

Accounting for Georgia's Public Water Supply

Water Policy Working Paper #2005-009

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ABBREVIATIONS

CWS	Community water system
Gpd	Gallons per day
Gpcpd	Gallons per capita per day
NTNCWS	Non-Transient, Non-Transient water system
PWS	Public water system
SPWS	Small Public Water System
TNCWS	Transient, Non-Transient water system

1. EXECUTIVE SUMMARY

Water Policy Working Paper # 2004-003 “Minimum Water Use Levels Requiring State Permits: Is Georgia’s 100,000 Gallons/Day Appropriate?” compares Georgia’s requirement for groundwater withdrawal permits with those of other states. Its findings were that Georgia was among a small number of states with a high threshold. This paper also takes up the question of the 100,000 gpd threshold for a groundwater withdrawal permit, but does so by asking the question how much water is withdrawn by systems falling below the 100,000 gpd limit. This question is examined by calculating estimated water withdrawn by those who self-supply and by small public water systems not holding a permit to withdraw 100,000 gpd or more.

This paper goes on to examine the changes in the number, size, and composition of small public water systems (hereafter SPWS). This assessment was done on the basis of changes by region over a two year recording period between 2002 and 2004.

It is estimated that unrecorded/unaccounted for water withdrawal in Georgia amounts to 165 million gpd: 115 million gpd for self supply; 36 million gpd for SPWS serving 1,000 or fewer people; and, 14 million gpd for CWS/PWS serving more than 1,000 people but not holding an identifiable permit to withdraw 100,000 gpd. Further, we believe that these are very conservative, low, estimates of unaccounted for water withdrawal.

During the two year period from 2002 to 2004, there were tremendous changes in the number, size, and composition of SPWS. Analysis based on looking at all systems statewide would suggest that the number of systems is static. However, deeper examination reveals substantial variation in changes in number, size, and composition of systems by region. As the communities in the Greater Atlanta Metro area grow, the number of SPWS systems in the region has decreased. On the other hand, for counties in Coastal Georgia where issuance of new groundwater permits is prohibited in 24 ‘capped’ counties, those counties with rapidly growing populations have experienced very rapid growth in the number of SPWS.

The variation in changes in SPWS by region leads us to conclude that SPWS play an important role in accommodating growth in Georgia’s small to mid-size communities. The majority of these systems are developed by private enterprise and they are thus

responsive to local growth needs. The combined effect of the cap on new water withdrawal permits for 100,000 gpd or more in Coastal Georgia and the relatively high threshold for requiring a permit has led to explosive growth in SPWS. Between 2002 and 2004, in the coastal counties with high population growth, the number of SPWS increased by 24.1 percent. The population served increased by 18.4 percent and total water supplied increased by 31.8 percent.

The restrictions on withdrawal permits within the 24 capped counties may be lifted or modified sometime in 2005 when the results of the Sound Science Study are presented, but the responsiveness of SPWS illustrated by the rapid growth while other groundwater sources have been prohibited begs the questions: Will these systems continue to grow? We believe that, should the large municipal systems in the coastal region be required to reduce dependence on groundwater and substitute more expensive surface water supplies, SPWS will continue to grow in the coast.

Other Findings of the study include:

- Between 2002 and 2004 there has been a trend towards the installation of larger systems within the category of systems serving 1,000 or fewer people. Statewide there was a 4 percent decline in systems serving 500 or fewer people and a 7 percent increase in systems serving 501 to 1,000.

- Statewide systems serving 1,000 or fewer people added one million gpd between 2002 and 2004. These systems provided 68 million gpd as of 2004.

- Private ownership represents the dominant ownership structure. Private owners control 83 percent Community Water Systems, 66 percent of the Non-Transient Non-Community Water Systems and 51 percent of the Transient Non-Community Water Systems.

- Groundwater is the source for 92 percent of the population served by Community/Public Water Systems.

- It is estimated that 18 percent of Georgia's population gets water by self-supply. This accounts for approximately 115 million gpd. Groundwater is almost exclusively the primary source of water for self supply.

- Large systems serving enough population to exceed the 100,000 gpd threshold for a

withdrawal permit, but not holding an identifiable permit, increased by 7 percent between 2002 and 2004. Total water used by these large systems increased by 8.2 percent for the same period.

➤ The total amount of water supplied by those falling below the 100,000 gpd threshold plus those systems exceeding the 100,000 gpd threshold without holding a permit for withdrawal is approximately 165 million gpd. Domestic self-supply accounts for 70 percent of this total.

➤ Twenty-four counties in Coastal Georgia have been ‘capped’ for additional groundwater withdrawal permits. Excluding these 24 counties, the number of SPWS decreased by 13.4 percent, while within the capped region it increased by 2.1 percent. In those capped counties with high rates of population growth SPWS increased by 24.1 percent.

➤ There is evident change in the composition of SPWS across the three demarcated regions. While TNCWS represent the most rapidly declining category at 37 percent in the rest of Georgia and 2.6 percent within all 24 capped counties, they represent the fastest growing category at 293 percent when looking at the capped region’s eleven fastest growing counties. This also holds true vice versa as growth in CWS is the weakest out of all categories within the latter region and strongest in the other two regions.

➤ For SPWS, again by definition those serving 1,000 or fewer people, on a statewide level excluding the 24 capped counties there was a decline of 0.8 percent in systems between 2002 and 2004. Over the same time period the number of SPWS increased by 3.8 percent in the 24 capped counties and by 18 percent in the high population growth counties within the capped region.

➤ It was hypothesized that the statewide decrease in systems might be explained by the absorption of smaller systems in the Greater Atlanta Metro area. Using both a 16 and a 44 county definition of the Greater Atlanta Metro area, the number of SPWS decreased by 15.8 and 4.4 percent respectively. Excluding the 16 counties in the Greater Atlanta Metro area diminishes the statewide loss of systems from a 13.4 percent decrease to a 1.9 percent decrease.

- Several data issues arose in the course of this study which should be noted.
 - There appear to be a number of Community Water Systems which even by Georgia Environmental Protection Division’s rule of thumb for assessing systems size exceed 100,000 gpd, but do not hold an identifiable permit for withdrawal. This means official accounts of water withdrawal understate actual withdrawal.
 - To examine the changes in SPWS it was necessary to compare panels from two different time periods. Simply adding date of issue for permits will make it easier to

monitor the changes over time in the number of systems and their potential impact on water use.

- Data on community/public water systems is not routinely updated due to budget and staff limitations which means the database on CWS and PWS does not reflect real time impacts on water use.

Regulations regarding the need for permits for withdrawal of water from ground and surface sources vary between states. For those twenty-six states which have a threshold limit requiring a withdrawal permit, only six (including Georgia) have a threshold limit of 100,000 gpd or higher. We believe that Georgia should lower its limit for requiring a withdrawal permit to 10,000 gpd. This would leave only self-supply systems out of the water accounting and reporting regime.

2. INTRODUCTION

Based on laws enacted in 1972 and 1977, the State of Georgia mandates obtaining a permit for ground or surface water withdrawal if the average daily withdrawal amount exceeds 100,000 gpd¹. As with all regulation, the user is confronted with a compliance cost and if the cost of the regulation may be reasonably avoided, the profit maximizing firm or utility maximizing household will choose to do so. Costs imposed on permittees are driven by complying with a number of Georgia Department of Natural Resources (hereafter GA DNR) rules implemented in 1994. These costs include targeting unaccounted for water, rate making, long range planning, and so forth. Georgia Environmental Protection Division (hereafter GA EPD) has argued that lowering the threshold from 100,000 gpd would create a substantial increase in the cost of managing withdrawal permits and that the amount of water withdrawn by smaller users is negligible. This paper examines some of the implications of Georgia's fairly high threshold for requiring a withdrawal permit.

The data this report relies on to develop an estimate of the amount of water used by SPWS, PWS using less than 100,000 gpd, was obtained from two publicly accessible databases. These databases are maintained by the GA EPD Water Resources Branch. The first database contains a list of holders of a public drinking water permit.² The second database is a list of permittees allowed to withdraw 100,000 gpd³ and more. Permits in the public drinking water database were cross-compared with those for withdrawals of 100,000 gpd or more to identify all large water use permittees. Those public drinking water systems that permitted for 100,000 gpd or more were excluded from this study. A complication for this study was that a number of systems did not appear in the 100,000 gpd permittee database, but served such a large number of persons that it is fair to conclude that they should have to obtain a withdrawal permit. These were handled as a separate category in this study. The methodology section of this paper focuses on the approach to estimating the amount of water accounted for by the various types of PWS.

The paper will first estimate the amount of water withdrawn by SPWS falling below the 100,000 gpd threshold. Since daily water use of less than 100,000 gpd is not subject to recording

¹ Surface water: O.C.G.A 12-5-31, ground water: 12-5-96

² GA EPD Water Resources Branch: List of Drinking Water/Public Water System Permittees

³ GA EPD Water Resources Branch: List Industrial and Municipal Ground/Surface Water Withdrawal Permittees

requirements entailed in a 100,000 gpd withdrawal permit, water use has to be estimated. Data from over a two year time span is available so that the paper will also address the question of growth (decline) in the number of systems and people served. In addition to information on water supplied by SPWS, there are two further sources of water use that are not subject to regulation and recording: self-supply and public water systems that are presumably using more than 100,000 gpd but do not appear to possess a withdrawal permit. Estimated water use by these two unrecorded groups is also provided in this paper.

This report then extends its focus to the case of the twenty-four county region (hereafter the 24 capped counties) in Coastal Georgia facing a temporary cap on new groundwater withdrawal permits for over 100,000 gpd, pending the outcome of a five year study on saltwater intrusion. This paper will examine the combined effect of the cap on new groundwater withdrawal permits and the high threshold of 100,000 gpd for a withdrawal permit. It is hypothesized that municipalities may be biased against providing water to large residential development in favor of protecting water capacity for higher-value commercial and industrial growth. The coast of Georgia is a high growth area and if municipalities are reluctant to commit water supplies for new residential development, SPWS may be growing rapidly in the 24 capped counties in order to fill the gap between the demand for and supply of drinking water systems. This report delineates developments in SPWS in the capped region and draws a comparison with the rest of Georgia based on the results.

An Overview of Public Water Systems

Public water supply is water withdrawn and used by public and private water suppliers and delivered to other users. Water is provided for a variety of uses, such as domestic, commercial, industrial, and public uses. In total, public water use accounted for 19 percent of total water use in Georgia with the largest public suppliers located in counties located within the various metropolitan areas of Georgia. The provision of drinking water is regulated nationally by the U.S. Environmental Protection Agency⁴, and in Georgia by the state's Environmental Protection Division⁵. Regulation covers the three types of public water systems (PWS):

⁴ The Safe Drinking Water Act was passed in 1974, amended in 1986 and 1997 (391-3-5).

⁵ The EPD's regulations focus on consumer protection, requiring that: water meet certain quality standards; adequate amounts be provided to customers, and that provisions are made to protect consumers in the case of company failure for financial or other reasons.

Community Water Systems (CWS), Non-Transient, Non-Community Water Systems (NTNCWS), and Transient, Non-Community Water Systems (TNCWS). A PWS serves at least 15 connections or regularly provides water for human consumption to at least 25 persons daily, for at least 60 days per year. For additional distinctions between the three types of PWS, please refer to the “Terminology” section below. The great majority of these systems are so small that they are not required to hold a permit for water withdrawal under Georgia regulations.

Serving a population of 500 or less, as of fiscal year 2003, there were 32,430 CWS, 17,294 NTNCWS, and 92,784 TNCWS nationwide, totaling 142,508 SPWS serving 15.2 million people. Including all PWS serving a population of over 500 people adds 27,868 systems resulting in a total of 170,376 PWS for the entire United States, which serve 275.5 million people⁶. Hence, very small systems serving a population of 500 or less make up the great majority of PWS in the United States at 84 percent of the total number of PWS. Despite a share of 84 percent in the number of systems, these SPWS-500 serve only 5.5 percent of the total population served by PWS. The number of systems serving a population larger than 500 within the three categories CWS, NTNCWS, and TNCWS consequently amounts to 16 percent, and a share of population served of 94.5 percent.

The respective percentages for Georgia’s PWS are notably different. As of 2004, there were 1,791 PWS serving a population of 500 or less. With a total of 2,490 PWS in the state of Georgia, the share of SPWS-500 is significantly lower at 72 percent than the national average of 84 percent. In terms of population served, however, Georgia’s SPWS-500 serve less than the national average at 3.3 percent of the 7.3 million people served by PWS in the state of Georgia, versus 5.5 percent nationally. It should be noted that in Georgia 18 percent of the population is self-supplied. This exceeds the national average by 3 percent.

In terms of public water supply, Georgia’s per capita supply is slightly higher than the national average at 186 gallons versus 179 gallons⁷. For an illustration of public water supply by state, refer to Table 1 below. It is important to note, however, that contrary to the focus of this report Table 1 includes large PWS, some of them using in excess of 1,000,000 gpd.

⁶ US EPA. “National Characteristics of Drinking Water Systems Serving Populations Under 10,000.”

⁷ USGS. “Estimated Use of Water in the United States in 2000”

Table 1. Public Water Supply by State and Source Type

STATE	POPULATION (in thousands)			WITHDRAWALS (in million gallons per day)			Per capita
	Total	Served by public supply		By source		Total	
		Population	Population (in percent)	Ground water	Surface water		
Alabama	4,450	3,580	80	281	553	834	233
Alaska	627	421	67	29.3	50.7	80	190
Arizona	5,130	4,870	95	469	613	1,080	222
Arkansas	2,670	2,320	87	132	289	421	181
California	33,900	30,100	89	2,800	3,320	6,120	203
Colorado	4,300	3,750	87	53.7	846	899	240
Connecticut	3,410	2,660	78	66	358	424	159
Delaware	784	617	79	45	49.8	94.9	154
District of Columbia	572	572	100	0	0	0	0
Florida	16,000	14,000	88	2,200	237	2,440	174
Georgia	8,190	6,730	82	278	968	1,250	186
Hawaii	1,210	1,140	94	243	7.6	250	219
Idaho	1,290	928	72	219	25.3	244	263
Illinois	12,400	10,900	88	353	1,410	1,760	161
Indiana	6,080	4,480	74	345	326	670	150
Iowa	2,930	2,410	83	303	79.8	383	159
Kansas	2,690	2,500	93	172	244	416	166
Kentucky	4,040	3,490	86	71	455	525	150
Louisiana	4,470	3,950	88	349	404	753	191
Maine	1,270	726	57	29.6	72.5	102	140
Maryland	5,300	4,360	82	84.6	740	824	189
Massachusetts	6,350	5,880	93	197	542	739	126
Michigan	9,940	7,170	72	247	896	1,140	159
Minnesota	4,920	3,770	77	329	171	500	133
Mississippi	2,840	2,190	77	319	40.4	359	164
Missouri	5,600	4,770	85	278	594	872	183
Montana	902	664	74	56.1	92.4	149	224
Nebraska	1,710	1,390	81	266	63.8	330	237
Nevada	2,000	1,870	94	151	478	629	336
New Hampshire	1,240	756	61	33	64.1	97.1	128
New Jersey	8,410	7,460	89	400	650	1,050	141
New Mexico	1,820	1,460	80	262	33.8	296	203
New York	19,000	17,100	90	583	1,980	2,570	150
North Carolina	8,050	5,350	66	166	779	945	177
North Dakota	642	493	77	32.4	31.2	63.6	129
Ohio	11,400	9,570	84	500	966	1,470	154
Oklahoma	3,450	3,150	91	113	562	675	214
Oregon	3,420	2,730	80	118	447	566	207
Pennsylvania	12,300	10,100	82	212	1,250	1,460	145
Rhode Island	1,050	922	88	16.9	102	119	129
South Carolina	4,010	3,160	79	105	462	566	179
South Dakota	755	625	83	54.2	39.1	93.3	149

Table 1 (continued)

STATE	POPULATION (in thousands)			WITHDRAWALS (in million gallons per day)			Per Capita
	Total	Served by public supply		By source		Total	
		Population	Population (in percent)	Ground water	Surface water		
Tennessee	5,690	5,240	92	321	569	890	170
Texas	20,900	19,700	94	1,260	2,970	4,230	215
Utah	2,230	2,180	97	364	274	638	293
Vermont	609	362	59	19.5	40.6	60.1	166
Virginia	7,080	5,310	75	70.7	650	720	136
Washington	5,890	4,900	83	464	552	1,020	208
West Virginia	1,810	1,300	72	41.6	149	190	146
Wisconsin	5,360	3,620	67	330	293	623	172
Wyoming	494	406	82	57.2	49.4	107	264
Puerto Rico	3,810	3,800	100	88.5	425	513	135
U.S. Virgin Islands	109	53.4	49	0.52	5.57	6.09	114
TOTAL	285,000	242,000	85	16,000	27,300	43,300	179

Source: US Geological Survey. "Estimated Use of Water in the United States in 2000.

Public Supply Water Withdrawal."

3. TERMINOLOGY

It is important to understand that this report looks specifically at the water use of “small public water systems” (SPWS). The term is defined and used differently in this paper than it is normally the case in the literature on PWS. U.S. public water supply is essentially provided by two kinds of water systems: large and small PWS. In surveys on PWS, the distinction is often made at a “population served” benchmark of 10,000 persons to discern small and large PWS. For the purpose of this study, a SPWS serves a population of less than 1,000 persons because this corresponds to an estimated maximum daily withdrawal volume of 100,000 gpd, presuming daily per capita use of 100 gallons.⁸ Under the formal definition provided by GA EPD, no withdrawal permit is required if the maximum water withdrawal capacity of one full day “cannot physically surpass” the 100,000 gpd threshold. Hence, water use falling below this threshold is not regulated and recorded only on a voluntary basis.

Due to the variety of lengthy definitional terms, we found it sensible to use a range of abbreviations throughout the text. These are shown in parentheses with the following definitions. The National Primary Drinking Water Regulations define a public water system (PWS) as “...a system for the provision to the public of water for human consumption through pipes or, after August 5, 1998, other constructed conveyances, if such system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least 60 days out of the year... such term does not include any ‘special irrigation district.’ A public water system is either a community water system or a Non-Transient water system.⁹ PWS can be operated and/or owned in four different ways: federally, locally, privately, or by the state.

A community water system (CWS) is defined as a public water system which serves at least fifteen service connections used by year round residents or regularly serves at least twenty-five year-round residents. CWS serve mostly residential purposes, from military institutions at the federal level to subdivisions at the private level.

The National Primary Drinking Water Regulations define a Non-Transient, Non-Transient water system (NTNCWS) as a PWS that is not a CWS and regularly serves at least

⁸ In its efforts to estimate public water supply by small water systems, GA EPD reportedly assumes per capita water consumption of 100 gallons daily. Information provided by the EPD’s Savannah office

⁹ Section 141.2 of the National Primary Drinking Water Regulations

twenty-five of the same persons over six months per year. Main examples are schools, commercial uses, and parks.

Transient Non-Transient water systems (TNCWS) generally do not serve the local population and demand, but rather serve the transient, traveling, and visiting public. TNCWS are defined as PWS that are not CWS, serving twenty-five persons or more, which are not regularly the same persons, over six months of the year. Hotels, restaurants, and public parks constitute the main examples for this type of water system.

4. METHODOLOGY

As described briefly above, two separately maintained databases were used to establish the number of PWS falling below the 100,000 gpd threshold requiring a withdrawal permit. The first database was the database maintained by GA EPD listing those permitted for the supply of water to the public as defined by the National Primary Drinking Water Regulations.¹⁰ The second database was a list maintained by GA EPD comprising all systems withdrawing 100,000 gpd or more.¹¹ By subtracting any permittee in the second database from the first, we were left with all those PWS presumably withdrawing less than 100,000 gpd. The balance of the methodology described here describes how estimates of the water withdrawn by these SPWS were developed.

GA EPD's database listing those permitted for the supply of water to the public also provides information regarding the population served by each PWS. Population served estimates for residential customers of SPWS are based on U.S. Census estimates of the average number of people per household. GA EPD multiplies the Census estimates of persons per household by the number of connections in a system. Each development served by an SPWS is visited periodically and population served estimates are revised by the changes in the number of housing units between visits. Population served by non-residential customers of SPWS is derived from self-reporting during the application process for a drinking water permit.¹²

The estimates presented in this paper for water withdrawn by SPWS are based on a GA EPD per capita use assumption of 100 gpd.¹³ This per capita assumption was adopted for this paper due to a complete lack of empirical estimates in the literature for per capita water use for NTNCWS and TNCWS as well.¹⁴

It is critical to note that assuming per capita water use of 100 gpd across all user categories of SPWS likely results in a rather conservative estimate of total water use, especially in light of the fact that the USGS derives a per capita water use figure of 186 gpd for all PWS,

¹⁰ GA EPD Water Resources Branch: List of Drinking Water/Public Water System Permittees

¹¹ GA EPD Water Resources Branch: List Industrial and Municipal Ground/Surface Water Withdrawal Permittees

¹², ¹³ Information was obtained through inquiry with GA EPD, Savannah office

¹⁴ Lack of other empirical evidence.

large or small, in Georgia.¹⁵ However, because the USGS average also encompasses large commercial uses, which are clearly not applicable to SPWS, actual per capita water use by SPWS must fall within the range of the two estimates: 100 gpcpd and 186 gpcpd. So, although GA EPD's 100 gpcpd figure strikes us fairly low, we decided to adopt it nonetheless, for lack of empirical estimate and because we consider it closer to the true value than 186 gpcpd. Moreover, using a very conservative figure should provide a defense to potential charges that this paper overestimates unaccounted for total water use by SPWS.

Having reached this conclusion, the 100 gpcpd benchmark figure was then utilized to identify SPWS that are likely to exceed the 100,000 gpd threshold without holding the corresponding withdrawal permit. This is accomplished by simply multiplying 100 gpcpd with the population served figure provided in the database for each PWS so that a population served of more than 1,000 draws the logical inference that the PWS withdraws more than 100,000 gpd. Similarly, by using total population served and 100 gpcpd total water use for all SPWS is estimated.

The final category of unrecorded withdrawal to get total unaccounted public water withdrawal is self-supply. To estimate total water use by self-supply, we adopted the USGS per capita figure for Georgia as reported for the year 2000.¹⁶ The reader should note, however, that this figure, 76 gpcpd, is based on a survey dating back to 1983.¹⁷ Again, for lack of alternative estimates we chose to adopt this figure which we consider rather conservative.¹⁸ First, it is an established fact that water consumption follows the consumption pattern of a normal good, e.g. as income rises, demand for a normal good rises as well. Second, the 76 gpcpd figure pertains only to domestic self-supply and does not take into consideration any outdoor use. Hence, based on relations between water use and causal factors, this paper's estimate for unaccounted water from self-supply captures a very low estimate for self-supply.

¹⁵ USGS. "Estimated Use of Water in the United States in 2000."

¹⁶ USGS. "Estimated Use of Water in the United States in 2000."

¹⁷ The survey result is quoted in USGS Information Circular 106. "Water Use in Georgia By County For 2000 And Water-Use Trends For 1980-2000."

¹⁸ Since the 76 gpcpd result from the survey dates back to 1983, we suspect that changes in income and the spread of appliances, such as dishwashers, washing machines, etc. are likely to mean that this estimate is now low for the average domestic user.

5. OVERVIEW OF SPWS IN GEORGIA

5.1 Categories and Count of SPWS

The summary data for SPWS in Georgia is displayed in Table 2 and 3. To better understand some of the dynamics of changes in the size of these small systems, data is displayed for two different sizes of small systems: systems serving less than 500 persons and those serving between 501 and 1,000 persons.

5.2 By Size

Referring to Tables 2 and 3, Georgia had 1,791 public water systems serving less than 500 persons and 164 serving between 501 and 1,000 persons in 2004. Compared to 2002, this constitutes a decrease of 4 percent in the former category, down from 1,868 and an increase of 7 percent in the latter category, up from 153. Small systems consistently account for well over 90 percent of all systems serving 25-1,000 persons. The combined amount of water supplied from these small systems is up slightly by 1 million gpd to 68 million from 2002 to 2004. In both years, the majority of systems are made up of CWS at 1,126, followed by TNCWS at 504, and 160 NTNCWS for the year 2004. In fact, over the two year time frame a slight trend towards more CWS can be identified as their share of all SPWS has risen from 61 percent to roughly 64 percent. The shift may be linked to a slight decrease in both the number of TNCWS and total PWS between 2002 and 2004.

Table 2. PWS Using Less than 100,000 Gallons by Size and Type 2002

Type of Water System		Small	Large	Total	% of total
		500 or less	501-1,000		
CWS	# Systems	1,126	109	1,235	61.1%
	Pop. Served	164,279	74,606	238,885	66.3%
	Water Supplied	16,428,000	7,460,600	23,888,600	66.3%
	% of All Systems	91.2%	8.8%	100.0%	
	% of Total Pop	68.8%	31.2%	100.0%	
NTNCWS	# Systems	174	22	196	9.7%
	Pop. Served	23,554	15,603	39,157	10.9%
	Water Supplied	2,355,400	1,560,300	3,915,700	10.9%
	% of All Systems	88.8%	11.2%	100.0%	
	% of Total Pop	60.2%	39.8%	100.0%	
TNCWS	# Systems	568	22	590	29.2%
	Pop. Served	66,336	16,181	82,517	22.9%
	Water Supplied	6,633,600	1,618,100	8,251,700	22.9%
	% of All Systems	96.3%	3.7%	100.0%	
	% of Total Pop	80.4%	19.6%	100.0%	
Total # water Systems		1,868	153	2,021	
% of Total Systems		92.4%	7.6%	100%	
Total pop. Served		254,169	106,390	360,559	
% of Total Pop.		70.5%	29.5%	100%	
Total Water Supplied		25,417,000	10,639,000	36,056,000	

* Calculations are based on an average daily water use of 100 gpcpd assumed by GA EPD.

Table 3. PWS Using Less than 100,000 Gallons by Size and Type 2004

Type of Water System		Small	Large	Total	% of Total
		500 or less	501-1,000		
CWS*	# Systems	1,126	119	1,245	63.7%
	Pop. Served	164,183	85,134	249,317	68.4%
	Water Supplied	16,418,300	8,513,400	24,931,700	67.8%
	% of CWS Systems	90.4%	9.6%	100.0%	
	% of Pop. Served	65.9%	34.1%	100.0%	
NTNCWS	# Systems	160	23	183	9.5%
	Pop. Served	23,381	16,277	39,658	10.3%
	Water Supplied	2,338,100	1,627,700	3,965,800	10.3%
	% of NTNCWS Systems	87.4%	12.6%	100.0%	
	% of Pop. Served	59.0%	41.0%	100.0%	
TNCWS	# Systems	504	22	526	26.1%
	Pop. Served	58,024	17,190	75,214	17.0%
	Water Supplied	5,802,400	1,719,000	7,521,400	17.0%
	% of TNCWS Systems	95.8%	4.2%	100.0%	
	% of Pop. Served	77.2%	22.8%	100.0%	
Total # water Systems		1,791	164	1,955	
% of Total Systems		91.6%	8.4%	100.0%	
Total Pop. Served		245,698	118,601	364,299	
% of Total Pop.		67.4%	32.6%	100.0%	
Total Water Supplied		24,569,800	11,860,100	36,422,900	

* Calculations are based on an average daily water use of 100 gpcpd assumed by GA EPD.

5.3 By Type and Ownership/Operator

In addition to classification by size, PWS are further categorized into CWS, NTNC, and TNC. Tables 4 and 5 show estimated water use by type of owner/operator for 2002 and 2004 respectively. In 2002, CWS accounted for the great majority out of these three categories at roughly 61 percent while TNCWS made up around 29 percent. In terms of population served, the contrast is more pronounced as CWS supplied 66 percent of the population served and TNCWS served roughly 23 percent. Comparing these figures with 2004 figures, the share of CWS in terms of both the number of systems and population served has risen to 63 percent and 68 percent respectively.

With regard to type of ownership or operation within each category, private ownership represents the dominant ownership structure. Private owners/operators outweigh federal, local, or state water suppliers by a great margin with shares of roughly 83 percent in CWS, 66 percent in NTNCWS, and 51 percent in TNCWS for the year 2002. This distribution is similar for the year 2004.

Table 4. Estimated Water Use by Public Water Systems by Owner/Operator 2002

PWS Type		COMMUNITY (daily water use)				
		Federal	Local	Private	State	Total
CWS	# of Systems	0	208	1,021	6	1,235
	Pop. Served	0	85,066	151,594	2,225	238,885
	Water Supplied	0	8,506,600	15,159,400*	222,500	23,888,500
	% of Systems	n/a	16.84%	82.67%	0.49%	100.00%
	% of Pop	n/a	35.61%	63.46%	0.93%	100.00%
	% of Total Water Use	n/a	35.6%	63.4%	1%	100%

*Employing a widely used per capita average of 76 for domestic use in place of GA EPD's 100 gpcpd, yields 11,521,144 gallons.

PWS Type		NON-TRANSIENT, NON-COMMUNITY (daily water use)				
		Federal	Local	Private	State	Total
NTNC	# of Systems	6	54	130	6	196
	Pop. Served	392	19,246	19,202	317	39,157
	Water Supplied	392,000	1,924,600	1,920,200	317,000	10,447,088
	% of Systems	3.06%	27.55%	66.33%	3.06%	100.00%
	% of Pop	1.00%	49.15%	49.04%	0.81%	100.00%

PWS Type		TRANSIENT, NON-COMMUNITY (daily water use)				
		Federal	Local	Private	State	Total
TNC	# of Systems	114	12	300	165	591
	Pop. Served	14,996	2,592	35,023	30,381	82,992
	Water Supplied	1,499,600	259,200	3,502,300	3,038,100	8,299,200
	% of Systems	19.29%	2.03%	50.76%	27.92%	100.00%
	% of Pop	18.07%	3.12%	42.20%	36.61%	100.00%

Table 5. Estimated Water Use by Public Water Systems by Owner/Operator 2004

PWS Type		COMMUNITY (daily water use)				
		Federal	Local	Private	State	TOTAL
CWS	# Systems	0	211	1,028	7	1246
	Pop. Served	0	89,499	157,593	2,225	249,317
	Water Supplied	0	8,949,900	15,759,300*	222,500	24,931,700
	% of Total Systems	n/a	16.93%	82.50%	0.56%	100.00%
	% of Pop	n/a	35.90%	63.21%	0.89%	100.00%
	% of Total Water Use	n/a	35.9%	63.2%	0.9%	100.00%

* Employing a widely used per capita average of 76 for domestic use in place of GA EPD's 100 gpcpd, yields only 11,977,068 gallons.

PWS Type		NON-TRANSIENT, NON-COMMUNITY (daily water use)				
		Federal	Local	Private	State	TOTAL
NTNCWS	# Systems	5	50	123	5	183
	Pop. Served	609	17,796	20,961	292	39,658
	Water Supplied	60,900	1,779,600	2,096,100	29,200	3,965,800
	% of Systems	2.73%	27.32%	67.21%	2.73%	100.00%
	% of Pop	1.54%	44.87%	52.85%	0.74%	100.00%

PWS Type		TRANSIENT, NON-COMMUNITY (daily water use)				
		Federal	Local	Private	State	TOTAL
TNCWS	# Systems	98	14	351	63	526
	Pop. Served	12,709	3,365	41,747	17,393	75,214
	Water Supplied	1,270,900	336,500	4,174,700	1,739,300	7,521,400
	% of Systems	18.68%	2.64%	66.42%	12.26%	100.00%
	% of Pop	16.90%	4.47%	55.50%	23.12%	100.00%

5.4 By Source Type

Approximately 92 percent of the entire population served by SPWS relies on groundwater sources. There is a slight trend indicating that as water systems get larger the percentage of population served by groundwater declines slightly in favor of surface water, see tables 6 and 7.

Table 6. Public Water Systems by Source Type 2002

Type of Water System	Size	Total Count	Source Type by category							
			Groundwater				Surface Water			
			Riparian		Purchased		Riparian		Purchased	
			Count	Pop. Served	Count	Pop. Served	Count	Pop. Served	Count	Pop. Served
CWS	Small	1,126	1,107	159,639	3	753	3	-	13	3,887
	Large	109	96	64,714	1	798	1	619	11	8,475
NTNCWS	Small	174	171	22,834	-	-	2	670	1	50
	Large	22	21	14,983	-	-	1	620	-	-
TNCWS	Small	568	566	65,736	1	200	1	400	-	0
	Large	22	21	16,584	-	-	-	-	1	606
	TOTAL	2,021	1,982	344,490	5	1,751	8	2,309	26	13,018
	% of Total		98%	95%	03%	0%	0.4%	1%	1.26%	4%

Table 7. Public Water Systems by Source Type 2004

Type of Water System	Size	Total Count	Source Type by category							
			Groundwater				Surface Water			
			Riparian		Purchased		Riparian		Purchased	
			Count	Pop. Served	Count	Pop. Served	Count	Pop. Served	Count	Pop. Served
CWS	Small	1,126	1,097	157,184	8	1,880	-	-	21	5,119
	Large	119	101	71,125	(1)	-	1	619	17	13,390
NTNCWS	Small	160	155	22,006	-	-	3	1,276	2	99
	Large	23	23	16,277	-	-	-	-	-	0
TNCWS	Small	504	502	59,934	-	-	-	-	2	80
	Large	22	29	16,584	-	-	-	-	1	606
	TOTAL	1,954	1,907	343,110	7	1,880	4	1,895	43	19,294
	% of Total		98%	94%	0%	0.4%	0%	0.2%	2.2%	5.2%

6. TOTAL UNRECORDED WATER USE

6.1 Self-Supplied Domestic Water Supply

The USGS estimates that as much as 18 percent of Georgia's population produces its own water supply, compared to 15 percent nationally. Based on surveys taken periodically, it is evident that groundwater comprises nearly 100 percent of self-supplied water. Daily domestic per capita use by self suppliers is estimated at 76 gallons.^{19 20} Consequently, self-supplied domestic water use for the entire state of Georgia amounts to roughly 115 million gpd by 2004.

6.2 Large Public Water Systems not Captured by the Permit Withdrawal Requirement

When applying the 100 gpcpd benchmark, as used by the GA EPD, a population served of over 1,000 implies that the 100,000 gpd threshold is exceeded. For the year 2004, there are 80 PWS serving more than 1,000 persons on a regular basis. However, they are not listed as holders of a water withdrawal permit. While these 80 systems make up a share of only about 4 percent of all SPWS they withdrew as much as 27 percent (13.5 million gallons daily) of the total amount of water used by SWPS in 2004. There is an increasing trend in the number of these systems from 70 to 80 over the two year time span between 2002 and 2004, as Table 8 shows.

Table 8. Public Water Systems Serving a Population Greater Than 1,000 That Are Listed in the SPWS Database

Public Water Systems serving more than more than 1,000 persons without being listed as permittee to withdraw over 100,000 gallons daily		
Year	2002	2004
Number of Systems	70	80
Percent of all Systems	3.40%	3.95%
Population Served	100,108	135,445
Water Use	10,010,800	13,544,500
% of Total Small Systems Total Water Use	22%	27%

¹⁹ 76 gpcpd is the estimate derived in a survey by the GWUP conducted in Athens, GA in 1983

²⁰ Note that actual self supplied water use per capita is presumably much higher because the sole estimate of self-supplied water use available pertains only to domestic uses.

6.3 Total Water Supply Not Subject to Withdrawal Permit

Table 9 below clearly disproves the popular argument that the amount of water withdrawn by SPWS is negligible. The total amount of water supplied publicly without a withdrawal permit amounts to approximately 165 million gpd with the largest share of 70 percent pertaining to domestic self-supply. In fact, the total amounts to as much as 13 percent of total public water supply in the State of Georgia. In terms of population served, non-permit PWS and self-suppliers serve roughly 23 percent of the state’s population.

Table 9. Unregulated Public Water Use

Category	Total Water Use, Daily (in million gallons)			Population Served (in thousands)		
	2002	2004	2004, % of Total	2002	2004	2004, % of Total
Small PWS	36	36.4	22.1%	364	360	18.8%
“Large” PWS*	10	13.5	8.2%	100	135	7%
Self-Supply, Domestic**	113	115	69.7 %	1,455	1,460	74.2%
TOTAL	159	164.9	100%	1,919	1,955	100%

* Not listed as permitted, but serving a population greater than 1,000, therefore termed “large”

** Estimated based on demographic developments

7. REGIONAL VARIATIONS: THE DYNAMICS OF CHANGE IN SPWS

While the volume of unaccounted for water is high, the statewide picture suggests only very small changes in the number of SPWS. An analysis of the systems between 2002 and 2004 by region shows tremendous and dynamic changes.

7.1 Coastal Georgia Capped Region

Due to the combined effect of the cap on new groundwater withdrawal permits and strong economic growth, changes in the number and structure of SPWS in Coastal Georgia deserve special attention. Even for the very limited time span covered from 2002 to 2004, trends identified within the region are supportive of our hypothesis that utility-maximizing individuals will face sufficient incentive to circumvent both the temporarily prevailing cap and potentially more stringent regulations for permit holders in the future. To investigate regional differences with regard to SPWS, the 24 capped county region is compared to the rest of Georgia. In addition, SPWS are analyzed for the capped region's fastest growing counties as measured by population growth.

➤ While the overall number of SPWS in Georgia, excluding the capped region, decreased by 13.4 percent (see Table 12), it increased slightly in the capped region at 2.1 percent (see Table 11) and rose by 24.1 percent in the capped counties whose population has increased above average population growth (see Table 10).

➤ There is evident change in the composition of SPWS across the three demarcated regions. While TNCWS represent the most rapidly declining category at 37 percent in the rest of Georgia and 2.6 percent within all 24 capped counties, they represent the fastest growing category at 293 percent when looking at the capped region's eleven most rapidly growing counties. The reverse is also true, as growth in CWS is the weakest of all categories within the latter region and strongest in the other two regions.

➤ As for the largest category CWS, it shows a slight decrease of 0.8 percent for the rest of Georgia, an increase of 3.8 percent for the capped region, and an increase of 18 percent for the fastest growing counties. Detailed statistics are shown in Table 10 through 12.

Table 10. Change in SPWS in Capped Region’s Fastest Growing Counties (based on average population growth)

Type of Water System		Fastest Growing Counties ²¹						
		Small 0-500		Large (501-1,000)		Total		%Change
		2002	2004	2002	2004	2002	2004	
CWS*	# Systems	217	258	11	11	228	269	18.0%
	Pop. Served	27,056	32,914	7,441	7,872	34,497	40,786	18.2%
	Water Supplied	2,705,600	3,291,400	744,100	787,200	3,449,700	4,078,600	18.2%
	% of Systems	95.2%	95.9%	4.8%	4.1%	100.0%	100.0%	
	% of Pop. Served	78.4%	80.7%	21.6%	19.3%	100.0%	100.0%	
NTNCWS	# Systems	18	29	7	6	25	55	120.0%
	Pop. Served	2,905	4,668	5,483	4,664	8,388	15,653	86.6%
	Water Supplied	290,500	805,100	548,300	758,400	838,800	1,563,500	86.4%
	% of Systems	6.8%		12.6%		100.0%		
	% of Pop. Served	8.7%		41.0%		100.0%		
TNCWS	# Systems	28	45	1	1	29	114	293.1%
	Pop. Served	3,264	4,630	690	690	3,954	16,335	313.1%
	Water Supplied	326,400	463,000	69,000	69,000	395,400	1,633,500	313.1%
	% of Systems	10.6%		100.0%		100		
	% of Pop. Served	9.8%		22.8%				
Total # water Systems	263	332	19	18	282	350	24.1%	
% of Total Systems	93.3%	94.9%	6.7%	5.1%				
Total Pop. Served	33,225	42,212	13,614	13,226	46,839	55,438	18.4%	
% of Total Pop.	70.9%	76.1%	29.1%	23.9%				
Total Water Supplied	3,322,500	4,559,500	1,361,400	1,614,600	4,683,900	6,174,100	31.8%	

²¹ These counties are, based on population growth, Brantley, Bryan, Bulloch, Camden, Candler, Effingham, Evans, Long, McIntosh, Tattnall, Wayne.

Table 11. Change in SPWS in 24 Capped Coastal Georgia Counties

Type of Water System		24 Capped Counties ²²						%Change
		Small 0-500		Large (501-1,000)		Total		
		2002	2004	2002	2004	2002	2004	
CWS*	# Systems	417	433	26	27	443	460	3.8%
	Pop. Served	56,309	59,395	16,966	18,533	73,275	77,928	6.4%
	Water Supplied	5,630,900	5,939,500	1,696,600	1,853,300	7,327,500	7,792,800	6.4%
	% of Systems	72.5%		9.6%		100.0%		
	% of Pop. Served	65.9%		34.1%		100.0%		
NTNCWS	# Systems	46	51	10	4	56	55	-1.8%
	Pop. Served	7,051	8,051	7,903	7,584	14,954	15,653	4.7%
	Water Supplied	705,100	805,100	790,300	758,400	1,495,400	1,563,500	4.6%
	% of Systems	8.0%		12.6%		100.0%		
	% of Pop. Served	9.2%		41.0%		100.0%		
TNCWS	# Systems	112	109	5	5	117	114	-2.6%
	Pop. Served	13,407	12,293	4,042	4,042	17,449	16,335	-6.4%
	Water Supplied	1,340,700	1,229,300	404,200	404,200	1,744,900	1,633,500	-6.4%
	% of Systems	19.5%		100.0%		100		
	% of Pop. Served	17.5%		22.8%				
Total # water Systems		575	593	41	36	616	629	2.1%
% of Total Systems		93.3%	94.3%	6.7%	5.7%			
Total Pop. Served		76,767	79,739	28,911	30,159	105,678	109,898	4.0%
% of Total Pop.		72.6%	72.6%	27.4%	27.4%			
Total Water Supplied		7,676,700	7,973,900	2,891,100	3,015,900	10,567,800	10,989,800	4.0%

²² These counties are Appling, Bacon, Brantley, Bryan, Bulloch, Burke, Camden, Candler, Charlton, Chatham, Effingham, Emanuel, Evans, Glynn, Jenkins, Liberty, Long, McIntosh, Pierce, Screven, Tattnall, Toombs, Toombs, Ware, Wayne.

Table 12. Change in SPWS in Georgia Excluding 24 Capped Coastal Georgia Counties

Type of Water System	Georgia Excluding Capped Region							
	Small 0-500		Large (501-1,000)		Total		%Change	
	2002	2004	2002	2004	2002	2004		
CWS*	# Systems	708	693	83	92	791	785	-0.8%
	Pop. Served	107,926	104,788	57,640	66,601	165,566	171,389	3.4%
	Water Supplied	10,792,600	10,478,800	5,764,000	6,660,100	16,556,600	17,138,900	3.4%
	% of Systems	89.5%	88.3%	10.5%	11.7%			
	% of Pop. Served	65.2%	61.1%	34.8%	38.9%			
NTNCWS	# Systems	128	110	12	13	140	123	-13.8%
	Pop. Served	16,503	15,334	7,700	8,693	24,203	24,027	-0.7%
	Water Supplied	1,650,300	1,533,400	770,000	869,300	2,420,300	2,402,700	-0.7%
	% of Systems	91.4%	89.4%	8.6%	10.6%			
	% of Pop. Served	68.2%	63.8%	31.8%	36.2%			
TNCWS	# Systems	541	395	25	17	566	412	-37.4%
	Pop. Served	62,382	45,837	17,149	13,148	79,531	58,985	-34.8%
	Water Supplied	6,238,200	4,583,700	1,714,900	1,314,800	7,953,100	5,898,500	-34.8%
	% of Systems	95.6%	95.9%	4.4%	4.1%			
	% of Pop. Served	78.4%	77.7%	21.6%	22.3%			
Total # of Systems	1,377	1,198	120	122	1,497	1,320	-13.4%	
% of Total Systems	92.0%	90.8%	8.0%	9.2%	100%	100.0%		
Total Pop. Served	7,996,426	6,221,888	2,542,540	2,250,701	10,538,966	8,472,589	-24.4%	
% of Total Pop.	75.9%	73.4%	24.1%	26.6%				
Total Water Supplied	18,681,100	16,595,900	8,248,900	8,844,200	26,930,000	25,440,100	-5.9%	

7.2 Metro Atlanta Area

The tables of Section 7.1 provide evidence that the number of PWS has grown significantly faster in the 24 capped coastal counties than in the rest of Georgia, and particularly so in capped counties showing above average population growth. A similar comparison between the metro Atlanta²³ area and the rest of Georgia reveals contrary yet logical results. With increasing population density towards the center of metropolitan areas SPWS tend to be consolidated into bigger systems. The numbers shown in Tables 13 and 14 clearly support this postulation while providing more detailed information than can be laid out here.

- From 2002 and 2004, the number of SPWS in the sixteen county metro Atlanta area decreased by 14 percent while the remaining systems serve 24 percent less people. By contrast, the remaining counties in Georgia only show a reduction of 2.8 percent in the total number of SPWS over the same time period.
- Looking at developments by PWS categories illustrates that the number of small CWS increased between 2002 and 2004 by 1.9 percent when excluding the Atlanta metro area. The sixteen county metro area meanwhile lost 15.8 percent of small CWS.
- Another noteworthy fact is that the number of people served by SPWS decreases substantially faster at 24 percent than the total number of systems, which decreased by 14 percent. This finding suggests that SPWS that were consolidated into larger systems had already served larger populations than the remaining PWS. Mapping of this development would show that the degree of SPWS consolidation is positively related to the degree of population density in the demarcated sixteen county region.

²³ Two definitions of the Metro Atlanta Area are used in the research. The first includes the sixteen counties as defined by the “Water Supply and Water Conservation Management Plan,” prepared for the Metropolitan North Georgia Water Planning District, September 2003. The second definition includes the forty-four counties comprised in the study termed “North Georgia Regional Water Supply Needs Assessment,” prepared by GA EPD in August 2003

Table 13. Change in SPWS in Sixteen County Metro Atlanta Area

Type of Water System	Growth in SPWS in Sixteen County Metro Atlanta Area ²⁴							
	Small 0-500		Large (501-1,000)		Total		%Change	
	2002	2004	2002	2004	2002	2004		
CWS*	# Systems	76	65	12	11	88	76	-15.8%
	Pop. Served	13,134	11,432	7,400	7,084	20,534	18,516	-10.9%
	Water Supplied	1,313,400	1,143,200	740,000	708,400	2,053,400	1,851,600	-10.9%
	% of Systems	86.4%	85.5%	13.6%	14.5%			
	% of Pop. Served	64.0%	61.7%	36.0%	38.3%			
NTNCWS	# Systems	4	2	-	-	4	2	-100.0%
	Pop. Served	250	160	-	-	250	160	-56.3%
	Water Supplied	25,000	16,000	-	-	25,000	16,000	-56.3%
	% of Systems	100.0%	100.0%	0.0%	0.0%			
	% of Pop. Served	100.0%	100.0%	0.0%	0.0%			
TNCWS	# Systems	19	20	2	1	21	21	0.0%
	Pop. Served	2,369	2,452	1,450	650	3,819	3,102	-23.1%
	Water Supplied	236,900	245,200	145,000	65,000	381,900	310,200	-23.1%
	% of Systems	90.5%	95.2%	9.5%	4.8%			
	% of Pop. Served	62.0%	79.0%	38.0%	21.0%			
Total # of Systems	99	87	14	12	113	99	-14.1%	
% of Total Systems	87.6%	87.9%	12.4%	12.1%	100%	100.0%		
Total Pop. Served	275,034	272,632	152,400	72,084	427,434	344,716	-24.0%	
% of Total Pop.	64.3%	79.1%	35.7%	20.9%				
Total Water Supplied	1,575,300	1,404,400	885,000	773,400	2,460,300	2,177,800	-13.0%	

²⁴ These counties are Bartow, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, Rockdale, Walton.

Table 14. Change in Georgia Excluding Sixteen Metro Atlanta Counties.

Type of Water System	Growth in SPWS Excluding Sixteen County Metro Atlanta Area							
	Small 0-500		Large (501-1,000)		Total		%Change	
	2002	2004	2002	2004	2002	2004		
CWS*	# Systems	1,050	1,061	97	108	1,147	1,169	1.9%
	Pop. Served	151,145	152,751	67,206	78,050	218,351	230,801	5.4%
	Water Supplied	15,114,500	15,275,100	6,720,600	7,805,000	21,835,100	23,080,100	5.4%
	% of Systems	91.5%	90.8%	8.5%	9.2%			
	% of Pop. Served	69.2%	66.2%	30.8%	33.8%			
NTNCWS	# Systems	170	158	22	23	192	181	-6.1%
	Pop. Served	23,304	23,221	15,603	16,277	38,907	39,498	1.5%
	Water Supplied	2,330,400	2,322,100	1,560,300	1,627,700	3,890,700	3,949,800	1.5%
	% of Systems	88.5%	87.3%	11.5%	12.7%			
	% of Pop. Served	59.9%	58.8%	40.1%	41.2%			
TNCWS	# Systems	549	485	20	21	569	506	-12.5%
	Pop. Served	63,967	55,682	14,731	16,540	78,698	72,222	-9.0%
	Water Supplied	6,396,700	5,568,200	1,473,100	1,654,000	7,869,800	7,222,200	-9.0%
	% of Systems	96.5%	95.8%	3.5%	4.2%			
	% of Pop. Served	81.3%	77.1%	18.7%	22.9%			
Total # of Systems	1,769	1,704	139	152	1,908	1,856	-2.8%	
% of Total Systems	92.7%	91.8%	7.3%	8.2%	100%	100.0%		
Total Pop. Served	8,878,245	8,043,051	3,100,606	3,359,750	11,978,851	11,402,801	-5.1%	
% of Total Pop.	74.1%	70.5%	25.9%	29.5%				
Total Water Supplied	23,841,600	23,165,400	9,754,000	11,086,700	33,595,600	34,252,100	1.9%	

7.3 Extended Forty-Four County Metro Area

Another area of interest in context with small PWS comprises the sixteen Metro Atlanta Counties plus 28 surrounding counties that increasingly grow together with the metro Atlanta area. Similar to findings for the metro Atlanta area, this region reveals a notably declining number of SPWS.

➤ Although the decline is not as great, it is still significantly faster at 8.4 percent than the decline in Georgia's remaining counties, in which the number of SPWS decreased by 2.3 percent between 2002 and 2004.

➤ In terms of population served, the discrepancy is even greater. SPWS in the forty-four county extended metro Atlanta area serve roughly 16 percent less people while SPWS in the rest of Georgia serve a slightly rising number of people.

➤ Consolidation in SPWS for the extended forty-four county metro area occurs faster than in the rest of Georgia as well. The number of SPWS declined by 4.4 percent between 2002 and 2004, which is significantly less than the 14 percent of the narrow metro area but clearly faster than the decline in the rest of Georgia at 2.3 percent.

Additional conclusions can be drawn by the reader through reference to Tables 15 and 16.

Table 15. Change in SPWS in Forty-Four County Extended Metro Atlanta Area

Type of Water System	Growth in SPWS in Forty-Four County Extended Metro Atlanta Area ²⁵							
	Small 0-500		Large (501-1,000)		Total		%Change	
	2002	2004	2002	2004	2002	2004		
CWS*	# Systems	251	228	34	45	285	273	-4.4%
	Pop. Served	39,189	34,925	23,321	33,467	62,510	68,392	8.6%
	Water Supplied	3,918,900	3,492,500	2,332,100	3,346,700	6,251,000	6,839,200	8.6%
	% of Systems	88.1%	83.5%	11.9%	16.5%			
	% of Pop. Served	62.7%	51.1%	37.3%	48.9%			
NTNCWS	# Systems	21	19	4	1	25	20	-25.0%
	Pop. Served	1,765	2,577	2,533	733	4,298	3,310	-29.8%
	Water Supplied	176,500	257,700	253,300	73,300	429,800	331,000	-29.8%
	% of Systems	84.0%	95.0%	16.0%	5.0%			
	% of Pop. Served	41.1%	77.9%	58.9%	22.1%			
TNCWS	# Systems	132	116	8	6	140	122	-14.8%
	Pop. Served	14,714	13,424	6,032	4,632	20,746	18,056	-14.9%
	Water Supplied	1,471,400	1,342,400	603,200	463,200	2,074,600	1,805,600	-14.9%
	% of Systems	94.3%	95.1%	5.7%	4.9%			
	% of Pop. Served	70.9%	74.3%	29.1%	25.7%			
Total # of Systems	404	363	46	52	450	415	-8.4%	
% of Total Systems	89.8%	87.5%	10.2%	12.5%	100%	100.0%		
Total Pop. Served	1,687,089	1,635,025	879,821	569,967	2,566,910	2,204,992	-16.4%	
% of Total Pop.	65.7%	74.2%	34.3%	25.8%				
Total Water Supplied	5,566,800	5,092,600	3,188,600	3,883,200	8,755,400	8,975,800	2.5%	

²⁵ These counties are Bartow, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, Rockdale, Walton, Banks, Barrow, Butts, Carroll, Clarke, Dawson, Floyd, Habersham, Haralson, Jackson, Jasper, Lamar, Lumpkin, Madison, Meriwether, Monroe, Morgan, Newton, Oconee, Pickens, Pike, Putnam, Rockdale, Spalding, Stephens, Upson, White.

Table 16. Change in SPWS in Georgia Excluding the Forty-Four County Extended Metro Atlanta Area

Type of Water System	Growth in SPWS Excluding Forty-Four County Extended Metro Atlanta Area							
	Small 0-500		Large (501-1,000)		Total		%Change	
	2002	2004	2002	2004	2002	2004		
CWS*	# Systems	876	898	75	74	951	972	2.2%
	Pop. Served	125,105	129,258	51,285	51,667	176,390	180,925	2.5%
	Water Supplied	12,510,500	12,925,800	5,128,500	5,166,700	17,639,000	18,092,500	2.5%
	% of Systems	91.2%	90.4%	8.8%	9.6%	100.0%	100.0%	
	% of Pop. Served	68.8%	65.9%	31.2%	34.1%	100.0%	100.0%	
NTNCWS	# Systems	153	141	18	22	171	163	-4.9%
	Pop. Served	21,789	20,804	13,070	15,544	34,859	36,348	4.1%
	Water Supplied	2,178,900	2,080,400	1,307,000	1,554,400	3,485,900	3,634,800	4.1%
	% of Systems	88.8%	87.4%	11.2%	12.6%	100.0%	100.0%	
	% of Pop. Served	60.2%	59.0%	39.8%	41.0%	100.0%	100.0%	
TNCWS	# Systems	440	389	14	16	454	405	-12.1%
	Pop. Served	52,337	44,710	10,149	12,558	62,486	57,268	-9.1%
	Water Supplied	5,233,700	4,471,000	1,014,900	1,255,800	6,248,600	5,726,800	-9.1%
	% of Systems	96.3%	95.8%	3.7%	4.2%	100.0%	100.0%	
	% of Pop. Served	80.4%	77.2%	19.6%	22.8%	100.0%	100.0%	
Total # of Systems	1,469	1,428	153	164	1,576	1,540	-2.3%	
% of Total Systems	93.2%	92.7%	9.7%	10.6%	100%	100.0%		
Total Pop. Served	199,231	194,772	74,504	79,769	273,735	274,541	0.3%	
% of Total Pop.	72.8%	70.9%	27.2%	29.1%	100%	100.0%		
Total Water Supplied	19,923,100	19,477,200	7,450,400	7,976,900	27,373,500	27,454,100	0.3%	

8. DATABASE ISSUES

The GA EPD databases addressing public water supply do not appear to be consistent. As previously mentioned, there are two separate public permit databases. One database, termed “List of Drinking Water/Public Water System Permittees” provides a list of all public water supply systems that are subject to drinking water regulations. The other database, separated into surface and groundwater permits named “List of Municipal and Industrial Surface/Groundwater Withdrawal Permittees” displays a list of all large water users who require a corresponding water withdrawal permit. When comparing the two databases a number of systems appear to exceed the 100,000 gpd withdrawal limit without holding the appropriate permit. Inquiries to GA EPD staff in charge of the databases to clarify these issues remain unanswered at the time of this work. However, since deviations between the databases were adjusted for, the findings presented in this text remain unaffected in their validity with regard to unaccounted for and unmeasured water withdrawal by SPWS.

A number of entries in the SPWS drinking water permit database show PWS with a population served figure of well over 1,000, indicating water withdrawal of more than 100,000 gpd. As these systems are not listed in the permittee database, it has to be assumed that they do not possess a permit for withdrawal of over 100,000 gpd. Table 8 in section 6.2 both lists and quantifies water use for these cases for the years 2002 and 2004. This apparent inconsistency serves as the reason why certain criteria, laid out in the Methodology part of this paper, had to be developed to establish a cut off that would eliminate these entries. The fairly trivial methodology used in this context is based on the variable population served and the GA EPD benchmark figure of 100 gallons daily per capita water use. Multiplying these values provides a total daily withdrawal amount for each SPWS. Various large water users are not listed in the drinking water database although these water systems presumably provide drinking water to some extent. For the purpose of this paper, only the former issue was relevant and had to be resolved because it impeded the identification of SPWS that actually fall below the 100,000 gallon per day threshold. Throughout this research project no clue was to be found on how to distinguish between large and small PWS within the drinking water database. Consequently, a

definite amount of water supplied by SPWS alone could not be derived without arbitrarily altering the data provided by GA EPD.

The inconsistency of the PWS databases may have two significant effects on research that is conducted based on them without accounting for the discrepancies. Water withdrawal from large systems may be significantly understated similar to the effect exerted by reliance on the public drinking water database as a proxy for public water supply. In either case, missing observations will result in underestimation of the total result.

An additional data issue came to light as a result of this study. To analyze changes in the number of systems one had to compare the cross-section of public water suppliers on two different dates. It turned out that some permits had not been updated for several years. We suspect that it is due to staffing and budget limitations that the database of PWS permittees does not reflect real-time numbers of PWS.

9. THRESHOLDS REQUIRING WITHDRAWAL PERMIT

Regulation regarding the need for withdrawal permits from ground and surface water varies between states.²⁶ There is, however, a broad trend towards lowering and/or establishing such a threshold. Table 17 provides an overview – though not complete due to some states' highly complicated user-specific permit provisions as in Utah's case, for instance – of permit threshold withdrawal amounts established in other states. Clearly, some states face greater water scarcity than Georgia and have therefore been forced to enact more stringent regulations while numerous other states do not appear to have a permit system in place at all.

However, further research in this subject matter would show that various other states besides West Virginia and Connecticut are in the process of implementing such legislation. Referring to Table 17, it can be noted that twenty-six states, including Georgia, either require all withdrawals to have a permit or they have a withdrawal thresholds of 100,000 gpd or more. Of the twenty-six only six have the relatively high threshold of 100,000 gpd or more.

²⁶ See also Water Policy Working Paper 2004 – 003 “Minimum Water Use Levels Requiring State Permits: Is Georgia's 100,000 Gallon/Day Appropriate?”

Table 17. Volume Thresholds Applicable to Public Water Permits by State²⁷

State	Permit generally required: if yes, threshold amount (gpd)	Threshold withdrawal amount that requires reporting/recording (gpd)
Alabama	No	all
Alaska	1,500	No
Arizona	50,000	No ²⁸
Arkansas	1,000 (surface), 50,000 [^] (groundwater)	50,000
California	Surface water only	Surface water only
Colorado	No	Only for major uses
Connecticut	No	50,000
Delaware	50,000	50,000
Florida	1,000,000 [^]	
Georgia	100,000	100,000
Hawaii	All	1,000
Kansas	1,000	
Kentucky	10,000	
Idaho	2,500	155,000
Illinois	Not specified	100,000
Indiana	100,000	100,000 [^]
Iowa	25,000 gpd [^]	
Louisiana	No	1,000,000
Maine	No	Yes
Maryland	Varies	10,000
Massachusetts	No ²⁹	all
Michigan	No*	100,000
Minnesota	10,000/1,000,000	10,000/1,000,000
Mississippi	Wells with diameter greater than 6 inches	No
Missouri	No	No
Montana	No	No
Nebraska	Not specified	Not specified
Nevada	Yes. Gpd varies	Contingent on permit
New Hampshire	57,000 (groundwater)	Not specified
New Jersey	100,000	100,000
New Mexico	All	All
New York	All	All
North Carolina	100,000 [^]	100,000 [^]
North Dakota	108,000	108,000
Ohio	100,000	100,000
Oklahoma	All	All
Oregon	5,000-15,000	All
Pennsylvania	10,000	10,000
Rhode Island	100,000	100,000
South Carolina	Not specified	100,000
South Dakota	25,000	Large PWS
Tennessee	No	5,000
Texas	Only for surface water withdrawals	All
Utah	Varies	180,000
Vermont	No	No
Virginia	Not specified	10,000
Washington	5,000	Not specified
West Virginia	No	No
Wisconsin	Not specified	100,000
Wyoming	All	All

Source: Water Science and Technology Board (2002)

Annotation: [^] Capacity, + Conducted by the state

²⁷ Several states have put restrictions in specific water scarce areas. Numerous states have the legal authority to require permits and registration/recording but normally refrain from imposing this legal power.

²⁸ Large users are required to report their usage

²⁹ Maximum except when exceeding maximum defined as “safe yield”

10. FINDINGS

To our knowledge this is the first study to examine how Community/Public Water Systems are changing in Georgia. As defined here, this paper focuses on all systems serving a population of 1,000 or fewer people. The following highlights some of the key findings:

- Between 2002 and 2004 there has been a trend towards the installation of larger systems within the category of systems serving 1,000 or fewer people. Statewide there was a 4 percent decline in systems serving 500 or fewer people and a 7 percent increase in systems serving 501 to 1,000.
- Statewide systems serving 1,000 or fewer people added one million gpd between 2002 and 2004. These systems provided 68 million gpd as of 2004.
- Private ownership represents the dominate ownership structure. Private owners control 83 percent CWS, 66 percent of the NTNCWS and 51 percent of the TNCWS.
- Groundwater is the source for 92 percent of the population served by PWS.
- It is estimated that 18 percent of the Georgia population gets water by self-supply. This accounts for approximately 115 million gpd. Groundwater is almost exclusively the primary source of water for self-supply.
- Large systems serving enough population to exceed the 100,000 gpd threshold for a withdrawal permit, but not holding an identifiable permit, increased by 7 percent between 2002 and 2004. Total water used by these large systems increased by 8.2 percent for the same period.
- The total amount of water supplied by those falling below the 100,000 gpd threshold plus those systems exceeding the 100,000 gpd without holding a permit for withdrawal is approximately 165 million gpd. Domestic self-supply accounts for 70 percent of this total.

- Twenty-four counties in Coastal Georgia have been ‘capped’ for additional groundwater withdrawal permits. Excluding these 24 counties, SPWS decreased by 13.4 percent, while within the capped region SPWS increased by 2.1 percent. In those capped counties with high rates of population growth SPWS increased by 24.1 percent.
- There is evident change in the composition of SPWS across the three demarcated regions. While TNCWS represent the most strongly declining category at 37 percent in the rest of Georgia and 2.6 percent within all 24 capped counties, they represent the fastest growing category at 293 percent when looking at the capped region’s eleven most rapidly growing counties. This also holds true vice versa as growth in CWS is the weakest out of all categories within the latter region and strongest in the other two regions.
- For SPWS, again by definition those serving 1,000 or fewer people, on a statewide level excluding the 24 capped counties there was been a decline of 0.8 percent in systems between 2002 and 2004. For the same years these SPWS increased by 3.8 percent in the 24 capped counties and by 18 percent in the high population growth counties within the capped region.
- It was hypothesized that the statewide decrease in systems might be explained by the absorption of smaller systems in the Greater Atlanta Metro area. Using both a 16 and a 44 county definition of the Greater Atlanta Metro area, SPWS decreased by 15.8 and 4.4 percent respectively. Excluding the 16 counties in the Greater Atlanta Metro area decreases the statewide loss of systems from a 13.4 percent decrease to a 1.9 percent decrease.
- Several data issues arose in the course of this study which should be noted.
 - There appears to be a number of Community Water Systems which even by Georgia Environmental Protection Division’s rule of thumb for assessing systems size exceed 100,000 gpd, but do not hold an identifiable permit for withdrawal. This means official accounts of water withdrawal understate actual withdrawal.

- To accomplish examining the changes in SPWS it was necessary to compare panels from two different time periods. Simply adding date of issue for permits will make it easier to monitor the changes over time in the number of systems and their potential impact on water use.
- Data on community/public water systems is not routinely update due to budget and staff limitations which means the database on CWS and PWS does not reflect real time impacts on water use.

➤ Regulations regarding the need for permits for withdrawal of water from ground and surface sources vary between states. For those twenty-six states which have a threshold limit requiring a withdrawal permit, only six (including Georgia) have a threshold limit of 100,000 gpd or higher. We believe that Georgia should lower its limit for requiring a withdrawal permit to 10,000 gpd. This would leave only self supply systems out of the water accounting and reporting regime.

11. CONCLUSIONS AND POLICY RECOMMENDATIONS

It is estimated that unrecorded/unaccounted for water withdrawal in Georgia amounts to 165 million gpd: 115 million gpd for self supply; 36 million gpd for SPWS serving 1,000 or fewer people; and, 14 million gpd for CWS/PWS serving more than 1,000 people but not holding an identifiable permit to withdraw 100,000 gpd. We believe that these are very conservative, low, estimates of unaccounted for water withdrawal.

In the two year period between 2002 and 2004 there were a tremendous number of changes in the number, size, and composition of SPWS. Analysis based on looking at all systems statewide would suggest that the number of systems is falling rapidly. However, deeper examination reveals substantial variation in the changes in the number, size, and composition of systems by region. As the communities in the Greater Atlanta Metro area grow, the number of SPWS systems in the region decreases. On the other hand, counties in Coastal Georgia that are not issued new groundwater permits while experiencing rapid population growth have seen tremendous increases in the number of SPWS.

The variation in changes in SPWS by region leads us to conclude that SPWS play an important role in accommodating growth in Georgia's small to mid-size communities. The majority of these systems are developed by private enterprise and they are thus responsive to local growth needs. The combined effect of the cap on new water withdrawal permits for 100,000 gpd or more in Coastal Georgia and the relatively high threshold for requiring a permit has lead to explosive growth in small PSW. Between 2002 and 2004 in the high population growth counties in the coast, SPWS increased by 24.1 percent. The population served increased by 18.4 percent and total water supplied increased by 31.8 percent.

The restrictions on withdrawal permits within the 24 capped counties may be lifted or modified sometime in 2005 when the results of the Sound Science Study are presented, but the responsiveness of SPWS illustrated by the rapid growth while other groundwater sources have been prohibited begs the question: Will these systems continue to grow? We believe that should the large municipal systems be required to reduce dependence on groundwater and substitute more expensive surface water supplies that SPWS will continue to grow in the coast.

Twenty-six states including Georgia have threshold limit for requiring a permit for withdrawal of water. Only six states, including Georgia, set that limit as high as 100,000 gpd or more. We believe that Georgia should lower its limit for requiring a withdrawal permit to 10,000 gpd. This would leave only self supply systems out of the water accounting and reporting regime.

One additional policy recommendation should be mentioned. Most of the challenges in examining SPWS arose from discrepancies how systems are reported to GA EPD. First, we recommend that the database on permits for operating CSW/PSW should include an issue date. This would make it much easier to monitor trends. Second, there are systems which by GA EPD's own rule likely exceed the 100,000 gpd threshold, but for whom there is no identifiable withdrawal permit. Information on the systems in the CSW/PWS database should include the permit identification code in the withdrawal permit database.

Appendix

Table 18. Estimated Use of Water in the United States in 2000: Self-Supply

STATE	POPULATION (in thousands)				WITHDRAWALS (in million gallons per day)		
	Total	Served by public supply	Self-supplied domestic		By source		Total
			Population	Population (in percent)	Ground water	Surface water	
Alabama	4,450	3,580	868	20	78.9	0	78.9
Alaska	627	421	206	33	10.9	0.25	11.2
Arizona	5,130	4,870	265	5	28.9	0	28.9
Arkansas	2,670	2,320	351	13	28.5	0	28.5
California	33,900	30,100	3,810	11	257	28.6	286
Colorado	4,300	3,750	555	13	66.8	0	66.8
Connecticut	3,410	2,660	749	22	56.2	0	56.2
Delaware	784	617	166	21	13.3	0	13.3
District of Columbia	572	572	0	0	0	0	0
Florida	16,000	14,000	1,950	12	199	0	199
Georgia	8,190	6,730	1,450	18	110	0	110
Hawaii	1,210	1,140	72.9	6	4.82	7.22	12
Idaho	1,290	928	366	28	85.2	0	85.2
Illinois	12,400	10,900	1,500	12	135	0	135
Indiana	6,080	4,480	1,600	26	122	0	122
Iowa	2,930	2,410	511	17	33.2	0	33.2
Kansas	2,690	2,500	193	7	21.6	0	21.6
Kentucky	4,040	3,490	552	14	19.5	8	27.5
Louisiana	4,470	3,950	523	12	41.2	0	41.2
Maine	1,270	726	549	43	35.7	0	35.7
Maryland	5,300	4,360	932	18	77.1	0	77.1
Massachusetts	6,350	5,880	473	7	42.2	0	42.2
Michigan	9,940	7,170	2,770	28	239	0	239
Minnesota	4,920	3,770	1,150	23	80.8	0	80.8
Mississippi	2,840	2,190	654	23	69.3	0	69.3
Missouri	5,600	4,770	824	15	53.6	0	53.6
Montana	902	664	238	26	17.3	1.29	18.6
Nebraska	1,710	1,390	324	19	48.4	0	48.4
Nevada	2,000	1,870	124	6	22.4	0	22.4
New Hampshire	1,240	756	479	39	40.9	0.16	41
New Jersey	8,410	7,460	952	11	79.7	0	79.7
New Mexico	1,820	1,460	360	20	31.4	0	31.4
New York	19,000	17,100	1,890	10	142	0	142
North Carolina	8,050	5,350	2,700	34	189	0	189
North Dakota	642	493	149	23	11.9	0	11.9
Ohio	11,400	9,570	1,790	16	132	2.71	134
Oklahoma	3,450	3,150	299	9	25.5	0	25.5
Oregon	3,420	2,730	692	20	68.3	7.97	76.2
Pennsylvania	12,300	10,100	2,190	18	132	0	132
Rhode Island	1,050	922	127	12	8.99	0	8.99
South Carolina	4,010	3,160	847	21	63.5	0	63.5

Table 1 (continued)

STATE	POPULATION (in thousands)				WITHDRAWALS (in million gallons per day)		
	Total	Served by public supply	Self-supplied domestic		By source		Total
			Population	Population (in percent)	Ground water	Surface Water	
South Dakota	755	625	129	17	9.52	0.01	9.53
Tennessee	5,690	5,240	453	8	32.6	0	32.6
Texas	20,900	19,700	1,190	6	131	0	131
Utah	2,230	2,180	56.2	3	16.1	0	16.1
Vermont	609	362	247	41	20.7	0.25	21
Virginia	7,080	5,310	1,770	25	133	0	133
Washington	5,890	4,900	993	17	125	0.02	125
West Virginia	1,810	1,300	505	28	39.6	0.81	40.4
Wisconsin	5,360	3,620	1,750	33	96.3	0	96.3
Wyoming	494	406	87.5	18	6.57	0	6.57
Puerto Rico	3,810	3,800	12.8	0	0.88	0	0.88
U.S. Virgin Islands	109	53.4	55.2	51	0	1.69	1.69
TOTAL	285,000	242,000	43,500	15	3,530	58.9	3,590

Source: Source: US Geological Survey. "Estimated Use of Water in the United States in 2000. Self Supplied Domestic Water Withdrawals, 2000."

References

- Adams, J., Cummings, R., Park, H. (2004) "Minimum Water Use Levels Requiring State Permits: Is Georgia's 100,000 Gallon/Day Appropriate?" Water Policy Working Paper # 2004-003. Andrew Young School of Policy Studies. Georgia State University.
- Agthe, D.E., Billings, R.B., Dworkin, J.M. (1988) "Effects of rate structure knowledge on household water use: Water Resources Bulletin." V. 24, no. 3, p. 627-630.
- Alber, M., Smith, C. (2001). "Proceedings of the 2001 Georgia Water Resources Conference." University of Georgia, Institute of Ecology, Athens, Georgia, March 26-27, 2003.
- Cummings, R., Rusert, W. (2004) "Characteristics of Water-use Control Policies: A Survey of 28 Eastern States." Water Policy Working Paper # 2004 -1. North Georgia Water Planning and Policy Center, Andrew Young School of Policy Studies.
- DeOreo, W.B., Mayer, P.W., Opitz, E.M., Dziegielewski, B., Kiefer, J.C., Davis, W.Y., Nelson, J.O. (1998) "Residential End Uses of Water: Final Report." AWWA Research Foundation. Denver, Colorado.
- Dodd, B. (2004). "Permit Transfers Hold Water for Georgia." Georgia Public Policy Foundation. January 30, 2004. <http://www.gppf.org/article.asp?RT=20&p=pub/Water/permits040130.htm>.
- Environmental Protection Division. (1997) "Interim Strategy for Managing Slat Water Intrusion in the Upper Floridan Aquifer of Southeast Georgia." April 1997.
- Fanning, J., L. (2003). "Water Use in Georgia by County for 2000 and Water Use Trends from 1980-2000." Information Circular 106, prepared by Georgia Environmental Protection Division., US Department of the Interior, US Geological Survey.
- Georgia Environmental Protection Division. "Water Resources Branch. (2004) "Environmental Protection Permits. List of Drinking Water/Public Water System Permittees." <http://www.state.ga.us/dnr/environ/>.
- Georgia Environmental Protection Division. "Water Resources Branch. (2004) "Environmental Protection Permits. List of Municipal and Industrial Surface Water Withdrawal Permittees, List of Municipal and Industrial Ground Water Withdrawal Permittees." (2004) <http://www.state.ga.us/dnr/environ/>.
- Georgia General Assembly. (2003) "House Bill 237/AP.
- Hatcher, K. J. (2003) "Proceedings of the 2003 Georgia Water Resources Conference." University of Georgia, Institute of Ecology, Athens, Georgia, April 23-24, 2003.

Hollis, P.L. (2003) "Georgia: Sweeping Water Laws Fail." Delta Farm Press, June 13, 2003.

Official Code of Georgia Annotated. Title 12. Conservation and Natural Resources. Chapter 5. Water Resources. Article 22. Control of Water Pollution and Surface Water Use.

Official Code of Georgia Annotated. Title 12. Conservation and Natural Resources. Chapter 5. Water Resources. Article 3. Wells and Drinking Water. Part 2. Ground-Water Use Generally.

United States Environmental Protection Agency (2004), "Factoids: Drinking Water and Groundwater Statistics for 2003." Office of Ground Water and Drinking Water, January, 2004.

United States Environmental Protection Agency. (1999) "National Characteristics of Drinking Water Systems Serving Populations Under 10,000." Prepared by The Cadmus Group, Inc., Waltham, MA.

United States Geological Survey. (2000) "Estimated Use of Water in the United States in 2000." <http://water.usgs.gov/pubs/circ/2004/circ1268/htdocs/text-do.html>.

Water Science and Technology Board. (2002) "Estimating Water Use in the United States: A New Paradigm for the National Water-Use-Information Program." <http://books.nap.edu/books/0309084830/html/172.html#pagetop>