

# AGRICULTURAL WATER USE IN GEORGIA: RESULTS FROM THE AG. WATER PUMPING PROGRAM

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**Abstract.** This paper presents the results for the period 1999 to 2002 from the monitoring program that is estimating agricultural water use across the entire state of Georgia. This program is called AG. WATER PUMPING (**Agricultural Water: Potential Use and Management Program in Georgia**). Current conflicts on water allocation in the ACT (Alabama, Coosa, and Talapoosa) and ACF (Apalachicola, Flint, and Chattahoochee) river basins, saltwater intrusion effects in the 24 county area of southeast Georgia, water level declines in the central region, and other potential impacts on water use are all limited by the lack of available information on agricultural water use. This 5-year project is nearing completion. The results for calendar years 2001 and 2002 are based on the complete monitoring site installation whereas previous years were during the installation (incomplete coverage in selected parts of the state).

## INTRODUCTION

Water use and management in Georgia is one of the most critical issues to be addressed at present. Allocation formulas for distribution of waters within the ACT (Alabama-Coosa-Tallapoosa) and ACF (Apalachicola-Chattahoochee-Flint) river basins between Alabama, Florida and Georgia have not been finalized (as of January, 2003). Salt water intrusion along the coast continues to be an issue. Water quality concerns throughout the state such as total maximum daily loading (TMDL's) are all exacerbated by four years of continuous drought conditions. All of these issues are under close scrutiny, but cannot be completely addressed because water use by agriculture remains an "estimate". Since agricultural water users are not required to report their water use, programs such as Ag. Water Pumping are essential to provide reasonable, statistically-valid estimates of agricultural water use.

The Ag. Water Pumping program will conclude in 2003

with expectations of improved approaches to determining agricultural water use for Georgia (Thomas et al., 2003). The program was designed to determine agricultural water use by irrigation for the state. A combination of monitoring and modeling is being used to determine the water use. This paper is designed to illustrate the distribution of irrigation and current results from the monitoring program. The first full year of monitoring from all sites was during the 2001 calendar year. The modeling program has provided preliminary estimates as well. Details about how the modeling approach will integrate the monitored data over the entire region are being addressed in companion papers and projects.

The primary concern associated with monitoring is to represent "what the farmers are actually doing". The monitoring program used a random selection of all permits and was designed to provide an "average" indication of how much water is being withdrawn for agricultural irrigation purposes. The monitoring program also includes the effects of localized weather, especially rainfall. For example, farmer A benefitted from a localized shower and did not irrigate, farmer B, just down the road, may not have received that rainfall and thus irrigated.

It is important to remember that the monitored irrigation results may not directly relate to how much water the crop actually "needs". The wide variety of irrigation scheduling approaches being used (from computer-based models to "none"), water resource availability (especially surface ponds), and economic decisions (will it pay for me to actually irrigate more considering the price of current commodities?) all affect the amount of water used by an individual farmer.

## PROCEDURES

### Monitoring Program

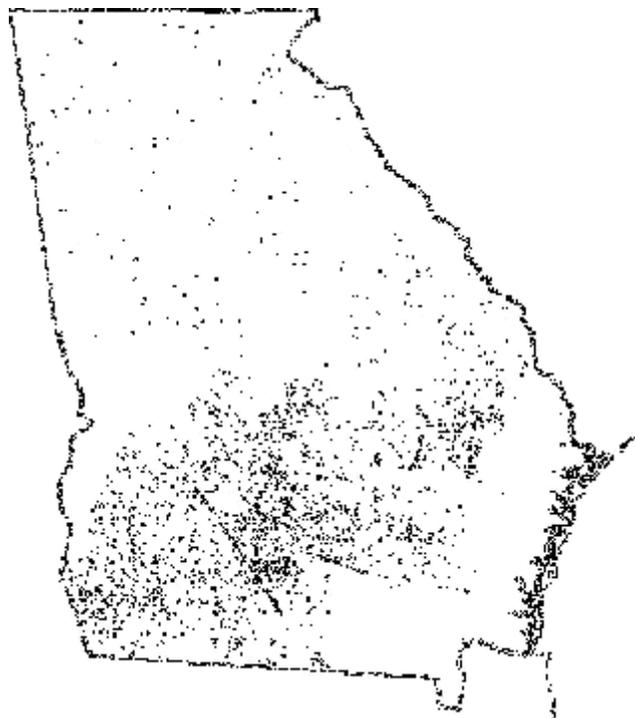
A monitoring program was implemented in 1998 to provide at least a 2% sample of the 19,000+ agricultural

withdrawal permits that were present across the state of Georgia (Fig. 1). At this time, over 20,000 permits have been issued across the state, and the sampling program was enhanced to ensure the 2% goal. The statistical-based selection process included representation of ground and surface water withdrawals and crop type. All selections were oriented toward a county being the smallest unit of sampling. Under that scenario, if a county had less than 50 agricultural withdrawal permits, none would be selected for monitoring. To allow all permits access to potential monitoring, all counties with less than 50 permits were lumped into a single group. Two percent of that group was then selected for monitoring. This process provided equal opportunity for monitoring, but did not address “regional representation”. In some cases, additional site selection was used to ensure that at least one monitoring site was included in the North Georgia regions.

In selecting sites for potential monitoring, an ordered statistical sample representing at least 6% of the total permits was developed. This procedure was used since the overall program was voluntary, and designated participants had the right to refuse to participate. In some cases, monitoring sites were not used due to other circumstances including: the permit was no longer being used, the complex nature of the irrigation water delivery did not allow for monitoring of actual water use on a particular area, or the irrigation system literally could not be monitored with any degree of accuracy.

For example, a farmer has a cable tow irrigation system that he uses in more than one field. Each field is a different size. No reasonable location is available to mount monitoring instrumentation (such as a timer), and the farmer can provide water to the cable tow unit from a pond or a well. The difficulty in assigning water use to a particular source and a particular area while having immense problems in monitoring would likely deny this site for the program.

In the final statistical analysis, over 67 % of the permit holders that were contacted agreed to participate. This high percentage of participation is an indication that voluntary programs can be very effective. In only six counties was there a modification made to the original list of selected permits. In one county, the statistical randomization was regenerated. In most problem situations, the small number of available withdrawal permits for that county did not produce a volunteer from the original list.



**Figure 1. Representative locations of agricultural withdrawal permits in Georgia through 1993.**

Representation by crop has been a concern throughout the monitoring program installation. Most field crops such as cotton, peanut, corn, soybean are well represented. However, crops such as sod production, pecan, onion, and watermelon are being more closely scrutinized. Some additional sites have been implemented to ensure at least a 2% sample for these major crops. It was determined during the installation that representation of all crops would be difficult (if not impossible) with over 30 different crops being grown (and monitored) in Georgia. For most field crops, a rotation system is used which places different crops in a field in different years (or seasons). The small land areas associated with many vegetables and a monitoring program tied to an irrigation system (not a crop) would logically miss selected crops in some areas each year. The modeling program is anticipated to help overcome the inadequacies of the small sample size in the monitoring program. However, in many cases, the representation of a particular vegetable/truck crop may not be obtained in any one year. It was decided by the team that most vegetable/truck crop results would be lumped into a category called “mixed” vegetables (truck crops). Only those truck crops with significant land areas (such as watermelon and onion) would be represented individually.

The project does use HOBO<sup>®1</sup> state-change data loggers on many of the irrigation monitoring sites to provide more accurate information on water use, especially where standard instrumentation cannot be used. These state loggers in combination with a pressure switch can allow logging of on- and off-times based on system water pressure. This type monitoring has been used on portable pumping units and traveler-type irrigation systems.

The current monitoring program has over 410 permitted irrigation withdrawals being monitored. The county-based representation of the monitoring is indicated in figure 2. Actual monitoring is being done on about 614 individual field sites and 60 other sites where water is being pumped from a well or other source into a pond (called a well-to-pond). The reason for the larger number of actual monitoring sites is that more than one irrigation system may be associated with a particular withdrawal. The total land area being monitored is at least 17,130 ha (42,330 ac). This sample represents about 2.0% of the agricultural irrigation land 770,000 ha (1.9 million ac) as determined from the agricultural withdrawal permit data base. Forty-five percent of the monitoring sites are ground water which is consistent with the ground water withdrawal percentage in the permit data base.

The monitoring installation was completed during the 2000 calendar year. The first complete monitoring year was 2001. The data is being collected on a monthly basis using personnel hired within the program. For additional information about procedures, refer to Thomas et al. (1999, 2001) and the project web site: [www.agwaterpumping.net](http://www.agwaterpumping.net).

## RESULTS

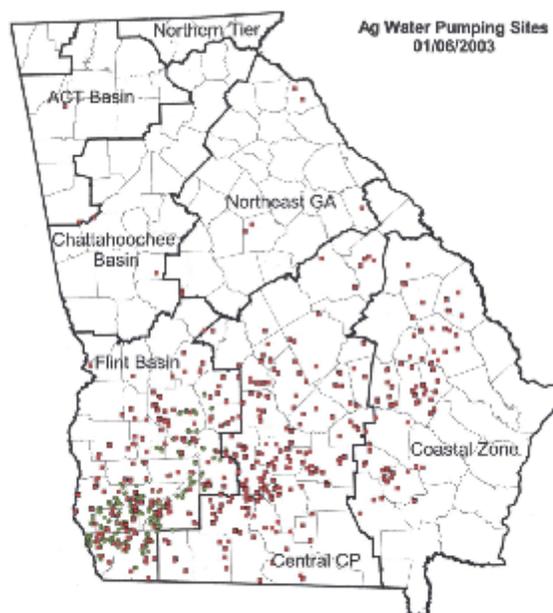
Results are indicated for the 1999 to 2002 calendar years. Rainfall during these years was low as compared to long-term normals. In 2001 and 2002, a drought was designated in the Flint River Basin, and the Flint River Drought Protection Act was initiated. Over \$9 million was paid to farmers to not pump water from the Flint River and/or tributaries that directly contribute to maintaining flows in the river. The rest of the agricultural regions of the state were in varying degrees of drought

conditions throughout the last four years. For a comprehensive analysis of rainfall conditions during the last four years, you are referred to Georgia Automated Environmental Monitoring Network (Hoogenboom et al., 1997).

Monitoring results over the current project period are presented in Table 1. The figures on acres and million gallons are directly associated with the average of the monitored sites.

The “Upper quartile” figures represent the monitoring locations (top 25%) where more water was required for irrigation than normal. All of these figures are based on full cropping season records. The upper quartile figures indicate that negotiations for future water allocation for farmers need to address the needs of those farmers who grow multiple crops during the year, or the plant investment is significant enough to require more water.

The effective rainfall at the monitoring sites, scheduling approaches used, water supply limitations, farmer decision processes (based on their particular economic situation), are all necessary to understand why irrigation amounts were as indicated. For years 2000, 2001, and 2002, we were able to determine that 2, 6, and 6 percent of the irrigation systems being monitored were “not” turned on at all in those respective years. The reasons why systems were not used could include water supply or system



**Figure 2. Ag. Water Pumping monitoring sites with additional automated sites in the Flint Basin.**

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<sup>1</sup>The use of tradenames, etc. in this publication does not imply endorsement of the product named, nor criticism of similar products not mentioned.

**Table 1. Statewide Ag. Water Pumping results for calendar years 1999 to 2002**

Statistic	1999*	2000*	2001	2002
Acres (ha) monitored	<b>4,571</b> (1,850)	<b>29,532</b> (11,952)	<b>43,049</b> (17,422)	<b>43,451</b> (17,585)
Million gal./year-withdrawal	31.01	31.74	19.63	22.14
Irrigation avg <sup>+</sup> in. (mm)	<b>8.74</b> (222)	<b>9.26</b> (235)	<b>6.65</b> (169)	<b>7.49</b> (190)
Upper quartile <sup>&amp;</sup> in. (mm)	<b>19.1</b> (485)	<b>17.0</b> (432)	<b>13.4</b> (341)	<b>14.0</b> (354)

\*Installation years, numbers reported for full season sites

+ "Irrigation average" is for all complete data collection sites (full season record) and is weighted by the number of acres being irrigated.

&"Upper quartile" is the number of inches irrigated by the top 25% of the full season irrigation records (also weighted).

problems, economic constraints, or sufficient water was supplied by rainfall.

The important result is that "on the average" irrigation water use was not extremely high for these drought years. The total water use was related to the rainfall over the regions during the growing season and results from past studies (Harrison and Tyson, 1999; Thomas et al., 1998).

The extrapolation of the irrigation results to the state requires reasonable estimates of the total number of withdrawals that were actually in operation. If we assume 20,000 permitted withdrawals, then all of the agricultural withdrawals combined used an estimated 443 billion gallons of water in 2002 (from surface and ground water resources). If this value is partitioned into logical results that match up with other water-use entities, then all of agriculture used about 1,213 million gallons per day (based on partitioning across a 365 day period). Unfortunately, this type estimate may not be truly represented over an entire year because agricultural withdrawals are less in the winter as compared to the summer.

The upper quartile results for the different years represent permits that were actually being used. On the average (within the top 25% of all monitored sites), 341 mm (13.4 in.) were used in 2001 and 354 mm (14.0 in.) were used in 2002. The widely varying amounts across years is indicative of the rainfall effect. It is important to

remember that if an allocation process is developed in the future, the water requirements and water use characteristics associated with nursery, vegetable, and turf production systems need to be addressed.

Additional results are being processed that have been separated into regions of the state. Weather patterns across the state result in varying amounts of water being used, depending on the location. The future results from this program are expected to be available through the web site: [www.agwaterpumping.net](http://www.agwaterpumping.net) or accessible through the NESPAL website within the College of Agricultural and Environmental Sciences at the University of Georgia.

## CONCLUSIONS

The Ag. Water Pumping program is working to achieve its expected role of providing reliable estimates of agricultural water use for the state of Georgia. The continued development of the modeling system, to allow improved "extrapolation" of the monitored results over the state, are essential to a comprehensive system. Unfortunately, modeling will only extrapolate the results so far. Without a consistent and reliable determination of the number of irrigation systems in operation, irrigation water use will remain an "estimate". Agriculture is using a significant amount of water and needs to provide a strong voice in partnership with other water users to ensure wise use of water resources for the future.

## ACKNOWLEDGMENTS

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