STORM WATER INFRASTRUCTURE – LESSONS LEARNED GWINNETT COUNTY, GEORGIA

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Abstract. The need for infrastructure inventory has existed for years. Requirements of the Metropolitan North Georgia Water Planning District Plans, GASB34 and re-issuance of the National Pollution Discharge Elimination System for Municipal Storm Sewer System have brought the issue to the forefront. Gwinnett County began collecting information for Storm Water Infrastructure Inventory 15 years ago. The methods used for data collection has changed many times over this period. Changes in technology, hardware and software have made the collection and maintenance of infrastructure inventory easier and faster. Our program has evolved over time; some of the things that were done worked and some of them did not. This evolution has gone from paper maps to a digital networked system that can trace flow upstream or downstream from any given point. Key factors in a successful program include data dictionary development, method of collection and storage, and the maintenance of the data set.

To date, Gwinnett County has collected information on over 82,000 structures and 950 miles of pipe

INTRODUCTION

The National Pollutant Discharge Elimination System (NPDES) Phase I Permit, along with the Metropolitan North Georgia Water Planning District Watershed Management Plan require inventory and mapping of storm water infrastructure (drainage system & structures). Gwinnett County is a 437 square mile county located northeast of the City of Atlanta. The population of Gwinnett County increased from 117,000 in 1980 to 700,000 in 2004. Gwinnett County was the fastest growing county in the nation in the late 80's and early 90s. With this growth came an extensive storm water infrastructure system. Most of this was designed and installed by developers and then dedicated to the county.

Mapping of the storm water infrastructure was identified as a need in the early 90s. Staff worked to develop a system that was time and cost effective through the 90s. Information that is collected is being used to respond to citizens request, asset management, spill containment, illicit connection detection, and system maintenance and design.

DATABASE DESIGN

Database design is the most important aspect of starting an infrastructure inventory program. First, determine what information is needed. This process should begin with talking to staff about what information they need to do their job. During this process the list of information needed will be very long. Everyone always wants all the information they can get. Taking the wish list and converting it to something that is affordable to collect and maintain is another story. The more complex the database, the more time it will take to populate and maintain, thus making it more expensive.

After interviewing staff the second step is to determine what minimum information is needed. Community needs can vary greatly. Communities with large flooding problems may need to collect invert information on all the pipes, were as a community that has limited flooding problems may choose not to collect invert information.

Gwinnett County's first priority was to identify our storm water infrastructure. Minimum requirements were determined to be location, material, size and condition. This priority was based on large pipe failures, as shown in the Figure 1. In the early 90s during a very wet period with many pipe failures, elected officials asked, "How big a problem is this anyway?" Staff could only estimate how big the problem was because no inventory existed. Major development in the Gwinnett County began in the late 70s and early 80s. During this period Gwinnett County had a small staff, and very few regulations. Record keeping was not a priority, so very little can be retrieved on these developments. Most of the pipes installed during this period were corrugated metal. As these pipe started to reach the end of their useful life of 15 to 25 years, pipe failures appeared. Pipe failures are dangerous and costly.

Figure 1: Material Pipe Failure

Gwinnett County's database design is very basic. Four feature classes - (inlets, ditch intersections, non-conduit lines and closed conduits) and one object class for Best Management Practices (BMPs). An object class is a table associated with a feature class that stores additional information about a subset of the feature class. Ditch intersections are placeholders at the intersection of non-conduit lines. This feature class was created to represent water quality BMPs such as grassed swales that did not have an outlet structure. The BMP object has to be associated with a feature. See Figure 2 for data model.
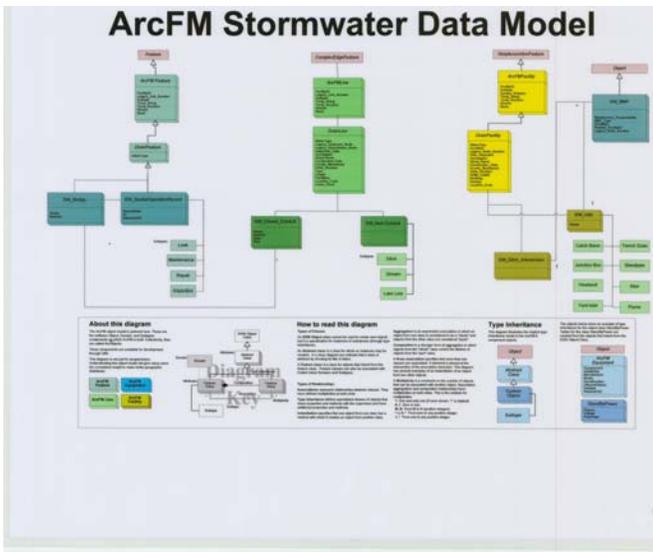

Figure 2: Gwinnett County Data Model

HARDWARE AND SOFTWARE

After database design comes the selection of hardware and software. This selection must also be based on the community needs. Gwinnett County started our database on an old PC with a couple of tables in Rbase, and the graphic being plotted on photographs. This process begins by answering these questions:

- What resources are currently available?
  - Computers/Servers
  - Software Packages
  - GIS system
  - Paper Maps
  - As-Builts/Final Plats
- What is the skill level of current staff?
- What is the budget for this effort?

These questions provide the information needed to decide if an off-the-shelf type of product will work for your organization or if a custom application may work better. Off-the-shelf products come in many sizes and shapes and work with a variety of software packages. Generally off-the-shelf products are less expensive than custom applications, but they do not allow the flexibility provided by a custom application. Organizations starting out should look at the off-the-shelf packages. Off-the-shelf packages come with a database design and generally work with some type of graphic software. The database design may be more complex than what is needed to get started, but if the minimum requirements are included, the software should be considered. Off-the-shelf products will have minimum hardware and software requirements, allowing the community to determine if additional hardware or software is required. For example, the off-the-shelf product may require Access 2000 be installed on the machine. Custom applications are generally created for the workflow of an organization. Gwinnett County started out using custom applications. First, Rbase and photographs, then we moved on to Oracle for the database and GDS software for the graphic. This approach worked well until another vendor purchased the software package and stopped supporting it. Custom applications generally require some form of additional customization with every new version of the software. Custom applications can help staff get exactly what they want, but can be very costly in the long run. At this time, Gwinnett County is using ESRI - ArcGIS 8.3 with Miner & Miner - ArcFM utility software to manage our storm water infrastructure.

DATA COLLECTION

With purchase of hardware and software, data collection can begin. Information can be collected in
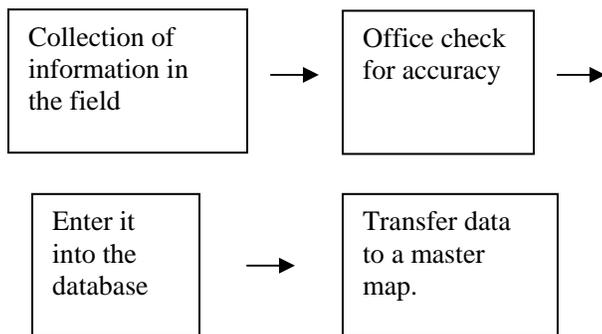
many ways from using a paper map and a paper form to hiring a consultant to use Global Positioning System (GPS) equipment to collect attribute information along with X, Y and Z coordinates for the structure. The method used to collect the data should be tracked to identify the accuracy of the data if different methods are used.

No matter how you choose to collect the information these questions will need to be answered?

- How big can delivery areas be?
- Who will do quality control of the information?
  o Attribute?
  o Graphic?
- How will it be entered into the database?
- Who will maintain the graphics?

These are all questions that Gwinnett County found out after data collection began. Size of delivery area directly affects the rest of these questions. It is hard to quality control large areas. Quality control in our case includes looking at each piece of information for accuracy in attribute data, position information, how the pieces connect to each other and flow direction. Setting delivery size to an area that can be easily verified in a reasonable amount of time is important for your staff and/or the consultant. The County uses the grid system developed for our GIS system. This system has worked well for both the consultants and our staff.

Collecting information using a paper map and forms should have the following workflow.

| Collection of information in the field | → | Office check for accuracy | → |
| Enter it into the database | → | Transfer data to a master map. | |

This is time consuming, but the process works as long as a procedure is in place.

If you select to purchase and use GPS equipment or hire a consultant, the same types of questions must be answered. Loading data into the software package can be a problem. In our case there was a method in the software, but each table required manual translation of field names used in data collection software (limitation of the field software) to the field name in the graphic software. Loading the information once with a few tables would not have been a problem. But at one time, Gwinnett County had three consultants and four internal staff members collecting information. A custom loader application was created to take the files generated for the GPS software and load them into our GIS.

Maintenance of graphic data must be addressed to insure that information in your GIS or on your map is consistent. Gwinnett County loads information into a storm water network. The network allows staff to trace up and down stream at any point on the network. Everything in the system must be connected and someone must check the system as new information is loaded to insure that everything is still connected and that part of the old network does not need to be deleted.

MAINTENANCE OF DATA

Storm water systems are dynamic. Replacements of existing drainage systems along with the addition of new drainage systems must be addressed. Having a plan to keep the data collected up to date is important. In Gwinnett County, in-house staff uses GPS equipment to collect information on new developments at the completion of the projects. The same staff also collects information on replacement projects, done by county crews or by outside contractors.

CONCLUSION

Gwinnett County continues to collect information on our storm water infrastructure. To date, 82,000 structures, and 950 miles of pipe have been collected, in approximately one third of the county. Information is collected by using a combination of consultants and in-house staff. Consultants are used to collect base information and in-house staff is used to collect new development and replacement information. Inventory already in the system is used to respond to citizens request, asset management, spill containment, illicit connection detection, and system maintenance and design. Information is being stored in ESRI – ArcGIS 8.3 and Miner & Miner – Arc FM software. Approximately $2,500,000 has been spent to date for hardware, software, GPS equipment and consulting services.