Jill C. Fike
Director

Angie Fiese
Deputy Director

Telephone
404.656.0015

Fax
404.657.0929

Senate Research Office
204 Paul D. Coverdell Legislative Office Building
18 Capitol Square
Atlanta, Georgia 30334

FINAL REPORT OF THE LONG-TERM AQUIFER STORAGE SENATE STUDY COMMITTEE

COMMITTEE MEMBERS

Senator Ross Tolleson, Chairperson
District 20

Senator Tyler Harper
District 7

Senator Rick Jeffares
District 17

Senator William Ligon, Jr.
District 3

Senator Freddie Powell Sims
District 12

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TABLE OF CONTENTS

Introduction 1

Background 1

Findings 3

Recommendations 6

INTRODUCTION

The Long-Term Aquifer Storage Senate Study Committee ("Committee") was created under the authority of Senate Resolution 4 in the interim between the 2014 and 2015 Legislative Sessions of the Georgia General Assembly.

The Committee was composed of five members: Senator Ross Tolleson, serving as Chairman; Senator Tyler Harper; Senator Rick Jeffares; Senator William Ligon, Jr.; and Senator Freddie Powell Sims.

The Committee held one meeting at the Jekyll Island Convention Center on August 4th, 2014, and one meeting at the State Capitol in Atlanta on September 25th, 2014. At the first meeting, the Committee heard testimony from Mr. Russ Pennington, Georgia Environmental Protection Division (EPD); Mr. John Sawyer, Public Works and Water Resources Bureau, City of Savannah; Mr. Doug Meill, Georgia Chamber; and Mr. Benjy Thompson, Georgia Coastal Region Water Council. At the second meeting, the Committee heard testimony from: Mr. Russ Pennington, Georgia EPD; Ms. June Mirecki, U.S. Army Corps of Engineers; and Mr. James Kennedy, Georgia Department of Natural Resources. The Committee also received public commentary at both meetings.

BACKGROUND

Georgia has abundant water resources, with 14 major river systems and multiple groundwater aquifer systems.[1] However, as our state's population and economy grow, demands on the state's water resources will grow as well. The State Water Plan, completed and approved in January of 2008, identifies Aquifer Storage and Recovery (ASR) as a possible water management practice to be employed, following state policy and guidance, to ensure that the anticipated demands can be met. The State Water Plan defines ASR as a process in which water is recharged (replenished) through a well into an aquifer and later withdrawn in time of need.

Most of Georgia's aquifers are confined, meaning they lie under impermeable layers of soil or rock, and are located in the Coastal Plain, south of the Fall Line. These include the Cretaceous, Claiborne, Gordon, Clayton, Brunswick, and Floridan Aquifers. Aquifers north of the Fall Line include the Paleozoic and Crystalline Rock Aquifers. Shallow surficial aquifers exist throughout the state, but are principally located in the Coastal Plain.

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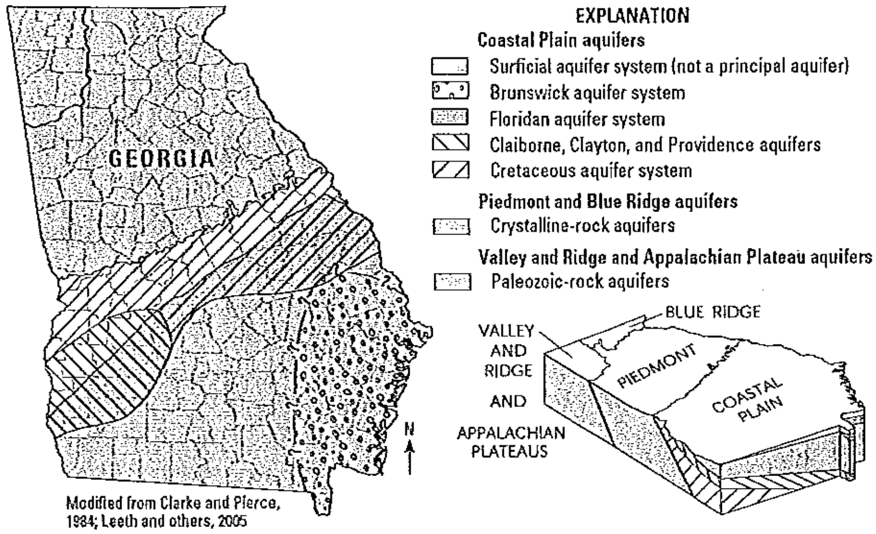
[1] Most of the Earth's surface is underlain by groundwater, which collects in pores and in the cracks in rocks. Layers of rock that can produce water when pumped are referred to as aquifers.

The Floridan Aquifer underlies a significant portion of Georgia's Coastal Plain, as well as areas of South Carolina, Alabama, Mississippi, and the entire state of Florida. The 100,000 square-mile aquifer is one of the most productive in the world, and is the principle source of groundwater in Georgia. In Georgia, the Floridan Aquifer system is divided into the Upper Floridan and the Lower Floridan.



The Floridan Aquifer has been used to supply municipal water for more than 100 years. However, the amount of water being used has increased, notably due to the expansion of irrigation, population, industry, and mining. Deep cones of depression have formed in the aquifer in the areas surrounding Brunswick, Savannah, Jesup, Riceboro, and St. Mary's, as well as some neighboring areas in South Carolina and Florida. Over time, saltwater has begun to intrude into the aquifer from the ocean in the Savannah area and from a deep pool of salt water in the Brunswick area.

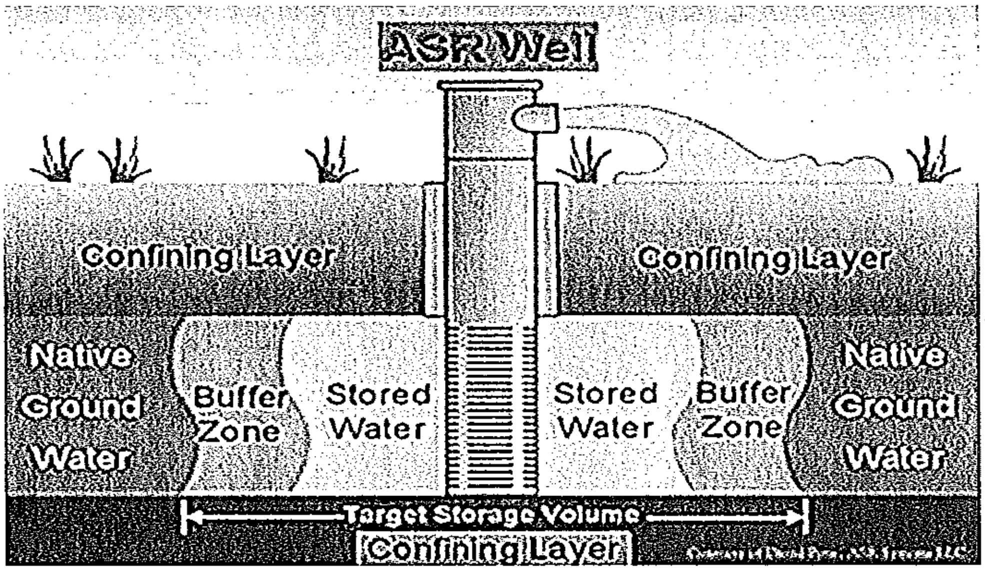
House Bill 502, which was passed during the 1999 Legislative Session of the Georgia General Assembly, instituted the first moratorium on ASR projects that would inject water into the Floridan Aquifer in the coastal Georgia region. The moratorium was initially set to expire on December 31, 2002. However, it was extended in subsequent legislation, the most recent being House Bill 552, which was passed during the 2009 Legislative Session. The moratorium instituted by HB 552 expired on July 1, 2014. Senate Bill 306, which would have permanently extended the moratorium, failed to pass during the 2014 Legislative Session.

FINDINGS

ASR Technology and Types of Systems

ASR is a relatively new technology. Worldwide, ASR systems are currently being operated in the United Kingdom, Canada, Australia, South Africa, and Israel. According to the Environmental Protection Agency's website, as of 2009, there were over 1200 ASR wells throughout the country (mostly in the Southeast, Southwest, and West), with most of the wells located in coastal areas. The use of ASR projects in the United States varies by region; its most predominant use is in areas that need additional drinking water supplies.

The technological process of ASR involves the storage of freshwater in a brackish-water aquifer through wells, during periods of heavy rainfall, for subsequent retrieval from wells during dry periods. The freshwater forms a bubble within the aquifer around the ASR well, and can be retrieved when needed.



Ms. Mirecki informed the Committee as to the four types of ASR systems:

1. *Potable (drinking) water*: Used to augment drinking water during peak demand. This type of ASR system is operated as a component of a drinking water treatment plant. It offers long-term, seasonal, or emergency storage of water. Water from the reservoir in the plant is treated prior to recharge and after recovery. No untreated water enters the public water supply. One advantage to this system is that the conjunctive use of ASR and a reservoir provides flexibility in operations. One disadvantage is the cost – treatment before and after storage increases unit cost.
2. *Surface water*: Used to maintain minimum flows and levels, ecosystem restoration, and to mitigate saltwater intrusion. It offers seasonal or long-term storage. Surface water is taken from a river or stream when flow is higher than normal, typically during the winter months. Water is treated prior to recharge and after recovery; however, the level of treatment depends on the application. One advantage to this system is that it leaves a small footprint. One disadvantage is a slow recharge rate that does not provide flood protection.
3. *Reclaimed water*: Highly treated wastewater is recharged for reuse for irrigation purposes. Wastewater is treated prior to entering the distribution system. One advantage to this system is that it re-uses wastewater rather than disposal by an injection well. One disadvantage is that it involves a lengthy permitting process.
4. *Inter-aquifer transfer, raw groundwater*: Used to transfer and store water between aquifers or with groundwater to augment stream flow. Requires no treatment prior to recharge, only after recovery.

Ms. Mirecki described the components of a surface water ASR system. A recharge pump withdraws the surface water and drives water through the treatment facility into the aquifer. A submerged well screen is designed to prevent fish larvae entrainment; an "air burst" system automatically cleans the screen when clogging occurs.

A pressure filter removes particles as they flow through a bed of sand and gravel. Disinfection of surface water is required before water enters the aquifer through the ASR well. The disinfection is required to kill pathogens such as fecal coliforms. Ultraviolet (UV) disinfection is preferred over chemical disinfection in a surface water system. However, it is more expensive. Chemical disinfection is used at potable water systems. The ASR well connects the surface with the aquifer. The pump recovers water from the aquifer. Typical pumping capacities range between one million and five million gallons of water per day. Oxygen is introduced into the water prior to distribution in the surface water.

Geological and Environmental Considerations

According to Mr. Kennedy, the reliability and productivity of groundwater aquifers depend on a wide variety of variables, including how easily water can pass through the rocks (permeability), the size and number of openings in the rock (porosity), the rate of leakage from adjacent geologic units, and the rate at which the water in the rocks is replenished by precipitation and its connections to surface water sources and recharge areas. The hydrogeological characteristics of a suitable storage zone for the water that is injected into the aquifer are: moderate permeability; confinement above and below by low-permeability sediments; and water quality as fresh as possible to minimize mixing. Natural water quality in the storage zone ranges from fresh, suitable for drinking without treatment, to brackish, a mix of salt and fresh water. Any mixing of the injected water with groundwater may cause precipitation in the well. Precipitation may cause clogging of the well screen which may decrease well productivity.

Recovery efficiency is an important water quality and operational criterion for successful ASR programs. It is defined as the volume of water that can be recovered that meets established water quality criteria during an individual ASR cycle, as a percentage of the volume stored in that cycle. There may be a difference between the amount of water recharged into an aquifer and the amount of recharged water pumped from an aquifer. Recovering only a portion of the recharged water may indicate recovery efficiency less than 100 percent. Recovering most of the recharged water, or more than is put in, may indicate high recovery efficiency. The amount of recovered water may be greater if fresh water is injected into the well, and fresh water is taken out. Mr. Sawyer emphasized that the withdrawal of water must be from the same storage zone. According to Mr. Kennedy, the coastal plain of Georgia is the most suitable for ASR.

Environmental considerations were reflected in the public commentary received by the Committee. These considerations specifically focused on: potential leaching of metals such as arsenic, mercury, and uranium from the limestone into the recovered water or into the surrounding aquifer; potential contamination of the aquifer with disinfection byproducts; potential contamination with pathogenic microbiota such as bacteria; and mixing with surrounding brackish water so that recovery efficiency is reduced to below actable levels. These concerns also differ greatly depending on the source of water. Surface water generally has a higher dissolved oxygen content, which may cause more leaching of trace metals and pathogens that require disinfection. Groundwater may have lower dissolved oxygen than surface water; however, groundwater may not always be available for recharge if it is being used for irrigation purposes.

ASR Implementation in Florida

Ms. Mirecki provided the Committee with information regarding Florida's utilization of ASR systems. ASR has been a water resource management tool in the state since 1983. Currently in the state, there are four potable water ASR systems with operating permits, and two reclaimed water ASR systems with operating permits. More operating permits are in the pipeline. In its operational testing of these systems, Florida evaluated the systems' technical performance using three criteria:

1. *Recoverability*: What percentage of the recharge volume can be recovered? Florida had 100 percent in fresh aquifers and a lower percentage in brackish aquifers due to mixing of fresh and salt water. The fresh water has a tendency to float on top of the brackish water.
2. *Water Quality*: Does the water quality degrade or improve during storage? Florida found that mixing will increase salinity. Reactions between the water and rock can degrade water quality, resulting in arsenic mobilization. The fate and control of arsenic depends on the type of system.
3. *Aquifer Integrity*: Do physical changes occur to the aquifer rock? Hydrofracturing takes place at exponentially higher pressures than those that operate in ASR systems.

ASR Implementation in Georgia

Currently, there are no ASR operations in Georgia. According to Mr. Pennington, Georgia requires that all new and existing underground injection wells be covered under an EPD permit. Permits are issued under the Rules for Underground Injection Control (UIC), which are part of the Rules for Water Quality Control. The UIC rules do not allow the injection of any substances (including hazardous waste or toxic chemicals) that would pose a threat to the state's underground sources of drinking water. ASR wells are regulated as Class V wells[2]; permit provisions govern well construction, conditions for system operation to protect groundwater quality and aquifer integrity, as well as any monitoring, testing, or reporting requirements.

Senate Bill 213, which was passed during the 2014 Legislative Session, allows the state to fund projects to augment stream flows in a portion(s) of the Flint River Basin. One project that has been funded is the Georgia ASR Demonstration Project in the Elmodel Wildlife Management Area. A well installed in the shallow Floridan aquifer will provide recharge water to an ASR well installed across the deeper Claiborne/Clayton aquifers, located in the southwest part of the state. The water will remain (stored) in the Claiborne/Clayton Aquifers until it is withdrawn (recovered) from the Claiborne/Clayton Aquifers to augment stream flow in the Chickasawhatchee Creek. This demonstration project will test the feasibility of ASR at this particular site, with a focus on determining storage volumes, recharge rates, recovery rates, and water quality changes that might result from storing water in the Claiborne/Clayton Aquifers. Mr. Pennington noted that this project is using an inter-aquifer type of ASR system. Because it does not involve injecting any water into the Floridan aquifer, and the water in the Floridan Aquifer does not have any dissolved oxygen content, the water quality of the aquifer will not be jeopardized.

RECOMMENDATION

The challenges to sustaining present and future water supplies are great and growing. Thus, demand for water management tools such as ASR is likely to continue to grow. ASR has the potential to be a useful water resource management tool in Georgia. However, each aquifer in Georgia has unique geologic and hydrogeological properties.

Therefore, the Committee recommends that the permitting of any ASR system in Georgia be site specific so as to ensure that the design, operation, and monitoring requirements are adequate to achieve the water resource management benefits while mitigating the environmental and geological concerns.

[2] Class V wells include recharge wells used to replenish or store water in an aquifer and salt water intrusion barrier wells used to inject water into a fresh water aquifer to prevent the intrusion of salt water into the fresh water.

DISSENT
ON THE LONG-TERM AQUIFER STORAGE SENATE STUDY COMMITEE REPORT

Honorable William Ligon
Senator, District 3

I. INTRODUCTION

The Long-Term Aquifer Storage Senate Study Committee was created pursuant to the passage of Senate Resolution 4 during the 2014 legislative session. The Committee was created in response to Senate Bill 306, which would have permanently banned pumping surface water into any aquifers governed by the Georgia Coastal Zone Management Program. Since 1999, the Georgia Legislature, in its collective wisdom on this issue, has repeatedly banned ASR projects. However, the moratorium lifted on July 1, 2014 due to the fact that SB 306 did not pass during the session. Although the Committee does not suggest any specific plan to allow ASR, it has left the door completely open for ASR projects in Georgia. Without a moratorium on any of Georgia's aquifers, permits can now be issued on a case-by-case basis.

II. ASR SENATE STUDY COMMITTEE REPORT IS FLAWED

I respectfully dissent from the December 2014 "Final Report of the Long-Term Aquifer Storage Senate Study Committee." The report is both inaccurate and incomplete, and it downplays the substantial risks that Aquifer Storage and Recovery (ASR) poses for Georgia's pristine aquifer systems, on which thousands of citizens depend for reliable drinking water.

ASR's potential in Georgia is based on an oversimplified and faulty assumption that is illustrated in the figure on page 3 of the report. This figure assumes that injected water will somehow remain separate from surrounding aquifer water, perhaps through an undefined "buffer zone." Yet the State Geologist himself testified that ASR water will not remain static if infused into the aquifer. This means that our pristine Georgia aquifers will be put at risk for contamination, costing taxpayers and ratepayers in higher water bills and greater cleanup technologies. We should not be rolling the dice with these critical resources.

II. ASR SENATE STUDY COMMITTEE REPORT IS INCOMPLETE

Dozens of commenters have been left out of the "Introduction" section of the report, including stakeholders at both hearings who presented valid concerns about the scientific and legal ramifications of ASR in Georgia. Furthermore, excessive weight has been placed on the testimony of Ms. June Mirecki, who, contrary to the report's characterization, actually appeared before the committee as a consultant and not as a representative of the U.S. Army Corps of Engineers. Her testimony about the "success" of ASR in Florida has also been questioned by other commenters and by scientific literature which has been submitted to the Study Committee, but which is nowhere reflected in the Final Report. Although it is mentioned that arsenic contamination does occur, it does not mention that Georgia's Floridan Aquifer would yield similar problems for coastal Georgia. In addition, Florida is presented as a success story with regard to ASR, however, of the 54 ASR sites in Florida, 32 of them are non-operational. Furthermore, nationwide, of the 204 ASR sites, only 37 percent are operational, 26 percent were operational then ceased, 12 percent started testing then stopped, and 24 percent are currently in the testing phase. The report also glosses over the risks of contamination, issues with the efficiency of recovering any stored water, and the significant costs of implementing ASR systems (or remediating potential contamination).

III. TOO RISKY FOR GEORGIA'S DRINKING WATER AQUIFERS

ASR is experimental at best. There is no justification for ASR wells in Georgia as augmentation for drinking water. The risk of contamination to the pristine water resources is too great. Furthermore, the notion that ASR can be an effective drought augmentation to increase flow in rivers is far-fetched. Only very small rates of flow can be delivered to the surface from ASR wells (compared to most river flows in Georgia). Even to achieve 1 percent of average flow would probably require multiple wells of exceptional delivery rates

IV. RECOMMENDATIONS

The General Assembly should prohibit the practice of ASR in drinking-water aquifers. Period. Continuing to press forward demonstrates a disregard for sound science, for less expensive alternatives to saltwater intrusion, for less expensive alternatives to water supply, and puts future generations at risk of compromised water supplies and higher costs due to constant and often unsuccessful site-specific testing and clean-up costs when contamination occurs.