Expanding Hazus Information for Flood Modeling in Monroe County

Justin D. Cole, GISP
Senior GIS Analyst
Monroe County Department of Environmental Services

Mapping Monroe
GIS Services Division
Department of Environmental Services

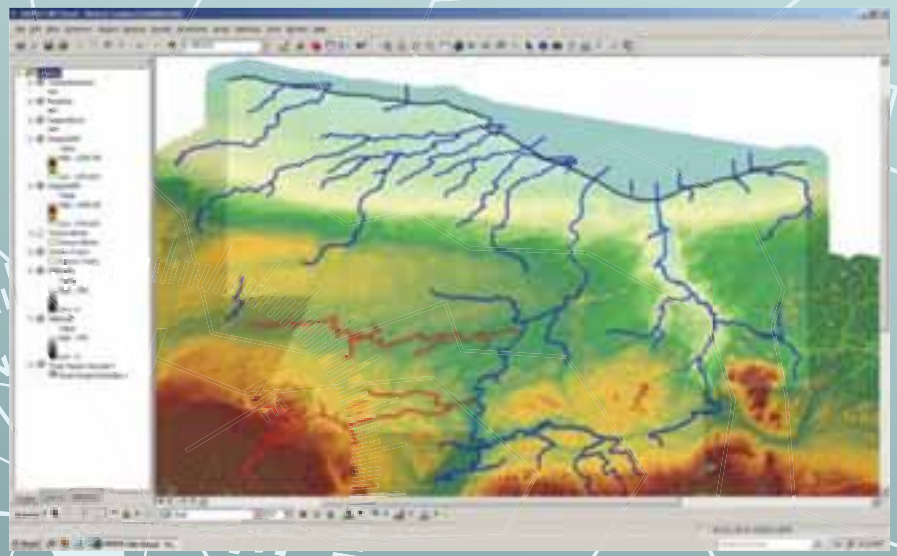
Agenda

- What is Hazus-MH and how it works
- Stream Network
- USGS DEM VS LiDAR Processing
- Critical Infrastructure
- Black Creek
- Black Creek Analysis Hazus-MH Tools
- Black Creek Analysis Monroe County GIS Data Tools
- Limitations
- Web Viewer
  - Hurricane Sandy
- Current and Future Work
- Conclusion

Processing Computer

- Virtual Machine
  - 32 Bit
  - 3 GB of Ram at 2.98 GHz
  - 3.00GHz single core
  - XP SP3
- ArcGIS 10
  - Hazus 2.1
  - Spatial Analyst
  - 3D Analyst
- 7.5 square mile drainage basins

Stream Network



- Developed based on the elevation data
- Can be adjusted based on the total square mileage of the drainage basin
- Needs to be created before any analysis
- Flood information based on discharge rates

Stream Network

USGS

LiDAR Derived

Stream Gauge Network

- Currently any model runs are based on the existing USGS Stream Gauge Network
- Most gauges have historic information to create baselines for other analysis
- As time permits field checking and portable stream systems will allow for more gauges to be created

USGS DEM VS LiDAR Processing

UGSG DEM

- ~10 meter per pixel
- Fast processing
  - ~10 minutes per water body
- Less accurate
- Less detail
- Better for quick situational awareness

LiDAR

- 10 feet per pixel (full resolution is 5feet per pixel)
- Slow processing
  - Over 4.5 hours to load alone
  - Over 36 hours to develop stream network
  - About 2.5 hours per flood model per watershed
- More accurate
- A lot of detail
- Better for planning and remediation

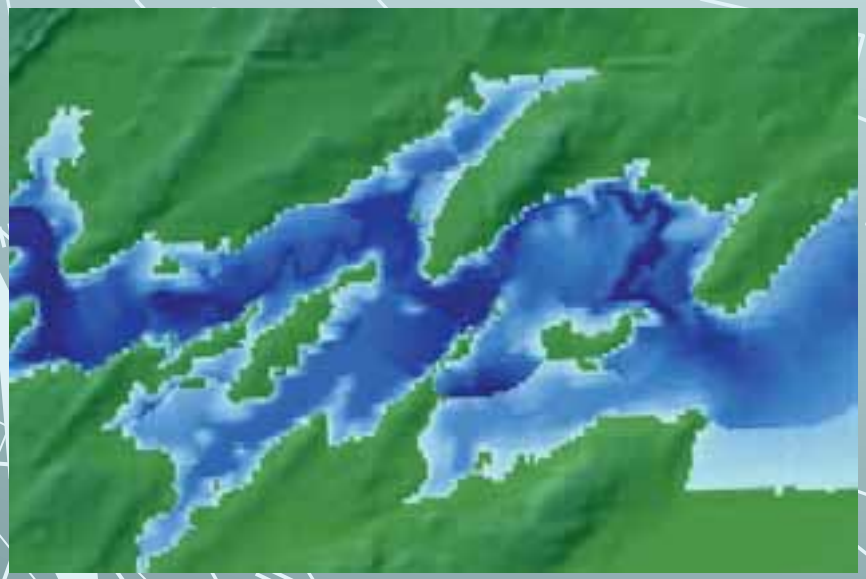
USGS DEM VS LiDAR Results

UGSG DEM

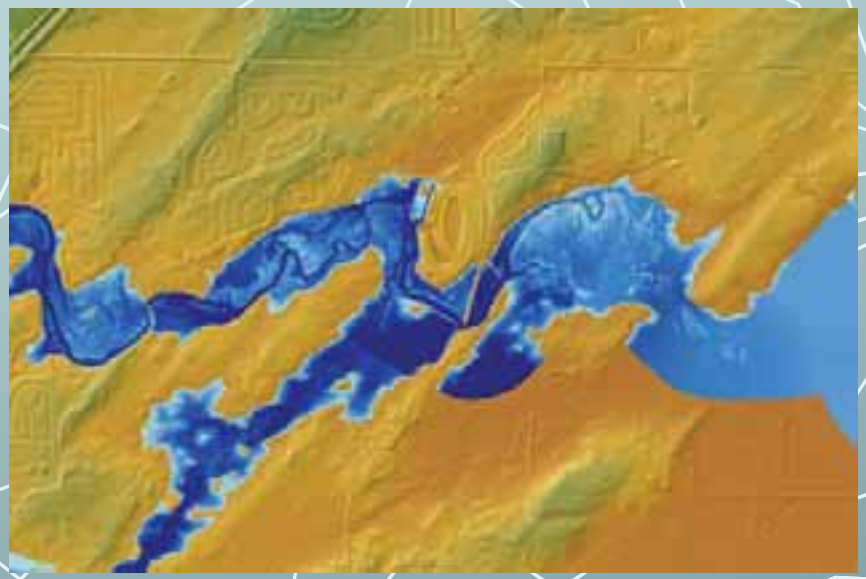
LiDAR

USGS DEM VS LiDAR Results

UGSG DEM

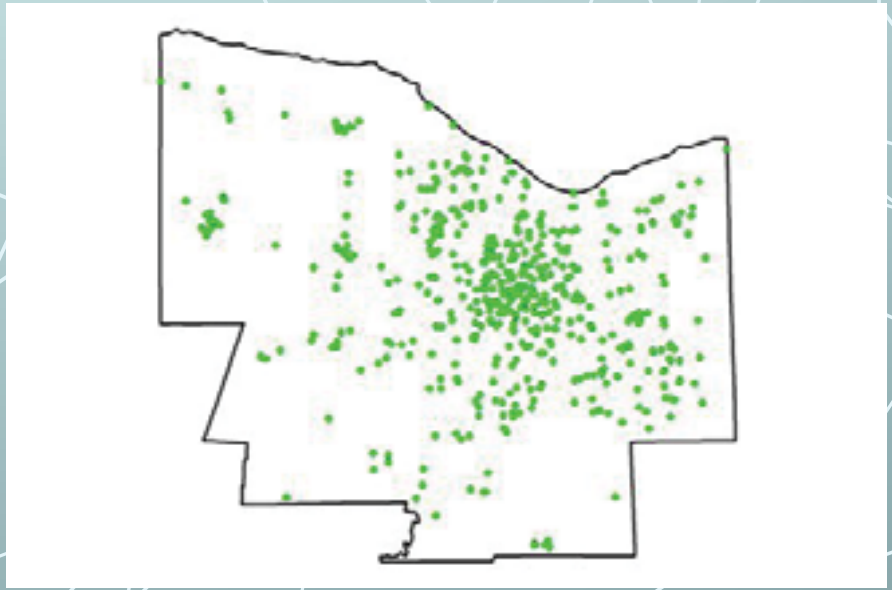


LiDAR



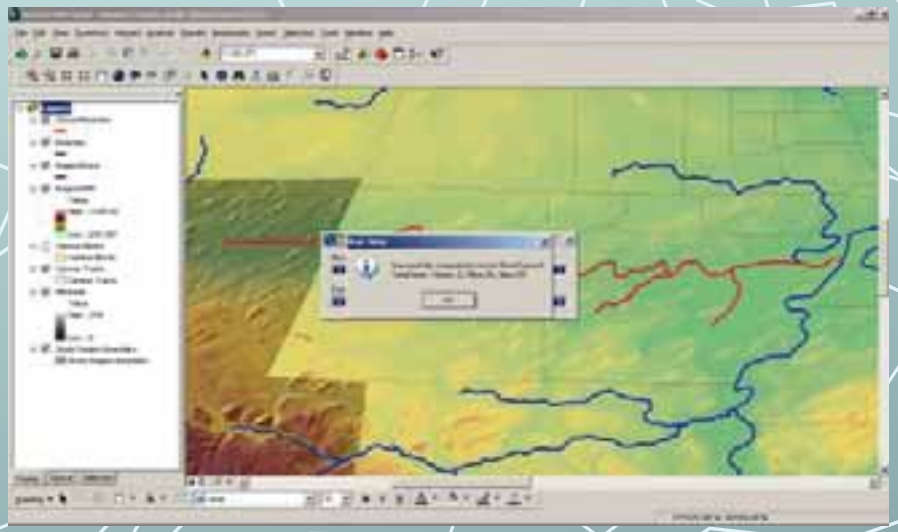
Critical Infrastructure of CI/KR Program

- Program was a partnership between the County and RIT as part of Urban Area Security Initiative (UASI)
- Involved capturing and filling data gaps in the GIS database emergency infrastructure
- Created a list of locations and evaluated their vulnerability to disruption for different scenarios



Black Creek

- Total Processing Time 2 and a half hours per run
- At this level will need preplans for each watershed
- For each watershed a list of discharge values were created using the USGS Stream Gauge Information

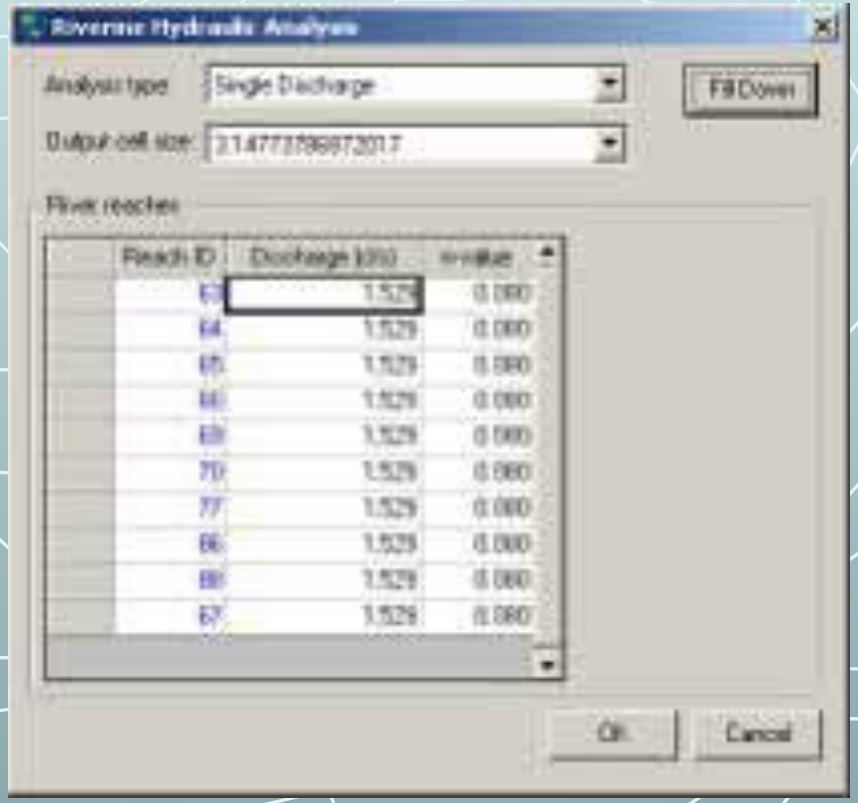


Black Creek

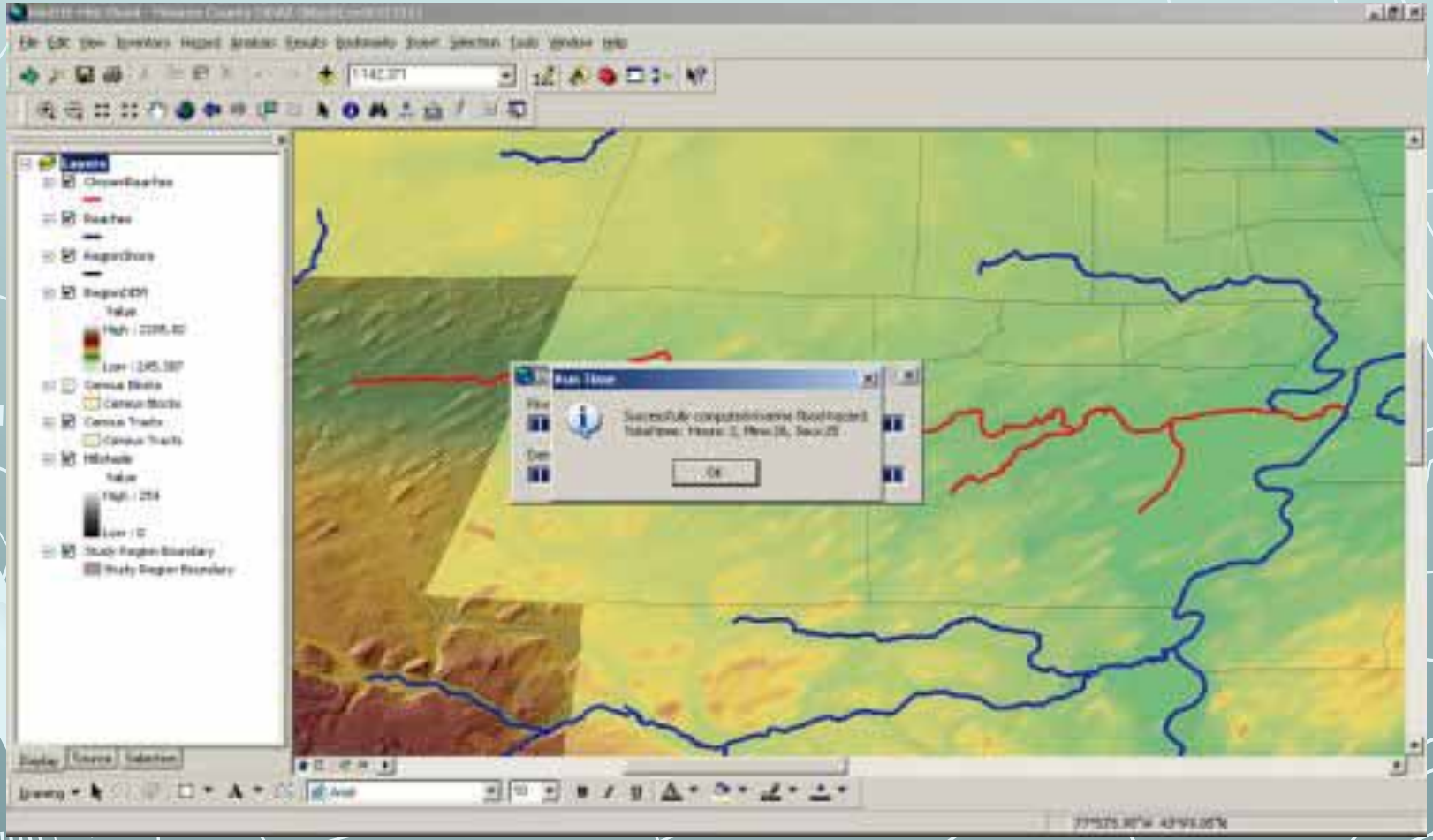
Stream (all measurements are cfs)	Max	Flood	Flood + 10%	Flood - 10%	flood + 20%	flood - 20%	Average	Average +20%	Average -20%
Black Creek	4880	1390	1529	1251	1668	1112	120	144	96

- The values of the preplans were created to try to estimate some stream emergencies
- This list is only the beginning, with more preplans available as the need arises

Black Creek


Riverine Hydraulic Analysis
Analysis type
Single Discharge
Fill Down
Output cell size
River reaches
Reach ID
Discharge (cfs)
n-value
OK
Cancel

Black Creek



Black Creek Average Flow 120 Cubic Feet Per Second

Black Creek Average Flow 120 Cubic Feet Per Second

Black Creek Flood Flow
1390 Cubic Feet Per Second

Black Creek Flood Flow
1390 Cubic Feet Per Second

Black Creek Max Recorded Flow 4880 Cubic Feet Per Second

Black Creek Max Recorded Flow 4880 Cubic Feet Per Second

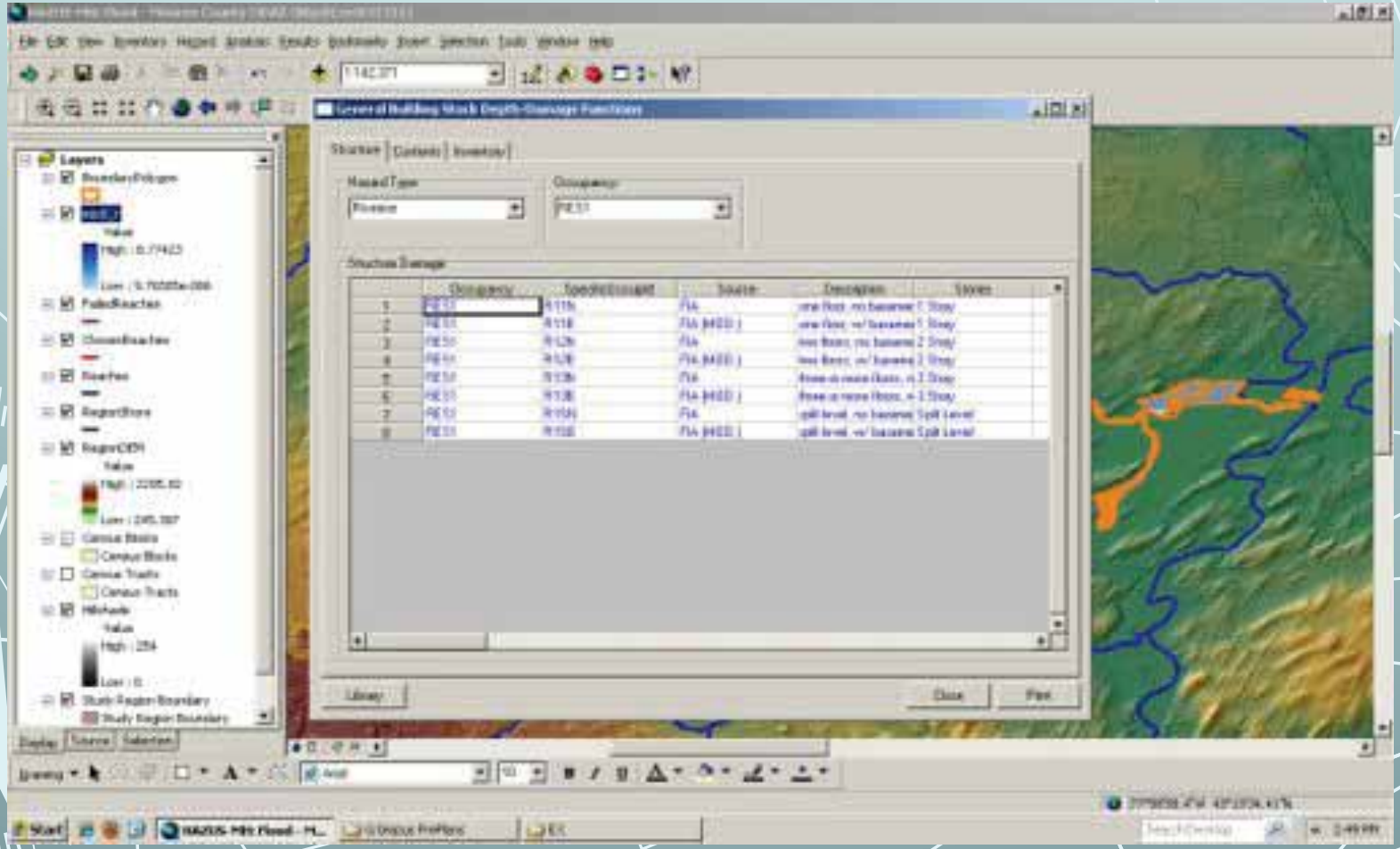
Black Creek Analysis

- Taking each of these preplans we then can use either the Hazus-MH reporting functions or using custom tools analyze Monroe County's GIS Data
- Both tools are run during an event
- Any Hazus Analyzed Population data is based on the 2000 census data
- The Monroe County's GIS Data is very current with Parcels and centerlines being at most 6 months out of date

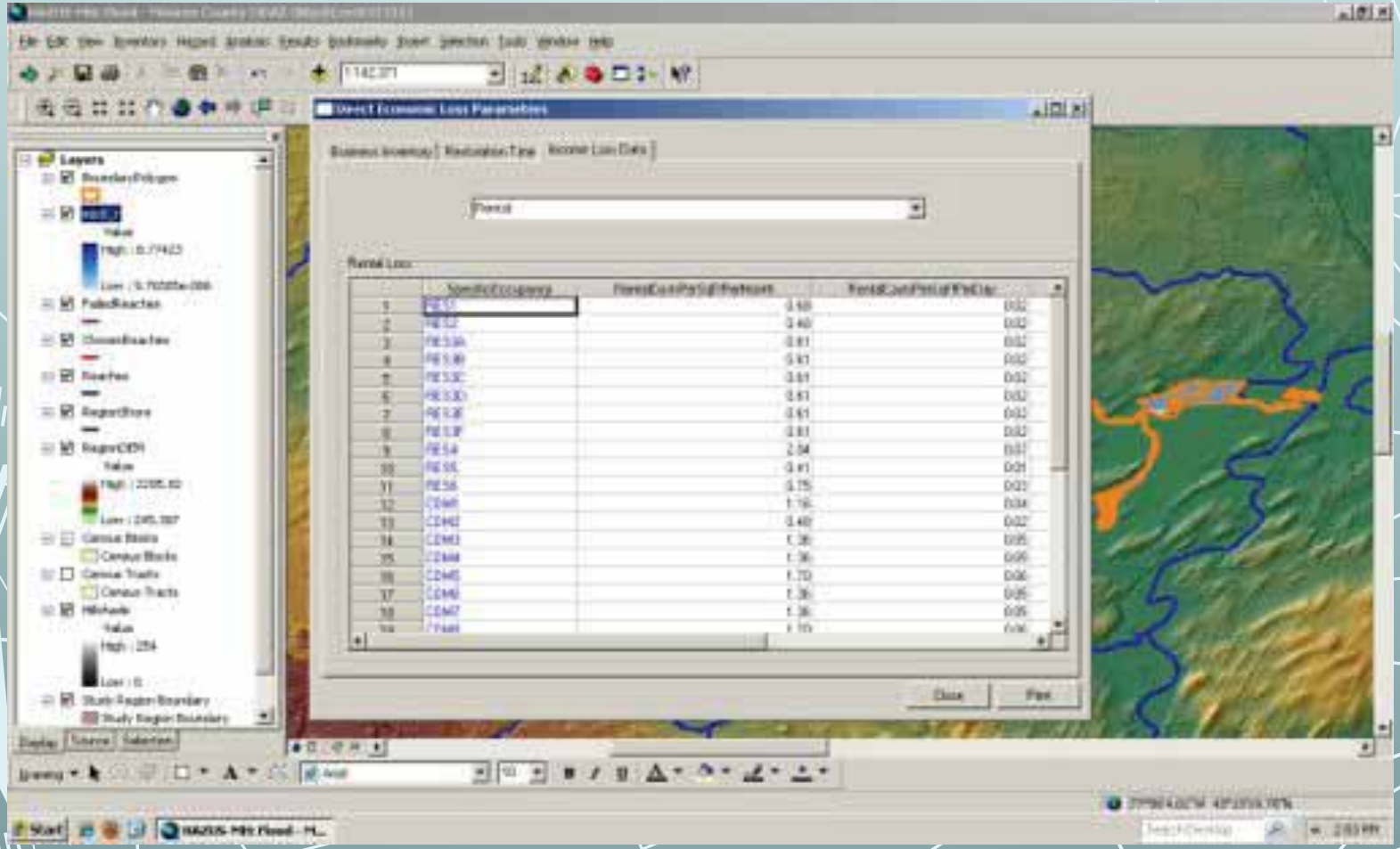
Black Creek Analysis Hazus-MH Tools

- Besides the hydrology tools Hazus-MH can take census data and report impacted area numbers
- This is particularly helpful because FEMA uses the same tools during an emergency
- These tools can be customized to a point

Black Creek Analysis Hazus-MH Tools



Black Creek Analysis Hazus-MH Tools



Black Creek Analysis Monroe County GIS Data Tools

- Monroe County needed more analysis than just the standard Hazus Reporting
- Using ArcGIS Model Builder and Python we created a set of tools to look at impacted infrastructure
- Things that were included were
  - Manholes
  - Fiber Splice Points
  - Hydrants
  - Etc.

Black Creek Analysis Monroe County GIS Data Tools

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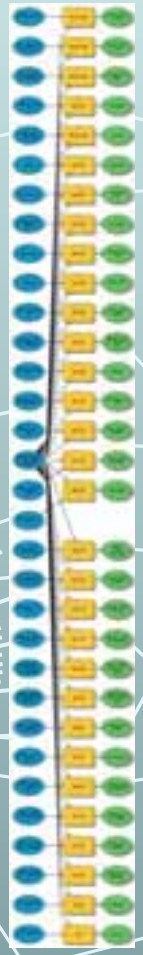

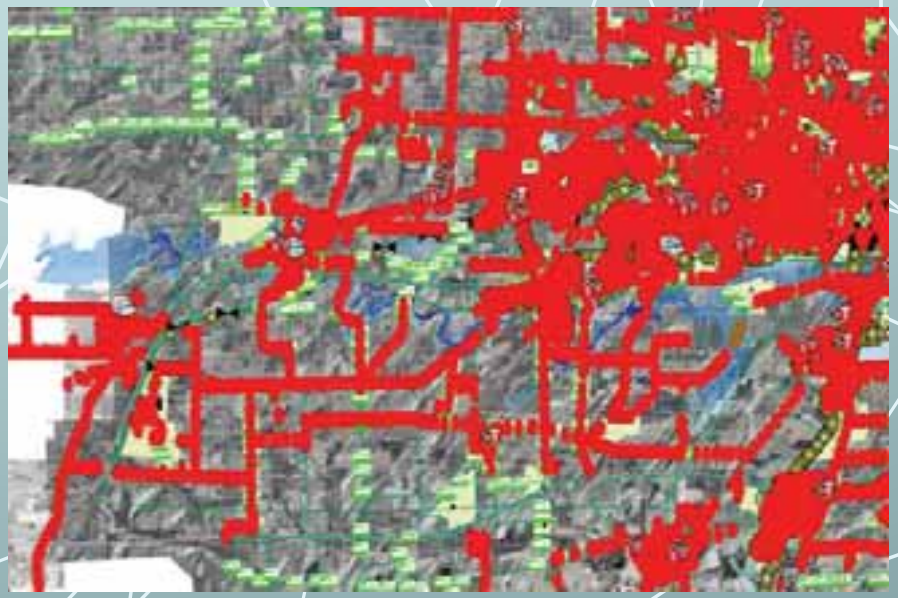

Black Creek Analysis Monroe County GIS Data Tools

```
* Process: Clip
arcpy.Clip_analysis(CCD_Schools, BlackCreekBound_nad88ifs, schools, "")

* Process: Intersect
arcpy.Intersect_analysis("BlackCreekBound_nad88ifs #;CCD_Hospitals #", hospitals, "ALL", ""
, "INPUT")

* Process: Clip (2)
arcpy.Clip_analysis(CCD_Colleges, BlackCreekBound_nad88ifs, Colleges, "")

* Process: Clip (3)
arcpy.Clip_analysis(CCD_Ambulance_Stations, BlackCreekBound_nad88ifs, Ambulance_Stations,
"")
```

```
* Process: Intersect (3)
arcpy.Intersect_analysis("BlackCreekBound_nad88ifs #;CCD_parcels #", CCD_Parcels__2_,
"ALL", "", "INPUT")

* Process: Intersect (4)
arcpy.Intersect_analysis("BlackCreekBound_nad88ifs #;CCD_medical_facilities #",
medical_facilities, "ALL", "", "INPUT")

* Process: Intersect (5)
arcpy.Intersect_analysis("BlackCreekBound_nad88ifs #;CCD_Areas_of_Interest #",
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```

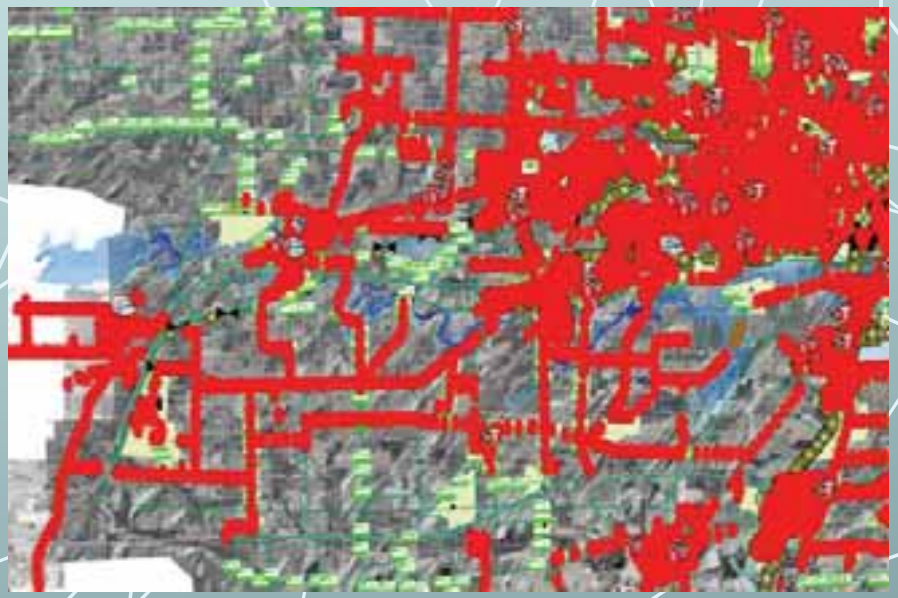

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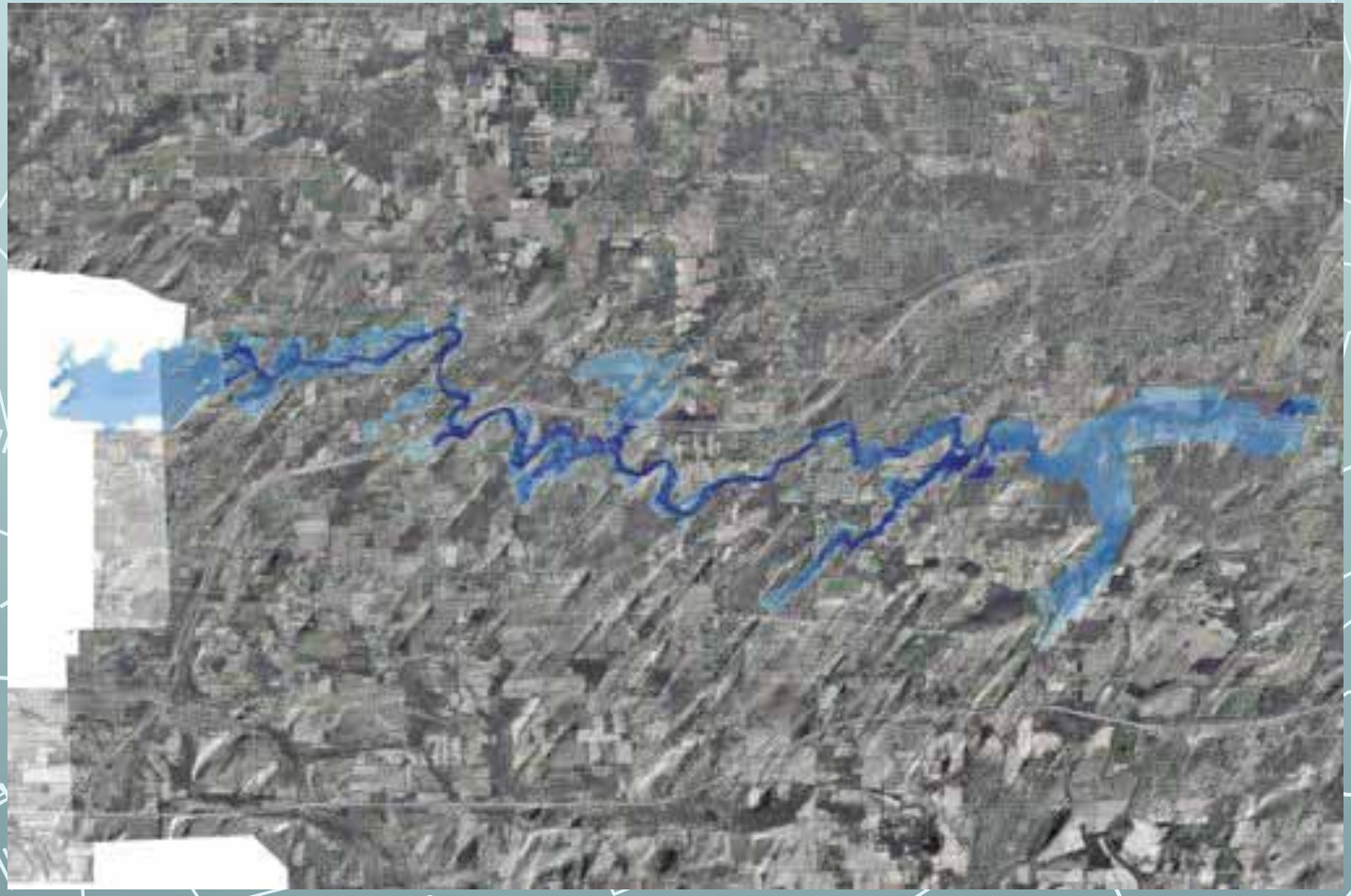

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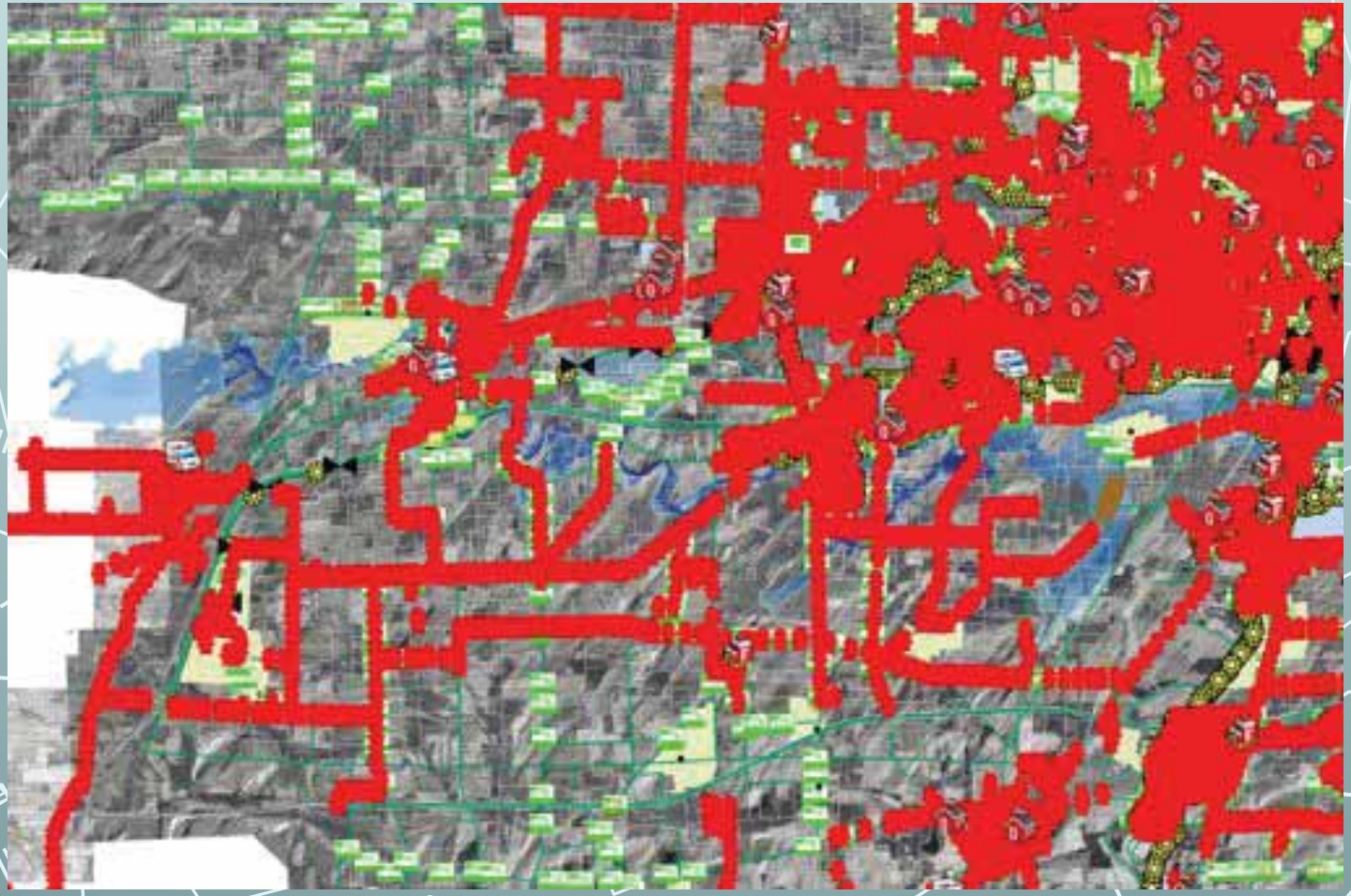

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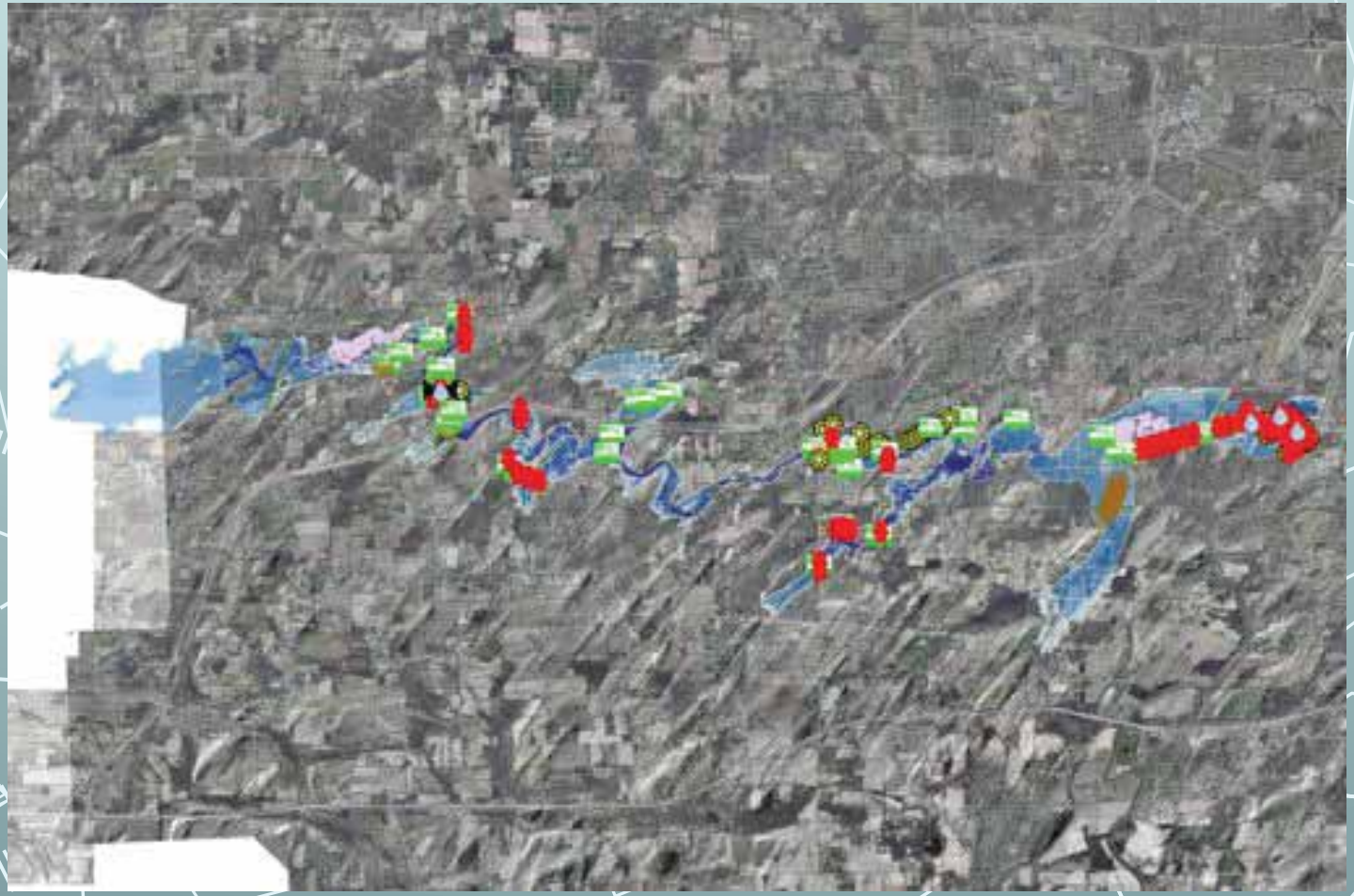

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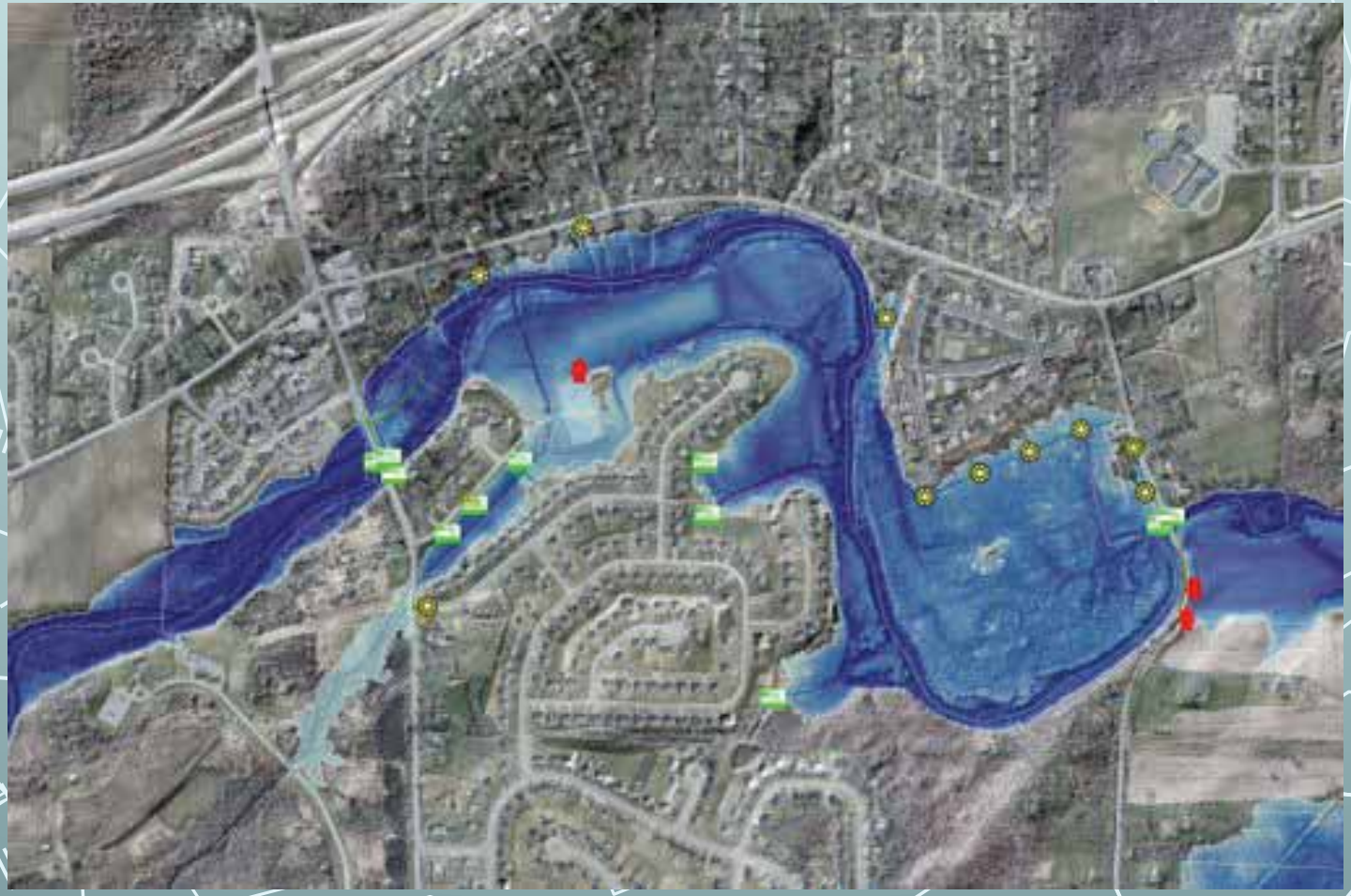
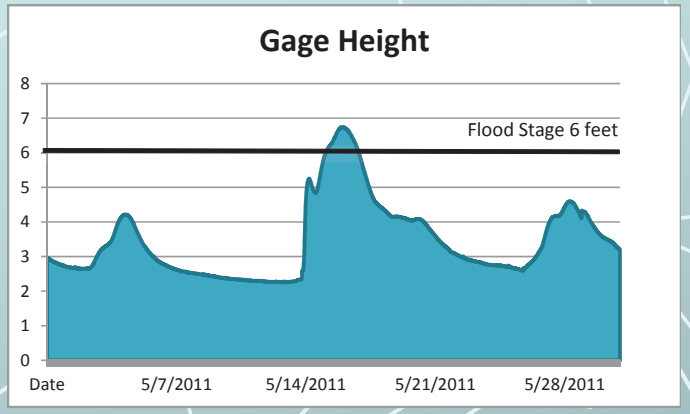


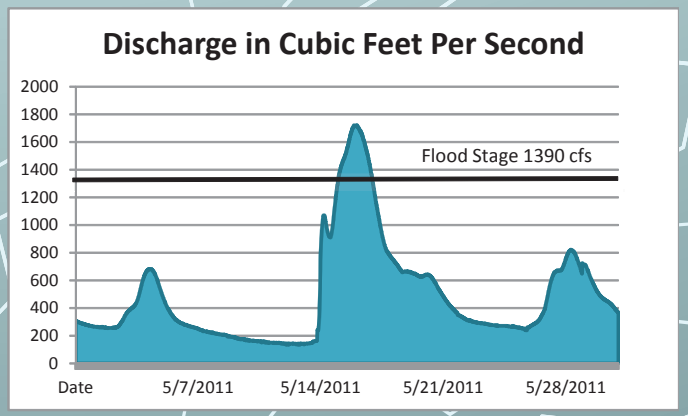
Black Creek Analysis Monroe County GIS Data Tools

- The tool gives us an ability to update relatively quickly data about an emergency
  - Processing time is about 3 minutes
  - Displayed on the map
- Can be saved for future planning
- Can be exported to field computers to allow crews to attempt to do active remediation and analysis of current infrastructure

Ground Truthing Black Creek

- May 2011 Black Creek Flooded
- Within 24 hours we went out with survey grade GPS to ground truth the zone
- Found that most areas were pretty good
  - Error was within a foot of the water depth
  - Did find that this varied with the zone of soil saturation





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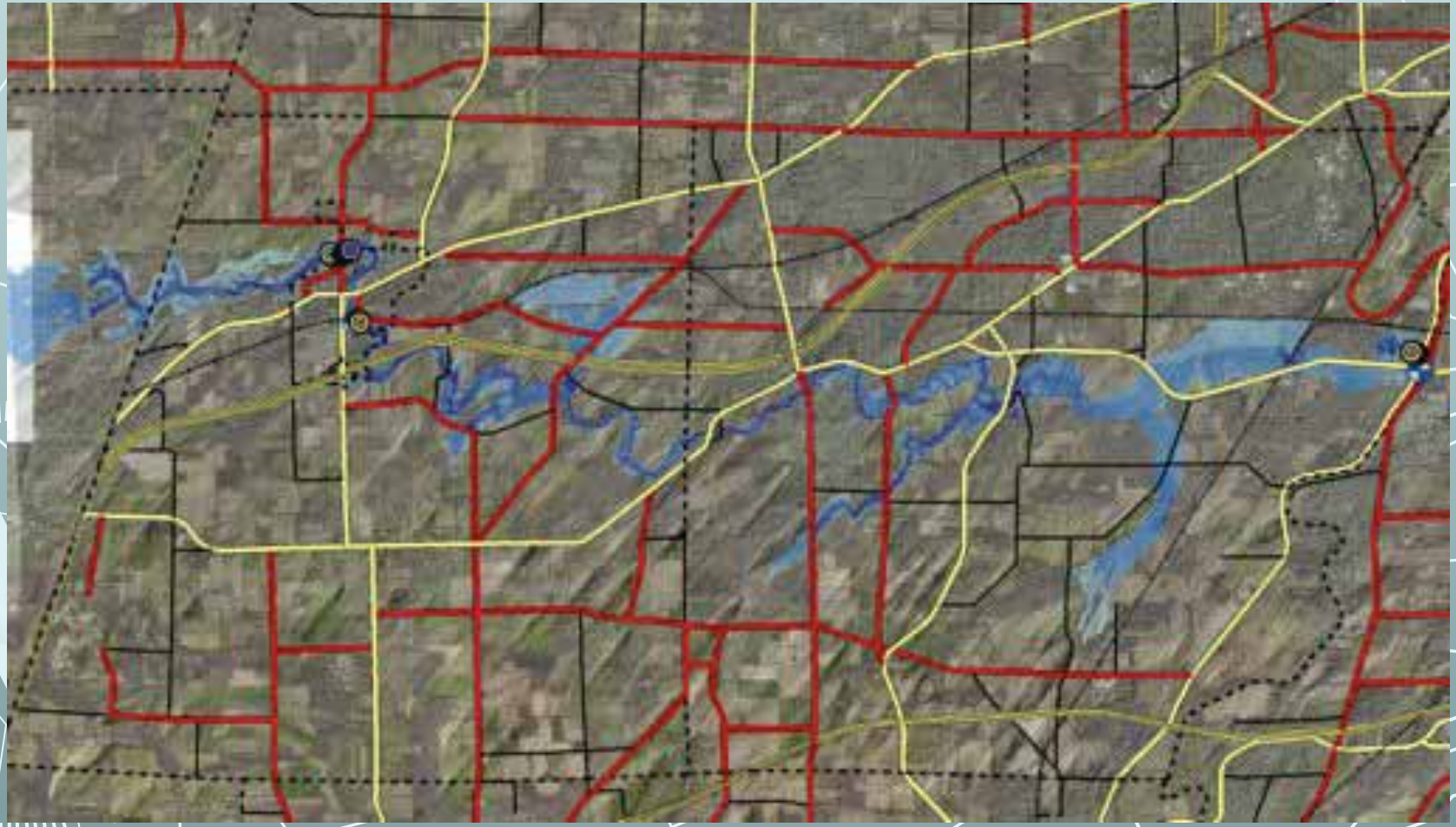

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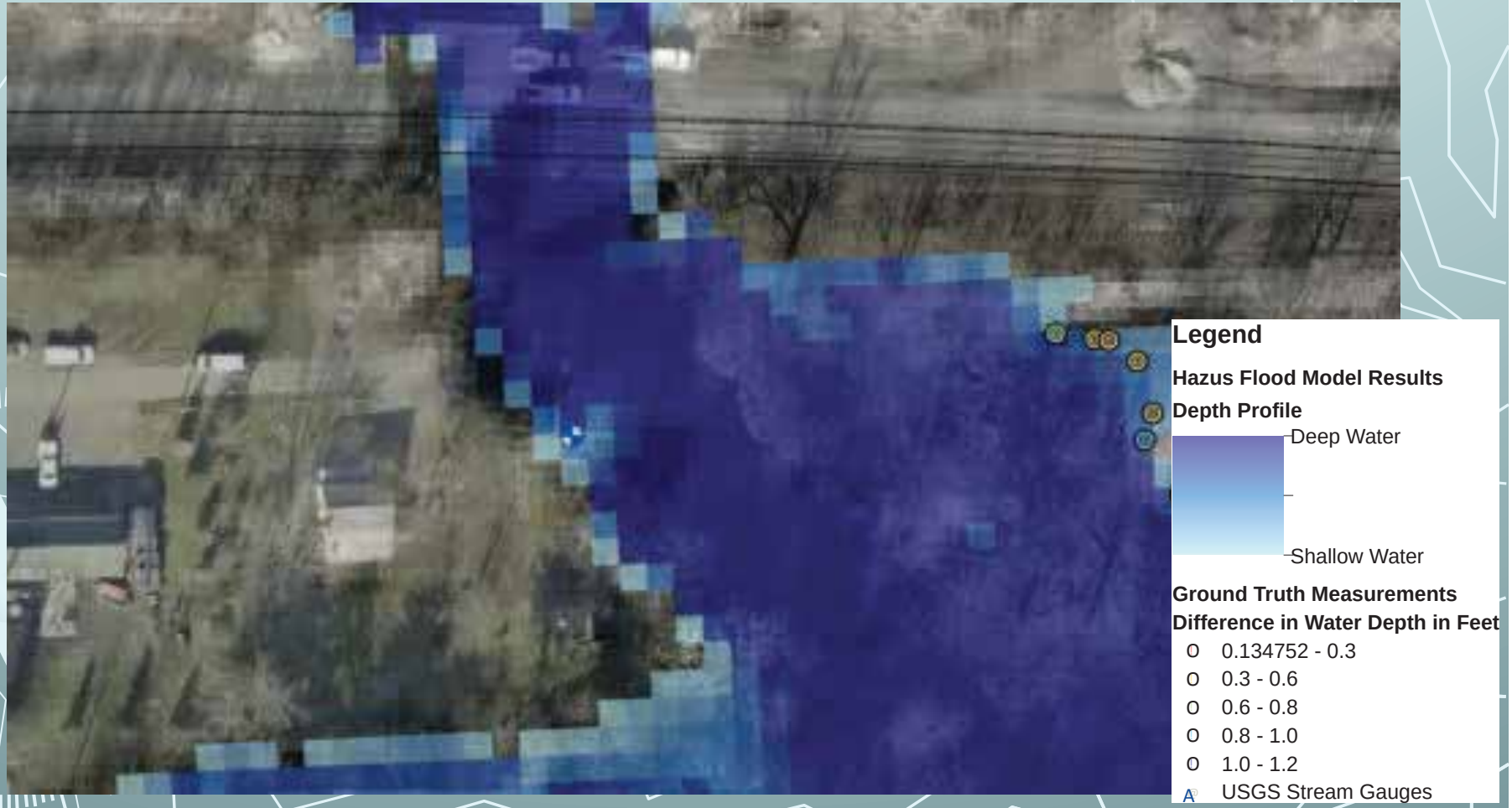

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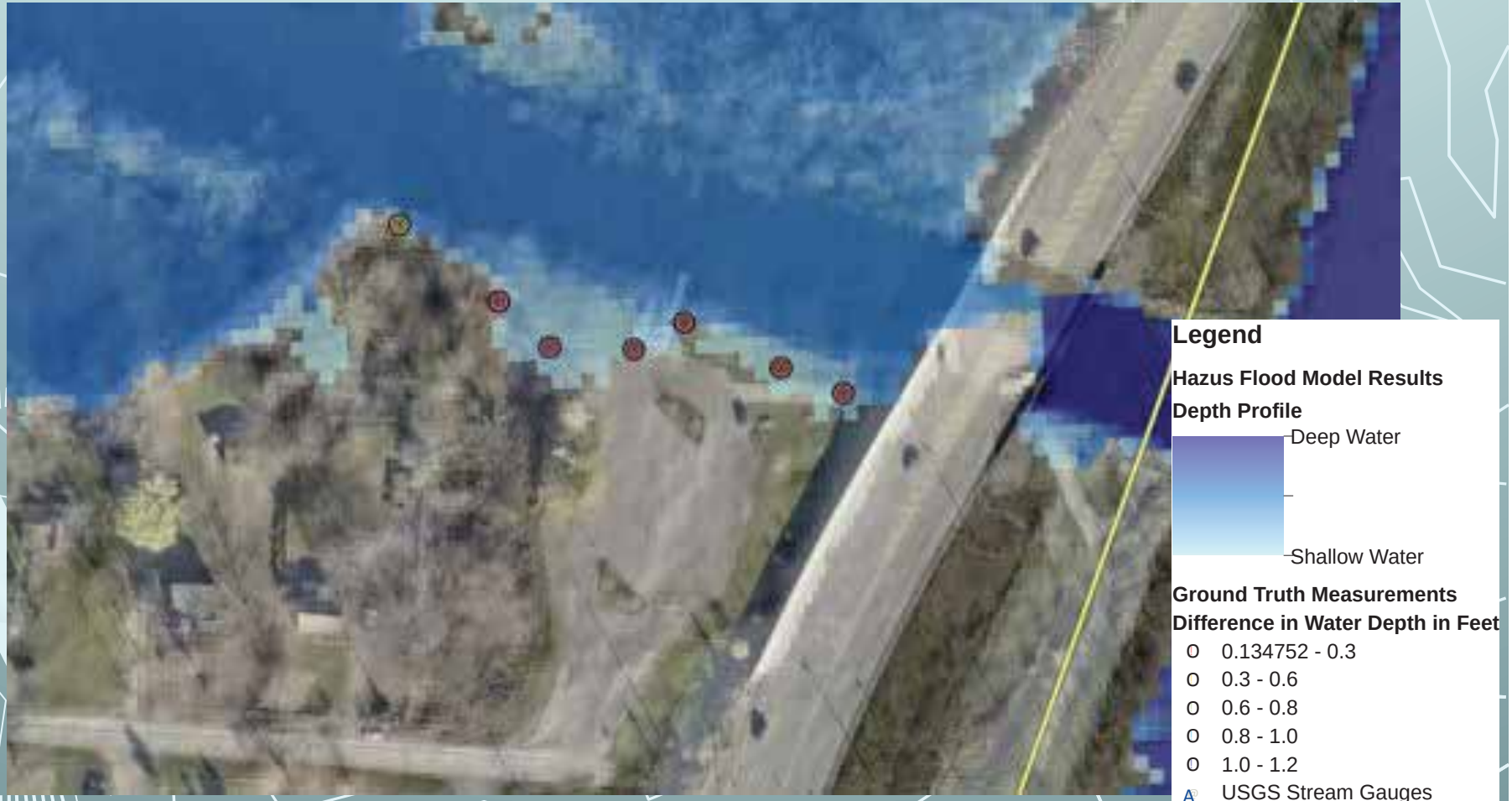


Limitations

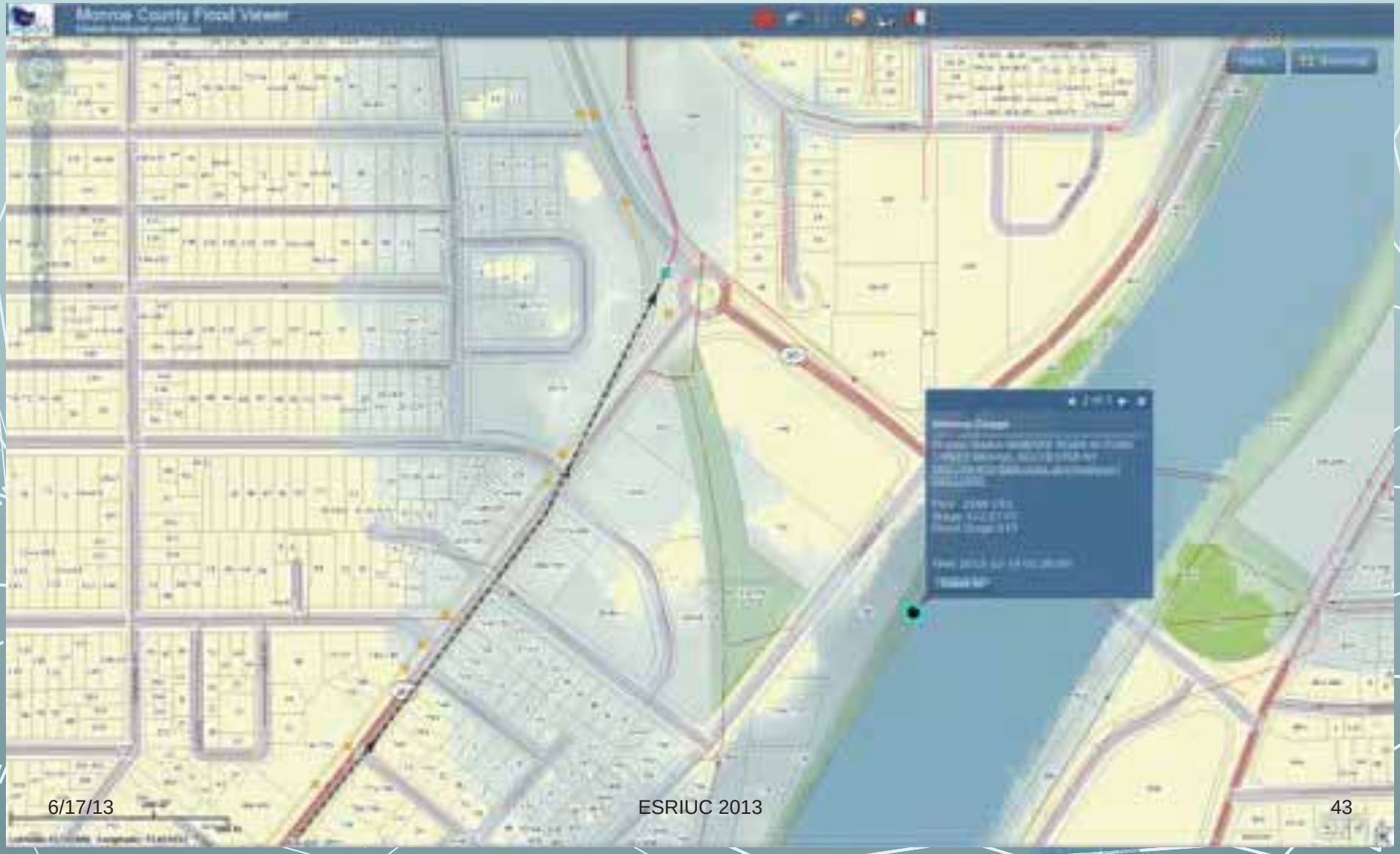
- With any analysis there are limitations
- The LiDAR is a preplan tool so it cannot be used in a real emergency
- With the small network of gauge stations, we do not have the flow for each stream reach, resulting in over estimations for some areas and under in others
- LiDAR data has its own limitations such as tree cover errors

Flood Viewer Flex Application

- To make the data more accessible we created a web viewer
- The first phase viewer was built using esri's flex application
  - Quickly customizable
  - Ability to use ArcGIS Online layers for weather, wind, and other critical live information
- Beyond that tools are being worked on for mobile access and automating geoprocessing of the impacted areas

Flood Viewer Flex Application

Flood Viewer Flex Application



Flood Viewer Flex Application

Flood Viewer Flex Application

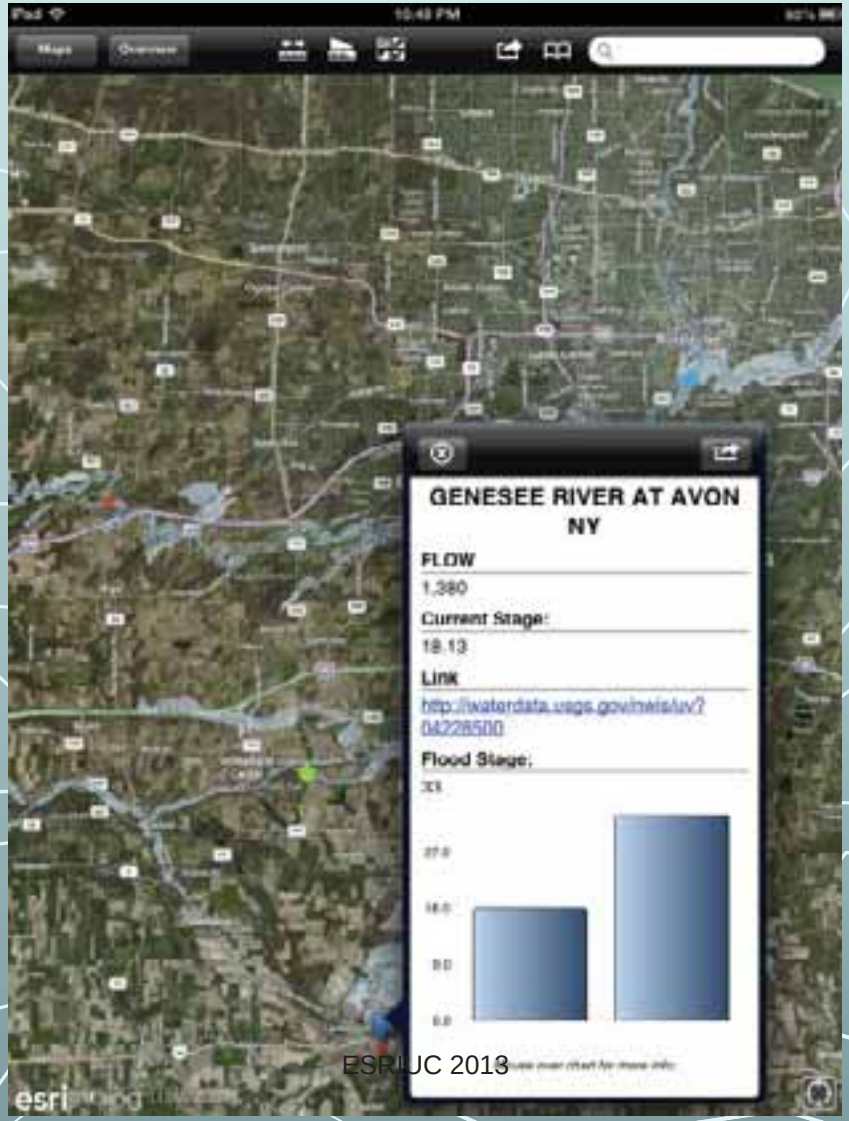
Hurricane Sandy

- During Hurricane Sandy the flood viewer had its first real usage
- It was on one of the screens at the Emergency Operations Center during the activation
- Besides monitoring the local water levels, the viewer was adapted to show wind, the storm track, and eventually wave heights
- We found some limitations in our models from the storm and are now working on improving them

Hurricane Sandy

Hurricane Sandy

Hurricane Sandy



Current and Future Work

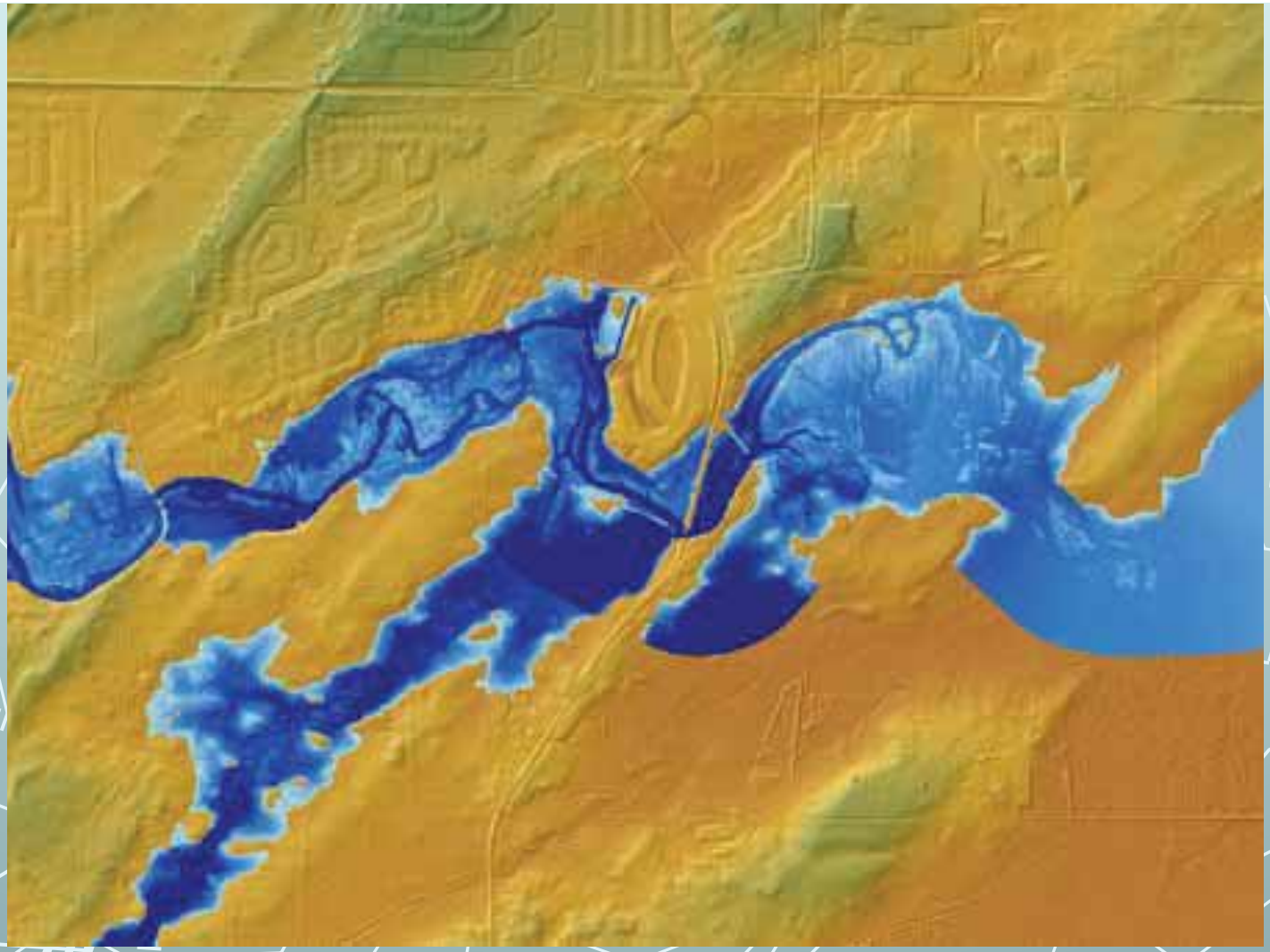
- Develop plans for each watershed we have discharge levels for
  - 10 Iterations are being made and posted to our SDE Server as preplans
  - All will be displayed in our Intranet Web Viewer showing county infrastructure
- Collect and Calibrate more gauge locations throughout the year

Future Work

- Work on coastal flooding issues
- Speeding up the process
  - Working on resampling the LiDAR to increase time with limited resolution loss
- Attempt to gather and get online more gauging sites (either fixed or mobile measurements)

Conclusion

- Depending on which data source you are using for the elevation you can process it quickly and rough, or slow and accurate
- LiDAR is a good aid in planning for a disaster
- Using the other tools you can estimate damage and other impacts from the event
- The Hazus-MH tools while good, need more customization to fit the multiple needs of the County



Questions

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jcole@monroecounty.gov