





# GIS Analytics for Engineering and Public Works

July 18, 2017

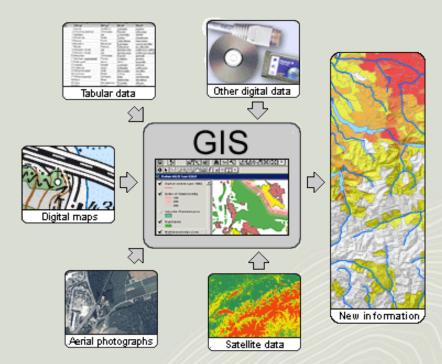
Daniel R. Mellott, GISP



ENGINEERING BETTER PARTNERSHIPS

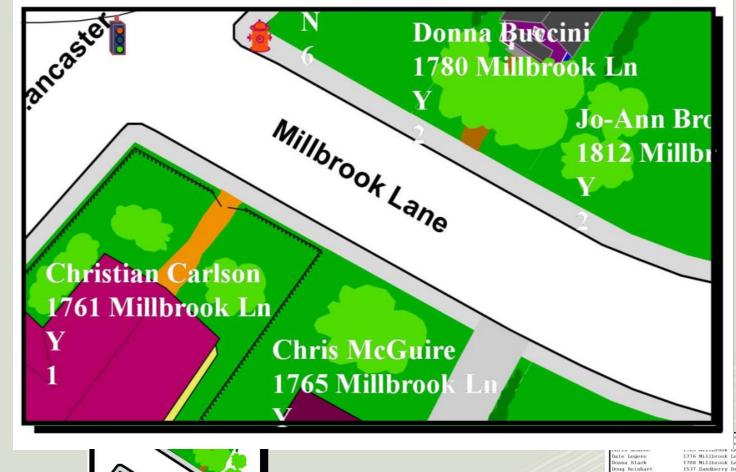
#### **GIS Overview**

- Geographic Information System (GIS)
  - A set of tools used to gather, transform, analyze, and produce information related to the surface of the Earth
  - Computer software that maps and analyzes geographic data





#### **GIS Overview**





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#### **GIS versus CAD**

- CAD Computer Aided Drafting
  - Typically used for designing a product or infrastructure in 2d and 3d diagrams (displays things that are going to be created)
    - Microstation
    - AutoCAD
- GIS Geographic Information System
  - Typically used to develop a relationship between data (information) and a geographic object (displays the world as it is)
    - ArcGIS (by ESRI)
    - GeoMedia (Microstation-based)
    - AutoCAD Map (AutoCAD-based)
    - MapInfo







### **Industries Using GIS Solutions**

- Electric/Gas Utilities
- Business/Marketing
- Telecommunications
- Transportation Logistics
- Petroleum & Mining
- Pipeline
- Water & Wastewater
- Health Care
- Federal Government
- National Agencies
- Environmental Mgmt.
- Local Government

- Public Sector
- Retail
- Military/Intelligence
- Computer Aided Dispatch
- Mapping
- Land Use Planning
- Real Estate & Cadastral
- Site Location
- Agriculture
- Forestry
- Land Use Planning
- Risk Management

# **Case 1: Horizontal Curve Study**



### **Case 1: Horizontal Curve Study**

- Project Description
  - Field review horizontal alignment on 4,356 miles of state roads and perform Road Safety Assessment at 368 sites
- Problem Summary
  - Project scoping and estimating
  - Large number of sites to inspect
  - Sites are located in DOT log-miles
  - Sites dispersed all over north Alabama
  - Multiple survey teams



#### **Pre-Project Planning**

- Define project areas
- Convert road segments to start points
- Identify regional "Depots"
- Estimate project mileage



### **Data Collection Planning**

- Estimate the number of sites that can be collected per day
  - Horizontal Curve Collection Sites Up to 15 per day
  - Road Safety Assessment Collection Sites Average 6 per day

**SAIN** associates

 Use "VehicleRoutingProblem" tool to optimize routes for Horizontal Curve and Road Safety Assessment data collection

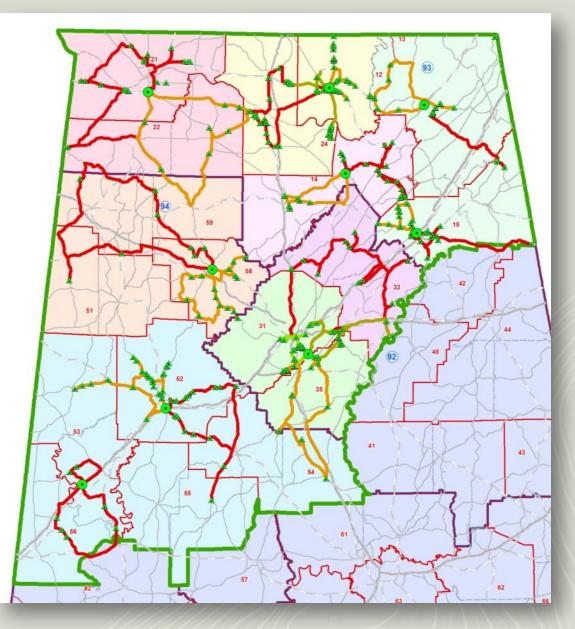


### **Data Collection Planning**

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#### **Data Collection Planning**

# Horizontal Curve Site Routes

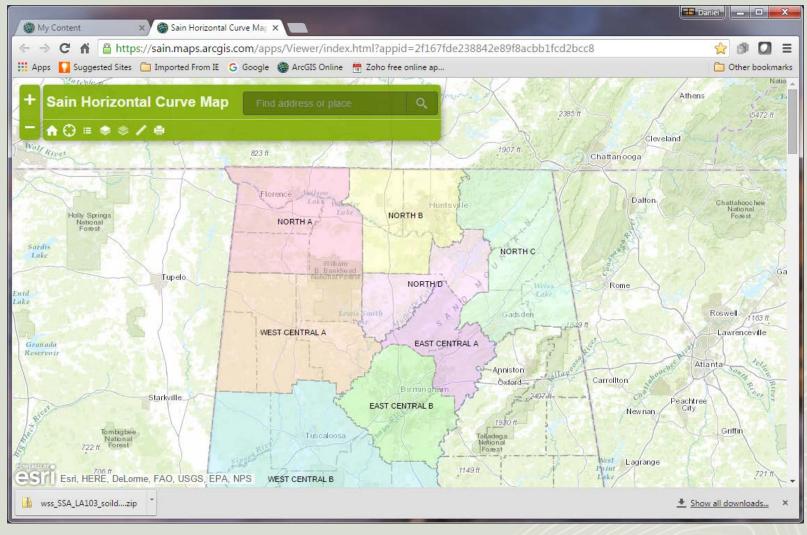


#### **Site Location**

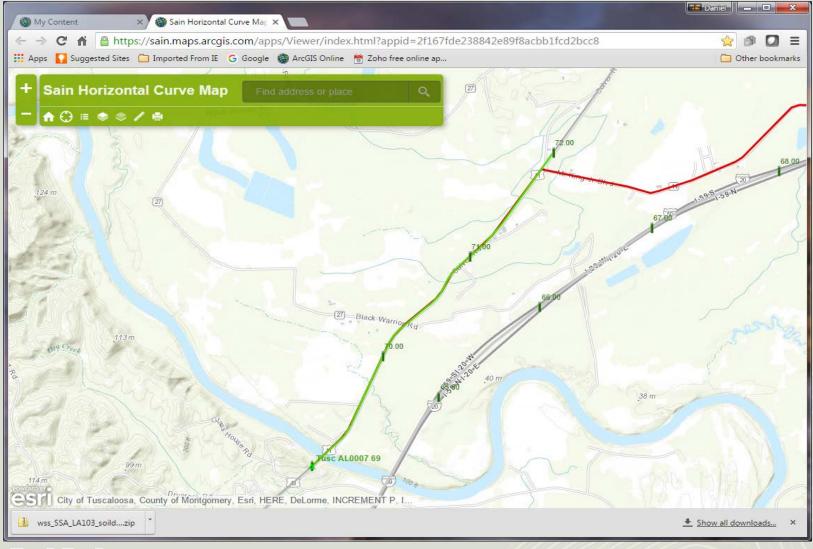
- Upload data to ArcGIS Online
- Setup a Web Mapping Application
- Provide instructions to Engineers

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#### **Site Location**

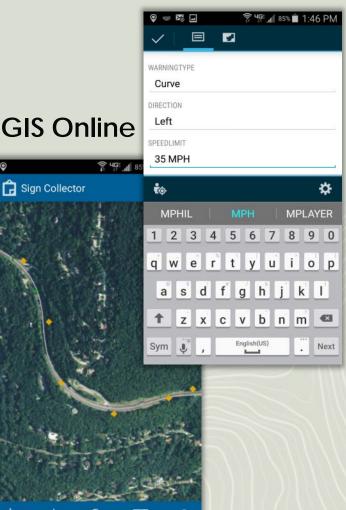


#### **Site Location**



### **Sign Data Collection**

- Setup File GDB for signs to be collected
  - Define Fields
  - Define Domains
- Publish editable Feature Layer to ArcGIS Online
- Setup Web Map
- Provide instructions to Engineers



### **Case 1: Horizontal Curve Study**

- Lessons Learned
  - GIS was helpful in developing a more accurate scope of work and estimate
  - GIS was more effective in planning Horizontal Curve site surveys than Road Safety Assessment site surveys
  - The GIS Web Map Application assisted Engineers with verifying they were in the correct location for collecting site surveys because the sites were defined by log miles instead of physical features
  - Using the ArcCollector app tended to be less effective because of the vehicle speed at which the Engineers were trying to collect information



# **Case 2: ADA Transition Plan**





### **Case 2: ADA Transition Plan**

- Project Description
  - Collect pedestrian facilities data to develop a plan to ensure facilities are Americans with Disabilities Act (ADA) compliant
- Problem Summary
  - Field data collection of pedestrian facilities
  - Evaluate facilities for ADA compliance
  - Develop plan to upgrade pedestrian facilities
  - Publish results for public review





### **Collect Pedestrian Facility Data**

- Course of Action
  - Develop database model for data
    - collection
      - Sidewalks
      - Crosswalks
      - Curb Ramps
      - Pedestrian Signals
      - On Street Parking
  - Upload Geo-database model to ArcGIS Online for data collection
  - Use ArcCollector to gather field data
    - Feature locations
    - Photos linked to pedestrian features



#### **Process Facility Data**

- Course of Action
  - Download Pedestrian data from ArcGIS Online
  - Analyze data to develop severity rating





### **Produce Transition Plan Report**

- Course of Action
  - Develop Transition Plan
  - Publish mapping results with ArcGIS Online for

public review

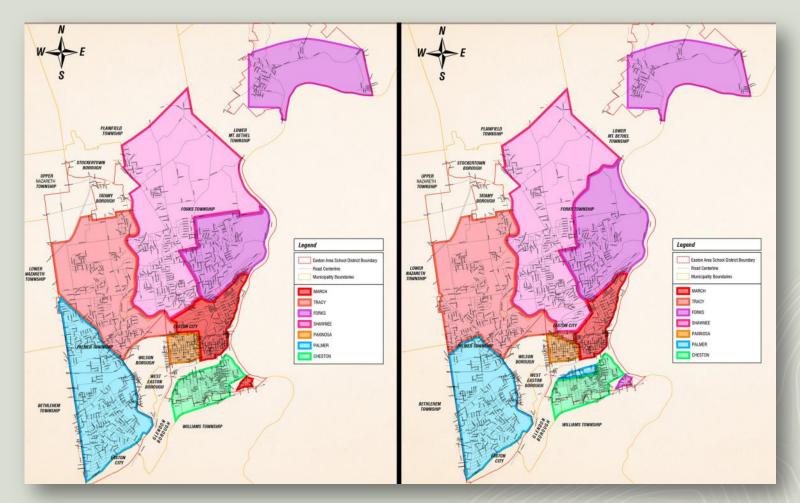
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 Y Irondale ADA Transition × C 🟠 🔒 Secure | https://irondaleal.maps.arcgis.com/apps/View/index.html?appid=0bef5c2f24c84ff3809cf608259b6d0b x D : 🔛 Apps 🚺 Suggested Sites 📒 Imported From IE 💪 Google 🚳 ArcGIS Online 🎁 Zoho free online app 👩 My Esri | Dashboard 🧄 Shelby County Bicycle Other bookmarks 39 rondale ADA Transition Plan 1611 51 **Transition Plan for ADA Compliance** For Pedestrian Facilities Located within Public Right-of-Way **City of Trussville** 16 th 18 DRAF Prepared by Sain Associates 2 Perimeter Park South Suite 500 East Gateway to Happy gham, AL 35243 Trussville, Alaba

#### **Case 2: ADA Transition Plan**

- Lessons Learned
  - A standard Geodatabase model could be used across multiple projects
  - Using ArcCollector for data collection saved time by ...
    - Inputting data one time; in the field
    - Using GIS for compiling data
    - Allowing input data to transition directly to report maps
  - Using ArcCollector improved quality because it only had to be input once; directly in the field
  - ArcGIS Online made it easy to share the results of the study with the public



# **Case 3: School Redistricting**



### **Case 3: School Redistricting**

- Project Description
  - Use GIS mapping to help substantiate the equitable redistribution of students, based on race, affected by a school redistricting plan
- Problem Summary
  - Develop the existing and proposed school district boundaries
  - Determine the location of all students based on address and determine in which existing and proposed school district they reside
  - Determine the volume of students, by race and school, that will be required to change schools due to the proposed redistricting



### Background

- Client was an attorney working on behalf of the school district
- Student information was provided in a tabular format by the school district, along with existing and proposed school district boundaries
- Address points and other base map data was provided by the local city government
- The information was highly sensitive

#### **Collect GIS Data from Various Sources**

- School District
  - Existing Districts
  - Proposed Districts
  - School Locations
  - Student Information
- Local Government
  - City Boundary
  - Address Points
  - Road Centerlines



Area where district is changing

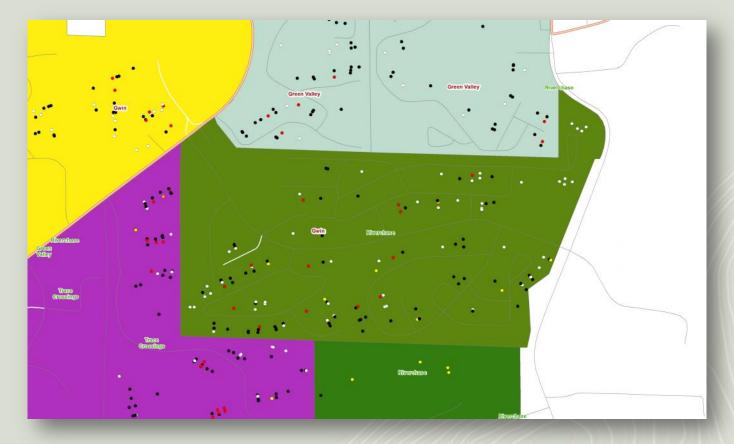
#### **Geocode Student Locations**

- Setup a Geocoding Service using the address points
- Geocode addresses from the student database
  - Initial pass match rate was about 95%
- Manually locate all unmatched address records
  - Approximately 400 records
  - Most unmatched records related to apartment addresses

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#### **Analyze Student Data by Location**

- Develop list of students to be affected by the redistricting
- Summarize student counts by school district and race

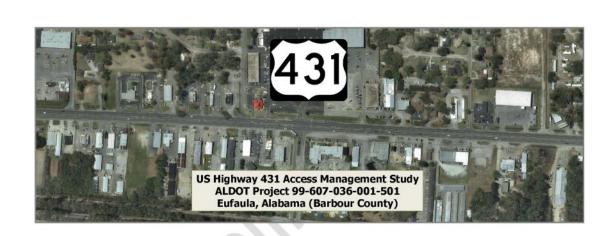


#### **Case 3: School Redistricting**

- Lessons Learned
  - It is important to have both accurate address base map data and source reference addresses when geocoding locations
  - GIS analytics is perfect for overlaying multiple feature layers and showing the spatial changes that occur
  - GIS allows users to perform complex calculations using many different parameters in a geospatial context



# Case 4: Access Management Plan





This is a preliminary document. Not to be used for construction, bidding, recordation, conveyance, sales, or as the basis for the issuance of a permit. Jeff Stephenson, P.E. AL License #25129



Sain Associates Two Perimeter Park South, Suite 500 East Birmingham, AL 35243

#### **Case 4: Access Management Plan**

- Project Description
  - Develop an Access Management Plan to alleviate traffic congestion issues
- Problem Summary
  - Need to collect existing conditions
  - Perform field survey
  - Produce concept maps showing plan recommendations





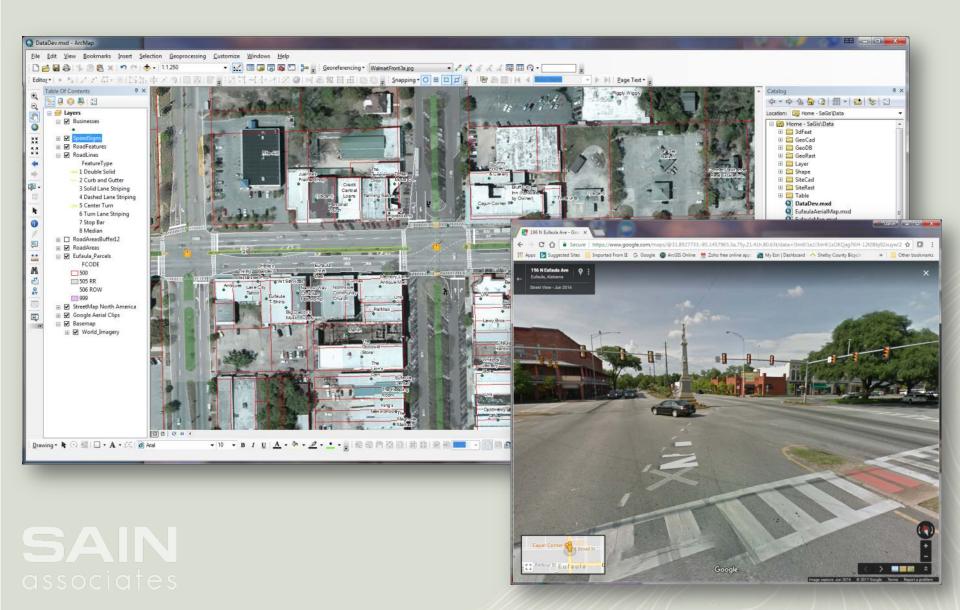
### **Develop Existing Conditions Data**

- Course of Action
  - Use aerial photography base map
  - Clip and geo-reference aerial updates from various sources
  - Develop road features
    - Paved areas (roads, driveways parking areas)
    - Road striping and markings
    - Speed limit signs
    - Business locations
  - Obtain parcel data from local government
  - Use Google StreetView to verify information





#### **Develop Existing Conditions Data**



### **Perform Field Survey**

- Course of Action
  - Use Map Book created by GIS
  - Verify business locations and names
  - Verify driveway and median locations
  - Verify speed limits
  - Mark up map book and return to office for updates





#### **Develop Concept Plans**

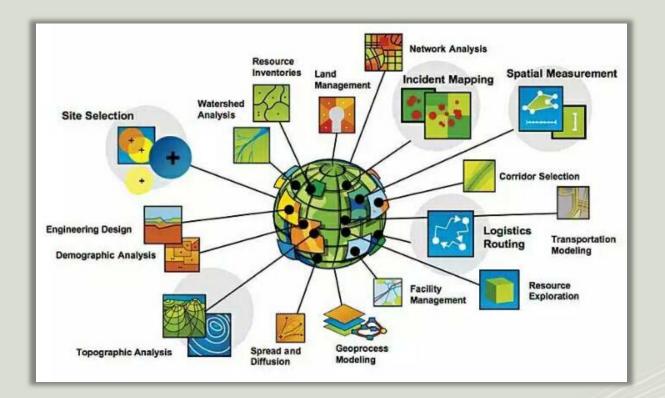


#### **Case 4: Access Management Plan**

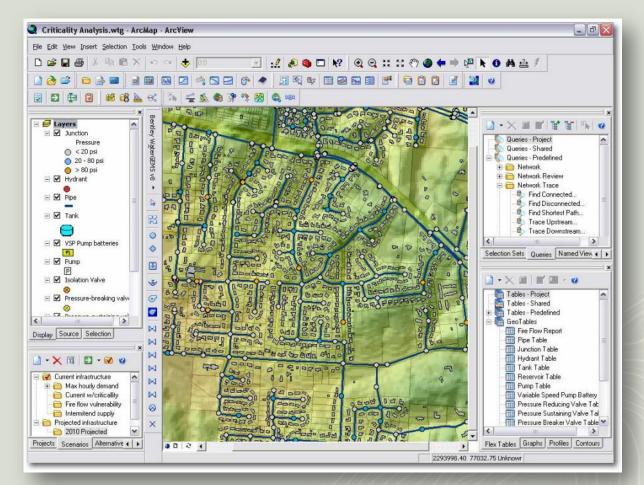
#### Lessons Learned

- GIS allows us to develop existing condition information before making a trip to the field
- Using the GIS to develop existing conditions greatly reduces the amount of time required in the field to collect and verify data
- GIS helps produce more accurate and high quality concept maps
- Volume data can be extracted directly from the GIS data to help produce more accurate cost estimates

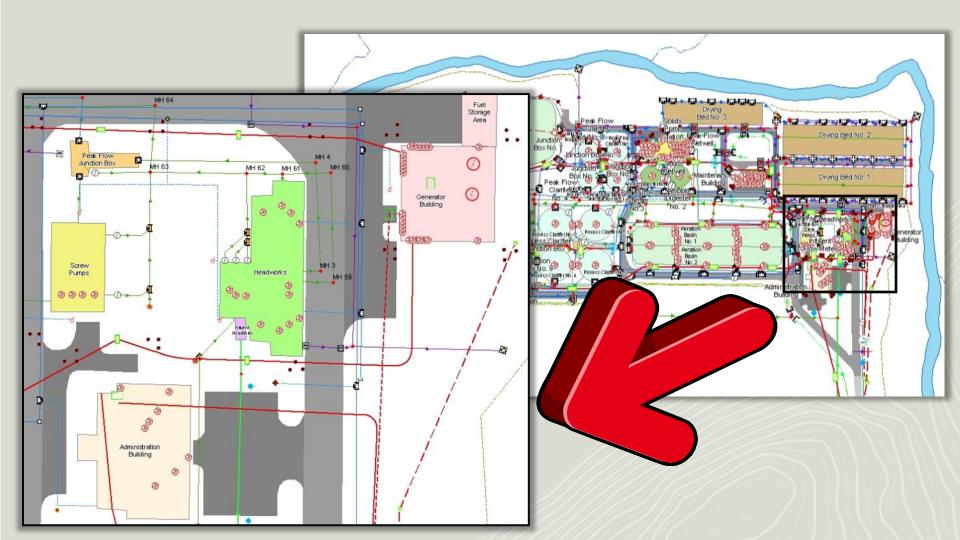




Utility Infrastructure Modeling



• Asset Management



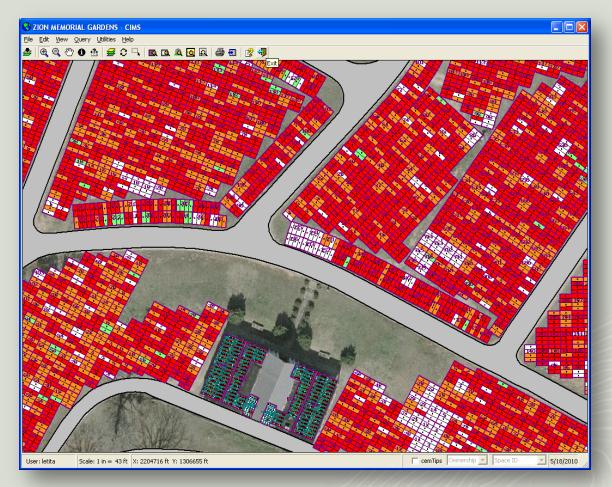
• Work Order Management

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Completed By USI, Inc.	
Actual Start/Finish 03/06/2002 🗧 🗸 03/06/2002 🚖 🗸	Date 03/06/2002 🚽 🔹
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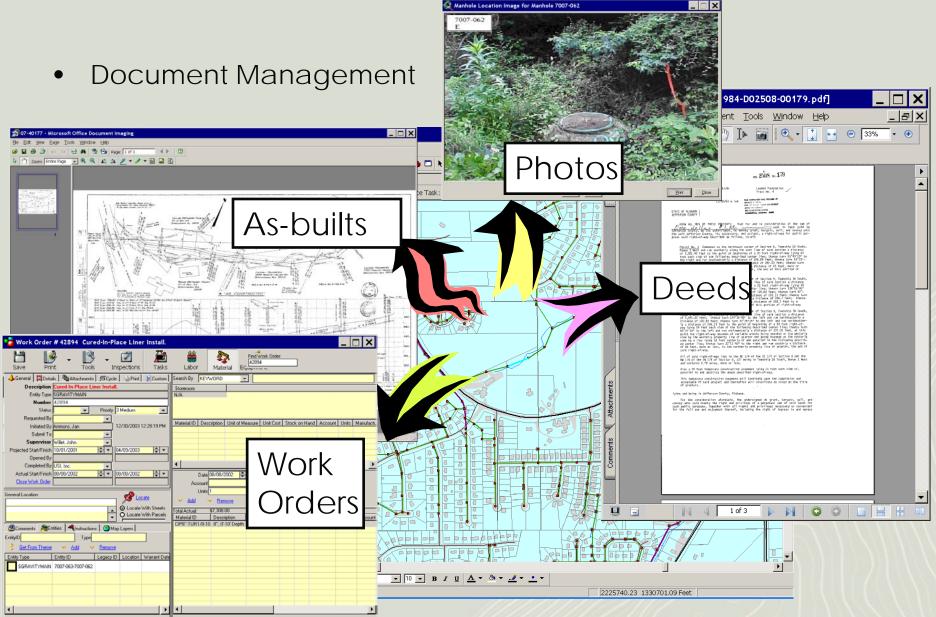
Address Management

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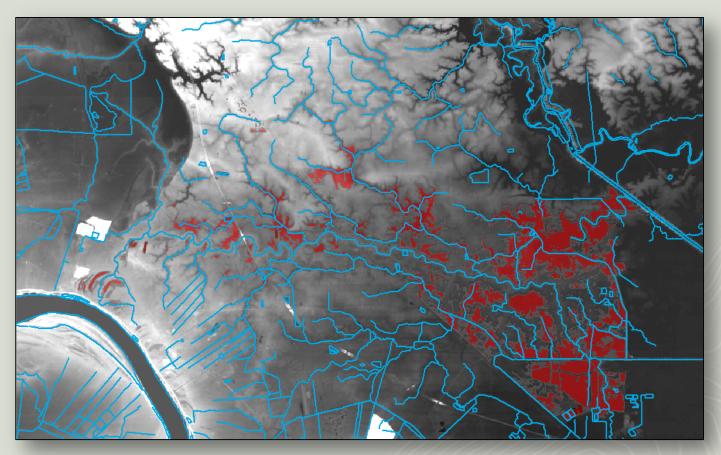
Cemetery Management





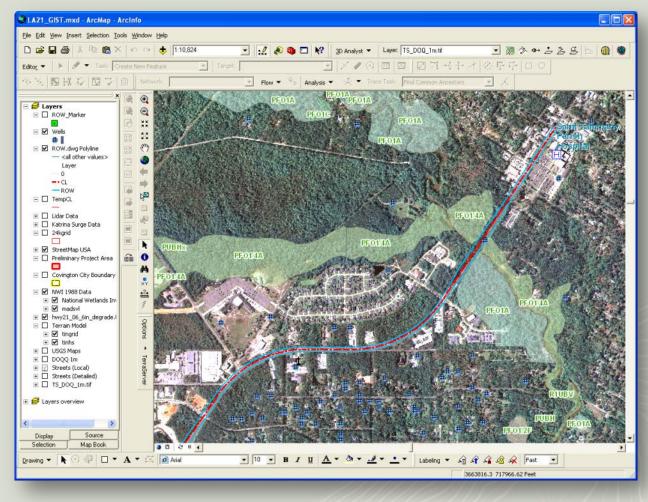


• Flood Mitigation

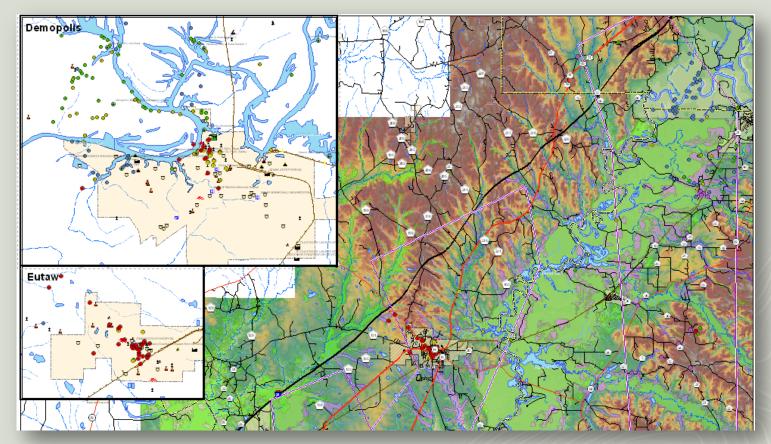




• Environmental Assessments



• Corridor Studies



• Site Planning



Let Sain Associates join you in a personal and proactive partnership centered on longevity, innovation, and value-creation beyond the project.

# **SAIN** associates

ENGINEERING BETTER PARTNERSHIPS

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