

Using GIS to Derive Base Flood Elevations for Building Permits



Evan H. Brown, GISP

Brent L. Johnson

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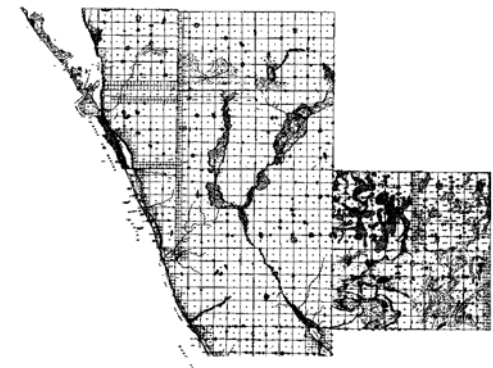
ABSTRACT

The Planning & Development Services Business Center of Sarasota County, Florida processes applications for construction permits. A critical element of each permit application is the minimum buildable elevation to prevent structure flooding. Staff previously used various paper map sources to formulate estimates in their analysis of an application. Hydrodynamic models and spatial data were developed to enable staff to provide a more effective and efficient determination of the minimum buildable elevation. An application was created using Avenue in ArcView 3.x to analyze the data and provide staff with essential information about the permit application. The application relates information about the location of the applicant parcel and, most importantly, supplies staff with the essential minimum buildable elevation. The GIS application enhances productivity and provides documentation for the application determination. The application was recently re-written in ArcObjects for use in ArcGIS 8.x and is now being ported to ArcGIS 9.x.

INTRODUCTION

Founded in 1921, Sarasota County encompasses approximately 575 square miles on the southwest coast of Florida. Sarasota County's beautiful beaches, barrier islands, and pristine natural areas make it a very desirable place to live. According to the United States Census Bureau's 2000 Census, Sarasota County had a total population of 325,457 people residing in 182,467 housing units. The 1990 Census counted 277,776 people housed in 125,493 housing units. In one decade Sarasota County experienced a 17% increase in population and a 19% increase in housing units.

Sarasota County is developing and thriving as a community, but what is the physical foundation for all this construction? Sarasota County has a distinct lack of topography. The coastal areas and beaches are at the waterline, while the highest point in Sarasota County is only 115 Feet NGVD1929 (Source: USGS). This lack of elevation results in a low-lying and damp landscape. Surveys conducted in 1847 by the Government Land Office (GLO) reflect these conditions. Sarasota County is drained by a handful of natural creeks and streams. The rest of Sarasota County is wetlands. Distinct drainage patterns are not readily observable.





A network of canals and ditches were constructed over time to accommodate Sarasota County's drainage needs. These canals and ditches usually maintain flow while preserving natural beauty. Very few of these canals and ditches are paved or hardened. The natural state of this drainage system is beautiful, but delicate. The canals and ditches must often be cleaned and cleared of natural vegetation and man made objects that impede flow. Flooding conditions develop if flow is obstructed. Proper operation of this drainage system is an essential component of the prevention of structure flooding.

Structure flooding is a very devastating event. While not as dramatic as fire or hurricane, a flood can still cause severe damage to a community and exhaust its support systems. Floodwaters destroy homes from the inside out. Many times furnishings and possessions in the home will also be lost. The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP) to track flood insurance statistics. According to FEMA's NFIP Sarasota County and the State of Florida have the following insurance statistics as of December 2004:

Sarasota County		
Policies	Total Value	Premiums
39,088	\$6,531,246,500	\$16,522,912
State of Florida		
Policies	Total Value	Premiums
1,873,521	\$315,745,783,300	\$661,755,539

These statistics communicate that flooding is a great concern to the citizens of not only Florida, but also Sarasota County in particular. Sarasota County Government strives to protect the 6.5 billion dollars in property that is insured against flood conditions. Flood protection is the priority for Sarasota County's Stormwater Environmental Utility (SEU). SEU is deeply committed to the computerized modeling of flood conditions. This computerized flood modeling information guides the permitting of new development in Sarasota County.

FLOOD MODELING

Sarasota County was divided into hydrologic units to begin the flood modeling effort. The County has five “top-level” watersheds. These watersheds are further subdivided into basins, sub-basins, and catchments. The watershed is the largest unit of drainage geography, while the catchment is the smallest unit:

Watersheds



Largest

Basins



Catchments



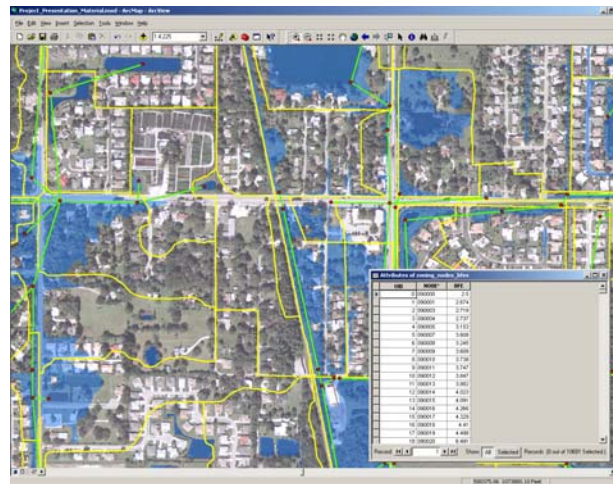
Smallest

Each hydrologic unit is examined for multiple characteristics that would influence drainage: land cover, land use, soil type, impervious surface area, topography, and existing drainage infrastructure. The drainage relationship between the hydrologic units is also determined. How does water flow within and through each hydrologic unit?

These characteristics are input data for the stormwater modeling software used by Sarasota County. The stormwater modeling software will compute flood data for specified rainfall events. Sarasota County models flood data based on the "100 Year, 24 Hour" storm event. This is a rainfall event that would occur every 100 years and would last 24 hours in duration.



The graphics on the border of this text are examples both the input and output to the stormwater modeling process. The graphic on the left is a completed hydrologic and hydraulic schematic. This is the data that is input to the modeling software. The graphic on the right is a map of the floodplain. The floodplain is a graphical depiction of the model output. Areas of land in the floodplain lie below the base flood elevation for the particular storm event being modeled.

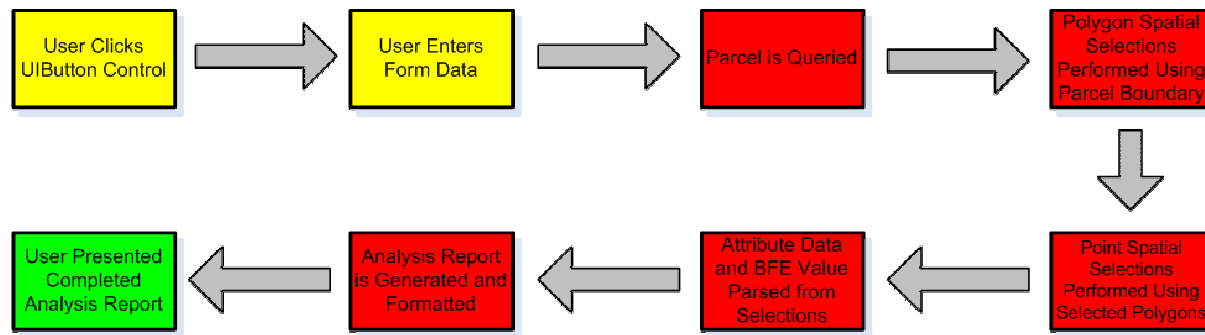


The resulting stormwater model output information is coordinated in Sarasota County's GIS. This information is easy to access, but to an untrained eye it is difficult to interpret. The information needed to be presented in a more direct and efficient manner. A user-friendly application was developed for this purpose.

BASE FLOOD ELEVATION APPLICATION

Technicians from Sarasota County's Zoning Department needed access to the information to determine construction elevations for building permit applications. The technicians are not experts in stormwater modeling, yet they need quick access to flood information to process permit applications. A GIS application was developed to facilitate their access to the needed information.

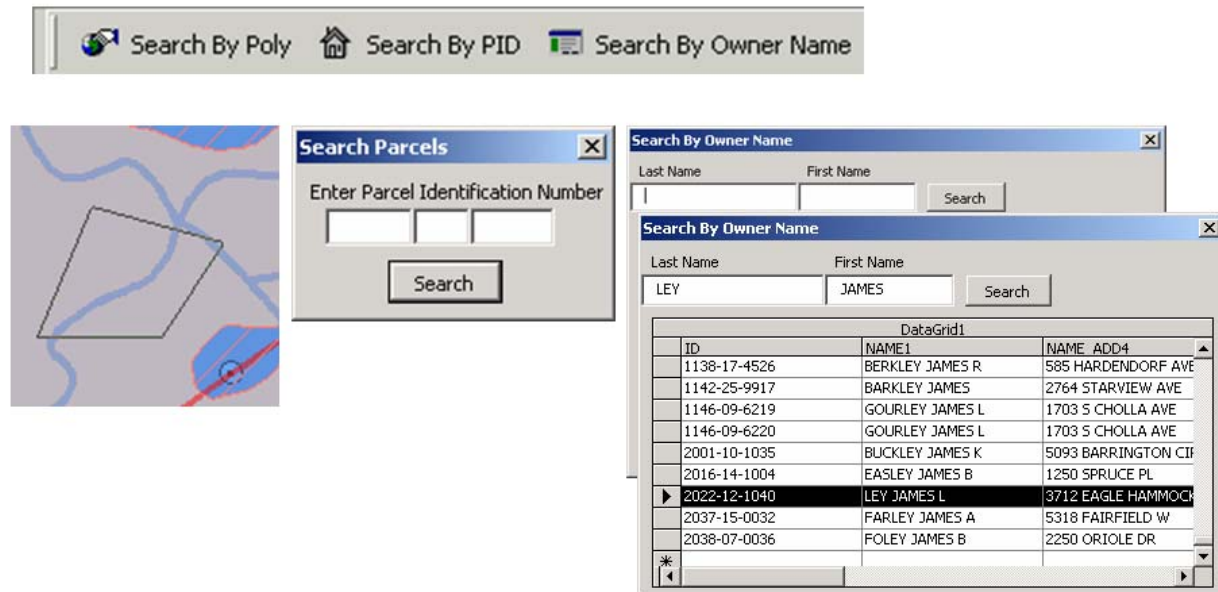
The application was originally written in Avenue for ArcView 3x. The application functioned well on this platform, but the application needed to be ported to ArcObjects as Sarasota County fully transitioned to the ArcGIS platform. The application code was completely re-written in ArcObjects. This was a complete regeneration of the application. Even though the code was different, the workflow of the application remained the same:



The goal of the workflow was to minimize user intervention. Events in the yellow boxes are user controlled. Events in the red boxes are performed by the application with no user intervention. The green box depicts the results presented to the user.

The normal workflow would progress as such: Zoning Technicians receive an application for a building permit. The application contains the Parcel Identification Number (PID) of the land that would be built upon. The Zoning Technician would click a UIButtonControl to begin the process. The Zoning Technician would be prompted to provide the PID for the analysis to start. The application performs the analysis and the results are presented to the Zoning Technician.

In addition to the PID, other methods for determining BFEs were requested by staff and end users of the application. A polygon can be drawn directly on the map display to denote an area for analysis. A property owner's name can be used to search for parcels. These methods are all accessed through UIButtonControls on a toolbar in a standard installation of ArcGIS Desktop.

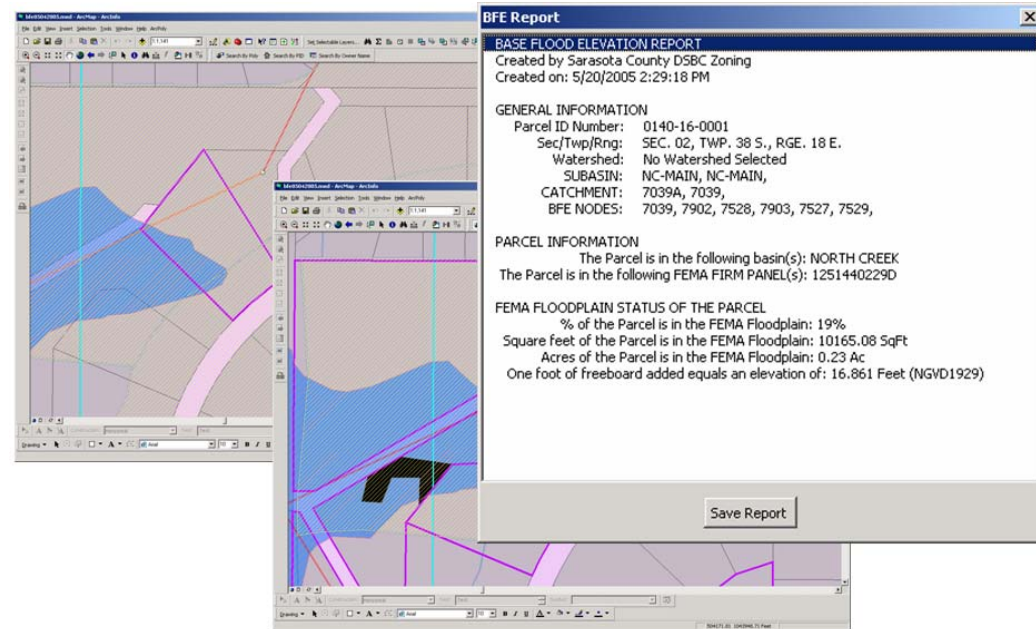


The analysis portion of the application performs a series of spatial selections to determine the relationship between the applicant parcel and the stormwater model information. To determine a base flood elevation, the BFE Application must be able to determine a minimum set of information: the catchment(s) intersecting the applicant parcel, the node(s) within the selected catchment(s), and a valid base flood elevation value from the stormwater model for the node(s). If any of this information is not present, the application will report an error and assist the user by directing them to the appropriate staff in Sarasota County's Stormwater Department for a manual determination.

If the criteria are all met, then the following details are reported to the user: the date and time the analysis was conducted, the PID, the Public Land Survey System section(s) the parcel intersects, the watershed(s) the parcel intersects, the basin(s) the parcel intersects, the catchment(s) the parcel intersects, the node(s) contained within the selected catchment(s), the basin(s) the parcel intersects, the FEMA FIRM Panels the parcel intersects, the spatial relationship of the floodplain to the parcel, and finally, the base flood elevation of the parcel.

An example of the map displays and results form presented to the user are shown at right. The map display automatically zooms to the applicant parcel that is used for the analysis. It is important to note that as an option the results report can be saved as an ASCII text file for future reference.

The text files can be archived so that changes in an area can be tracked with development. The archived text files can also serve as a permanent record of permitting history and details.



TECHNOLOGY OF THE APPLICATION

The data necessary for the BFE Application is housed in Sarasota County's SDE implementation running on Oracle. The only necessary client software needed by the user is ArcGIS Desktop 8x or 9x. The BFE Application itself is coded in ArcObjects through VBA. Advanced programming techniques are used to perform the analysis: IQueryFilter is used to select the Parcel for analysis by user specified PID, ADO Record Sets are used to search records from Sarasota County's property database by user specified name, ISpatialFilter is used to perform spatial selections of polygons and points, ICursor is used to loop through multiple selections and selection sets, and finally, ListBox.AddItem is used to generate and format the analysis report for the user.

As noted previously, this application was originally developed using Avenue for ArcView 3x. Sarasota County teamed with an independent GIS consultant, James Crandall, to accomplish the porting of the code to ArcObjects. Sarasota County staff was fortunate to learn many complex programming techniques from Mr. Crandall. This "team" approach to application development promises to be very productive in the future.

CONCLUSION

The citizens of Sarasota expect the growth and development of their community to be conducted in a careful and well planned manner. Drainage and flooding issues are of primary concern with new development. These issues are important not only for the new development, but also for the surrounding property and existing structures. Efficient access to flood model information is significant to the process of evaluating a building permit application.

GIS is an intuitive tool to deliver the necessary flood model information. GIS enables users to access flood information in an easy to understand graphical format. The BFE Application provides users with just the necessary information – not overloading them with useless and distracting data. The use of GIS technology and the BFE Application has proven to be an effective tool to manage this volume of much-needed flood model information.

AUTHOR INFORMATION

Mr. Evan H. Brown, GISP
GIS Architect – Natural Systems
Sarasota County Watershed Management
1001 Sarasota Center Boulevard
Sarasota, FL 34240
Phone - (941) 650-3491
E-Mail - ebrown@scgov.net

Mr. Brent L. Johnson
GIS Architect – Built Systems
Sarasota County Geomatics
1301 Cattlemen Road
Sarasota, FL 34232
Phone - (941) 861-6534
E-Mail - bljohnson@scgov.net