Enhanced GIS Presentation for Harris County Capital Improvement Projects through Flash & GIS integration

By: Todd Thompson, Wanjoo Choi, Ph.D., and Todd Buehlman

Abstract

Harris County, TX Flood Control District ("HCFCD") wanted to deliver maps and information regarding Capital Improvement Projects ("CIPs") to the public with an inviting, compelling, user-friendly map interface. Harris County worked with Idea Integration to develop a "Flash GIS" integration engine that allows delivery of dynamic GIS data in an animated, clean Flash map. The public can now access CIP project timelines, budgets and notes through a seamless, movie-like GIS landscape.

Paper

Problem Statement

HCFCD was delivering massive amounts of project data on their Web site, using static HTML and out-of-the-box ArcIMS for Web-based mapping tools. Users were not finding the information they needed, and maintaining all the static information was time-consuming and costly.

Goals

The short-term objective of HCFCD is to generate an effective method of storing, reviewing and disseminating CIP collateral. The primary goal is to educate citizens about the current and future projects that will improve the infrastructure they use throughout Harris County.

The stated vision for this solution is a Flash interface with a true GIS backend for the CIP application, with the ability to deliver multimedia and HCFCD Infrastructure project information. The interface should be in the current HCFCD brand, and exhibit a level of creative design not ordinarily attributed to standard ESRI GIS sites and solutions. The intent is to utilize Flash technology to generate a dynamic, truly GIS-enabled interface with a powerful and engaging design. Eventually, a Flash-based interface providing access to spatial data, static content and multimedia, could serve as a primary delivery vehicle for all Harris County Flood Control District websites – both primary (www.hcfcd.org) and project-related sites.

In order to achieve this vision, it was necessary for Idea to verify the feasibility, complexity and magnitude of this effort so that reasonable cost estimates, deliverables, technologies, schedules and risks could be provided to HCFCD stakeholders. A "Feasibility Study" was performed over several months to test the interplay of Flash and dynamic, spatial data. The Feasibility Study purported to prove that the final solution would:

- Take geographic information as input
- Translate spatial data to Flash, maintaining true geographic relationships
- Output Dynamic Geo-Flash to web sections
- Allow Geo-Flash to have "hover over" behavior
- Minimize trips to server to retrieve data
- Hide any necessary trips to server as much as possible

Technical Solution

Three-Tiered Approach:

- First-Tier (Display): Macromedia Flash Remoting Technology
  - Flash User Interface (Web browser or standalone)
  - CIP project location information rendered to Flash vector
- Second-Tier (Business Logic): Microsoft ASP.NET Technology
  - Web Services based
  - Data streaming
  - ArcIMS Service
- Third-Tier (Database): Spatial and Attribute Data
  - ArcSDE
  - Personal Geodatabase

Environment Analysis

- **Target Client Environment:**
  - Standard web browsers with Flash Player plug-in (version 6.0 or later) installed

- **Server-side Technologies:**
  - Existing resources:
    - Windows 2000 Server
    - IIS 5.0
    - ESRI ArcIMS 4.01
    - ASP.NET Framework 1.1
  - Shape to Flash conversion utility
    - C# programming using .NET ArcObjects (requires ArcView for Personal Geodatabase and ArcInfo for Enterprise)
    - Converts shape geometry flash objects
    - Optimizes the geometry based on the map size and scale
  - FlashGIS ASP.NET middle-ware applications
    - Manages Flash calls at server
    - Manages reference to ArcXML web service
    - Receives queries for feature geometry, project information, and ArcIMS images then processes them and return the result to flash

Preparation of GIS Layers

- ArcMap project layers identified
  - Simple base layers
  - Used ESRI ArcGIS for automated tiling and layering
    - SVG layers
  - Flash Objects layers initiated and project area defined with fixed map extent

Database Handling for Spatial Attributes

- Personal Geodatabase
- Enterprise Geodatabase (SDE)
  - This database contains both tabular and spatial attributes
  - Can be used by ArcGIS and web applications

- ArcMap project created for verifying spatial and tabular attributes

User Interface Design

- ArcXML web service
    - XML web service using .NET client (ref. ESRI Whitepaper - Consuming ArcIMS Image and ArcMap Image Services using .NET Client Web Applications)
- Flash User Interface
    - Macromedia Flash technology
    - Action Script programming
- Flash MX 2004 project with Action Script programming.
- Communication with ASP.NET application with Web Services
- Bonus components
- Application Features
    - Dynamic link between main map and index map
    - ArcIMS image overlay tool
    - ArcIMS image transparency control
    - Touch-sensitive, clickable watersheds (can be any layer)
    - Automatic zoom to selected watershed feature with a click
    - On-the-fly generation of touch-sensitive, clickable project features (points, lines, and polygons) for the selected watershed area
    - Project feature information cached to memory per watershed to save trips to the server when the same query is requested
    - Automatic zoom to selected project feature with a click (maximum zoom level enforced)
    - Project information displayed in the table area for the selected project feature
    - ArcIMS map image can be overlaid (button control for one time load; check box control for automatic load)
    - Zoom control can used for zooming in and out
    - Zoom control automatically updated with feature related automatic zoom
    - Scale bar automatically updated with new zoom level
    - Different numbers of background layer tiles are displayed at different zoom levels

Issues

- Flash 7 allows only limited number of depths (~10,000)
- Flash 7 allows only limited number of recursions (matters with XML data processing for geometry information)
- Flash 7 accepts only jpeg type images for dynamic overlay (could conflict with ArcIMS image types)
- Performance limitations - better limit number of features to be rendered within a given time frame
- Query lifetime handling – need to manually define object lifetime handling for external queries (e.g. ArcIMS image queries) for better performance

Benefits to Harris County Flood Control District and Users/Citizens

- Fast user interaction
    - No waiting until features are fully drawn
    - Project features are cached once queried and displayed from memory next time
- Higher image quality
    - Project features are drawn on the fly and all vector-based

    - Complex features are pre-rendered (all vector-based) and displayed at the appropriate zoom scale
- Smart memory handling
    - Tiled layers are downloaded only if they are within the current view area and at the appropriate zoom level. If not, they are removed from memory.
- Reliability
    - Uses up to date mainstream technologies
- Flexibility
    - Works with any ArcIMS map service
    - Works with any business data source
    - Does not require ESRI license once published
- Scalability
    - Can be plugged into other enterprise web applications like Idea Integration's Constellation ™
- Extendibility
    - Can be extended to any project
    - Limitations of Flash are the only limitations of Flash GIS
- Compatibility
    - Runs on any operating system
    - Works with any other development environment
    - Works with any database server
    - Run on Web browsers and standalone Flash players
- Affordability
    - Flash licensing is affordable
    - Does not require extra database server licensing
    - Use ESRI licenses you already own

Appendices: FlashGIS Images

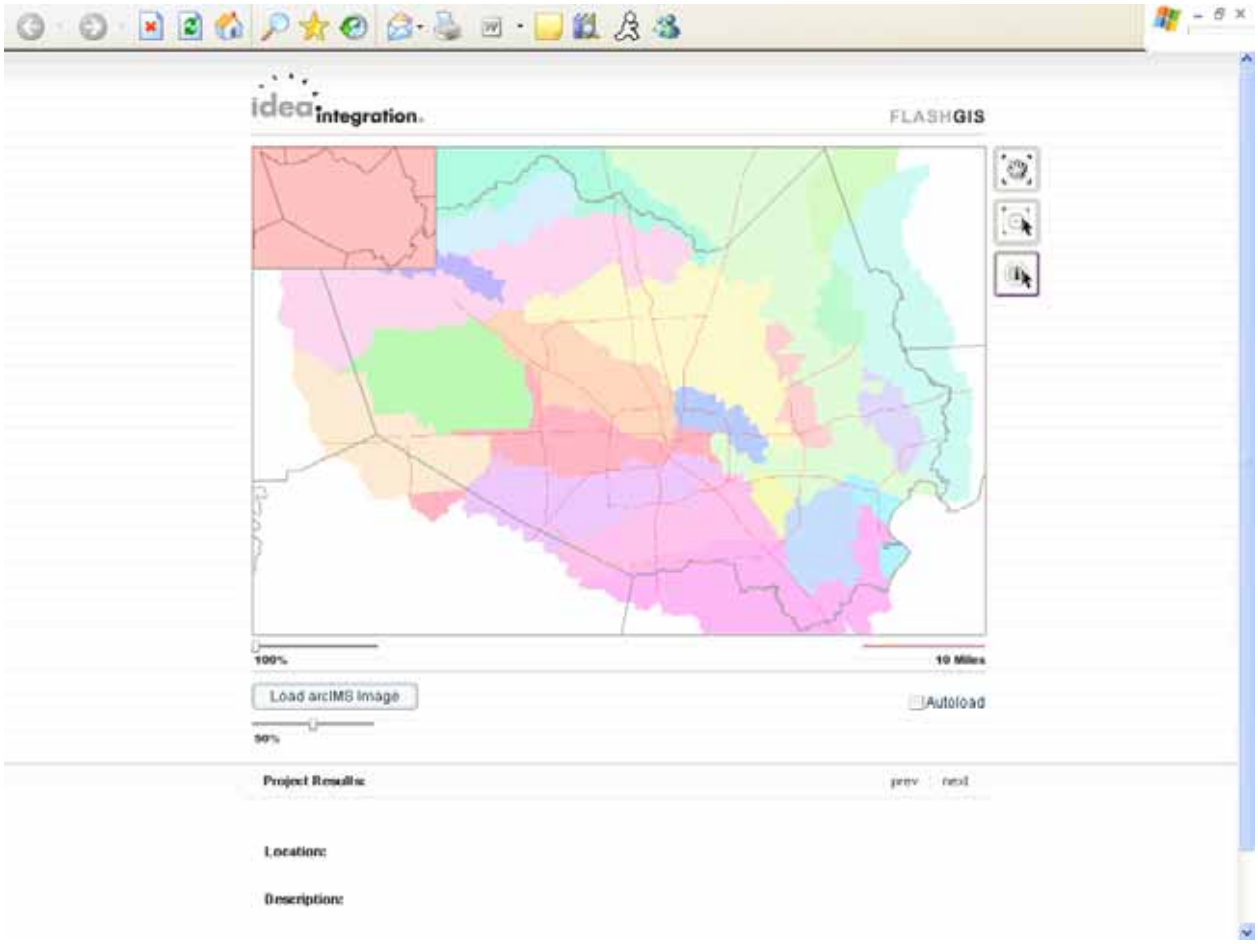

Figure 1: Site Entry – Click on a Watershed to Seamlessly Zoom to Watershed Extents

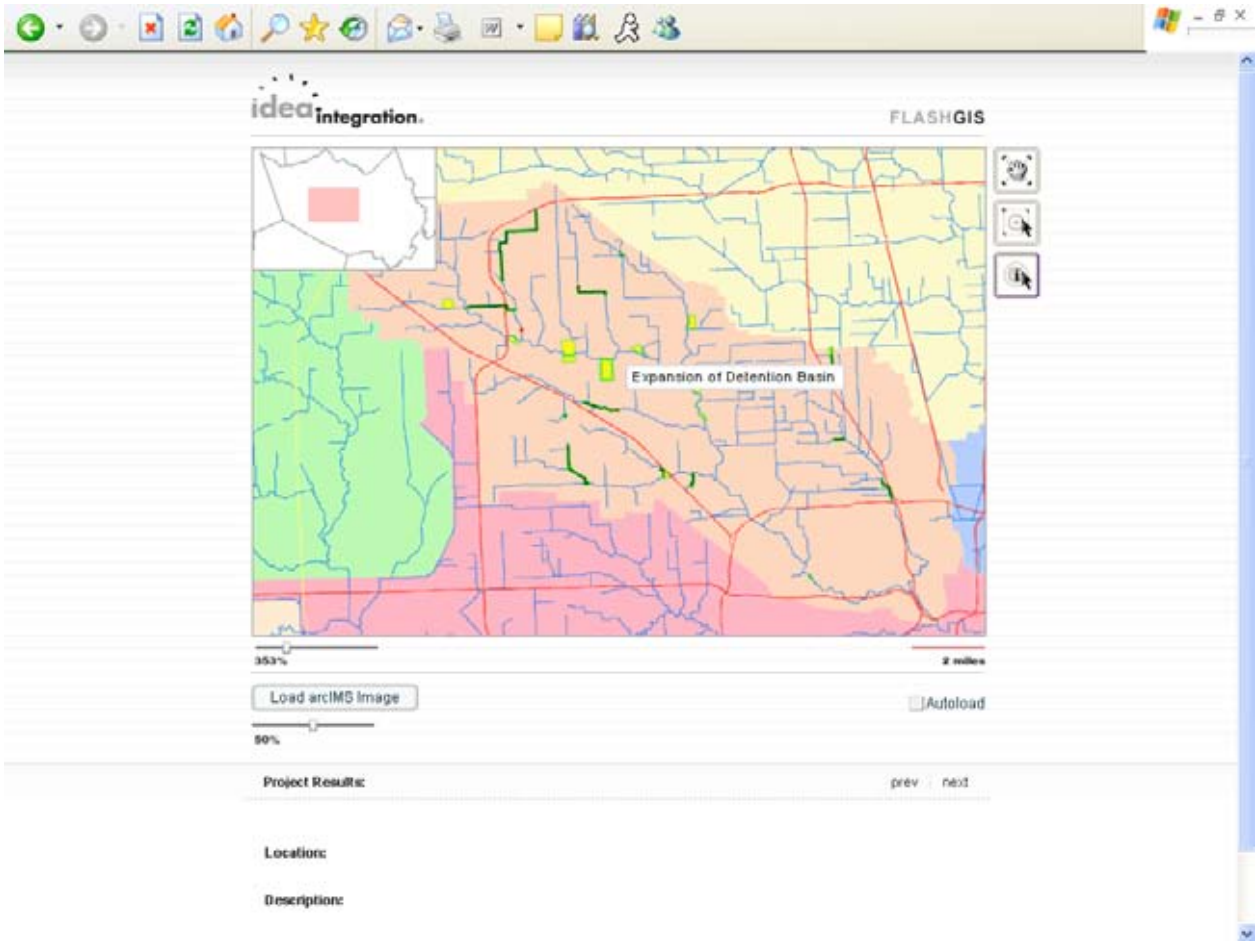

Figure 2: Scale Dependant Layers and Feature Mouse-over

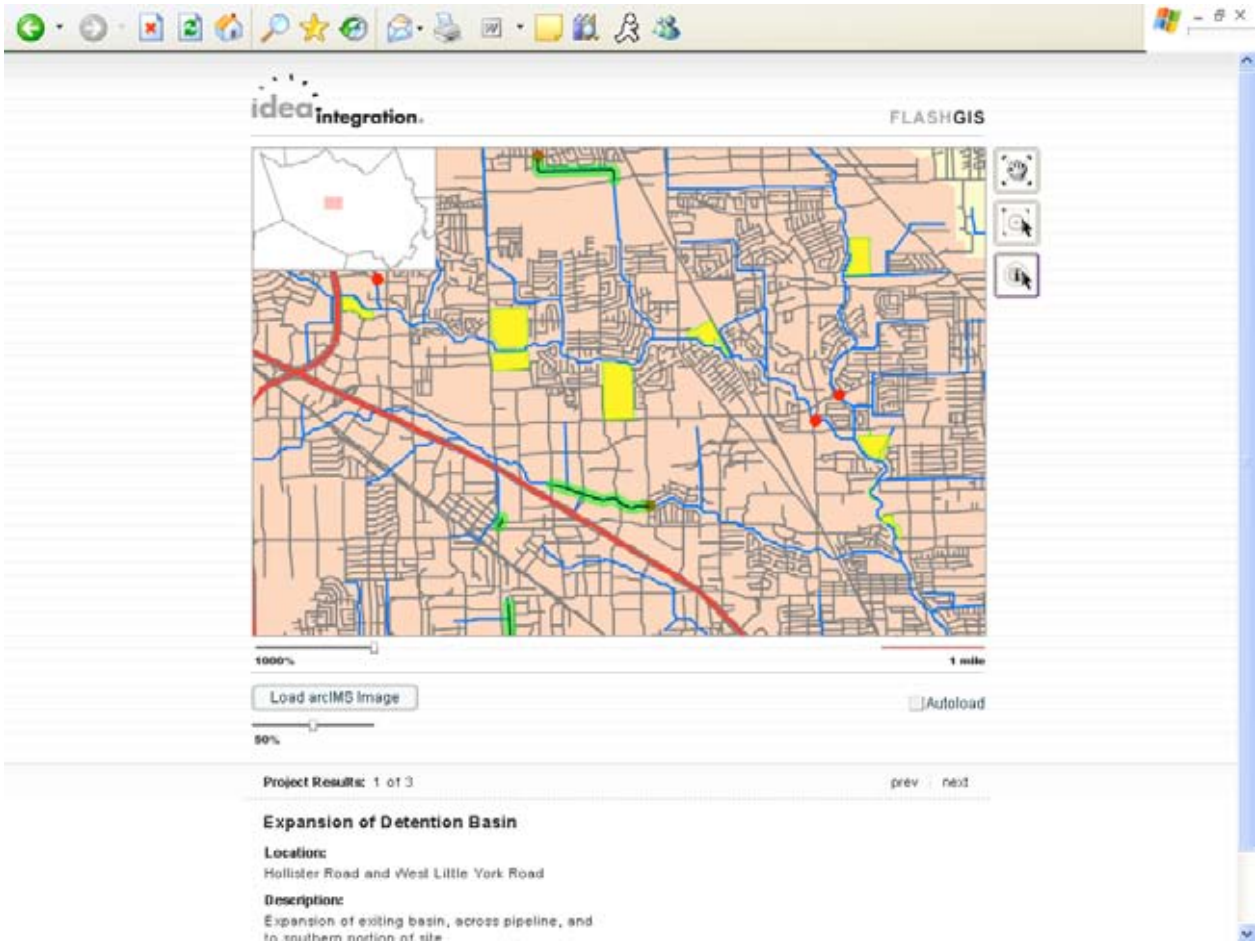

Figure 3: Click on a CIP Project to Retrieve Project Data and Zoom In

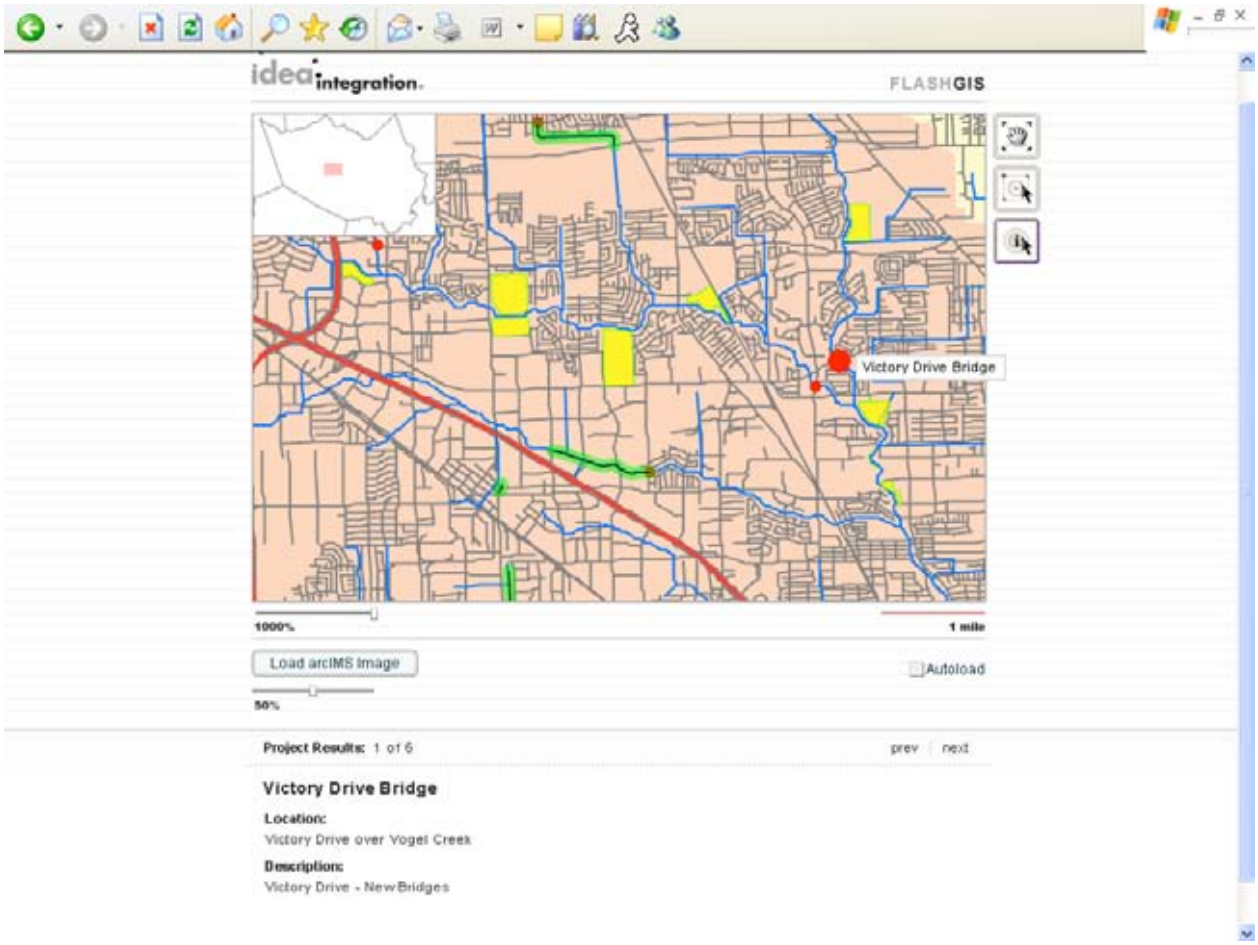

Figure 4: Variable Symbology Based on Mouse-Over and Scale

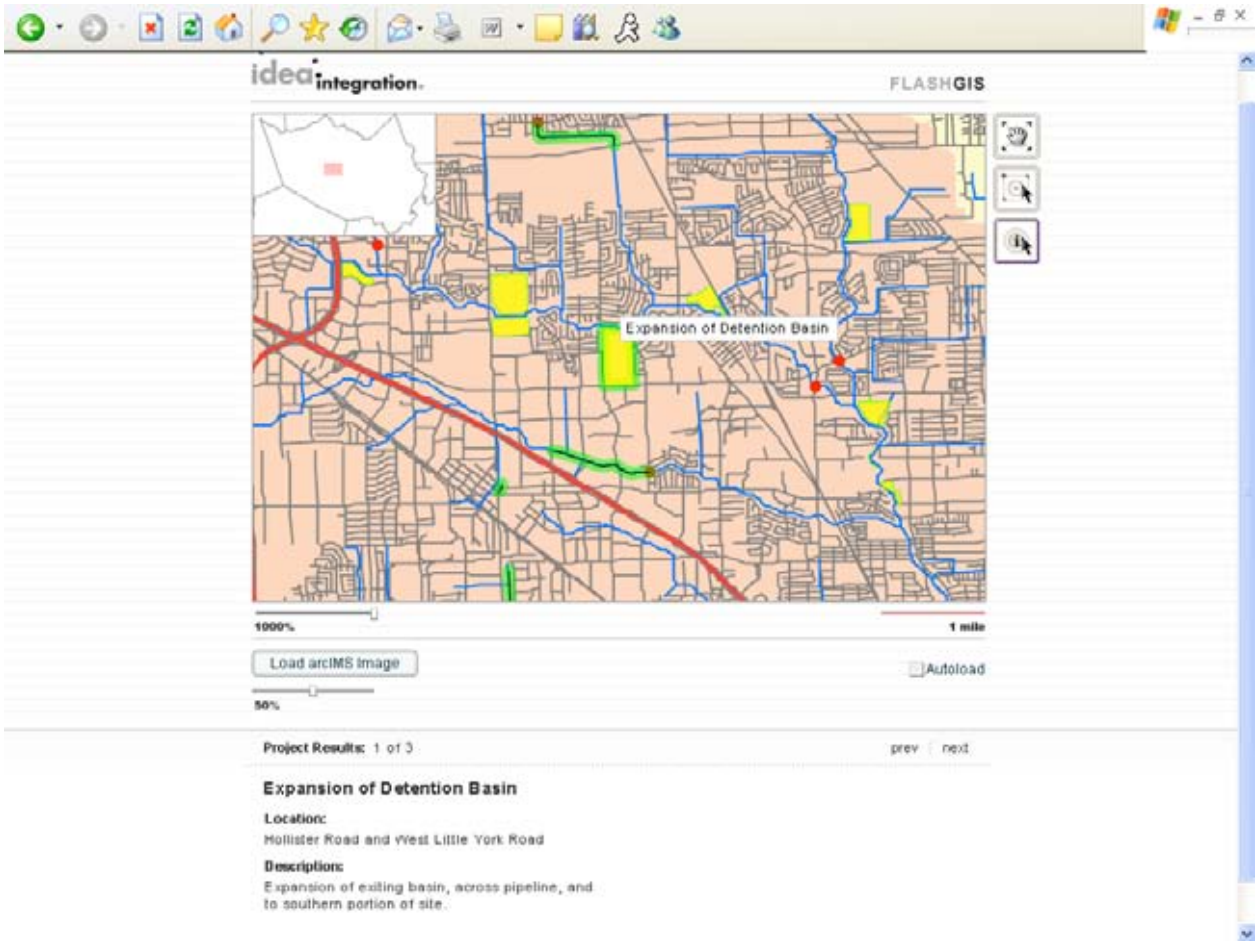

Figure 5: Variable Symbology Based on Mouse-Over and Scale

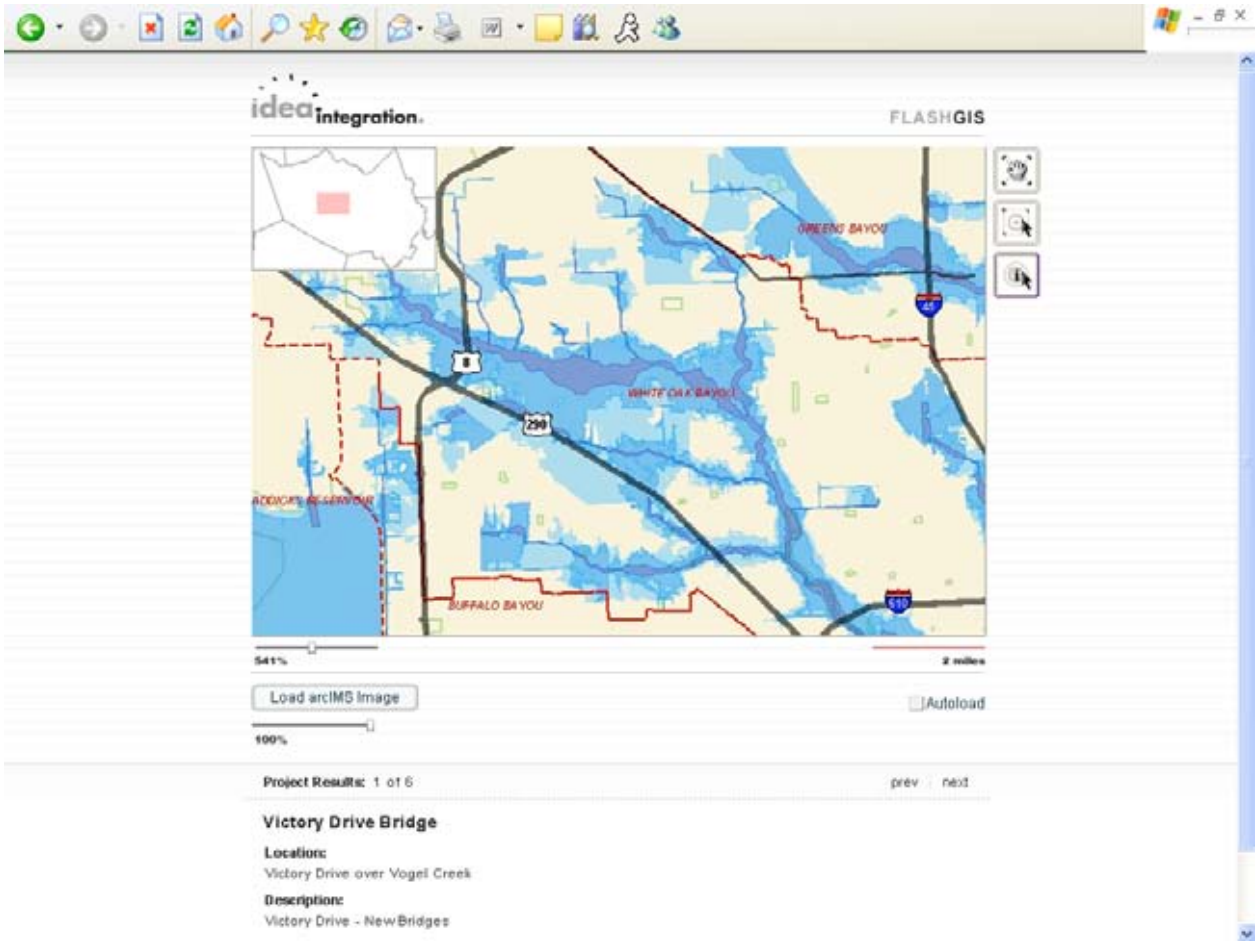

Figure 6: Load ArcIMS Image for Additional Information

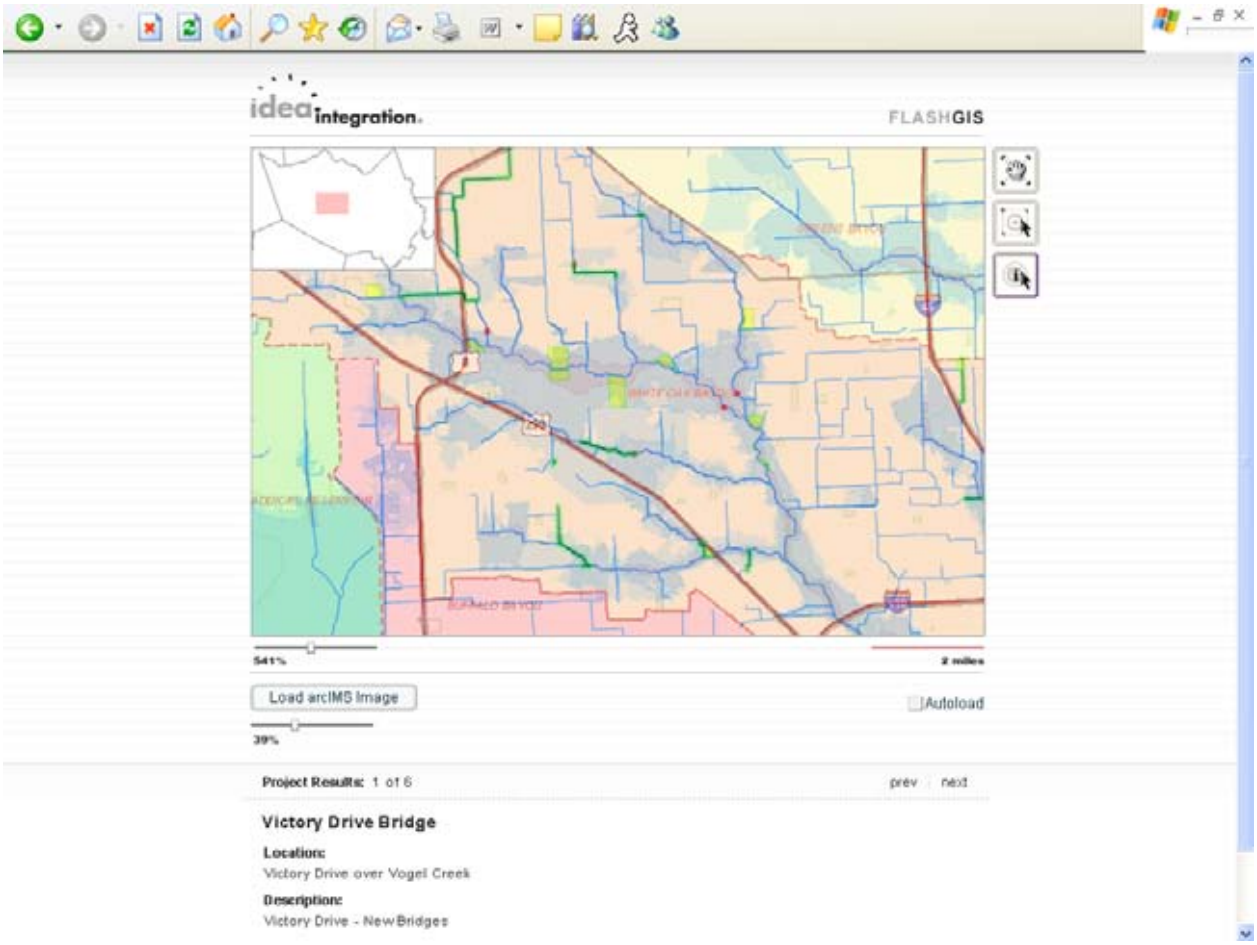

Figure 7: Set ArcIMS Image Transparency on the Fly

Author Information

Todd Thompson
Creative Director, Communications Division
Harris County Flood Control District
9900 Northwest Freeway
Houston, TX 77092
713-684-4016
todd.thompson@hcfcd.org

www.hcfcd.org

Wanjoo Choi
Senior GIS Consultant
Idea Integration
3200 Southwest Freeway #2900
Houston, TX 77027

713-353-6722
wanjoo.choi@idea.com

www.idea.com

Todd Buehlman
GIS Practice Director
Idea Integration
3200 Southwest Freeway #2900
Houston, TX 77027
713-353-6722
todd.buehlman@idea.com

www.idea.com