

No. 142, Original

In The
Supreme Court of the United States

STATE OF FLORIDA,

Plaintiff,

v.

STATE OF GEORGIA,

Defendant.

**DIRECT TESTIMONY OF
GAIL COWIE, Ph.D.**

October 26, 2016

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I, Gail Cowie, offer the following as my Direct Testimony.

INTRODUCTION

1. I am Assistant Branch Chief of the Watershed Protection Branch at the Georgia Environmental Protection Division (“EPD”). I have worked for EPD since 2005. During my tenure at EPD, Georgia has taken a number of proactive measures to manage water use across the state, and specifically in the Flint River Basin. Three examples of initiatives undertaken by the State, in which I have been directly involved, are the 2006 Flint River Basin Regional Water Development and Conservation Plan (“2006 Plan”), the State Water Plan, and the 2014 amendments to the Flint River Drought Protection Act.

2. In recent years, EPD has continued to study additional potential management tools that would further strengthen and improve Georgia’s management of water use and streamflows in the Flint River Basin, including moving groundwater or surface water users to deeper aquifers, aquifer storage and recovery, and agricultural easements. These studies are ongoing, and Georgia has not yet reached any conclusion as to the feasibility of these additional potential management tools, their potential costs, and what stream-flow benefits, if any, they might yield. Georgia will continue to explore these, and other additional potential management tools to support long-term water use and streamflows in the Flint River Basin.

PERSONAL AND PROFESSIONAL BACKGROUND

3. I live in Atlanta, Georgia, and have lived in Georgia for over 35 years. I have a bachelor’s degree in Biology from Wells College, a master’s degree in Zoology from the University of Georgia, and a Ph.D. in Public Administration from the University of Georgia. My Ph.D dissertation focused on interstate management of river basins.

4. I first began working EPD in 2005 as a contractor. In that capacity I worked in then-EPD Director Carol Couch’s office, principally advising Director Couch on environmental assessment, cross-media policy, and developing Georgia’s State Water Plan. In September 2007, Director Couch hired me as a Senior Policy Advisor at EPD, a role I held through 2011. Since 2012, I have served as Assistant Branch Chief of the Watershed Protection Branch of EPD. In

that role, I coordinate non-routine aspects of the Watershed Protection Branch's Programs in the Coosa, Chattahoochee, Flint, Ochlockonee and Tennessee River basins.

2006 FLINT RIVER BASIN REGIONAL WATER DEVELOPMENT AND CONSERVATION PLAN

5. The 2006 Plan was released in March 2006, following a moratorium on the issuance of new farm use permits in the Lower Flint River Basin that lasted over six years. During the pendency of that moratorium Georgia, together with technical experts, policymakers, farmers, environmental groups, and other stakeholders carefully studied agricultural water use, hydrogeology, and the impacts of water use on the stream-aquifer system and stream ecology in the Flint River Basin. The 2006 Plan resulted in a progressive set of EPD permitting and water resource management actions, which reflected the then-most-recent and comprehensive scientific understanding of agricultural pumping and its effects on the water resources in Southwest Georgia.

6. I worked as a contractor at EPD during the period in which the 2006 Plan was being finalized. After the 2006 Plan was issued, I worked with farmers and other stakeholders in the Flint River Basin to help them understand the relevant portions of the 2006 Plan. During the course of my time working at EPD over the past decade, I also became familiar with the history and background of the 2006 Plan. JX-21 is a true and correct copy of the 2006 Plan.

A. Background of the 2006 Plan.

7. In October 1999, in response to growth in agricultural irrigation and a sustained drought, Georgia sought to increase its understanding of agricultural water use in the Flint River Basin and of the interaction between agricultural irrigation and Flint River flows. To that end, then-EPD Director Harold Reheis launched a Sound Science Study (the "Sound Science Study") to better understand agricultural water use and the hydrogeology of the Flint River Basin. The Sound Science Study was designed to improve the scientific understanding of the nature and effects of agricultural water use in the Flint River Basin and lay the foundation for a regional water development and conservation plan in the Flint River Basin—ultimately, the 2006 Plan.

8. The Georgia General Assembly specifically allocated funding for the Sound Science Study, and EPD subsequently engaged numerous subject matter experts, including the University of Georgia and the U.S. Geological Survey (“USGS”), to compile and analyze information on irrigated acreage, agricultural water use, groundwater hydrology, surface water flow regimes, and technical modeling of ground and surface water resources. In connection with the Sound Science Study, these contractors and in-house EPD employees performed substantial technical modeling, which significantly advanced Georgia’s scientific understanding of the Lower Flint River Basin.

9. On October 14, 1999, Director Reheis announced a moratorium on all groundwater permit applications from the Upper Floridan aquifer in areas of the Lower Flint River Basin (called “Subarea 4” by the USGS), and on all surface water permits from the Flint River Basin, during the pendency of the Sound Science Study. After Director Reheis announced the impending moratorium, but before it was instituted, farm-use permit applications continued to be submitted to EPD. EPD staff engaged in field-verification efforts to determine which applications were for existing withdrawals, and which were for proposed withdrawals. EPD issued permits for existing withdrawals, and held permits for proposed irrigation systems in abeyance. This led to a “backlog” of applications for approximately 1134 permits, which were held in abeyance pending the outcome of the Sound Science Study and the release of the 2006 Plan (the “Backlogged Applications”).

10. To assist with the development of the 2006 Plan, Georgia formed a Stakeholder Advisory Committee (“SAC”) and a Technical Advisory Committee (“TAC”). The SAC was comprised of various southwest Georgia stakeholders, including representatives from agricultural, industrial, municipal and ecological interests who were actively involved in regional discussions around water issues. The SAC was charged with developing a plan for water withdrawals in the Flint River Basin that appropriately balanced conservation and economic development, delivering recommendations for best managing resources in the Flint River Basin under existing law, and recommending potential statutory and regulatory reforms. The TAC included biologists, geologists, economists, and agricultural specialists. It provided independent data and analysis to EPD, prepared information on the stream hydrology, hydrogeology, ecology,

water use patterns and economy of the region, and addressed technical questions raised by the SAC.

B. Permitting and Water Resource Management Actions Under the 2006 Plan.

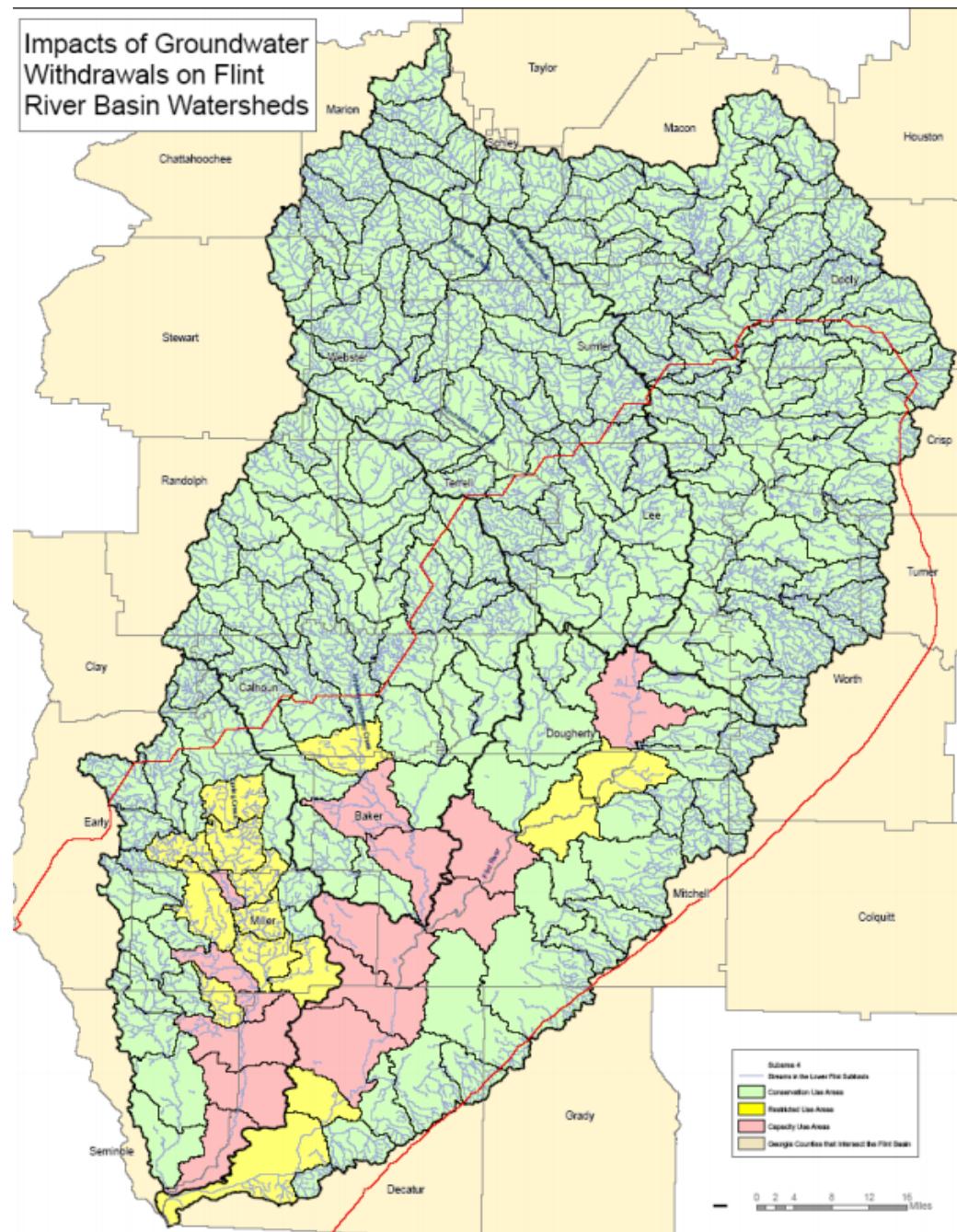
11. Director Couch approved and issued the 2006 Plan on March 20, 2006. It incorporated policy recommendations developed by the SAC, and was heavily informed by the technical findings of the TAC and the Sound Science Study.

12. The 2006 Plan resulted in a variety of EPD permitting and water resource management actions. It added specific provisions for permitting of agricultural withdrawals that apply in the Flint River Basin, in addition to existing provisions generally applicable to all basins, and set forth how EPD conducts management of agricultural water use and permitting in that area. It covers agricultural water use in the entire Flint River Basin, however, the permitting and resource management actions are focused in the Lower Flint River Basin where agricultural water use is greatest. These permitting and resource management actions included mandatory conservation requirements and low flow protection plans for certain farm use permits, and restrictions on the issuance of permits in designated watersheds or for certain well locations based on their proximity to nearby users, streams or springs.

1. Restrictions in Designated Watersheds.

13. The 2006 Plan divided the watersheds within the Lower Flint River Basin into three categories: Capacity Use Areas, Restricted Use Areas, and Conservation Use Areas. Cowie Demo. 1 is a map showing the locations of Capacity Use Areas, Restricted Use Areas, and Conservation Use Areas under the 2006 Plan. *See Exhibit JX-21 at 25.* Capacity Use Areas are shown in red; Restricted Use Areas are shown in yellow; and Conservation Use areas are shown in green.

Cowie Demo. 1. Classification of Watersheds in Flint River Basin



Source: JX-21 (2006 Plan) at 25

14. These three categories were based on the best available information from the Sound Science Study and the TAC regarding irrigation practices in the Flint River Basin and the modeled impacts of groundwater pumping on streamflow. Generally speaking, under the 2006

Plan, the greater the modeled impact of groundwater pumping on streamflow in a watershed, the greater the corresponding restrictions on the issuance of farm use permits. Capacity Use Areas were found to have the greatest modeled impact from groundwater pumping on streamflow and thus were given the most severe restrictions on the issuance of permits, with Restricted Use Areas having the next strictest limitations, followed by Conservation Use Areas. *See JX-21 at 26.*

15. Pursuant to the 2006 Plan, EPD maintained the restrictions on the issuance of new groundwater permits from the Upper Floridan aquifer and new surface water permits in Capacity Use areas, which were previously specified in the 1999 Moratorium, with the exception of (1) the Backlogged Applications and (2) Upper Floridan aquifer applications for individual farms that straddled the divide between a Capacity Use Area and Restricted or Conservation Use Areas.

16. For Backlogged Applications issued in Capacity Use Areas concerning (1) groundwater withdrawals from the Upper Floridan aquifer or (2) surface water withdrawals, the 2006 Plan required as a condition of issuance of the permit that the permit applicant adopt a suite of specific irrigation management and conservation requirements. Specifically, the 2006 Plan required that the irrigation system associated with the permit application: (1) have end-gun shut off switches installed on center pivot systems; (2) be maintained to prevent and repair leaks; (3) have pump-safety shutdown systems installed on center pivot systems, and (4) have rain gage shut-off switches for traveler, solid set, or drip irrigation systems. JX-21 at 34. Each of these requirements was designed to ensure that permittees used agricultural water conservation techniques that were state-of-the-art and operate to reduce the volume of water withdrawn, used, or applied to their crops.

17. In Restricted Use Areas, permits issued or modified after March 1, 2006 for irrigation systems supplied by groundwater withdrawals from the Upper Floridan aquifer or surface water withdrawals, including Backlogged Applications, were required, as a condition for the issuance of the permit, to, adopt the same suite of conservation requirements required for new permittees in Capacity Use Areas. *See id.*

18. Lastly, all new permits in Conservation Use Areas for groundwater withdrawals from the Upper Floridan aquifer or surface water withdrawals were required, as a condition for the issuance of the permit, to have (1) end gun shut off switches; and (2) maintenance to prevent and repair leaks. *See id.*

2. Low Flow Protection Plans.

19. The 2006 Plan required that all newly issued surface water withdrawal permits in the Spring Creek and Ichawaynochaway sub-basins have a low flow protection plan. *See id.* at 35. These low flow protection plans required a complete cessation of withdrawals from the newly permitted source when discharge at the withdrawal location falls below 25% of the average annual discharge, calculated from the period of record for the nearest downstream continuous flow gauge, plus a prorated portion of the permitted amount of downstream users. *See id.* Use of 25% of the annual average discharge is a stricter threshold for low flow protection than applied in agricultural permits in other watersheds.

3. Proximity to Nearby Users, Streams and Springs

20. The 2006 Plan also imposed new restrictions on the granting of groundwater withdrawal permits based on an improved understanding of the hydrology and hydrogeology of the Flint River Basin. Pursuant to the 2006 Plan, EPD no longer issues permits for proposed wells withdrawing groundwater from the Upper Floridan aquifer if the new well is within 0.25 miles of another user's well, unless hydrogeologic evaluation indicates that the proposed well would not cause or contribute to excessive drawdown in the other user's well. *See id.* at 33.

21. In addition, the 2006 Plan provides that proposed irrigation wells that would draw from the Upper Floridan aquifer within 0.5 miles of an in-channel spring or stream which exhibits a demonstrable connection with the Upper Floridan aquifer will not be permitted if hydrogeologic evaluation indicates that, for the stream reach closest to the proposed well, the well would lower the Upper Floridan aquifer water level to below the average stream stage or decrease the discharge of the spring. *See id.*

22. Following issuance of the 2006 Plan, EPD identified sources of best available information indicating a demonstrable connection between surface waters and the Upper

Floridan aquifer, combined several of the best available indicators to designate what came to be called “critical streams,” and established half-mile buffers on either side of those critical streams. EPD no longer allows the drilling of proposed Upper Floridan wells within those buffers. All of these permitting requirements from the 2006 Plan continue to remain in place today, except to the extent that then-EPD Director Jud Turner augmented those requirements pursuant to the permitting moratorium he declared on July 30, 2012.

23. The 2006 Plan provides that it will be re-evaluated every three years based on new scientific information. *See id.* at 36. By 2009, the regional water planning process (described below) had been established, and so the review of the 2006 Plan was subsumed in the regional water plan development process.

C. The Plan Balanced Between Conservation and Economic Activity.

24. One of the goals of the 2006 Plan was that “[a] balance . . . be struck between acceptable water use that allows for robust economic activity and strong communities, and acceptable conservation that maintains the aquatic health of the water resources.” JX-21 at 42. To support an appropriate balancing of these factors, the 2006 Plan included several findings regarding the significance of the Flint River Basin’s ecological resources as well as the significance of agriculture, and in particular, agricultural irrigation to the Flint River Basin economy and community.

25. The 2006 Plan measured the total impact of agriculture in the Lower Flint River Basin as of 2006 to be approximately \$5.8 billion, or 34% of the regional economy. *See id.* at 17. The 2006 Plan specifically found that “[t]he economic vitality of southwest Georgia communities is closely tied to the availability of water for irrigation,” that “[t]he availability of water for irrigation is a financial consideration in determining property values, loan rates, profit margins, and other measures of economic security for farmers and their communities” and that “[d]enying or severely limiting access to water for farm use would have a devastating economic impact on the entire region.” *Id.* at 44. The 2006 Plan also found that the Flint River Basin “is ecologically significant due to its unique geology, long stretches of unimpeded flow, and threatened or federally protected and endangered aquatic species.” *Id.* at 41.

26. The findings of the 2006 Plan and the permitting and water resource management actions mandated by the 2006 Plan are based on modeling, statistical analysis and scientific review that utilized the best information available at the time. Within the constraints on available information, Georgia worked to strike a balance between allowing sufficient agricultural irrigation given its importance to the regional economy and to the well-being of many communities in the region versus imposing new permitting and management requirements on permits to appropriately conserve water resources in the region.

27. I understand that Florida has taken certain statements in the 2006 Plan out of context or has misinterpreted certain statements in the 2006 Plan. For example, I understand that Florida has suggested that the 2006 Plan requires or recommends a reduction of irrigation in certain sub-basins during drought conditions, and has claimed that Georgia has failed to implement this requirement. This misreads the 2006 Plan.

28. The 2006 Plan's required permitting and water resource management actions are included in Part I.B of the 2006 Plan. *See id.* at 23-36. That section does not propose, much less require, a 20% or 40% reduction in irrigation in particular sub-basin, or anywhere in the Flint River Basin. In fact, in connection with the 2006 Plan, Georgia hired contractors to analyze the economic impacts of 20%, 30%, and 40% reductions in irrigated acreage in the Ichawaynochaway and Spring Creek sub-basins. *See id.* at 152. This economic analysis, which is reported in the 2006 Plan for illustrative purposes, concluded that the economic effects of any such restriction would be severe—\$70 million of losses to total economic output and the loss of nearly 1,000 jobs. *See id.* at 157. These findings underscore the importance of agricultural irrigation to economic well-being and livelihood of residents of the Flint River Basin and demonstrate the importance of a sensible balance between the economy of the region and our collective interest in protecting the resource.

STATE WATER PLAN

29. In 2008, Georgia adopted a State Water Plan. It was the result of four years of study and development based on the 2004 Comprehensive State-wide Water Management Planning Act, which authorized the preparation and adoption of a State Water Plan and gave the EPD Director duties and responsibilities in chairing a water council to help oversee development

of the State Water Plan. The State Water Plan provided for a comprehensive process to ensure that Georgia's water resources are managed in a sustainable manner across the state.

30. At EPD, I was a part of the core team that oversaw the development of the State Water Plan. Subsequently, I was part of the team that detailed the regional water planning process, including coordinating the Regional Water Councils created by the State Water Plan as they developed their Regional Water Plans.

A. Background of the State Water Plan.

31. In 2004, while EPD was conducting the Sound Science Study in the Flint River Basin, the Georgia Legislature passed the Comprehensive Statewide Water Management Planning Act (the "2004 Act"). GX-0064 is a true and correct copy of the 2004 Act, which is maintained as part of the official records of Georgia. I became familiar with the 2004 Act in connection with my responsibilities overseeing the development of the State Water Plan.

32. The 2004 Act created the Georgia Water Council, which was comprised of state legislators, officials from various government agencies, and stakeholder citizens. The 2004 Act directed EPD to develop and submit a draft comprehensive state-wide water management plan to the Georgia Water Council in accordance with the policy to "manage[] water resources in a sustainable manner to support the state's economy, to protect public health and natural systems, and to enhance the quality of life for all citizens." GX-0064 at 2. The 2004 Act directed the Water Council to provide oversight to EPD with respect to the plan's development. After EPD submitted the draft State Water Plan, the 2004 Act called for the Water Council to review it and submit a final plan to the Georgia General Assembly for passage. *Id.* at 3-4.

33. The 2004 Act required that all water withdrawal permitting decisions made by EPD be made in accordance with the new State Water Plan. It also provided that any political subdivisions or water authorities not in compliance with the State Water Plan would be ineligible for state grants or loans for all water projects (except for those designed to bring them in compliance with the plan). *Id.* at 3.

34. Following passage of the 2004 Act, I was part of the EPD team responsible for assembling and coordinating with basin advisory committees, a statewide advisory committee,

and technical advisory committees that were established to consider and evaluate water policy options and management practices as preparation for drafting the State Water Plan. EPD also managed an extensive public involvement process to solicit input for the State Water Plan from hundreds of individuals representing agricultural and business interests, local governments, trade associations, and non-profit agencies, among others.

35. EPD and the Water Council prepared a draft Plan that went through a public comment and review process, was revised several times, and was ultimately approved by the Water Council on January 8, 2008. The final State Water Plan was adopted by the General Assembly, and signed by the Governor in February 2008. GX-210 is a true and correct copy of the State Water Plan, which is maintained as part of the official records of Georgia.

B. The State Water Plan and Regional Water Planning Process.

1. The State Water Plan.

36. The State Water Plan established ten Regional Water Planning Councils (“Regional Council”) and required each one to develop and recommend a Regional Water Development and Conservation Plan (“Regional Water Plan”) to submit to EPD.

37. The ten new Regional Councils were Coosa-North Georgia, Middle Chattahoochee, Upper Flint, Lower Flint-Ochlockonee, Savannah - Upper Ogeechee, Upper Oconee, Middle Ocmulgee, Altamaha, Suwannee-Satilla, and Coastal Georgia. The Metropolitan North Georgia Water Planning District was separately established by statute in 2001, and represents Georgia’s eleventh water planning region. The following Regional Councils include counties that lie wholly or partially in the ACF Basin in Georgia: Coosa-North Georgia, Middle Chattahoochee, Upper Flint, Lower Flint-Ochlockonee, and the Metro Water District. Cowie Demo. 2 below shows the geographic area covered by each Regional Council.

Cowie Demo. 2. Georgia's Water Planning Regions



Source: GX-387 at 3

38. The State Water Plan requires each Regional Water Plan to include forecasts of water supply, and wastewater demands within the planning area. The State Water Plan charged EPD with providing technical assistance to the Regional Water Councils by performing evaluations of the capacity of the water resources in each Water Planning Region to meet these demands for water supply and assimilative capacity, called “water resource assessments.” EPD is tasked with providing these technical assessments to the Regional Councils to serve as part of the foundation for regional water planning.

39. In addition to mandating water resource assessments, the State Water Plan required the Regional Plans to compare water demand forecasts with the water resource assessments. Based on those comparisons, each Regional Plan recommended actions that could

be taken to meet the Regional Water Councils' goals and to ensure that the forecasted regional water and wastewater needs could be met within the region's water resources capabilities.

40. The State Water Plan charged EPD with reviewing the Regional Water Plans to ensure they were complete and consistent with established guidance, working with the Regional Councils to make any necessary changes, and, if warranted, approving the Regional Water Plans.

2. 2009 - 2011: First Round of Regional Water Planning.

41. The first round of regional planning began in 2009. GX-347 is a true and correct copy of a report summarizing the timeline and expenditures in connection with the first round of regional water planning. The report was written in the regular course of business at EPD and is maintained as part of the official records of Georgia. The first step was appointment of the Regional Council members, the initial rounds of Regional Water Council meetings, and the preliminary development of the required analyses. Those included (1) forecasts of future water supply and wastewater demands, which were developed with input from representatives and experts from agricultural, energy, municipal, and industrial sectors, and (2) water resource assessments, which were developed by EPD and contractors hired by EPD. GX-347 at 2.

42. EPD and its contractors completed draft resource assessments and presented them to the Regional Councils at joint statewide Regional Council meetings in early 2010. Exhibits JX-160 and JX-148 are true and correct copies of the synopses of the Groundwater Assessment, and Surface Water Assessment, respectively. In 2010, forecasts of regional water and wastewater demands were presented to Regional Water Councils. After reviewing both the draft resource assessments and the forecasted regional water and wastewater needs, the Regional Councils began to identify regionally appropriate management practices to ensure their goals and needs were met. GX-347 at 2.

43. In 2011, the Regional Councils submitted initial draft Regional Water Plans to EPD. EPD reviewed the draft Regional Water plans and managed a public comment period. After the public comment, internal review, and revision of draft plans in response to comments, EPD adopted all ten Regional Water Plans in November of 2011. During the first round of regional water planning, Georgia invested nearly \$30 million in technical work and activities to support regional water planning. On top of the financial investment, over 15,000 volunteer hours

were contributed by Regional Council members and other participants in development of the Regional Water Plans. *Id.*

44. Since the Regional Water Plans were adopted in 2011, a substantial number of management practices identified by those plans have been implemented. GX-1249 is a true and correct copy of a presentation I made at a Water Resource Management and Economics Conference at Troy University on October 22, 2014. It was created in the regular course of business at EPD. Cowie Demo. 3 summarizes implementation activities undertaken through FY 2014. *See* GX-1249 at 8. These include activities taken pursuant to Regional Water Plans, with the first row including water audits required by the 2010 Water Stewardship Act.

Cowie Demo. 3. RWP Implementation Activities through 2014

NUMBER OF PRACTICES IMPLEMENTED	Lower Flint-Ochlockonee Water Plan	Middle Chattahoochee Water Plan	Upper Flint Water Plan	Coosa-North Georgia Water Plan
Demand Management Practices	25	23	23	64
Water Supply Practices	14	9	13	2
Water Quality Practices	17	9	4	26
Data Needs, Etc.	4	4	4	3

Source: GX-1249 at 8

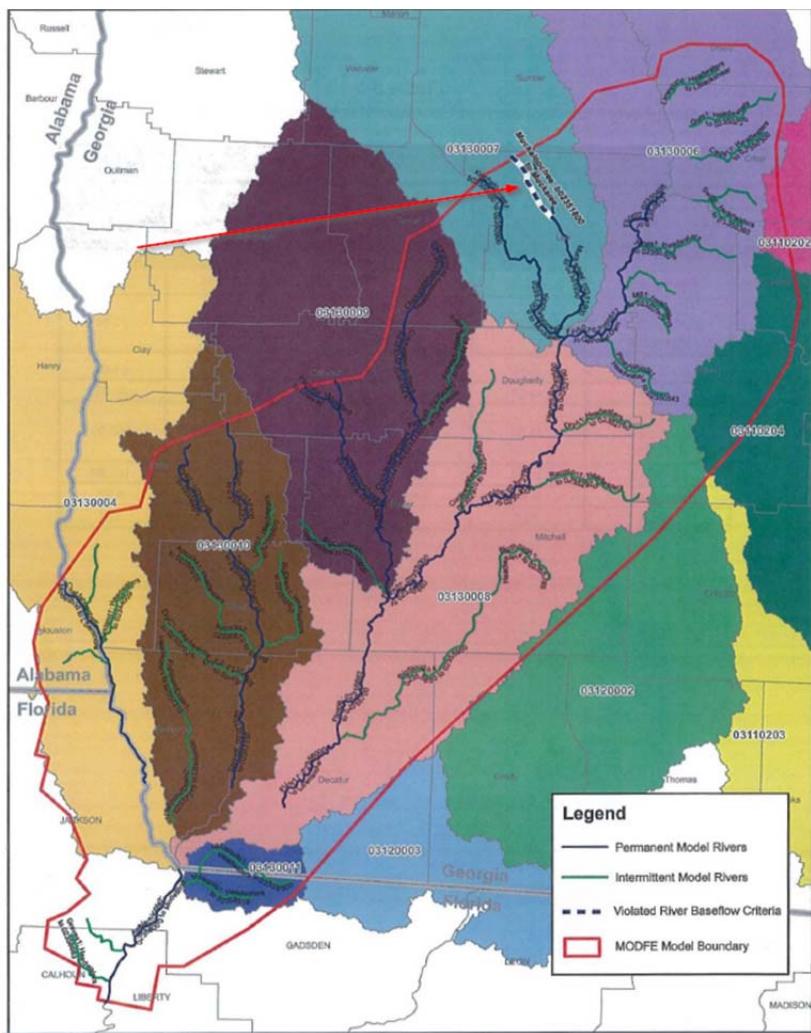
45. I understand that Florida has focused on one modeling result from the first round of water planning: the model output indicating that demand exceeded “sustainable yield” for the Upper Floridan Aquifer in the Dougherty Plain, and that therefore there was a “gap” between demand and resource capacity there. Florida misinterprets the significance of this aspect of Georgia’s regional water planning.

46. The “sustainable yield” analysis was never intended to set a “ceiling” of use that cannot be exceeded. It would be inappropriate to characterize or apply Georgia’s inquiry as a method to determine or set such a ceiling. Nor was the “sustainable yield” analysis intended to evaluate the impact of water use on flow of the Chattahoochee and Flint Rivers or the flows at the state line.

47. The purpose of the “gap” analysis was to compare resource capacity with the forecasted demand for water or wastewater, and to use that information to highlight for the Regional Councils the areas where more focused management attention may be needed. The regional water planning process was always intended to be iterative; if a “gap” was identified, that identification became a focal point for the discussion and work of the Regional Councils as they proceeded through the regional water planning process. That process included work with the Regional Councils to further understand and refine modeling assumptions, identify any needs for improved information, and identify management practices to address the effects of resource use in areas where gaps were indicated.

48. Moreover, the sustainable yield analysis is designed such that the violation of a sustainable yield metric anywhere in the region of interest determines the “sustainable yield” for the whole region. That sustainable yield is then compared with demand to determine whether or not there is a “gap.” This means that a “sustainable yield” limit can be set, and a “gap” created, based on local impacts to streamflow that have an extremely small impact on river flows. One example is Cowie Demo. 4 below, which shows the model area used to estimate the sustainable yield for the Upper Floridan aquifer in the Dougherty plain. *See JX-160 at Figure S-7.*

Cowie Demo. 4. Model Area for Sustainable Yield of Floridan Aquifer in Dougherty Plain



Source: JX-160 at Figure S-7

49. The blue and white dashed line on the upper portion of Cowie Demo. 4 shows the portion of the stream segment in which the modeling showed that the sustainable yield criterion was reached. The blue and white dashed line is located on the Muckaloochee Creek, which is a small stream that has a very small contribution to the total Flint River stream flow. It would be a mistake to conclude that, just because Muckaloochee Creek met one of the sustainable yield criteria with a low level of withdrawal, pumping in the rest of the region would have a similar impact. That is definitely not the case; the modeling was designed to identify localized impacts, and such impacts do not translate into region-wide limits on pumping or into significant changes in total baseflow contribution to the Flint River.

50. As Cowie Demo. 4 shows, the sustainable yield metric used in the Regional Water Planning Process is extremely conservative. It was meant to be a planning tool, to highlight for the Regional Councils the water resources where management attention may need to be focused. It is not meant to be and should not be used as an analysis that establishes limitations on water use in the modeled areas or to evaluate the impact of water use on flow of the Chattahoochee and Flint Rivers.

3. 2012 - 2016: Second Round of Regional Water Planning.

51. The second round of regional water planning is ongoing. In connection with that process I have been meeting with Regional Councils and technical leads on their resource assessments. EPD continues to build from the experiences gained during the first round of regional water planning to refine the technical basis for the Regional Water Plans and has worked cooperatively with the Regional Councils to refine and further develop their Regional Water Plans. The Regional Councils are tentatively expected to complete revised Regional Water Plans in June 2017.

IRRIGATION EFFICIENCY REQUIREMENTS

52. The Georgia General Assembly created and passed into law the Flint River Drought Protection Act in 2000. The Flint River Drought Protection Act created a program providing financial incentives to farmers in return for them agreeing to temporarily cease irrigating agricultural lands during times of declared severe drought.

53. In 2014, Georgia enacted a set of amendments to the Flint River Drought Protection Act (the “Amendments”) that established additional conservation mandates and enhanced Georgia’s ability to manage water use within the Flint River Basin. I was involved in soliciting stakeholder input on potential management measures, drafting the legislation, and drafting the implementing rules for the legislation. JX-105 and GX-765 are true and correct copies of the Amendments and the implementing rules, respectively. They are maintained as part of the official records of Georgia.

54. The Amendments and implementing rules specify irrigation efficiency requirements for all farm use permits in “affected areas” of the Flint River basin, “Affected

areas” is defined as “those specific portions of the state lying within the Flint River basin where ground-water use from the Upper Floridan aquifer can affect stream flow or where drainage into Spring Creek, Ichawaynochaway Creek, Kinchafoonee Creek, and Muckalee Creek occurs.” GX-0765 at A-19. This definition was designed to (and does) cover the large majority of agricultural water use in the Flint River Basin.

55. The irrigation efficiency standards specified in the Amendments and rules were rooted in management practices identified in the 2011 Regional Water Plans adopted by the Lower Flint-Ochlockonee and Upper Flint Regional Councils. They were refined by EPD in consultation with the Georgia Soil and Water Conservation Commission, and other irrigation efficiency experts.

56. EPD sought to implement efficiency thresholds that would both advance water savings in the Basin and were achievable in light of the irrigation technology available to farmers. The standards also reflect the recommendations of Regional Water Councils and irrigation efficiency experts to account for the variety of on-the-ground environmental and operational conditions faced by farmers throughout the affected area.

57. The Amendments and implementing rules require that center pivot systems achieve irrigation efficiencies of 80 percent or greater. JX-105 at 5. Center pivots are, by far, the most common irrigation systems in the Basin. The deadline for meeting this requirement depends on the date of issuance for the permit associated with the irrigation system:

- For permits issued on or after January 1, 2006, the associated irrigation system needs to meet the 80 percent efficiency requirement by January 1, 2016.
- For permits issued between 1991 and 2005, the associated irrigation system needs to meet the 80 percent efficiency requirement by January 1, 2018.
- For permits issued prior to 1991, the associated irrigation system needed to meet the 80 percent efficiency requirement by January 1, 2020.

58. The Amendments require mobile and solid set irrigation systems, which are much less common than center pivot and other types of irrigation systems, to achieve irrigation

efficiencies of 60 percent or greater by the deadlines set forth above. *Id.* All other irrigation systems are required to meet the same 80 percent efficiency standard as center pivot systems by the deadlines set forth above. *Id.* The most common method of compliance is for farmers to install or retrofit their center pivot sprinklers with low pressure systems and to implement leak detection and repair plans.

PRELIMINARY STUDIES OF ADDITIONAL POTENTIAL MANAGEMENT TOOLS

59. Beginning in 2012, Georgia began studying a number of potential additional management tools to further strengthen and improve Georgia's management of water use and stream flows in the Flint River Basin during dry periods. I coordinated with personnel from EPD, the Georgia Environmental Finance Authority ("GEFA"), and a variety of contractors hired by Georgia to study and evaluate these potential tools. Technical studies are ongoing, and Georgia has yet to reach any final conclusions about the potential costs or streamflow benefits associated with the proposals, much less whether the proposals would be justified from a cost-benefit perspective.

A. Moving Users to Deeper Aquifers.

60. One potential management tool EPD is in the process of investigating is moving surface water users or Upper Floridan aquifer users in targeted areas to deeper aquifers, principally the Claiborne aquifer. In 2012, EPD conducted a preliminary analysis of the well replacement costs and potential streamflow benefits of moving ground and surface water users in targeted areas along the Spring Creek, Ichawaynochaway Creek, and the Lower Flint River to the Claiborne aquifer. This analysis was done with limited information and was intended to determine whether further study was warranted.

61. GX-1253 is a true and correct copy of a memorandum summarizing the results of this preliminary analysis. The memorandum was written in the regular course of business at EPD and is maintained as part of the official records of Georgia. It estimated that well replacement costs would range from \$85,000 to \$414,000 per individual well, depending on the location of the user, with total well-construction estimated at \$60 to \$110 million, depending on the number and location of the users being moved. GX-1253 at 12. Likewise depending on the number and location of the users being moved, this preliminary analysis estimated June

streamflow benefits ranging from 72 cfs to 149 cfs, roughly equivalent to up to 1.2 feet of storage in Lake Lanier. *Id.* at 8-10. The irrigated acreage covered by the users under this preliminary analysis ranged between 23,882 and 53,538 irrigated acres. *Id.* at 12.

62. Following this preliminary analysis, and to determine the feasibility of moving users to deeper aquifers as a potential management tool, EPD commissioned studies on the yield, capacity, and water quality of those aquifers to determine whether they can effectively, safely, and sustainably support increased demand. This work involved partnering with GEFA and USGS to drill multiple test wells in areas where data for the Claiborne aquifer have not been available. EPD also screened the feasibility of moving specific, individual surface water users in the Ichawaynochaway basin. As part of this evaluation, EPD studied the costs of drilling wells to tap deeper aquifers as well as increased energy costs associated with pumping from deeper aquifers. EPD's analysis of potentially moving users to deeper aquifers is ongoing. EPD has not yet reached any conclusions about the viability of deeper aquifers as a source of water supply on a large scale in the Lower Flint River Basin.

63. I have reviewed the direct testimony submitted by Dr. David L. Sunding, one of Florida's expert witnesses. Dr. Sunding proposes that Georgia move 75 percent of "high-value" crops to deeper aquifers, which he assumes would amount to 83,392 acres of cropland. Dr. Sunding estimates that such a measure would save 321 to 376 cfs of peak streamflow depletions in a drought year, and testifies that "Georgia ha[d] indeed considered this option itself." Sunding Direct Testimony ¶ 86. Dr. Sunding is incorrect; Georgia has not considered such a proposal. EPD has not analyzed the feasibility of a project of the type or scale proposed by Dr. Sunding, much less "considered" implementing such a proposal. As indicated earlier in my testimony, the preliminary analysis EPD conducted in 2012 focused on targeted areas and was on a substantially smaller scale. Targeting is important because it uses hydrologic modeling to identify areas where actions can produce the most streamflow benefits for the dollars required to implement the practice. Dr. Sunding also ignores current limitations on information on productivity and overall capacity of these aquifers, a limitation that Georgia is currently studying. In short, it is uncertain whether Dr. Sunding's proposal is technically feasible or can be cost-effectively implemented at the scale proposed.

B. Aquifer Storage & Recovery.

64. Another potential management tool EPD has studied in the Flint River Basin is creating water reserves for use in dry periods through a process called aquifer storage and recovery, or “ASR.” Aquifer characteristics can limit the amount of groundwater available for a specific purpose, such as supplementing streamflow in dry periods. ASR is a technology that, depending on site conditions, may be used to provide additional water when needed for this or other project purpose(s).

65. Generally speaking, ASR involves injecting water into an aquifer for storage during times of plenty, and pumping it back up when it is needed during times of drought or low flows. In other words, ASR can be similar to storing water in an underground reservoir.

66. ASR has been used with some success in other states. However, it is a highly complex and technical water management tool, and its effectiveness is site-specific. To determine the feasibility of ASR in the Flint River Basin, EPD partnered with GEFA as well as a variety of contractors to conduct an ASR demonstration project at the Elmodel Wildlife Management Area, located in Baker County, Georgia (the “ASR Project”).

67. The ASR Project was designed to use a well in the Upper Floridan aquifer to provide recharge water to an ASR well installed in the Claiborne and Clayton Aquifers. That ASR well would in turn be used to augment stream flow in the Chickasawhatchee Creek. EPD worked with GEFA over the course of 2014 and 2015 to construct monitoring wells in the Claiborne and Clayton aquifers and an Upper Floridan aquifer supply well, requisite first steps in evaluating the technical feasibility of ASR at this site.

68. After expenditures totaling more than \$1.3 million, in July of 2015, GEFA announced the peer-reviewed results of analysis of data from the monitoring wells. The analysis showed that the Claiborne monitoring well’s 24-hour specific capacity was approximately 1.16 gallons per minute per foot of drawdown (gpm/ft) at a pumping rate of 104 gpm with 90 feet of water level drawdown., and the Clayton monitoring well’s 24-hour specific capacity was approximately 1.68 gpm/ft at a pumping rate of 98 gpm with 58.4 feet of water level drawdown.

69. Based on the yield performance of the monitoring wells, GEFA concluded that a dual aquifer ASR well at the Elmodel WMA is unlikely to produce enough water for streamflow augmentation in Chickasawhatchee Creek. Accordingly, GEFA determined not to complete the demonstration project at that site.

70. Separately, GEFA and EPD had constructed a lower aquifer well at Stripling Irrigation Park in Mitchell County (approximately twelve miles from the Elmodel site) to test productivity of the Claiborne aquifer and study its use for irrigation purposes. The well at Stripling had twice the productivity of the Elmodel site, suggesting either well construction issues at the Elmodel site or great variability in productivity across the aquifer. Further evaluation of ASR is ongoing; Georgia has yet to determine whether to undertake another demonstration project at a different site.

C. Agricultural Easements.

71. One other potential management tool EPD is evaluating is incentivizing agricultural water users to voluntarily (1) take marginally productive irrigated land out of production and manage that land for restoration; or (2) cease irrigation on marginally productive irrigated land (to either engage in dryland farming or non-agricultural uses on the land). This concept would involve the users receiving tax benefits or direct payments from private or federal parties in return for entering legal agreements that specify forgoing irrigation or agricultural use of their property. EPD has engaged in high-level conceptual discussions internally and with non-governmental organizations concerning this potential management tool, but has yet to begin formally analyzing potential interest from agricultural users or potential streamflow benefits associated with the concept.

72. I have been working on water resource management issues in Georgia for my entire professional life, and am very proud of the progress Georgia has made during that time. The 2006 Plan, State Water Plan, and Amendments provide examples of the considerable resources Georgia has devoted to water management and conservation measures in the state. Georgia's efforts to explore additional water resource management tools demonstrate Georgia's ongoing commitment to remaining at the forefront of responsible water stewardship.