LESSONS LEARNED FROM TURBIDITY FIELD MONITORING OF 12 METROPOLITAN ATLANTA STREAMS

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ABSTRACT

Introduction Gwinnett County, in metropolitan Atlanta, Ga., is one of the most rapidly growing areas in the United States. Nonpoint-source pollution is highly complex because it arises from varied, but unknown sources especially in areas of urban growth. The U.S. Geological Survey (USGS), in cooperation with Gwinnett County, Department of Public Utilities, established a water-quality monitoring program in 1996 to assess and analyze the impacts of nonpoint-source contamination. The program provides information that can aid land and water-resource managers in making resource management decisions that can affect water quality. The Gwinnett County Watershed Monitoring Program (GCWMP) includes the development of a network of real-time, continuous water-quality stations, which provide continuous monitoring of turbidity, specific conductance, flow and precipitation, augmented with intensive water-quality sampling and analysis of likely contaminants. Long-term monitoring may help to quantify and describe the fluctuation of contaminants within a stream. Analysis of water-quality within a stream, over time, may aid in delineating possible water-quality trends in the watershed; thereby identifying how land use and development may impact a watershed. A real-time monitoring network was installed and has been fully operational since September 2001. During the installation and monitoring phase of the project, many deployment concerns were addressed, and several adaptations were made to collect the best data possible. This paper describes the sonde deployment strategy, which includes the project design, implementation and modifications made to the water-quality monitoring network in Gwinnett County.

Scope and Study Area Gwinnett County, located in the Piedmont physiographic province, is one of the most rapidly growing areas in the Unites States. Gwinnett County is a mostly headwater area where streams drain into one of three major river basins the Chattahoochee, Ocmulgee, and Oconee. Land use varies greatly throughout the County; however, residential land use is more than 50 percent of the county's total land area when grouping all classes of residential land use. Twelve watersheds were selected for the network based on land use and watershed features. Drainage area, point-source discharges, suitability for instrumentation installation, stage-discharge control, flow characteristics, and availability of existing stage-discharge relations were considered in selecting monitoring locations within each watershed. The stations provide real-time continuous, water-quality data in watersheds that represent a wide range of land-use conditions and encompass more than 70 percent of Gwinnett County. The monitored basins range in size from 1.42 to 162 square miles. Six stations have operated since 1996 as stage and periodic water-quality sampling sites, and six additional stations were added in 2001 when the project became real-time. Of the twelve sites, five are located at culvert sites, the remainder are located at bridge sites.

Sonde Deployment Strategy The first step in developing the sonde deployment strategy for the 12 streams in the GCWMP was to perform a reconnaissance to identify a stream-reach where gage construction would be practical. Once a stream-reach was selected the next step was to

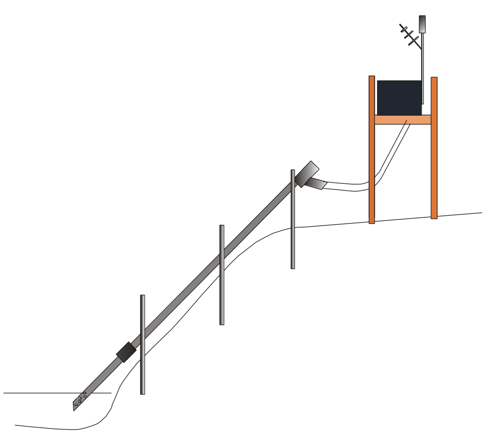
verify that the sonde location was representative of the stream cross section; urban streams often have large flow variability, low flow or base flow during dry periods, and relatively large flows during runoff events.

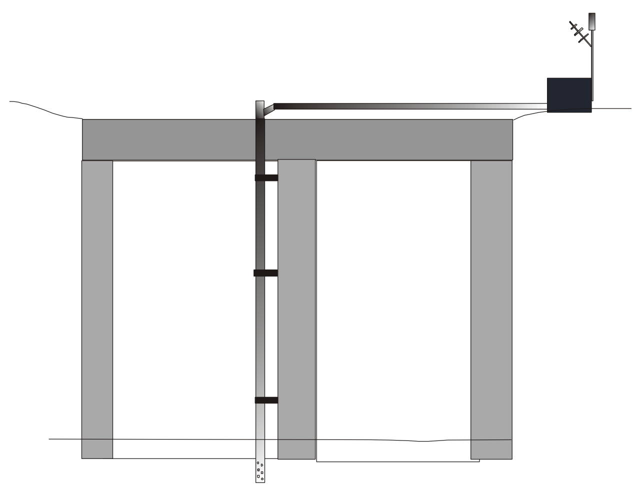
A final location was chosen when the following criteria were met:

- Adequate mixing of the stream where-by the position of the insitu sonde was representative of the whole cross-section at low, medium, and high flow,
- Sufficient velocity to create a natural flushing of the sonde to reduce fouling caused by debris,
- The sonde must be safely serviced/retrieved at all ranges of stage,
- Adequate protection of the sonde during high flow,
- Adequate depth during low flow.

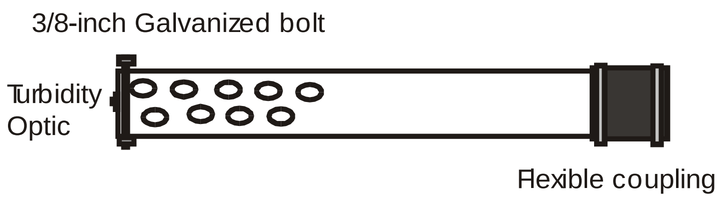
The position of the sonde relative to stream-depth is an important consideration. For example, it was estimated that if the sonde were deployed at least twelve inches off the streambed, the effects of bedload during high flow would be minimized. However deploying the sonde a minimum of twelve inches off the streambed led to concerns that the sonde sensors would not remain submerged, or only half of the sonde bulkhead would be submerged. At two installations, the control was modified to "build up" the sonde pool to ensure that the sensors would remain submerged. The manufacturer of the sonde alleviated concerns regarding the necessity of submerging the sonde bulkhead. Therefore it was decided that if the proposed deployment would guarantee total submersion of the sensors during all conditions of flow, the installation would proceed.

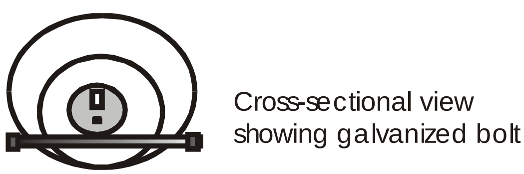
Two types of sonde deployment configurations were used depending on the conditions at the site. Where possible, a bank installation was chosen over a headwall mount as shown in the diagram below.





Both configurations use four-inch schedule 40-PVC pipe supported by either signpost rails or four-inch "U" brackets. At the landward end of the pipe there is a PVC "Y" connector with a locking four inch well cap, which allows for easy retrieval of the sonde. The communication cable is run through the 45-degree sweep of the "Y" connector, through a four-inch by two-inch slip reducing bushing, which connects to a length of two-inch flexible conduit, which is then run to the gagehouse. The streamward end of the pipe was modified several times until a satisfactory design was reached. The design development is as follows. At the bank installations, the first approach utilized a four-inch "T" placed inline with the flow of the stream. It was hoped that the "T" would funnel stream water across the sonde; however, the "T" proved to be a debris trap. A four-inch landscaping screen was added to the upstream opening. The screen slowed the stream velocity and created an eddy, which in turn directed debris into the "T" from the downstream end. The "T" was removed and ¾ -inch holes were drilled into the four-inch pipe. The pipe was left open-ended with a set bolt to ensure that the sonde was installed at the same position after each service. The open-ended vertical pipe was the configuration used at the culvert sites. At this time a suggestion was made by the visiting sonde representative that a screen should be wrapped around the outside of the four-inch PVC pipe to reduce the collection of debris inside the pipe. A ¼-inch landscape netting was used; however this proved to be an attachment point for filamentous algae growth which often produces false readings by the turbidity optic. The final modification proved to be the most successful. The devices used to protect the sensors were acting as traps for debris. The turbidity optic needs an unobstructed view of the creek. Therefore the bottom of the sonde guard was cut off and a new section of 4-inch PVC pipe was installed with a set bolt that positioned the turbidity optic flush with the end of the pipe as shown in the diagram below. The new PVC pipe was drilled with 1&1/8 –inch holes and the sonde guard, sonde, including the sensors, and PVC pipe were treated with an anti-fouling spray. The new length of PVC pipe was attached to the existing PVC via a flexible coupling.





The flexible coupling allows for easy removal and cleaning of the sonde housing, and absorbs the impact of debris during high flow. The sonde within the pipe is secured and retrieved with a steel cable.

<u>Conclusions</u> The Gwinnett County Watershed Monitoring Program, which includes the real-time monitoring of turbidity, has been fully operational since September 2001. A sonde deployment strategy was used to identify suitable locations for the deployment of the water-quality sonde. During the construction and operating phases of the project, several modifications were made to the original design. The current design, which will be used in upcoming and developing projects within the USGS, Georgia District, allows for the collection of the best data possible, and is used by water resource managers to make timely decisions regarding water-quality within twelve watersheds in the County.