

# USING TECHNOLOGY TO MEET THE MNGWPD FLOODPLAIN MAPPING REQUIREMENTS

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**Abstract.** The recent guidance and required floodplain management ordinances developed by the MNGWPD have created new flood study and floodplain mapping requirements for the 16-county District covering greater metro Atlanta. Meeting the new floodplain mapping requirements will address an important need in light of recent and continuing growth, while also creating technical and fiscal challenges for district municipalities. The MNGWPD now requires all its communities to develop future conditions 100-year floodplains, and strongly urges flood studies to be conducted up to a 100-acre drainage point, rather than simply up to the traditional 1 square mile (640 acres) drainage area limit historically used by FEMA. Leveraging the latest GIS, modeling, and terrain capturing technologies can enable communities to accurately and efficiently meet the new flood study and mapping requirements. This paper examines the different approaches utilized in the completed flood study program in Gwinnett County, the recently launched Countywide floodplain mapping program in DeKalb County, as well as ongoing efforts in Cobb County.

## REQUIREMENTS OF THE MNGWPD MODEL FLOODPLAIN ORDINANCE

The MNGWPD has developed a new model floodplain ordinance which is intended for adoption by all municipalities within the 16 county district. The Georgia EPD is requiring all communities in the District to adopt the model ordinance in order to continue to be eligible for permits. There are at least two significant new requirements for floodplain mapping imposed on local governments by the new floodplain management ordinance. The first major requirement is for Future Conditions 100-year floodplains to be developed for all flooding sources in the community with a drainage area exceeding one square mile (640 acres). Future conditions shall be based on land use mapping representing ultimate build out or some long term plan date, such as Year 2025. Beginning in 2005, each community is required to map at least 10% of its future floodplain area per year until complete. The second requirement is for communities to map the future floodplain up to the 100 acre drainage area limit, or require developers to determine the future floodplain on a site by

site basis for developments along streams with a drainage area exceeding 100 acres but less than one square mile. By relegating the future floodplain mapping requirement to developer's in these areas, communities risk having an un-manageable hodge-podge of models, with differing methodologies and resolutions, as well as the possibility of dubious results, and also the added cost for staff review time of each individual study. For these reasons it may be preferable for the communities to develop future 100-year floodplains in these upper stream reaches as well as the traditional areas with drainage areas over 1 square mile.

Both of the new floodplain mapping requirements, future conditions 100-year floodplains, and what we refer to as "100-acre flood studies", introduce new planning and budgetary challenges for district municipalities. Several different approaches and level of study have been or are currently being utilized to meet the MNGWPD floodplain mapping requirements by Gwinnett, DeKalb, and Cobb Counties. The common theme among the three is leveraging quality topographic and GIS datasets, as well as utilizing the efficiencies of the latest hydrologic, hydraulic, and GIS software to develop high quality, easily managed floodplain data at a reasonable cost.

## Gwinnett County

A combination of outdated FEMA FIRMs and rapidly changing land use prompted Gwinnett County to embark on a 5 year countywide flood study program in 1999. Although the launch of this program pre-dated both the MNGWPD's original 2002 and updated 2006 Model Floodplain Management Ordinances, the County still recognized the need to develop future 100-year floodplain mapping in addition to updated modeling and mapping of the existing land use conditions floodplains across the County. Gwinnett found that by adding future conditions floodplains to a scope of study that included new existing conditions floodplains, the added cost was insignificant (less than 5% of the total cost) because the County had both existing and future (Year 2020) land use mapping in GIS format. Simple spatial analysis algorithms in ArcGIS allowed for the NRCS Curve Number parameter in the hydrologic modeling to be updated from existing land use to future land use conditions for an entire watershed's worth of sub-basins with a few clicks of a button.

Similarly, both existing and future land use conditions 100 year floodplains were delineated simultaneously using available spatial and three dimensional analyses capabilities in ArcGIS. The availability of accurate and up-to-date topographic data derived from LiDAR proved to be extremely valuable in producing high quality floodplain mapping in an efficient manner.

Because Gwinnett County was ahead of the curve in proactively launching their flood study program, most of the County had completed detailed flood studies (for both existing and future land use conditions) up to a 1 square mile (640 acres) drainage area limit before the MNGWPD Model Ordinance required studies up to the 100 acre drainage area limit. Because of this timing, Gwinnett was forced to tackle the challenge of extending its floodplain mapping further upstream after its detailed flood studies were complete and adopted on the official FEMA DFIRMs.

Gwinnett County's desire was to add existing and future 100-year floodplain mapping up to the 100 acre limit in a fast, cost-effective manner, yet not be inconsistent with the methodologies used in their previously completed detailed flood studies. The unique solution they developed met both goals, and further leveraged available County datasets. The County developed an automated approach to performing limited detailed studies based on the same NRCS rainfall-runoff hydrology used in the full detailed studies. This approach avoided the inconsistencies of mismatching flood discharge values of the typically used regression equations with the discharges of the HEC-HMS rainfall runoff modeling from the full detail studies.

The use of the NRCS Curve Number method also enables a more direct correlation in the changes in land use between existing and future conditions than does a regression equation that only utilizes impervious area. The County leveraged its stormwater structure inventory data to supply the limited detail models with the culvert specifications needed for the HEC-RAS hydraulic models. All other geometric data was automatically extracted from the County digital terrain data via the off-the-shelf HEC-GeoRAS extension in ArcGIS, meaning no costly field survey was needed, yet the conveyance of structures and flood elevations around road crossings were still accurately modeled. Very light ArcGIS programming enabled Gwinnett to combine best of features from the ArcHydro toolset, HEC-GeoHMS, and HEC-GeoRAS to create an automated solution to mapping very accurate floodplains up to the 100-acre drainage area limit.

One final element of Gwinnett County's flood study program will enable it to maintain its significant investment in floodplain modeling and mapping and conditions continually change in the future is the implementation of an ArcHydro geo-database that stores and manages every model (hydraulic, hydrologic, water quality, dam break)

and flood hazard mapping element. Integrated tools allow County staff such management functions as querying the flood elevations for a parcel, or packing a hydraulic model and supporting GIS data for a developer at the push of a button. This system makes the jobs of County staff easier and ensure that the large investment of their 5 year flood study program will not be required in another 5 years due to obsolescence of the flood hazard data.

**DeKalb County.** With the adoption of a Stormwater Utility fee just 2 years ago, and the recent adoption of the MNGWPD Model Floodplain Ordinance, the timing was right for DeKalb County's recent launch of a comprehensive countywide flood study program. While the official effective date of DeKalb County's FEMA DFIRMs is 2002, like many communities DeKalb county knows that in fact the actual hydrology, hydraulics, and floodplain mapping for much of the County is now over 30 years old. Because DeKalb has started their program subsequent to the latest MNGWPD Model ordinance requirements, they have chosen to develop full detail, seamless flood studies for every flooding source in the County up to the 100-acre drainage area limit, including both existing and future land use conditions.

Currently in year 1 of the program, DeKalb is planning for the flood study program to last a total of 5 years, during which time over 500 miles of detailed modeling and mapping will be created. Recognizing the need for a consistent, uniform study methodology across all watersheds, DeKalb County is utilizing the best of available public domain software and GIS applications, including ArcHydro, HEC-GeoHMS, HEC-GeoRAS, in addition to built in spatial and 3-D analyst functions of ArcGIS 9.x. The ArcHydro toolset was utilized to delineate all the watersheds and 100 acre streamlines for the County, so up front, detailed scoping could be performed in order to best plan and prioritize the flood study process. The availability of highly accurate 2 foot contour interval topographic data derived from photogrammetry, along with high quality aerial imagery and planimetric vector data in GIS is leveraging both the quality and efficiency of the program, with the terrain data reducing the need for costly field survey, and enabling automated hydrologic processing without concerns over quality.

By extending full detailed studies up to the 100-acre drainage area limit, DeKalb is seeing an economy of scale, and the time consuming requirement to incorporate many isolated flood studies performed by developer's in these upstream areas will be eliminated or at least greatly reduced. Similarly, by studying existing and future land use conditions hydrology concurrently using NRCS Curve Number methodology, there is no appreciable difference on cost due to the ease of toggling between the land use datasets in ArcGIS, and the available interface software

that automatically imports the hydrologic parameters into the HEC-HMS models.

**Cobb County.** Cobb County currently has a “mixed bag” of flood study modeling and floodplain mapping, ranging from high quality models and mapping using the latest technology and including future conditions, to old, outdated models and floodplain delineations based on long ago topography that do not match well with today’s more accurate 2 foot topographic data collected by the County. This mixed bag means Cobb does not need to start from scratch with a comprehensive flood study program, but still has had to address existing deficiencies along with the new MNGWPD requirements watershed by watershed to varying degrees.

For watersheds with good quality hydrologic and hydraulic modeling that already include future land use conditions, Cobb County has elected to simply redelineate the floodplains using a very accurate semi-automated procedure to improve on floodplain delineations that were either based on older, coarse contour data, or were automatically delineated using techniques that left too much “clean-up” or coarse grid like floodplain boundaries when viewed at a parcel level.

Because previous flood study models in Cobb were also based on the much preferable rainfall runoff hydrology, Cobb has also elected to employ a limited detail approach based on NRCS Curve Number approach hydrology to develop existing and future 100-year floodplains up to the 100-acre limit. Similar in approach to Gwinnett County, accurate curve numbers and discharge values are coupled with a limited detail GIS terrain-based HEC-RAS model, using a combination of ArcHydro, geo-HEC-HMS, and geo-HEC-RAS, along with a semi-customized floodplain mapping methodology that improves on the approach utilized by geo-HEC-RAS. Cobb County has also elected to utilize this approach to replace the floodplains identified as Approximate Zone A of the FEMA DFIRMs.

While the MNGWPD model floodplain ordinance have introduced new and needed flood study requirements, Cobb County has also recognized one aspect of the new stricter regulations that should reduce level of effort. Because the new ordinance requires communities to regulate the future conditions 100 year floodplain in a manner that is at least as strict as FEMA’s regulatory language for Floodways, Cobb County has recognized that there is no need to develop any floodways for newly studied floodplain areas, which is a cost savings in both the current study effort as well as future maintenance and upkeep of the HEC-RAS models and flood hazard mapping.