LONG-TERM MONITORING OF WATER FLOW AND QUALITY IN THE PEE DEE AND WACCAMAW RIVER BASINS, HORRY COUNTY, SOUTH CAROLINA, 2005-2008

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Extended Abstract. Water flow and quality have been monitored continuously at three sites in the Pee Dee and Waccamaw River Basins in Horry County since October 2005 and 2 sites since 2006 as part of a cooperative investigation by the Horry County Stormwater Department and the U.S. Geological Survey, South Carolina Water Science Center. The sites consist of sensors located in the water column that measure, record, and transmit data about water height (stage), discharge, and velocity, as well as parameters such as dissolved oxygen, temperature, specific conductivity, *p*H, and turbidity. Precipitation at each site also is measured. The sites were selected because they represent parts of major basins in Horry County characterized by low dissolved oxygen levels or high fecal coliforms counts, as listed on the 2004 303(d) list prepared by South Carolina DHEC. The monitoring sites also provide the opportunity to assess the response of the measured parameters to short-term (daily) and longer-term (seasonal) changes in meteorological inputs, such as drought conditions since 2007. Moreover, factors not anticipated to affect surface-water flow and quality, such as ground-water discharge and evapotranspiration, can be examined. Results for one site (Chinners Swamp) are discussed herein. The other sites are not discussed in this report due to space constraints.

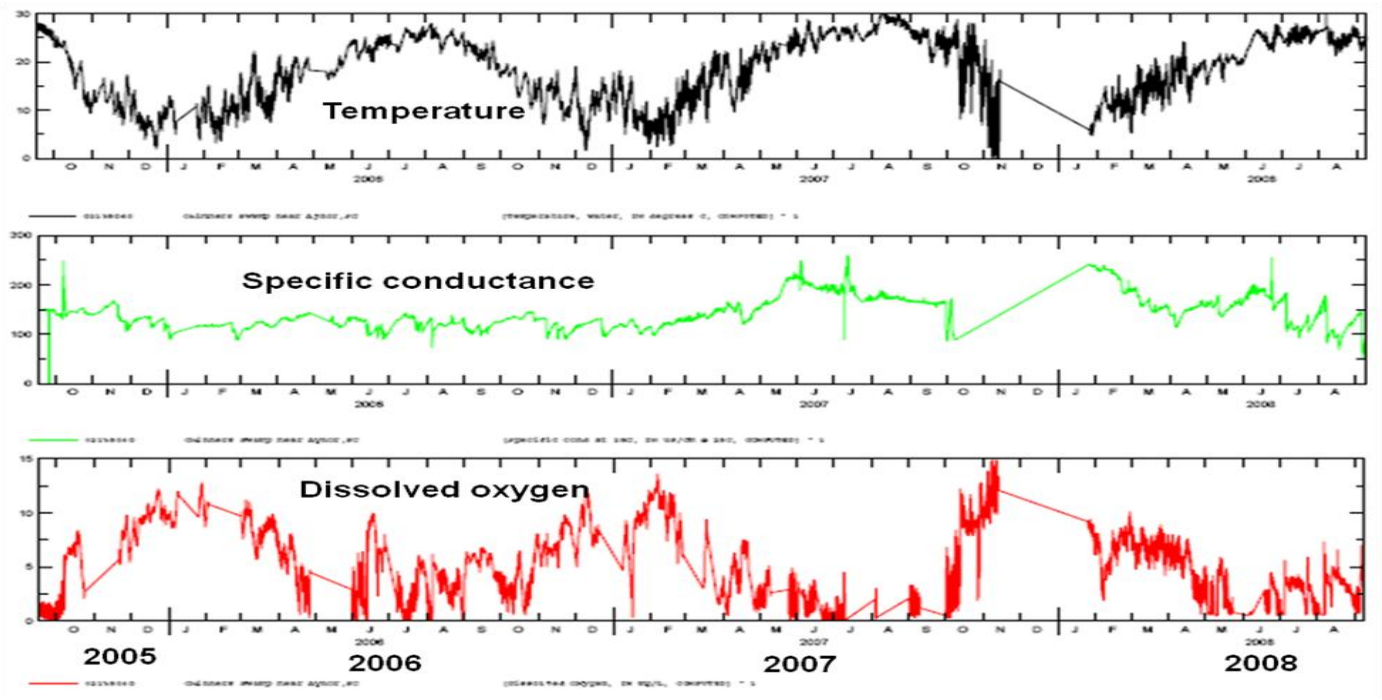

Figure 1. Surface-water temperature, specific conductance, and dissolved oxygen at the Chinners Swamp site, near Aynor, South Carolina, October 2005 to October 2008. The straight line between November 2007 and January 2008 reflects the lack of data due to the water-quality sensors being exposed above the lowered surface-water level.

Chinners Swamp is located south of Aynor, South Carolina, and drains from east to west to the Pee Dee River. Chinners Swamp represented the least developed of the 5 sites, being primarily agricultural and forested land. Data from 2005 indicates that it was a blackwater system characterized by specific conductance less than 200 microSiemens per centimeter (µS/cm), summertime dissolved oxygen less than 6 milligrams per liter (mg/L) (Figure 1), pH less than 7, turbidity values between precipitation events less than 10 formazin nephelometric units (FNU) with precipitation "spikes" no higher than 400 FNU (data not shown).

The Chinners Swamp site underwent significant land-use change between 2005 and 2008. The data depict a changing trend from these average values beginning in early 2007. For example, the average stage at baseflow for Chinners Swamp decreased during the summer from about 12-feet (ft) above sea level to less than 9-ft. (Figure 2). The lower amount of precipitation received in Chinners Swamp during 2007 drought conditions relative to 2006 helps explain the lower surface-water levels.

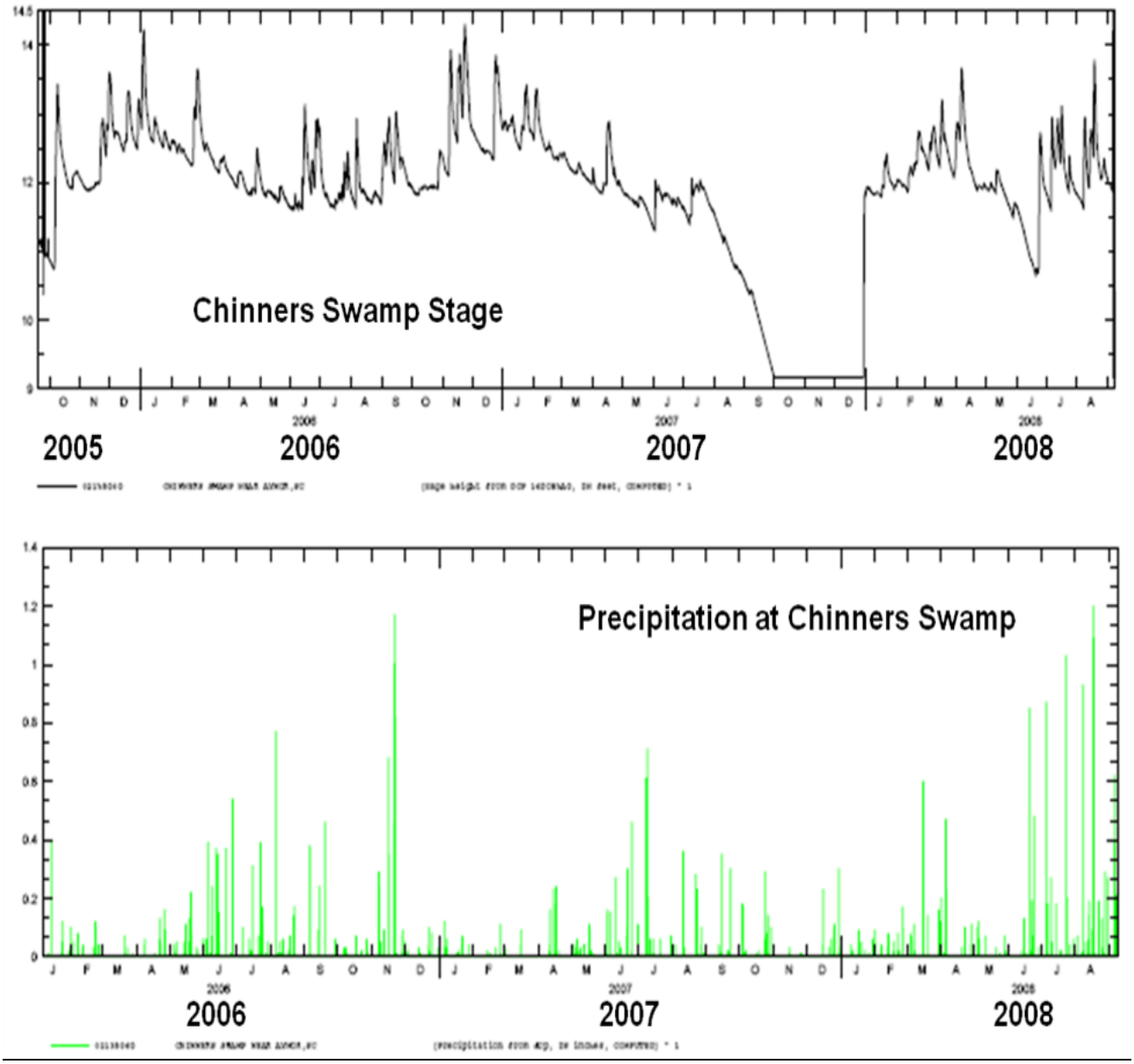

Figure 2. Stage and precipitation from 2005 to 2008 at the Chinners Swamp monitoring site.

In addition to lower precipitation amounts, the land on both sides of part of the drainage basin immediately upstream of the monitoring location had most of the trees removed; some trees were left uncut in the riparian zone about 100-ft on either side of the Swamp. This removal of trees exposed the land surface, near-surface soil moisture, and shallow ground-water table to evaporation that did not occur when the tree canopy was intact. Although trees remove soil moisture and shallow ground water by transpiration, this process removes less water than evaporation because it is controlled by the resistance of water movement through living plants.

That greater levels of incident solar radiation reached the ground surface following tree removal also can be seen in the increased average summer temperature of surface water from about 25ºC in 2006 to 29ºC in 2007 (Figure 1). The average concentration of specific conductance also changed from about 150 to 200 µS/cm during this time period (Figure 1). This increase in specific conductance may be explained by increased runoff after tree removal, but drought conditions suggest that this represents a larger input of more mineralized ground-water discharge to the Swamp. This would be expected if the tree-uptake of ground water had ceased following cutting. No wells, however, were installed or sampled to test this hypothesis.

Additional in-stream water-quality parameters that changed during and after the land-use change included *p*H and turbidity. The average *p*H of Chinners Swamp decreased from 6.5 to 6.0. Because *p*H is measured on a logarithmic scale, this change is significant. The lower *p*H may be explained by the increased addition of plant material to the Swamp during and after the trees were cut. Increased loading of such organic material to an aquatic environment also would tend to increase the biological oxygen demand (BOD) in the Swamp; lower levels of dissolved oxygen are measured during and after 2007 (Figure 1). The turbidity measured at the site also changed as a result of the tree removal. Prior to tree removal, precipitation events at the basin resulted in turbidity levels that increased from background conditions of less than 10 FNUs to no greater than 200 to 400 FNUs. At the end of 2007 and beginning of 2008, however, turbidity "spikes" increased to over 1,000 FNUs, even though the precipitation events were smaller than in 2006 (Figure 3).

In summary, the long-term monitoring of surface-water stage and water quality at the Chinners Swamp site revealed the effect of drought conditions and land-use changes on surface-water levels, specific conductance, dissolved oxygen, *p*H, water temperature, and turbidity. Although the sensors are measuring the water quality of the surface water, during summer the water-quality parameters are driven as much by ground-water discharge as by precipitation events, especially during drought conditions. Moreover, the effect of trees and their removal on surface-water stage and quality warrants further investigation.

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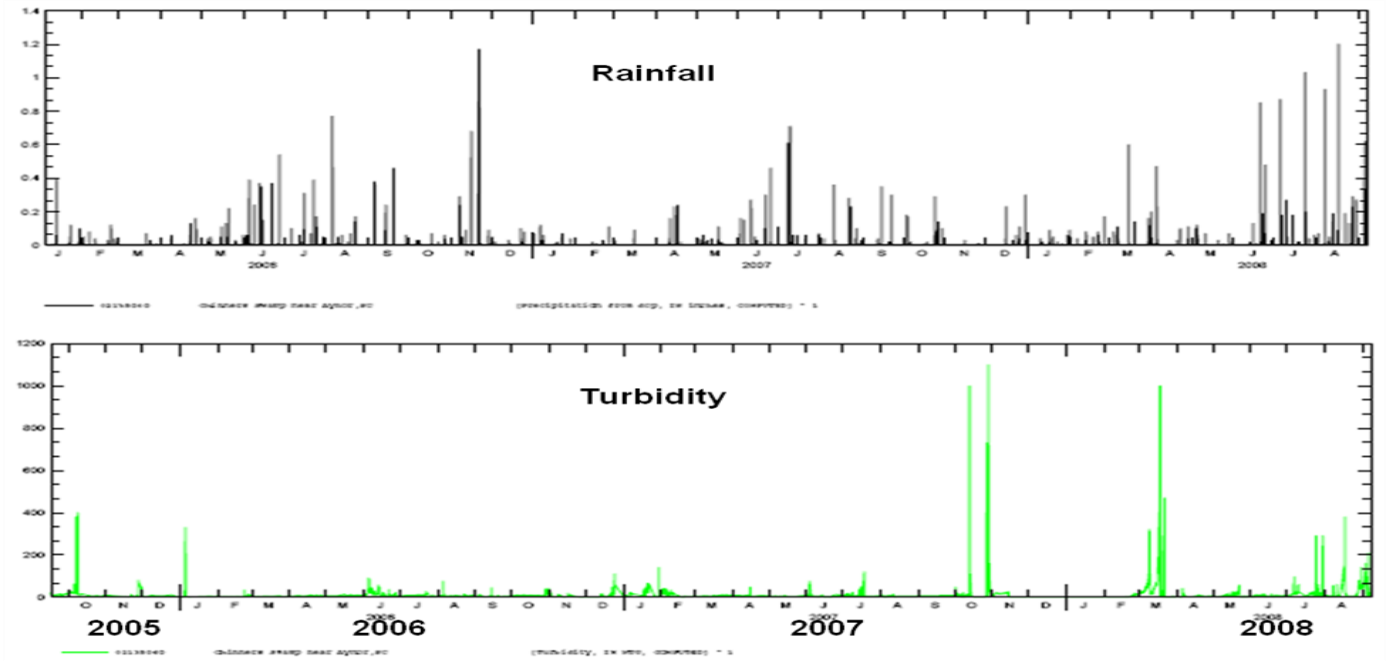

Figure 3. Precipitation and turbidity from 2005 to 2008 at the Chinners Swamp monitoring site.