearing debris and repairing damage to roads, bridges and culverts. Remmert said FEMA is very careful about reimbursing expenses and requires substantial documentation, which FEMA also audits. Required documentation for each location runs the gamut from multiple photographs taken at different times, to invoices to time sheets. The "paper trail" must show that the damage was caused by the flood and that the repairs were actually made.

Barton County had 50 different damaged locations, and staff needed to provide documentation for each of them. If they had submitted hard copies to FEMA, they would have "killed a forest," said Remmert.

Solution: Geo-reference all the documents and create a virtual filing cabinet

Instead, they used a computer to file, organize, and report geo-referenced documents. The county scanned, created or received all kinds of documents related to the repairs (showing conditions before and after flooding, and during and after repair) and "filed" them electronically by the lat-long coordinates of the site. Then they could pull up a damaged site in Google Earth and see the physical location and all the files for that location, each of which could be clicked on to see a pop-up window with more detail.

For example, when looking in Google Earth at the location of a damaged culvert that needed replacement and debris cleanup at NE 70, NE 30 Road, the names of picture files could be seen for the structure six months before the flood, the crew cleaning debris at the location, and after clean-up. You would also see invoice files for crane rental and the new culvert, a photo of the crane working at the site, and a photo of the finished work.

To start creating the documentation, county personnel took photographs of each damaged location with a digital camera that also recorded its GIS coordinates. The photographs showed debris piled up, roads washed out, and structural damage. "When we dropped [the photos] into Google Earth, we could take a tour of the flood-damaged areas without getting
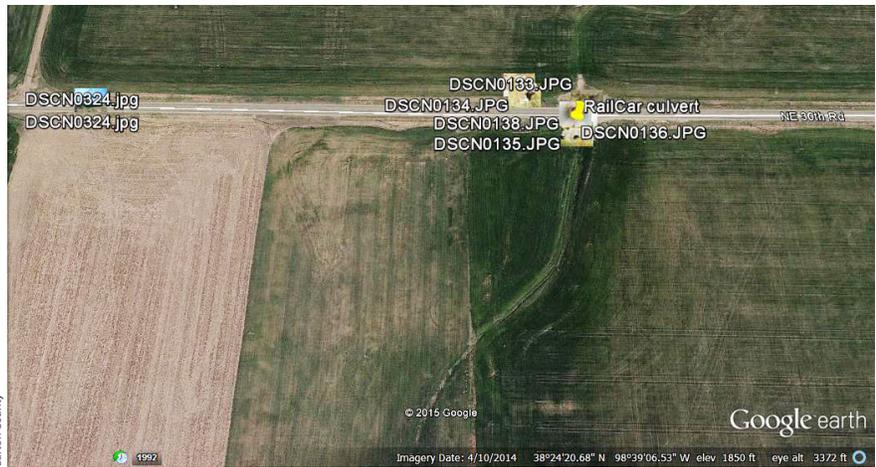
This map shows the location of a damaged bridge replaced with a railroad car bridge and the files associated with that remediation.

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images of those bridges before they were damaged by the flood.

The documentation came in handy for bridges on the federal aid system (FAS) too, Remmert said. "FEMA won't pay for FAS bridges but we use the same documentation to submit to the state to get those fixed as well."

Barton County kept records for a township that sustained damages too. "It was really quite easy," Remmert said, "and we're a lot better set up for that kind of thing than the township."

Benefits of geo-referencing files

"The time savings are phenomenal," Remmert said. "Think about the filing aspect. You might have the documents for a structure in several locations—an electronic photo in one place, a hard copy photo in another, the plans in another. Then you start adding in the documentation for repairs—the hard copy invoices for structures, materials, cranes, more pictures... you could end up with 35 documents per location, when all is said and done."

Road and bridge documents can be filed any number of ways... by street number, 911 location, township location, bridge inventory number, etc., Remmert said. "Geo-coding the

into a truck," Remmert said.

Staff took photographs of the repair work under way, as well. If a crane was rented to set a new culvert, they took a picture of the crane working at the job site. That came in handy when FEMA did their audit, and they could match it up against the invoice for the crane, which was also scanned and geo-coded to the location.

When crews did work orders, Remmert tracked those and then marked

locations that had been remediated.

When the work was completed, the county photographed the location one last time, to document "after" conditions.

Barton County had a lucky break in pulling together their "before" documentation due to the fact that, six months before, Kirkham and Michael had done a bridge survey of 50 percent of their bridges, and the survey included taking geo-located photos. This provided the County with electronic

Other uses for GIS in Barton County

Ever since student intern Dylan Dreiling set up their simple GIS system a few years ago (a system that uses spreadsheets and Google FusionTables to display spreadsheet data in Google Earth), Barton County has been discovering more and more ways to use the technology. For example:

• If the County helps other communities with storm cleanup, they can track that work in the same way as their own work, by location. It's easy to pull up the documentation whenever you need it, Remmert said.

• Remmert attended a recent LTAP workshop on crash analysis, and is planning to map five years of crashes and identify the County's most hazardous intersections.

• The County can create an on-screen collage of any work that has been done in a given area in 4-5 years. Remmert said this is virtually impossible to pull together from historical files.

• The County uses GIS-based software to manage signs. They have 4,800 regulatory signs on 400 miles of blacktop. They also have old aerial photographs scanned; Remmert said that comes in handy if anyone claims there used to be a stop sign at an intersection years ago and it was taken down. You can go back to an aerial photo for that location and tell quite plainly that one was not there. Same for culverts, Remmert said.

• The public works department has taken over the County cemetery and will be adding curb and gutter. To design the placement, the crew viewed the cemetery in Google Earth on a smart board and they drew on it to indicate where the curb and gutter will go. Photographs of the headstones are also being geo-located, and that information is given to the mortuary to decrease the likelihood of someone being buried in the wrong plot. (This did happen at least once in Barton County.) All the information is networked with a GoPro tablet, in real time. "You don't want the mortuary getting that information two days later, after the person is buried in the wrong plot," Remmert said.

Remmert credits department head Dale Phillips with the advances they have made in using GIS for their operations. He said Phillips "is very much in tune with new technology and how it can be used to save time and money. We use it on a daily basis."

documents eliminates the guesswork and looking around. It's all in one place by lat-long. It took me longer to photocopy time sheets than to assemble all the rest of the documents," he said. "We could have scanned those, too, but we learned at a conference that FEMA prefers to see copies of the originals."

FEMA audit and reaction

Remmert said FEMA wanted to monitor 10 percent of Barton County's sites as part of a routine audit. A "site" for FEMA might be 3-4 locations in an area or along a particular road. The County's Google Earth formatting benefited the FEMA audit process because FEMA is also Google Earth-based. When the auditor asked for supporting documentation, Remmert downloaded the spreadsheet of damages and the GIS-located documentation onto a zip drive which the auditor was able to open and use. The auditors didn't have to look for an invoice to tie to a site; they just clicked on a site pop-up.

FEMA has three categories for reimbursement: cleanup, remediation and emergency call out. Each could be separated out.

At the FEMA close-out meeting, Remmert heard the state FEMA director tell a national FEMA rep who asked about documentation: "You have no idea how well this guy has documented." That was nice to hear, Remmert said, especially because using GIS had been, until recently, "a real stretch of technology for this old guy."

For more information, contact John Remmert at (620) 793-1816 or highwaydept@bartoncounty.org. ∎

Reprinted from the Winter 2015 issue of the *Kansas LTAP Newsletter*, a publication of the Kansas Local Technical Assistance Program (LTAP) at the Kansas University Transportation Center.