July 2003

Crooked Creek
Storm Water Master Plan

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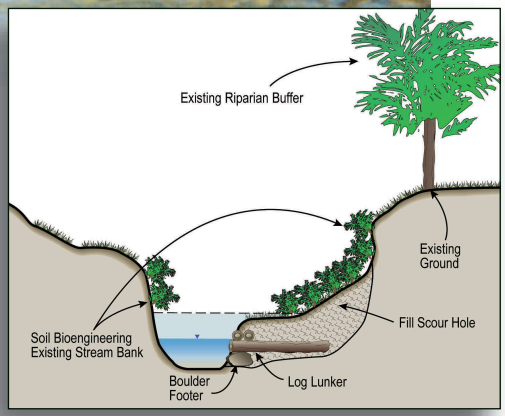

prepared for

Gwinnett County, Georgia

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Crooked Creek Storm Water Master Plan

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Executive Summary

Background

In 2000, Gwinnett County completed a watershed assessment for the entire county that included an evaluation of the condition of the streams and surrounding watersheds. Although the average condition of the streams based on biological, habitat, and water quality parameters was fair to good, urbanization has still had significant impacts on many stream segments. The altered hydrology due to changes in land use was identified as one of the primary stressors contributing to stream degradation. As the native vegetation is removed from the watershed, particularly along stream banks, the potential for erosion is increased and exposed soils scour and wash into the stream. This erosion, particularly along the stream banks, is especially pronounced if the change in land use is from vegetated to impervious surface. High levels of fecal coliform have also been identified as a major problem in the Crooked Creek watershed and, as a result, this system is on the State 303(d) list as not supporting the designated use of fishing.

As part of the County-wide Watershed Assessment, the Crooked Creek Watershed was identified as one of the watersheds most impaired by urban development. Crooked Creek is a 9-square mile watershed located in western Gwinnett County, as shown in Figure 1. The leading causes of biological degradation include:

- Loss of habitat due to altered hydrology and resulting severe channel and bank erosion
- Loss of habitat due to sediment loads
- Destruction of riparian habitat due to encroachment of development activities

Identification of these causes led to recommendations to: (1) target watershed management techniques related to controlling peak flow rates from a range of storm events, (2) install or retrofit best management practices (BMPs) to reduce total suspended solids (TSS) and other pollutant loads, and (3) protect or restore stream buffers. Once the causes are managed, stream channel restoration can be effective at improving aquatic habitat to a suitable level for a diverse biological community.

In 2001, CH2M HILL began a more detailed assessment of the entire Crooked Creek watershed, including a flood study, a drainage infrastructure inventory, BMP evaluations, and a stream survey of approximately 19 miles of channels. This evaluation was to determine flooding and drainage conditions in the watershed, as well as the relevant habitat availability, stream morphology and degradation, pollutant and sediment loads to the system, and overall water quality of Crooked Creek and its tributaries. The ultimate goal of this study was to identify problem areas and propose capital improvement and restoration procedures. This resulting Capital Improvement Program (CIP) will serve as the basis for re-establishing and creating viable habitat, morphology, and quality to the waters in this basin.

Purpose of the Storm Water Master Plan

The purpose of this Storm Water Master Plan is to provide a framework within which individual CIP projects can be undertaken that will improve drainage conditions and water quality problems related to development of the Crooked Creek Watershed. The Master Plan is an extension of the County-wide Watershed Protection Plan (WPP), completed in 2000. The Storm Water Master Plan goes beyond the more general WPP to identify specific CIP projects in the Crooked Creek Watershed that will help the meet the County's water quality and quantity goals.

To protect and improve the integrity of the Crooked Creek watershed and its streams, a Storm Water Master Plan was developed with the following objectives:

- Identify problems, needs, and opportunities related to flooding, drainage, and water quality within the Crooked Creek watershed.
- Mitigate the changes in runoff volume and time of concentration caused by developed and, particularly, impervious areas.
- Protect or restore stream riparian areas and buffers as one means to improve aquatic habitat and reduce stream temperature.
- Reduce the amount of pollutants released to streams via storm water runoff from developed areas.
- Reduce sources of sediment from scour of stream beds and banks.

Regulatory Overview

NPDES Permit Requirements

The Georgia Water Quality Control Act of 1994 requires that watershed assessments and watershed protection plans be developed for the service area of any water or wastewater utility that is expanding service or renewing their withdrawal or discharge permit. Watershed protection is thus a requirement of Gwinnett County's permits under the National Pollutant Discharge Elimination System (NPDES). The permit for the F. Wayne Hill Water Reclamation Center (Georgia EPD Permit GA0038130) directly addresses the requirement for water quality protection.

In addition to the NPDES permit for wastewater treatment plant effluent discharges, storm water discharges in Gwinnett County are regulated under the Municipal Separate Storm Sewer System (MS4) permit. The MS4 permit requires storm water management programs to be put into place and monitoring of storm water runoff.

Total Maximum Daily Load (TMDL) Limits

In an effort to improve water quality in areas where streams are not supporting their designated uses, the Georgia EPD is in the process of establishing Total Maximum Daily Load (TMDL) limits for streams. The TMDL program will specify maximum loads, concentration, or reductions from current conditions for specific parameters. EPD has

developed a TMDL addressing fecal coliform bacteria for Brushy Fork in Gwinnett County, and the County has implemented programs to address this issue.

Level of Service

The level of service defines the ultimate goals of the management plan. It clarifies the responsibilities of the County and guides the expectations of the community for dealing with local problems.

Flooding

The level of service that Gwinnett County strives for is to avoid or minimize threats to life and property. This includes enforcing flood plain management requirements on new development to avoid increases in flood conditions due to development, defining flood plain limits to identify flood prone areas, and maintaining drainage infrastructure to safely carry the design flows. For new construction, the County goal is to have no new road surfaces or habitable buildings subject to flood threats from the 100-year storm based on future land use conditions.

In addition to limiting the flood threats from extreme events, the County has also established a level of service for frequent storms. For new development, extended detention for the 1-year storm must be provided such that the runoff is released over a 24-hour period. The purpose of this criterion is to provide protection to downstream channels from scour due to excessive velocities and duration of bankfull conditions.

Local Drainage System

For local drainage, the goal for Gwinnett County is to inventory and map the drainage system and provide a visual evaluation of the condition of major structures. The inventory results can be used to identify potential problem areas related to clogging, deterioration, or damage.

Pollutant Loads

As part of the 2000 Watershed Assessment, Gwinnett County has established target levels of TSS that are needed to meet the EPD criteria for aquatic biota under the designated use of fishing. There are two key tools for meeting this objective:

1. The Gwinnett Storm Water Design Manual provides guidance on managing water quantity and quality through hydrologic controls and water quality BMPs.
2. The Storm Water Quality Performance Review Form and supporting computer tool provide a method to quickly evaluate the pollutant (TSS) load associated with a specific development against the overall County target.

The 2000 Watershed Assessment showed that managing TSS to the defined limits is essential to protecting or improving the water quality and biotic conditions in Gwinnett County streams.

Habitat Restoration

While managing hydrology and pollutant loads is expected to avoid new problems associated with new development, restoration projects are needed to address those areas that have already been degraded. The 2000 Watershed Assessment showed a correlation between habitat score, established through standardized, objective criteria, and the Index of Biotic Integrity (IBI). The IBI indicates the abundance and diversity of fish in a stream. Figure 2 shows the correlation between the IBI score and habitat score developed in the 2000 Watershed Assessment. The correlation shows that a minimum habitat condition is necessary to support a desirable fish population, even if the chemical and sediment characteristics of the stream are acceptable.

Suitable habitat and healthy fish population are important criteria for supporting the designated use assigned by the State EPD for Gwinnett County streams. To meet these criteria, Gwinnett County plans to implement channel restoration projects to improve habitat conditions to a level that will support a viable fish population.

Approach

Flood Evaluation

A flood evaluation was completed, which included hydrologic and hydraulic modeling of storms with recurrence intervals ranging from 2 to 500 years. The purpose of the modeling effort included:

- Develop revised flood discharges and elevations for use in updating the Federal Emergency Management Agency (FEMA) Flood Insurance Study and Flood Insurance Rate Maps.
- Develop a set of computer models that can be used to evaluate potential CIP projects.
- Develop floodplain boundaries that reflect current and future land use conditions in the watershed to assist Gwinnett County in managing floodplain activities.
- Identify streamflow characteristics that can be used in the design of stable channels.

For the hydrologic model, standard SCS procedures were used within the HEC-HMS computer program, based on guidance described in the Gwinnett County Storm Water Management Manual. Model parameters were based on the latest information available from the County GIS, supplemented with field reconnaissance.

The HEC-RAS model was used to estimate the flood elevations. Data input to the HEC-RAS model included stream valley cross sections from the effective Flood Insurance Study, supplemented with new survey data where conditions had changed or where bridge and culvert data were needed.

Drainage Inventory and Evaluation

A drainage inventory was completed to document the location and condition of the drainage system within the public right-of-way. All drainage features along major roads, including catch basins, storm drains, outfalls, etc., were identified through field

reconnaissance; and inventory data were recorded in field computers. In residential neighborhoods, only major drain pipes (those 36 inches in diameter or larger) or pipes needed to connect other inventory facilities were included.

The purpose of the drainage inventory was to provide documentation on the location of various types of drainage facilities and their physical condition, as it affects their performance. The types of drainage features inventoried included:

- BMPs
- Catch basins
- Closed conduits
- Headwalls
- Junctions
- Flumes
- Ditches
- Yard inlets
- Weirs
- Trench drains
- Standpipes
- Lakes

Stream Assessment

The approach CH2M HILL used for assessing the condition of the streams and riparian zones in the Crooked Creek watershed required a pedestrian survey to document degraded conditions and the causes of degradation. In spring 2001, CH2M HILL conducted a Phase 1 survey of the Crooked Creek mainstem and tributaries documenting infrastructure items (e.g., utilities, road crossings, pipes, and drainage ditches), severe erosional areas, habitat conditions, and a stream morphology classification (Rosgen, 1996). Prepared forms used in the inventory included a range of impact scores for rating the conditions observed in the field. This approach provided a semi-quantitative condition assessment of each parameter evaluated.

Areas with higher levels of degradation, as determined from the initial stream walks, as well as an evaluation of public land ownership and location in the watershed, were more thoroughly investigated in a second phase of field investigations performed in April 2001. The initial assessment data were confirmed, site constraints that might affect an engineering design were noted, and restoration design concepts were sketched. The data collected (including photographs) were entered into a geographic information system (GIS) database for analysis, ranking of the stream conditions, and identifying and prioritizing restoration projects for future management decisions on a watershed basis.

In all, 68 preservation or restoration projects of varying types totaling more than 79,000 linear feet of stream, have been identified along Crooked Creek and its tributaries. The 68 stream projects were ranked for their priority of implementation and 27 of these projects are included in the final recommendations In addition, while not part of the 27 priority projects, 16 preservation projects are recommended to protect the existing conditions of streams currently in relatively good shape. The proposed stream restoration projects were

coordinated with recommendations for upland BMP, flood control, and drainage projects to form the recommended CIP for the Crooked Creek watershed.

BMP Assessment

An assessment of upland BMPs was completed to verify the existence and evaluate the condition of BMPs that serve developments in the Crooked Creek watershed. The approach included review of development plans, aerial photos, topographic maps, and field investigations to identify and catalog BMPs, such as detention ponds, wet ponds, and other structural measures; inventory of the location and basic information about each; and following up evaluations of those BMPs that may provide watershed-wide benefits. In addition, topographic maps and field reconnaissance were used to identify opportunities for new BMPs that could be beneficial in meeting water quality and flood management goals of the Crooked Creek watershed. Eleven upland BMP projects were considered and six of the projects are included in the priority list of CIP projects to meet the watershed goal for TSS reduction. Section 4.0 of this report provides a detailed discussion of the BMP assessment.

Summary of Watershed Needs

The 2000 Watershed Assessment established a link among pollutant loads, aquatic habitat, and biotic integrity. Water quality and biological monitoring were used to characterize the streams of Gwinnett County; water quality modeling was completed to estimate pollutant loads under existing and potential future conditions. Observed biotic integrity was linked to pollutant loads and to aquatic habitat; and County-wide goals were established for TSS loads and for aquatic habitat scores. These goals, applied on a local basis, define the improvement needs of the Crooked Creek Watershed related to reductions in TSS loads and improvement of aquatic habitat. The current Crooked Creek study confirmed these needs and identified specific needs and opportunities for improvement on a local basis. A CIP list of 33 projects is presented in Section 6.0 of this report to address the water quality and habitat needs of the Crooked Creek Watershed.

Flood management needs included identification of floodprone areas through the hydrologic and hydraulic modeling and floodplain mapping.

The results of the watershed needs analysis are presented in Section 5.0 of this report.

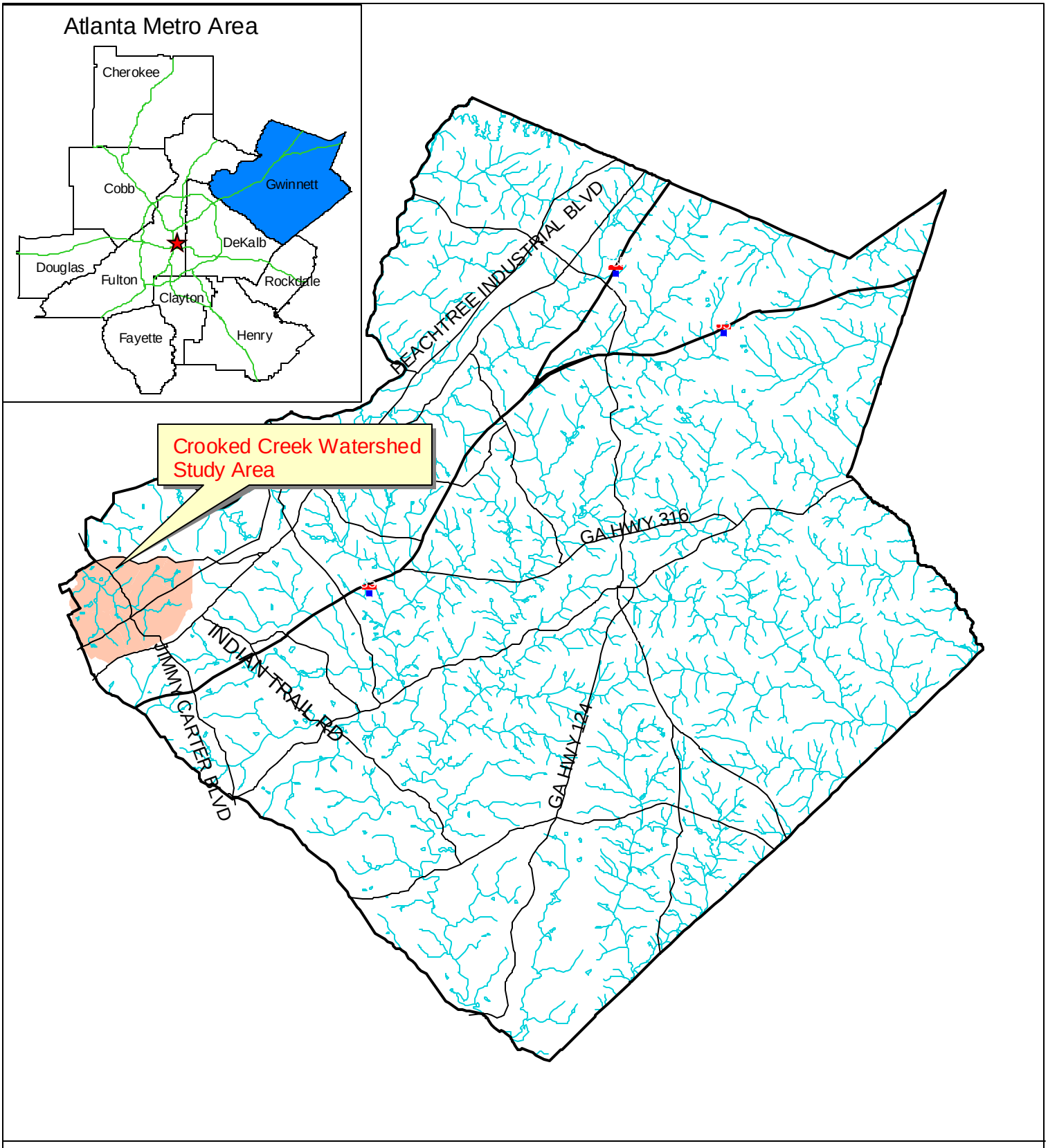

Figure 1
Study Area Location Map
Crooked Creek Storm Water Master Plan
Gwinnett County DPU

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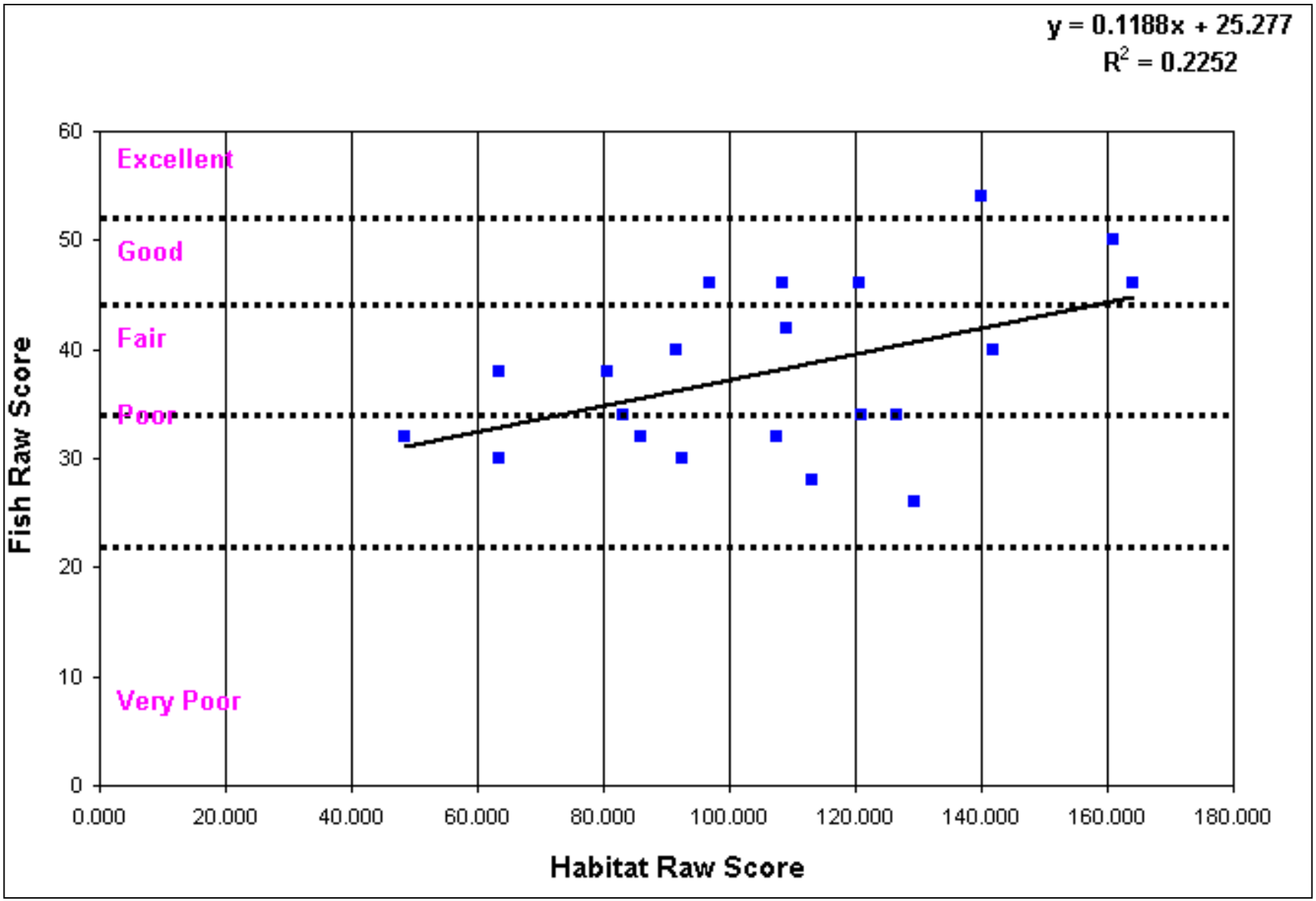

Figure 2
Correlation Between Fish and Habitat Scores
Crooked Creek Storm Water Master Plan
Gwinnett County DPU

1.0 Flood Study

A flood study was completed to evaluate the impacts of recent development on flood conditions in the Crooked Creek Watershed. The Flood Insurance Study (FIS), completed in 1984 and revised in 1992, formed the basis of the evaluation, and was updated to reflect existing conditions. Hydrologic and hydraulic modeling data were taken from the previous studies, where possible, and updated to current conditions where necessary.

A hydrologic (HEC-HMS) model was developed to serve as the Corrected Effective Model and subbasin curve numbers (CN) were determined from GIS mapping and current land use. A CN was assigned to each land use/hydrologic soil group combination, as recommended in the Gwinnett County Drainage Manual. The corrected effective hydraulic data was input to a HEC-RAS model; and revised flood elevations and flood boundaries were developed. The corrected effective models include changes in hydrology, cross sectional data, river stationing, roughness coefficients, floodway encroachments, storage areas, and bridges and culverts.

A detailed discussion of the subbasin data development is included in the Proposed LOMR Flood Study for Crooked Creek, prepared by Greenhorne & O'Mara in 2002.

1.1 Flood Study Results

1.1.1 Flood Boundaries and Floodways

Flood boundary and floodway maps were developed based on the HEC-RAS model results. Mapping was completed using the current topographic maps available from Gwinnett County. Flood boundary and floodway maps were provided to Gwinnett County separate from this report. Refer to the Proposed LOMR Flood Study for Crooked Creek, prepared by Greenhorne & O'Mara in 2002.

1.1.2 Hydraulic Performance of Bridges and Culverts

Detailed hydraulic analyses were completed for 22 road crossings over streams in the Crooked Creek watershed. The hydraulic performance of each structure is summarized in Table 1.

TABLE 1
Hydraulic Performance of Bridges and Culverts

Stream	Road Name	HEC-RAS Section	Top of Road (ft)	Roadway Overtopping Depth (ft)		
				10-year Existing	100-Year Existing	100-year Future
Crooked Creek	Spalding Drive	90	889.6	0	0	0
	Meadow Rue Drive	4376	893.9	0.03	1.3	1.6
	Pineland Wood Drive	6627	904.7	0	0	0
	Peachtree Corners West	7402	914.3	0	0	0
	Peachtree Industrial Blvd	13361	967.1	0	0	0
Tributary A	Pineland Wood Drive	1252	903.4	0	0	0.4
	Jones Mill Road	4440	920.6	0	0.6	1.2
Tributary 2	Jimmy Carter Blvd	2751	934.9	0	0	0
	Woodhill Drive – Holcomb Bridge Road	5837	942.3	0	0	0
	Jay Bird Alley	7452	947.5	0.3	0.7	0.8
	Parkway Lane	8687	951.3	0	0	0
	Engineering Drive	10340	964.6	0	0	0
Tributary 2.1	Peachtree Parkway (s/b)	798	933.6	0	0	0
	Access Road	1109	930.9	0	0	0.7
	Peachtree Industrial Blvd (s/b)	1381	942.7	0	0	0
	Bridge @ Crossing Park	3173	934.2	0	3.1	4.0
	Atlantic Blvd	3768	941.3	1.05	2.5	3.0
	Holcomb Bridge Road	4503	945.0	2.0	2.7	2.9
	Sunset Drive	5496	961.3	0	0	0.10
	Sunset Drive	5990	971.9	0	0	0
Tributary 2.1.1	Langford Drive	690	954.4	0	0	0
	Bridge to United Consultants	1251	965.8	0	0	0

The flood study results show that, in general, road crossings in the Crooked Creek Watershed perform well under existing conditions. The exceptions include Meadow Rue Drive over Crooked Creek, Jones Mill Road over Tributary A, Jay Bird Alley over Tributary 2, and Atlantic Boulevard and Holcomb Bridge Road over Tributary 2.1. A private drive over Tributary 2.1 near Atlantic Boulevard is also subject to flooding.

2.0 Drainage Inventory and Evaluation

A drainage inventory and evaluation was completed in the Crooked Creek watershed to document the location and condition of various parts of the storm water infrastructure. The inventory focused on the following four areas:

- **Major thoroughfares –** Along selected major transportation rights-of-way, all drainage structures in the public right-of-way were included in the inventory, as well as private structures with diameters 36 inches and greater. Drainage structures on private property were included to the extent that they were needed to define a continuous flow path for other inventory features.
- **Neighborhood streets –** In areas other than the selected major thoroughfares, the drainage inventory included conveyance structures with an equivalent size of 36 inches in diameter or larger. Peripheral structures, catch basins, and other inlets were included.
- **Stream channels –** The stream channels are considered integral parts of the drainage network, and were included in the drainage inventory. Open channels help to define continuous flow paths for all Crooked Creek Watershed drainage areas to the watershed outlet at Spalding Drive.
- **Best Management Practices –** Structural BMPs were included in the inventory to document the locations and conditions of facilities that help to mitigate peak flow rates and reduce pollutant loads. A more detailed description of the BMP evaluation is provided in Section 4.0 of this report.

A total of 1,854 drainage structures were included in the drainage inventory. A data base of structure characteristics was prepared and delivered to the County. In addition, ArcView layers of the structure locations were prepared and uploaded to the County GIS.