APPENDIX

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IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF MISSISSIPPI
DELTA DIVISION

Civil Action No. 2:05CV32-GHD

JIM HOOD, ATTORNEY GENERAL, *EX REL.*,
THE STATE OF MISSISSIPPI, ACTING FOR ITSELF
AND *PARENS PATRIAE* FOR AND ON BEHALF OF THE
PEOPLE OF THE STATE OF MISSISSIPPI,
Plaintiff,

v.

THE CITY OF MEMPHIS, TENNESSEE,
AND MEMPHIS LIGHT, GAS & WATER DIVISION,
Defendants.

COMPLAINT

PARTIES

PLAINTIFF

1. Jim Hood, the duly elected and present Attorney General of the State of Mississippi, according to law and equity, brings this action on behalf of Plaintiff, the State of Mississippi, acting for itself and *parens patriae* for and on behalf of the People of the State of Mississippi ("the State").

2. The State is a sovereign body politic governed by the Constitution and laws of Mississippi and, as such, is authorized, entitled and required to bring this action pursuant to law. This interstate suit concerns, *inter alia*, matters of state-wide interest and is brought by the State on behalf of itself and certain of its agencies, boards and commissions, including the Mississippi Department of Environmental Quality ("MDEQ").

3. Under the Mississippi Constitution of 1890 and other laws of the State of Mississippi, including Mississippi's common law or decisional law, and including, among other applicable laws, Mississippi Code Annotated Title 51, Chapter 3, Article 1, Sections 51-3-1, *et seq.*, the State has certain rights and duties and is responsible, in the exercise of its police powers, for management, supervision, control, regulation, enforcement and use of the water resources of Mississippi for purposes of, *inter alia*, the following:

(a) Promotion, expansion and protection of the rights, interests and general welfare of the State and the People of Mississippi;

(b) Enforcement of requirements that the water resources owned by, and subject to the right of use of, the State and Mississippi landowners and riparians be put to reasonable and beneficial use to the fullest extent for the State and the People of Mississippi;

(c) Prevention and prohibition of, and prosecution of claims and issues relative to, the unlawful and unreasonable diversion, taking and use, or unlawful and unreasonable methods of diversion, taking and use, of such water resources;

(d) Protection and conservation of the quantity and quality of such water resources to ensure reasonable and beneficial use thereof in the interest of the People of Mississippi and for advancement and safe-guarding of the State's correlative rights in such water resources;

(e) Supervision, administration, regulation and advancement of the policies and public laws of Mississippi, and resort to judicial remedies available under common law and such other measures as necessary to effectively and effi-

ciently preserve, conserve, manage, protect, control, develop and use Mississippi's water resources for reasonable, beneficial purposes.

4. The State owns and exercises rights, interests, entitlements, privileges and/or duties which authorize and empower the State to act for itself and *parens patriae* herein.

DEFENDANTS

5. Defendant, Memphis Light, Gas & Water Division is a division of Defendant, the City of Memphis, Tennessee, both of whom are often collectively referred to herein as "MLGW." MLGW is a non-resident foreign municipal utility company, organized and existing by virtue of an amendment to the Memphis City Charter, Chapter 381 of the Private Acts of the General Assembly of Tennessee, adopted March 9, 1939, as amended, whose address is 220 South Main Street, Memphis, Tennessee 38103, and who is now, and at all times pertinent hereto has been, doing business in Mississippi and, as a result of the acts complained of herein, has committed, and continues to commit, torts in whole or in part in Mississippi for purposes of, *inter alia*, MISS. CODE ANN. Section 13-3-57 (1972 & Supp. 2003).

6. Pursuant to Rule 4(j)(2), FED. R. CIV. P., MLGW may be served with process by delivery of a copy of a summons and this Complaint to, and service of same upon, its President and Chief Executive Officer, Joseph Lee, Ill, or as prescribed by applicable law.

7. MLGW, the nation's largest three-service municipal utility, provides electricity, gas and water to its customers in Shelby County, Tennessee, including the City of Memphis, and also engages in direct business or commerce in Mississippi through its

electric and gas interconnections and gas distribution activities, as well as through sales of water to customers located in Mississippi, such as the City of Olive Branch, Mississippi.

8. Additionally, MLGW owns and operates one of the largest artesian water systems in the world and, as a result, the City of Memphis is the largest city in the world that relies solely on artesian water wells for its water supply, despite the close proximity and availability of an adequate alternative source of supply from the nearby Mississippi River. In fact, approximately one-third (1/3) of the City of Memphis' artesian water supply, or about 60,000,000 gallons per day (60 MGD), comes from high-quality aquifer groundwater unreasonably and unlawfully diverted and withdrawn by MLGW from underneath lands situated exclusively within the State of Mississippi, and belonging to the State and the overlying residential, commercial, agricultural and municipal owners of these groundwater resources as set forth in Paragraph Nos. 15 through 22 (and subparts) hereof.

JURISDICTION AND VENUE

9. Jurisdiction in this interstate groundwater dispute is proper in this Court under 28 U.S.C.A. Sections 1331 & 1332 inasmuch as, *inter alia*, there are presented herein certain federal questions calling for application of federal and/or interstate common law, in addition to state law, and because there exists complete diversity of citizenship between the parties. The amount in controversy exceeds the sum or value of seventy-five thousand dollars ($75,000.00) exclusive of interests and costs.

10. Venue in this cause is proper in this Court under 28 U.S.C.A. Sections 1391(a)(2) & (b)(2).

INTRODUCTION

NATURE OF DISPUTE

11. This is an interstate groundwater action in which the State, for itself and for the People of Mississippi, seeks damages and/or just compensation, declaratory judgment(s) and/or injunctive relief for MLGW's unlawful diversion and excessive and unreasonable withdrawal of high quality groundwater from the portion of the Memphis Sand Aquifer underlying Mississippi lands in direction violation, destruction or diminution of the rights and interests of the State, including, *inter alia*, the correlative rights and rights of reasonable and beneficial use of groundwater belonging to the State and its citizens.

NATURE OF RELIEF SOUGHT

12. Damages. The State seeks past, present and future damages in an aggregated amount, sum or value estimated to be in a range of several hundreds of millions of dollars for MLGW's unlawful diversion and withdrawal of the State's groundwater. The State reserves the right to supplement its allegations regarding the total amount of and/or bases for such damages.

13. Declaratory Judgment(s). The State seeks certain declaration(s), including those set forth in Paragraph Nos. 56(a)-(j) hereof, establishing, among other things, that (a) MLGW is, and has been, taking the State's groundwater and violating Mississippi's water rights by virtue of its continuous and repeated wrongful diversion and excessive, unreasonable withdrawal or misappropriation of the State's groundwater and that (b) MLGW is liable for and must pay the State monetary damages for the unjust benefits derived by MLGW based upon or measured by, *inter alia*, the fair market value or monetary equivalent

of the billions of gallons of groundwater taken by MLGW from the State and/or any values obtained, amounts received and/or profits recovered or realized by MLGW, along with all other damages and forms of relief and declarations claimed herein.

14. Injunctive Relief. The State seeks an order(s) enjoining MLGW to, *inter alia*, (a) stop immediately, or as soon as practicable, its wrongful diversion and excessive, unreasonable withdrawal of the State's groundwater from the Memphis Sand Aquifer and/or to (b) plan, fund, construct, implement and operate an alternate water treatment plant to access and use water from other nearby abundant and available sources, such as the Mississippi River, as a substitute for the water MLGW is withdrawing and taking from Mississippi.

STATEMENT OF FACTS COMMON TO ALL CLAIMS

15. The Memphis Sand Aquifer, or "Sparta Aquifer" as it is known in Mississippi ("the Aquifer"), is an underground reservoir that underlies hundreds of square miles in West Tennessee and Northern Mississippi, along with other lands.

16. The Aquifer, consisting of a 400-900 foot thick layer of very fine to very coarse sand interlaced with beds of clay and silt, is an optimum source of high-quality water supply for Mississippi riparian owners and the State. It constitutes a unique and extremely valuable natural resource of the State. In fact, the groundwater from the Aquifer is considered to be among the best water sources in the United States.

17. MLGW, the largest user of the Aquifer, is currently, and has been for many years, taking massive quantities of Mississippi's portion of the groundwater, thus exceeding and/or overdrafting its rightful

share of the Aquifer and is withdrawing, without permit, right or authority, thirty percent (30%), or about 60 MGD, of the City of Memphis' water supply from portions of the Aquifer underlying property owned by the State and Mississippi citizens.

18. Three (3) of the well fields serving MLGW's ten (10) water-pumping stations extend within two and one-half (2.5) miles of the Mississippi border. Heavy pumping of these municipal wells has been so excessive as to divert and change the natural flow path of the Aquifer, causing the State's groundwater to be siphoned and drained away from Mississippi into the City of Memphis. In West Tennessee and North Mississippi, the natural flow of groundwater in the Aquifer is to the west and southwest. However, due to MLGW's excessive pumping, the Aquifer water flow path has been diverted "uphill," northward from Mississippi across the State line into MLGW's wells.

19. As a result of MLGW's overdrafting, diversion and excessive and unreasonable taking and use of the State's groundwater from the Aquifer, MLGW has damaged and diminished the Aquifer, and the State's rights and interests therein, by various acts including, *inter alia*, (a) unlawfully taking, without payment or compensation, groundwater that belongs to the State for use by the People of Mississippi; (b) improperly exceeding MLGW's share of the Aquifer for which it must compensate or reimburse the State; (c) lowering of the Aquifer groundwater table or artesian pressure; (d) injuring the Aquifer's ability to recharge, or replenish itself naturally; (e) the creation of "cones of depression" which have caused, contributed to or resulted in diversion of the State's water into the Memphis area; (f) the withdrawals

of an excessive, unreasonable and disproportionate share of the Aquifer by MLGW in a manner which has violated and continues to violate the State's water rights; (g) causing, or contributing to, serious and irreparable contamination of the high quality groundwater contained in the Aquifer; and (h) causing fear of current and future injury and damage and uncertainty regarding the quality and availability of sufficient quantities of water supplies, which has caused, and will increasingly cause or contribute to, existing and/or potential prospective irreparable injury and harm, or, at a minimum, financially devastating damage to, destruction of or detrimental impact upon residential and commercial development of Northwest Mississippi.

20. During the periods involved in this action, MLGW's acts that have damaged, and continue to damage, the State include the following:

MLGW's Improper Withdrawals Have Exceeded Its Share of the Aquifer

(a) MLGW has improperly taken, and continues to improperly take, quantities of groundwater exceeding its reasonable or beneficial share of the Aquifer in violation of Mississippi's correlative rights and the rights for reasonable and beneficial use of the People of the State. Extensive technical studies or reports prepared and disseminated by scientists and legal experts for, or on behalf of, MLGW, and/or under the auspices of Memphis and/or Tennessee governmental and regulatory authorities or agencies, as well as by independent federal agencies, confirm conclusively that MLGW has taken, and continues to take, quantities of groundwater in excess of its share of the Aquifer to the direct ultimate detriment of the State. Such expert analyses and conclusions have been pre-

pared for and reported to MLGW, the City of Memphis and various other governmental departments, agencies and branches of Tennessee in published material confirming the nature and extent of MLGW's improper, unlawful withdrawals of groundwater from the Aquifer and MLGW's liability to Mississippi, and its citizens, for the damages and other forms of remedies or relief requested herein.

Lowering the Aquifer Groundwater Table

(b) There is undisputed scientific and technical evidence of serious declines in the Aquifer groundwater table levels caused by MLGW's excessive pumping. The largest and most damaging declines have been in the Memphis area, where a major, expanding cone of depression has developed due to long-term heavy pumping at MLGW's well fields. Overdrafting or excessive taking of the State's groundwater by MLGW will prevent or inhibit the water level from returning to normal levels even if MLGW's excessive pumping ceases, thus causing substantial economic and environmental damages to the State.

Damage to Aquifer Recharge

(c) Aquifer recharge, or replenishment, occurs along a broad outcrop belt that stretches across West Tennessee. Excessive overdrafting or improper, illegal mining of the Aquifer by MLGW are diminishing and adversely impacting Aquifer recharge, thus causing long-term and permanent damage to the Aquifer and the State's rights and interests therein.

Creation of a Cone of Depression

(d) MLGW's excessive pumping of the Aquifer has created a tremendous, expanding cone of depression in the Memphis area; in fact, the cone of depression

centered at Memphis now extends over ten (10) miles into Desoto County, Mississippi. Undisputed estimates of competent, objective and independent federal agency studies, confirmed and adopted by MLGW and/or the Tennessee state authorities or agencies referenced hereinabove, show that thirty percent (30%) of MLGW's water, some 60 MGD, is now coming from under Desoto County by virtue of MLGW's siphoning of Mississippi's groundwater, causing it to flow across the State line into the City of Memphis.

Causing and Increasing Danger of Aquifer Contamination

(e) MLGW's withdrawals have caused or contributed to current and ongoing contamination and increased the risk of serious future contamination of the Aquifer by artificially increasing the rates of recharge into the Aquifer from polluted surficial water sources, such as creeks, waste disposal and abandoned dumpsites in the Memphis area. Arsenic, barium, cadmium, chromium, copper, lead, mercury, strontium, zinc and other dangerous contaminants have been found in the Aquifer, thus demonstrating the accumulation of concentrations of such pollutants in the drinking water supplies of the State's groundwater.

21. As a direct result of MLGW's unreasonable and excessive taking and use of Mississippi's groundwater from the Aquifer, the City of Memphis boasts water rates well below other large cities located on the Mississippi River and using primarily river water, such as St. Louis, Missouri and New Orleans, Louisiana, and is, therefore, benefitting substantially at the expense of Mississippi's riparian owners and to the ultimate detriment and damage of the State. The City of Memphis has expanded beyond and

outgrown its ability to rely on groundwater and is better suited and obligated to access and use water available from the Misississippi River to supply its customers' requirements without improperly usurping and relying on the valuable, high-quality groundwater MLGW has taken, and continues to take, unlawfully from the State.

22. According to reliable data, MLGW is the largest municipal user of Mississippi's groundwater. MLGW's excessive, grossly disproportionate use will invariably increase proportionate to its growth and further expansion of residential, commercial and industrial water needs. The State's existing and prospective values of groundwater uses, land and real estate, investments, business development and commercial enterprises are being, and will in the future be, diminished, damaged or destroyed due to uncertainty regarding the quality, availability and reliability of present and future water supplies caused by MLGW's past and continuing actions. These circumstances give rise to a cloud over the security of the State's current and future water supply that have an immediate and prospectively worsening detrimental chilling effect on residential, commercial, industrial and economic development of Northwest Mississippi.

CLAIMS FOR RELIEF

COUNT I: UNJUST ENRICHMENT/ RESTITUTION

23. The State adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 22 of this Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of the State herein.

24. MLGW has exercised illegal control and dominion over, and taken wrongful and improper possession, without right, authority or permission, of Mississippi's valuable groundwater in direct contravention of the State's groundwater rights. As a result, MLGW has been unjustly enriched and has improperly and inequitably obtained, and continues to reap, substantial economic benefits in relation to, and because of its misappropriation and unreasonable use of, the State's property, which in good conscience and justice MLGW should not retain.

25. By virtue of MLGW's unjust enrichment, to the ultimate detriment and injury of the State and the People of Mississippi, MLGW is liable for, and must pay over and return to the State, the use value and value of benefits derived by MLGW attributable to the Aquifer groundwater taken from the State and Mississippi riparian owners represented by the State herein.

26. In accordance with the foregoing, the State is entitled to, and claims herein, restitution, equitable disgorgement and/or recovery of actual, compensatory, incidental or consequential damages in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein. Alternatively, or in addition to such damages, the State seeks an injunction to prevent, prohibit and stop future, continued wrongs and injuries as specified herein. The State further requests such declarations as may be necessary or appropriate to support and effectuate any damages and/or injunction ordered in this cause.

COUNT II: RESTATEMENT (SECOND) OF TORTS, SECTION 858(1)(a) & (b)

27. The State adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 26 of this Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of the State herein.

28. Restatement (Second) of Torts, Section 858(1)(a) & (b) provide:

> (1) A proprietor of land or his grantee who withdraws groundwater from the land and uses it for a beneficial purpose is not subject to liability for interference with the use of water by another, **unless**
>
> (a) the withdrawal of groundwater unreasonably causes harm to a proprietor of neighboring land through lowering the water table or reducing artesian pressure, [or]
>
> (b) the withdrawal of groundwater exceeds the proprietor's reasonable share of the annual supply or total store of groundwater.

29. MLGW's unlawful diversion and withdrawal of the State's groundwater have lowered the Aquifer's water table and/or pressure and have exceeded MLGW's reasonable share of the Aquifer, thus violating the State's correlative rights and rights of reasonable or beneficial use of its share of groundwater from the Aquifer.

30. Because of the past, current and continuing actions of MLGW, the State is entitled to, and claims alternatively or in addition to the other claims or

causes of action set forth herein, recovery of actual, compensatory, incidental or consequential damages or compensation in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein. The State is also entitled to, and claims herein, declaratory judgment(s) and injunctive relief in order to protect its existing and future rights and interests from being damaged, diminished or destroyed by MLGW's misconduct.

COUNT III: TRESPASS

31. The State adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 30 of this Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of the State herein.

32. MLGW's actions constitute an unlawful present and continuing physical invasion of the State's rights and interests in the Aquifer made and committed without authority, permission, permit, license, consent, approval or acquiescence of the State. MLGW's overdrafting, diversion, withdrawal, and excessive taking and improper use of the State's groundwater has been, and continues to be, intentional, willful, wanton and reckless in direct infringement upon or usurpation of the groundwater resources of the State and Mississippi riparian owners represented by the State herein. Alternatively, the actions of MLGW constitute negligence on the part of MLGW for, *inter alia*, failing to fairly, equitably and reasonably take and use its proper share of the Aquifer and further failing to establish, develop

and utilize existing available sources for supplying its customers' water requirements other than the groundwater unlawfully taken from Mississippi.

33. Accordingly, MLGW has committed, and continues to commit, a willful, intentional and/or negligent trespass for which MLGW is liable to the State for, *inter alia*, damages and/or injunctive relief as requested herein.

34. In accordance with the foregoing, the State is entitled to, and claims alternatively or in addition to the other claims or causes of action set forth herein, recovery of actual, compensatory, incidental or consequential damages in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein. Alternatively, or in addition to such damages, the State seeks an injunction to prevent, prohibit and stop future, continued wrongs and injuries as specified herein. The State further requests such declarations as may be necessary or appropriate to support and effectuate any damages and/or injunction ordered in this cause.

COUNT IV: CONVERSION

35. The State adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 34 of this Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of the State herein.

36. MLGW is now, and has been, taking and using Aquifer groundwater owned by the State for the benefit and use of the People of Mississippi for the

wrongful purpose and intent of misappropriating and selling Mississippi's water to MLGW customers. As a result of the positive and tortious acts of MLGW, MLGW and/or the City of Memphis have unjustly and improperly benefitted, and have enjoyed substantial gains and profits, to the ultimate detriment of the State and its citizens.

37. MLGW has assumed and exercised, and continues to assume and exercise, unlawful control and dominion over Mississippi's groundwater in a manner which interferes and is inconsistent with and detrimental to the rights and interests of the State and the People of Mississippi. MLGW has knowingly and intentionally taken and used, and continues to unlawfully take and use, the State's groundwater and has, as a result, enjoyed illegally and inequitably, tremendous profits and benefits in relation to its business operations conducted for, or as part of, its utility service to, the City of Memphis.

38. MLGW's conduct constitutes conversion of the property of the State and the riparian owners owning lands overlying the Aquifer within the State of Mississippi. MLGW's misappropriation or conversion of the State's property is unlawful and inequitable, and, alternatively, its actions are and have been willful, malicious and fraudulent, such that the State, for itself and its citizens, is entitled to receive, and MLGW is liable for and must unconditionally pay to the State, the fair market value of the State's converted property and/or any and all amounts received by MLGW as a result of its misappropriation or conversion of the State's property, together with values of any profits or other benefits derived by MLGW, or the City of Memphis, by virtue of MLGW's conduct complained of herein.

39. In accordance with the foregoing, the State is entitled to, and claims alternatively or in addition to the other claims or causes of action set forth herein, restitution, equitable disgorgement, and/or the recovery of actual, compensatory, incidental or consequential damages in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein. Alternatively, or in addition to such damages or forms of compensation, the State seeks an injunction to prevent, prohibit and stop future, continued wrongs and injuries as specified herein. The State further requests such declarations as may be necessary or appropriate to support and effectuate any damages and/or injunction ordered in this cause.

COUNT V: IMPOSITION OF CONSTRUCTIVE, IMPLIED OR RESULTING TRUST

40. The State adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1-39 of this Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of the State herein.

41. MLGW's excessive pumping of Aquifer groundwater and its improper taking and use of, and exercise of illegal control and dominion over, the State's property, in violation of the correlative rights and/or rights of reasonable and beneficial use of the State and its citizens, have unjustly enriched, and continue to improperly and inequitably inure to the benefit of, MLGW and the City of Memphis.

42. The State and the People of Mississippi own unique and valuable rights and interests in relation

to the Aquifer groundwater, including the groundwater unlawfully taken and used by MLGW. As a result of MLGW's unjust and inequitable conduct described herein, MLGW has obtained, held or enjoyed property rights and interests, and derived monies, profits or benefits therefrom, which rightfully belong to the State and its citizens and which MLGW, in equity or good conscience, has no right or entitlement to hold or enjoy.

43. MLGW's conduct is such that warrants, to the extent applicable herein, the imposition of a constructive, implied or resulting trust over all properties or rights and interests therein owned by the State, as well as all revenues or funds or other profits, benefits or values derived, claimed or held by MLGW, for itself or on behalf of the City of Memphis, in relation to all of the groundwater diverted, withdrawn, taken and used by MLGW to the ultimate detriment of the State and the People of Mississippi.

44. Accordingly, to the extent applicable, the State is entitled to, and requests alternatively or in addition to the other claims or causes of action set forth herein, the imposition of an implied, constructive or resulting trust upon all property and rights and interests converted by MLGW and all monies, revenues, funds or other benefits, profits or values conferred upon or derived, claimed or illegally retained by MLGW and/or the City of Memphis, together with an order requiring MLGW to unconditionally return to the State all such converted property, rights and interests and to pay the State all monies, revenues, funds, benefits, profits or values unjustly obtained or retained by MLGW. The State also requests an award of actual, compensatory, incidental or consequential damages in an amount, sum or value currently estimated as several hundred

million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein. Alternatively, or in addition to such damages, the State seeks an injunction to prevent, prohibit and stop future, continued wrongs and injuries as specified herein. The State further requests such declarations as may be necessary or appropriate to support and effectuate any damages and/or injunction ordered in this cause.

COUNT VI: NUISANCE

45. The State adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 44 of this Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of the State herein.

46. MLGW's excessive pumping of its well fields bordering Mississippi for the purpose of taking and using, without legal right, permit or authority, groundwater belonging to the State and the People of Mississippi has caused present and continuing, and will cause future, injury and damage to the Aquifer and the rights and interests of the State and Mississippi riparians in the ownership and use thereof.

47. Some or all of the actions of MLGW as complained of herein, including those enumerated in Paragraphs 19, 20(a)-(e), 21 & 22 hereof, constitute a present and continuing significant and unreasonable interference with the groundwater ownership rights and interests of the State and Mississippi riparian owners represented by the State herein, which are common to the general public welfare and public trust. MLGW's past, present and continuing taking of the

State's groundwater contravenes, and is proscribed by, state and, where applicable, federal common law, statutory laws and regulations and, if unabated and allowed to continue without monetary compensation to the State, along with other relief sought herein, has had, and will continue to have, a long-lasting, substantial negative effect and adverse impact upon the Aquifer and the State's rights and interests. MLGW knows, or has reason to know, or has for some time known or had reason to know, that its actions and conduct have had, and continue to have, such effect and impact.

48. In accordance with the foregoing, the State is entitled to, and claims alternatively or in addition to their other claims set forth herein, recovery of actual, compensatory, incidental or consequential damages in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein. Alternatively, or in addition to such damages, the State seeks an injunction to prevent, prohibit and stop future, continued wrongs and injuries as specified herein. The State further requests such declarations as may be necessary or appropriate to support and effectuate any damages and/or injunction ordered in this cause.

COUNT VII: UNLAWFUL TAKING OR INVERSE CONDEMNATION

49. The State adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 48 of this Complaint to the extent such allegations, statements or averments support or are

consistent with the claims or causes of action of the State herein.

50. Under the applicable state and federal laws, private property shall not be taken or damaged for public use except upon just compensation being first made.

51. MLGW has taken and damaged, and continues to take and damage, valuable property and property rights belonging to the People of Mississippi represented by the State herein.

52. As a result of MLGW's illegal and unconstitutional takings of Aquifer groundwater owned by the State, and subject to the right of beneficial use of the People of Mississippi, without their knowledge, approval, consent, permission or acquiescence, the State is entitled to recover, and demands recovery of, compensation in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein.

COUNT VIII: DECLARATORY JUDGMENT

53. The State adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 52 of this Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of the State herein.

54. Under Rule 57, FED. R. CIV. P. and 28 U.S.C.A. Sections 2201, *et seq.*, this Court has the power and authority to declare the rights, interests and other legal relations of the parties as to the matters which

are the subject of this cause. This interstate groundwater dispute is a present, justiciable controversy as to which this Court may order a speedy hearing.

55. There exist in this cause questions regarding, *inter alia*, the clarification and establishment of legal relationships between the parties, including, *inter alia*, MLGW's liabilities to the State and MLGW's duties and obligations to pay damages to the State and to take actions to mitigate or eliminate diminution or destruction of the State's groundwater and rights and interests in the Aquifer.

56. Accordingly, Plaintiff, the State, requests declaratory judgment from this Court including, but not limited to, the following:

(a) a declaration that MLGW has improperly taken, and continues to improperly take, Aquifer groundwater from the State and the People of Mississippi;

(b) declarations(s) that MLGW's diversion, withdrawal, and/or use of such groundwater is and has been excessive, unreasonable and unlawful;

(c) a declaration that MLGW has diverted, withdrawn or taken, and continues to divert, withdraw or take, such groundwater without permit or legal authority and/or that such takings, diversions or withdrawals constitute unlawful overdrafting or mining of the Aquifer;

(d) a declaration that the actions of MLGW complained of herein, including, but not limited to, the acts enumerated in Paragraph Nos. 56(a)-(c) hereof, have violated, and will continue to violate Mississippi's water rights by virtue of MLGW's continuous and repeated wrongful diversion and excessive withdrawal, taking or misappropriation of the State's groundwater;

(e) declaration(s) providing that MLGW must pay the State (i) damages and other sums, values or compensation referenced herein for MLGW's past and ongoing present unlawful and improper use of the State's groundwater for all applicable retroactive periods and (ii) all future damages or payments that may accrue due to MLGW's continued unlawful, excessive withdrawal, taking and use of the State's groundwater;

(f) declarations that, in addition to quantifying and requiring unconditional payment of the past, present and future damages or payments requested herein, provide that MLGW shall be required to cease taking and using the State's groundwater and/or that MLGW must obtain, at MLGW's sole cost, expense and effort, alternative sources for its water supply other than water from the State's share of the Aquifer;

(g) declaration(s) establishing criteria to govern future or prospective withdrawals of Aquifer groundwater so that MLGW's takes (i) do not encroach upon, diminish or destroy the State's share of the Aquifer, (ii) do not cause further monetary damages to the State, (iii) do not exceed MLGW's reasonable share of the Aquifer, (iv) do not unreasonably lower Aquifer water table or pressure, (v) do not adversely affect, restrict, or impair Aquifer recharge capacity or capability, (vi) do not cause or contribute to Aquifer contamination or damage, (vii) do not alter Aquifer flow path or create additional or worse cone(s) of depression, and (viii) do not diminish, hinder, impair, damage or destroy any of the State's rights and interests, including the State's interests, and the interests of

its citizenry, in the economic development and viability of Northwest Mississippi;

(h) in addition to an award of past and future damages and/or compensation as requested herein, declaration(s) establishing future allocation, apportionment and use criteria, or implementing a physical solution, to adjust, stabilize and maintain proper and equitable withdrawals of groundwater by MGLW, and by the State, and to prevent or minimize the occurrence of disputes and controversies over or regarding the Aquifer prospectively;

(i) in addition to an award of past and future damages and/or compensation as requested herein, such declaration(s) as warranted under the circumstances to effectuate all actions necessary and appropriate to ensure the fair, equitable, reasonable and legal use of the Aquifer prospectively consistent with all applicable laws, rules, regulations and orders; and

(j) such declarations as may be required to implement, mandate, support and make fully effective each and every request, claim or demand for relief and remedy set forth herein, including, but not limited to declaration(s) as may be necessary or appropriate to quantify and facilitate MLGW's payment of damages or compensation claimed by the State.

Plaintiff, the State, requests and reserves the right to expand, clarify, amend and/or supplement the declarations sought or to be sought in this cause.

COUNT IX: INJUNCTIVE RELIEF

57. The State adopts and incorporates by reference, as if fully restated herein, the allegations,

statements or averments of Paragraph Nos. 1 through 56 of this Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of the State herein.

58. The ongoing excessive pumping by MLGW, siphoning tremendous quantities of valuable groundwater each day from Mississippi's share of the Aquifer, has caused, and will continue to cause, immediate and continuing irreparable harm and damage to the State and the riparian owners or landowners represented by the State herein, because, among other things, MLGW's wrongful diversion and withdrawal of Mississippi's Aquifer groundwater constitutes a continuing trespass and/or nuisance for which there is no adequate remedy, in whole or in part, for past, present and/or future damages which will, absent the injunctive relief requested herein, require a multiplicity of suits.

59. MLGW's illegal and unreasonable exploitation of Mississippi's groundwater will, absent the injunctive relief requested herein, continue for an indefinite time in the future, and it is, and will be, unconscionable, harsh and inequitable to require the State to bring a multiplicity of successive future suits as MLGW continues to aggressively draw down Mississippi's reasonable, beneficial share of the Aquifer until the groundwater quantities and quality are jeopardized or damaged and the resulting monetary damages, or sums awarded for just compensation, are or become increasingly difficult to measure and quantify. Mississippi's Aquifer groundwater is a unique and valuable resource belonging to the State and, thus, to the People of Mississippi for their use, benefit and welfare. MLGW's continuous and repeated invasion upon the State's property and

rights and interests therein, and its threatened future diversions and withdrawals from the Aquifer, entitle the State to the entry of an injunction in addition to all damages or compensation sought in this cause.

60. Because of the important and substantial rights and interests involved in this dispute, and because there exists no complete adequate remedy at law for a substantial portion of the injuries suffered, and to be suffered, by the State, Plaintiff seeks entry of a permanent, mandatory injunction directing and compelling MLGW to (a) cease and desist entirely from the overdrafting, diversion, withdrawal, taking and/or use of Aquifer groundwater located under Mississippi lands and belonging to the State, including the quantities of groundwater referenced in this Complaint, and to (b) immediately and prospectively take all steps or measures, make all arrangements and agreements and obtain all approvals and authorizations necessary or appropriate to plan, fund, implement, construct and operate a river water treatment plant designed to access and make available for use water from, *inter alia*, the Mississippi River as a substitute for the amounts of groundwater being taken by MLGW currently, or to be taken by MLGW prospectively, from the share of the Aquifer owned by and attributable or allocable to the rights and interests of the State and the owners of water and water rights represented by the State herein.

PRAYER FOR RELIEF

WHEREFORE, PREMISES CONSIDERED, Plaintiff, the State, requests an award or judgment from the Court providing:

A. An award of actual, compensatory, incidental or consequential damages in an amount, sum or value

currently estimated as several hundreds of millions of dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein for all injuries sustained and damages caused by MLGW's conduct as of the date of the filing of this Complaint, together with all damages, sums, values and other monetary payments or compensation as may accrue or become due and owing prospectively;

B. An award of pre-judgment interest, post judgment interest, attorney's fees, costs, expenses or other monetary payments, sums or values as may be warranted by the evidence presented at trial or other proceedings herein;

C. Alternatively, or in addition to such damages, payments or compensation, an award of an injunction to prevent, prohibit and stop future, continued wrongs and injuries as specified in this Complaint, including, but not limited to, the injunctive relief requested in Paragraph No. 60 hereof;

D. An award of such declarations as may be necessary or appropriate to support or effectuate any damages and/or injunctive relief ordered in this cause, including, but not limited to, the declaratory judgment(s) requested in Paragraph Nos. 56(a)-(j);

E. An award of such other or further relief which this Court, in equity and good conscience, finds and declares is necessary or appropriate to afford complete availability and recovery of all damages, payments, compensation, or other forms of remedies or relief sought by the State, for itself and/or the People of the State of Mississippi, for the past, current and continuing, and future, illegal misconduct of MLGW as specified herein.

Dated this the 1st day of February, 2005.

Respectfully submitted,

Attorneys for Jim Hood, Attorney General, *ex rel.*, The State of Mississippi, Acting for Itself and *Parens Patriae* for and on behalf of the People of the State of Mississippi

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IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF MISSISSIPPI
DELTA DIVISION

Civil Action No. 2:05CV32-GHD

JIM HOOD, ATTORNEY GENERAL, *EX REL.*,
THE STATE OF MISSISSIPPI, ACTING FOR ITSELF
AND *PARENS PATRIAE* FOR AND ON BEHALF OF THE
PEOPLE OF THE STATE OF MISSISSIPPI,
Plaintiff,

v.

THE CITY OF MEMPHIS, TENNESSEE,
AND MEMPHIS LIGHT, GAS & WATER DIVISION,
Defendants.

FIRST AMENDED COMPLAINT
(JURY TRIAL REQUESTED)

PARTIES

PLAINTIFF

1. Jim Hood, the duly elected and present Attorney General of the State of Mississippi, according to law and equity, brings this action on behalf of Plaintiff, the State of Mississippi, acting for itself and *parens patriae* for and on behalf of the People of the State of Mississippi ("Mississippi" or "Plaintiff").

2. Plaintiff is a sovereign body politic governed by the Constitution and laws of Mississippi and, as such, is authorized, entitled and required to bring this action pursuant to law. Under the Mississippi Constitution of 1890 and other laws of the State of Mississippi, including Mississippi's common law or decisional law, and including, among other applicable laws, Mississippi Code Annotated Title 51, Chapter 3,

Article 1, Sections 51-3-1, *et seq.*, Mississippi owns the water resources of the State and has certain rights, interests and duties and is responsible, in the exercise of its police powers, for management, supervision, control, regulation, enforcement and use of the water resources of Mississippi for purposes of, *inter alia*, prevention and prohibition of, and prosecution of claims and issues relative to, the unlawful and unreasonable diversion, taking and use, or unlawful and unreasonable methods of diversion, taking and use, of such water resources as described in Paragraph Nos. 10 & 14-22 hereof.

3. Plaintiff, Mississippi, owns and exercises rights, interests, entitlements, privileges and/or duties which authorize and empower Mississippi to act for itself and *parens patriae* herein.

DEFENDANTS

4. Defendant, Memphis Light, Gas & Water Division ("MLGW") is a division of Defendant, the City of Memphis, Tennessee ("Memphis"), both of whom are often collectively referred to herein as "Memphis-MLGW" or "Defendants." Memphis-MLGW is a non-resident foreign municipal utility company, organized and existing by virtue of an amendment to the Memphis City Charter, Chapter 381 of the Private Acts of the General Assembly of Tennessee, adopted March 9, 1939, as amended, whose address is 220 South Main Street, Memphis, Tennessee 38103, and who is now, and at all times pertinent hereto has been, doing business in Mississippi and, as a result of the acts complained of herein, has committed, and continues to commit, torts in whole or in part in Mississippi for purposes of, *inter alia*, MISS. CODE ANN. Section 13-3-57 (1972 & Supp. 2006).

5. Pursuant to Rule 4(j)(2), FED. R. CIV. P., Memphis-MLGW was properly served with process by Plaintiffs' counsel on February 1, 2005, by delivery of a summons and Complaint to, and personal service of same upon, MLGW's President and Chief Executive Officer, Joseph Lee, III, and by other contemporaneous service of process properly effected in accordance with applicable law upon Memphis' Mayor, Dr. Willie W. Herenton (served February 1, 2005), Memphis' City Attorney, Sara L. Hall (served February 1, 2005) and MLGW's General Counsel, J. Maxwell Williams (served February 1, 2005).

6. MLGW, the nation's largest three-service municipal utility, provides electricity, gas and water to its customers in Shelby County, Tennessee, including the City of Memphis, and also engages in direct business or commerce in Mississippi through its electric and gas interconnections and gas distribution activities, as well as through sales of water to customers located in Mississippi, such as the City of Olive Branch, Mississippi.

7. Additionally, MLGW owns and operates one of the largest artesian water systems in the world and, as a result, Memphis is the largest city in the world that relies solely on ground water wells for its water supply. Because of the acts of Memphis-MLGW as set forth in Paragraph Nos. 14-22 hereof, a substantial portion of Memphis' water supply comes from high-quality aquifer ground water unlawfully diverted and withdrawn by MLGW from underneath lands situated exclusively within and belonging to Mississippi. Memphis-MLGW is the largest pumper and user of Mississippi's ground water from wells and wellfields operated in and encompassed within the Memphis area.

JURISDICTION AND VENUE

8. Jurisdiction in this interstate or transboundary ground water dispute is proper in this Court under 28 U.S.C.A. Sections 1331 & 1332 inasmuch as, *inter alia*, there are presented herein certain federal questions calling for application of federal and/or interstate common law, in addition to Mississippi state law, and because there exists complete diversity of citizenship between the parties. The amount in controversy exceeds the sum or value of seventy-five thousand dollars ($75,000.00) exclusive of interests and costs.

9. Venue in this cause is proper in this Court under 28 U.S.C.A. Sections 1391(a)(2) & (b)(2).

INTRODUCTION

NATURE OF DISPUTE

10. Mississippi seeks damages for MLGW's diversion and pumping and withdrawal of ground water from the Memphis Sand or Sparta Aquifer underlying Northwest Mississippi, specifically portions of Desoto County, Mississippi and Marshall County, Mississippi. For decades, Memphis-MLGW has been taking, without permission or payment, vast quantities of its water supply from Mississippi. It is currently estimated that one-third (1/3) of Defendants' water requirements, or 60,000,000 gallons per day (60 MGD), are pumped by MLGW's wells and wellfields from Mississippi's ground water resources. Memphis-MLGW in turn sells and supplies this ground water to its customers, thus unjustly benefitting by its misappropriation of Mississippi's ground water. Absent obtaining the retroactive and prospective relief requested by Plaintiff herein, it is anticipated that Memphis-MLGW's pumpage and taking of Mississippi's ground water will continue and increase prospec-

tively. Therefore, in addition to damages, Mississippi seeks injunctive relief and declaratory judgment(s) to, *inter alia*, require Memphis-MLGW to stop taking Mississippi's ground water and to prohibit Defendants from diverting, pumping and misappropriating Mississippi's ground water in the future.

NATURE OF RELIEF SOUGHT

11. Damages. Mississippi requests recovery of damages, plus interest, in an aggregated amount equal to the value of Mississippi's ground water unlawfully taken by Memphis-MLGW for the period 1985 to the present or such other time-frames that may apply. Additionally, and/or in the alternative, Mississippi requests recovery of damages measured by, *inter alia*, the unjust benefits derived and costs avoided by Defendants by virtue or as a result of Memphis-MLGW's failure and refusal to take advantage of other available sources and methods of obtaining its water supply instead of Defendants' unlawful taking of Mississippi's ground water. These damages and payments due are estimated to be in a range of several hundreds of millions of dollars. Mississippi reserves the right to supplement its allegations regarding the total amount of and/or bases for such damages.

12. Declaratory Judgment(s). Mississippi seeks certain declaration(s), including those set forth in Paragraph Nos. 45-48 hereof, establishing, among other things, that (a) Memphis-MLGW is, and has been, pumping and taking Mississippi's ground water and violating Mississippi's water rights by virtue of its continuous and repeated wrongful diversion and withdrawal or misappropriation of Mississippi's ground water; that (b) Memphis-MLGW is liable for and must pay Mississippi monetary damages

measured by, *inter alia*, (i) the unjust benefits derived and costs avoided by Defendants and/or (ii) the fair market value or other value or monetary equivalent of the billions of gallons of ground water taken by Memphis-MLGW from Mississippi and/or (iii) any values obtained, amounts received and/or profits recovered or realized by Defendants, along with all other damages and forms of relief and declarations claimed herein; and that (c) Memphis-MLGW must take such actions as necessary or appropriate to cease taking Mississippi's ground water and to eliminate or reduce the potential for future damages to Mississippi's ground water rights and interests.

13. Injunctive Relief. Mississippi requests an order(s) enjoining and requiring Memphis-MLGW to, *inter alia*, stop immediately, or as soon as practicable, its diversion and pumping and withdrawal of Mississippi's ground water from the Memphis Sand or Sparta Aquifer.

STATEMENT OF FACTS
COMMON TO ALL CLAIMS

14. The Memphis Sand Aquifer, or "Sparta Aquifer" as it is known in Mississippi ("the Aquifer"), is an underground reservoir that underlies portions of West Tennessee and Northwest Mississippi.

15. The Aquifer, consisting of a 400-900 foot thick layer of very fine to very coarse sand interlaced with beds of clay and silt, is an optimum source of high-quality water supply for Mississippi. It constitutes a unique and extremely valuable natural resource and the ground water produced from the Aquifer is considered to be among the best water sources in the United States.

16. Memphis-MLGW is currently, and has been for many years dating back to 1965 and earlier,

taking billions of gallons of Mississippi's portion of the Aquifer ground water without permit, right or authority. Based on scientific and other reports prepared by or for Memphis-MLGW, it is currently estimated that a minimum of 1/3, or about 60 MGD, of Memphis' water supply comes from portions of the Aquifer underlying, and which belong to, Mississippi.

17. Memphis-MLGW operates hundreds of wells in numerous wellfields, many of which are geographically situated close to the Mississippi border. For decades, Memphis-MLGW's heavy pumping of these municipal wells has caused or contributed to diversion and change of the pre-development or natural south-westerly flow path of the Aquifer so that ground water is now, and has for years been, flowing northward from Mississippi into Memphis. As a result of Memphis-MLGW's pumping, a cone of depression centered under and expanding outward from Memphis has formed in the Aquifer. This has for, at least, the past four decades, caused billions of gallons of Mississippi's ground water to flow northward away from Mississippi, across the border, and into Defendants' wells and wellfields for production of such ground water into MLGW's water distribution system for sale and delivery to Defendants' customers.

18. Numerous and extensive, publicly available scientific and technical studies and reports prepared by or on behalf of Memphis-MLGW demonstrate and confirm conclusively that Defendants' pumping has (a) caused or contributed to the cone(s) of depression centered in and underlying Memphis and extending into Northwest Mississippi; (b) changed or contributed to change of the natural flow path or gradient of the Aquifer to a northwest direction away from Mississippi and into the Memphis area; and (c) resulted in

diversion and taking by Defendants of Mississippi's ground water for use by and sale to Memphis-MLGW's customers.

19. Memphis-MLGW has no permit, right or authority to have taken, or to continue to take, Mississippi's Aquifer ground water. Defendants have, thus, misappropriated, and are continuing to misappropriate, and to take and use, Mississippi's ground water resources without compensation or payment.

20. As a direct result of Defendants' pumping, taking and use of Mississippi's ground water from the Aquifer, Memphis boasts water rates well below other peer cities, including other large cities located on the Mississippi River and using primarily river water. By misappropriating Mississippi's ground water, Memphis-MLGW has avoided costs of constructing and operating alternate water supply systems and facilities and is, therefore, benefitting substantially and unjustly to the detriment and damage of Mississippi. Defendants have the capability to access and use water available from the Mississippi River, or other sources, to supply its customers' requirements without improperly usurping and relying on the valuable, high-quality ground water Memphis-MLGW has taken, and continues to take, unlawfully, without permit or payment, from Mississippi.

21. Defendant's pumping and use of Mississippi's ground water will invariably increase proportionate to Memphis' growth and further expansion of residential, commercial and municipal water needs. Public and private studies and reports available to Memphis-MLGW demonstrate that Defendants have known that MLGW has been pumping, diverting and

taking Mississippi's ground water for many years and that Memphis-MLGW will in the future have to cease, or reduce, its taking of Mississippi's ground water. Even so, Memphis-MLGW has made no plans and taken no action to reduce or eliminate its known and undeniable taking and use of ground water sourced in and withdrawn from Mississippi.

22. As a result of the acts complained of herein, Mississippi is entitled to (a) recovery of damages measured by and equal to, *inter alia*, (i) the value, plus interest, of all of Mississippi's Aquifer ground water pumped and taken by Memphis-MLGW annually from 1985 to the present (or such other timeframes that may apply) and/or (ii) the monetary equivalent of the past and future unjust benefits derived or costs avoided by Memphis-MLGW due to its taking and use of Mississippi's Aquifer ground water; and (b) order(s) requiring Memphis-MLGW to stop taking and misappropriating Mississippi's ground water and to plan, fund and implement all operational strategies and alternate facilities as may be required to eliminate Defendants' misappropriation of Mississippi's ground water now and in the future.

CLAIMS FOR RELIEF

COUNT I: CONVERSION

23. Mississippi adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 22 of this First Amended Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of Mississippi herein.

24. Memphis-MLGW is now, and has been, taking and using Aquifer ground water owned by Mississippi for the wrongful purpose and intent of misappropri-

ating and selling Mississippi's water to Memphis-MLGW customers. As a result of the tortious acts of Defendants, MLGW and Memphis have unjustly and improperly benefitted, and have enjoyed substantial gains and profits, to the ultimate detriment of Mississippi.

25. Defendants have assumed and exercised, and continue to assume and exercise, unlawful control and dominion over Mississippi's ground water in a manner which interferes and is inconsistent with and detrimental to the rights and interests of Mississippi. Memphis-MLGW has knowingly and intentionally taken and used, and continues to unlawfully take and use, Mississippi's ground water and has, as a result, enjoyed illegally and inequitably, tremendous profits and benefits in relation to its business operations conducted for, or as part of, its utility service to Memphis and its customers.

26. Memphis-MLGW's conduct constitutes conversion of the property of Mississippi. Defendants' misappropriation or conversion of Mississippi's property is unlawful and inequitable, and, alternatively, its actions are and have been willful, malicious and fraudulent, such that Mississippi is entitled to receive, and Memphis-MLGW is liable for and must unconditionally pay to Mississippi, the fair market value, plus interest, of Mississippi's converted property and/or any and all amounts or values received by Memphis-MLGW as a result of, or relating to, Defendants' misappropriation or conversion of Mississippi's property, together with values of any profits or other benefits derived or costs avoided by MLGW and Memphis by virtue of Defendants' conduct complained of herein.

27. In accordance with the foregoing, Mississippi is entitled to, and claims alternatively or in addition to the other claims or causes of action set forth herein, restitution, equitable disgorgement, and/or the recovery of actual and compensatory damages in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein.

COUNT II: TRESPASS

28. Mississippi adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 27 of this First Amended Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of Mississippi herein.

29. Memphis-MLGW's actions constitute an unlawful present and continuing physical invasion of Mississippi's rights and interests in the Aquifer made and committed without authority, permission, permit, license, consent, approval or acquiescence of Mississippi. Memphis-MLGW's pumping, diversion, withdrawal, and taking and improper use of Mississippi's ground water has been, and continues to be, intentional, willful, wanton and reckless in direct infringement upon or usurpation of the ground water resources of Mississippi. Alternatively, the actions of Memphis-MLGW constitute negligence on the part of Defendants for, *inter alia*, (a) pumping Memphis' water supply from the Aquifer so aggressively as to divert and take, without payment or permission, substantial volumes of Mississippi's ground water to be

sold to customers of Memphis-MLGW and (b) failing to establish, develop and utilize existing available alternate sources for supplying its customers' water requirements other than the ground water unlawfully taken from Mississippi.

30. Accordingly, Memphis-MLGW has committed, and continues to commit, a willful, intentional and/or negligent trespass for which Defendants are liable to Mississippi for, *inter alia*, damages and/or injunctive relief as requested herein.

31. In accordance with the foregoing, Mississippi is entitled to, and claims alternatively or in addition to the other claims or causes of action set forth herein, recovery of actual and compensatory damages in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein.

COUNT III: UNJUST ENRICHMENT/ RESTITUTION

32. Mississippi adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 31 of this First Amended Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of Mississippi herein.

33. Memphis-MLGW has exercised illegal control and dominion over, and taken wrongful and improper possession, without right, authority, permit, payment or permission, of Mississippi's valuable ground water in direct contravention of Plaintiffs' ground water rights. As a result, MLGW has been unjustly

enriched and has improperly and inequitably obtained, and continues to reap, substantial economic benefits in relation to, and because of its misappropriation and unreasonable use of, Mississippi's property, which in good conscience and justice Memphis-MLGW should not retain.

34. By virtue of Defendants' unjust enrichment, to the ultimate detriment and injury of Mississippi, Memphis-MLGW is liable for, and must pay over and return to Mississippi, the use value and value of benefits derived by Defendants attributable to the Aquifer ground water taken from Mississippi.

35. In accordance with the foregoing, Mississippi is entitled to, and claims herein, restitution, equitable disgorgement and/or recovery of actual and compensatory damages in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein.

COUNT IV: IMPOSITION OF CONSTRUCTIVE, IMPLIED OR RESULTING TRUST

36. Mississippi adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1-35 of this First Amended Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of Mississippi herein.

37. Memphis-MLGW's pumping of Aquifer ground water and its improper taking and use of, and exercise of illegal control and dominion over, Mississippi's property, have unjustly enriched, and continue to

improperly and inequitably inure to the benefit of, MLGW and Memphis.

38. Mississippi owns unique and valuable rights and interests in relation to the Aquifer ground water, including the ground water unlawfully taken, used and sold by Memphis-MLGW. As a result of Defendants' unjust and inequitable conduct described herein, Memphis-MLGW has obtained, held or enjoyed property rights and interests, and derived monies, profits or benefits therefrom, which rightfully belong to Mississippi and which Memphis-MLGW, in equity or good conscience, has no right or entitlement to hold or enjoy.

39. Memphis-MLGW's conduct is such that warrants the imposition of a constructive, implied or resulting trust over all properties or rights and interests therein owned by Mississippi, as well as all revenues or funds or other profits, benefits or values derived, claimed or held by MLGW, for itself or on behalf of Memphis, in relation to all of the ground water diverted, withdrawn, taken and used by Memphis-MLGW to the ultimate detriment of Mississippi.

40. Accordingly, Mississippi is entitled to, and requests alternatively or in addition to the other claims or causes of action set forth herein, the imposition of an implied, constructive or resulting trust upon all property and rights and interests converted by Memphis-MLGW and all monies, revenues, funds or other benefits, profits or values conferred upon or derived, claimed or illegally retained by MLGW and/or Memphis, together with an order requiring Defendants to pay the State all monies, revenues, funds, benefits, profits or values unjustly obtained or retained by Memphis-MLGW. Mississippi also

requests an award of actual and compensatory damages in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein.

COUNT V: NUISANCE

41. Mississippi adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 40 of this First Amended Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of Mississippi herein.

42. Memphis-MLGW's pumping of its wellfields resulting in Defendants' taking and use, without legal right, permit or authority, of ground water belonging to Mississippi has caused present and continuing, and will cause future, injury and damage to the rights and interests of Mississippi in the Aquifer.

43. Some or all of the actions of Defendants as complained of herein, including those enumerated in Paragraphs 10 & 14-22 hereof, constitute a present and continuing significant and unreasonable interference with the ground water ownership rights and interests of Mississippi, *i.e.*, the pumping and taking or misappropriation of Mississippi's ground water without payment or compensation. Memphis-MLGW's past, present and continuing taking of Mississippi's ground water contravenes, and is proscribed by, state and, where applicable, federal common law, statutory laws and regulations and, if unabated and allowed to continue without monetary compensation

to Mississippi, along with other relief sought herein, has had, and will continue to have, a long-lasting, substantial negative effect and adverse impact upon Mississippi. Memphis-MLGW knows, or has reason to know, or has for some time known or had reason to know, that its actions and conduct have had, and continue to have, such financial effect and impact.

44. In accordance with the foregoing, Mississippi is entitled to, and claims alternatively or in addition to their other claims set forth herein, recovery of actual, compensatory damages in an amount, sum or value currently estimated as several hundred million dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein.

COUNT VI: DECLARATORY JUDGMENT

45. Mississippi adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 44 of this First Amended Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of Mississippi herein.

46. Under Rule 57, FED. R. CIV. P. and 28 U.S.C.A. Sections 2201, *et seq.*, this Court has the power and authority to declare the rights, interests and other legal relations of the parties as to the matters which are the subject of this cause. This interstate or transboundary ground water dispute is a present, justiciable controversy as to which this Court may order a speedy hearing.

47. There exist in this cause questions regarding, *inter alia*, the clarification and establishment of legal relationships between the parties, including, *inter*

alia, Memphis-MLGW's liabilities to Mississippi and Memphis-MLGW's duties and obligations to pay damages to Mississippi and to take actions to mitigate or eliminate diminution or destruction of Mississippi's ground water and rights and interests in the Aquifer.

48. Accordingly, Plaintiff, Mississippi, requests declaratory judgment from this Court including, but not limited to: (a) a declaration that, in addition to the payment of damages requested herein, Memphis-MLGW must pay damages prospectively for all quantities of Mississippi's ground water taken in the future; and (b) a declaration appointing a special master and providing for this Court's continuing supervision and oversight over this cause, and future claims and issues, in order to grant further relief to ensure that Mississippi is compensated and receives such damages, payments or other forms of relief necessary or appropriate for the protection and enforcement of Mississippi's Aquifer ground water rights and interests. Plaintiff, Mississippi, requests and reserves the right to expand, clarify, amend and/or supplement the declarations sought or to be sought in this cause.

COUNT VII: INJUNCTIVE RELIEF

49. Mississippi adopts and incorporates by reference, as if fully restated herein, the allegations, statements or averments of Paragraph Nos. 1 through 48 of this First Amended Complaint to the extent such allegations, statements or averments support or are consistent with the claims or causes of action of Mississippi herein.

50. The ongoing pumping by Memphis-MLGW, siphoning tremendous quantities of valuable ground water each day from Mississippi, has caused, and

will continue to cause, immediate and continuing irreparable harm and damage to Mississippi because, among other things, Memphis-MLGW's wrongful diversion and withdrawal of Mississippi's Aquifer ground water constitutes a continuing trespass and/or nuisance for which there is no adequate remedy, in whole or in part, for past, present and/or future damages which will, absent the injunctive relief requested herein, require a multiplicity of suits.

51. Memphis-MLGW's illegal exploitation of Mississippi's ground water will, absent the injunctive relief requested herein, continue for an indefinite time in the future, and it is, and will be, unconscionable, harsh and inequitable to require Mississippi to bring a multiplicity of successive future suits as Memphis-MLGW continues to aggressively misappropriate Mississippi's ground water quantities and the resulting monetary damages are or become increasingly difficult to measure and quantify. Mississippi's Aquifer ground water is a unique and valuable natural resource and Memphis-MLGW's continuous and repeated invasion upon Mississippi's property and rights and interests therein, and its threatened future diversions, pumping and withdrawals from the Aquifer, entitle Mississippi to the entry of an injunction, in addition to all damages sought in this cause.

52. Because of the important and substantial rights and interests involved in this dispute, and because there exists no complete adequate remedy at law for a substantial portion of the injuries suffered, and to be suffered, by Mississippi, Plaintiff seeks entry of a permanent, mandatory and/or prohibitory injunction directing and compelling MLGW to cease

and desist entirely from the pumping, diversion, withdrawal, taking and/or use of Mississippi's ground water, including the quantities of ground water referenced in this First Amended Complaint.

PRAYER FOR RELIEF

WHEREFORE, PREMISES CONSIDERED, Plaintiff, Mississippi, requests an award or judgment from the Court providing:

A. An award of actual and compensatory damages in an amount, sum or value currently estimated as several hundreds of millions of dollars, together with interest, attorneys' fees, costs, expenses or such other monetary sums or values as may be warranted by the evidence presented at trial or other proceedings herein for all injuries sustained and damages caused by Memphis-MLGW's conduct as of the date of the trial of this matter, together with all damages, sums, values and other monetary payments or compensation as may accrue or become due and owing prospectively;

B. An award of pre-judgment interest, post judgment interest, attorney's fees, costs, expenses or other monetary payments, sums or values as may be warranted by the evidence presented at trial or other proceedings herein;

C. Alternatively, or in addition to such damages, payments or compensation, an award of an injunction to prevent, prohibit and stop future, continued wrongs and injuries as specified in this First Amended Complaint, including, but not limited to, the injunctive relief requested in Paragraph No. 52 hereof;

D. An award of such declarations as may be necessary or appropriate to support or effectuate any damages and/or injunctive relief ordered in this

cause, including, but not limited to, the declaratory judgment(s) requested in Paragraph No. 48 hereof;

E. An award of such other or further relief which this Court, in equity and good conscience, finds and declares is necessary or appropriate to afford complete availability and recovery of all damages, payments, compensation, or other forms of remedies or relief sought by Mississippi, for the past, current and continuing, and future, illegal misconduct of Memphis-MLGW as specified herein.

Dated this the 5th day of October, 2006.

Respectfully submitted,

Attorneys for Jim Hood, Attorney General, *ex rel.*, The State of Mississippi, Acting for Itself and *Parens Patriae* for and on behalf of the People of the State of Mississippi

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UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF MISSISSIPPI
DELTA DIVISION

Civil Action No. 2:05CV32-GHD

JIM HOOD, ATTORNEY GENERAL, *EX REL.*,
THE STATE OF MISSISSIPPI, ACTING FOR ITSELF
AND *PARENS PATRIAE* FOR AND ON BEHALF OF THE
PEOPLE OF THE STATE OF MISSISSIPPI,
Plaintiff,

v.

THE CITY OF MEMPHIS, TENNESSEE,
AND MEMPHIS LIGHT, GAS & WATER DIVISION,
Defendants.

[Additional Captions Omitted]

VIDEOTAPE DEPOSITION OF MDEQ 30(b)(6)
JAMIE CRAWFORD

[July 30, 2007]

* * *

[142]

* * *

Q. And that – and that happens a lot when we look, for example, potiometric maps where they'll stop at like the Mississippi, [143] Tennessee border, for example.

A. Absolutely.

Q. Or the Mississippi, Arkansas border.

A. Absolutely.

Q. Because different states may take water level measurements at different times of the year, for example, and it may not match up correctly.

A. That's correct.

Q. That's why it's important for a regional approach involving all three states involved in this particular area that we're discussing in west Tennessee, north Mississippi, and eastern Arkansas, right?

A. Oh, sure. I mean, ultimately, that's the only way to do it, to get an overall view of everything is for – to be looking at everything at the same time.

* * *

UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF MISSISSIPPI
DELTA DIVISION

Civil Action No. 2:05CV32-GHD

JIM HOOD, ATTORNEY GENERAL, *EX REL.*,
THE STATE OF MISSISSIPPI, ACTING FOR ITSELF
AND *PARENS PATRIAE* FOR AND ON BEHALF OF THE
PEOPLE OF THE STATE OF MISSISSIPPI,
Plaintiff,

v.

THE CITY OF MEMPHIS, TENNESSEE,
AND MEMPHIS LIGHT, GAS & WATER DIVISION,
Defendants.

[Additional Captions Omitted]

VIDEOTAPED DEPOSITION OF
CHARLES THOMAS BRANCH

[October 1, 2007]

* * *

[45]

* * *

Q When you say all the groups having a stake in the aquifer, you are talking about [46] everybody in the region, all the tri-state region; East Arkansas, West Tennessee, North Mississippi, right?

A In this particular case, we were talking about those groups that were utilizing the aquifer right there in the Memphis and adjoining areas; Eastern Arkansas and Northwest Mississippi and, of course, the City of Memphis.

* * *

IN THE
SUPREME COURT OF THE UNITED STATES

No. 139, Original

THE STATE OF MISSISSIPPI,
Plaintiff,
v.

THE CITY OF MEMPHIS, TENNESSEE,
MEMPHIS LIGHT, GAS & WATER DIVISION,
AND THE STATE OF TENNESSEE,
Defendants.

COMPLAINT

The State of Mississippi, by its Attorney General, Jim Hood, brings this suit against the City of Memphis, Tennessee, Memphis Light, Gas & Water Division and the State of Tennessee, and for its cause of action states as follows:

INTRODUCTION

1. The Memphis Sand or "Sparta" Aquifer ("the aquifer") is a five hundred to eight hundred ninety foot thick formation or stratum of permeable sand, rock and gravel confined between clay layers below the surface of lands situated in the northwest, part of the State of Mississippi ("Mississippi") and the western part of the State of Tennessee ("Tennessee"). Naturally stored in the sand formation for thousands of years is ground water considered to be among the best water resources in the United States. This action arises from the wrongful transboundary diversion and unlawful taking and conversion of the aquifer ground water underlying and owned by Mississippi, which diversion, taking and conversion is caused by the municipal well pumping and water

sales operations of the City of Memphis, Tennessee ("Memphis"), and its wholly-owned division, Memphis Light, Gas & Water ("MLGW").

2. The formation comprising the aquifer spans a subterranean area between Mississippi and Tennessee, although the ground water stored in the dense sands is not a natural resource shared between these states. Rather, Mississippi and Tennessee separately own and control the valuable ground waters within their respective sovereign borders. Neither state has dominion over the other's resources. Mississippi and Tennessee were apportioned or allocated their discrete respective shares of the ground water stored in the sand formation upon attaining statehood as a fundamental, self-evident attribute of sovereignty.

3. The ground water beneath Mississippi is the primary source of water supply for Desoto County, Mississippi, providing valuable high quality water for residential and commercial uses in that rapidly developing area of the State. Just across the state line, Defendants Memphis and MLGW operate a tremendous artesian water pumping and distribution system with more than one hundred seventy-five wells in ten large wellfields supplying over two hundred million gallons of ground water daily to Memphis and MLGW's other customers. MLGW's pumping has created a geophysical feature called a "cone of depression" in the aquifer centered under Memphis and expanded deeply into north Mississippi. The cone siphons and diverts over twenty-four million gallons of ground water each day from under Mississippi into storage under Memphis to supply MLGW's wells.

4. The diverted ground water is being artificially siphoned from Mississippi and into Memphis through the mechanical operation of MLGW's wells, not by

natural forces. The diverted ground water would never under normal, natural circumstances have migrated across the state line into Memphis, or anywhere else in Tennessee. But for the actions of Memphis and MLGW, the diverted quantities of ground water would still be contained within Mississippi's borders. More than three hundred sixty-three billion gallons, approximately 15-22% of Memphis' water supply, has been wrongfully taken from Mississippi from 1965 to 2006, and the massive continuing diversions exceed twenty-four million gallons daily, or 8.54 billion gallons annually.

5. As remedies for these past and continuing pumping-induced diversions, Mississippi brings this action to obtain the following relief:

(a) Mississippi seeks an award of monetary damages against Memphis and MLGW equal to the value of Mississippi's water diverted and wrongfully taken. Such damages, plus equitable or prejudgment interest (accrued through 2007), are in a range of $980 million to $1.23 billion for ground water diverted, taken and converted from 1965 through 2006. For periods from 2007 through 2017, Mississippi anticipates additional damages ranging from $105 million to $160 million (exclusive of interest). *See Kansas v. Colorado*, 533 U.S. 1, 6, 8-10 (2001).

(b) Mississippi seeks an injunction requiring Memphis and MLGW to timely take all financial; operational or other actions necessary to cease their diversion and wrongful taking of Mississippi's ground water. *See Wisconsin v. Illinois & Sanitary Dist. of Chicago*, 278 U.S. 367, 420-21 (1929).

(c) Alternatively, and *if and only if* this Court determines that Mississippi does not own and

control the ground water resources within its borders and that the aquifer ground water must be apportioned or allocated between Mississippi and Tennessee in a manner different from the inherent apportionment that occurred upon the States' attainment of statehood, then Mississippi requests this Court to (i) adjudicate the parties' dispute, (ii) determine the equitable apportionment of the ground water contained in the aquifer, (iii) award Mississippi monetary damages against Memphis and MLGW for any past diversions and takings of ground water by Memphis and MLGW that are inconsistent with the Court's apportionment; and (iv) enjoin Memphis and MLGW from future diversions and takings of ground water in a manner inconsistent with the Court's apportionment.

PARTIES

6. Plaintiff, Mississippi, is a sovereign State of the United States. Mississippi owns the ground water located or residing within its territorial boundaries.

7. Mississippi brings this suit in its capacity as sovereign and as *parens patriae* for its citizens.

8. Defendant MLGW, the nation's largest water, gas and electric utility, is a division of Defendant Memphis, a political subdivision of Tennessee. These Defendants may be served with process by delivery and service of a summons and Complaint upon MLGW's President and Chief Executive Officer, and upon Memphis' Mayor in the manner provided in Supreme Court Rule 29.

9. Tennessee is a sovereign State of the United States. Tennessee owns the ground water located or residing naturally within its territorial boundaries.

10. Tennessee may be served with process under Supreme Court Rule 29 by delivery and service of a summons and this Complaint upon its Governor and Attorney General as required by Supreme Court Rule 17.

JURISDICTION AND VENUE

11. The exclusive and original jurisdiction of this Court over controversies between two States[1] and involving two non-state parties is invoked, provisionally, under Article III, Section 2, clause 2 of the United States Constitution and 28 U.S.C. §§ 1251(a) & (b)(3).

THE DIVERSION AND CONVERSION OF MISSISSIPPI'S GROUND WATER RESOURCES BY MEMPHIS AND MLGW

12. The aquifer, whose distinct portions underlie northwest Mississippi and western Tennessee, consists of a five hundred foot thick layer of very fine to very coarse sand interlaced with beds of clay and silt, and is an optimum source of high-quality water supply for a variety of residential and commercial uses. Only ground water originally residing, or now residing,

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[1] Mississippi originally filed its action in U.S. District Court against Defendants Memphis and MLGW only under 28 U.S.C. § 1331 and *Illinois v. Milwaukee*, 406 U.S. 91 (1972). In trial court proceedings, however, Memphis and MLGW claimed that Tennessee's sovereign interests were implicated, a position first rejected and then later adopted *sua sponte* by the District Court on the eve of trial. Mississippi appealed and the Fifth Circuit affirmed. Tennessee, appearing *amicus curiae* in the appeal, asserted its sovereign powers to the extent Mississippi's claims affect ground water within Tennessee's borders. Thus, Mississippi has provisionally filed this original action under Supreme Court Rule 17 for the reasons expressed in Mississippi's Motion for Leave to File Bill of Complaint in Original Action and supporting brief filed contemporaneously herewith.

within Mississippi's sovereign borders is at issue in this dispute.

13. The aquifer underlying Mississippi is a deep subterranean sand formation confined between clay layers containing a reserve of pure ground water that has been trapped and stored for thousands of years in the dense sands within Mississippi's present borders. This ground water takes thousands of years to replenish as its movement is naturally restricted by the porosity and friction of the constituents of the geology. Under natural conditions, the same geological factors created a similar but separate reserve of ground water naturally stored beneath Tennessee.

14. Mississippi's ground water in the aquifer is essentially a static resource, naturally filtered by "moving" imperceptibly in the sands. Unless it is disturbed by stresses, such as MLGW's pumpage, the subject ground water stays in a static or steady-state condition with a constant volume of water being always present and contained within the territorial boundaries of Mississippi. In fact, but for MLGW's pumping-induced diversions, the ground water diverted by Memphis and MLGW would still reside in Mississippi and would have never crossed the state line or otherwise become commingled with Tennessee's ground water resources.

15. The natural path of ground water movement within Mississippi was, prior to MLGW's pumping operations, east to west through pore spaces (between sand and rock against friction) at a rate imperceptible to humans. The diverted ground water was confined and stored for millennia beneath lands that became encompassed within Mississippi's sovereign borders upon Mississippi's attainment of statehood.

16. MLGW's pumping has created a cone of depression that has crossed the Mississippi-Tennessee state border into Mississippi, forever altering the natural steady-state condition of Mississippi's ground water. The movement of Mississippi's ground water has been permanently changed from its natural east to west direction and imperceptibly slow rate to a northward direction, moving by artificial siphoning and mechanical ground water pumping and extraction methods at an accelerated rate toward the steepest part of the cone underlying Memphis to supply MLGW's wells.

17. Since at least 1965, independent federal and state ground water scientists and experts from the United States Geological Survey ("USGS") and the University of Memphis Ground Water Institute ("GWI") have recorded and reported the cone's existence and the resulting aquifer drawdown and huge diversions of ground water from Mississippi into the Memphis area. These scientific publications have, over decades, uniformly confirmed MLGW's permanent alteration in natural flow path and rate of movement of Mississippi's ground water.

18. In the mid-1990's, representatives of the Mississippi Department of Environmental Quality ("MDEQ") contacted officials at MLGW to arrange for a joint, cooperative study of the ground water diversion problem. The MDEQ urged cooperation from Memphis and MLGW in studying the issues to find a physical solution to the problem, but they declined to participate.

19. In the late 1990's, the Memphis news media published articles confirming these scientists and regulatory authorities, reporting that heavy pumping of municipal wells in Memphis had diverted the flow of Mississippi's ground water, creating a cone of

depression that pulled Mississippi's ground water from the south in a northward direction toward Memphis' pumping centers, providing over 20% of Memphis' water supply. Contemporaneously, the Tennessee Department of Environment and Conservation ("TDEC") commissioned a legal and water management policy study of MLGW's pumpage and the effect of the tremendous cone of depression on north Mississippi. In June 2000, a report evaluating the potential liability of Memphis and MLGW to Mississippi was presented to senior officials of Memphis, MLGW and TDEC. Still, no action was taken to mitigate the diversions.

20. In March 2002, the Tennessee Comptroller's Office prepared a special report directed to Tennessee's legislature advising of the serious ground water diversions caused by MLGW's pumpage and the need for a prompt legislative or regulatory response. No action was taken to cease or mitigate the past and continuing diversions.

21. Memphis and MLGW have been diverting and capturing Mississippi's ground water on a continual basis for many years. Over three hundred sixty-three billion gallons of Mississippi's ground water have been permanently diverted and wrongfully taken and converted from Mississippi by Memphis and MLGW during the forty year period from 1965 through 2006. The conversion of Mississippi's ground water is ongoing; the present level of Memphis' diversions, at some twenty-four million gallons each day, are expected to continue until 2017.

22. Absent total cessation of MLGW's pumpage, Memphis' and MLGW's conversion of Mississippi's ground water will continue for the foreseeable future life of the aquifer. Because of the alteration of the ground water system, even if MLGW were to

completely cease pumping from its wells, the ground water already wrongfully diverted by Memphis and MLGW into Tennessee from Mississippi will not return to Mississippi. MLGW's cessation of pumping will simply mitigate additional future diversions.

23. Once Mississippi's ground water is diverted by MLGW and Memphis it becomes captured within Memphis' hydrologic ground water inventory, and there is a continuous, ongoing process in which water that reaches MLGW's wells or well fields is constantly being replaced by water being continually taken from Mississippi. The quantities of Mississippi's ground water diverted and taken by Memphis have, therefore, become permanently incorporated into Memphis' ground water supply inventory or "budget" and have been permanently lost by Mississippi.

24. The actions of Memphis and MLGW constitute an unlawful present and continuing physical invasion and willful, intentional trespass upon Mississippi's valuable water resources. Memphis and MLGW are, and have been, exercising unlawful control and dominion over Mississippi's ground water through their wrongful diversion, taking and conversion of state-owned natural resources. Memphis and MLGW have been unjustly enriched to the ultimate detriment of Mississippi and its citizens.

PRAYER FOR RELIEF

WHEREFORE, the State of Mississippi prays for an award of monetary damages and injunctive or other relief as set forth in Paragraph 5 (and subparts) of this Complaint. Mississippi also respectfully requests the Court to grant such other or further relief to which Mississippi, in equity and good conscience, may be entitled.

Respectfully submitted,

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September 2, 2009

IN THE
SUPREME COURT OF THE UNITED STATES

No. 143, Orig.

STATE OF MISSISSIPPI,
Plaintiff,
v.

STATE OF TENNESSEE, CITY OF MEMPHIS, TENNESSEE, AND MEMPHIS LIGHT, GAS & WATER DIVISION,
Defendants.

On Bill of Complaint Before the Special Master, Hon. Eugene E. Siler, Jr.

DEFENDANTS' PROPOSED FINDINGS OF FACT

[Counsel Omitted]

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PROPOSED FINDINGS OF FACT

I. BACKGROUND FACTS

A. Study Of Aquifers Generally

1. Hydrology is the study of the overall movement and occurrence of water in the environment. Tr. 969:25-970:10 (Langseth).[1]

2. The study of hydraulics concerns the physics of how water might move, how fast it might move, and how much might be flowing. Tr. 969:25-970:10 (Langseth).

3. Groundwater hydrology concerns the occurrence, movement, and quality of water beneath the surface of the ground. J-40 at 6.[2]

4. Hydrogeology is a specialization within the general field of geology that concerns groundwater. Tr. 37:8-19 (Spruill).

5. The United States Geological Survey ("USGS") is a federal agency that is tasked, in part, with monitoring and evaluating the water resources of the United States. Tr. 568:11-16 (Larson); D-197 at 25.

B. Overview Of Aquifers

6. Groundwater is water that occurs beneath the land surface in the pore spaces of rocks and sediments. Tr. 47:22-25 (Spruill); 568:17-22 (Larson); D-197 at 11; J-29 at 20; J-40 at 6-7.

7. A hydrogeologic unit (or "hydrogeological unit") is a layer of geological material containing water

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[1] Defendants' proposed findings of fact are supported by relevant record citations. These citations are not intended to be exhaustive, and there are additional citations in the record that support Defendants' proposed findings of fact.

[2] All page number citations to exhibits reference the stamped page of the exhibit.

that is recognized by hydrogeologists as a distinct formation based on similarity of hydrogeologic characteristics, principally its ability to transmit water (i.e., permeability or hydraulic conductivity). Tr. 82:7-14 (Spruill); 571:13-21 (Larson); D-191 at 10.

8. "Hydraulic conductivity" is a measure of the ease with which water will flow through an aquifer. It is also called permeability. Tr. 165:15-22 (Spruill); D-194 at 9; J-29 at 44; J-40 at 17.

9. More permeable hydrogeological units are characterized as aquifers. Tr. 571:13-21, 592:24-593:7 (Larson). An aquifer is a formation (or group of formations, or part of a formation) made of rock or sediment that contains sufficient saturated, permeable material to yield usable quantities of water to wells and springs. S17;[3] Tr. 53:6-10 (Spruill); 569:1-5 (Larson); 805:17-19 (Waldron); D-191 at 9; J-29 at 65, 324; J-40 at 11.

10. An aquifer, by definition, includes both the formation's (or group of formations', or part of the formation's) geological material and the water within it. A geological formation without water is not an aquifer. Tr. 319:7-8 (Spruill); 588:8-16, 642:4-6 (Larson); 988:3-8 (Langseth).

11. Less permeable hydrogeological units are characterized as confining layers. Tr. 571:13-21, 592:24-593:7 (Larson). Confining layers can overlie or underlie a confined aquifer. Confining layers do not restrict the lateral movement of water in an aquifer. They restrict, but generally do not completely obstruct, the vertical movement of water out of

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[3] Citations to "S__" are to the Stipulated Facts submitted as part of the parties' Joint Statement of Stipulated and Contested Facts (Dkt. No. 64).

the aquifer. S20; Tr. 57:16-25 (Spruill); 573:14-21 (Larson); 805:20-24, 813:5-14 (Waldron); D-197 at 11; D-191 at 9; J-40 at 11.

12. The geological material of an aquifer or confining layer may consist of consolidated sediments, such as various types of rock, or unconsolidated sediments of varying grain sizes, such as sand, silt, or clay. Tr. 48:12-52:2, 54:4-55:14 (Spruill); J-2 at 17; J-40 at 7.

13. The word "facies" is a term for the character of geological material. A "facies change" is an area of a hydrogeologic unit where there is gradual change in the character of the geological material of the hydrogeologic unit from one place to another. For example, a facies change could describe the transition in geological material from a coarse-grained material (like sand) to a finer-grained material (like clay). Tr. 607:8-13 (Larson); D-194 at 8 & n.1.

14. "Transmissivity" is the ability of an aquifer to transmit water. Transmissivity is calculated by multiplying the hydraulic conductivity of the aquifer by the saturated thickness of the aquifer. Tr. 174:19-175:15 (Spruill); 920:7-11 (Waldron); J-29 at 77. The saturated thickness of the aquifer is a measurement of the thickness of the aquifer that is fully saturated with water. J-40 at 31.

15. "Storage" is the capacity of an aquifer for containing water. The storage characteristics of an aquifer are a measure of how potentiometric levels in the aquifer will change with pumping. Storage does not imply that the water within an aquifer remains static or that there are specific water molecules permanently stored within an aquifer. D-197 at 25; D-194 at 9; J-29 at 76-80.

16. A hydrogeologic system, aquifer system, or groundwater system means a group of hydrogeologic units, such as aquifers and confining units, that are hydrologically interconnected such that water can flow from one unit to another. Frequently, a hydrogeologic system is a series of laterally extensive aquifers that are above and below each other and separated by intervening confining layers. Tr. 62:17-23 (Spruill); 571:4-12 (Larson); J-40 at 19.

17. "Discharge" commonly refers to water that moves out of an aquifer. S21; Tr. 569:23-24 (Larson); J-29 at 229; J-40 at 19.

18. "Recharge" commonly refers to water that moves into an aquifer. One example of recharge is rainfall that seeps through the ground into an aquifer. S28; Tr. 569:22-23 (Larson); J-29 at 229; J-40 at 19.

19. Recharge and discharge are constantly occurring within a typical aquifer. Tr. 582:8-9 (Larson).

C. Determining The Extent Of Hydrogeological Units

20. In hydrogeology, a cross section is a graphical representation of a vertical slice of the underground surface that shows the arrangement of the various hydrogeological units beneath the surface between two points. Hydrogeologists construct cross sections depicting the various hydrogeological units within a hydrogeological system, often based on borehole log data. Tr. 89:25-90:14 (Spruill); 999:10-1000:1 (Langseth).

21. Hydrogeologists can determine the lateral extent of an aquifer by relying on the information geologists obtain from borehole logs about the geological material beneath the ground surface. Hydro-

geologists correlate areas where various properties of the materials such as grain size, sedimentation, fossil records, or biological flora are similar in order to identify distinct hydrogeological units. Tr. 824:9-17 (Waldron); 1005:9-1006:2, 1057:8-11 (Langseth); D-194 at 8; J-2 at 17; J-36 at 9; J-37 at 5, 7; J-58 at 51 (Plate 1).

22. Heterogeneity, or variations in physical properties, is common within a single hydrogeological unit. Tr. 55:22-56:13 (Spruill); 572:19-20, 593:8-10 (Larson); 825:8-19 (Waldron); J-7 at 12. A single aquifer frequently contains variations in properties like permeability, thickness, and storage. Tr. 825:1-19 (Waldron); J-29 at 66.

D. Characteristics Of Aquifers; Potentiometric Surface

23. A confined aquifer (or confined area of an aquifer) is an aquifer (or area of an aquifer) that has an overlying confining layer and in which the pressure in the aquifer is high enough that the potentiometric level in the aquifer rises above the bottom of the overlying confining layer. S19; Tr. 60:7-10 (Spruill); 575:7-15 (Larson); 816:25-817:4 (Waldron); D-197 at 11; J-40 at 11.

24. An unconfined aquifer (or unconfined area of an aquifer) is an aquifer (or area of an aquifer) in which the water level is below the overlying confining layer or in which no overlying confining layer is present. S29; Tr. 59:15-18 (Spruill); 577:6-12 (Larson); J-40 at 11.

25. An outcrop area is an area of an aquifer where the aquifer has no confining layer above and comes to the surface (or close to the surface). The outcrop area can function as a recharge zone. S25; D-197 at 12; D-191 at 10.

26. The potentiometric level in an aquifer (also called the potentiometric head or potentiometric elevation) is the elevation to which water rises inside a tightly cased, properly screened well at a given location in a confined aquifer. Casing refers to sealing the well off from the surrounding geological materials by filling the hole outside the well with grouting material such as cement. A "well screen" is the section of the well that allows water to flow from the aquifer into the well. The potentiometric level is the sum of the elevation of the well screen and the pressure in the aquifer at the well screen. S26; Tr. 135:9-19, 137:14-18 (Spruill); 575:22-576:8 (Larson); D-197 at 11; D-194 at 8; J-29 at 39; J-40 at 15.

27. The potentiometric level or water level in a well is measured by determining the elevation of the top of the well above mean sea level and subtracting the depth to the water in the well. Tr. 577:17-578:1 (Larson).

28. A contour line (also called an equipotential line) is a line depicted on a potentiometric map along which the potentiometric level or water level in the aquifer is estimated to be the same. S22; Tr. 579:25-580:7 (Larson); 1016:23-1017:3 (Langseth).

29. A potentiometric surface of an aquifer is a representation of the potentiometric level of an aquifer over a region and is often represented on a potentiometric surface map by showing equipotential lines. S27; Tr. 147:25-148:9 (Spruill); 602:9-13 (Larson); J-29 at 67.

30. Water in an aquifer moves around the grains of sediment as it flows in a given direction. Tr. 116:10-16, 117:3-118:1 (Spruill); D-197 at 12.

31. A flow path (also called a flow line) is the average, generalized path of groundwater flow. The

flow path of groundwater is perpendicular to the contour lines on a potentiometric map in the direction of decreasing potentiometric level. S23, S30, S31; Tr. 116:10-16, 117:3-118:1 (Spruill); 580:14-18 (Larson); 1017:10-15 (Langseth).

32. In order to determine the direction of groundwater flow at any given point, a hydrologist generally needs the potentiometric level for at least three different wells around that point. Tr. 338:19-24 (Spruill).

33. Considering more potentiometric-level data permits a more detailed analysis of groundwater flow patterns within an aquifer. Tr. 339:11-15 (Spruill); 859:8-16 (Waldron).

34. The groundwater within an aquifer is not static; it is constantly moving from places of higher potentiometric level to places of lower potentiometric level. Tr. 1014:18-1015:2 (Langseth); D-197 at 12, 14; D-194 at 8.

35. Groundwater generally flows from places of recharge to places of discharge. Tr. 63:22-64:1 (Spruill); 569:21-24 (Larson); D-197 at 6; J-2 at 15; J-40 at 19.

36. If the rates of recharge and discharge in an aquifer are roughly in balance, the potentiometric levels in the aquifer will remain relatively stable. Tr. 582:12-17 (Larson).

37. Even if the potentiometric levels within an aquifer remain relatively stable, the groundwater within the aquifer will still be constantly moving. D-197 at 12.

E. Groundwater Pumping, Cones Of Depression, And Groundwater Flow

38. Pumping groundwater lowers the potentiometric level in the area surrounding the well, with the lowest potentiometric level located at the well. This decrease in the potentiometric level caused by the well's pumping is called "drawdown." Tr. 584:6-12 (Larson).

39. The area of lowered potentiometric level around a well is called a "cone of depression." The term "cone of depression" describes the phenomenon of drawdown associated with pumping being greatest at the well and decreasing as the effects of pumping diminish at greater distances from the well – forming roughly the shape of a cone. S18; Tr. 585:8-16 (Larson); 1036:13-20 (Langseth); D-197 at 12-13; J-29 at 338.

40. The cone of depression is what allows a well to remove water from an aquifer. Tr. 586:6-13 (Larson); D-197 at 12-13. The decreasing potentiometric level at the well causes water to move toward the well, because water moves from areas of higher potentiometric level to areas of lower potentiometric level. Tr. 497:20-25 (Wiley); 583:12-17, 585:1-7 (Larson); D-197 at 12-13.

41. Every well creates a cone of depression, Tr. 435:15-19, 497:13-16 (Wiley), and a cone of depression is a natural result of pumping, Tr. 586:6-13 (Larson); Crawford Dep. 85:10-13; Hoffman Dep. 25:22-26:1; D-197 at 12-13. It is impossible to develop a groundwater resource without creating a cone of depression. Tr. 586:6-13 (Larson); D-197 at 12-13; J-59 at 17.

42. Individual cones of depression can overlap and combine to form a broader regional cone of depres-

sion. S32; Tr. 435:16-21, 453:5-16, 498:23-499:2 (Wiley).

43. Cones of depression are depicted on a potentiometric-level map as a series of roughly circular, closed contour lines moving outward from a pumping center, in a bullseye pattern, although the cone of depression extends beyond the outermost circular contour line. Tr. 434:21-435:4 (Wiley); 1038:5-15 (Langseth).

44. Cones of depression can also be seen on drawdown maps. Drawdown maps directly show the change in potentiometric level caused by pumping (i.e., "drawdown") – instead of showing the potentiometric levels within an aquifer. Tr. 1041:8-13 (Langseth).

45. Despite lowered potentiometric level, a confined aquifer remains fully saturated with water as long as the potentiometric level is not drawn down below the top of the overlying confining unit. Tr. 584:13-20 (Larson); J-2 at 19; J-9 at 3.

F. Groundwater Modeling

46. Hydrologists develop groundwater models to simulate real-world groundwater systems. Models can simulate how a natural system might react under certain conditions. Tr. 416:6-12, 520:24-521:1 (Wiley); D-194 at 9-10.

47. Particle tracking is a mathematical way to track the general pathway of a hypothetical molecule of water through a three-dimensional groundwater system. It is another way of representing groundwater flow paths. Tr. 510:15-21 (Wiley); 1022:25-1023:4 (Langseth).

II. FACTS PROVING THAT THE MIDDLE CLAIBORNE AQUIFER, INCLUDING THE GROUNDWATER IN IT, IS AN INTERSTATE RESOURCE

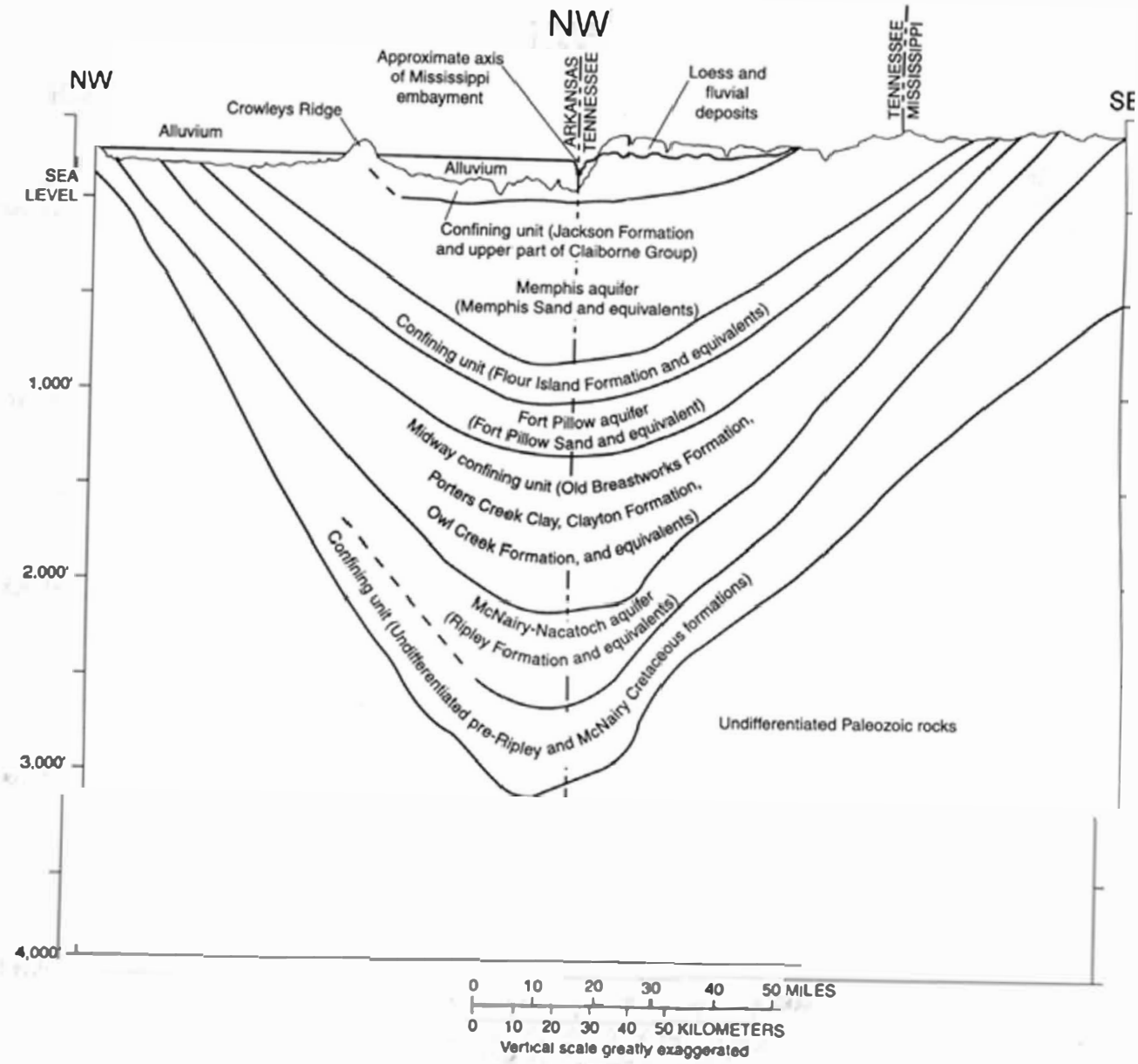
A. Background Facts About The Mississippi Embayment And The Middle Claiborne Aquifer

48. The Mississippi Embayment Regional Aquifer System (sometimes "Mississippi Embayment") is a regional hydrogeological system located in the Gulf Coast Plain generally around the Mississippi River. S24; Tr. 805:7-16 (Waldron); D-191 at 10; J-3 at 11; J-5 at 20; J-10 at 12; J-17 at 16; J-36 at 14.

49. The Mississippi Embayment is a south-plunging trough. The axis of the Mississippi Embayment (the line connecting the deepest points) is generally understood to be roughly below and parallel to the Mississippi River, falling on the western side of the river. S24; D-197 at 24; D-191 at 10; J-15 at 12.

50. The Mississippi Embayment is composed of multiple hydrogeologic units. Tr. 78:9-17 (Spruill); 570:19-21 (Larson); 805:7-16 (Waldron); J-4 at 10; J-5 at 21; J-19 at 11.

51. The figure on page 32 of J-76 is a northwest-southeast cross section of the Mississippi Embayment and shows the generalized stratigraphy of the hydrogeological units in the Mississippi Embayment in the area of Memphis.


NW
NW
SE
Approximate axis of Mississippi embayment
ARKANSAS
TENNESSEE
TENNESSEE
MISSISSIPPI
Loess and fluvial deposits
Crowleys Ridge
Alluvium
Alluvium
SEA LEVEL
Confining unit (Jackson Formation and upper part of Claiborne Group)
Memphis aquifer (Memphis Sand and equivalents)
Confining unit (Flour Island Formation and equivalents)
Fort Pillow aquifer (Fort Pillow Sand and equivalent)
Midway confining unit (Old Breastworks Formation, Porters Creek Clay, Clayton Formation, Owl Creek Formation, and equivalents)
McNairy-Nacatoch aquifer (Ripley Formation and equivalents)
Confining unit (Undifferentiated pre-Ripley and McNairy Cretaceous formations)
Undifferentiated Paleozoic rocks
1,000'
2,000'
3,000'
4,000'
0 10 20 30 40 50 MILES
0 10 20 30 40 50 KILOMETERS
Vertical scale greatly exaggerated

52. The hydrogeologic units in the Mississippi Embayment are hydrologically interconnected, which means that there is an exchange of water between different units. Tr. 615:2-5 (Larson); 812:19-813:1 (Waldron).

53. Under pre-development conditions, groundwater in the Mississippi Embayment, including in the Middle Claiborne Aquifer, generally moved from areas of significant recharge on the eastern and western edges of the Embayment, migrated laterally within the aquifers (generally toward the deepest part of the Embayment), and then traveled upward through overlying confining units and aquifers before ultimately discharging into the alluvial aquifer near the Mississippi River. Tr. 615:20-616:7 (Larson); D-197 at 16, 25; J-4 at 28; J-5 at 22; J-19 at 21, 24; J-34 at 13.

54. The northern extent of the Mississippi Embayment is approximately where the Ohio River joins the Mississippi River, and the southern extent is in southern Mississippi and central Louisiana. S24; Tr. 570:19-23 (Larson); J-3 at 10; J-4 at 14.

55. The approximate geographic extent of the Mississippi Embayment is depicted by the brown outline on page 37 of J-18. Tr. 596:16-20 (Larson); 806:4-16 (Waldron); 997:18-24 (Langseth); *see* J-4 at 10.

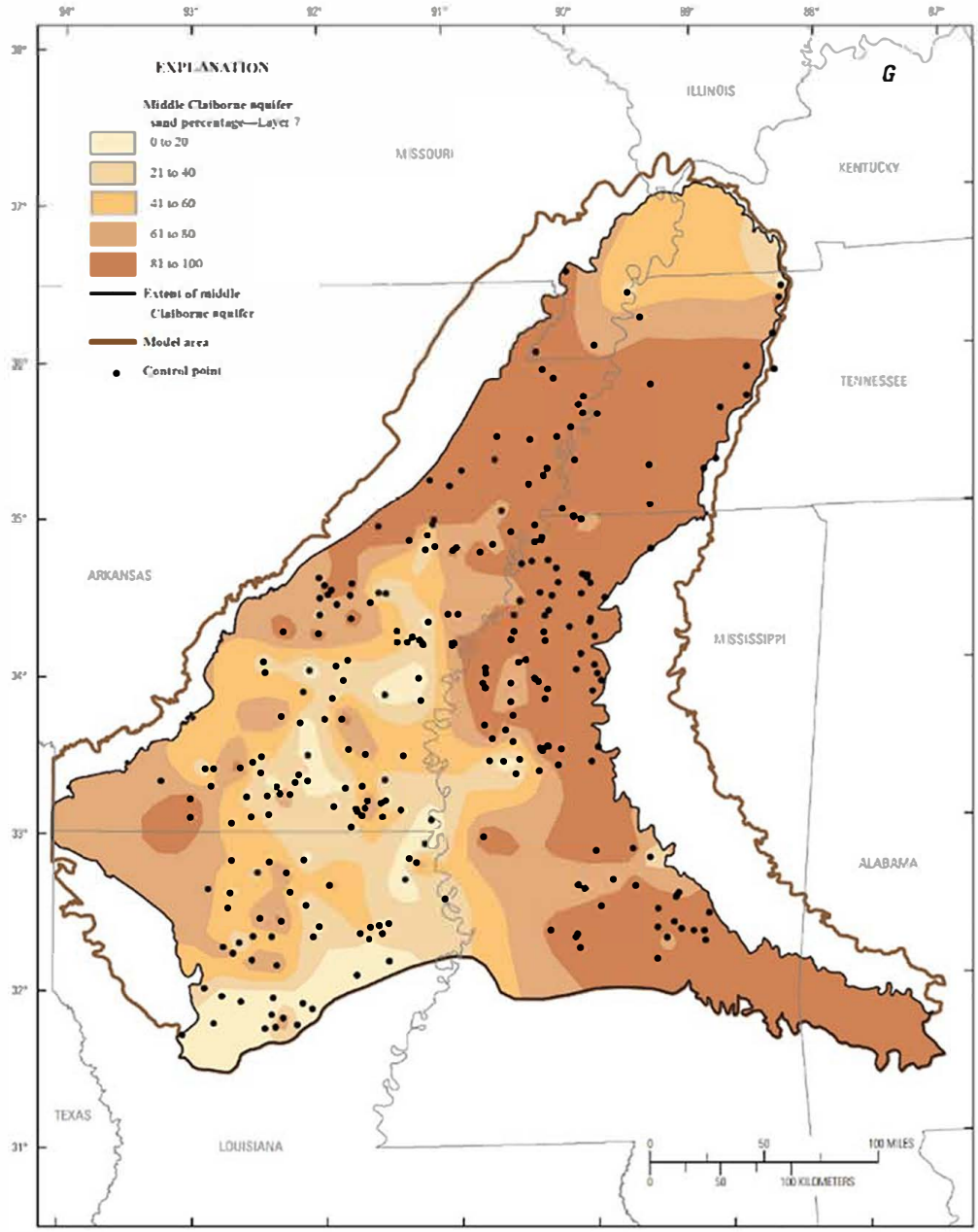


Figure 14. Sand percentage for select hydrogeologic units in the Mississippi Embayment Regional Aquifer Study area.—Continued

56. The Mississippi Embayment underlies Louisiana, Mississippi, Alabama, Arkansas, Tennessee, Kentucky, Missouri, and Illinois. Tr. 278:15-22 (Spruill); 596:12-597:8 (Larson); J-3 at 10.

57. The Middle Claiborne Aquifer is an aquifer within the Mississippi Embayment. Tr. 87:4-5, 278:8-14 (Spruill); 491:3-4 (Wiley); 572:8-13, 593:18-23, 616:20-22 (Larson); 805:25-806:3 (Waldron); 997:4-8 (Langseth); D-197 at 7; J-4 at 20-21; J-5 at 21.

58. The Middle Claiborne Aquifer is composed of geologic materials – primarily sand with interbedded layers of less permeable materials such as silt – saturated with water. Tr. 597:16-20 (Larson); D-197 at 6, 13; J-7 at 9-11; J-15 at 21; J-17 at 16; J-22 at 22; J-49 at 5.

B. The Middle Claiborne Aquifer Is An Interstate Aquifer Because It Underlies Portions Of Tennessee, Mississippi, And Six Other States

1. *Geographic extent of the Middle Claiborne Aquifer*

59. The USGS commonly refers to the aquifer at issue in the case as the Middle Claiborne Aquifer, but sometimes the Aquifer or portions of the Aquifer are called by various other names (including the Sparta Aquifer, Memphis Aquifer, and variations of those names such as the Memphis-Sparta Aquifer). All of these names refer to the same Aquifer. Tr. 87:4-88:15 (Spruill); 523:7-15 (Wiley); 567:25-568:10 (Larson); 814:20-815:10 (Waldron); 986:7-987:14 (Langseth); D-194 at 5; J-4 at 20-21; J-5 at 21; J-55 at 326.

60. The Middle Claiborne Aquifer extends throughout most of the Mississippi Embayment. Tr. 278:23-25 (Spruill); 596:25-597:3 (Larson); 807:1-10 (Waldron); 997:25-998:5 (Langseth); J-36 at 22, 26.

61. The approximate geographic extent of the Middle Claiborne Aquifer is generally agreed upon by scientists. Tr. 491:9-12 (Wiley).

62. Two scientifically accepted maps, below, depict the extent of the Middle Claiborne Aquifer as the shaded area within the black outlined boundary on the first figure, the map on page 37 of J-18, Tr. 596:21-24 (Larson); 806:4-19 (Waldron), and the blue-shaded areas within the blue outlined boundary on the second figure, the map on D-13, Tr. 997:15-998:5 (Langseth). Although they are not entirely identical, these maps illustrate the general scientific consensus around the Middle Claiborne Aquifer's eight-state geographic extent.

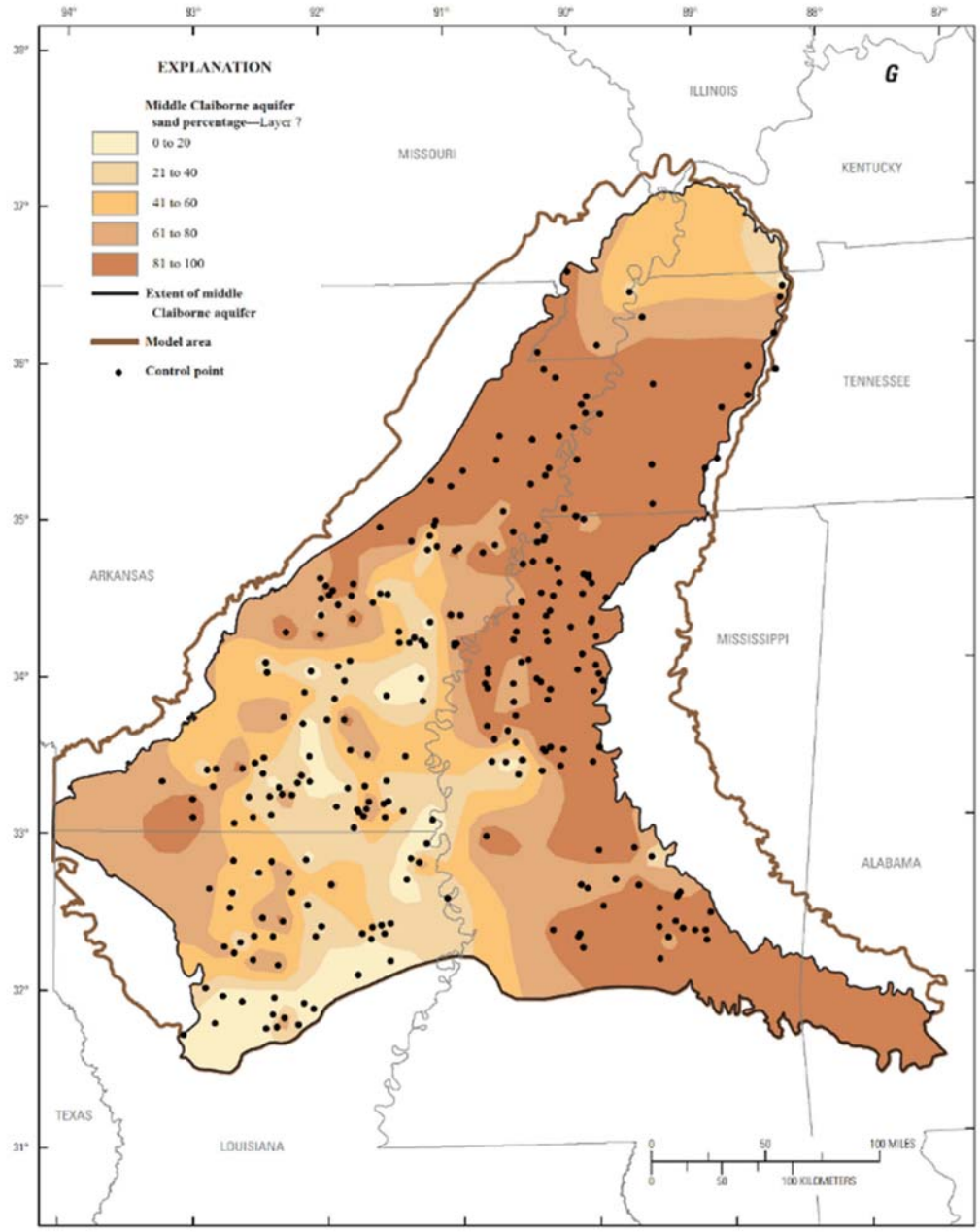
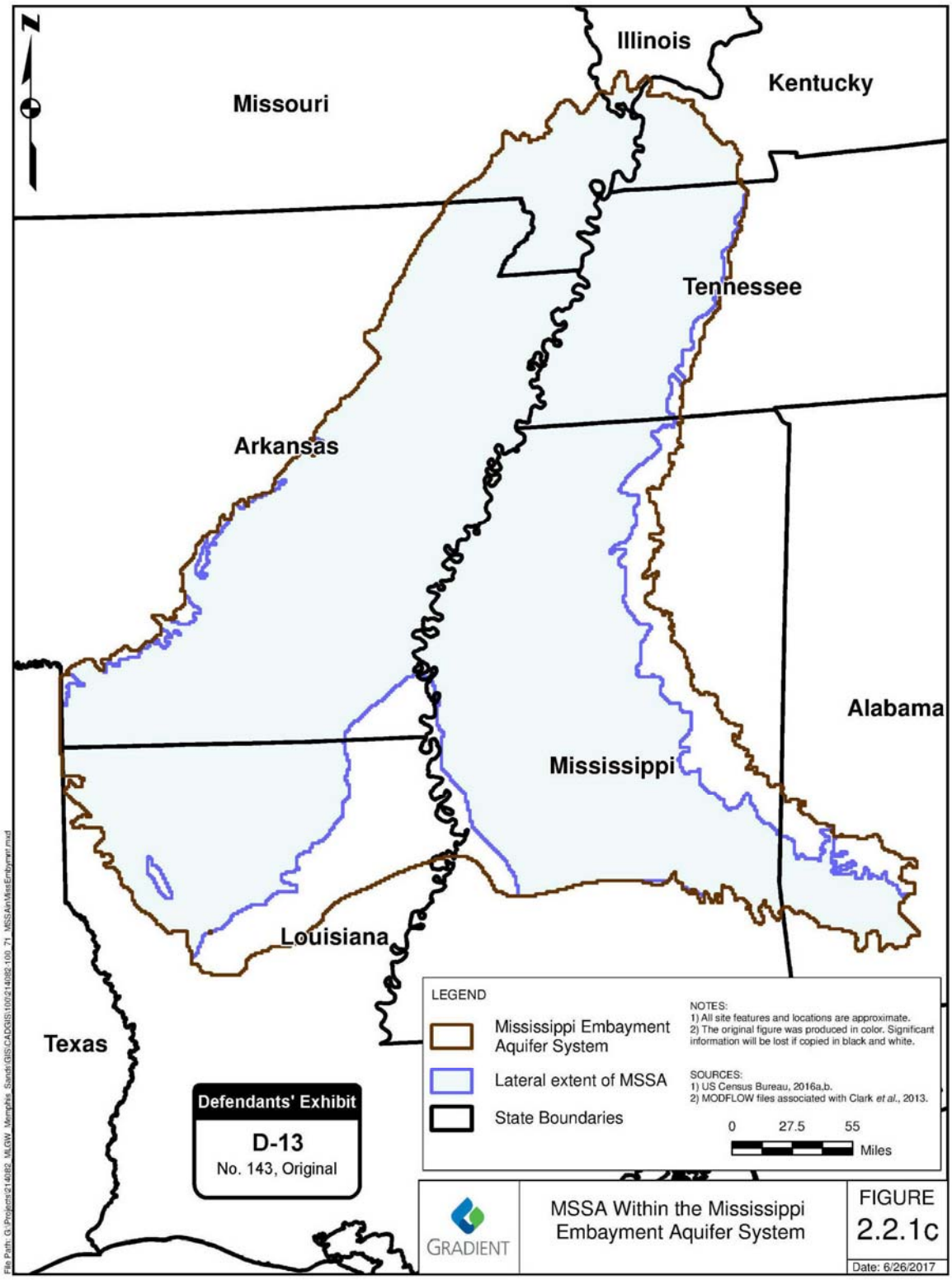


Figure 14. Sand percentage for select hydrogeologic units in the Mississippi Embayment Regional Aquifer Study area.—Continued


N
Illinois
Kentucky
Missouri
Tennessee
Arkansas
Alabama
Mississippi
Louisiana
Texas
LEGEND
Mississippi Embayment Aquifer System
Lateral extent of MSSA
State Boundaries
NOTES:
1) All site features and locations are approximate.
2) The original figure was produced in color. Significant information will be lost if copied in black and white.
SOURCES:
1) US Census Bureau, 2016a,b.
2) MODFLOW files associated with Clark et al., 2013.
0 27.5 55
Miles
Defendants' Exhibit
D-13
No. 143, Original
GRADIENT
MSSA Within the Mississippi Embayment Aquifer System
FIGURE
2.2.1c
Date: 6/26/2017
File Path: G:\Projects\214082_MLGW_Memphis_Sands\GIS\CADGIS\100\214082-100_71_MSSAinMissEmbymnt.mxd

63. The Middle Claiborne Aquifer extends beneath the Mississippi River. Tr. 491:13-14, 535:8-24 (Wiley); D-195 at 5.

2. *The Middle Claiborne Aquifer is a single hydrogeological unit that extends across multiple state boundaries*

64. The Middle Claiborne Aquifer is a hydrogeologic unit that extends beneath portions of eight States: Kentucky, Illinois, Missouri, Tennessee, Arkansas, Mississippi, Louisiana, and Alabama. Tr. 103:23-104:4, 278:8-279:8, 354:24-355:5, 366:23-24 (Spruill); 505:16-20, 506:3-7, 572:8-13 (Wiley); 572:8-13, 597:4-8 (Larson); 807:15-25, 904:21-905:1 (Waldron); 987:7-14, 998:15-20 (Langseth); D-197 at 6; D-194 at 5.

65. Borehole log data indicate that the Middle Claiborne Aquifer is a single hydrogeological unit that continues without interruption across the Mississippi-Tennessee state line. Tr. 824:9-21 (Waldron); 1052:13-1053:6, 1057:2-22 (Langseth); J-19 at 50; J-35 at 13; J-36 at 22.

66. Wells in both Mississippi and Tennessee are pumping groundwater from the Middle Claiborne Aquifer. Tr. 492:17-493:1 (Wiley).

67. The composition of the Middle Claiborne Aquifer is continuous as the aquifer crosses state borders, including the Tennessee-Mississippi border. Political borders do not affect the composition of the Middle Claiborne Aquifer. Tr. 598:1-12, 600:4-11 (Larson); J-18 at 35-37.

68. The Middle Claiborne Aquifer is not homogenous throughout its extent. There are differences in thickness, sand percentage, hydraulic conductivity, storage, porosity, and other properties between

different portions of the Middle Claiborne Aquifer. Tr. 598:25-599:4 (Larson); 825:1-10 (Waldron); J-5 at 34; J-10 at 28; J-7 at 9; J-16 at 17.

69. Variations in the hydrological properties of the Middle Claiborne Aquifer do not align with political boundaries, and political boundaries have no effect on the Middle Claiborne Aquifer's hydrological properties. Tr. 825:20-826:1 (Waldron).

70. Variations in the hydrological properties of the Middle Claiborne Aquifer do not represent or create barriers to groundwater flow or to the effects of pumping. Tr. 599:5-9 (Larson).

71. The hydraulic conductivity of the Middle Claiborne Aquifer is continuous across state borders, including the Tennessee-Mississippi border. Tr. 601:19-602:2 (Larson); J-18 at 26, 29.

72. The potentiometric levels within the Middle Claiborne Aquifer extend across state borders without interruption, including the Tennessee-Mississippi border. Tr. 598:13-19, 602:14-20 (Larson); J-71; J-4 at 64; J-22 at 66 (Plate 4).

73. Continuous potentiometric levels reflect the continuity of an aquifer and the groundwater flow patterns within an aquifer; state borders do not affect the flow of water. Tr. 598:13-19, 602:21-603:4 (Larson). The fact that cones of depression in the Middle Claiborne Aquifer propagate across state borders demonstrates the Aquifer's continuity across state lines. Tr. 606:18-22 (Larson); 1042:8-13 (Langseth).

74. The fact that the cone of depression in the Middle Claiborne Aquifer around Memphis crosses the state line into Mississippi indicates that the Middle Claiborne Aquifer extends continuously

beneath Tennessee and Mississippi. Tr. 1040:13-23 (Langseth).

75. Groundwater within the Middle Claiborne Aquifer moves from areas of recharge to areas of discharge, flowing continuously beneath state borders. Tr. 602:21-603:4 (Larson).

76. There is no physical or hydrological barrier that stops the flow of water in the Middle Claiborne Aquifer across the Mississippi-Tennessee border in either direction. Tr. 298:17-24, 361:4-364:16 (Spruill); 493:14-17, 493:22-494:3 (Wiley); 597:9-12 (Larson); 826:2-8 (Waldron); 1011:18-24 (Langseth); D-197 at 13; D-194 at 13, 15.

77. Under pre-development conditions, there was no physical or hydrological barrier that stopped the flow of water in the Middle Claiborne Aquifer across the Mississippi-Tennessee border in either direction. Tr. 299:10-300:1, 363:18-364:16 (Spruill).

3. *Facies change*

78. There is a facies change (i.e., a change in the character of the geological material) in a portion of the Middle Claiborne Aquifer that occurs approximately 6 to 20 miles south of the Mississippi-Tennessee border. It occurs entirely south of that border. Tr. 282:9-12, 389:15-390:25 (Spruill); 527:11-528:2 (Wiley); 822:2-5 (Waldron); J-3 at 12-13; J-4 at 21.

79. North of this facies change, the entire Middle Claiborne Aquifer is composed primarily of coarse-grained sand saturated with water. At the facies change, or transition zone, a section in the middle (vertically) of the Middle Claiborne Aquifer gradually transitions to a finer-grained clay material (with some finer-grained sand) saturated with water. Tr.

91:19-92:5 (Spruill); 607:14-19, 608:10-18 (Larson); J-4 at 21; J-5 at 24; J-10 at 17.

80. As one moves farther south of the facies change into Mississippi, that clay material is present in increasing quantities until it is present in sufficient quantities that hydrogeologists recognize a separate hydrogeological unit known as the Lower Claiborne Confining Unit. Tr. 90:25-91:2, 101:9-12 (Spruill); 608:10-25 (Larson); 821:16-822:1 (Waldron); D-197 at 15; J-4 at 22-23; J-5 at 24; J-36 at 22, 28; J-42 at 17, 21.

81. The more permeable sands of the Middle Claiborne Aquifer continue uninterrupted above and below the Lower Claiborne Confining Unit. Tr. 283:17-23 (Spruill); 608:19-21, 609:2-8 (Larson); 820:3-821:10 (Waldron); J-10 at 17; J-42 at 21-23.

4. *Confined and unconfined portions of the Middle Claiborne Aquifer*

82. Portions of the Middle Claiborne Aquifer are confined. In its confined areas, the Middle Claiborne Aquifer has an overlying lower-permeability confining unit and its potentiometric level rises above the bottom of that unit. Tr. 816:7-10, 816:25-817:4 (Waldron); D-194 at 8; J-11 at 10.

83. Portions of the Middle Claiborne Aquifer are unconfined. For example, it is unconfined in the outcrop area on the western edges of the formation where the geological formation comes to the ground surface. In its unconfined areas, the Middle Claiborne Aquifer is not overlain by a confining unit, and water is able to recharge directly into the Aquifer. Tr. 111:8-12 (Spruill); 816:7-24 (Waldron); D-194 at 8; J-7 at 12; J-11 at 12; J-22 at 22; J-34 at 14; J-35 at 14; J-42 at 12.

84. The confined and unconfined parts of the Middle Claiborne Aquifer are part of the same hydrogeologic unit. Tr. 817:12-19 (Waldron).

85. There is no barrier to the flow of water between the confined and unconfined portions of the Middle Claiborne Aquifer. Tr. 817:5-11 (Waldron).

5. *Interstate / transboundary aquifer: definition and as applied to the Middle Claiborne Aquifer*

86. An interstate aquifer is a continuous hydrogeological unit that is classified as an aquifer and extends beneath two or more States. Tr. 316:25-318:11 (Spruill); 587:16-588:7 (Larson); 827:1-5 (Waldron); 1001:16-21 (Langseth).

87. If an aquifer extends beneath multiple States, then water is capable of flowing within the aquifer from beneath one State to beneath a different State – whether under natural conditions or in response to pumping. Tr. 587:16-588:7 (Larson); 827:1-5 (Waldron); 1002:20-1003:1 (Langseth); D-194 at 5.

88. Defining an "interstate aquifer" as an aquifer that extends beneath two or more States is consistent with the use of that term in a report from the Advisory Committee on Water Information's groundwater subcommittee, to which Dr. Langseth contributed as a member of the subcommittee, concerning developing a national groundwater monitoring network. Tr. 1003:10-19 (Langseth); J-1 at 77.

89. Defining an "interstate aquifer" as an aquifer that extends beneath two or more States is consistent with the common meaning of the word "interstate," the scientific meaning of the word "aquifer," and the use of the term "interstate aquifer" in

the scientific and technical literature. Tr. 1003:2-9, 1003:20-25 (Langseth).

90. A "transboundary aquifer" is an aquifer that physically underlies a political boundary. Tr. 279:19-22 (Spruill); 491:15-20 (Wiley); 827:13-16 (Waldron); 1004:1-10 (Langseth).

91. The term "transboundary aquifer" is a hydrogeological term. Tr. 828:2-7 (Waldron).

92. The term "transboundary aquifer" has been used in scientific and technical literature to refer to aquifers that cross political boundaries – including state boundaries. Tr. 1004:1-10 (Langseth).

93. The Middle Claiborne Aquifer physically crosses multiple political boundaries – specifically, boundaries between States, including the boundary between Mississippi and Tennessee. Tr. 366:9-11, 366:23-24 (Spruill); 491:18-492:2 (Wiley); 828:8-12 (Waldron); 1004:13-1005:8 (Langseth).

94. The Middle Claiborne Aquifer is a "transboundary aquifer" under the ordinary hydrogeological understanding of that term. Tr. 491:25-492:2 (Wiley); 828:8-12 (Waldron); 1004:1-10 (Langseth).

95. The Middle Claiborne Aquifer is an interstate aquifer. Tr. 318:12-16 (Spruill); 588:22-589:3 (Larson); 826:21-827:5 (Waldron); 987:22-988:2 (Langseth); D-197 at 6.

96. During Mississippi's case-in-chief, Mississippi's experts – Dr. Spruill and Mr. Wiley – did not offer an opinion about whether the Middle Claiborne Aquifer or the groundwater at issue in this case is interstate or intrastate in nature. Tr. 316:12-24 (Spruill); 533:24-534:12 (Wiley). However, on cross-examination, Dr. Spruill admitted that he has previously used the term "interstate aquifer" to describe

an aquifer that exists beneath two or more States, and, based on that definition, the Middle Claiborne Aquifer would be an interstate aquifer because it physically exists beneath multiple States. Tr. 318:12-16 (Spruill).

6. *The Middle Claiborne Aquifer is and has been recognized by hydrogeologists, including for the State of Mississippi, as a shared, regional resource*

97. For at least the past 90 years, the USGS has recognized that the Aquifer at issue in this case (which it now calls the Middle Claiborne Aquifer) is a regional aquifer extending beneath multiple States. J-71; J-15 at 10; Tr. 281:6-9 (Spruill); 638:20-639:5 (Larson); 991:9-13, 1013:21-1014:7 (Langseth); D-197 at 26.

98. The USGS has recognized the importance of studying the Middle Claiborne Aquifer on a regional (i.e., multi-state) basis. J-71; Tr. 636:17-638:10 (Larson); D-197 at 25.

99. In the late-1970s, the USGS started the Regional Aquifer System Analysis ("RASA") program. The purpose was to evaluate large-scale, regional aquifer systems like the Mississippi Embayment Regional Aquifer System as a single entity rather than evaluating them in a piecemeal fashion, artificially constrained by political boundaries. Tr. 633:24-634:8 (Larson); D-197 at 25; J-28 at 5; J-68 at 9-10.

100. The USGS studied the Middle Claiborne Aquifer on a regional basis as part of the RASA program. Tr. 634:14-635:8 (Larson); J-3 at 10; J-4; J-5 at 3; D-197 at 26.

101. The USGS has recognized that many older studies of the Middle Claiborne Aquifer were artifi-

cially limited to local areas based on political boundaries rather than studying the aquifer on a regional basis. J-4 at 5; J-25 at 5; Tr. 634:22-636:4 (Larson).

102. Similarly, other hydrogeologists, including in a study funded by the Environmental Protection Agency ("EPA"), have recognized that early studies of the Middle Claiborne Aquifer were less scientifically useful because they were not coordinated across state lines. Tr. 810:1-22 (Waldron); J-76 at 5.

103. The same EPA-funded study, like the USGS, recognized the importance of studying the Middle Claiborne Aquifer on a regional basis. Tr. 810:6-811:7 (Waldron); J-76.

104. The Mississippi, Arkansas, Tennessee Regional Aquifer Study, or "MATRAS," was an effort to study the Middle Claiborne Aquifer in a cooperative way. The members of MATRAS included representatives of the various Mississippi, Arkansas, and Tennessee state agencies charged with managing water resources; the University of Memphis; the USGS offices in Mississippi, Arkansas, and Tennessee; Shelby County; and the US Army Corps of Engineers. Tr. 811:8-25 (Waldron); Hoffman Dep. 43:7-15.

105. The Mississippi Department of Environmental Quality ("MDEQ") is the official agency for the State of Mississippi that administers, studies, and researches groundwater. Crawford Dep. 23:20-24; J-57 at 5-14.

106. MDEQ, through the testimony of its Federal Rule of Civil Procedure 30(b)(6) designee, agrees that, to efficiently protect the Middle Claiborne Aquifer, Mississippi and Tennessee must cooperate. Crawford Dep. 136:11-18, 138:13-15.

107. MDEQ, through its Rule 30(b)(6) designee, agrees that, because earlier aquifer studies in different States occurred at different times of the year, it is important to take a regional approach to studying the Middle Claiborne Aquifer that involves Tennessee, Mississippi, and Arkansas. Crawford Dep. 142:23-143:18. MDEQ has used regional-scale USGS models to study the Mississippi Embayment on a regional basis. J-59 at 21-22.

108. Citizens in Tennessee, Mississippi, and Arkansas rely on the Middle Claiborne Aquifer as a public water source. Tr. 368:7-19 (Spruill).

109. The groundwater in the Middle Claiborne Aquifer is a "shared natural resource." Tr. 321:13-18 (Spruill).

7. *Interstate aquifers are common in the United States*

110. There are numerous interstate aquifers within the United States in addition to the Middle Claiborne Aquifer. Tr. 996:3-8 (Langseth). *See* Tr. 564:6-16 (Larson) (the Hueco Bolson Aquifer underlies parts of Texas and New Mexico); J-16 at 14 (the Cambrian-Ordovician Aquifer underlies Montana, North Dakota, South Dakota, Wyoming, and parts of Canada); J-26 at 18 (the Ozark Aquifer underlies Kansas, Oklahoma, Missouri, and Arkansas); J-54 (the Potomac-Patapsco Aquifer underlies New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, and South Carolina); J-55 at 13 (the High Plains Aquifer underlies South Dakota, Wyoming, Nebraska, Kansas, Colorado, Oklahoma, New Mexico, and Texas); J-55 at 16 (the Chattahoochie River Aquifer underlies Mississippi, Alabama, Georgia, South Carolina, and Florida); *see also* J-28 at 24, 35 (the Entrada-Preuss Aquifer and the Navajo-Nugget

Aquifer underlie Wyoming, Utah, Colorado, Arizona, and New Mexico; three other aquifers underlie Wyoming, Utah, and Colorado); J-32 at 42 (the Columbia River Basalt Aquifer underlies Idaho, Oregon, and Washington); J-73 (same); J-44 at 17 (Upper Floridan Aquifer underlies Florida, Georgia, and Alabama); J-45 at 88-109 (describing various aquifers underlying groups of States); J-46 at 13 (Spokane Valley-Rathdrum Prairie Aquifer underlies Washington and Idaho); J-47 (same); J-51 at 6 (Madison Aquifer underlies Wyoming, Montana, South Dakota, North Dakota, and Nebraska); J-55 at 17, 287, 310 (the St. Peter-Prairie du Chien-Jordan Aquifer underlies Wisconsin, Michigan, Illinois, Indiana, Missouri, Iowa, and Minnesota); J-55 at 283-85, 308-09 (the Silurian-Devonian Aquifer underlies Ohio, Indiana, Illinois, Iowa, Wisconsin, and Michigan); J-52 (same).

111. Many of the "Principal Aquifers of the United States" identified by the USGS are interstate aquifers, underlying multiple States. Tr. 995:14-996:14 (Langseth).

C. The Middle Claiborne Aquifer Is An Interstate Aquifer Because The Impact Of Pumping From The Aquifer In One State Can And Does Affect The Aquifer In Other States

1. *Cones of depression form from pumping*

112. A cone of depression is an effect of pumping. Tr. 583:3-6 (Larson). When cones of depression cross state lines, the effects of pumping can be seen directly crossing states lines. Tr. 1040:13-1042:17 (Langseth).

113. Cones of depression that cross state lines confirm that the aquifer in which the cone of depres-

sion exists also crosses state lines. Tr. 1040:13-23 (Langseth).

114. Cones of depression are not affected by overlying state lines. Tr. 1043:1-5 (Langseth).

115. The fact that pumping from an aquifer in one State affects the water in the same aquifer in another State demonstrates that the aquifer is an interstate resource. Tr. 663:3-7 (Larson); 1035:22-1036:9 (Langseth).

116. In an interstate aquifer, there is no way to withdraw meaningful quantities of water from an area near a state border without affecting the groundwater in the other State. Tr. 645:21-646:9 (Larson); D-198 at 7.

2. *Pumping groundwater from the Aquifer in Tennessee affects the groundwater in the Aquifer beneath Mississippi and vice versa*

117. Wells in the Middle Claiborne Aquifer in the Memphis area are drilled straight down and are not slanted. S35; Tr. 300:7-16 (Spruill); 492:3-16 (Wiley); 603:10-13 (Larson).

118. Wells in the Middle Claiborne Aquifer that are drilled in Tennessee do not extend into Mississippi, and wells that are drilled in Mississippi do not extend into Tennessee. S35; Tr. 300:7-16 (Spruill); 492:3-16 (Wiley); 603:10-13 (Larson).

119. Cones of depression from pumping in Mississippi extend into Tennessee. Tr. 605:21-23 (Larson); 1045:4-18 (Langseth).

120. The regional cone of depression around Memphis is caused in part by pumping in DeSoto County, Mississippi. Tr. 501:6-9 (Wiley).

121. The regional cone of depression around Memphis crosses the border between Mississippi and Tennessee. Tr. 435:22-25, 525:15-18 (Wiley); 604:15-24, 605:21-23 (Larson); 1040:1-10 (Langseth); J-19 at 49.

122. The regional cone of depression around Memphis crosses beneath the Mississippi River and the border between Arkansas and Tennessee. Tr. 525:15-25, 535:8-24 (Wiley); 604:18-24 (Larson); 1040:1-12 (Langseth); J-19 at 49.

123. Pumping from the Middle Claiborne Aquifer within Mississippi near the Mississippi-Tennessee border affects the flow of groundwater in the same Aquifer beneath Tennessee and can cause groundwater to flow south across the state line from Tennessee into Mississippi. Tr. 300:17-20 (Spruill); 826:16-20 (Waldron); Crawford Dep. 136:1-10; D-198 at 11.

124. Pumping from the Middle Claiborne Aquifer near the Mississippi-Tennessee border within Tennessee affects the flow of groundwater in the same Aquifer beneath Mississippi and can cause groundwater to flow across the state line from Mississippi into Tennessee. Tr. 300:2-6, 358:10-18 (Spruill); 493:2-13 (Wiley); 826:9-15 (Waldron); Crawford Dep. 136:1-10; D-198 at 11.

125. Pumping from the Middle Claiborne Aquifer within Tennessee affects the flow of groundwater in the same Aquifer beneath Arkansas. Pumping from the Middle Claiborne Aquifer within Arkansas affects the flow of groundwater in the same Aquifer beneath Tennessee. Tr. 526:1-10 (Wiley); J-76 at 20.

3. *There are at least four cones of depression in the Middle Claiborne Aquifer that show that pumping within that aquifer has cross-border effects*

126. Based on a USGS potentiometric map of the Middle Claiborne Aquifer for the year 2007, there were many cones of depression in the Middle Claiborne Aquifer, at least four of which touched or crossed state lines. Tr. 1038:3-1040:12 (Langseth); J-71.

127. There is a cone of depression in the Middle Claiborne Aquifer caused by pumping in southern Mississippi near the Arkansas-Louisiana state line that extends across the border into Louisiana. Tr. 1038:3-1039:10 (Langseth); J-71.

128. There is a large cone of depression in the Middle Claiborne Aquifer caused by pumping in Mississippi near the City of Jackson that extends across the border into Louisiana. This cone of depression causes water to flow from Louisiana into Mississippi. Tr. 606:7-10, 661:17-662:10 (Larson); J-19 at 49; J-71.

129. There are a series of large overlapping cones of depression in the Middle Claiborne Aquifer caused by pumping near Union County, Arkansas, that extend across the Arkansas-Louisiana border. The pumping in that area affects the flow of water in Louisiana and causes water to flow from Louisiana into Arkansas. Tr. 606:11-17 (Larson); 1042:10-25 (Langseth); J-19 at 49; J-71.

130. There is a large cone of depression caused by pumping near Stuttgart, Arkansas, that extends across the Arkansas-Mississippi border. This cone of depression affects the flow of water in Mississippi and causes water to flow from Mississippi into

Arkansas. Tr. 1043:6-16 (Langseth); J-19 at 34, 49; D-31; J-71.

D. The Middle Claiborne Aquifer Is An Interstate Aquifer Because Groundwater Naturally Flowed Across State Lines Before Pumping Began

1. *General background*

131. Pre-development conditions (also called natural conditions) refer to the state of an aquifer prior to the influence of pumping. Pre-development conditions in the Middle Claiborne Aquifer are generally understood to be the state of the Aquifer prior to 1886. Tr. 442:13-16, 458:21-23 (Wiley); 586:14-21 (Larson); 831:22-832:5 (Waldron); J-4 at 26; J-5 at 11; J-7 at 14; J-10 at 33; J-11 at 5.

132. A pre-development potentiometric surface map shows the estimated potentiometric levels of an aquifer or portion of an aquifer prior to pumping within that aquifer. Tr. 602:9-13, 622:19-22 (Larson).

2. *Interstate flow paths*

133. "Interstate flow" describes the flow of groundwater that crosses state boundaries. Examples in the Middle Claiborne Aquifer include the interstate flow from Mississippi to Tennessee, and from Tennessee to Arkansas, under pre-development conditions. Tr. 304:13-306:17 (D-112), 318:20-319:2 (D-129) (Spruill); 506:19-507:13, 508:3-509:1 (P-168) (Wiley).

134. Any "flow paths" or "flow lines" (i.e., estimates of the direction of groundwater flow starting from a particular point) that cross state boundaries are "interstate flow paths" or "interstate flow lines." Tr. 507:7-10, 508:7-18 (Wiley).

3. *Every study of pre-development conditions in the Middle Claiborne Aquifer concludes that there was natural groundwater flow from Mississippi into Tennessee*

135. Every study of pre-development conditions in the Middle Claiborne Aquifer has concluded that there was natural flow across state borders. Tr. 304:7-11, 360:21-361:1 (Spruill); 506:19-507:13, 507:14-508:2 (P-168) (Wiley); 858:3-6 (Waldron); 1020:10-15, 1025:24-1026:7 (Langseth); D-194 at 16; J-5 at 35.

136. All of the pre-development potentiometric maps of the Middle Claiborne Aquifer based on observed or measured data reflect natural flow across state borders: the Reed (1972) map (J-67); the Criner & Parks (1976) map (J-24 at 23, figure 4); Mr. Wiley's own "Figure 9" map (D-112, P-168); and the Waldron & Larsen (2015) map (D-174 at 17, figure 4); D-194 at 16.

137. Reed (1972) is a USGS publication that includes a water-level contour map of pre-development conditions in the Middle Claiborne Aquifer that, the author suggests, was based on observed data. J-67; D-196 at 25. Reed's map shows groundwater flowing, under natural conditions, from Mississippi to Tennessee, and also from Mississippi and Tennessee into Arkansas and from Mississippi into Louisiana. Tr. 623:10-625:8 (Larson); 1019:25-1020:9 (Langseth); *see* Tr. 875:20-876:2 (Waldron); D-194 at 26.

138. Criner & Parks (1976) is a USGS publication that includes a map depicting pre-development conditions, based on four observed data points. J-24 at 23, figure 4 (also P-205). Criner & Parks also shows water flowing from Mississippi into Tennessee and

from both Mississippi and Tennessee into Arkansas. Tr. 625:9-24 (Larson); 1016:7-1017:20 (Langseth); *see* Tr. 875:20-876:2 (Waldron); D-198 at 6; D-194 at 20-21.

139. Figure 9 from the report of Mississippi's expert David Wiley (D-112 and P-168) depicts an area identified within a yellow triangle from which Wiley reports that groundwater in the Aquifer flowed naturally from Mississippi into Tennessee. Tr. 305:3-20 (Spruill); 459:15-24, 507:11-25, 541:8-13 (Wiley). *See also* Tr. 647:2-14 (Larson); 875:20-876:2 (Waldron); D-194 at 21-22.

140. Figure 9 from David Wiley's report (D-112 and P-168) also includes pre-development flow paths showing water in the Aquifer naturally flowing from Mississippi into Tennessee, which the figure identifies as "Interstate Flow." Tr. 306:5-13 (Spruill); 495:2-7, 506:19-507:13 (Wiley).

141. The contours on David Wiley's Figure 9 show that the actual area from which groundwater in the Aquifer would naturally have flowed from Mississippi to Tennessee during pre-development times is larger than the yellow triangle depicted on Wiley's Figure 9. Tr. 550:12-24 (Wiley); 1034:11-1035:14 (Langseth). The actual area of natural cross-border flow would extend farther west, as depicted by the red triangle shown on D-199. Tr. 550:23-24, 556:10-19 (Wiley). The area of natural flow from Mississippi into Tennessee would also extend farther east than the yellow triangle depicts, extending across Marshall County, Mississippi, and into Benton County, Mississippi. Tr. 517:5-519:9 (Wiley); *see* P-185.

142. Waldron & Larsen (2015) published a peer-reviewed journal article that included a map of pre-development conditions in the Middle Claiborne

Aquifer derived from early USGS data dating from between 1886 and 1906. Tr. 832:9-833:4, 837:11-838:25 (Waldron); D-194 at 27-28; J-21. The state border had no effect on the methods by which Waldron & Larsen created their map. Tr. 889:20-890:1 (Waldron).

143. Waldron & Larsen's map also shows water moving from Mississippi into Tennessee, and from both Mississippi and Tennessee into Arkansas. Tr. 627:8-628:18 (Larson); 857:4-10 (Waldron); 1018:21-1019:24 (Langseth); D-194 at 28.

144. The existence of natural cross-border flow in the Middle Claiborne Aquifer from Mississippi into Tennessee is also confirmed by all existing computer or "numerical" groundwater models that can be used to estimate pre-development conditions: the Arthur & Taylor (1998) model (J-4), the Brahana & Broshears (2001) model (J-15), and the Mississippi Embayment Regional Aquifer Study model[4] first described in Clark & Hart (2009) (J-18); D-194 at 16, 26-27. The Mississippi Embayment Regional Aquifer Study model is sometimes referred to as the "MERAS model."

145. Arthur & Taylor (1998) is a USGS publication describing a regional model, which included a modeled estimate of pre-development conditions in the Middle Claiborne Aquifer. J-4 at 64 (Plate 5). This map depicts water flowing from Mississippi into Tennessee, Arkansas, and Louisiana; there is also water flowing from Arkansas into Louisiana and from Arkansas back into Mississippi. Tr. 626:3-627:3

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[4] *See* proposed findings of fact concerning the MERAS model *infra* ¶¶ 272-281.

(Larson); 1025:13-23 (Langseth); *see* Tr. 875:20-876:2 (Waldron); D-194 at 16-17.

146. Although no map was presented during the hearing showing the Brahana & Broshears (2001) *model*[5] results for pre-development conditions (as opposed to their figure 16, which is a reproduction of the contours in the Criner & Parks (1976) map), Brahana & Broshears's model also demonstrates cross-border flow under pre-development conditions. Tr. 450:14-19 (Wiley); 1025:5-12 (Langseth); J-15 at 48.

147. Using the MERAS model to generate pre-development water-level contours shows water naturally crossing multiple state borders, including from Mississippi into Tennessee. Tr. 873:12-874:11 (Waldron); 1023:14-1024:6, 1027:4-1029:20 (Langseth); D-194 at 26-27.

148. Using the MERAS model for particle tracking analyses shows cross-border flow in the Middle Claiborne Aquifer under pre-development conditions, including from Mississippi into Tennessee, Tennessee into Mississippi, Tennessee and Mississippi into Arkansas, and Arkansas into Mississippi. Tr. 514:5-515:6, 516:9-518:8 (P-185) (Wiley); 1030:8-1032:19 (D-27) (Langseth).

149. A "water budget" analysis using the MERAS model (i.e., calculating total inflows and outflows within a given area of the model) also shows water flowing across the Mississippi-Tennessee border under pre-development conditions. Tr. 482:24-483:18 (Wiley).

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[5] *See* proposed findings of fact concerning the Brahana & Broshears model *infra* ¶¶ 282-285.

150. A reasonable estimate, based on the MERAS model, is that, under pre-development conditions, approximately 37 million gallons of water naturally flowed within the Middle Claiborne Aquifer from Mississippi into other States every day. Tr. 532:20-533:2 (Wiley).

4. *The Waldron & Larsen (2015) study shows substantially more pre-development flow from Mississippi into Tennessee than previous studies*

151. Waldron & Larsen's map of water-level contours estimated that the predominant direction of pre-development flow in the Middle Claiborne Aquifer near Memphis was naturally from Mississippi into Tennessee, in a southeast-to-northwest direction across the state border. Tr. 850:25-851:4 (Waldron).

152. Waldron & Larsen's estimate of flow direction shows even more substantial flow across the border, in a more northerly direction, than other efforts to estimate the direction of pre-development flow. Tr. 857:4-15 (Waldron); *see* D-174; D-194 at 28.

153. Waldron & Larsen compared the amount of estimated pre-development flow from Mississippi to Tennessee based on their map to the amount of estimated groundwater flow from Mississippi to Tennessee in 2007 based on the Schrader (2008) publication. Tr. 851:16-23 (Waldron). Schrader (2008) used the most recent data available and mapped water levels in the Aquifer in both the confined and unconfined areas and across state borders. Tr. 851:24-852:9 (Waldron).

154. Waldron & Larsen's analysis concluded that the average estimated cross-border flow from Mississippi into Tennessee for 2007 was lower than the average estimated cross-border flow from Mississippi

into Tennessee under pre-development conditions. Tr. 853:6-15 (Waldron); D-194 at 6. In other words, it concluded that groundwater flow in the Middle Claiborne Aquifer from Mississippi into Tennessee has declined over the past 130 years.

155. One reason why the overall cross-border flow volume has diminished is that water users in Mississippi have also increased their pumping out of the Aquifer significantly, causing the well fields in Shelby County to draw water from other directions, either from other parts of Tennessee or from Arkansas. Tr. 496:23-497:1 (Wiley); 853:16-854:6 (Waldron); *see* Tr. 651:25-652:11 (Larson: Mississippi's depiction of "diversion" flow paths does not reflect substantial pumping in Mississippi).

156. At the same time, pumping from the Middle Claiborne Aquifer in Shelby County has increased the rate of recharge from the overlying surficial aquifer, providing an alternative source of water and decreasing the need for groundwater in surrounding areas of the Middle Claiborne Aquifer to flow toward the well fields in Shelby County. Tr. 853:16-854:23 (Waldron); J-4 at 41; J-35 at 30.

5. *Waldron & Larsen's 2015 analysis offers the most reliable estimate of pre-development conditions in the Middle Claiborne Aquifer* [6]

157. Waldron & Larsen's 2015 paper was a peer-reviewed publication whose sole purpose was to investigate pre-development conditions in the Middle

[6] Defendants do not believe it is necessary to decide which of the pre-development maps is the most reliable because all of the maps show pre-development flow from Mississippi into Tennessee. Defendants include these facts for the Special Master's convenience and to preserve their positions.

Claiborne Aquifer in the Memphis area. Tr. 832:6-833:4 (Waldron).

158. The pre-development potentiometric map created by Waldron & Larsen used the earliest known data, reported in three USGS publications dating to 1903 through 1906, derived from measurements that were taken close in time to the pre-development period. Tr. 837:9-838:25 (Waldron); D-194 at 27-28; *see* J-21; J-30; J-31.

159. Waldron & Larsen's pre-development potentiometric map is based on 27 control points across nine counties. Tr. 839:15-840:2, 945:18-21 (Waldron).

160. Dr. Waldron verified the locations and elevations of the control points used in his research using a variety of methods. Tr. 840:3-844:7 (Waldron: verifying locations), 844:16-847:7 (Waldron: estimating elevations), 847:8-848:24 (Waldron: confirming that wells were screened in the correct aquifer).

161. Dr. Waldron performed an error analysis to determine whether uncertainty about location or elevation of a control point could have a significant effect on the ultimate map, and found that, even assuming the highest statistical error rate, there was little change in the overall location of the water-level contours or direction of groundwater flow. Tr. 854:24-857:3 (Waldron).

162. The findings in Waldron & Larsen (2015) are based on more control points, data closer in time to pre-development conditions, and better-quality data than previous studies of pre-development conditions in the Middle Claiborne Aquifer. Additionally, Waldron & Larsen (2015) is the only study of the Middle Claiborne Aquifer focused solely on developing an accurate depiction of pre-development condi-

tions. Tr. 858:23-25, 868:19-22, 869:20-870:6, 873:8-11, 874:12-15, 876:3-10 (Waldron).

163. Criner & Parks (1976) had only four control points and no data south of the Tennessee-Mississippi state border. Tr. 341:14-16 (Spruill); 859:8-860:9 (Waldron). A map is more reliable when it has more data spread out over a larger area, so that a hydrologist can avoid extrapolating too far away from data points. Tr. 859:8-16 (Waldron). Further, of Criner & Parks's four data points, the one closest to the Mississippi-Tennessee border is not a well; it is a tunnel to a 40-foot cistern. Tr. 862:18-863:7 (Waldron). Because water-level measurements taken from such a cistern are less accurate than water-level measurements taken from a well, Criner & Parks's reliance on the 40-foot cistern further undermines the relative accuracy of their pre-development map. Tr. 864:6-17 (Waldron); D-196 at 19.

164. Without any data points near or south of the state border, there is no apparent scientific basis for the bends in Criner & Parks's contours near the state border. These unsupported contours create the misleading impression that the direction of the water flow in the Aquifer was more east-to-west (parallel to the border) rather than south-to-north (across the border). Omitting the unsupported bends in the contour lines on Criner & Parks would result in more natural flow from Mississippi to Tennessee. Tr. 345:12-347:11 (Spruill); 860:10-862:17 (Waldron).

165. Criner & Parks's control points are based on measurements taken 40 to 70 years after development began in 1886, compared with no more than 20 years post-development for Waldron & Larsen's data. D-196 at 24; J-24 at 11-15.

166. Data based on measurements taken nearer in time to pre-development is preferable and tends to yield more reliable results. Tr. 864:11-25 (Waldron).

167. Because Mr. Wiley's Figure 9 map is based almost completely on the Criner & Parks (1976) map, it suffers from the same deficits that the Criner & Parks map does. Tr. 869:20-870:6 (Waldron).

168. The only substantive change Mr. Wiley made from Criner & Parks was to extend the water-level contour lines even farther south into Mississippi. Tr. 544:1-5 (Wiley). However, Mr. Wiley did not use any observation wells, control points, or other data to extend those lines. Tr. 545:2-6 (Wiley); 870:7-871:9 (Waldron).

169. Like Mr. Wiley's Figure 9, Brahana & Broshears (2001)'s Figure 16 derives its contours directly from Criner & Parks (1976) without change and, therefore, suffers from the same deficiencies. The only substantive change was the erroneous notation on the map of an additional fifth control point, which did not appear on Criner & Parks's map and, in fact, did not actually exist. Tr. 865:17-869:1 (Waldron).

170. The potentiometric map and associated text published by Reed (1972) did not include any explanation of Reed's methodology, supporting data, or how many control points might have been used. Tr. 347:24-348:6 (Spruill); 874:16-875:19 (Waldron); 1015:24-1016:2 (Langseth); *see* J-67. Without such supporting data, Reed (1972) provides a less reliable basis for estimating the Middle Claiborne Aquifer's pre-development equipotential surface than does Waldron & Larsen (2015).

171. Both Arthur & Taylor (1998) and MERAS are numerical computer models that simulate

pre-development conditions in an aquifer based on computer data rather than observed data. For estimating conditions in an aquifer at a particular time in the past, it is preferable to rely on observed water levels that are obtained close in time to the period being estimated. Tr. 872:16-873:3 (Waldron).

6. *Groundwater was and is leaving Mississippi*

172. The water within the Middle Claiborne Aquifer is not static. Before and after pumping began, the groundwater in the Middle Claiborne Aquifer was and is constantly moving. Tr. 303:17-25, 364:17-21 (Spruill); 503:21-504:2 (Wiley); 589:19-22, 621:23-622:2 (Larson); 831:8-10 (Waldron); D-197 at 8; J-55 at 327.

173. Recharge and discharge are constantly occurring in the Middle Claiborne Aquifer. Tr. 582:8-9 (Larson).

174. Under pre-development conditions and since then, all of the water within the Middle Claiborne Aquifer beneath Mississippi has already left or will eventually leave the State of Mississippi. Tr. 307:5-10 (Spruill); 626:18-20 (Larson); 1048:12-20 (Langseth); D-197 at 8.

175. The groundwater in the Middle Claiborne Aquifer leaving the area beneath Mississippi is constantly replaced by water recharging into the Aquifer from rainfall infiltration, surface water, or groundwater flow from overlying or underlying hydrogeologic units. D-197 at 8, 24.

E. The Middle Claiborne Aquifer Is An Interstate Aquifer Because It Is Hydrologically Connected To Interstate Surface Water And Other Interstate Aquifers

1. *The Aquifer is hydrologically connected to interstate surface water*

176. The Middle Claiborne Aquifer is hydrologically connected to interstate surface waters. Tr. 358:25-360:13 (Spruill); 502:15-19 (Wiley); 617:11-21 (Larson); J-35. Groundwater should not be studied in isolation but must be considered together with the surface water to which it is hydrologically connected. J-79 at 6-7.

177. Water in the outcrop area of the Middle Claiborne Aquifer has a direct hydrological connection to surface water. Tr. 302:12-15 (Spruill); J-7 at 29.

178. The Wolf River begins in Mississippi, then flows into Tennessee before discharging into the Mississippi River. Tr. 502:23-503:7 (Wiley); 618:11-14 (Larson); 1047:7-17 (Langseth); J-18 at 13; J-19 at 16.

179. The Wolf River flows through the outcrop area of the Middle Claiborne Aquifer. Tr. 503:5-11 (Wiley); J-7 at 29; J-10 at 19.

180. The Middle Claiborne Aquifer has a direct hydrological connection to the Wolf River in the outcrop area. Water from the Wolf River in the outcrop area can directly recharge the Middle Claiborne Aquifer, or water from the Middle Claiborne Aquifer can directly discharge into the Wolf River, depending on the relative water levels in the river and the Aquifer. Tr. 619:8-13 (Larson); 1046:17-24 (Langseth);

D-197 at 17, 23; J-7 at 29; J-10 at 19; J-11 at 13; J-58 at 11-13.

181. The alluvial aquifer is situated above the Middle Claiborne Aquifer. It is separated from the Middle Claiborne Aquifer by a confining layer. The alluvial aquifer has a direct hydrological connection to the Mississippi River. Tr. 619:14-22 (Larson); J-6 at 9.

182. The Mississippi River is an interstate river. Tr. 620:6-10 (Larson); D-198 at 8.

183. The Middle Claiborne Aquifer is hydrologically connected to the Mississippi River. Groundwater in the Middle Claiborne Aquifer can flow upward through overlying confining layers and aquifers into the Mississippi River. The Mississippi River is an area of discharge in the Mississippi Embayment. Tr. 303:13-16 (Spruill); 503:14-20 (Wiley); D-197 at 16; D-198 at 8.

184. The Middle Claiborne Aquifer is directly hydrologically interconnected to the Mississippi River where the Middle Claiborne Aquifer outcrops in the northern portion of the Mississippi Embayment. Tr. 1046:1-8 (Langseth); J-4 at 18; J-5 at 21.

185. The Middle Claiborne Aquifer is interstate because it is hydrologically connected to interstate bodies of surface water. Tr. 587:21-23 (Larson); 1045:21-1046:12 (Langseth).

2. *The Middle Claiborne Aquifer is hydrologically connected to other interstate aquifers*

186. Within the Mississippi Embayment, groundwater is able to flow from one aquifer to another aquifer through confining units because confining units in the Mississippi Embayment limit, but do not

prevent, the vertical flow of groundwater. Tr. 301:1-19, 303:2-6 (Spruill); 615:24-616:7, 619:18-22 (Larson); J-7 at 13; J-8 at 7; J-15 at 9; J-35 at 7.

187. Pumping within one aquifer can affect groundwater in adjoining aquifers. Tr. 616:13-19 (Larson); J-15 at 9; J-35 at 20.

188. The Middle Claiborne Aquifer is hydrologically connected to the overlying and underlying aquifers within the Mississippi Embayment because water can flow through the intervening confining units between the aquifers. Tr. 524:7-525:1 (Wiley); J-7 at 13; J-8 at 7; J-19 at 20; J-15 at 9; J-35 at 23-24.

189. The Fort Pillow Aquifer is located beneath the Middle Claiborne Aquifer and separated from it by a confining layer. The Fort Pillow Aquifer extends beneath at least Arkansas, Tennessee, and Mississippi. The Middle Claiborne Aquifer is hydrologically connected to the Fort Pillow Aquifer because water is able to flow through the intervening confining unit. Tr. 524:19-525:1 (Wiley); 818:6-10 (Waldron); J-76 at 32; J-4 at 53.

190. The Middle Claiborne Aquifer is interstate because it is hydrologically connected to other interstate aquifers. Tr. 587:21-23 (Larson).

III. FACTS REFUTING MISSISSIPPI'S POSITIONS[7]

A. Mississippi's Contention That There Are Two Aquifers Is Not Supported By The Facts

1. *Naming conventions*

191. There are a variety of different regional names sometimes used to refer to the Middle Claiborne Aquifer. Tr. 595:8-12, 595:19-23 (Larson); 814:15-815:6 (Waldron); 986:7-19, 986:23-987:16 (Langseth); D-197 at 6, 16.

192. Local naming conventions are variations in how people refer to the Aquifer in different locations; they do not change the hydrogeological nature of the Aquifer. Tr. 814:19-815:14 (Waldron).

193. The area of the Middle Claiborne Aquifer north of the Mississippi-Tennessee border is sometimes called the Memphis Sand Aquifer or Memphis Aquifer. Tr. 88:8-10, 354:11-15 (Spruill); 814:20-25 (Waldron); D-197 at 6.

194. The area of the Middle Claiborne Aquifer south of the Mississippi-Tennessee border is sometimes called the Sparta Sand or Sparta Aquifer. Tr. 814:20-815:6 (Waldron); D-197 at 6.

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[7] Many of the proposed findings in Section III concern issues that are the subject of Defendants' pending motions in limine, including the motion to exclude irrelevant evidence. By including these proposed findings here, Defendants do not suggest that they are relevant, nor do Defendants waive their arguments to limit or exclude evidence. Defendants therefore request that the Special Master grant their pending motions and exclude all evidence (on both sides) about these topics as irrelevant and prejudicial. That said, these proposed findings are included here for the Special Master's convenience and to preserve and support Defendants' factual position if the Special Master were to find them relevant.

195. The area sometimes called the Sparta Aquifer and the area sometimes called the Memphis Aquifer are part of a single hydrogeological unit: the Middle Claiborne Aquifer. Tr. 298:1-9 (Spruill); 611:14-612:2 (Larson); 814:20-815:3, 822:13-17 (Waldron); D-197 at 16.

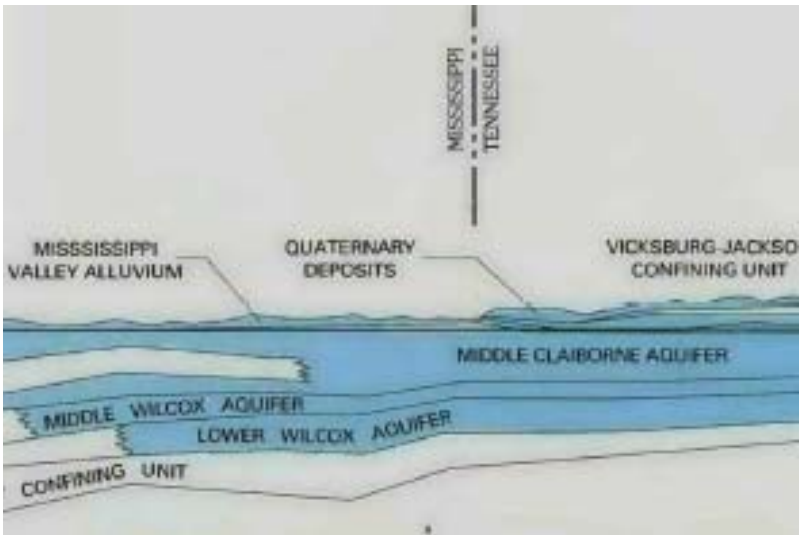
196. The terms "Sparta Sand," "Sparta Aquifer," "Memphis Sand Aquifer," and "Memphis Sand" are often used interchangeably to refer to the Middle Claiborne Aquifer. Tr. 293:23-294:4 (Spruill); 487:21-490:18 (Wiley); 595:8-23 (Larson).

197. The Middle Claiborne Aquifer is sometimes called the Memphis-Sparta Sand Aquifer or Sparta-Memphis Sand Aquifer, a combination of the more commonly used regional names. Tr. 293:5-9 (Spruill); 986:11-19 (Langseth).

2. *The Middle Claiborne Aquifer is continuous north and south of the facies change*

198. Moving south through the Aquifer from Tennessee, the facies change begins 6 to 20 miles south of the Tennessee-Mississippi border where a clay layer begins to form in the middle part (from a vertical perspective) of the Middle Claiborne Aquifer. The permeable Middle Claiborne Aquifer continues above and below the intervening confining layer. This continuation of the Middle Claiborne Aquifer above and below the facies change can be conceptualized as a two-pronged fork. The "handle" of the fork is the part of the Middle Claiborne Aquifer that lies north of the facies change. Moving south, the "handle" splits into an "upper prong" above and a "lower prong" below the intervening clay layer. Tr. 607:23-25 (Larson); 820:1-821:10 (Waldron); J-13 at 13; *see also* J-42 at 35; J-76 at 35.

199. One scientifically accepted depiction of the facies change is a figure on Plate 2 of J-4. J-4 at 61. An excerpt is shown here with the area referred to as the "handle" appearing on the right of the figure (north of the facies change):



200. The Lower Claiborne Confining Unit, the intervening clay confining unit resulting from the facies change, does not impede the lateral flow of groundwater within the Middle Claiborne Aquifer. Tr. 608:22-25 (Larson).

201. The Lower Claiborne Confining Unit does not prevent water within the Middle Claiborne Aquifer from flowing across the Mississippi-Tennessee border. Tr. 299:15-23 (Spruill).

202. North of the facies change, the "handle" of the Middle Claiborne Aquifer is sometimes called the "Memphis Sand," "Memphis Aquifer," or "500-Foot Sand." Tr. 91:16-18, 97:21-23 (Spruill); 595:19-23, 611:5-13 (Larson); D-197 at 15; J-4 at 20; J-5 at 23; J-7 at 9; J-13 at 16-18; J-25 at 24; J-58 at 15-16.

203. South of the facies change, the "upper prong" of the Middle Claiborne Aquifer (the part above the Lower Claiborne Confining Unit) is sometimes called the "Sparta Sand" or "Sparta Aquifer." Tr. 88:2-15, 97:22-23, 354:11-15 (Spruill); 611:5-13 (Larson); 814:20-815:3, 822:6-12 (Waldron); Hoffman Dep. 32:16-20; D-197 at 6; J-4 at 20; J-5 at 23; J-13 at 16-18; J-15 at 12-13.

204. South of the facies change, the "lower prong" of the Middle Claiborne Aquifer (the part below the Lower Claiborne Confining Unit) is sometimes called the "Lower Claiborne Aquifer" or the "Meridian Sand." Tr. 88:16-19, 102:13-22 (Spruill); 613:21-614:6 (Larson); 823:5-23 (Waldron); J-5 at 24; J-13 at 16-18.

205. Water can flow within the Middle Claiborne Aquifer from the "handle" of the Middle Claiborne Aquifer (sometimes called the Memphis Sand) to the "upper prong" area of the Middle Claiborne Aquifer (sometimes called the Sparta Sand), and vice versa. There is no physical barrier that prevents groundwater in the Middle Claiborne Aquifer from flowing laterally above the facies change. Tr. 609:9-13 (Larson); 822:18-22 (Waldron).

206. A cone of depression from pumping within the "handle" of the Middle Claiborne Aquifer (sometimes called the Memphis Sand) can extend south into the "upper prong" of the Middle Claiborne Aquifer (sometimes called the Sparta Sand), and vice versa. Tr. 610:10-16 (Larson).

207. Water can flow within the Middle Claiborne Aquifer from the "handle" of the Middle Claiborne Aquifer (sometimes called the Memphis Sand) to the "lower prong" of the Middle Claiborne Aquifer (sometimes called the Meridian Sand or Lower Claiborne

Aquifer), and vice versa. There is no physical barrier to water flowing laterally below the facies change. Tr. 284:19-24, 285:6-8, 388:21-389:8 (Spruill); 609:23-610:9 (Larson); 823:20-824:8 (Waldron).

208. A cone of depression from pumping within the "handle" of the Middle Claiborne Aquifer (sometimes called the Memphis Sand) can extend south into the "lower prong" of the Middle Claiborne Aquifer (sometimes called the Lower Claiborne Aquifer or Meridian Sand), and vice versa. Tr. 610:10-16 (Larson).

209. Potentiometric levels within the Middle Claiborne Aquifer are continuous across the facies change. Tr. 610:17-22 (Larson).

3. *Lower Claiborne Aquifer*

210. The "lower prong" of the Middle Claiborne Aquifer (sometimes called the Lower Claiborne Aquifer) and the "handle" of the Middle Claiborne Aquifer are part of the same hydrogeological unit. J-18 at 11; Tr. 594:10-17, 782:18-783:8 (Larson); 823:20-824:3 (Waldron); J-22 at 19.

211. In some publications, the USGS includes the Lower Claiborne Aquifer as part of the Middle Claiborne Aquifer. J-15 at 15, figure 3; Tr. 291:20-292:25 (Spruill).

212. The USGS sometimes labels the Lower Claiborne Aquifer separately from the Middle Claiborne Aquifer in order to identify the presence of the Lower Claiborne Confining Unit above it. Tr. 784:16-785:2 (Larson); J-4 at 21; J-5 at 24; J-18 at 15.

4. *The various names by which the areas of the Middle Claiborne Aquifer are identified are irrelevant to any hydrogeological facts and do not change the interstate character of the Aquifer*

213. Even if Mississippi's claim were valid (which it is not) that the areas of the Middle Claiborne Aquifer commonly called the Memphis Aquifer and Sparta Aquifer should be considered separate sub-aquifers (or "units," or "sub-units," or "aquifers"), the resource would still properly be considered interstate. The part of the Middle Claiborne Aquifer called the Memphis Aquifer and the part of the Middle Claiborne Aquifer called the Sparta Aquifer are hydrogeologically continuous. There is no barrier that prevents water from flowing from one area to the other or prevents the effects of pumping from being transmitted across the place where the name change is being used – in either direction. Tr. 612:3-16 (Larson).

214. Even if the "handle" of the Middle Claiborne Aquifer, sometimes called the Memphis Aquifer, were considered to be a separate aquifer, it would be an interstate aquifer because it extends beneath Mississippi, Tennessee, Arkansas, and Kentucky, and because there is a continuity of properties across these state borders. Tr. 391:1-4 (Spruill); 612:17-613:6 (Larson); J-4 at 20; J-5 at 23.

215. Even if the "upper prong" of the Middle Claiborne Aquifer south of the facies change, sometimes called the Sparta Aquifer, were considered to be a separate aquifer, it would be an interstate aquifer because it extends beneath Mississippi, Arkansas, and Louisiana and there is a continuity of properties

across these state borders. Tr. 613:7-20 (Larson); J-4 at 20-21; J-5 at 23.

216. Even if Mississippi's claim were valid (which it is not) that the areas of the Middle Claiborne Aquifer commonly called the Lower Claiborne Aquifer and the Middle Claiborne Aquifer were considered separate sub-aquifers (or "units," or "sub-units," or "aquifers"), the resource would still properly be considered interstate. The Lower Claiborne Aquifer and the Middle Claiborne Aquifer are hydrogeologically continuous. There is no barrier between the two that prevents water from flowing from one to the other or prevents the effects of pumping from being transmitted across the place where the name change is being used – in either direction. Tr. 388:21-389:8 (Spruill); 785:11-20 (Larson); 824:4-8 (Waldron).

217. Mississippi's claims only allege that Defendants are responsible for taking water in the "Sparta Sand" – i.e., the part of the Middle Claiborne Aquifer that continues above the facies change.

B. Mississippi Produced No Evidence To Support Its Contention That MLGW Was Not A Good Manager Of The Aquifer

218. Water can be removed from an aquifer only using a well. Tr. 134:9-16 (Spruill). Well drillers use a variety of techniques to determine where to place a well in order to obtain the desired quantity of water, including consulting with other water users; reviewing relevant literature; and drilling exploratory or "pilot" holes. Tr. 136:10-137:13 (Spruill).

219. Well fields are designed based on knowledge of the hydraulic properties of the aquifer in which the wells are drilled. Tr. 145:21-146:1 (Spruill). Based on the hydraulic properties of the aquifer, a hydrologist can predict how pumping from the well will

affect the surrounding area and, in particular, how much drawdown will occur in the aquifer's water levels around the well. Tr. 151:19-152:9, 163:1-165:14 (Spruill).

220. A cone of depression is an unavoidable consequence of using a well. Tr. 465:7-8 (Wiley). Well fields generally have wells close enough together that their cones of depression overlap, creating "well interference." Tr. 177:9-179:16 (Spruill). As a practical matter, all well fields exhibit well interference, meaning that the cones of depression overlap. Well fields in Mississippi, like MLGW's well fields, exhibit well interference. Tr. 336:16-21 (Spruill).

221. Dr. Spruill did not opine that MLGW's well fields were inconsistent with good well-field design. *See generally* Tr. 183:19-201:4, 204:24-221:7, 250:16-256:15, 273:9-277:5 (Spruill).

222. Dr. Spruill did no analysis to determine how many wells are located in Mississippi within one mile of the state border. Tr. 336:12-15 (Spruill).

223. Dr. Spruill had no basis to disagree with the assertion that there is a well field in Southaven, Mississippi, less than one mile from the Mississippi-Tennessee border, where the wells are placed much closer together than they are in MLGW's Davis, Palmer, or Lichterman well fields. Tr. 336:22-337:4 (Spruill); *see* J-56 at 1-13.

224. Dr. Spruill made no effort to analyze whether groundwater wells in Mississippi that are pumping from the Middle Claiborne Aquifer are consistent with the principles of good well design. Tr. 337:5-9 (Spruill).

C. There Is No Evidence That Pumping From The Aquifer In Shelby County, Tennessee, Exceeds The Amount Of Water Recharging Into The Aquifer

225. MLGW's groundwater pumping system currently consists of approximately 160 wells located in 10 different well fields in Shelby County, Tennessee. S11.

226. MLGW's total pumping increased from 1965 to 2000 from roughly 72 million gallons of water per day to roughly 162 million gallons per day. From 2000 to 2016, it decreased to approximately 124 million gallons per day. Tr. 200:14-21 (Spruill).

227. The regional cone of depression in the Middle Claiborne Aquifer around the Memphis area is caused by the combined pumping of MLGW and other users, including pumping in other States. Tr. 499:15-501:22 (Wiley); J-76 at 20-21.

228. The regional cone of depression created by pumping from the Aquifer in the Memphis area (including in north Mississippi) has stabilized and begun to shrink, in part because MLGW has been pumping less. Tr. 456:9-19 (Wiley); D-198 at 10.

229. There is no evidence in the record that MLGW is withdrawing groundwater from the Middle Claiborne Aquifer at a rate greater than the recharge rate. Tr. 325:14-17 (Spruill); D-198 at 10.

230. The stabilization of the cone of depression in the Middle Claiborne Aquifer around Memphis means that there is a relative balance or equilibrium between recharge and discharge (including withdrawal). Tr. 657:7-15 (Larson); D-198 at 10.

231. The volume of groundwater in the Aquifer flowing from Mississippi to Tennessee has decreased

over the past years because pumping in Shelby County, Tennessee, has decreased and, at the same time, pumping in DeSoto County, Mississippi, has increased. Tr. 496:5-497:1 (Wiley). In recent years, groundwater withdrawals in DeSoto County from the Middle Claiborne Aquifer have increased to approximately 20 million gallons per day from approximately 3.6 million gallons per day in 1983. Tr. 652:5-11 (Larson); P-158; J-76 at 20-21.

232. Around the Memphis area, potentiometric levels within the Middle Claiborne Aquifer declined until roughly the 1970s, then stabilized, and have increased in recent years. Tr. 654:17-655:4 (Larson); D-197 at 23; D-198 at 10; J-18 at 57.

233. When recharge and discharge are relatively stable, the total volume of water within the Aquifer does not change significantly, but water is constantly flowing out of the Aquifer and is replaced by new water that is constantly flowing into the Aquifer. D-197 at 8, 12.

D. Mississippi's Groundwater Model Is Unreliable

234. There is pumping from the Middle Claiborne Aquifer in Arkansas, in Mississippi outside of DeSoto County, in Tennessee outside of Shelby County, and in Shelby County other than by MLGW. Tr. 499:23-25, 500:1-4, 500:7-13, 521:9-24 (Wiley); J-76 at 20-21.

235. Mississippi's groundwater model simulates pumping from the Middle Claiborne Aquifer only by pumpers in DeSoto County, Mississippi, and by MLGW in Shelby County, Tennessee. Tr. 499:15-22 (Wiley).

236. The groundwater model used by Mississippi's expert did not simulate pumping in Shelby County,

Tennessee, by anyone other than MLGW; pumping in Crittenden County, Arkansas; or pumping in Marshall County, Mississippi. Tr. 500:1-13, 521:25-522:1 (Wiley).

237. The results produced by Mississippi's model do not reflect the impact of pumping from the Middle Claiborne Aquifer from wells in Mississippi outside of DeSoto County, from wells in Arkansas, or from wells in Tennessee other than MLGW. Tr. 499:23-25, 500:1-6, 521:9-522:10 (Wiley).

238. Mississippi's groundwater model was calibrated with real-world data only up until the year 1980. Tr. 538:7-12 (Wiley). Mississippi's expert did not recalibrate his model with more recent data, even though such data are available, and recalibration with more current data could have improved the accuracy of the model. Tr. 538:19-539:20 (Wiley).

E. Mississippi Provided No Meaningful Evidence Of Any Injury

1. *No evidence of meaningful harm to Mississippi water users*

239. Mississippi's experts did not attempt to calculate the reduction in total available drawdown in Mississippi caused by the regional cone of depression. Tr. 325:18-326:1 (Spruill).

240. Given the current water demand in Mississippi, water purveyors in Mississippi are currently able to meet demand for water from the Middle Claiborne Aquifer beneath Mississippi. Tr. 325:6-10 (Spruill).

241. The volume of water beneath DeSoto County, Mississippi, at any given time has changed very little since pumping began more than 100 years ago. Tr. 504:14-17 (Wiley).

242. There is no evidence that water users in Mississippi have been unable to withdraw as much water as desired from the Aquifer. D-198 at 10.

243. Water users in Mississippi have been able to significantly increase their usage of water from the Middle Claiborne Aquifer over the last few decades, without having any difficulty withdrawing the desired quantities of water. Tr. 647:23-648:16 (Larson); D-198 at 12.

244. Drawdown in an aquifer increases the cost of electricity required to pump water from a well located within the cone of depression, but Mississippi's expert made no attempt to quantify the potential cost of additional electricity needed to pump water from the Aquifer due to a decline in water levels. Tr. 213:21-214:3 (Spruill). Any such cost would be much smaller than the damages sought in this case. Tr. 650:19-23 (Larson).

245. It is theoretically possible that a user might need to lower a well's pump as a result of drawdown, Tr. 214:4-10 (Spruill), but Mississippi's experts offered no evidence that any well user in Mississippi has had to lower the well's pump as a consequence of the regional cone of depression.

246. Pumping water from an aquifer can theoretically cause water from other aquifers to migrate into the pumped aquifer more quickly, Tr. 209:12-24 (Spruill), but Mississippi's experts had no evidence of any degradation in water quality (from any cause) in the Middle Claiborne Aquifer in Mississippi. *See*, *e.g.*, Tr. 325:11-13 (Spruill).

247. Mississippi's expert admits that pumping has not caused any subsidence to the Middle Claiborne Aquifer. Tr. 198:13-20 (Spruill).

248. Mississippi's experts have not estimated any costs associated with the impact of the cone of depression in the Middle Claiborne Aquifer. *See*, *e.g.*, Tr. 335:22-336:3 (Spruill).

249. Mississippi offered no evidence that pumping by MLGW or any other pumper in the Memphis area has damaged the aquifer. If all the pumping wells in the Middle Claiborne Aquifer were turned off, the cone of depression caused by those wells would disappear, and the Aquifer would return to its pre-development conditions. Tr. 198:1-11 (Spruill); J-19 at 32.

2. *Mississippi's experts agreed that there would be significant costs associated with moving MLGW's groundwater wells farther north*

250. Dr. Spruill speculated that moving MLGW's well fields farther to the north (if even feasible) might lessen the extent of the cone of depression across the Mississippi-Tennessee state line. Tr. 326:2-8 (Spruill). However, Dr. Spruill had no basis to disagree with an analysis done by Mr. Wiley, in which Mr. Wiley concluded, among other things, that moving the three MLGW well fields closest to Mississippi (Davis, Palmer, and Lichterman) all the way to the northern part of Shelby County would cause very little change in the cone of depression's extent into Mississippi. Tr. 328:23-330:10 (Spruill).

251. Mr. Wiley could not say whether, in his opinion, moving all of MLGW's well fields north by 20 miles would eliminate the extent of the cone of depression into Mississippi. Tr. 485:7-11 (Wiley).

252. Dr. Spruill agreed with Mr. Wiley's conclusion that moving most of MLGW's wells north of Shelby County, Tennessee, would require the design

and construction of hundreds of new wells and many miles of pipeline, at an enormous cost. Tr. 332:16-333:6 (Spruill).

253. Dr. Spruill did not calculate, or offer any opinion concerning, how much it would cost to move MLGW's well fields. Tr. 326:9-327:5 (Spruill).

3. *The regional cone of depression around Memphis is less significant than other cones of depression in the Middle Claiborne Aquifer*

254. The cone of depression centered in the southwest Tennessee–northwest Mississippi area in the Middle Claiborne Aquifer is neither the largest nor the deepest cone of depression in the Middle Claiborne Aquifer. J-19 at 34; J-18 at 57-58; Tr. 660:25-661:11, 662:11-17 (Larson); J-71.

255. Compared to historical decreases in potentiometric levels in the Middle Claiborne Aquifer in the southwest Tennessee–northwest Mississippi area, more significant declines have been caused by pumping near Jackson, Mississippi; Jefferson County, Arkansas; and Union County, Arkansas. Tr. 658:3-660:10 (Larson); J-18 at 57.

256. In contrast to water levels around Memphis, which have stabilized and in fact have increased in recent years, Tr. 654:17-655:9, 656:25-657:6 (Larson), the decreases in water levels in Madison County, Mississippi – near Jackson, Mississippi – caused by wells pumping in that area have continued to decline, Tr. 658:3-6 (Larson); J-18 at 57.

257. The cones of depression caused by pumping in Union County, Arkansas, and nearby Louisiana; Jefferson County, Arkansas; and Jackson, Mississippi, are the deepest and largest cones of depression

in the Middle Claiborne Aquifer. Tr. 660:18-662:17 (Larson); J-19 at 34; J-71.

258. The Memphis metropolitan area is the largest urban area overlying the Middle Claiborne Aquifer. Tr. 664:5-13 (Larson); J-18 at 11; J-19 at 15.

259. Memphis relies on groundwater as its primary public water source. There has been pumping in Memphis since 1886. J-7 at 14; J-17 at 16; J-18 at 11; J-19 at 11, 27.

F. The Velocity Or "Residence Time" Of Groundwater Is Not Relevant To Whether The Aquifer Is Interstate

260. Neither the velocity of groundwater nor the amount of time it would remain in a particular State ("residence time") is material to whether the Aquifer is interstate. Tr. 642:7-643:7 (Larson); 830:23-831:10 (Waldron).

261. Groundwater velocity can be significantly slower than the velocity of flowing surface waters. Tr. 121:1-126:4 (Spruill); 405:10-16, 461:8-15 (Wiley).

262. The velocity of groundwater movement can vary in confined and unconfined areas of an aquifer. In unconfined groundwater systems, water generally moves from areas of recharge to areas of discharge over a period of weeks or years. In confined groundwater systems, water generally moves from areas of recharge to areas of discharge over centuries. Tr. 63:20-64:14 (Spruill).

263. A typical velocity for groundwater in the confined areas of the Middle Claiborne Aquifer is approximately one inch or inches per day. Tr. 106:3-17, 121:1-10 (Spruill); 450:20-24 (Wiley).

264. Groundwater is continually flowing, although slowly, and water is continually recharging into

and discharging out of the Middle Claiborne Aquifer. Tr. 504:3-8 (Wiley); 642:15-22 (Larson); 831:1-10 (Waldron); D-197 at 12.

265. Groundwater in the Middle Claiborne Aquifer is continually moving across the Mississippi-Tennessee border, as well. Tr. 642:16-25 (Larson); 828:17-21 (Waldron).

266. There is no permanent "store" of particular water molecules in Mississippi (or anywhere else) within the Middle Claiborne Aquifer. Tr. 643:1-11 (Larson); D-197 at 23, 24.

267. The portion of the Middle Claiborne Aquifer beneath Mississippi is always saturated with water, but it does not always contain the *same* water molecules; the water is moving from place to place. Tr. 644:3-7 (Larson); D-197 at 25.

268. Mississippi's expert estimated that under pre-development conditions approximately 37 million gallons of groundwater in the Middle Claiborne Aquifer naturally flowed out of Mississippi into other States every day. Tr. 532:20-533:2 (Wiley).

G. A Hydrologist Cannot Isolate Individual Water Molecules From Within A Hydrogeological Unit

269. It is possible to draw general conclusions about the average speed or direction of water movement within an aquifer, but it is not possible to follow individual molecules of water. Tr. 644:8-12 (Larson).

270. Hydrologists do not work on the level of individual molecules, which are not observable, or even on the level of larger water particles, which are still microscopic. Generally, hydrologists work on the macroscopic scale, meaning they look at how – on

average – large numbers of water particles travel through porous media (like sand). Tr. 829:2-22 (Waldron); D-197 at 6.

271. The Middle Claiborne Aquifer is a continuous hydrological unit, and there is no scientific basis to isolate artificially a particular piece of that aquifer or water in it for purposes of hydrological analysis. All of the water in the Middle Claiborne Aquifer is hydrologically connected to, and acting on, water in the neighboring areas of the Aquifer. Tr. 830:5-17 (Waldron).

IV. COMPUTER MODELS OF THE MISSISSIPPI EMBAYMENT REGIONAL AQUIFER SYSTEM

A. The MERAS Model

272. The most recent computer model of the Mississippi Embayment Regional Aquifer System was developed by the USGS as part of the Mississippi Embayment Regional Aquifer Study ("MERAS"). The model is called the "MERAS model." Tr. 992:16-993:11 (Langseth); J-18 at 9.

273. The studies developing the MERAS model used the term "Middle Claiborne Aquifer" to refer to the Aquifer at issue. Tr. 568:4-10 (Larson); *see generally* J-18; J-19.

274. The MERAS model is based on, among other data, reviews of 2,600 borehole logs within the Mississippi Embayment area to refine the vertical and horizontal delineation of the various hydrogeological units. Tr. 1021:6-12 (Langseth); J-18 at 28; J-19 at 24.

275. The geographic scope of the MERAS model covers portions of eight States. The boundaries of the MERAS model follow the extent of the Mississippi Embayment and are not limited by political bounda-

ries. Tr. 596:21-597:12 (Larson) (J-18 at 37); D-197 at 7, 17; J-18 at 9; J-19 at 23.

276. The MERAS model includes the aquifers and confining units within the Mississippi Embayment. Tr. 993:5-11 (Langseth); J-18 at 11; J-19 at 23.

277. The MERAS model is a fully three-dimensional model. Tr. 1023:9-10 (Langseth); J-18 at 8, 16; J-19 at 23.

278. The MERAS model represents the various hydrogeological units within the Mississippi Embayment in 13 model layers. D-197 at 17; D-198 at 12; J-18 at 15; J-19 at 23.

279. The MERAS model uses multiple model layers to represent some of the hydrogeological units within the Mississippi Embayment in order to study each unit in greater detail. Tr. 779:22-780:10 (Larson); D-197 at 18; J-18 at 16.

280. The Middle Claiborne Aquifer is present in all or portions of layers 5-10 in the MERAS model. Tr. 482:6-9 (Wiley); D-191 at 10; J-18 at 15.

281. The MERAS model simulates the hydrological connections between surface water and groundwater within the Mississippi Embayment. D-197 at 18, 23; J-18 at 23, 25.

B. The Brahana & Broshears Model

282. The model of the Mississippi Embayment used by Mississippi's experts in this case was created by Brahana & Broshears in the 1970s-1980s based on technology available at that time. Tr. 519:10-22 (Wiley); J-15 at 34.

283. The Brahana & Broshears model consists of three horizontal layers. Tr. 519:23-520:2 (Wiley); J-15 at 34.

284. All three layers of the Brahana & Broshears model extend across the entire span of the modeled area, which includes portions of Mississippi, Tennessee, Arkansas, Missouri, and Kentucky. Tr. 520:3-14 (Wiley).

285. The Middle Claiborne Aquifer is represented in the Brahana & Broshears model as layer 2. Layer 2 represents the Middle Claiborne Aquifer as a single, continuous layer throughout the model's extent – extending well north and south of the Mississippi-Tennessee boundary. Tr. 520:15-23, 528:9-14 (Wiley); J-15 at 34, 35.

V. EXPERT QUALIFICATIONS

A. Steven Larson Qualifications

286. Mr. Steven Larson, expert for the State of Tennessee, is a Vice President at S.S. Papadopulos & Associates, an environmental consulting firm. Tr. 559:9-21 (Larson); D-197 at 27.

287. Mr. Larson has worked for S.S. Papadopulos for 39 years. Tr. 559:22-23 (Larson); D-197 at 27.

288. Mr. Larson specializes in groundwater hydrology. Tr. 559:24-560:2 (Larson).

289. Before working at S.S. Papadopulos, Mr. Larson worked nine years for the Water Resources Division of the United States Geological Survey. Tr. 560:3-10 (Larson); D-197 at 27.

290. At the USGS, Mr. Larson was a hydrologist who worked on water resource investigations and conducted research in the area of computer simulation models. Tr. 560:11-19 (Larson).

291. Mr. Larson has a bachelor's degree in civil engineering and a master's degree in civil engineering, both from the University of Minnesota. Tr. 560:20-24 (Larson); D-197 at 27.

292. Mr. Larson belongs to the American Institute of Hydrology and the National Groundwater Association. Tr. 560:25-561:4 (Larson); D-197 at 27.

293. Mr. Larson has published papers about groundwater hydrology and modeling. Tr. 561:5-6 (Larson).

294. The purpose of Mr. Larson's testimony is to offer an opinion about whether or not the Middle Claiborne Aquifer is an interstate water resource. Tr. 561:7-14 (Larson).

295. Mr. Larson has testified before a judge or Special Master or in arbitration more than 50 times. Tr. 562:2-7 (Larson).

296. Mr. Larson has served as a hydrological expert in interstate water disputes before the Supreme Court of the United States in several matters including: *Colorado v. Kansas*, *Kansas v. Nebraska*, *Nebraska v. Wyoming*, *Montana v. Wyoming*, and *North Carolina v. South Carolina.* Tr. 562:8-20 (Larson); D-197 at 27.

297. Mr. Larson's testimony in *Kansas v. Colorado*, *Kansas v. Nebraska*, *Nebraska v. Wyoming*, and *Montana v. Wyoming* included opinions concerning groundwater. Tr. 562:24-564:1 (Larson).

298. Mr. Larson has also testified as a hydrological expert in non-original actions involving the effects of groundwater use. Tr. 564:2-16 (Larson).

299. Mr. Larson was tendered as an expert in the field of groundwater hydrology without objection. Tr. 564:22-565:2 (Larson).

B. Brian Waldron Qualifications

300. Dr. Brian Anthony Waldron is an associate professor at the University of Memphis in the department of civil engineering and director of the Center

for Applied Earth Science and Engineering Research ("CAESER"). Tr. 797:1-9 (Waldron).

301. Dr. Waldron has been at the University of Memphis for approximately 20 years and has been a tenured professor there since 2010. Tr. 797:10-14 (Waldron).

302. Dr. Waldron teaches undergraduate and graduate courses including groundwater hydraulics, which covers the construct of water moving through porous media. Tr. 797:17-24 (Waldron).

303. Dr. Waldron has taught groundwater modeling at the university for more than 10 years. Tr. 798:1-8 (Waldron).

304. Dr. Waldron received his undergraduate degree in civil engineering at Memphis State University, now the University of Memphis; his master's in civil engineering at the University of Memphis; and his doctorate in civil engineering specializing in groundwater from Colorado State University. Tr. 798:9-18 (Waldron).

305. At CAESER, Dr. Waldron conducts research and engages in director-type operations. Tr. 798:19-23 (Waldron).

306. Dr. Waldron's research includes numerical modeling of groundwater and contaminant transport in the Middle Claiborne Aquifer; subsurface mapping of the confining clay above the Middle Claiborne Aquifer in the Memphis area and elsewhere; water sampling and age dating of the groundwater in the Middle Claiborne Aquifer; studies of recharge to the Middle Claiborne Aquifer; and water-level measurements and water-level maps of the Middle Claiborne Aquifer and shallow aquifer; and educational outreach to kids about water and how to conserve it. Tr. 798:24-799:16 (Waldron).

307. Dr. Waldron has published approximately 22 research papers, 16 of which concern groundwater hydrology. Tr. 799:21-800:3 (Waldron).

308. Dr. Waldron has studied the Middle Claiborne Aquifer for more than 20 years. Tr. 800:4-22 (Waldron).

309. Dr. Waldron spends 50-60% of his professional time studying the Middle Claiborne Aquifer. Tr. 800:23-801:2 (Waldron).

310. Dr. Waldron has studied the Middle Claiborne Aquifer for approximately 20,000 hours of his professional life. Tr. 801:3-6 (Waldron).

311. Dr. Waldron was admitted as an expert in the field of groundwater hydrology without objection. Tr. 802:10-13 (Waldron).

C. David Langseth Qualifications

312. Dr. David Langseth obtained a bachelor's degree in civil engineering and mathematics at the University of Minnesota in 1977. Tr. 966:3-8 (Langseth).

313. Dr. Langseth's undergraduate courses included a general water resources course that included groundwater, and a series of courses called geotechnical engineering that had a heavy component of the flow of water through granular materials, which is effectively groundwater flow. Tr. 966:12-19 (Langseth).

314. Dr. Langseth's undergraduate studies included work in mathematical modeling, which is how we understand groundwater flow. Tr. 966:20-24 (Langseth).

315. Mathematical or computer modeling is how we characterize groundwater flow. When looking at large natural systems, they are too complicated to solve mathematical equations by hand, so we

use computers, through methods called numerical methods, to break down a large area into small pieces. We use the same mathematics over all those small pieces, doing hundreds of thousands – in some cases millions – of calculations in order to solve those same fundamental equations over a long area. Tr. 967:4-22 (Langseth).

316. While an undergraduate student at the University of Minnesota, Dr. Langseth was employed at Barr Engineering where a large part of his work was hydrologic monitoring; for example, measuring groundwater monitoring levels, surface water monitoring, and installing groundwater monitoring wells. Tr. 967:23-968:18 (Langseth).

317. Dr. Langseth obtained his master's and doctorate from the Massachusetts Institute of Technology ("MIT"). Tr. 968:19-21 (Langseth).

318. During his postgraduate work at MIT, Dr. Langseth took courses in hydrology and, specifically, groundwater hydrology. Tr. 968:22-969:1 (Langseth).

319. Dr. Langseth's postgraduate work at MIT also included a course focused on numerical methods for solving environmental problems, which included a course in solving equations of groundwater flow. Tr. 969:4-9 (Langseth).

320. Since graduating from MIT, Dr. Langseth's focus has been in groundwater and surface water hydrology and hydraulics. Tr. 969:13-17 (Langseth).

321. After MIT, Dr. Langseth worked at Metcalf & Eddy, where he was asked to develop the company's groundwater modeling expertise. Dr. Langseth then went to Arthur D. Little for 12 years where he conducted groundwater modeling in addition to other groundwater-type projects. Tr. 970:11-971:5, 972:24-25 (Langseth).

322. Dr. Langseth then worked for Exponent and continued to work on projects that involved water hydrology until he joined the faculty at Northeastern University in the civil and environmental engineering department. Tr. 973:1-18 (Langseth).

323. At Northeastern, Dr. Langseth taught graduate level groundwater hydrology and quality courses, surface water hydrology and water quality courses, and general environmental management. He also taught undergraduate hydraulic engineering. Tr. 973:19-25 (Langseth).

324. Dr. Langseth's primary research area at Northeastern was a detailed study of groundwater and surface water interactions. Tr. 974:1-7 (Langseth).

325. After leaving Northeastern, Dr. Langseth joined Gradient, which is an environmental and risk sciences consulting firm. Dr. Langseth is a principal at Gradient and has worked on a variety of projects, many involving groundwater and surface water hydrology. Tr. 974:9-19 (Langseth).

326. Dr. Langseth belongs to the American Society of Civil Engineers, and a subgroup of that organization called the Environmental Water Resources Institute. Tr. 974:20-975:1 (Langseth).

327. Dr. Langseth belongs to the National Groundwater Association and, within that organization, is a representative on the Federal Advisory Committee on Water Information, which advises all of the federal agencies that deal with water information such as the USGS, and is also a member of the Subcommittee on Groundwater that was established under the Advisory Committee. Tr. 975:2-18 (Langseth).

328. Dr. Langseth has served as an expert or given expert testimony in cases involving ground-

water approximately 20 times, including serving as a groundwater expert in *Florida v. Georgia*, No. 142, Orig., before the United States Supreme Court. Tr. 975:19-976:25 (Langseth).

329. Dr. Langseth served as an expert concerning this same Aquifer in *Mississippi v. City of Memphis, et al.*, No. 2:05CV0032 (N.D. Miss.). Tr. 977:1-8 (Langseth).

330. Dr. David Langseth was admitted as an expert in the field of groundwater hydrology without objection. Tr. 978:14-18 (Langseth).

Respectfully submitted,

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