IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

1. STATE OF OKLAHOMA, ex rel. OKLAHOMA SECRETARY OF THE ENVIRONMENT J.D. STRONG in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,	)	
Plaintiff,	)	
v.	)	Case No. 4:05-cv-00329-GKF-PJC
1. TYSON FOODS, INC., 2. TYSON POULTRY, INC., 3. TYSON CHICKEN, INC., 4. COBB-VANTRESS, INC., 5. CAL-MAINE FOODS, INC., 6. CARGILL, INC., 7. CARGILL TURKEY PRODUCTION, LLC, 8. GEORGE'S, INC., 9. GEORGE'S FARMS, INC., 10. PETERSON FARMS, INC., and 11. SIMMONS FOODS, INC.,	)	
Defendants.	)	

THE STATE OF OKLAHOMA'S PROPOSED
FINDINGS OF FACT AND CONCLUSIONS OF LAW

TABLE OF CONTENTS

FINDINGS OF FACT

I. Introduction 2

II. An Overview of the History of the Litigation 3

III. Road Map 6

IV. The Illinois River Watershed 7

A. The Illinois River and Its Tributaries 8

B. Lake Tenkiller 11

C. Topography, Hydrology, Geology and Soils of the IRW 12

1. Topography and Hydrology 12

2. Geology and Soils 15

D. Land Uses in the IRW 16

V. Ownership / Possessory Property Interests 17

VI. Regulation of the Waters of IRW in Oklahoma 18

A. "Outstanding Water Resources" Designation of Certain IRW Waters 21

B. Water Quality Standards 22

1. Narrative and Numerical Water Quality Standards 24

2. Antidegradation Standards 26

3. Designated Beneficial Uses of Waters in the IRW 27

C. Total Maximum Daily Load (TMDL) 29

1. The Role of TMDLs in Protecting Water Quality 29

2. The Development of TMDLs for the IRW 30

D. Oklahoma's Public Policy Regarding Pollution of Waters of the State 34

VII. Uses of the Waters of the IRW 35

A. Recreation and Aesthetics 35

B. Drinking Water 38

C. Fish and Wildlife Propagation 39

VIII. Current Condition of the Waters of the IRW in Oklahoma 39

A. Rivers and Streams 40

1. High Phosphorus Levels and Algae 40

2. Phosphorus-Induced Algae Biomass and Its Consequences 48

a. Aesthetics 48

b. Dissolved Oxygen Concentrations 51

c. pH 52

d. Aquatic Habitat 53

e. Disinfection Byproducts 54

f. Personal Observation 59

3. Summary of Findings Regarding the Rivers and Streams of the IRW 59

B. Lake Tenkiller 61

1. Trophic State 61

a. Phosphorus 66

b. Blue-Green Algae 68

c. Chlorophyll 69

d. Transparency 70

e. AHOD 70

f. Dissolved Oxygen 71

g. Drs. Cooke's and Welch's Conclusions 71

h. Government Studies 72

i. Defendants' Response 72

2. Consequences of the Phosphorus-Induced Eutrophic State of Lake Tenkiller 73

a. Aesthetics 73

b. Aquatic Habitat 75

c. Human Health Endangerment 79

i. Blue-Green Algae or Cyanobacteria 79

ii. Disinfection Byproducts (DBPs) 81

3. Summary of Findings Regarding Lake Tenkiller 82

C. Injury Summary 84

IX. Sources of High Phosphorus Loading to the Waters of the IRW 85

A. Distinction Between Point Sources and Nonpoint Sources 85

B. Point Sources Contributing to Loading of Phosphorus to the Waters of the IRW 85

C. Nonpoint Sources Contributing to Loading of Phosphorus to the Waters of the IRW 86

D. Relative Loading of Phosphorus in the IRW Between Point Sources and Nonpoint Sources 87

1. The Illinois River and Its Tributaries 87

2. Lake Tenkiller 89

E. Types of Phosphorus in the Loading 90

F. Environmental Impacts of Point Source Phosphorus Loading vs. Nonpoint Source Phosphorus Loading 93

G. Summary of Findings 98

X. Overview of the Poultry Industry in the IRW 99

A. The Players 99

1. The Tyson Defendants 101

2. The Cargill Defendants 101

3. The George's Defendants 101

4. Defendant Simmons 102

5. Defendant Peterson 102

6. Defendant Cal-Maine 102

B Integrated Poultry Production in the IRW and the Integrator-Grower Relationship 103

C. Characteristics, Concentration and Locations 115

D. Summary 117

XI. Poultry Waste and Its Generation 117

A. Constituents of Poultry Waste 119

B. Amounts 121

C. Summary 123

XII. Poultry Waste Land Application 123

A. Manner 124

B. Timing 124

C. Location 125

D. Behavior of Phosphorus in the Soil and STPs 126

E. Not-Well Balanced / Over-Application 129

F. Summary 135

XIII. Regulation of Poultry Waste 135

A. Oklahoma 135

B. Arkansas 143

1. The Protective Rate 145

2. The Phosphorus Index 145

3. 2010 Amendments 147

XIV. Land-Applied Poultry Waste is a Source of the High Phosphorus Loadings to the Waters of the IRW 148

A. Government Findings 149

1. Oklahoma Office of the Secretary of the Environment 149

2. Oklahoma Conservation Commission 150

3. Oklahoma Scenic Rivers Commission, Oklahoma State University and the National Park Service 150

4. United States Geological Survey 150

5. United States Department of Agriculture 151

6. State of Arkansas 151

B. Mass of Poultry Waste Generated & Method of Disposal 152

C. Phosphorus Loadings from Nonpoint Sources 154

D. Mass Balance Analysis 155

E. Geology of the IRW 163

F. Chemical Ratio Analysis 164

G. Pathway Concentration Analysis 176

1. Dr. Olsen's "Leachate" Test 177

2. Pathway Concentration Analysis Study Design, Methodology and Results 178

3. Ultimate Conclusions 181

4. Defendants' Critique and the State's Response 181

H. Lake Tenkiller Geochronological Sediment Analysis 183

I. Poultry House Density Analyses 193

1. Dr. Engel 193

2. Dr. Stevenson 197

3. Defendants' Critique and the State's Response 200

J. Modeling Analysis 203

1. Dr. Engel's Nonpoint Source Field Model and Routing Model 203

2. Modeling Results 209

3. Defendants' Critique and the State's Response 213

K. Upstream - Downstream Sampling 220

L. Direct Observation 221

M. Defendants' Expert 222

N. Defendants' Admissions 222

O. Some Fraction of Phosphorus from All Poultry Waste that Is Land-Applied in the IRW Runs Off and Ends Up in the Waters of the IRW 225

P. Phosphorus Concentrations in Other Watersheds Do Not Negate the Fact that Poultry Waste is Impacting Phosphorus Concentrations in the IRW 227

Q. Summary 229

XV. Phosphorus that Has Run Off from Land-Applied Poultry Waste Is a Significant Source of the Phosphorus Causing the Injuries to both the Rivers and Streams of the IRW in Oklahoma and Lake Tenkiller 229

XVI. Continued Land Application of Poultry Waste in the IRW Will Result in Continued Injuries to the Waters of the IRW in Oklahoma 234

A. Phosphorus Loading 234

B. Injuries to IRW Rivers and Streams 236

C. Lake Tenkiller 237

D. Summary 238

XVII. Defendants' Awareness that Phosphorus from Land-Applied Poultry Waste Is Contributing to Water Pollution in the IRW 238

A. Known or Knowable 238

1. Known 238

2. Knowable 238

B. Investigations by Defendants 246

1. The Tyson Defendants 246

2. The Cargill Defendants 247

3. The George's Defendants 247

4. Defendant Simmons 248

5. Defendant Peterson 248

6. Defendant Cal-Maine 249

C. Summary 249

XVIII. Other Possible Contributors to Phosphorus Loading to the Waters of the IRW 250

A. Waste Water Treatment Plants 250

B. Urban Runoff 250

C. Commercial Fertilizers 251

D. Cattle 251

E. Streambank Erosion 253

F. Roads 255

G. Septic 255

H. Nurseries 257

I. Golf Courses 257

J. Gravel Mining 258

K. Human Recreation Activities 259

L. State Conduct 260

M. Summary 260

XIX. Efforts by the State to Address Phosphorus Loading in the IRW 261

XX. Fixing the Problem 263

A. Restrictions on the Land Application of Poultry Waste 267

1. Effectiveness 267

2. Implementability 268

3. Cost 270

a. Poultry Waste Transport 270

b. Impact on Hay and Cattle Producers 271

c. Recreational Impacts 272

d. Coexistence 273

4. Summary regarding restricting land application to areas with STP not greater than 65 lbs/acre 273

B. Remedial Investigation and Implementation of Recommendations 274

XXI. Summary of Findings of Fact 274

CONCLUSIONS OF LAW

I. Introduction 275

II. Standing 275

III. Circumstantial Evidence 280

IV. The Causation Standard 281

V. The State's Causes of Action 286

A. State Law Public Nuisance & Federal Common Law Nuisance 286

1. Introduction 286

2. Elements of State Law Public Nuisance 286

3. Elements of Federal Common Law of Nuisance 287

4. Displacement of the Federal Common Law of Nuisance 289

5. Substantive Similarity of State Law Nuisance and Federal Common Law of Nuisance 299

6. Analysis of Claims 300

a. Direct Liability 300

i. Defendants' Business Structure and Conduct 300

ii. Company-Owned and Company-Managed Farms 301

iii. Defendants' Direct Liability for the State's Injuries 302

b. Vicarious Liability 303

i. Employer-Employee / Principal-Agent Liability 303

ii. Restatement of Torts (Second), § 427B Liability 309

8. The AWMPs and 50 Okla. Stat. § 4 316

9. 50 Okla. Stat. § 1.1 320

10. Summary of Conclusions of Law Regarding Common Law Nuisance Claims 321

B. Trespass 321

C. Violations of 27A Okla. Stat. § 2-6-105 322

1. Injunctive Claim 326

a. Direct Liability 326

b. Vicarious Liability 328

2. Penalty Claim 329

D. Violations of 2 Okla. Stat. § 2-18.1 332

E. Affirmative Defenses 334

1. Political Question Doctrine 334

2. The Arkansas-Oklahoma Arkansas River Basin Compact 336

3. Other Affirmative Defenses 338

VI. Intentionality and Joint and Several Liability (Restatement (Second) of Torts, § 825) 338

VII. Relief 340

A. Injunctive Relief Standard and the Equitable Jurisdiction of the Court 340

B. Relief Being Sought 343

C. No Adequate Remedy at Law 344

D. TMDLs 344

E. Irreparable Harm 350

F. Balancing of the Equities 351

G. Public Interest 352

H. Diminution in Value 353

I. Defendant Cargill, Inc., Defendant Peterson Farms, Inc., and Defendant

Cal-Maine Foods, Inc. 354

J. Penalties 354

K. 12 Okla. Stat. § 940 355

L. Summary of Relief to Which the State Is Entitled 355

L. A Special Master Should Be Appointed 356

Conclusion 357

WHEREAS, the State of Oklahoma (the "State") in 2005 filed a multi-claim action against Tyson Foods, Inc., Tyson Poultry, Inc., Tyson Chicken, Inc., Cobb-Vantress, Inc., Cal-Maine Foods, Inc., Cargill, Inc., Cargill Turkey Production, LLC, George's, Inc., George's Farms, Inc., Peterson Farms, Inc. and Simmons Foods, Inc. (collectively "Defendants"), as well as against other parties subsequently dismissed from this action, alleging that, *inter alia*, phosphorus from land-applied poultry waste is threatening to pollute and is polluting the waters of the State located in the Illinois River Watershed (the "IRW"), and that Defendants are legally liable for this threatened pollution and actual pollution;

WHEREAS, these Defendants have denied this core allegation and raised affirmative defenses;

WHEREAS, through extensive pretrial proceedings, the claims being asserted in this action have been narrowed by rulings of the Court, as well as, in some instances, by the State;

WHEREAS, as to those claims being asserted in this action that have been narrowed by rulings of the Court, all rights are preserved;

WHEREAS, a bench trial of this matter,[1] as narrowed, began on September 24, 2009, and proceeded for 51 trial days, during which time the Court heard testimony from some 68 lay and expert witnesses and received into evidence more than 625 exhibits;

NOW, THEREFORE, upon due consideration of this extensive evidentiary record and the applicable law, the Court makes the following Findings of Fact and Conclusions of Law:[2]

---

[1] The State waived its demand for a jury trial on its claim for civil penalties under 27A Okla. Stat. § 2-6-105(A), and Defendants consented. *See* Sept. 16, 2009 Hrg. Trans., 42:22-43:1. Based upon the Court's prior rulings, the claim for civil penalties under 27A Okla. Stat. § 2-6-105(A) was the sole "live" claim remaining to which the State's jury demand applied. *See* DKT #2527.

FINDINGS OF FACT

I. Introduction

1. This is an environmental case brought by the State in its sovereign and quasi-sovereign capacities. The State is alleging non-point source pollution[3] of the waters of the State[4] in the IRW by Defendants. Specifically, the State has alleged that Defendants have annually placed over one hundred million of their birds in the IRW, together with the phosphorus-laden feed that these birds consume. The State has alleged that Defendants are responsible for the safe handling and disposal of the hundreds of thousands of tons of poultry waste that their birds generate annually in the IRW. The State has alleged that Defendants, however, have failed to properly manage these hundreds of thousands of tons of poultry waste; rather, this poultry waste has been and continues to be land-applied in the IRW. According to the State, phosphorus from this land-applied poultry waste can, and does, run off and leach into waters of the IRW, and is threatening to cause, and is in fact causing, pollution of the waters of the State in the IRW, including the biota therein. The State claims that Defendants are legally responsible for this threatened and actual harm. Under the claims as currently postured before the Court, the State is

---

[2] Findings of fact shall be construed as conclusions of law and *vice versa* as appropriate.

[3] "Non-point source" pollution is pollution that is not from a point source. *See* Daily Trans., 9140:24-9141:1 (Connolly Testimony) ("Nonpoint-source pollution is pollution coming from something other than pipes entering the river, which is what we characterize as point sources"). Runoff of constituents from land-applied poultry waste is non-point source pollution. *See* Daily Trans., 1626:11-1627:10 (Fisher Testimony).

[4] Waters of the State means "all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, storm sewers and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, which are contained within, flow through, or border upon this state or any portion thereof, and shall include under all circumstances the waters of the United States which are contained within the boundaries of, flow through or border upon this state or any portion thereof. . . ." *See* 27A Okla. Stat. § 2-1-102(15).

seeking injunctive relief, including but not limited to abatement and remediation, as well as costs associated with determining the types and scope of remediation. The State is also seeking certain civil penalties. Defendants have denied liability on the State's claims and raised affirmative defenses.

II. An Overview of the History of the Litigation[5]

2. The Complaint in this action was filed on June 13, 2005. *See* DKT #2. A First Amended Complaint was filed on August 19, 2005. *See* DKT #18. The First Amended Complaint asserted claims for CERCLA cost recovery, CERCLA natural resource damages, imminent and substantial endangerment under RCRA, state law nuisance (including nuisance *per se*), federal common law nuisance, trespass, violations of 27A Okla. Stat. § 2-6-105, violations of 2 Okla. Stat. § 2-18.1, violations of 2 Okla. Stat. § 10-9.7 and Okla. Admin. Code § 35:17-5-5, violations of Okla. Admin. Code § 35:17-3-14, and unjust enrichment / restitution / disgorgement. *See* DKT #18. The gravamen of the State's claims was, and remains, that constituents of land-applied poultry waste are threatening to pollute and are polluting the waters of the State located in the IRW, and that Defendants are legally liable for this threatened pollution and actual pollution.

3. Defendants filed various Fed. R. Civ. P. 12(b) motions regarding the State's claims, *see, e.g.*, DKT ##64-67 & #75, as well as answers generally denying the allegations of the State's First Amended Complaint. *See* DKT #142, ##144-46 & #149. While these motions were pending, the State of Arkansas petitioned the United States Supreme Court seeking leave to file a bill of complaint to enjoin this lawsuit. Following the denial of that petition, the State of

[5] This case has spanned nearly five years, three district judges, and more than 2800 docket entries. This overview is just that -- an overview. No effort has been made to chronicle the entirety of this case.

Arkansas then moved to intervene in this action. *See* DKT #499. That motion was denied. *See* DKT #1141.

4. Meanwhile, Defendants filed third party complaints naming various individuals, entities and municipalities. *See* DKT #80 & #82. The State moved to sever and / or stay the proceedings with respect to these third party complaints. *See* DKT #247. That motion was granted. *See* DKT #916.

5. At hearings on June 14-15 and July 5, 2007, Defendants' Fed. R. Civ. P. 12(b) motions were denied except in the following two regards. First, the Court dismissed that portion of the State's claim under 27A Okla. Stat. § 2-6-105 to the extent it sought to affix liability for conduct occurring in Arkansas. *See* DKT #1187. And second, the Court ordered the State to replead its trespass claim to "assert those properties over which it has standing to assert a trespass claim on." *See* DKT #1187. In compliance with this Order, the State filed a Second Amended Complaint. *See* DKT #1215. Defendants filed a Fed. R. Civ. P. 12(b) motion on the repled trespass claim, *see* DKT #1235, as well as answers. *See* DKT ##1236-1243. Defendants' Fed. R. Civ. P. 12(b) motion regarding the repled trespass claim was denied. *See* DKT #1439.

6. In November 2007, the State filed a motion for preliminary injunction against Defendants, asserting that bacteria from the disposal in the IRW of poultry waste generated by Defendants' birds was causing an imminent and substantial endangerment to human health under RCRA, 42 U.S.C. § 6972(a)(1)(B). *See* DKT #1373. Following an eight-day evidentiary hearing in February and March 2008, the Court denied the motion. *See* DKT #1765. The State appealed to the Tenth Circuit. *See* DKT #1774. The Court's order was affirmed. *See Oklahoma v. Tyson Foods, Inc.*, 565 F.3d 769 (10th Cir. 2009).

7. Between the two sides, between February and May 2009, 10 motions for summary judgment were filed. *See* DKT #1872, #1876, #2031, #2033, #2050, #2055, #2057, #2062, #2069 & #2079. In addition, in May 2009, 13 *Daubert* motions were filed. *See* DKT #2028, #2056, #2060, #2063, #2067, #2068, #2071, #2072, #2074, #2078, #2082, #2083 & #2090. And in August 2009, 37 motions *in limine* were filed. *See* DKT #2393, ##2395-2409, ##2411-2416, #2418, ##2421-2424, ##2426-2430 & ##2432-2436. Between July and September 2009, some 10 days of hearings were held and rulings made on these motions. *See* DKT ##2386-87, ##2466-67, #2472, #2569, #2596, #2617, #2629 & #2642.

8. Meanwhile, in October 2008, Defendants filed a Fed. R. Civ. P. 19 motion seeking dismissal of the State's non-injunctive and non-penalty claims on the ground that the Cherokee Nation was a necessary party. *See* DKT #1788. In July 2009, the Court granted that motion. *See* DKT #2362. The Court denied reconsideration of that Order in August 2009, *see* DKT #2467, and a motion by the Cherokee Nation to intervene in September 2009. *See* DKT #2617. The denial of the Cherokee Nation's motion to intervene is currently on appeal to the Tenth Circuit. *See* DKT #2618.

9. On September 24, 2009, trial began on the following claims: injunctive relief under RCRA, injunctive relief under state law nuisance (including nuisance *per se*), injunctive relief under federal common law nuisance, injunctive relief under trespass, injunctive relief and civil penalties under 27A Okla. Stat. § 2-6-105, and injunctive relief under 2 Okla. Stat. § 2-18.1.[6]

---

[6] The State previously dismissed its claims for violations of 2 Okla. Stat. § 10-9.7 and Okla. Admin. Code § 35:17-5-5, and for violations of Okla. Admin. Code § 35:17-3-14. *See* DKT ##2041-42.

10. At the conclusion of the State's evidence, the Court granted Defendants' Fed. R. Civ. P. 52(c) motion with regard to the State's RCRA claim. *See* Daily Trans., 8410:17-8413:5. Findings of fact and conclusions of law will be separately entered with respect to the State's RCRA claim.

11. The evidentiary phase of the trial concluded on January 26, 2010.

III. Road Map

12. Given the voluminous nature of the evidence in this case, a brief road map to the Court's findings is in order. The Court will begin with a general overview of the IRW and its waters, the uses of those waters, and the State's regulation of those waters. It will then proceed to analyzing the current injured conditions of the rivers and streams of the IRW, as well as Lake Tenkiller and the fact that phosphorus is causing those injuries. And following that, the Court will identify the relative significance of point and nonpoint source phosphorus in the waters of the IRW.

13. Next, the Court will review the State's evidence that phosphorus from poultry waste generated by Defendants' birds is a significant source of the phosphorus that is causing the injuries to the waters of the State in the IRW. It will analyze the integrator-grower relationship and Defendants' operations in the IRW, how poultry waste is managed in the IRW, and examine the State's proof that phosphorus from land-applied poultry waste generated by each Defendants' birds is running off into the waters of the IRW, that this phosphorus is a significant source of the phosphorus that is causing injuries to the waters of the State in the IRW, and that unless there are significant reductions in the amount of poultry waste being land applied, the waters of the State in the IRW will continue to be injured. Finally, the Court will analyze Defendants' knowledge of the environmental problems that phosphorus in poultry waste is causing the waters of the IRW.

14. As the last step in its findings of fact, the Court will review ways to address the problems being caused by phosphorus from land applied poultry waste.

IV. The Illinois River Watershed

15. The IRW, comprising slightly over one million acres, straddles the Oklahoma-Arkansas border. *See* State's Ex. 3351 at OSU0005147. Slightly over half of the watershed -- approximately 576,030 acres -- is located in Oklahoma. *See* State's Ex. 3351 at OSU0005147. Within the IRW are the Illinois River, its major tributaries, the Baron (a/k/a Barren) Fork River, the Caney Creek and the Flint Creek, and a number of smaller streams and creeks. *See* State's Ex. 3351 at OSU0005160; *see also* Daily Trans., 10105:7-20 (Grip Testimony)[7] (testifying there exists "a dense network of drainage channels within the IRW"). The Illinois River and its tributaries generally flow from northeast to southwest, that is from Arkansas and into Oklahoma. *See* State's Ex. 3351 at OSU0005147.

16. The Illinois River feeds into Lake Tenkiller. *See* State's Ex. 3351 at OSU0005147. Lake Tenkiller (a/k/a Tenkiller Ferry Lake) was formed in 1953 when the United States Army Corps of Engineers constructed a dam on the Illinois River. *See* State's Ex. 3113 at p. 458; State's Ex. 5593A at p. 537. Lake Tenkiller is approximately 12,500 acres in size. *See* State's Ex. 3351 at OSU0005174.

17. The rivers and streams in the IRW range from first-order streams (the small streams which may be intermittent) all the way up to sixth- or seventh-order streams (*e.g.*, the

[7] Mr. Wayne Grip is a photogrammetrist and photointerpreter. *See* Daily Trans., 9991:15-17 (Grip Testimony). Mr. Grip is the co-founder and president of a consulting firm named Aero-Data Corporation. *See* Daily Trans., 9986:11-25 (Grip Testimony). Mr. Grip testified as a retained expert for Defendants.

Illinois River).[8] *See* Daily Trans., 10866:6-10; 10866:15-21; 10867:3-6 (Sullivan Testimony);[9] Daily Trans., 7158:21-7159:1 (Stevenson Testimony).

18. Being a watershed, the IRW is by definition a single, interconnected hydrologic unit. *See, e.g.,* Daily Trans., 5954:18-5955:18; 5955:25-5957:3 (Chaubey Testimony);[10] *see also* Daily Trans.,8371:8 (Court agreeing that "this [watershed] is a single hydrologic unit").

A. The Illinois River and Its Tributaries

---

[8] The size of streams is often defined using the Strahler stream order system which defines stream size based on a hierarchy of tributaries. *See* Daily Trans., 10867:3-6 (Sullivan Testimony). The first and second order streams are the small streams some of which are intermittent. *See* Daily Trans., 10866:15-21 (Sullivan Testimony). Third order streams in this watershed are the medium size streams seen on most stream maps. *See* Daily Trans., 7158:21-7159:1 (Stevenson Testimony); Daily Trans., 10866:6-10 (Sullivan Testimony). By the time that the Illinois River reaches Lake Tenkiller it is a sixth and even seventh order stream. *See* Daily Trans., 10866:6-10 (Sullivan Testimony).

[9] Dr. Timothy Sullivan is president of E&S Environmental Chemistry, Inc. which conducts work on human activities and water quality, and on environmental restoration and watershed assessments. *See* Daily Trans., 10565:7-12, 10571:20-10572:20 (Sullivan Testimony). He received a Ph.D. in biological sciences from Oregon State University after which he conducted postdoctoral research in Norway on hydrological flow paths in watersheds. *See* Daily Trans., 10565:15-25, 10568:25-10569:14 (Sullivan Testimony). He worked for two years at the EPA research laboratory in Corvallis, Oregon on the National Lake Survey. *See* Daily Trans., 10569:24-10570:9 (Sullivan Testimony). Dr. Sullivan testified as a retained expert for Defendants.

[10] Dr. Indrajeet Chaubey is a tenured professor at Purdue University with appointments in the departments of agricultural and biological engineering, earth and atmospheric sciences, and ecological and environmental engineering. *See* Daily Trans., 5917:23-5918:21 (Chaubey Testimony). Dr. Chaubey received a Ph.D. in biosystems engineering from Oklahoma State University in 1997. *See* Daily Trans., 5925:5-11 (Chaubey Testimony). He has received many awards including the New Holland young researcher award, the Gamma Sigma Delta outstanding research award, the outstanding researcher award from the University of Arkansas college of engineering, and the outstanding engineer award from the Arkansas chapter of the American Society of Agricultural and Biological Engineers. *See* Daily Trans., 5926:11-5927:13, (Chaubey Testimony). He has published 48 peer-reviewed articles. *See* Daily Trans., 5930:14-22 (Chaubey Testimony). Dr. Chaubey's studies have involved agricultural activities and the movement of pollutants in the watersheds of Eucha-Spavinaw, Beaver Lake and the Illinois River/Tenkiller Lake. See Daily Trans., 5935:11-25; 5937:2-21 (Chaubey Testimony). Dr. Chaubey testified as a non-retained expert.

19. The Illinois River has, historically, been recognized as being particularly beautiful. An 1867 report had this to say:

> The Illinois River, the first great tributary of the Arkansas River on the north, from its mouth, is a wide, clear, rapid, pebbly, ever-running stream. It is impossible in this brief Report to recount the riches, resources, and loveliness of this river . . . .

See State's Ex. 3100. An 1870 report had this to say:

> On the east side of the Arkansas [River] is the Illinois River, rising in the mountainous regions southeast of Fort Gibson, said to be one of the prettiest rivers on the continent, sparkling with crystal waters.

See State's Ex. 3121 at OK0003528. A 1952 report had this to say:

> Any description of the Illinois River should properly be filled with glowing adjectives and loaded with phrases of superlative beauty. For the "Illinois" is a clear, spring-fed stream, flowing through the oak and hickory clad Ozark hills in a succession of sparkling riffles and long, quiet pools, that inspires cries of "Eureka!!" when first viewed by people from the short grass country.

See State's Ex. 3089. An April 16, 1961 article described the Illinois River as:

> a sparkling spring-fed masterpiece of nature. . . . The Illinois is a succession of alternating deep pools and swift shallows flowing over beds of gravel. The average drop is 5 feet per mile and the normal speed of river flow is 13 miles per hour -- much faster over shoals and in narrow channels and almost at a standstill on the mile-long deep holes.

See State's Ex. 3116 at OK0003578.

20. A 1992 report stated that "[t]he Illinois River is cherished for its beauty." *See* State's Ex. 3351 at OSU0005174. And a 1998 report described the Illinois River as "unquestionably one of Oklahoma's outstanding natural resources." *See* DJX 0147 at p. iv. The Baron Fork, meanwhile, was described as "one of Oklahoma's greatest all-around fishing streams . . . ." *See* State's Ex. 3116 at OK0003579.

21. Additionally, various witnesses testified as to the historic clarity of the Illinois River. For example, Mr. Fite provided a particularly illustrative recollection from his childhood

concerning the historic clarity of the waters of the Illinois River. Mr. Fite testified that one fall afternoon in the early 1960s when he was five years old, he, his father, his grandfather and his uncle were walking by a bluff adjacent to the Illinois River when he accidentally dropped a white-handled toy cap gun into the water. He testified that the water was so clear that he could see the cap gun on the river bottom as if it were only in six inches of water. However, when his father, grandfather and uncle went into the river to retrieve the cap gun they had to dive over six feet down to get it. *See* Daily Trans., 669:12-670:23 (Fite Testimony).

22. Similarly, Mr. Gerald Hilsher,[11] commissioner and chairman of the Oklahoma Scenic Rivers Commission, testified that in the mid-1970s the Illinois River was clear and the rocks were distinct. *See* Daily Trans., 610:2-7 (Hilsher Testimony). According to Mr. Hilsher, "you could tell if a rock was light gray or it was black or if it was brown, and there wasn't, you know, algae, green algae, growing on it or dead brown algae growing on it. It was a clear-bottom stream." *See* Daily Trans., 610:7-11 (Hilsher Testimony).

23. Ms. Shanon Phillips,[12] Director of the Water Quality Division at the Oklahoma Conservation Commission, testified that as a young child she spent summers playing in the river.

---

[11] Mr. Gerald Hilsher is a commissioner and currently chairman of the Oklahoma Scenic Rivers Commission. *See* Daily Trans., 581:3-6 (Hilsher Testimony). Mr. Hilsher began serving on the Commission in May 1998 when he was appointed by then-Governor Frank Keating. *See* Daily Trans., 581:7-9 (Hilsher Testimony). Prior to his appointment to the Commission, Mr. Hilsher served on Governor Keating's Animal Waste and Water Quality Protection Task Force. *See* Daily Trans., 581:17-24 (Hilsher Testimony). In addition, he has been a member of Save the Illinois River for 8-10 years during which he served as its director. *See* Daily Trans., 579:25-580:4 (Hilsher Testimony). Mr. Hilsher received his J.D. from the Texas School of Law in 1979 and currently practices environmental and commercial litigation law in Tulsa. *See* Daily Trans., 577:23-578:8 (Hilsher Testimony).

[12] Shanon Phillips is the director of the Water Quality Division of the Oklahoma Conservation Commission ("OCC"). *See* Daily Trans., 972:12-13 (Phillips Testimony). Ms. Phillips began work with OCC in 1997, and became director of the Water Quality Division in March 2009. *See* Daily Trans., 974:18-19 & 976:4-6 (Phillips Testimony). Ms. Phillips is

See Daily Trans., 978:11-18 (Phillips Testimony). According to Ms. Phillips, when she was a child "the waters were clearer and the rocks were brightly colored." She recalled floating the river and collecting the brightly colored stones from the river. *See* Daily Trans., 978:24-979:3 (Phillips Testimony).

24. The Illinois River generally maintains a perennial flow. *See* State's Ex. 3351 at OSU0005160. Flow is generally highest from March through June. *See* State's Ex. 3351 at OSU0005160. During the summer months -- portions of June, as well as July and August -- the Illinois River is typically at base flow. *See* Daily Trans., 817:4-14 (Fite Testimony).

B. Lake Tenkiller

25. Like the Illinois River and its tributaries, Lake Tenkiller has, historically, been recognized as a natural resource of exceptional quality. Lake Tenkiller was described in a 1957 guide as follows:

> Tenkiller is Oklahoma's most beautiful lake. For sheer eye-filling grandeur, it is without an equal in all the Southwest. For a distance of more than 30 miles above the dam near Gore that holds back its deep, crystal-clear waters, it stretches in a northeasterly direction through the fabled and picturesque Cookson Hills.

State's Ex. 3106 at OK0003576; *see also* Daily Trans., 978:24-979:9 (Phillips Testimony) (Ms. Shanon Phillips testifying as to clarity of Lake Tenkiller when she was a child). Similarly, a 1968-69 article stated that "Tenkiller is not the largest lake in the state but it is the deepest and is considered by many visitors to be the most beautiful." *See* State's Ex. 3113 at p. 458; *see also* State's Ex. 5593A at p. 537 ("Tenkiller Ferry Lake is one of the lake jewels of Oklahoma . . .").

---

responsible for overseeing a staff of over 40 individuals who focus on OCC's carbon sequestration program, 319 nonpoint source pollution program, and wetlands program. *See* Daily Trans., 976:7-11 (Phillips Testimony). Ms. Phillips received a master's degree in zoology from Oklahoma State University where her masters research was nutrient limitation in Lake Tenkiller. *See* Daily Trans., 972:22-973:7 (Phillips Testimony).

C. Topography, Hydrology, Geology and Soils of the IRW

1. Topography and Hydrology

26. The IRW is located within the western flank of the Ozark Plateaus, which are part of a large structured dome that centers in southeastern Missouri. *See* State's Ex. 3351 at OSU0005148; Daily Trans., 1594:25-1595:1 (Fisher Testimony).[13] The elevations of the IRW are higher in the east, and lower in the west and southwest. *See* Daily Trans., 1594:14-16 (Fisher Testimony); State's Ex. 2490. The northern two-thirds of the IRW consist of gently undulating to steeply rolling topography. *See* State's Ex. 3351 at OSU0005148. The lower portion of the IRW is characterized by greater slopes and overall ruggedness. *See* State's Ex. 3351 at OSU0005155. There is very little flat land in the IRW. *See* Daily Trans., 1598:3-7 (Fisher Testimony).

27. This topography determines the surface hydrology of the IRW. *See* Daily Trans., 1594:2-3 (Fisher Testimony). Waters that fall in the IRW travel from the east / northeast to the west / southwest. *See* Daily Trans., 1594:17-22 (Fisher Testimony). The major drainage features of the IRW include the Illinois River (which arises in the eastern part of the IRW and

---

[13] Dr. J. Berton Fisher holds a Ph.D. in earth sciences. *See* Daily Trans., 1560:11-16 (Fisher Testimony). Dr. Fisher is the author of a number of peer-reviewed articles dealing with various aspects of contaminant fate and transport and source identification. *See* Daily Trans., 1561:3-8 (Fisher Testimony). Dr. Fisher has significant experience with issues of the fate and transport of environmental constituents and contaminants. *See* Daily Trans., 1561:13-1562:9; 1563:1-1566:13; 1567:2-1568:15; 1569:6-7; 1569:14-1570:15; 1571:13-1573:17; 1574:7-1575:15 (Fisher Testimony) (testifying that "[m]ost of my life I've worked on source identification and fate and transport issues"). Dr. Fisher has taught at multiple institutions of higher learning, most recently at the University of Tulsa's Department of Geosciences. *See* Daily Trans., 1575:16-1578:9 (Fisher Testimony). Dr. Fisher assisted a Tulsa Metropolitan Utility Authority board member with her investigation of the impacts of poultry waste on the water quality of the City of Tulsa's public water supply in the Eucha-Spavinaw Watershed. *See* Daily Trans., 1578:17-1581:3 (Fisher Testimony). Dr. Fisher is presently the founder of Lithochimeia, Inc., an environmental consulting firm. *See* Daily Trans., 1574:10-14 (Fisher Testimony). Dr. Fisher testified as a retained expert by the State.

flows into Lake Tenkiller in the southwestern part of the IRW), Caney Creek (which arises near the Oklahoma-Arkansas border near Stillwell and flows east to west into the Illinois River near Lake Tenkiller), the Baron Fork (which arises in Arkansas and flows generally east to west into the Illinois River near Lake Tenkiller), Flint Creek (which arises in the northeastern portion of the IRW and flows into the Illinois River in Oklahoma near the Oklahoma-Arkansas border). *See* Daily Trans., 1601:24-1602:3; 1603:2-8; 1603:21-1604:21 (Fisher Testimony); State's Ex. 2519.

28. These major drainage features of the IRW are determined by the underlying geological structure -- faults that are a consequence of the geological phenomenon known as the Ozark uplift. *See* Daily Trans., 1604:25-1605:11 (Fisher Testimony). These faults extend through the rocks that underlie the IRW. *See* Daily Trans., 1605:4-8 (Fisher Testimony). As such, groundwater flow is generally along these fractures. *See* Daily Trans., 1605:12-21 (Fisher Testimony); *see also* Daily Trans., 1598:20-24 (Fisher Testimony) (testifying that, like surface water, groundwater also moves from areas of higher elevation to lower elevation). Because of these fractures, groundwater moves relatively rapidly in the IRW. *See* Daily Trans., 1604:25-1606:7-11 (Fisher Testimony). Moreover, because of these fractures, surface water and groundwater in the IRW are "fairly closely linked." *See* Daily Trans., 1606:14-21 (Fisher Testimony).

29. Under base flow conditions, rivers and streams in the IRW are fed primarily from groundwater. *See* Daily Trans., 5528:8-12; 5530:4-10; 5369:2-3 (Olsen Testimony)[14] ("base

[14] Dr. Roger Olsen received a Ph.D. in geochemistry from the Colorado School of Mines in 1979 where he was also an instructor of chemistry and geochemistry. *See* Daily Trans., 5203:10-14, 5204:9-12 (Olsen Testimony). Dr. Olsen has worked at a variety of consulting companies over the past 30 years in the area of environmental geochemistry, during which time he has studied environmental contamination at over 500 sites. *See* Daily Trans., 5204:20-5205:7

flow is mostly groundwater surfacing to surface water"); Daily Trans., 6533:15-19 (Engel Testimony).[15] The alluvium -- the soil area adjacent and contiguous to rivers and streams -- is recharged by high waters in rivers and streams during high flow events, and once the river or stream level drops, the water from the recharged alluvium drains back into the river or stream. *See* Daily Trans., 5778:11-18 (Engel Testimony) ("[D]uring surface runoff, it would be typical during these higher flow events that we may have some of that water reaching the stream moving into the alluvium in and along the stream. And so, again, on days like today, it's not raining, we still have water, that water's coming back out of the surrounding materials from the stream, and back from the shallow groundwater."); Daily Trans., 2071:1-16 (Fisher Testimony) ("[A]lluvial water is frequently recharged [from surface waters] during periods of high flow. . . . When the streams reach a high -- as they rise, they flow into the alluvium, which is porous and permeable, along the stream courses and raise the water level within those stream courses -- I mean, within the alluvium.").

(Olsen Testimony). Dr. Olsen is presently employed at Camp Dresser & McKee, Inc. (CDM). *See* Daily Trans., 5466:13-20 (Olsen Testimony). Dr. Olsen testified as a retained expert for the State.

[15] Dr. Bernard Engel holds a Ph.D. in agricultural engineering. *See* Daily Trans., 5639:12-20 (Engel Testimony). Dr. Engel is head of the agricultural and biological engineering program at Purdue University, which has been ranked as the top-ranked agricultural and biological engineering program in the United States. *See* Daily Trans., 5641:11-5642:4 (Engel Testimony). Dr. Engel has significant experience teaching on, researching, using, publishing and consulting on issues pertaining to environmental modeling. *See* Daily Trans., 5642:20-5670:24 (Engel Testimony). He has published more than 110 peer-reviewed scientific articles, mostly in the area of hydrologic water quality modeling. *See* Daily Trans., 5660:21-5661:5 (Engel Testimony). He has received many awards, including outstanding researcher from the American Society of Agricultural and Biological Engineering and outstanding researcher from the Purdue University College of Agriculture. *See* Daily Trans., 5659:12-5660:20 (Engel Testimony). Dr. Engel served as the court-appointed special master in the *City of Tulsa v. Tyson Foods, Inc.* case, and was charged with assessing the hydrologic water quality modeling that had been done in that case. *See* Daily Trans., 5663:3-15 (Engel Testimony). Dr. Engel testified as a retained expert for the State.

2. Geology and Soils

30. The geology of the IRW is one of "mantle karst." *See* Daily Trans., 1608:11-15 (Fisher Testimony). Mantle karst is fractured bedrock overlaid by a mantle of weathered material.[16] *See* Daily Trans., 1608:16-18 (Fisher Testimony).

31. The bedrock is primarily limestone and is very soluble. *See* State's Ex. 3351 at OSU0005155; Daily Trans., 1608:18-25 (Fisher Testimony). There are networks of underground drainage channels in the limestone, and sinkholes, caves and fissures are common. *See* State's Ex. 3351 at OSU0005155; Daily Trans., 1608:18-25 (Fisher Testimony); State's Ex. 6923-STOK0055502 (representative photograph of fractured limestone bedrock in IRW). Springs are numerous throughout the IRW. *See* State's Ex. 3351 at OSU0005155; Daily Trans., 1620:10-13 (Fisher Testimony); State's Ex. 6923-STOK0033387 (representative photograph of fractured bedding limestone in IRW with substantial spring); Daily Trans., 944:15-20 (Fite Testimony) (testifying that natural seeps and springs occur throughout the IRW).

32. The weathered mantle of residual soil in the IRW is material that has been formed by in-place dissolution. *See* Daily Trans., 1609:8-10 (Fisher Testimony). It is a rocky cobble generally with chert gravels and boulders in it, and is topped with a very thin layer of organic soil. *See* Daily Trans., 1609:10-15 (Fisher Testimony); State's Ex. 6923-STOK0039169 & State's Ex. 6923-STOK0047621 (representative photographs of mantle soils in IRW).

33. The soils in the Oklahoma portion of the IRW are marginal, at best. *See* Daily Trans., 920:2-4 (Fite Testimony).

34. The soils in the IRW are, in their natural state, not high in macronutrients. *See* Daily Trans., 1527:4-7 (Phillips Testimony). For, example, background soil test phosphorus in

---

[16] Karst is solution-enhanced, partially dissolved rock. *See* Daily Trans., 1615:21-22 (Fisher Testimony).

the IRW is in the range of 20 lbs. / acre. *See* Daily Trans., 5718:16-5719:5 (Engel Testimony). There are not, however, any substantial deficiencies of micronutrients in the IRW. *See* Daily Trans., 5186:10-13 (Johnson Testimony).[17]

35. The soils that overlay the limestone of the IRW generally have intermediate to high run-off potential and nominal to intermediate leaching potential. *See* State's Ex. 3351 at OSU0005159-60; Daily Trans., 1609:18-22 (Fisher Testimony).

D. Land Uses in the IRW

36. Land use (or land cover) is a means of classifying the nature of the earth's surface. *See* Daily Trans., 1621:19-24 (Fisher Testimony).

37. The IRW is predominantly a rural watershed. *See* Daily Trans., 1623:25 (Fisher Testimony); State's Ex. 2491. According to the United States Geological Survey ("USGS"), "[t]he basin is dominated by about equal proportions of agricultural (pasture and cropland) and forest land uses and is interspersed with minor amounts of commercial and residential land uses." *See also* State's Ex. 5862 at p. 4. Grassland makes up approximately 45 percent of the IRW. *See* State's Ex. 3351 at OSU0005155. Forest land makes up approximately 44 percent of the IRW. *See* State's Ex. 3351 at OSU0005156. Cropland makes up approximately 2 percent of the IRW. *See* State's Ex. 3351 at OSU0005156. Orchards and vineyards make up approximately 1 percent

[17] Dr. Gordon Johnson was a professor of soil science at Oklahoma State University from 1977 until he retired as Regents Professor in 2004. *See* Daily Trans., 4985:18-20 (Johnson Testimony). Prior to coming to Oklahoma State University, Dr. Johnson was a professor in the Department of Agriculture, Chemistry and Soils at the University of Arizona from 1969-1977 where he taught and conducted research in nutrient management. *See* Daily Trans., 4986:18-24 (Johnson Testimony). In 1977 he was hired by OSU as a state specialist in nutrient management in the cooperative extension service and as the director of the soil, water and forage testing laboratory. *See* Daily Trans., 4987:2-6 (Johnson Testimony). Dr. Johnson received his Ph.D. in soil science with a specialty in chemistry and biology in 1969 from the University of Nebraska at Lincoln. *See* Daily Trans., 4986:10-16 (Johnson Testimony). Dr. Johnson testified as a retained expert for the State.

of the IRW. *See* State's Ex. 3351 at OSU0005156. Urban areas make up approximately 6 percent of the IRW. *See* State's Ex. 3351 at OSU0005156. And other land use (*e.g.*, confined animal operations, roads and railroads and water) make up approximately 2 percent of the watershed. *See* State's Ex. 3351 at OSU0005156.

38. The easternmost portion of the IRW is the site of a fast-growing urban area (Fayetteville-Springdale-Rogers, Arkansas). *See* State's Ex. 5862 at p. 4; *see also* Daily Trans., 10091:2-11 (Grip Testimony). The human population of the IRW is currently approximately 340,000. *See* Daily Trans., 1624:16-18 (Fisher Testimony). In 2000, it was approximately 280,000. *See* Daily Trans., 1624:14-15 (Fisher Testimony). Most of this population growth has occurred in urban areas. *See* Daily Trans., 1538:24-1539:4 (Phillips Testimony). Waste from this urban population growth is generally treated at wastewater treatment plants rather than by septic systems. *See* Daily Trans., 1539:5-8 (Phillips Testimony).

39. A significant amount of the pastureland of the IRW, which is primarily in the upstream part of the basin in Arkansas, is used for cattle production. *See* State's Ex. 5862 at 4. The use of poultry waste on the pasturelands of the IRW is what has enabled those lands to support the size herds that they do. *See* Daily Trans., 951:20-25 (Fite Testimony); Daily Trans., 9603:9-14 (Smith Testimony).[18]

V. Ownership / Possessory Property Interests

40. The State claims sovereign and quasi-sovereign interests in the waters in the Oklahoma portion of the IRW. *See* DKT #1822.

---

[18] Mr. Earl Smith is chief of the Arkansas Natural Resources Commission water management division where he has been employed since 1985. *See* Daily Trans., 9462:19-9463:8 (Smith Testimony). He has been a member of the engineering committee of the Arkansas-Oklahoma Arkansas River Compact Commission since the mid-1980s. *See* Daily Trans., 9464:23-9465:18 (Smith Testimony).

41. Specifically, the State claims a possessory property interest in the waters in the Oklahoma portion of the IRW running in definite streams, formed by nature, over or under the surface. *See* Daily Trans., 309:18-310:12 (Tolbert Testimony); [19] Court's Ex. 14 at p. 11 (Smithee Dep.)[20] (testifying that surface water is public water and hence owned by the State).

42. Further, the State claims a public trust interest in these waters. *See* DKT #1822.

43. The State, through its agencies, claims to manage and control these waters. *See* Daily Trans., 310:13-20 (Tolbert Testimony).

44. Defendants claim no ownership or possessory property interests in the waters at issue in this litigation.

VI. Regulation of the Waters of IRW in Oklahoma

45. The State manages and controls the waters and biota of the IRW. Through the Oklahoma Water Resources Board ("OWRB"),[21] the Oklahoma Scenic Rivers Commission

---

[19] C. Miles Tolbert served as the Oklahoma Secretary of the Environment from 2003 to 2008. *See* Daily Trans., 303:11-15 (Tolbert Testimony). Prior to becoming the Oklahoma Secretary of the Environment, Mr. Tolbert had also served as the chief of the environmental protection unit of the Oklahoma Attorney General's Office. *See* Daily Trans., 303:7-10 (Tolbert Testimony). Mr. Tolbert has also served on the Arkansas-Oklahoma Arkansas River Compact Commission from 2003 to the present. *See* Daily Trans., 306:25-307:9 (Tolbert Testimony). Mr. Tolbert received a J.D. from Harvard Law School, after which he clerked for Judge Holloway on the Tenth Circuit Court of Appeals. *See* Daily Trans., 302:24-303:3 (Tolbert Testimony). Mr. Tolbert currently practices law in Oklahoma City. *See* Daily Trans., 303:13-15 (Tolbert Testimony).

[20] Derek Smithee has served as the Chief of Water Quality at the Oklahoma Water Resources Board since 1995, and served as the Water Quality Standards Coordinator at the Oklahoma Water Resources Board from 1988-1995. *See* Court's Ex. 14 at p. 2 (Smithee Depo.).

[21] *See, e.g.*, 82 Okla. Stat. § 1085.2(4) (OWRB develops water plans for the waters of the State, including those in the IRW); 82 Okla. Stat. § 1085.2(8) (OWRB institutes and maintains actions to stop or prevent any use, misuse, appropriation or taking of waters of the state that is in violation of the law); 82 Okla. Stat. § 1085.2(9)(c) (OWRB determines applications for permits to appropriate stream water, including permits to appropriate water in the IRW); 82 Okla. Stat. § 1085.2(16) (OWRB sets water quality standards for waters of the State, including those in the IRW, and classifies those waters according to their best uses in the

("OSRC"),[22] the Oklahoma Department of Wildlife Conservation ("ODWC"),[23] the Oklahoma Secretary of the Environment ("OSE"),[24] the Oklahoma Department of Environmental Quality

---

interest of the public); 82 Okla. Stat. § 1085.30(A)(1) (OWRB promulgates water quality standards that establish classifications of uses of waters of the state, including those in the IRW, criteria to maintain and protect such classifications, and other standards or policies pertaining to the quality of such waters); 27A Okla. Stat. § 1-3-101(C) (outlining OWRB's jurisdictional areas of environmental responsibility).

[22] *See, e.g.*, 82 Okla. Stat. § 1452(A) (Oklahoma Legislature designates certain waters in the IRW as "scenic rivers" in order to preserve them for the benefit of the Oklahoma people and directs that they be preserved as a part of Oklahoma's diminishing resource of free-flowing rivers and streams); 82 Okla. Stat. § 1457(A) (Executive Directors of the ODEQ, OCC, ODAFF, OWRB, ODWC and OCC charged with assisting the Scenic Rivers Commission in maintaining and improving water quality and in preventing and eliminating pollution of waters within a scenic river area); 82 Okla. Stat. § 1457(B), (C) & (D) (OSE, in coordination with the appropriate state environment agencies, charged with creating a coordinated watershed restoration and protection strategy for each impaired scenic river in this state, and submitting annual progress report on this strategy to the Governor and the Oklahoma legislature); 82 Okla. Stat. § 1457(E)(1) (OSRC requires licensed recreational users of scenic rivers to implement a program to control the amount of pollution from such recreational activities from entering impaired scenic river watersheds); 82 Okla. Stat. § 1461(G)(1) (OSRC charged with promulgating rules and issuing orders necessary to protect the public interest and to achieve the purposes of the Scenic Rivers Act); 82 Okla. Stat. § 1462(4) (Oklahoma Tourism and Recreation Department charged with establishing a Scenic Rivers Commission for the Flint Creek, Illinois River Scenic River Areas, and those portions of Barren Fork Creek within Cherokee County); 82 Okla. Stat. § 1470 (OSRC for the Flint Creek and Illinois River within Adair, Cherokee and Delaware Counties and those portions of Barren Fork Creek within Cherokee County authorized to charge user fees for floating and camping).

[23] *See, e.g.*, 29 Okla. Stat. § 4-101 (ODWC requires licenses for taking wildlife, including wildlife in the IRW); 29 Okla. Stat. § 4-110 (ODWC issues fishing licenses, including for fishing in the IRW); 29 Okla. Stat. § 6-301 (ODWC regulates manner of fishing, including fishing in the IRW); 29 Okla. Stat. § 6-302 (ODWC regulates methods of fishing, length limits and bag limits, including for fishing in the IRW); 27A Okla. Stat. 1-3-101(H) (outlining ODWC's jurisdictional areas of environmental responsibility).

[24] *See, e.g.*, 27A Okla. Stat. § 1-2-101(A)(3) (OSE charged with coordinating pollution control and complaint management activities of the state carried on by all state agencies to avoid duplication of effort); 27A Okla. Stat. § 1-2-101(B)(1) (OSE charged with developing and implementing procedures for development / modification of 303(d) report, 305(b) report, and 319 report).

("ODEQ"),[25] the Oklahoma Department of Agriculture, Food and Forestry ("ODAFF"),[26] and the Oklahoma Conservation Commission ("OCC"),[27] the State manages and regulates every aspect of the water and biota at issue, including water appropriation, water use, water quality standards, pollution prevention, watershed protection and restoration, fish and fishing, recreational activities, federal programs and environmental regulation.

46. The principal agencies having jurisdiction over environmental matters in the Oklahoma portion of the IRW include ODEQ, OWRB, ODAFF, OCC, ODWC and OSRC. *See* 27A Okla. Stat. § 1-3-101; *see also* Daily Trans., 304:18-305:8 (Tolbert Testimony). The activities of these agencies are coordinated through the Oklahoma Secretary of the Environment. *See* Daily Trans., 303:24-304:1 & 304:18-305:8 (Tolbert Testimony).

47. Additionally, there exists an interstate organization named the Arkansas-Oklahoma Arkansas River Compact Commission ("Compact Commission"). The Compact Commission, however, has no regulatory authority. *See* Daily Trans., 307:20-22 (Tolbert Testimony); 82 Okla. Stat. § 1421. The Compact Commission was formed as a result of the Arkansas-Oklahoma Arkansas River Compact, which was negotiated in 1970 between Arkansas

---

[25] *See, e.g.*, 27A Okla. Stat. § 1-3-101(B) (ODEQ charged with managing all point and nonpoint source pollution to waters, including waters in the IRW, except to extent jurisdiction assigned to other agencies).

[26] *See, e.g.*, 27A Okla. Stat. § 1-3-101(D)(1)(a) (ODAFF charged with environmental responsibility for point source discharges and nonpoint runoff from agricultural crop production, agricultural services, livestock production, silviculture, feed yards, livestock markets and animal waste, including for such activities in the IRW).

[27] *See, e.g.*, 27A Okla. Stat. 1-3-101(F)(1) (OCC charged with responsibility for soil conservation, erosion control and nonpoint source management except as otherwise provided for by law); 27A Okla. Stat. § 1-3-101(F)(2) (OCC charged with monitoring, evaluation and assessment of waters to determine the condition of streams and rivers impacted by nonpoint source pollution, including streams and rivers in the IRW); 27A Okla. Stat. § 1-3-101(F)(6) (OCC charged with assessment and conservation plan development in watersheds of clean lakes).

and Oklahoma in order to administer the appropriation of water in the Arkansas River basin. *See* Daily Trans., 644:14-19 (Fite Testimony). The Compact Commission's primary role is not water quality, but rather water quantity. *See* Daily Trans., 307:25-308:9 (Tolbert Testimony); Daily Trans., 9464:23-9465:10 (Smith Testimony).

A. "Outstanding Water Resources" Designation of Certain IRW Waters

48. Because of its special character, in 1970, approximately 70 miles of the Illinois River in Oklahoma were designated by the Oklahoma Legislature as a Scenic River Area. *See* 82 Okla. Stat. § 1452.[28] Additionally, approximately 35 miles of the Baron Fork Creek and approximately 12 miles of the Flint Creek were designated by the Oklahoma Legislature as Scenic River Areas. *See* 82 Okla. Stat. § 1452; *see also* Daily Trans., 313:21-314:2 (Tolbert Testimony). The designation as "Scenic River Areas" reflects a recognition by the Oklahoma Legislature that these rivers and streams "possess such unique natural scenic beauty, water conservation, fish, wildlife and outdoor recreational values of present and future benefits to the people of the state that it is the policy of the Legislature to preserve these areas for the benefit of the people of Oklahoma." *See* 82 Okla. Stat. § 1452; *see also* Daily Trans., 314:22-315:17 (Tolbert Testimony).

49. By virtue of being designated Scenic River Areas, these waters have been denominated by the Oklahoma Water Resources Board as "Outstanding Resource Waters." *See* Okla. Admin. Code § 785:45-3-2(a). This denomination reflects a recognition that these waters are "an outstanding resource or have exceptional recreational and / or ecological significance."

---

[28] "The law of any State of the Union, whether depending upon statutes or upon judicial opinions, is a matter of which the courts of the United States are bound to take judicial notice, without plea or proof." *See Lamar v. Micou*, 114 U.S. 218, 223 (U.S. 1885).

See Okla. Admin. Code § 785:45-3-2(a). Under Oklahoma law, "[n]o degradation of water quality shall be allowed in these waters." *See* Okla. Admin. Code § 785:45-3-2(a).

50. As explained by Mr. Fite, "[t]he Illinois River and other scenic rivers are the top tier of water quality standards of our state, they're the best of the best. They are the water bodies of our state that the state does everything humanly possible to protect. There's a prohibition on the introduction of manmade pollutants or new point-source discharges into a scenic river once designated. Existing dischargers cannot increase loadings." *See* Daily Trans., 707:8-16 (Fite Testimony).

B. Water Quality Standards

51. The Oklahoma Water Resources Board sets water quality standards for the waters of the State, including the waters of the State in the IRW. *See* 82 Okla. Stat. § 1085.2(16); 82 Okla. Stat. § 1085.30(A)(1); *see also* Daily Trans., 323:23-25 (Tolbert Testimony).

52. Water quality standards are provisions of law that identify beneficial uses of waters and govern how clean that water is supposed to be. *See* Daily Trans., 321:16-20 (Tolbert Testimony); Daily Trans., 3180:6-12 (Strong Testimony).[29] Beneficial uses are assigned to waters of the State based upon what those water bodies should be able to support (*e.g.*, a public water supply, agriculture, fish and wildlife propagation, recreation). *See* Daily Trans., 3180:13-20 (Strong Testimony); Okla. Admin. Code § 785:45-1-2 (a beneficial use "means a classification of the waters of the State, according to their best uses in the interest of the public"). "Beneficial uses are protected through the restrictions imposed by the antidegradation policy

[29] J.D. Strong is the current Oklahoma Secretary of the Environment. *See* Daily Trans., 3129:18-20 (Strong Testimony). Mr. Strong was appointed the Oklahoma Secretary of the Environment in September 2008. *See* Daily Trans., 3129:21-22 (Strong Testimony). Mr. Strong has been an employee of the office of the Oklahoma Secretary of the Environment since 1996. *See* Daily Trans., 3140:5-9 (Strong Testimony).

statement, narrative criteria and numerical standards." *See* Okla. Admin. Code § 785:45-5-2(a).[30]

53. Water quality standards are set differently for every body of water in the State. *See* Daily Trans., 321:21-23 (Tolbert Testimony); Daily Trans., 3180:21-23 & 3183:7-19 (Strong Testimony). They are set on the basis of scientific surveys. Daily Trans., 3180:24-3181:4 (Strong Testimony). They identify the beneficial uses of the water at issue, the criteria needed to protect those uses, and the prohibitions against antidegradation. *See* Daily Trans., 321:23-322:7 (Tolbert Testimony).

54. Water quality standards apply to pollution from both point and non-point sources. *See* Daily Trans., 322:8-12 (Tolbert Testimony).

55. A water body that does not meet water quality standards is described as "impaired." *See* Daily Trans., 322:13-16 (Tolbert Testimony); Daily Trans., 3165:15-17 (Strong Testimony) (testifying that water quality standards are one of the primary measures for determining whether a water body is impaired).

56. The State's water quality standards are promulgated as regulations in the Oklahoma Administrative Code at title 785, chapter 45. *See* Okla. Admin. Code § 785:45; State's Ex. 5108; Daily Trans., 3178:11-16 (Strong Testimony). The designated beneficial uses and antidegradation protections that have been set for particular bodies of waters are found in Appendix A to title 785, chapter 45 of the Oklahoma Administrative Code. *See* Daily Trans., 3184:5-10 (Strong Testimony).

---

[30] Narrative criteria "means statements or other qualitative expressions of chemical, physical or biological parameters that are assigned to protect a beneficial use." *See* Okla. Admin. Code § 785:45-1-2. Numerical criteria "means concentrations of other quantitative measures of chemical, physical or biological parameters that are assigned to protect a beneficial use." *See* Okla. Admin. Code § 785:45-1-2.

57. The State's water quality standards for the IRW have been submitted to and approved by the Environmental Protection Agency ("EPA"), and as such have become federal law. *See* Daily Trans., 372:2-10 (Tolbert Testimony).

58. As noted above, the criteria are both numerical (*e.g.*, a concentration level in the water) and narrative (*e.g.*, a qualitative description of the condition of water quality). *See* Daily Trans., 3182:8-3183:6 (Strong Testimony); Okla. Admin. Code § 785:45-1-2. Where there is a conflict between a narrative criterion and a numerical criterion, the more stringent criterion controls. *See* Okla. Admin. Code § 785:45-5-4(d); Daily Trans., 3188:25-3189:3 (Strong Testimony). Additionally, antidegradation standards, as the term suggests, prohibit degradation of water quality in the waters of the State. *See* Daily Trans., 3183:20-23 (Strong Testimony).

1. Narrative and Numerical Water Quality Standards

59. The State's water quality standards contain a general narrative standard with respect to nutrients that applies to all beneficial uses. It provides that "[n]utrients from point source discharges or other sources shall not cause excessive growth of periphyton, phytoplankton, or aquatic macrophyte communities which impairs any existing or designated beneficial use." *See* Okla. Admin. Code § 785:45-5-9(d); Daily Trans., 3449:8-25 (Strong Testimony).

60. The narrative and numerical water quality standards for aesthetics beneficial use are found at Okla. Admin. Code § 785:45-5-19. *See* Daily Trans., 3189:9-20 (Strong Testimony). The narrative standard provides that "[t]o be aesthetically enjoyable, the surface waters of the state must be free from floating materials and suspended substances that produce objectionable color and turbidity" and that "[t]he water must also be free from noxious odors and taste, from materials that settle to form objectionable deposits, and discharges that produce

undesirable effects or are a nuisance to aquatic life." *See* Okla. Admin. Code § 785:45-5-19(a) & (b); Daily Trans., 3190:6-22 (Strong Testimony). The numerical standard provides that "[t]he thirty (30) day geometric mean total phosphorus concentration in waters designated 'Scenic River' in Appendix A of this Chapter shall not exceed 0.037 mg/L." *See* Okla. Admin. Code § 785:45-5-19(c)(2); Daily Trans., 3189:21-3190:5 (Strong Testimony). The numerical standard for total phosphorus became effective on July 1, 2002. *See* Daily Trans., 3190:23-25 (Strong Testimony).

61. The narrative and numerical water quality standards for the fish and wildlife propagation (cool water aquatic community) beneficial use are found at Okla. Admin. Code § 785:45-5-12. *See* Daily Trans., 3443:18-22 (Strong Testimony). The narrative biological standard provides that "[a]quatic life in all waterbodies with the beneficial use designation of Fish and Wildlife Propagation (excluding waters designated 'Trout, put-and-take') shall not exhibit degraded conditions as indicated by one or both of the following: (i) comparative regional reference data from a station of reasonably similar watershed size or flow, habitat type and Fish and Wildlife beneficial use subcategory designation or (ii) by comparison with historical data from the waterbody being evaluated." *See* Okla. Admin. Code § 785:45-5-12(f)(5)(A); Daily Trans., 3450:25-3451:18 (Strong Testimony). The standard further provides that "[c]ompliance with the biological criteria to protect Fish and Wildlife Propagation set forth in this paragraph shall be based upon measures including, but not limited to, diversity, similarity, community structure, species tolerance, trophic structure, dominant species, indices of biotic integrity (IBI's), indices of well being (IWB's), or other measures." *See* Okla. Admin. Code § 785:45-5-12(f)(5)(B); Daily Trans., 3451:19-25 (Strong Testimony). The numerical standard for dissolved oxygen provides that "[e]xcept for naturally occurring conditions, the dissolved

oxygen criteria are as set forth in Table 1 of Appendix G." *See* Okla. Admin. Code § 785:45-5-12(f)(1)(C). Appendix G provides that for early life stages (March 1 through May 31) the dissolved oxygen criterion is 7 mg/L at seasonal temperatures of 22 degrees centigrade, for other life stages in summer conditions (June 1 through October 15) the dissolved oxygen criterion is 6 mg/L at seasonal temperatures of 29 degrees centigrade, and for other life stages in winter conditions (October 16 through February 28) the dissolved oxygen criterion is 6 mg/L at seasonal temperatures of 18 degrees centigrade. *See* Okla. Admin. Code, § 785:45 (Appendix G); Daily Trans., 3444:17-3445:2 (Strong Testimony).

62. The narrative and numerical water quality standards for public and private water supply beneficial use are found at Okla. Admin. Code § 785:45-5-10. *See* Daily Trans., 3445:9-14 (Strong Testimony). The numerical standard for chlorophyll-a provides that "[t]he long term average concentration of chlorophyll-a at a depth of 0.5 meters below the surface shall not exceed 0.010 mg/L in Wister Lake, Tenkiller Ferry Reservoir, nor any waterbody designated SWS [sensitive water supply] in Appendix A of this Chapter. Wherever such criterion is exceeded, numerical phosphorus or nitrogen criteria or both may be promulgated." *See* Okla. Admin. Code § 785:45-5-10(7); Daily Trans., 3445:18-3446:10 (Strong Testimony).

2. Antidegradation Standards

63. The Oklahoma water quality standards specifically provide that "[n]o water quality degradation which will interfere with the attainment of maintenance of an existing or designated beneficial use shall be allowed." *See* Okla. Admin. Code § 785:45-3-2(d); Daily Trans., 3452:8-20 (Strong Testimony).

64. The Oklahoma water quality standards establish a more stringent antidegradation requirement for Scenic Rivers, Outstanding Resource Waters, and waters located within the

watersheds of Scenic Rivers by providing that "[n]o degradation of water quality shall be allowed in these waters. *See* Okla. Admin. Code § 785:45-3-2(a); Daily Trans., 3452:21-3453:18 (Strong Testimony).

65. The Oklahoma water quality standards also establish a more stringent antidegradation requirement for High Quality Waters which are waters of the state that "possess existing water quality which exceeds those levels necessary to support propagation of fishes, shellfishes, wildlife, and recreation in and on the water" by providing that "[t]hese high quality waters shall be maintained and protected." *See* Okla. Admin. Code § 785:45-3-2(b); Daily Trans., 3456:3-18 (Strong Testimony).

66. The implementation policies for these antidegradation standards include a prohibition on any new point source discharges of designated pollutants, including phosphorus, or any increased load of designated pollutants, including phosphorus, from any existing point source discharger in Outstanding Resource Waters, Scenic Rivers, and waterbodies within the watersheds of Scenic Rivers after June 25, 1992. *See* Okla. Admin. Code, § 785:45-5-25(a) & (c)(1); Daily Trans., 3455:3-16 (Strong Testimony).

67. Similarly, these implementation policies include a prohibition on any new point source discharges of designated pollutants, including phosphorus, or any increased load of designated pollutants, including phosphorus, from any existing point source discharger in High Quality Waters except in limited circumstances (which have not occurred in the IRW). *See* Okla. Admin. Code, § 785:45-5-25(c)(3); Daily Trans., 3458:1-15 (Strong Testimony).

3. Designated Beneficial Uses of Waters in the IRW

68. The beneficial uses that have been designated for Lake Tenkiller are public and private water supply, cool water aquatic community, agriculture, primary body contact

recreation, and aesthetics. *See* Okla. Admin. Code, § 785:45 (Appendix A); Daily Trans., 3184:16-20 (Strong Testimony). Additionally, Lake Tenkiller has been designated a "high quality water" and as being located in a "nutrient limited watershed." *See* Okla. Admin. Code, § 785:45 (Appendix A); Okla. Admin. Code, § 785:45-5-29(b)(19); Daily Trans., 3185:3-7 (Strong Testimony).

69. The beneficial uses that have been designated for Baron Fork from its mouth upstream to Highway 59 are public and private water supply, cool water aquatic community, agriculture, primary body contact recreation, and aesthetics. *See* Okla. Admin. Code, § 785:45 (Appendix A); Daily Trans., 3186:1-6 (Strong Testimony). Additionally, Baron Fork has been designated an "outstanding resource water" and as being a "scenic river." *See* Okla. Admin. Code, § 785:45 (Appendix A); Daily Trans., 3186:7-16 (Strong Testimony). The beneficial uses that have been designated for Baron Fork from Highway 59 to the Arkansas state line are public and private water supply, cool water aquatic community, agriculture, primary body contact recreation, and aesthetics. *See* Okla. Admin. Code, § 785:45 (Appendix A); Daily Trans., 3186:17-25 (Strong Testimony). Additionally, Baron Fork has been designated an "outstanding resource water" and as being located in a "nutrient limited watershed." *See* Okla. Admin. Code, § 785:45 (Appendix A); Okla. Admin. Code, § 785:45-5-29(b)(19); Daily Trans., 3187:1-5 (Strong Testimony).

70. The beneficial uses that have been designated for the upper Illinois River upstream from the Baron Fork confluence to the Arkansas state line are public and private water supply, cool water aquatic community, agriculture, primary body contact recreation, and aesthetics. *See* Okla. Admin. Code, § 785:45 (Appendix A); Daily Trans., 3186:6-12 & 3187:22-3188:1 (Strong Testimony). Additionally, it has been designated an "outstanding resource

water," as being a "scenic river," and as being located within a "nutrient limited watershed." *See* Okla. Admin. Code, § 785:45 (Appendix A); Okla. Admin. Code, § 785:45-5-29(b)(19); Daily Trans., 3186:6-12 (Strong Testimony). Further, the Illinois River is a "high use waterbody." *See* Daily Trans., 3441:25-3442:7 (Strong Testimony).

71. The beneficial uses that have been designated for Flint Creek from its mouth to the state line are public and private water supply, cool water aquatic community, agriculture, primary body contact recreation, and aesthetics. *See* Okla. Admin. Code, § 785:45 (Appendix A); Daily Trans., 3188:5-9 (Strong Testimony). Additionally, Flint Creek has been designated an "outstanding resource water," as being a "scenic river," and as being located within a "nutrient limited watershed." *See* Okla. Admin. Code, § 785:45 (Appendix A); Okla. Admin. Code, § 785:45-5-29(b)(19); Daily Trans., 3188:10-16 (Strong Testimony).

72. The Boone Aquifer has been designated a "nutrient-vulnerable groundwater" in the Oklahoma water quality standards. *See* Okla. Admin. Code, § 785:45 (Appendix D, Table 2), Daily Trans., 3473:8-20 (Strong Testimony).

C. Total Maximum Daily Load (TMDL)

1. The Role of TMDLs in Protecting Water Quality

73. A total maximum daily load ("TMDL") is defined as:

> The sum of the individual WLAs [Wasteload Allocation] for point sources and LAs [Load Allocation] for nonpoint sources and natural background. If a receiving water has only one point source discharger, the TMDL is the sum of that point source WLA plus the LAs for any nonpoint sources of pollution and natural background sources, tributaries, or adjacent segments. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure. If Best Management Practices (BMPs) or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations can be made less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs.

40 C.F.R. § 130.2(i).[31]

74. A TMDL is thus a planning tool used to determine the greatest amount of loading that a water body can receive without violating water quality standards (*i.e.*, a load capacity), and to apportion that loading capacity between loads from point and nonpoint sources. *See* Daily Trans., 3608:14-17 (Strong Testimony) ("it's generally a process of establishing an allocation of a pollutant necessary to bring a waterbody into compliance with its beneficial uses"); Court's Ex. 13 at p. 12 (Thompson Depo.)[32] ("that's the calculation of the contribution of load pollution by all sources of pollution to a waterbody, and what percentage contribution is done by all those contributing factors"). A TMDL is not self-executing. *See* COL, ¶¶ 171-184.

2. The Development of TMDLs for the IRW

75. Oklahoma has a draft TMDL for the Oklahoma portion of the IRW, but that draft has not been finalized. *See* Daily Trans., 1396:1-13 (Phillips Testimony); Daily Trans., 3704:9-14 (Strong Testimony).

---

[31] Wasteload allocation means:

> The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation.

40 C.F.R. § 130.2(h). Load allocation means:

> The portion of a receiving water's loading capacity that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loads should be distinguished.

40 C.F.R. § 130.2(g).

[32] Mr. Stephen Thompson is the Executive Director of the Oklahoma Department of Environmental Quality where he has worked since 1985. *See* Court's Ex. 13 at p. 1 (Thompson Testimony). He served as assistant Secretary of the Environment from 1992-1993. *See* Court's Ex. 13 at p. 1 (Thompson Testimony).

76. According to Mr. Stephen Thompson, director of the Oklahoma Department of Environmental Quality (ODEQ), a completed TMDL for the IRW will result in a determination that phosphorus loads from point sources and nonpoint sources need to be reduced. *See* Daily Trans., 10769:12-25 (Thompson Testimony). Point sources in the Oklahoma portion of the IRW include the City of Tahlequah, City of Westville and the City of Stilwell and ODEQ is legally required to implement any loading reductions required by a TMDL in these point sources NPDES permits. *See* Daily Trans., 10770:1-25 (Thompson Testimony). Mr. Thompson testified that ODEQ has no authority regarding reducing poultry litter-based load reductions required by a TMDL and can only make recommendations. *See* Daily Trans., 10771:18-25 (Thompson Testimony). Although phosphorus loading also originates in the Arkansas portion of the IRW, no agency of the State of Oklahoma has authority to enforce nonpoint source loading reductions from a TMDL in the State of Arkansas. *See* Daily Trans., 10776:17-10777:6 (Thompson Testimony).

77. Mr. Thompson testified that ODEQ is concerned that the TMDL process in the IRW will result in an unfair allocation in load reductions because of some technical issues relating to the number of samples required and the methodology of cutting out higher phosphorus loadings that will skew the results in favor of nonpoint sources. *See* Daily Trans., 10769: 7-11; 10772:23-10773:25; 10782:14-23 (Thompson Testimony) (testifying that the ODEQ believes there should be a set number of high flow and low flow samples and that, once the data is collected, none should be cut out and it should all be considered). Most of the phosphorus loading in the IRW occurs during high flow times and these technical issues result in not capturing a lot of the high flow loading. *See* Daily Trans., 10775:8-25 (Thompson Testimony). Loading during high flows are generally attributed to nonpoint sources while low flow loading is

generally attributed to point sources. *See* Daily Trans., 10773: 3-12 (Thompson Testimony). Under these circumstances, in Mr. Thompson's view, point sources included in the TMDL would incur an unfair, expensive requirement to meet a TMDL load reduction. *See* Daily Trans., 10776:3-8 (Thompson Testimony).

78. As a result, Mr. Thompson asked his former Water Quality Division Chief to work with the Oklahoma Water Resources Board to resolve the issue, but it is not yet resolved. *See* Daily Trans., 10776:14-16; 10776:9-16 (Thompson Testimony). This issue has been assigned to the new Division Chief to continue to work with the Oklahoma Water Resources Board to resolve the issue. *See* Daily Trans., 10778:16-10779:5 (Thompson Testimony). Mr. Thompson does not know when the OWRB will definitively make its decision. *See* Daily Trans., 10787:11-15 (Thompson Testimony). If the issue is not resolved, ODEQ will have to proceed to generate a TMDL. *See* Daily Trans., 10785:13-19 (Thompson Testimony).

79. Based upon attention of environmental agencies on nutrient concerns in the IRW, including the attention of the ODEQ with respect to point sources,[33] the EPA has proposed to develop a model of the IRW incorporating all relevant segments and nutrient sources in both Arkansas and Oklahoma.[34] *See* Daily Trans., 10794:20-10795:15 (Thompson Testimony); DJX

---

[33] The State of Oklahoma contends, for example, that a new point source discharge permit for the Northwest Arkansas Conservation Authority (NACA) waste water treatment plant to discharge into a nutrient impaired segment of the Illinois River is improper. *See* Daily Trans., 10836:3-21 (Thompson Testimony).

[34] At the conclusion of trial, after Defendants announced they had no surrebuttal testimony, Defendants asked the Court to take judicial notice of an entry in the Federal Register by which the EPA sought data concerning its IRW modeling effort and a December 29, 2009 letter from EPA Regional Administrator Shawn Garvin to the Virginia Secretary of Natural Resources dealing with a TMDL of the Chesapeake Bay Watershed. *See* Daily Trans., 11589:7-11591:15. Defendants designated Chesapeake Bay letter DJX 8158 and the Federal Register entry DJX 8159. *See* Daily Trans., 11597:1-4, 11599: 5-9 . The Court reserved judgment on the request to take judicial notice. *See* Daily Trans., 11600:2-5.

8090 (Oct. 1, 2009 EPA letter). Specifically, the EPA has written officials in both Oklahoma and Arkansas concerning a modeling effort for the waters of the IRW. *See* Daily Trans., 10793: 9-19 (Thompson Testimony); DJX 8090 (October 1, 2009 EPA letter). The EPA expects that this modeling effort "may lead to the development of one or more Total Maximum Daily Loads" for the IRW. *See* Daily Trans., 10797: 9-14 (Thompson testimony); DJX 8090 (emphasis added).

80. The ODEQ has named a technical liaison for this effort to coordinate with both EPA and Arkansas and be Oklahoma's "voice at the table." *See* Daily Trans., 10796: 13-10797:8 (Thompson Testimony). The ODEQ is providing EPA with substantial data in its possession from state and federal agencies. *See* Daily Trans., 10806:22-10807:6 (Thompson Testimony). Arkansas is also providing data to the EPA. *See* Daily Trans., 9544:3-11 (Smith Testimony). The EPA held an organizational kickoff meeting in Dallas on November 20, 2009, which was attended by EPA staff and representatives of Oklahoma and Arkansas. *See* Daily Trans., 10799:25-10802:9 (Thompson Testimony).

81. The EPA has set a tentative schedule for its IRW modeling project that contemplates finalizing any TMDL on or about September 15, 2011. *See* DJX 8126. The Court

---

Upon reflection, and after examining proposed exhibits DJX 8158 and 8159, the Court declines to take judicial notice of either. The Chesapeake Bay TMDL letter, DJX 8158, does not support Defendants' erroneous contention that the EPA in any way regulates nonpoint source pollution under the Clean Water Act, *see* COL, ¶¶ 35-51, 171-184, and, moreover, deals with a watershed that is the subject of a unique Executive Order of the President -- Executive Order 13508, a unique provision of the Clean Water Act, 33 U.S.C. § 1267, as well as agreements between various states and the District of Columbia, none of which are at issue in the present case. The Federal Register entry, DJX 8159, is a call for data about the IRW required to support the EPA modeling effort in the Watershed that adds nothing to the Court's understanding of the EPA effort not already disclosed in testimony and exhibits already received in evidence. DJX 8159 does not support Defendants' contention that the EPA in any way regulates nonpoint source pollution under the Clean Water Act. *See* COL, ¶¶ 35-51, 171-184. Consequently, neither DJX 8158 nor 8159 is helpful to the Court resolving the issues of this case. Defendants' request is denied.

shares Mr. Thompson's lack of optimism that this deadline will be met. *See* Daily Trans., 10838: 7-22 (Thompson Testimony) (testifying that he has been involved in environmental protection in Oklahoma for 25 years, is acquainted with the EPA's track record for meeting its own deadlines, and that track record shows the EPA meets its own deadlines rarely or never).

D. Oklahoma's Public Policy Regarding Pollution of Waters of the State

82. It is the clear public policy of the State that there be no pollution of the waters of the State. A sampling of such pronouncements may be found in the statutes and regulations of the State.

83. For instance, 27A Okla. Stat. § 2-6-105(A) states that: "It shall be unlawful for any person to cause pollution of any waters of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any air, land or waters of the state. Any such action is hereby declared to be a public nuisance."

84. 27A Okla. Stat. § 2-6-102 states that: "Whereas the pollution of the waters of this State constitutes a menace to public health and welfare . . . it is hereby declared to be the public policy of this state . . . to provide that no waste or pollutant be discharged into any waters of the state or otherwise placed in a location likely to affect such waters without first being given the degree of treatment or taking such other measures as necessary to protect the legitimate beneficial uses of such waters [and] to provide for the prevention, abatement and control of new or existing water pollution . . . ."

85. 82 Okla. Stat. § 1084.1 states that: "Whereas the pollution of the waters of this state constitutes a menace to public health and welfare . . . it is hereby declared to be the public policy of this state to conserve and utilize the waters of the state and to protect, maintain and improve the quality thereof for public water supplies, for the propagation of wildlife, fish and

aquatic life and for domestic, agricultural, industrial, recreational and other legitimate beneficial uses . . ."

86. 2 Okla. Stat. § 10-9.7(B)(4)(a) & (b) states that: "Poultry waste handling, treatment, management and removal shall: (a) not create an environmental or a public health hazard, (b) not result in the contamination of waters of the state . . . ."

87. Okla. Admin. Code § 785:45-3-2(a) states that: "Certain waters of the state constitute an outstanding resource or have exceptional recreational and/or ecological significance. These waters include streams designated 'Scenic River' or 'ORW' in Appendix A of this Chapter, and waters of the State located within watersheds of Scenic Rivers. . . . No degradation of water quality shall be allowed in these waters."

88. Okla. Admin. Code § 785:45-3-2(b) states that: "It is recognized that certain waters of the state possess existing water quality which exceeds those levels necessary to support propagation of fishes, shellfishes, wildlife, and recreation in and on the water. These high quality waters shall be maintained and protected."

VII. Uses of the Waters of the IRW

89. As noted above, the waters of the IRW in Oklahoma have been designated for multiple beneficial uses, including but not limited to uses for recreation and aesthetics, drinking water, and fish and wildlife propagation. *See, supra*, FOF, ¶¶ 68-72; *see also* State's Ex. 5862 at p. 3 ("Streams in the Illinois River basin are used for primary body contact recreation . . . and fisheries. Water from these streams also is used for public and private water supply and non-irrigation agriculture"). The record reflects such uses.

A. Recreation and Aesthetics

90. The IRW is one of the most important recreational watersheds in Oklahoma. *See* Daily Trans., 324:10-15 (Tolbert Testimony). As explained by Dr. Lowell Caneday:

> Clearly, the Illinois River, the Flint Creek and the Barren Fork are the premier float streams in Oklahoma. They are the longest stretch of unimpounded water in a picturesque environment. They provide the necessary support amenities from river access on public properties to the outfitters that provide a variety of other services. There just are no other streams of that nature in Oklahoma.

See Daily Trans. 4346:19-4347:1 (Caneday Testimony);[35] State's Ex. 3285 at pp. 32-33 (". . . Tenkiller Lake historically has been a popular recreation area. People from surrounding counties use the lake for a variety of water-related recreational activities.").

91. Recreational activity has been occurring in the Illinois River corridor as long as there have been people there. *See* Daily Trans., 4336:20-4337:10 (Caneday Testimony); 4339:3-4342:12 (Caneday Testimony); State's Ex. 3116; State's Ex. 3113.

92. The IRW is a highly utilized natural resource. With respect to the Illinois River, Mr. Fite estimated that close to 500,000 individuals visit there annually. *See* Daily Trans., 796:1-3 (Fite Testimony); DJX 0147 at 28 ("The Illinois River and its tributaries are among the primary tourist attractions within northeastern Oklahoma. Canoeists and tourists from across Oklahoma, and parts of Arkansas, Missouri, Kansas, and Texas are drawn to the River Corridor."). Approximately 105,000 registered floaters floated on the Illinois River in 2007. *See*

---

[35] Dr. Lowell Caneday holds a Ph.D. in recreation, park and leisure studies. *See* Daily Trans., 4328:25-4329:6 (Caneday Testimony). Dr. Caneday is a professor of leisure studies in the School of Applied Health and Educational Psychology at Oklahoma State University. *See* Daily Trans., 4327:24-2328:5 (Caneday Testimony). Dr. Caneday is a certified park and recreation professional (CPRP). *See* Daily Trans., 4329:14-16 (Caneday Testimony). He is a Fellow in the National Recreation and Park Association, the American Academy of Park and Recreation Administrators, and the American Leisure Academy. *See* Daily Trans., 4330:1-6 (Caneday Testimony). He has written 35 to 40 refereed journal articles, numerous state and regional articles, and 55 to 60 technical reports including the 1999 Illinois River Management Plan. *See* Daily Trans., 4330:18-23, 4333:7-15 (Caneday Testimony). Dr. Caneday testified as a retained expert for the State.

State's Ex. 505; Daily Trans., 4348:2-8 (Caneday Testimony); Daily Trans., 796:9-15 (Fite Testimony) (estimating 150,000-180,00 floaters on the Illinois River each year). Floating activity includes inner tubing, kayaking, canoeing and rafting. *See* Daily Trans., 959:20-22 (Fite Testimony). Non-floating activities on the river include swimming, fishing, camping, hunting, equestrian tours, mountain bike rides, motorcycle poker runs, foliage tours, church baptisms, church retreats, spiritual enhancement, and studies of geography, water quality and other issues. *See* Daily Trans., 959:22-960:14 (Fite Testimony).

93. The smaller streams of the IRW also are used for recreational purposes. *See* Daily Trans., 7190:18-25 (Stevenson Testimony); Daily Trans., 4604:13-21 (Saunders Testimony).[36]

94. With respect to Lake Tenkiller, there were approximately 375,000 campers at Lake Tenkiller in 2007. *See* State's Ex. 495; Daily Trans., 4355:12-18 (Caneday Testimony). There were approximately 2.3 million day visitors to Lake Tenkiller in 2007. *See* State's Ex. 496; Daily Trans., 4356:21-4357:3 (Caneday Testimony). There were just under 350,000 boaters (including water skiers and scuba divers) on Lake Tenkiller in 2007. *See* State's Ex. 497; Daily Trans., 4358:8-4359:1 (Caneday Testimony). And there were approximately 2.6 million total visitors to Lake Tenkiller in 2007. *See* State's Ex. 498; Daily Trans., 4359:25-4360:9 (Caneday Testimony).

95. Economic contributions from recreational activities on the waters of the IRW are significant. *See* State's Ex. 5862 at p. 3 ("About 400,000 tourists spend an estimated $12 million per year in the basin. . ."); DJX 0147 at p. 32-33 ("The Oklahoma Scenic Rivers Commission

[36] Mr. Al Saunders has been a grower for the Tyson Defendants in the northeastern Oklahoma portion of the IRW for 2 years, and before that he was a grower for Defendant Peterson for 7 years. *See* Daily Trans., 4529:8-15, 4530:15-4531:1 (Saunders Testimony).

(OSRC) estimates that recreation had a total economic impact in excess of $11 million in 1997 in the region around the Illinois River. This figure is conservative since it includes only the estimated expenditures of river floaters and not fishermen, campers, and other visitors."); DJX 0147 at p. iv ("The river basin is also a vital economic resource for many businesses in the city of Tahlequah and along the scenic State Highway 10 corridor."); State's Ex. 5862 at p. 3 ("An estimated $16.5 million is generated annually by about 1,500,000 visitors per year to the area around this lake").

96. The recreation-based economy of the area relies on maintenance of aesthetically pleasing water quality in Lake Tenkiller. *See* State's Ex. 5862 at p. 3; *see also* State's Ex. 3285 at p. 34 ("Further degradation would directly impact . . . recreationalists. . . . Because Tenkiller Lake offers unique recreation opportunities within the region, water based recreationalists would experience a decline in quality of the recreation experience. Further degradation would indirectly impact those who have an economic interest in the recreation industry in the areas surrounding Tenkiller Lake. Users would most likely seek out alternate recreation areas and activities, and those individuals and businesses providing goods and services to Tenkiller Lake recreationalists would experience a loss in income as fewer people visited the lake.").

B. Drinking Water

97. In addition to their recreational uses, the waters of the IRW are also used for drinking water. *See* Daily Trans., 339:1-4 (Tolbert Testimony). There are some 18 public water supplies drawing water from the Oklahoma portion of the IRW. *See* Daily Trans., 6086:18-

6087:9 (Teaf Testimony);[37] State's Ex. #5202. Some public water supplies draw water from Lake Tenkiller. *See* Daily Trans., 339:18-20 (Tolbert Testimony); State's Ex. #5202.

C. Fish and Wildlife Propagation

98. The rivers and streams of the IRW have historically been the habitat to a broad range of fish. *See* State's Ex. 3116 at OK0003578 ("For more years than most of us can count for our own the Illinois and its principal tributaries Flint and Barren Fork creeks have lured anglers to the picturesque hill-country in search of smallmouth, largemouth, Kentucky spotted, rock and brownie bass. Great green perch, crappie and channel cats also abound in the river.") (1961); State's Ex. 3113 at p. 457 ("[The Illinois River] has always been among the best fishing streams in the state) (1968-69).

99. Smallmouth bass and walleye pike are important fish to Lake Tenkiller. *See* Daily Trans., 7765:17-19 (Welch Testimony). Lake Tenkiller has historically been stocked with smallmouth bass, walleye pike and striped bass. *See* Daily Trans., 7767:2-21; 7781:18-7782:5 (Welch Testimony).

VIII. Current Condition of the Waters of the IRW in Oklahoma

---

[37] Dr. Christopher Teaf holds a Ph.D. in toxicology. *See* Daily Trans., 6038:16-6039:12 (Teaf Testimony). Dr. Teaf is board certified by the Academy of Toxicological Sciences. *See* Daily Trans., 6046:15-16 (Teaf Testimony). Dr. Teaf has been on the faculty at Florida State University for 30 years. *See* Daily Trans., 6040:22-25 (Teaf Testimony). Dr. Teaf is also a faculty member at the Center for Biomedical and Toxicological Research at Florida State University, and since 1983 has served as the associate director of that center. *See* Daily Trans., 6040:1-10 (Teaf Testimony). The specialties of that center involve research into the areas of toxicology, risk assessment and evaluation of contaminated sites. *See* Daily Trans., 6040:6-10 (Teaf Testimony). Dr. Teaf has served on the editorial boards of several scientific journals, including the *Journal of Environmental Toxicology*. *See* Daily Trans., 6048:13-6049:1 (Teaf Testimony). Additionally, Dr. Teaf has a consulting firm called Hazardous Substance and Waste Management Research. *See* Daily Trans., 6044:8-6045:6 (Teaf Testimony). Dr. Teaf testified as a retained expert for the State.

100. The Court received substantial evidence on the question of whether the rivers and streams of the IRW in Oklahoma and Lake Tenkiller have been injured.

A. Rivers and Streams

1. High Phosphorus Levels and Algae

101. The State's expert, Dr. Jan Stevenson,[38] developed and directed an IRW stream sampling program that was conducted in summer 2006, spring 2007, and summer 2007. *See* Daily Trans., 6984:23-7000:10 (Stevenson Testimony). The summer 2006 sampling program focused largely on measuring habitat condition, land use, nutrient concentrations, algal biomass, diatom species composition and benthic invertebrates. *See* Daily Trans., 6988:1-6993:1 (Stevenson Testimony); State's Ex. 4508. The spring 2007 sampling program focused largely on filamentous green algae and benthic invertebrate responses to filamentous green algae. *See* Daily Trans., 6993:2-6996:19 (Stevenson Testimony); State's Ex. 4468. And the summer 2007 sampling program focused largely on nutrient concentrations and fish assemblages. *See* Daily Trans., 6996:20-7000:10 (Stevenson Testimony); State's Ex. 4477. All three sampling programs specifically investigated phosphorus concentrations. *See* Daily Trans., 7012:2-13 (Stevenson Testimony).

---

[38] Dr. Jan Stevenson holds a Ph.D. in natural resources and the environment from the University of Michigan. *See* Daily Trans., 6962:9-20 (Stevenson Testimony). Dr. Stevenson's Ph.D. research focused on benthic algae. *See* Daily Trans., 6965:5-7 (Stevenson Testimony). Dr. Stevenson is currently a professor at Michigan State University. *See* Daily Trans., 6965:23-6966:2 (Stevenson Testimony). Dr. Stevenson served from 2007-2008 as the president of the North American Benthological Society. *See* Daily Trans., 6971:21-6972:2 (Stevenson Testimony). Dr. Stevenson has published more than 100 articles in peer-reviewed journals. *See* Daily Trans., 6971:1-20; 6973:8-6974:8; 6876:21-25 (Stevenson Testimony). In addition, Dr. Stevenson is the author of that section of the EPA bioassessment protocols addressing the methods that should be used by federal and state agencies to assess algae in streams. *See* Daily Trans., 6975:16-6976:10 (Stevenson Testimony). Dr. Stevenson has significant professional experience in studying nutrient and algal impacts on steams. *See* Daily Trans., 6972:14-6978:10 (Stevenson Testimony). Dr. Stevenson testified as a retained expert for the State.

102. There are two major habitats in which algae occur in aquatic ecosystems. Those that are attached to the bottom are called benthic algae, while those that float in the water column are call planktonic algae. *See* Daily Trans., 6964:19-6965:4 (Stevenson Testimony).

103. There are many nutrients that algae need to grow; the two primary nutrients for algal growth are nitrogen and phosphorus. *See* Daily Trans., 7000:25-7001:2 (Stevenson Testimony). In most freshwater ecosystems, phosphorus is the limiting nutrient. *See* Daily Trans., 7001:22-23 (Stevenson Testimony). "Limiting" refers to Liebig's law of the minimum. That is, whichever nutrient is in lowest relative supply, that nutrient constrains the growth of the algae. *See* Daily Trans., 7001:5-9 (Stevenson Testimony); Daily Trans., 7376:20-25 (Cooke Testimony);[39] Daily Trans., 983:11-16 (Phillips Testimony) ("Nutrient limitation[s] are the nutrients that control the growth of algae commodity, so they're the nutrients that if you added more of, there would be more algae growth and if you took away, there would be less algae growth").

104. Algae have a nitrogen to phosphorus ratio of 16 to 1 atoms in their tissues -- that is, they have 16 atoms of nitrogen for every one atom of phosphorus. *See* Daily Trans., 7001:9-12 (Stevenson Testimony). If the nitrogen to phosphorus ratios are greater than 16 to 1, then nitrogen would be in excess in the environment. *See* Daily Trans., 7001:13-16 (Stevenson

---

[39] Dr. G. Dennis Cooke was a professor at Kent State University from 1967-2003 where he taught and conducted research on eutrophication in lakes and reservoirs. *See* Daily Trans., 7335:23-7337:5 (Cooke Testimony). He has published books, 70 peer-reviewed articles in scientific journals and hundreds of technical reports on eutrophication. *See* Daily Trans., 7336:22-7337:11 (Cooke Testimony). He was the founding president of the North American Lake Management Society and associate editor of its journal. *See* Daily Trans., 7342:1-9 (Cooke Testimony). He received a Ph.D. from the University of Iowa Department of Zoology with a major in limnology and a minor in developmental biology, after which he was a postdoctoral fellow at the University of Georgia for two years sponsored by the National Institute of Health and the National Aeronautics and Space Administration. *See* Daily Trans., 7334:2-24 (Cooke Testimony). Dr. Cooke testified as a retained expert for the State.

Testimony). Phosphorus would thus be the limiting nutrient, and phosphorus concentrations would control the growth of the organisms. *See* Daily Trans., 7001:16-18 (Stevenson Testimony).

105. The nitrogen to phosphorus ratios in the Illinois River are almost always well above 16 to 1. *See* Daily Trans., 7001:23-25 (Stevenson Testimony). Therefore, phosphorus is the limiting nutrient in the Illinois River. *See* Daily Trans., 7001:25-7002:2 (Stevenson Testimony).

106. There are typically three different fractions of phosphorus within the water column of an aquatic ecosystem -- dissolved inorganic phosphorus (also referred to as PO_4, phosphate or soluble reactive phosphorus),[40] dissolved organic phosphorus, and particulate phosphorus. *See* Daily Trans., 7003:7-7004:15 (Stevenson Testimony). Together these are termed "total phosphorus." *See* Daily Trans., 5357:20-5360:2 (Olsen Testimony).

107. All three forms of phosphorus are available for algae to use in the aquatic ecosystem. *See* Daily Trans., 7004:16-19 (Stevenson Testimony). Therefore, all three forms of phosphorus are important in the investigation of phosphorus availability in water.

108. Dissolved inorganic phosphorus (*i.e.*, soluble reactive phosphorus) can be taken up immediately by algae. *See* Daily Trans., 7004:23-7005:2 (Stevenson Testimony); Daily Trans., 8900:10-13 (Connolly Testimony)[41] (soluble reactive phosphorus is the form of phosphorus that is primarily available for algae growth).

---

[40] Dissolved inorganic phosphorus is soluble reactive phosphorus. *See, e.g.*, Daily Trans., 5359:2-11 (Olsen Testimony); Daily Trans. 8899:5-6 (Connolly Testimony) ("Soluble-reactive phosphorus is mostly dissolved inorganic phosphorus.").

[41] Dr. John Connolly is a consultant at Anchor QEA which he founded following his work at the consulting firm Hydroqual. *See* Daily Trans., 8825:16-8826:7 (Connelly Testimony). He received a Ph.D. in environmental health engineering from the University of

109. Most algae cannot take up dissolved organic phosphorus directly. Rather such algae secrete an enzyme called phosphatase that cleaves the phosphate group off the organic phosphorus molecule. *See* Daily Trans., 7005:3-11 (Stevenson Testimony). Thus, when inorganic phosphorus becomes depleted in the water column, algae will start breaking down dissolved organic phosphorus for use. *See* Daily Trans., 7005:12-18 (Stevenson Testimony); Daily Trans., 9384:19-23 (Connolly Testimony) ("Algae can do that for certain simpler organic compounds").

110. Particulate phosphorus in the water column is also an important form of phosphorus for algae. As Dr. Stevenson explained, particulate phosphorus can be trapped in algae as it floats by, at which time bacteria breaks down the particulate phosphorus into inorganic phosphorus for use by the algae. *See* Daily Trans., 7005:20-7006:6 (Stevenson Testimony). Thus, particulate phosphorus can be a "very important source" of inorganic phosphorus to thick algae mats that develop in streams. *See* Daily Trans., 7006:1-6 (Stevenson Testimony). Additionally, aquatic invertebrate ingest particulate phosphorus and through the digestive process secrete inorganic phosphorus, as well as organic phosphorus. *See* Daily Trans., 7006:7-21 (Stevenson Testimony).

111. Because all three forms of phosphorus are available for algae to use in the aquatic ecosystem, all three forms of phosphorus are important in an investigation of phosphorus

---

Texas. *See* Daily Trans., 8822:18-22 (Connelly Testimony). He taught undergraduate and graduate level courses in environmental engineering for 14 years at Manhattan College where he conducted EPA research. *See* Daily Trans., 8824:7-14 (Connelly Testimony). He worked for 2 years at the EPA lab in Gulf Breeze, Florida. *See* Daily Trans., 8823:19-21 (Connelly Testimony). He is a member of EPA's standing committee on environmental engineering and the American Academy of Environmental Engineers. *See* Daily Trans., 8826:13-8827:2 (Connelly Testimony). He has published between 30 and 35 peer-reviewed papers and served as a peer reviewer for two journals and the EPA. *See* Daily Trans., 8827:9-8828:15 (Connelly Testimony). Dr. Connolly testified as a retained expert for Defendants.

availability to algae. *See* Daily Trans., 7007:25-7009:13 (Stevenson Testimony). Put another way, total phosphorus is the best indicator of phosphorus availability. *See* Daily Trans., 7008:6-9 (Stevenson Testimony). Use of total phosphorus as the best indicator of phosphorus availability is a position supported by the EPA and the scientific community. *See* Daily Trans., 7008:10-18 (Stevenson Testimony); Daily Trans., 9366:16-19 (Connolly Testimony) (agreeing that EPA focuses "[a]t a gross scale" on total phosphorus as a benchmark for water quality).

112. The summer 2006 sampling program revealed total phosphorus concentrations ranging from 0.008 mg/L to 0.648 mg/L, with a median concentration of 0.076 mg/L, and 25th and 75th quartiles of 0.037 mg/L and 0.118 mg/L, respectively. *See* Daily Trans., 7013:3-7014:10 (Stevenson Testimony). The spring 2007 sampling program revealed total phosphorus concentrations ranging from 0.007 mg/L to 1.254 mg/L, with a median concentration of 0.057 mg/L, and 25th and 75th quartiles of 0.026 mg/L and 0.113 mg/L, respectively. *See* Daily Trans., 7014:13-18 (Stevenson Testimony). The summer 2007 sampling program revealed total phosphorus concentrations ranging from 0.007 mg/L to 0.945 mg/L, with a median concentration of 0.067 mg/L, and 25th and 75th quartiles of 0.029 mg/L and 0.142 mg/L, respectively. *See* Daily Trans., 7015:1-5 (Stevenson Testimony).

113. Similarly, Defendants' retained expert Dr. Connolly found that phosphorus concentrations in the Illinois River are in the range of 0.100 mg/L. *See* Daily Trans., 9320:13-15 (Connolly Testimony).

114. The background or natural total phosphorus concentration in the rivers and streams of the IRW would be expected to be about 0.010 mg/L. *See* Daily Trans., 7016:19-7017:10 (Stevenson Testimony). In the IRW, however, more than 25 percent of the streams sampled in the sampling program had total phosphorus concentrations of greater than 0.100

mg/L. *See* Daily Trans., 7017:17-19 (Stevenson Testimony). Dr. Stevenson testified that the total phosphorus concentrations in the streams of the IRW "are higher than anyplace that I've seen work done in similar geologic settings." *See* Daily Trans., 7017:19-22 (Stevenson Testimony).

115. Moreover, between two-thirds and three-fourths of the streams sampled in the sampling program had total phosphorus concentrations exceeding Oklahoma's 0.037 mg/L scenic river water quality standard. *See* Daily Trans., 7015:6-7016:13 (Stevenson Testimony). And there were five stations on scenic river reaches of the Illinois River and Flint Creek where the geometric mean of the sampling results revealed levels exceeding Oklahoma's 0.037 mg/L scenic river water quality standard. *See* Daily Trans., 7015:6-19 (Stevenson Testimony).

116. Dr. Stevenson's investigations and conclusions concerning the scope and severity of phosphorus pollution in the IRW are corroborated by the findings of the USGS.[42] In a 2006 report, the USGS found that the rivers and streams of the IRW have higher total phosphorus concentrations in comparison to other relatively undeveloped watersheds in the United States:

> Estimated mean flow-weighted phosphorus concentrations at the stations in the basin were more than 10 times greater than the median flow-weighted concentrations (0.022 mg/L) and were consistently greater than the 75th percentile of flow-weighted phosphorus concentrations in relatively undeveloped basins of the United States (0.037 mg/L). In addition, flow-weighted phosphorus concentrations in 2000-2002 at all Illinois River stations and at Flint Creek were approximately equal to or greater than the 75th percentile of all National Water-Quality Assessment program stations in the United States (0.29 mg/L).

See State's Ex. 5862 at p. 20 (internal citations omitted).

---

[42] The work of the USGS is authoritative. *See* Daily Trans., 1298:4-8 (Phillips Testimony) ("The Court: And in terms of its quality of reporting, where does the USGS fall? Ms. Phillips: They are very well respected. They're among the highest caliber. They're extensively peer reviewed.").

117. The State's 2008 Water Quality Assessment Integrated Report (a/k/a "Integrated Report"), prepared by the ODEQ and submitted to the EPA pursuant to sections 303(d) and 305(b) of the Clean Water Act, which lists impaired waters in the State, confirms Dr. Stevenson's conclusion that phosphorus is causing injury to the aesthetics of the rivers and streams of the IRW in Oklahoma. *See* State's Ex. 6008 at Appendix C; Daily Trans., 3492:8-14 & 3492:22-25 (Strong Testimony). The 2008 Integrated Report has been approved by the EPA. *See* Daily Trans., 399:11-17 (Tolbert Testimony).

118. When a body of water is listed as impaired on the Integrated Report it means that waterbody is not meeting its water quality standards. *See* Daily Trans., 391:5-16 (Tolbert Testimony). The 2008 Integrated Report lists the following segments of rivers and streams of the IRW in Oklahoma as having aesthetic impairment caused by total phosphorus: a 7.68-mile segment of the Illinois River having the segment code OK121700030010_00; a 31.68-mile segment of the Illinois River having the segment code OK121700030080_00; a 15.65-mile segment of the Illinois River having the segment code OK121700030280_00; a 5.18-mile segment of the Illinois River having the segment code OK121700030350_00; a 23.30-mile segment of the Illinois River; the Baron Fork having the segment code OK121700050010_00; a 1.60-mile segment of the Flint Creek having the segment code OK121700030290_00; and a 7.75-mile segment of the Flint Creek having the segment code OK121700060010_00. *See* State's Ex. 6008 at C-15 & C-16; Daily Trans., 3493:15-3496:12 & 3498:12-3500:8 (Strong Testimony). These streams are not meeting water quality standards for total phosphorus.

119. The Beneficial Use Monitoring Report (BUMP) for the Illinois River, Baron Fork Creek and Flint Creek also demonstrates that these waterbodies are not meeting water quality standards. Specifically, the aesthetics beneficial use is impaired for total phosphorus and the

total phosphorus criteria is being exceeded. *See* State's Ex. 5594 (2007 Report of the Oklahoma Beneficial Use Monitoring Program -- Streams Report). For the Baron Fork at Eldon station, the BUMP Report finds that "[t]he aesthetics beneficial use is impaired for total phosphorus. Of the fifty-one (51) 3-month rolling geometric means calculated from total phosphorus samples (c), eighteen (18) geometric means (or 35%) exceed the prescribed scenic river total phosphorus criterion of 0.037mg/L." *See* State's Ex. 5594 at p. 108. For the Flint Creek station, the BUMP Report finds that "[t]he aesthetics beneficial use is impaired for total phosphorus. All 3-month rolling geometric means calculated from total phosphorus samples as well as all phosphorus samples exceeded the prescribed scenic river total phosphorus criterion of 0.037mg/L." *See* State's Ex. 5594 at p. 110. For the Illinois River at Watts station, the BUMP Report finds that "[t]he aesthetics beneficial use is impaired for total phosphorus. Of the fifty-three (53) 3-month rolling geometric means calculated from total phosphorus samples, 53 geometric means (or 100%) exceed the prescribed scenic river total phosphorus criterion of 0.037mg/L." *See* State's Ex. 5594 at p.113. For the Illinois River at Tahlequah station, the BUMP report finds that "[t]he aesthetics beneficial use is impaired for total phosphorus. Of the fifty-three (53) 3-month rolling geometric means calculated from total phosphorus samples, fifty (50) geometric means (or 94%) exceeded the prescribed scenic river total phosphorus criterion of 0.037mg/L." *See* State's Ex. 5594 at p. 112.

120. The Court finds that phosphorus concentrations in streams and rivers of the IRW in Oklahoma are elevated beyond natural or background levels in violation of the Oklahoma antidegradation standards for these waters which prohibit any degradation of water quality in the IRW. *See* Okla. Admin. Code § 785:45-3-2(a). The Court further finds that phosphorus concentrations in the Illinois River, Flint Creek and Baron Fork Creek exceed the total

phosphorus criterion applicable to scenic rivers, and the aesthetics beneficial use is impaired for total phosphorus in violation of Oklahoma Water Quality Standards. *See* Okla. Admin. Code § 785:45-5-19(c)(2).

2. Phosphorus-Induced Algae Biomass and Its Consequences

121. Increases in algae biomass impact aesthetics, dissolved oxygen concentrations, pH and aquatic habitat. *See* Daily Trans., 7018:18-7026:16 (Stevenson Testimony).

a. Aesthetics

122. Algae biomass is determined with reference to the habitat in which the algae occur. *See* Daily Trans., 7022:3-4 (Stevenson Testimony). Algae biomass in the water column is determined with reference to the cell volume of chlorophyll per unit volume of water, while algae biomass on the stream bottom is determined with reference to the weight of algae per unit area. *See* Daily Trans., 7022:4-14 (Stevenson Testimony).

123. At background or natural total phosphorus concentrations, filamentous green algae cover is typically 5 to 10 percent. *See* Daily Trans., 7019:11-16 (Stevenson Testimony). When total phosphorus concentrations increase, there is a dramatic increase in filamentous green algae. *See* Daily Trans., 7019:17-19 (Stevenson Testimony). Twenty percent filamentous green algae cover is considered to be a nuisance level. *See* Daily Trans., 7019:19-7020:12 (Stevenson Testimony);[43] *see also* Daily Trans., 9316:3-9318:21 (Connolly Testimony) (testifying that he has seen studies reporting that between 20 to 30 percent algae coverage is a nuisance).

---

[43] While Defendants' retained expert Mr. Chadwick opined that 20 percent algae cover would not be a nuisance aesthetically to him personally, he freely admitted that he has never given an opinion in this or any other matter concerning nuisance levels of filamentous green algae. *See* Daily Trans., 9980:19-22 (Chadwick Testimony). Moreover, at trial Mr. Chadwick contradicted his prior deposition testimony that one would not expect to find 20 percent filamentous green algae cover absent any anthropogenic effects. *See* Daily Trans., 9980:23-9982:21 (Chadwick Testimony).

124. The EPA recommends using filamentous green algae cover as an indicator of impaired use for a stream. *See* Daily Trans., 7033:25-7034:5 (Stevenson Testimony).

125. Filamentous green algae cover on IRW stream sites sampled in spring 2007 ranged from 0 to 91 percent. The median was 20 percent coverage -- the benchmark for a problem with aesthetics. *See* Daily Trans., 7038:6-25 (Stevenson Testimony). That is to say, half of the streams sampled had nuisance levels of algae. Furthermore, 25 percent of the IRW stream sites had greater than 50 percent filamentous green algae cover. *See* Daily Trans., 7039:22-7040:1 (Stevenson Testimony); *see also* State's Ex. 4466; State's Ex. 4467; State's Ex. 4469 (photographs depicting filamentous green algae cover on IRW streams).

126. Even using 30 percent coverage as the basis for a nuisance, some 35 percent of the stream sites sampled in the IRW had nuisance levels of algae. *See* Daily Trans., 9319:2-18 (Connolly Testimony).

127. There is a strong relationship between total phosphorus concentrations and algae biomass in those streams. *See* Daily Trans., 7062:6-15 (Stevenson Testimony). The total phosphorus threshold for dramatic benthic algae growth in IRW streams is at concentrations of 0.027 mg/L. *See* Daily Trans., 7070:4-7071:7 (Stevenson Testimony). At levels above this phosphorus threshold, benthic algae coverage jumped from approximately 4 percent to 36 percent. *See* Daily Trans., 7070:4-7071:7 (Stevenson Testimony); State's Ex. 4473.

128. In sum, Dr. Stevenson concluded that 83 percent of the third order rivers and streams of the IRW were injured for aesthetics due to having total phosphorus concentrations of 0.027 mg/L or higher. *See* Daily Trans., 7159:5-17 (Stevenson Testimony).

129. Because the laboratory that analyzed the chlorophyll samples analyzed them incorrectly, Dr. Stevenson was not able to reach conclusions regarding nuisance algae biomass in

the water columns of IRW rivers and streams. *See* Daily Trans., 7060:15-7061:1 (Stevenson Testimony).

130. The significant benthic algae coverage of IRW rivers and streams that was documented in Dr. Stevenson's investigation is confirmed by the testimony of other witnesses. For example, Mr. Hilsher testified that the rocks on the bottom of the Illinois River are covered with green and brown algae. *See* Daily Trans., 610:17-612:6 (Hilsher Testimony). Similarly, Mr. Fite testified that in April, May and the summer months -- as recently as 2006 -- he has observed algae, scum and unclear water on stream segments in the IRW that are in sub-basins that do not receive discharges from wastewater treatment plants (*e.g.*, Steeley Hollow, Peavine Hollow, Ballard Creek, Fagan Creek, Telemay Hollow and Oil Springs). *See* Daily Trans., 694:2-20 (Fite Testimony).

131. Significantly, neither of Defendants' retained experts, Mr. Chadwick and Dr. Connolly, did any field studies in the IRW concerning algae nor did any analysis as to whether benthic algae cover in the rivers and streams of the IRW has changed over time. *See* Daily Trans., 9980:7-14 (Chadwick Testimony);[44] Daily Trans., 9321:6-10 (Connolly Testimony).

132. The USGS has concluded that "[e]levated phosphorus concentrations promote algae growth in streams (Sharpley, 1995), ... Phosphorus levels in streams in the basin have

---

[44] Mr. James Chadwick holds a masters degree in fish and wildlife management from Montana State University. *See* Daily Trans., 9923:10-25 (Chadwick Testimony). He is a certified fishery scientist by the American Fisheries Society and a certified wildlife biologist. *See* Daily Trans., 9925:22-25 (Chadwick Testimony). He is certified in habitat evaluation procedure by the U.S. Fish and Wildlife, and has performed Incremental Flow Instream Modeling training. *See* Daily Trans., 9926:4-16 (Chadwick Testimony). He has published 25 articles in peer-reviewed journals and served as a peer reviewer. *See* Daily Trans., 9927:1-21 (Chadwick Testimony). Mr. Chadwick is a consultant at the aquatic ecological consulting company, which he founded in Denver in 1979 and which was acquired by GEI in 2006. *See* Daily Trans., 9924:1-7 (Chadwick Testimony). Mr. Chadwick testified as a retained expert for Defendants.

resulted in the growth of excess algae, which have degraded the aesthetic benefits of water bodies in the basin, especially the Illinois River . . . (Oklahoma Water Resources Board, 2002b)." *See* State's Ex. 5862 at p. 3 & p. 20.

b. Dissolved Oxygen Concentrations

133. Increases in phosphorus concentrations stimulate increases in algae biomass, and increases in algae biomass generate low dissolved oxygen conditions. *See* Daily Trans., 7091:8-13; 7087:6-19; 7090:17-18 (Stevenson Testimony).

134. At night, algae do not photosynthesize; rather they respire. *See* Daily Trans., 7021:3-5 (Stevenson Testimony). Thus, when there are large masses of algae in a stream, such algae will cause dramatic decreases in dissolved oxygen concentrations at night. *See* Daily Trans., 7020:23-7021:18; 7085:14-7086:10 (Stevenson Testimony). Low dissolved oxygen concentrations affect fish communities by stressing fish, thereby reducing their reproduction and even eliminating sensitive species from their habitats. *See* Daily Trans., 7086:11-19 (Stevenson Testimony). In severe cases low dissolved oxygen concentrations from excess algae can result in fish kills. *See* Daily Trans., 7086:20-7087:5 (Stevenson Testimony).

135. Oklahoma's water quality standards address dissolved oxygen levels. *See* FOF, ¶ 61.

136. The summer 2006 sampling results revealed that 30 out of 69 stream samples had dissolved oxygen levels of less than 5 mg/L. *See* Daily Trans., 7089:8-17 (Stevenson Testimony). Oklahoma's water quality standard for dissolved oxygen levels in cool-water streams is 6 mg/L. *See* FOF, ¶ 61.

137. Sampling data taken at a fish kill in April 2006 near Round Hollow on the Illinois River revealed large amounts of algae biomass and dissolved oxygen levels of between 1 mg/L

to 2.5 mg/L. *See* Daily Trans., 7092:2-7100:23 (Stevenson Testimony); State's Ex. 4451; Daily Trans., 694:23-696:19 (Fite Testimony) (testifying that "the river had just been through a series of days of overcast skies where there wasn't direct sunlight, we had an enormous amount of algae that was growing that time of the year, and the dissolved oxygen levels dropped to a point that there was a fish-kill"). Dr. Stevenson concluded that low dissolved oxygen was the likely cause of this fish kill. *See* Daily Trans., 7096:4-12 (Stevenson Testimony).

138. Additionally, the State's 2008 Integrated Report corroborates Dr. Stevenson's conclusion that low dissolved oxygen levels are impairing fish and wildlife propagation in cool water aquatic communities on the rivers and streams of the IRW in Oklahoma. *See* State's Ex. 6008 at Appendix C; Daily Trans., 3492:8-14; 3492:22-25; 3493:15-3496:12 & 3498:12-3500:8 (Strong Testimony).

c. pH

139. Increases in pH correlate with phosphorus concentrations because algae biomass increases with phosphorus concentrations. *See* Daily Trans., 7103:25-7104:5 (Stevenson Testimony).

140. When algae photosynthesize, they take carbon dioxide, which causes a shift in the carbonate equilibrium in the water, thereby alkalizing the water. *See* Daily Trans., 7102:1-7 (Stevenson Testimony). Background levels of pH in the streams of the IRW are 8 to 8.5. *See* Daily Trans., 7104:6-9 (Stevenson Testimony).

141. Oklahoma's water quality standards address pH. *See* Daily Trans., 7102:8-15.

142. Sampling data revealed that with increased algae biomass in IRW streams there was also an increase in high pH values. *See* Daily Trans., 7103:16-24; 7104:10-13 (Stevenson

Testimony) ("The frequency of pH values above 9 seems to be not natural and related to high algal biomass").

143. pH levels are one of the most important environmental variables affecting biodiversity in rivers and streams. *See* Daily Trans., 7101:4-12 (Stevenson Testimony). Changes in pH levels can adversely affect biota in rivers and streams. *See* Daily Trans., 7101:11-20 (Stevenson Testimony).

d. Aquatic Habitat

144. The natural condition of an IRW stream is bare rock. *See* Daily Trans., 7026:4-16 (Stevenson Testimony). Increases in filamentous green algae disrupt that physical habitat for any fish or invertebrate or other algae that lives among the rocks on the bottom of the stream. *See* Daily Trans., 7026:4-16 (Stevenson Testimony).

145. As discussed above, increased algae can also disrupt the aquatic habitat by causing changes in dissolved oxygen levels and pH. *See* FOF, ¶¶ 133-143.

146. Dr. Stevenson's investigation revealed that the fish communities of the IRW have been injured; specifically, there has been a 20 percent reduction in fish species diversity in the streams of the IRW and a 70 percent reduction of the number of individuals belonging to carnivorous species as compared to natural conditions. *See* Daily Trans., 7132:13-7134:1. (Stevenson Testimony).

147. Significant detrimental impacts on fish numbers and species diversity occur in waters such as those found in the IRW when total phosphorus concentrations reach or exceed 0.060 mg/L. *See* Daily Trans., 7139:7-18. (Stevenson Testimony). Using that phosphorus threshold criteria about half of the third order rivers and streams in the IRW have been injured by a reduction in fish biodiversity. *See* Daily Trans., 7159:11-17 (Stevenson Testimony).

148. Defendants proffered retained expert Mr. Chadwick to opine on the health of the fish communities in the rivers and streams of the IRW. The Court does not find the conclusions of Mr. Chadwick compelling.

149. First, the conclusions of Mr. Chadwick, regarding fish biodiversity in the rivers and streams of the IRW were hedged with significant qualifying language. *See, e.g.*, Daily Trans., 9959:12-9961:5 (Chadwick Testimony) ("The communities by and large, as a whole, yes, they are fairly healthy. . . . The -- by and large, the fish communities that I looked at, the majority of those are fairly diverse")(emphasis added).

150. Further undercutting the weight that the Court assigns the conclusions of Mr. Chadwick regarding the health of fish communities in the rivers and streams of the IRW is the fact that Mr. Chadwick analyzed Dr. Stevenson's fish data against the Oklahoma Index of Biological Integrity ("IBI") despite knowing that Dr. Stevenson's fish data had been collected by a fish sampling protocol different from that specified for use with the IBI and acknowledging that use of that different fish sampling protocol may have had an impact on the results of an evaluation using the IBI. *See* Daily Trans., 9964:24-9967:10; 9940:14-17 (Chadwick Testimony).

151. Yet further, Mr. Chadwick, despite having historical fish data, did no analysis to determine whether there had been any historical changes regarding fish biodiversity in the rivers and streams of the IRW. *See* Daily Trans., 9971:15-9972:14 (Chadwick Testimony).

e. Disinfection Byproducts

152. Disinfection byproducts (DBPs) are chemicals formed during the disinfection of drinking water when carbon in raw water comes into contact with the chlorination process. *See* Daily Trans., 6078:12-17 (Teaf Testimony). Various factors influence the amount of DBPs

created during the disinfection of drinking water, including the amount of organic carbon in the raw water, pH level, water temperature, and chlorine contact time. *See* Daily Trans., 6079:8-18; 6080:1-4 (Teaf Testimony).

153. DBPs are a human health concern because of their carcinogenic qualities, and also because of developmental and reproductive risks, such as embryotoxicity, that they present. *See* Daily Trans., 6085:3-20; 6100:9-6101:11 (Teaf Testimony); Daily Trans., 7462:20:22 (Cooke Testimony).

154. DBPs are currently regulated by the Stage 1 DBP Rule which sets the maximum contaminant level (MCL) at 80 micrograms per liter for trihalomethanes and 60 micrograms per liter for haloacetic acids. *See* Daily Trans., 11124:23-11125:12 (Gibb Testimony);[45] Daily Trans., 6083:8-9 (Teaf Testimony). The Stage 1 DBP Rule was determined by the EPA not to be sufficiently protective to human health. Daily Trans., 6083:10-12 (Teaf Testimony). Thus, the Stage 2 DBP Rule was promulgated by EPA in 2006. Daily Trans., 6083:12-13 (Teaf Testimony). The Stage 2 DBP Rule was adopted by the State of Oklahoma, and deadlines for compliance with the Stage 2 DBP Rule begin in 2012. *See* Daily Trans., 6083:6-15; 6097:21-25 (Teaf Testimony).

155. The Stage 2 DBP Rule includes a maximum contaminant level goal (MCLG) for DBPs, which is the health-based standard created by the EPA. *See* Daily Trans., 6092:11-21

---

[45] Dr. Herman Gibb received a Ph.D. in epidemiology from Johns Hopkins University. *See* Daily Trans., 11115:16-20 (Gibb Testimony). Dr. Gibb is the president of the health-risk assessment consulting firm Tetra Tech Sciences and a faculty member at the George Washington University School of Public Health. *See* Daily Trans., 11115:6-13, 11116:13-14 (Gibb Testimony). He worked at the EPA from 1974-2004, mostly at the National Center for Environmental Assessment developing risk assessment methodology, where he began as a staff epidemiologist, after which he became the assistant director for health, and the science adviser to the director of the National Center for Environmental Assessment. *See* Daily Trans., 11116:15-1117:6, 11118:2-15 (Gibb Testimony). Dr. Gibb testified as a retained expert for Defendants.

(Teaf Testimony). Unlike the MCL, which considers cost and technical feasibility, the MCLG takes only health considerations into account. *See* Daily Trans., 6092:11-21 (Teaf Testimony).

156. In addition to the MCLG, there exists a separate risk-based screening level criterion. *See* Daily Trans., 6092:23-6093:15 (Teaf Testimony). While the risk-based screening level criterion is not part of the Stage 2 DBP Rule, *see* Daily Trans., 6093:2-4 (Teaf Testimony), it is used by toxicologists as a starting point for evaluating potential health risk. *See* Daily Trans., 6093:5-15 (Teaf Testimony).

157. The State's retained expert Dr. Teaf evaluated the presence of DBPs in water treatment systems in the IRW. First, Dr. Teaf evaluated the total organic carbon loading found in the State's edge-of-field samples and found that total organic carbon levels were greater in the edge-of-field samples than in background samples. *See* Daily Trans., 6080:19-25 (Teaf Testimony). Dr. Teaf testified that the organic carbon in the water, whether it comes from algae or whether it comes from direct, dissolved and particulate organic carbon, can contribute to the formation of DBPs. *See* Daily Trans., 6081:15-19 (Teaf Testimony).

158. Second, Dr. Teaf evaluated data from ODEQ reporting the values of various DBPs in the treated water produced by the water treatment plants in the IRW (*i.e.*, tap water). *See* Daily Trans. 6086:18-6087:19; 6094:6 (Teaf Testimony); State's Ex. 5212. He found that a little over 90 percent of the ODEQ values exceeded the risk-based screening level criterion, that 55.5 percent of the ODEQ values exceeded the risk-based screening level criterion for the DBP bromodichloromethanes, that 92.5 percent of the ODEQ values exceeded the risk-based screening level criterion for the DBP dibromochloromethane, that 11.4 percent of the ODEQ values exceeded the Stage 2 Rule MCL for the DBP total trihalomethanes, and that 11.2 percent

of the ODEQ values exceeded the Stage 2 Rule MCL for the DBP haloacetic acids. *See* Daily Trans., 6093:22-6096:15; 6097:16-6099:9 (Teaf Testimony).

159. Third, Dr. Teaf evaluated DBP data gathered by CDM from tap water distribution points in water systems in the IRW. *See* Daily Trans., 6101:12-6102:16 (Teaf Testimony). Dr. Teaf testified that there were numerous exceedences of the risk-based screening level criterion or MCLG for various DBPs in the treated water he evaluated. *See* Daily Trans., 6109:8-6111:17 (Teaf Testimony); State's Ex. 5213.

160. From his DBP investigation in the IRW, Dr. Teaf testified "the breadth both in time and in space of the detected concentrations, the magnitude of those concentrations, and the significance of the substances renders this to be a significant health issue that needs to be addressed." *See* Daily Trans., 6117:5-20 (Teaf Testimony).

161. Defendants' retained expert Dr. McGuire[46] criticized Dr. Teaf's analysis of DBPs, arguing that Dr. Teaf attempted to categorize individual exceedences of MCLGs and MCLs as violations of statutory standards that are determined by running annual averages rather than single samples. *See* Daily Trans., 11026:12-11029:11 (McGuire Testimony). However, as Dr. McGuire later conceded, Dr. Teaf made it clear that he was looking at single sample

[46] Dr. Michael J. McGuire received a Ph.D. in environmental engineering from Drexel University. *See* Daily Trans., 10987:6-13-18 (McGuire Testimony). Dr. McGuire has worked as an engineer for the Philadelphia Water Department and with the U.S.G.S. sampling watersheds and investigating urbanization of streams, as well as with Brown and Caldwell Consulting Engineers in California on wastewater, industrial waste cleanup and surveys. *See* Daily Trans., 10988:7-10989:21 (McGuire Testimony). He also was a project engineer/water quality engineer for the Metropolitan Water District of Southern California, where he headed the water quality laboratory. *See* Daily Trans., 10990:14-10991:13 (McGuire Testimony). Dr. McGuire is president of Michael J. McGuire, Inc. which provides consulting services to water utilities on water quality and treatment issues. *See* Daily Trans., 10987:6-11 (McGuire Testimony). Dr. McGuire testified as a retained expert for Defendants.

exceedences, not quarterly averages. *See* Daily Trans., 11029:5-7 (McGuire Testimony); State's Ex. 5212.

162. Dr. McGuire also acknowledged that one third of the 18 IRW water treatment plants experienced violations of the DBP MCL, and that 9 to 10 percent of the samples from the IRW water treatment plants were in violation of the regulatory standards that use annual running averages. *See* Daily Trans., 11031:3-5; 11076:10-16; 11077:8-12 (McGuire Testimony).

163. Dr. McGuire also opined that the manner in which some of the water treatment plants treat their water is causing elevated levels of DBPs in the IRW, rather than quality of the raw water. *See* Daily Trans., 11042:1-11 (McGuire Testimony). Additionally, Dr. McGuire opined that it is not possible to identify sources of total organic carbon (TOC) in the water treated by water treatment plants. *See* Daily Trans., 11060:4-16 (McGuire Testimony). However, Dr. McGuire admitted that he has never previously conducted research into identifying sources of organic carbon in raw water supplies, *see* Daily Trans., 11072:2-11073:13 (McGuire Testimony), and acknowledged that animal manure is a potential contributor to algae and organic matter to water. *See* Daily Trans., 11084:1-17; 11084:22-11085:1 (McGuire Testimony); DJX 6042.

164. Defendants' retained expert Dr. Gibb attempted to critique Dr. Teaf's opinions regarding DBPs in the IRW on the ground that because some of the risk-based limits are based on animal tests, they do not demonstrate human health risks. *See* Daily Trans., 11140:17-11141:8 (Gibb Testimony). Dr. Gibb, however, later testified that he does not disagree with the EPA's methodologies for determining MCLs, but rather maintained that the EPA's MCLs and MCLGs for DBPs are so low that even if one were exposed to levels twice the MCL, there would not be any risk to human health. *See* Daily Trans., 11163:4-20 (Gibb Testimony). Further, Dr.

Gibb compared the DBP levels in the IRW to DBP levels in other parts of Oklahoma and concluded that there are no more DBP violations in the IRW than in other parts of the State. *See* Daily Trans., 11143:4-22 (Gibb Testimony). Dr. Gibb's testimony essentially boils down to an opinion that if there is any human health risk posed by DBPs, it is minimal, and that because the DBP problem is present in other locations outside the IRW, it should be ignored within the IRW.

165. The Court finds that the increases in the amounts of algae and organic carbon in the waters of the IRW are contributing to the production of DBPs in some IRW water treatment facilities. The DBP data for IRW water treatment facilities and supplies reveal a significant number of exceedences of risk-based screening level criteria, as well as MCLGs, thereby reflecting increased risks to human health.

f. Personal Observation

166. Mr. Fite -- who both sides agree is one of the most knowledgeable persons about the rivers and streams of the IRW, *see* Daily Trans., 260:17-18 (Elrod Admission); Daily Trans., 619:8 (Hilsher Testimony); Daily Trans., 4374:7-10 (Caneday Testimony) -- disagrees that there have been improvements in the condition of the Illinois River or the Baron Fork. *See* Daily Trans., 785:1-786:7 (Fite Testimony).

3. Summary of Findings Regarding the Rivers and Streams of the IRW[47]

167. Based on the foregoing, the Court finds that the rivers and streams of the IRW have elevated phosphorus concentration levels above natural or background levels.

168. Based upon the foregoing factual findings, the Court finds that these elevated phosphorus concentration levels have resulted in significant increases in the algae biomass in the rivers and streams of the IRW.

---

[47] Summaries of findings are not intended to displace, and should not be construed as displacing, findings made in the body of a subsection.

169. Based upon the foregoing factual findings, the Court finds that these increases in algae biomass have impacted the aesthetics of the rivers and streams of the IRW.

170. Based upon the foregoing factual findings, the Court finds that these increases in algae biomass have resulted in lowered dissolved oxygen concentrations, higher pH and other adverse effects on the aquatic habitat of the rivers and streams of the IRW, and that these adverse effects have injured fish communities in these rivers and streams.

171. Based on the foregoing factual findings, the Court finds that phosphorus concentrations in excess of natural or background levels have caused degradation of water quality in the rivers and streams of the IRW in Oklahoma in violation of Oklahoma's antidegradation standards in Okla. Admin. Code § 785:45-3-2(a) and that the aesthetics beneficial use is impaired by total phosphorus in violation of the total phosphorus criterion for scenic rivers established in section Okla. Admin. Code § 785:45-5-19(c)(2) of Oklahoma's Water Quality Standards.

172. Based on the foregoing factual findings, the Court finds that phosphorus concentrations in excess of background or natural levels have caused excessive growth of periphyton, phytoplankton, or aquatic macrophyte communities in the rivers and streams of the IRW which impairs the aesthetics, fish and wildlife and public water supply beneficial uses in violation of Okla. Admin. Code, § 785:45-5-9(d).

173. Based on the foregoing factual findings, the Court finds that as a result of phosphorus concentrations in excess of natural or background levels in the rivers and streams of the IRW in Oklahoma, these rivers and streams contain floating materials and suspended substances that produce objectionable color and materials that settle to form objectionable deposits in violation of Sections 785:45-5-19(a) & (b) of Oklahoma's Water Quality Standards.

174. Based upon the foregoing factual findings, the Court finds that increases in the amounts of algae and organic carbon in the waters and streams of the IRW have resulted in the creation of DBPs in the IRW's public water treatment facilities and supplies, and that this is presenting an increased risk to human health.

B. Lake Tenkiller

1. Trophic State

175. Eutrophication is the addition of nutrients, organic matter and silt to lakes and reservoirs at a rate that will increase biological production and sometimes even lead to a decrease in volume of the system. *See* Daily Trans., 7347:24-7348:3 (Cooke Testimony). "Production" or "productivity" means the rate at which algae biomass is produced in a lake or reservoir. *See* Daily Trans., 7350:6-11 (Cooke Testimony). Viewed another way, eutrophication of a reservoir is a change in the kinds and amounts of algae present. *See* Daily Trans., 7393:9-13 (Cooke Testimony).

176. Trophic state is an estimation of the degree of biological production of the lake or reservoir. *See* Daily Trans., 7348:7-9 (Cooke Testimony). There are three trophic states: oligotrophic, mesotrophic and eutrophic. *See* Daily Trans., 7348:20-21 (Cooke Testimony). There are no distinct breaks between these trophic states; rather it is a continuum. *See* Daily Trans., 7348:21-25 (Cooke Testimony).

177. An oligotrophic reservoir is defined as one having "[l]ow primary productivity and / or low nutrient levels." *See* State's Ex. 0578 at p. 18. More specifically, an oligotrophic reservoir has very low phosphorus concentrations, including very low phosphorus concentrations in the inflows to the reservoir. The water is clear with high transparency. There is an absence of scum-forming or bloom-forming blue-green algae or cyanobacteria. The productivity of algae is

very low. Total organic carbon is low. There is lots of dissolved oxygen in the water column from surface to bottom. And the sediments are nutrient poor, and there is little or no sediment phosphorus release. *See* Daily Trans., 7349:3-25 (Cooke Testimony).

178. A mesotrophic reservoir is a reservoir that has more productivity in it than an oligotrophic reservoir, and is defined as one having "[m]oderate primary productivity with moderate nutrient levels." *See* Daily Trans., 7350:1-5 (Cooke Testimony); State's Ex. 0578 at p. 18. Mesotrophy is a transition from oligotrophy to eutrophy. *See* Daily Trans., 7350:15 (Cooke Testimony).

179. A eutrophic reservoir is defined as one having "[h]igh primary productivity and [being] nutrient rich." State's Ex. 0578 at p. 18. The water is not clear, and the transparency is very low. There is abundant blue-green algae or cyanobacteria. It will have very high amounts of algae. It will have no dissolved oxygen in the bottom waters, and possibly no dissolved oxygen even in middle zone waters. The rate at which oxygen is consumed by bacteria in the reservoir -- that is, the aerial hypolimnetic oxygen deficit (AHOD) -- is very high. The sediments are greatly enriched with phosphorus. And there will be low populations of cool water game fish, while warm-water game fish may be abundant. *See* Daily Trans., 7350:16-7351:24 (Cooke Testimony).

180. There is a distinction between natural eutrophication and cultural eutrophication. *See* Daily Trans., 7352:5-8 (Cooke Testimony). The rate of natural eutrophication is measured in centuries and possibly millennia. *See* Daily Trans., 7352:9-21 (Cooke Testimony). In contrast, cultural eutrophication can be measured in decades. *See* Daily Trans., 7352:20-7353:5 (Cooke Testimony). Cultural eutrophication requires that nutrient materials flow into a reservoir at very high rates. *See* Daily Trans., 7353:5-8; 7351:24-7352:4 (Cooke Testimony). As

explained by Dr. Cooke, "[i]t's like making the engine run in your car; you've got to put fuel in it, and you've got to have a spark to make that engine run. In a reservoir, that fuel is phosphorus and the spark is sunshine." *See* Daily Trans., 7353:9-13 (Cooke Testimony).

181. Reservoirs differ from lakes in that they have a one-way flow of water through them. *See* Daily Trans., 7353:19-7354:22 (Cooke Testimony). Reservoirs, such as Lake Tenkiller, have different zones that are characterized by their proximity to the river inflow, the flow velocity, size and shape: a riverine zone, a transition zone, and a lacustrine zone. *See* Daily Trans., 7353:19-7359:10 (Cooke Testimony).

182. The initial zone of a reservoir -- the riverine zone -- is dominated by the river flow and contains nutrients, silt and organic matter from the river. *See* Daily Trans., 7354:15 & 7354:23-7355:3 (Cooke Testimony). If the river entering the reservoir is nutrient rich, there will be a lot of algae produced in the riverine portion of a reservoir. *See* Daily Trans., 7355:3-4 (Cooke Testimony).

183. As the flowing water reaches the wider portion of the reservoir -- the transition zone -- the velocity of the water slows down and nutrients, silt and organic matter, as well as algae produced in the riverine zone, begin to drop down and sediment out. *See* Daily Trans., 7355:5-14 (Cooke Testimony); Daily Trans., 7741:11-15 (Welch Testimony). Additionally, the cooler and denser riverine river water will plunge to a depth equal to its density, which is generally in the middle zone of the reservoir. *See* Daily Trans., 7355:15-7354:6 (Cooke Testimony). This area is called the plunge point. *See* Daily Trans., 7355:15-7356:6 (Cooke Testimony). The plunging nutrients, silt, organic matter and algae in this water are food for bacteria that live in the middle to bottom waters of the reservoir. *See* Daily Trans., 7357:5-13 (Cooke Testimony). Bacteria respiration in the deeper reservoir waters causes dissolved oxygen

levels in these waters to become low because no new oxygen is being added by algal photosynthesis. *See* Daily Trans., 7357:18-7358:9 (Cooke Testimony); Daily Trans., 7753:20-24 (Welch Testimony).

184. Finally, there is the lacustrine zone of the reservoir -- that part of the reservoir nearest the dam and having the deepest waters. At this point, most organic and nutrient materials have sedimented out, and the phosphorus levels are low in comparison to the riverine and transition zones. Thus, there is less algae being produced in this part of the reservoir, and the water is clearer. *See* Daily Trans., 7358:22-7359:5 (Cooke Testimony).

185. These general reservoir descriptions and processes occur in Lake Tenkiller. *See* Daily Trans., 7358:10-14; 7354:9-14 (Cooke Testimony).

186. Down the length of a reservoir like Lake Tenkiller, there is a gradient of conditions; but it is still one reservoir. *See* Daily Trans., 7359:6-10 (Cooke Testimony). Significantly, there is not one area or zone in particular that is used to judge the trophic state of a reservoir. *See* Daily Trans., 7359:11-16 (Cooke Testimony). In order to evaluate properly the trophic state of a reservoir, one must sample down the length of the reservoir and from the surface to the bottom of the reservoir. *See* Daily Trans., 7360:17-21 (Cooke Testimony). Additionally, trophic state analysis of a reservoir should be done from late spring to early fall. *See* Daily Trans., 7370:5-24 (Cooke Testimony).

187. Various factors are considered when determining the trophic condition of a lake or a reservoir. As explained in the 2004 BUMP Report, "[s]ome of the commonly used water quality parameters utilized in trophic state indices include chlorophyll-a, secchi disc depth, total phosphorus, total nitrogen, aquatic macrophytes, organic nitrogen, turbidity, lake user surveys, and hypolimnetic oxygen depletion rates, etc." State's Ex. 0578 at p. 17.

188. In connection with their analysis of the trophic state of Lake Tenkiller, the State's experts undertook a sampling program at Lake Tenkiller to supplement the extant data. *See* Daily Trans., 7366:15-7373:24 (Cooke Testimony); State's Ex. 0705. The sampling stations in this program were set up to sample all the zones of Lake Tenkiller and to match as closely as possible previous sampling by the United States Army Corps of Engineers, the OWRB and the EPA. *See* Daily Trans., 7369:5-20 (Cooke Testimony). The sampling program was carried out from late-May to mid-September in 2005, 2006 and 2007. *See* Daily Trans., 7370:5-7371:8 (Cooke Testimony).

189. A sampling program was also undertaken by the State's experts at Broken Bow Reservoir. *See* Daily Trans., 7373:19-24; 7425:12-7427:3 (Cooke Testimony); State's Ex. 0717. Broken Bow Reservoir was chosen by the State's experts as the reference reservoir for comparison with Lake Tenkiller because Broken Bow Reservoir is in the same ecoregion as Lake Tenkiller, meaning its soils, vegetation, physiography, rainfall, and morphology were very similar to those influencing Lake Tenkiller, *see* Daily Trans., 7421:6-7424:11 (Cooke Testimony), and, like Lake Tenkiller, phosphorus is the limiting nutrient in Broken Bow Reservoir. *See* Daily Trans., 7381:25-7382:13 (Cooke Testimony). Additionally, it was chosen because there already existed a body of data on Broken Bow Reservoir from its riverine zone to its dam, as well as a body of fish data. *See* Daily Trans., 7421:17-7424:11 (Cooke Testimony).

190. The key differences between Lake Tenkiller and Broken Bow Reservoir are (1) the land uses in their respective watersheds -- the IRW is approximately 45 percent forest and 45 percent pasture with a significant number of poultry houses in it, while Broken Bow Reservoir's watershed is approximately 80 percent forest with comparatively fewer poultry houses in it, and

(2) the "tremendous" difference in the phosphorus concentrations flowing into the respective reservoirs. *See* Daily Trans., 7424:12-7425:11 (Cooke Testimony).

a. Phosphorus

191. The phosphorus concentrations in Lake Tenkiller are determined by the flow weighted concentrations of phosphorus entering the Lake from the Illinois River less what is deposited in its sediments. *See* Daily Trans., 7736:8-7737:2 (Welch Testimony). On an annual basis the volume weighted phosphorus concentration entering Lake Tenkiller is 0.227 mg/L. *See* Daily Trans., 7737:7-8; 7745:23-7746:4 (Welch Testimony). For Lake Tenkiller, this equates to a phosphorus loading of 5.1 grams per square meter of lake surface per year. *See* Daily Trans., 7739:2-14; 7746:5-10 (Welch Testimony).

192. Additionally, some of the phosphorus that is deposited in Lake Tenkiller's sediments recycles back into the water column from the sediments -- a process called sediment phosphorus release or sediment flux. *See* Daily Trans., 7742:19-7745:2; 7744:9-24; 7748:23-7751:22 (Welch Testimony); State's Ex. 0724. This internal phosphorus loading from sediments can also affect the water quality. *See* Daily Trans., 7752:3-5 (Welch Testimony). Dr. Welch's investigation revealed that this internal loading averages approximately 3.0 $mg/m^2/day$ and that that is "a very high rate." *See* Daily Trans., 7751:20-21 (Welch Testimony).

193. The natural or background phosphorus inflow concentrations for a waterbody such as Lake Tenkiller should be approximately 0.020 mg/L. *See* Daily Trans., 7748:7-15 (Welch Testimony). Currently at 0.227 mg/L, the phosphorus inflow concentrations for Lake Tenkiller are roughly ten times that amount. *See* Daily Trans., 7748:7-17 (Welch Testimony). The phosphorous loadings to Lake Tenkiller are higher than all but two of thirty-nine North American lakes investigated by Dr. Welch. *See* Daily Trans., 7748:3-6 (Welch Testimony).

194. Phosphorus has an effect on the trophic state of a reservoir because phosphorus controls the amount of algae production in a reservoir. *See* Daily Trans., 7374:1-7375:21 (Cooke Testimony); Daily Trans., 7733:15-16 (Welch Testimony) ("there's [sic] few limnologists that won't agree that phosphorus is the key to eutrophication").

195. Phosphorus is the limiting nutrient in Lake Tenkiller, and thus controls the amount of algae production in Lake Tenkiller. *See* Daily Trans., 7375:22-7376:19; 7377:1-7382:13 (Cooke Testimony); State's Ex. 0745.

196. Limnologists have agreed that a reservoir transitions from oligotrophic to mesotrophic at phosphorus concentration levels of about 0.010 mg/L, transitions from mesotrophic to eutrophic at phosphorus concentration levels of about 0.030 mg/L, and transitions from eutrophic to hypereutrophic at phosphorus concentrations of about 0.100 mg/L. *See* Daily Trans., 7386:15-7387:5 (Cooke Testimony); State's Ex. 0747.

197. Phosphorus concentrations in a reservoir are affected by water residence times. *See* Daily Trans., 7388:5-6 (Cooke Testimony) ("[r]esidence time is the key to understanding phosphorus concentration"). "Residence time" is simply how long it takes a drop of water to flow out of a reservoir from the time it enters the reservoir. *See* Daily Trans., 7387:11-20 (Cooke Testimony). Residence times in various zones of a reservoir can vary based upon reservoir inflows. *See* Daily Trans., 7390:9-7393:3 (Cooke Testimony).

198. On the basis of the phosphorus concentration data, Dr. Cooke concluded that Lake Tenkiller is eutrophic. *See* Daily Trans., 7392:1-7393:3 (Cooke Testimony); State's Ex. 0747. In contrast, on the basis of the phosphorus concentration data, Dr. Cooke concluded that the reference reservoir, Broken Bow Reservoir, is on the borderline between oligotrophic and

mesotrophic except for 1997. *See* Daily Trans., 7429:25-7430:5 (Cooke Testimony); State's Ex. 0714.

199. The average spring-summer inflow phosphorus concentration for Lake Tenkiller was 0.166 mg/L, while the spring-summer inflow phosphorus concentration for Broken Bow Reservoir was 0.027 mg/L. *See* Daily Trans., 7431:3-10 (Cooke Testimony). This explains why Lake Tenkiller is eutrophic, while Broken Bow Reservoir is oligotrophic. *See* Daily Trans., 7431:3-10 (Cooke Testimony).[48]

b. Blue-Green Algae

200. When a reservoir is becoming eutrophic, blue-green algae becomes very abundant, and scum formation or bloom formation becomes more common. *See* Daily Trans., 7394:19-7395:14 (Cooke Testimony).

201. The Lake Tenkiller sampling data revealed that blue-green algae was the dominant type of algae in the reservoir at every sampling station. *See* Daily Trans., 7398:12-7403:1 (Cooke Testimony). The dominant form of blue-green algae in Lake Tenkiller for 2005, 2006 and 2007 was a species in the genus *Cylindrospermopsis*. *See* Daily Trans., 7474:14-7475:3 (Cooke Testimony).

202. The abundance of blue-green algae in Lake Tenkiller is directly related to phosphorus concentrations. *See* Daily Trans., 7476:2-5 (Cooke Testimony). An abundance of

---

[48] During cross examination, counsel for Defendants suggested that Dr. Cooke excluded certain historical data from his analysis because it showed that total phosphorus in Lake Tenkiller had declined since 1986. *See* Daily Trans., 7558:13-25, 7566:7-18 (Cooke Testimony). However, as Dr. Cooke explained, he excluded those data because they were developed by a method -- the "HACH" method -- which Dr. Cooke considered to be flawed. *See* Daily Trans., 7700:22-7701:8 (Cooke Testimony). Indeed, Dr. Cooke excluded phosphorus data from 2001 – 2004 on the same basis which showed "a tremendous amount of phosphorus in these years". *See* Daily Trans., 7702:1-11 (Cooke Testimony).

blue-green algae is also a characteristic of a eutrophic lake. *See* Daily Trans., 7350:18-7351:6 (Cooke Testimony).

203. Based on the fact that blue-green algae is the dominant form of algae, Dr. Cooke concluded that Lake Tenkiller is eutrophic. *See* Daily Trans., 7403:8-17 (Cooke Testimony) ("these phytoplankton data clearly support that conclusion that Tenkiller was, from the 1990s on, and through today, eutrophic"); *see also* Daily Trans., 7420:1-7 (Cooke Testimony). In contrast, Dr. Cooke's evaluation of the types of algae in Broken Bow Reservoir revealed that while there is some blue-green algae, they are tiny, nonscum-forming or bloom-forming algae -- that is, not the type of blue-green algae one would find in a eutrophic system. *See* Daily Trans., 7434:3-17 (Cooke Testimony). From this, Dr. Cooke concluded that the reference reservoir is oligotrophic based upon algae types. *See* Daily Trans., 7434:17-22 (Cooke Testimony).

c. Chlorophyll

204. Chlorophyll is a very good direct measure of the biomass of algae. *See* Daily Trans., 7405:11-15 (Cooke Testimony). It is well-accepted in the scientific community that a reservoir transitions from oligotrophic to mesotrophic at chlorophyll a levels of about 0.0035 mg/L, transitions from mesotrophic to eutrophic at chlorophyll levels of about 0.009 mg/L, and transitions from eutrophic to hypereutrophic at chlorophyll levels of about 0.025 mg/L. *See* Daily Trans., 7408:10-21 (Cooke Testimony); State's Ex. 0754.

205. Based upon the chlorophyll levels found in the Lake Tenkiller sampling data, Dr. Cooke concluded that "presently, and since 1986, [Lake Tenkiller] is eutrophic." *See* Daily Trans., 7410:12-17; 7420:1-7 (Cooke Testimony); State's Ex. 0754. In contrast, based upon the chlorophyll data for Broken Bow Reservoir, Dr. Cooke concluded that this reference reservoir is

oligotrophic to borderline mesotrophic. *See* Daily Trans., 7431:22-7433:16 (Cooke Testimony); State's Ex. 715.

d. Transparency

206. As noted above, transparency is another metric that may be used in determining the trophic state of a reservoir. Transparency is determined by use of a device called a Secchi disk -- a metal disk, 20 centimeters in diameter and divided into four quadrants alternating black and white that is lowered into water until it just barely appears. *See* Daily Trans., 7412:13-7413:7 (Cooke Testimony).

207. Between 1986 and 2007, the data reflects about a 30 percent decrease in the transparency of the water of Lake Tenkiller. *See* Daily Trans., 7419:19-25; State's Ex. 756. Based upon the transparency data, Dr. Cooke concluded that Lake Tenkiller is eutrophic. *See* Daily Trans., 7420:1-7 (Cooke Testimony). In contrast, based on the transparency data for Broken Bow Reservoir, Dr. Cooke concluded that the reference reservoir was and is, with the exception of 1997, mesotrophic. *See* Daily Trans., 7434:23-7438:1 (Cooke Testimony); State's Ex. 0716.

e. AHOD

208. As noted above, hypolimnetic oxygen depletion rates are another way to measure the trophic state of a water body. The aerial hypolimnetic oxygen deficit (AHOD) rate is an indicator of the oxygen removal rate in a reservoir as a whole. *See* Daily Trans., 7788:13-7789:1 (Welch Testimony). AHOD is measured in milligrams per square meter per day. *See* Daily Trans., 7789:1-6 (Welch Testimony). There are scientifically-agreed-upon levels of AHOD between trophic states. *See* Daily Trans., 7789:7-17 (Welch Testimony). The boundary level

between eutrophic state and hypereutrophic state for AHOD in lakes is 550 mg/m^2/day. *See* Daily Trans., 7792:1-7 (Welch Testimony); State's Ex. 0726.

209. The average AHOD in Lake Tenkiller was about 1300 mg/m^2/day. *See* Daily Trans., 7793:3-9 (Welch Testimony); State's Ex. 0726. Based upon this data, Dr. Welch concluded that Lake Tenkiller is hypereutrophic. *See* Daily Trans., 7796:19-21 (Welch Testimony). Dr. Welch found that Lake Tenkiller's AHOD rate was higher than all 39 North America reservoirs he evaluated. *See* Daily Trans., 7796:1-6 (Welch Testimony).

f. Dissolved Oxygen

210. A lack of dissolved oxygen in lake waters is also evidence of eutrophication. *See* Daily Trans., 7350:16-25 (Cooke Testimony). Lake Tenkiller has less dissolved oxygen than Broken Bow Reservoir. *See* Daily Trans., 7784:8-12 (Welch Testimony).

g. Drs. Cooke's and Welch's Conclusions

211. Based upon the data discussed above and his analysis of it, Dr. Cooke concluded: "Tenkiller has become eutrophic. It wasn't always eutrophic. The algae data tell us very strongly that Tenkiller, in 1974, was -- in 1960 even was oligotrophic. And the same in 1974 and 1975. But by 1986, no question, Tenkiller is eutrophic, and has remained so." *See* Daily Trans., 7420:7-12 (Cooke Testimony). Strong confidence in this conclusion is justified inasmuch as there are six years of phosphorus data for Lake Tenkiller, nine years of algae data for Lake Tenkiller, ten years of chlorophyll data for Lake Tenkiller, and ten years of transparency data for Lake Tenkiller. *See* Daily Trans., 7420:13-7421:1 (Cooke Testimony) (testifying the data for Lake Tenkiller "represents possibly the largest dataset for evaluation of trophic state in North America. There may be some as good, but few, if any, better than this one.").

212. Based upon this data and their analysis of it, Dr. Cooke further concluded that Lake Tenkiller's eutrophic state is being caused by the increasing phosphorus concentrations in the reservoir. *See* Daily Trans., 7382:14-19 (Cooke Testimony); *see also* Daily Trans., 7732:20-7733:4 (Welch Testimony)

h. Government Studies

213. Drs. Cooke and Welch are not alone in their conclusion that Lake Tenkiller is eutrophic. The June 1996 "Clean Lakes" study of Lake Tenkiller conducted by the OWRB, the United States Army Corps of Engineers and Oklahoma State University concluded that "[t]he present trophic status of Lake Tenkiller is classified as eutrophic." *See* State's Ex. 3285 at p. 80. The Clean Lakes study based its classification "upon excessive levels of nitrogen and phosphorus concentrations in the lake, nitrogen and phosphorus loads impinging the lake, and resultant increased algal standing crop and hypolimnetic oxygen depletion." *See* State's Ex. 3285 at p. 80; *see also* State's Ex. 3285 at p. iv.

214. Further, the 2007 BUMP Lakes Report concluded that "[i]n summary, Tenkiller Ferry Lake was classified as eutrophic, indicative of high primary productivity and nutrient levels (Plate 113)." *See* State's Ex. 5593A, p. 540.

i. Defendants' Response

215. Defendants do not seriously contest that Lake Tenkiller is eutrophic. Rather, Defendants undertake to isolate certain zones of Lake Tenkiller and point out that they have differing trophic conditions. *See* Daily Trans., 9122:16-9123:1 (Connolly Testimony). As noted above, however, the trophic state of a reservoir is determined by evaluating the entirety of the reservoir. *See* Daily Trans., 7359:14-18 (Cooke Testimony) ("Long ago, that was discarded as an idea in limnology. Nobody uses that anymore. There is no representative zone. Unlike lakes,

where it's possible you might find a representative zone, not in a reservoir, because there's such a gradient."). There is simply no valid basis to credit Defendants' flawed analytical approach, which would ignore -- and thereby "write off" -- large portions of Lake Tenkiller that have, thus far, suffered the most from pollution. In any event, even under Defendants' flawed analytical approach some portions of Lake Tenkiller are eutrophic. Daily Trans., 9418:10-9419:17 (Connolly Testimony).

216. Defendants also posit that the trophic state of Lake Tenkiller is not unusual for lakes in Oklahoma. *See* Daily Trans., 9122:18-22 (Connolly Testimony). However, that fact is of no consequence without taking into account the fact that Lake Tenkiller is in a different ecoregion than many of these other lakes -- a fact not considered or analyzed by Defendants. *See* Daily Trans., 9423:3-9424:10 (Connolly Testimony).

2. Consequences of the Phosphorus-Induced Eutrophic State of Lake Tenkiller

a. Aesthetics

217. As a consequence of its change in trophic state, there have been aesthetic changes in Lake Tenkiller. *See* Daily Trans., 7445:15-22 (Cooke Testimony).

--. The water in Lake Tenkiller is green, and there is a lot of algae in it. *See* Daily Trans., 7445:23-7446:3 (Cooke Testimony); Daily Trans., 979:10-12 (Phillips Testimony) (the color of the water in Lake Tenkiller "varies depending on where you are in the lake, but it ranges from a brown to a deep green").

218. There are blue-green algae blooms in Lake Tenkiller, creating a scum on the surface of the water. *See* Daily Trans., 7446:22-7449:20 (Cooke Testimony); State's Ex. 743; Daily Trans., 4362:11-4363:10 (Caneday Testimony) (testifying as to various studies in which

the public has commented on algae blooms in Lake Tenkiller that have restricted certain parts of the Lake for use during the summer).

219. The water in Lake Tenkiller has low transparency. *See* Daily Trans., 7446:8-16 (Cooke Testimony). At least two zones of Lake Tenkiller have transparency of a meter or less every summer, while the other has a transparency of 2 meters or less. *See* Daily Trans., 7446:8-16 (Cooke Testimony) (testifying that "[t]hat's pretty cloudy water").

220. Dr. Caneday, for example, testified that decreases in the transparency of Lake Tenkiller "has definitely changed the recreational use of the lake." *See* Daily Trans., 4363:22-4364:25 (Caneday Testimony). Dr. Caneday testified that in the late 1980s, students in the Oklahoma State University scuba classes used that area of Lake Tenkiller near the dam for check dives, but that "[w]e had gotten to the place by 1991 that we were down to less than an arm's length of visibility in Lake Tenkiller. And by 1993, we stopped taking groups to Lake Tenkiller." *See* Daily Trans., 4363:22-4364:25 (Caneday Testimony). Dr. Caneday further testified that there used to be a "a number of" scuba outfitters near Lake Tenkiller, but it is now down to just one licensed operator. *See* Daily Trans., 4365:5-18 (Caneday Testimony) (scuba diving in Lake Tenkiller has "really dropped off dramatically").

221. Ms. Phillips, likewise, testified that "the lake, [when I was a child,] you could see your feet when you [were] swimming in the lake. Not just, you know, a two-year-old's, but my parents could see their feet. . . . [Now] you can't see past your knees when you swim in the lake." *See* Daily Trans., 978:21-979:9 (Phillips Testimony).

222. The State's 2008 Integrated Report corroborates Dr. Cooke's, Dr. Welch's and Dr. Stevenson's conclusion, as well as these other witnesses' testimony, that phosphorus is impairing the aesthetics of Lake Tenkiller. *See* State's Ex. 6008 at Appendix C; Daily Trans., 3492:8-14 &

3492:22-25 (Strong Testimony). The 2008 Integrated Report lists total phosphorus as causing aesthetic impairment to an 8,440.00 acre segment of Lake Tenkiller having the segment code OK121700020020_00. *See* State's Ex. 6008 at C-15; Daily Trans., 3493:15-3496:12 & 3498:12-3500:8 (Strong Testimony).

223. Similarly, the USGS has concluded that "[p]hosphorus levels in streams in the basin have resulted in the growth of excess algae, which have degraded the aesthetic benefits of water bodies in the basin, especially . . . Lake Tenkiller (Oklahoma Water Resources Board, 2002b)." *See* State's Ex. 5862 at p. 3 & p. 20.

b. Aquatic Habitat

224. Eutrophication, when coupled with lake dynamics, affects dissolved oxygen levels in a reservoir. *See* Daily Trans., 7753:17-24 (Welch Testimony). Dissolved oxygen levels, in turn, have an effect on aquatic life. *See* Daily Trans., 7763:25-7764:2 (Welch Testimony).

225. Over the course of the year, the water column in a reservoir naturally stratifies by temperature as the weather warms, with the warmer water above and the denser cooler water below. In the winter, the Lake is isothermal -- that is, the water is the same temperature and same density from top to bottom. *See* Daily Trans., 6701:23-25 (Wells Testimony). In the spring, the surface temperature of the water starts to heat up due to solar heating and that warmer water stays on the surface of the Lake, creating an upper layer in the Lake called the epilimnion. *See* Daily Trans., 6701:25-6702:5 (Wells Testimony). In the fall, the surface temperature of the water cools and the epilimnion increases in size until gradually there occurs a process of "lake overturn" in October or November, at which time the Lake destratifies completely and becomes

isothermal again. *See* Daily Trans., 6702:6-12 (Wells Testimony); Daily Trans., 7364:1-6 (Cooke Testimony).

226. Dissolved oxygen levels in Lake Tenkiller are driven by multiple factors, including rearation -- that, is, the exchange between the atmosphere and the surface water. *See* Daily Trans., 6708:10-20 (Wells Testimony). Because of stratification, the lower portions of the water column that are not exposed to the atmosphere do not get rearated. *See* Daily Trans., 6708:10-20 (Wells Testimony); Daily Trans., 7364:7-7365:14 (Cooke Testimony).

227. Algae production, however, is the major factor determining dissolved oxygen levels in Lake Tenkiller. *See* Daily Trans., 6709:10-21 (Wells Testimony). As phosphorus is the limiting nutrient in Lake Tenkiller, phosphorus concentrations determine the amount of algae growth in Lake Tenkiller. *See* Daily Trans., 6709:22-6910:5 (Wells Testimony).

228. Specifically, most algae will settle to the bottom of the Lake where they will respire and biodegrade due to heterotrophic bacteria, thereby consuming the oxygen in the hypolimnion. *See* Daily Trans., 6708:21-6909:3 (Wells Testimony); Daily Trans., 7364:7-7365:14 (Cooke Testimony). Additionally, plunging flow from the riverine zone of Lake Tenkiller -- which is rich in organic matter, including algae, upon which bacteria feed -- causes depletion in the oxygen in the cooler metalimnion. *See* Daily Trans., 7754:2-7763:5 (Welch Testimony); Daily Trans., 6714:1-4 (Wells Testimony) ("[T]here is the algae that is settling through the water column. Once it gets below light, it starts to respire. So there is oxygen demand of the algae as it's settling"); Daily Trans., 7364:7-7365:14 (Cooke Testimony). By the end of July, both the hyperlimnion and metalimnion of Lake Tenkiller become oxygen-depleted. *See* Daily Trans., 7761:1-7 (Welch Testimony); State's Ex. 721; Daily Trans., 6710:11-17 (Wells Testimony) ("So it's common for it to be zero milligrams per liter of oxygen below the depth of

that epilimnion, which is that well-mixed upper level"). Because of this, during the summer months Lake Tenkiller does not meet State water quality standards for a cool water fishery. *See* Daily Trans., 7766:19-24 (Welch Testimony).

229. As noted above, smallmouth bass and walleye pike are important fish to Lake Tenkiller. *See* Daily Trans., 7765:17-19 (Welch Testimony). Eutrophication specifically affects smallmouth bass and walleye pike in Lake Tenkiller because they are cool water species that are squeezed by the lack of suitable habitat. *See* Daily Trans., 7765:20-7766:8 (Welch Testimony). During the summer months when the water temperature increases and begins exceeding their preferred temperatures, smallmouth bass and walleye pike will begin to seek cooler water of the reservoir. *See* Daily Trans., 7765:22-25 (Welch Testimony). If the cooler water has depleted oxygen levels, the smallmouth bass and walleye pike will have to exist in a water layer that has insufficient oxygen, which can affect their activity and growth; in fact these fish might avoid these areas altogether. *See* Daily Trans., 7765:25-7766:5; 7773:23-7774:5 (Welch Testimony). This is characterized as a habitat "squeeze." *See* Daily Trans., 7766:5 (Welch Testimony); Daily Trans., 6728:14-16 (Wells Testimony) ("This is what is called the squeeze, so you have low DO from the bottom and you have high temperature from the top, so it squeezes out the habitat of the fish").

230. In fact, for about two and a half months during the summer there is no water in Lake Tenkiller that is suitable for the optimal growth of smallmouth bass. *See* Daily Trans., 7771:10-7773:22; State's Ex. 733 (graphs showing volumes of water in Lake Tenkiller that are optimal and suboptimal for smallmouth bass). And for about three months during the summer there is no volume of water in Lake Tenkiller that is suitable for even the suboptimal growth of walleye pike. *See* Daily Trans., 7775:13-7776:3; State's Ex. 733 (graph showing volumes of

water in Lake Tenkiller that are suboptimal for walleye pike). As a result, during the summer months Lake Tenkiller does not meet Oklahoma's water quality criteria for cool water fish species. *See* Daily Trans., 7766:19-24 (Welch Testimony).

231. Because of this problem, stocking of Lake Tenkiller with smallmouth bass and walleye pike has stopped. *See* Daily Trans., 7767:9-21; 7781:18-21 (Welch Testimony); *see also* Daily Trans., 4363:11-12 (Caneday Testimony) ("There are indications from anglers that the fish species have changed dramatically").

232. Significantly, the abundance of smallmouth bass in Broken Bow Reservoir, the reference lake, is higher than the abundance of smallmouth bass in Lake Tenkiller by a factor of three. *See* Daily Trans., 7777:7-7778:15 (Welch Testimony); State's Ex. 730. And the abundance of walleye pike in Broken Bow Reservoir is higher than the abundance of smallmouth bass in Lake Tenkiller by a factor of two. *See* Daily Trans., 7780:3-17 (Welch Testimony).

233. In contrast, largemouth bass are not affected by the habitat squeeze because they are warm water species that prefer eutrophic waters. *See* Daily Trans., 7766:9-18 (Welch Testimony); Daily Trans., 7786:12-13 (Welch Testimony) ("Largemouth favor eutrophic conditions . . ."). The abundance of largemouth bass in Lake Tenkiller is higher than the abundance of largemouth bass in Broken Bow Reservoir by roughly a factor of two. *See* Daily Trans., 7785:22-7786:5 (Welch Testimony).

234. Dr. Welch's analysis of the data leads him to conclude that quality of the fisheries in Broken Bow Reservoir, the reference reservoir, are better than they are in Lake Tenkiller. *See* Daily Trans., 7782:6-14 (Welch Testimony). The reduced quality of Lake Tenkiller's fishery is an injury resulting from increased eutrophication of its waters. *See* Daily Trans., 7765:17-7766:5; 7766:19-24 (Welch Testimony)

235. Low dissolved oxygen also affects bottom invertebrates in Lake Tenkiller. *See* Daily Trans., 7786:22-7788:12 (Welch Testimony). Dr. Welch's investigation revealed that the population density of bottom invertebrates in Lake Tenkiller is roughly one-sixth that of Broken Bow Reservoir. *See* Daily Trans., 7787:15-7788:4 (Welch Testimony). The reduced number of the invertebrates living in the sediments of Lake Tenkiller is due to low levels of dissolved oxygen during the summer months. *See* Daily Trans., 7786:22-7788:12 (Welch Testimony).

236. The State's 2008 Integrated Report corroborates Dr. Cooke's and Welch's conclusion that low levels of dissolved oxygen are impairing fish and wildlife propagation in Lake Tenkiller. *See* State's Ex. 6008 at Appendix C; Daily Trans., 3492:8-14 & 3492:22-25 (Strong Testimony). The 2008 Integrated Report lists low levels of dissolved oxygen as causing impairment to fish and wildlife propagation in an 8,440.00 acre segment of Lake Tenkiller having the segment code OK121700020020_00 and a 5,030.00 acre segment of Lake Tenkiller having the segment code OK121700020220_00. *See* State's Ex. 6008 at C-15; Daily Trans., 3493:15-3496:12 & 3498:12-3500:8 (Strong Testimony).

c. Human Health Endangerment

i. Blue-Green Algae or Cyanobacteria[49]

237. As noted above, the Lake Tenkiller sampling data revealed that blue-green algae dominated the reservoir at every sampling station. *See* Daily Trans., 7398:12-7403:1 (Cooke Testimony); State's Ex. 706. The dominant form of blue-green algae in Lake Tenkiller for 2005, 2006 and 2007 was a species in the genus *Cylindrospermopsis*. *See* Daily Trans., 7474:14-7475:3 (Cooke Testimony).

---

[49] Cyanobacteria are a form of blue-green algae. *See* Daily Trans., 6061:7-8 (Teaf Testimony). Specifically, cyanobacteria are that subset of blue-green algae that is harmful. *See* Daily Trans., 6061:8-12 (Teaf Testimony).

238. Blue-green algae in the genus *Cylindrospermopsis* forms a serious hepatoxin to humans. *See* Daily Trans., 7474:22-7475:12 (Cooke Testimony). Other blue-green algae species -- anabaena and aphanizomenon -- are also present in Lake Tenkiller, and are known to produce toxins. *See* Daily Trans., 7475:13-18 (Cooke Testimony). At phosphorus concentration levels of above 30 mg/L there is an exponential increase in cyanobacteria volume in a lake or reservoir. *See* Daily Trans., 7706:3-7709:5 (Cooke Testimony); State's Ex. 0747.

239. Cyanobacteria can pose a public health risk to persons recreating in water. *See* Daily Trans., 6062:18-6063:23 (Teaf Testimony) ("[I]n a recreational lake or river system, you have direct exposure on a regular basis, particularly in the times of the year in which cyanobacteria are most likely to bloom, in which there are warm temperatures, long daylight areas, long photo periods, high degree of recreational contact and high nutrient levels"); Daily Trans., 6067:10-13 (Teaf Testimony) ("Skin exposure can occur, obviously, from activities that involve swimming or wading or rafting or canoeing, those kinds of things that put people in direct contact with the surface water").

240. There is conflicting evidence on the issue of whether there is a risk to the public from cyanobacteria in the IRW. On the one hand, Defendants' retained expert Dr. Gibb opines that cyanobacteria in the IRW does not present "any" risk to human health, *see* Daily Trans., 11153:21-25 (Gibb Testimony). On the other hand, in its 2008 report entitled "Coordinated Watershed Restoration and Protection Strategy for Oklahoma's Impaired Scenic Rivers" issued pursuant to 82 Okla. Stat. § 1457, the Office of the Oklahoma Secretary of the Environment reports that:

> Sampling of Lake Tenkiller Ferry by the Corps of Engineers showed that a new and potentially toxin-producing algae is present in the lake. Test results by the COE, OWRB, and OU Health Sciences Center show that the blue-green algae *Cylindrospermopsis raciborskii* has colonized Lake Tenkiller. Algae of the

> genus, *Cylindrospermopsis* have been known to produce the potent cyanotoxin, cylindrospermopsin. Because of this potential, Lake Tenkiller was included in the OWRB's Harmful Algae Bloom ("HAB") project. Here, BUMP lake sampling was leveraged to allow a grab sample of algae community to be enumerated and compared against World Health Organization criteria of risk due to recreational exposure. HAB algae samples were taken in August 2004, March 2005, and May 2005 from five lacustrine zone sites in the lake. The overall recreational risk in Lake Tenkiller due to HAB toxins was found to be moderate. Algae of the genus *Cylindrospermopsis* and *Aphanocapsa* presented the greatest risk for cyanotoxin production in Lake Tenkiller.

State's Ex. 5662 at 17 (emphasis added); s*ee also* Daily Trans., 3508:11-3511:8 (Strong Testimony) (discussing formation of a work group to monitor and respond to threats of blue-green algae toxins as a result in part from Army Corps of Engineers, OWRB and Oklahoma University Health Science test results).

241. In light of the State's evidence, the Court cannot agree with Defendants that there is not "any" risk to human health.

ii. Disinfection Byproducts (DPBs)

242. As with water treatment plants drawing water from rivers and streams in the Oklahoma portion of the IRW, water treatment plants drawing from Lake Tenkiller are experiencing issues with DBPs. *See* FOF, ¶¶ 157-174.

243. The State's 2008 Integrated Report finds that chlorophyll is impairing public and private water supply uses of Lake Tenkiller. *See* State's Ex. 6008 at Appendix C; Daily Trans., 3492:8-14 & 3492:22-25 (Strong Testimony). The 2008 Integrated Report lists chlorophyll as causing impairment to public and private water supply uses of a 5,030.00 acre segment of Lake Tenkiller having the segment code OK121700020220_00. *See* State's Ex. 6008 at C-15; Daily Trans., 3493:15-3496:12 & 3498:12-3500:8 (Strong Testimony). Chlorophyll is a cause behind the creation of DBPs. *See generally* Daily Trans., 6082:11-21 (Teaf Testimony); Daily Trans. 7452:22-7453:7; 7463:18-7465:17 (Cooke Testimony).

244. The public water supplies drawing upon Lake Tenkiller rely on the maintenance of clean water. *See* State's Ex. 5862 at p. 3; *see also* State's Ex. 3285 at p. 34 ("Further degradation would directly impact water supply users . . . . Water supply users would have to bear the cost of additional treatment.").

3. Summary of Findings Regarding Lake Tenkiller

245. Based upon the foregoing factual findings, the Court finds that Lake Tenkiller was not always, but has become, eutrophic, and that this eutrophication is being caused by increasing phosphorus concentrations in the reservoir.

246. Based upon the foregoing factual findings, the Court finds that Lake Tenkiller's phosphorus-induced eutrophic condition is manifested in a variety of ways, including an increase in amounts of algae, including blue-green algae, a decrease in water clarity, and a decrease in dissolved oxygen.

247. Based upon the foregoing factual findings, the Court finds that the decreases in water clarity in Lake Tenkiller are having an adverse impact on recreational activities and aesthetics.

248. Based upon the foregoing factual findings, the Court finds that the decreases in dissolved oxygen in Lake Tenkiller are having an adverse impact on cool-water fish and bottom invertebrates.

249. Based upon the foregoing factual findings, the Court finds that the increases in amounts of blue-green algae in Lake Tenkiller are presenting an increased risk to human health.

250. Based upon the foregoing factual findings, the Court finds that increases in the amount of algae and organic carbon in Lake Tenkiller have resulted in the creation of DBPs in

the IRW's public water treatment facilities and supplies, and that this is presenting an increased risk to human health.

251. Based on the foregoing factual findings, the Court finds that phosphorus concentrations in excess of natural or background levels have caused degradation of water quality in Lake Tenkiller that reduce the historically high quality of the water and impair its aesthetics, fish and wildlife, primary body contact, and public water supply beneficial uses in violation of Oklahoma's antidegradation standards in Okla. Admin. Code § 785:45-3-2(b) and (d).

252. Based on the foregoing factual findings, the Court finds that phosphorus concentrations have caused excessive growth of periphyton, phytoplankton, or aquatic macrophyte communities in Lake Tenkiller which impairs its aesthetics, fish and wildlife, primary body contact, and public water supply beneficial uses in violation of Okla. Admin. Code, § 785:45-5-9(d);

253. Based on the foregoing factual finding, the Court finds that total phosphorus concentrations have caused impairment of the aesthetic beneficial use for 8,440 acres of Lake Tenkiller that is designated in Section 785:45 (Appendix A) of the Oklahoma Water Quality Standards.

254. Based on the foregoing factual findings, the Court finds that as a result of phosphorus concentrations the waters of Lake Tenkiller are not meeting their aesthetics beneficial use due to floating materials and suspended substances that produce objectionable color and materials that settle to form objectionable deposits in violation of Section 785:45-5-19(a) & (b) of Oklahoma's Water Quality Standards.

255. Based on the foregoing factual findings, the Court finds that phosphorus concentrations have caused impairment of the fish and wildlife beneficial use designated in Section 785:45 (Appendix A) of the Oklahoma Water Quality Standards in Lake Tenkiller by depleting dissolved oxygen in the hypoliminion and metaliminion, violating the dissolved oxygen standard in Section 785:45-5-12(f)(1)(C) and Appendix G of the Oklahoma Water Quality Standards, and because aquatic life in Lake Tenkiller exhibited degraded conditions based on comparative reference historical data in violation of Section 785:45-5-12(f)(5)(A) of the Oklahoma Water Quality Standards.

256. Based on the foregoing factual findings, the Court finds that as a result of phosphorus concentrations a 5,030 acre section of Lake Tenkiller is not meeting its public water supply beneficial use and is violating water quality standards due to chlorophyll-a levels in excess of the numerical criterion in Section 785:45-5-10(7) of Oklahoma's Water Quality Standards.

257. Based on the foregoing factual findings, the Court finds that phosphorus concentrations in excess of natural or background levels have caused blue-green algae that produce human toxins to dominate in Lake Tenkiller in violation of Section 785:45-5-10(B) which requires that waters not be toxic in order to protect the public water supply beneficial use of Lake Tenkiller and Section 785:45-5-16(a) which requires that waters not contain chemical or biological substances that are irritating to skin or sense organs or are toxic or cause illness upon ingestion by human beings in order to the protect the public water supply beneficial use of Lake Tenkiller.

C. Injury Summary

258. Based on the foregoing, the Court finds that phosphorus has caused, and is causing, injury to the rivers and streams of the IRW in Oklahoma, as well as the biota therein.

259. Based on the foregoing, the Court finds that phosphorus has caused injury to Lake Tenkiller, as well as the biota therein.

IX. Sources of High Phosphorus Loading to the Waters of the IRW

A. Distinction Between Point Sources and Nonpoint Sources

260. Nonpoint source pollution, as opposed to point source pollution, is pollution that comes from diffused sources, often resulting from runoff of pollutants over land surface. In contrast, point source pollution comes from a specific discernable place, such as an outfall from a discharge from a wastewater treatment plant or an industrial site. *See* Daily Trans., 977:5-10 (Phillips Testimony).

261. Once a specific phosphorus molecule enters the waters of the IRW it is not possible to determine whether it is from a point or nonpoint source generally, or from a particulate point or nonpoint source specifically. *See* Daily Trans., 1492:11-13 (Phillips Testimony) ("When the phosphorus is in the river, it doesn't have a logo on it that tells you where it came from, no."); Daily Trans., 8770:5-9 (Tyson Admission) ("Once it's all the way downstream, you can't assign -- figure out where the phosphorus came from.").

262. However, it is possible to determine relative loadings of phosphorus to the waters of the IRW from point and nonpoint sources.

B. Point Sources Contributing to Loading of Phosphorus to the Waters of the IRW

263. Wastewater treatment plants are the primary source of phosphorus point-source loading to the waters of the IRW. *See* Daily Trans., 3149:22-3150:6 (Strong Testimony); *see*

also Daily Trans., 9128:19-25 (Connolly Testimony) (disclaiming knowledge of any other point sources in the IRW).

264. There are two wastewater treatment plants in Oklahoma and five wastewater treatment plants in Arkansas that discharge to the waters of the IRW. *See* Daily Trans., 511:7-13 (Tolbert Testimony); State's Ex. 5862 at p. 2.

265. There has been a concerted effort by Oklahoma and Arkansas to reduce phosphorus concentrations from wastewater treatment plant discharges in the Illinois River Watershed. See State's Ex. 5666, Attachment C, p. 4. (Statement of Joint Principles and Actions).

266. The wastewater treatment plants at Westville and Tahlequah have reduced the phosphorus in their point source discharges to less than 1.000 mg/L. *See* Daily Trans., 3168:22-3169:12 (Strong Testimony). In addition, there are also some wastewater treatment plants in Arkansas that have reduced the phosphorus in their point source discharges to less than 1.000 mg/L. *See* Daily Trans., 3169:13-24 (Strong Testimony). These various wastewater treatment plant upgrades were largely completed by 2004. *See* Daily Trans., 8915:8-10 (Connolly Testimony). The upgrades to the wastewater treatment plant at Siloam Springs that would reduce the phosphorus in its point source discharges to less than 1.0 mg/L., however, have not gone online yet. *See* Daily Trans., 9525:11-9526:19 (Smith Testimony).

C. Nonpoint Sources Contributing to Loading of Phosphorus to the Waters of the IRW

267. The respective sides to this litigation have identified various nonpoint sources that may be contributing to the loading of phosphorus to the waters of the IRW. These include not only the subject matter of this litigation -- poultry waste -- but also septic systems, urban runoff, commercial fertilizer, streambank erosion, cattle, nurseries, recreational users, and golf courses.

While there is general agreement that these all may be contributors to the loading of phosphorus to the waters of the IRW, there is not agreement that each source -- poultry waste in particular -- is in fact a significant contributor to injury to the rivers and streams of the IRW in Oklahoma or to Lake Tenkiller.

D. Relative Loading of Phosphorus in the IRW Between Point Sources and Nonpoint Sources

268. It is undisputed in the record that point sources account for less than 20 percent of the phosphorus load reaching Lake Tenkiller. *See* Daily Trans., 8922:8-20 (Connolly Testimony); Daily Trans., 10907:23-10908:1 (Sullivan Testimony). Indeed, Defendants' own expert, Dr. Connolly, calculates that 82 percent of the phosphorus load reaching Lake Tenkiller is from nonpoint sources. *See* Daily Trans., 9141:15-9142:8 (Connolly Testimony) ("Mr. Page: So your calculation, sir -- thank you -- of nonpoint-source contribution of phosphorus to the IRW is 82 percent, correct, of all the phosphorus? Dr. Connolly: Yes, yes."). Dr. Connolly further believes that it would be "pretty silly" to suggest that phosphorus from nonpoint sources does not enter the streams of the IRW. *See* Daily Trans., 9142:16-20 (Connolly Testimony). As reflected below, Dr. Connolly's opinions in this regard are entirely consistent with the findings of many other researchers who have studied nutrient loading in the IRW.

1. The Illinois River and Its Tributaries

269. The USGS has extensively studied phosphorus loading to the Illinois River and its tributaries. *See* State's Ex. 5861; State's Ex. 5862.

270. A 2006 report by the USGS makes clear that the overwhelming majority of the phosphorus loading to the rivers and streams of the IRW is from non-point sources:

> Runoff components of the annual total load for Flint Creek ranged from 68 to 84 percent from 2000 to 2004 (table 5). At the Illinois River stations, the range in runoff component of the annual total load was 75 to 88 percent (table 5). Runoff

> components of the annual total load at Baron Fork ranged from 91 to 96 percent (table 5).

See State's Ex. 5862 at p. 11 (emphasis added).

271. Furthermore, the USGS found that "[p]hosphorus concentrations in the Illinois River basin were significantly greater in runoff samples than in base flow samples." *See* State's Ex. 5862 at p. 1.[50] That the rivers and streams can maintain high phosphorus concentrations despite the dilution caused by the extra amount of water in the system is "a very important conclusion" and speaks to the amount of phosphorus in the runoff. *See* Daily Trans., 5597:15-5598:13 (Olsen Testimony).

272. Similarly, Dr. Indrajeet Chaubey testified that the major source of nutrient loading in the watershed occurs during high-flow conditions. *See* Daily Trans., 6018:24-6019:2 (Chaubey Testimony); *see also* Court's Ex. 8 at pp. 16-17 (Haggard Dep.)[51] (testifying that he

---

[50] "Historical water-quality data collection in the Illinois River basin has been biased toward sampling during base-flow (non-runoff) conditions." *See* State's Ex. 5862 at p. 3. "That means that you are likely underestimating the total phosphorus loading because you are not capturing the loading that occurs at all of the high flow events, so more of your estimate is based off of your base flow events." *See* Daily Trans., 1290:9-16 (Phillips Testimony).

A prime example of this fact is the monitoring done in connection with the Arkansas-Oklahoma effort to reduce the annual total phosphorus loading of the Illinois River by 40 percent. In 1997, the OCC adopted a goal of reducing the annual total phosphorus loading of the Illinois River by 40 percent, with the baseline of the 40 percent being the loadings for 1980 to 1993 reported in the Clean Lakes study. *See* Daily Trans., 9467:1-20; 9476:18-9477:23 (Smith Testimony). Mr. Smith maintains that for three of four monitoring locations in Arkansas, the 40 percent total phosphorus loading reduction goals have been met. *See* Daily Test., 9479:22-9480:1 (Smith Testimony). Mr. Tolbert, in contrast, testified that the goals of reducing total phosphorus loading have not been met, and in fact the situation has gotten worse. *See* Daily Trans., 553:7-14 (Tolbert Testimony). Mr. Smith, however, testified that the work being done by the OCC to evaluate whether the goal of a 40 percent reduction in phosphorus loading is being achieved does not target high-flow events. *See* Daily Trans., 9565:12-9571:25 (Smith Testimony) ("Oh, I'd certainly -- it would be remarkable if it collected -- if it caught all the storm flow events").

[51] Dr. Brian Haggard is an associate professor at the University of Arkansas and the director of the Arkansas Water Resource Center. *See* Court's Ex. 8 at p. 3 (Haggard Dep.). He was employed as a hydrologist with the U.S.G.S. from 2000-2001 and as a research hydrologist

agrees that storm runoff plays a major role in phosphorus transport and that diffuse phosphorus pollution is a major contributor to freshwater systems).

273. Defendants' retained expert Dr. Connolly agrees that it is reasonable to assume that total phosphorus concentrations above background in the waters of the IRW are probably due to anthropogenic sources. *See* Daily Trans., 9224:22-9225:2 (Connolly Testimony). This is significant in that Dr. Connolly agrees that there are a substantial number of locations in the IRW not influenced by wastewater treatment plant discharges where total phosphorus levels in the water are greater than 0.050 mg/L. *See* Daily Trans., 9217:3-9218:10 (Connolly Testimony); *see also* Daily Trans., 9222:3-9224:7 (Connolly Testimony) (Dr. Connolly agreeing that there are a lot of locations in the IRW not influenced by wastewater treatment plant discharges where total phosphorus levels in the water are greater than 0.037 mg/L.). Accordingly, the only logical explanation for these phosphorus concentrations is that they are a result of nonpoint source loadings.

2. Lake Tenkiller

274. The USGS has extensively studied phosphorus loading to Lake Tenkiller. *See* State's Ex. 5861; State's Ex. 5862.

275. A 2006 report by the USGS makes clear that the overwhelming majority of the phosphorus loading to Lake Tenkiller is from non-point sources:

> The estimated mean annual phosphorus load entering Lake Tenkiller ranged from about 391,000 pounds per year to 712,000 pounds per year, and from about 83 to 90 percent of the load was transported to the lake by runoff.

See State's Ex. 5862 at pg. 1.

---

with the USDA from 2001-2006. *See* Court's Ex. 8 at p. 2 (Haggard Dep.). Dr. Haggard received his Ph.D. in biosystem engineering from Oklahoma State University in 2000. *See* Court's Ex. 8 at p. 1 (Haggard Dep.).

276. In addition, to be consistent with Dr. Connolly's calculation, *see* Daily Trans., 8922:8-20; 9142:5-8 (Connolly Testimony) (agreeing that nonpoint source phosphorus loading is 82 percent), the conclusions of the USGS are entirely consistent with the findings of Dr. Engel. Dr. Engel found that the total phosphorus loading to Lake Tenkiller is approximately 505,000 lbs./yr, *see* Daily Trans., 6225:6-17 (Engel Testimony), that non-point source loading pre-2003 was approximately 300,000 lbs./yr., *see* Daily Trans., 6225:6-17 (Engel Testimony), and that non-point source loading post-2003 is approximately 410,000 lbs./yr. *See* Daily Trans., 6225:6-17 (Engel Testimony).

277. Yet further, the Clean Lakes study conducted by the OWRB, the USACE and OSU shows that the estimated average total phosphorus load at Horseshoe Bend from nonpoint sources is 83 percent, and that the estimated high flow contribution of total phosphorus loading at Horseshoe Bend from nonpoint sources is 88 percent. *See* State's Ex. 3285 at p. 55 (Table XXIV).

278. Nonpoint sources also contribute to phosphorus loading to Lake Tenkiller during low-flow or base-flow conditions. The Clean Lakes study concluded that "[d]uring low flow periods, point and nonpoint source contributions were approximately equal." *See* State's Ex. 3285 at p. iv; State's Ex. 3285 at p. 55 (Table XXIV).

E. Types of Phosphorus in the Loading

279. As discussed above, there are three principal types of phosphorus in the waters of the IRW: inorganic phosphorus (also referred to as soluble reactive phosphorus), dissolved organic phosphorus, and particulate phosphorus. *See* Daily Trans., 7003:7-7004:15 (Stevenson Testimony). As discussed above, all three forms of phosphorus are available for algae to use in

the aquatic ecosystem. *See* Daily Trans., 7004:16-7006:21; 7007:25-7008:5 (Stevenson Testimony).

280. At base flow at Tahlequah, 15 percent of total phosphorus is particulate and 85 percent is dissolved. *See* Daily Trans., 9289:19-9290:1 (Connolly Testimony). Typically 80 percent or more of total phosphorus in the waters of the IRW is soluble reactive phosphorus. *See* Daily Trans., 5363:19-21 (Olsen Testimony).

281. With respect to the total phosphorus in IRW wastewater treatment discharge samples, approximately 70 percent is dissolved phosphorus and 30 percent is particulate phosphorus. *See* Daily Trans., 9282:1-9286:3 (Connolly Testimony). Roughly 80 percent of this dissolved phosphorus is soluble reactive phosphorus. *See* Daily Trans., 9286:4-11 (Connolly Testimony). Put another way, only slightly more than 50 percent of the total phosphorus from wastewater treatment plants is soluble reactive phosphorus. *See* Daily Trans., 9286:4-9288:25 (Connolly Testimony).

282. Nonpoint source runoff is comprised primarily of dissolved phosphorus. *See* Daily Trans., 9298:11-9299:4 (Connolly Testimony) (testifying that the vast majority of runoff events in the IRW between 1994 and 2008 had more dissolved phosphorus in them than particulate phosphorus). Nonpoint source runoff from fields is largely comprised of soluble reactive phosphorus. *See* Daily Trans., 5356:17-19 (Olsen Testimony) (testifying that about half of all phosphorus running off fields is soluble reactive phosphorus); Daily Trans., 9207:1-12 (Connolly Testimony) (agreeing with Dr. Sharpley that dissolved phosphate in runoff is mostly orthophosphate which is immediately available for algal uptake). Water moves downhill and groundwater gets into streams. *See* Daily Trans., 5969:24-5670:2 (Tyson Stipulation).

283. Importantly, once phosphorus leaves the fields, "that soluble-reactive part is pretty conservative as it moves through the basin." *See* Daily Trans., 5367:8-19; 5369:11-15 (Olsen Testimony). Thus, nonpoint sources directly contribute soluble reactive phosphorus to the waters of the IRW. *See* Daily Trans., 9134:24-9135:16; 9129:12-17; 9133:24-9134:8 (Connolly Testimony); *see also* Daily Trans., 6233:4-8 ("So phosphorus is a conservative substance so it's not going to be volatized and lost. So once the phosphorus is input into the streams, it really is a matter of time before it's going to be delivered to a point of interest like at Tahlequah."); 6237:15-20; 6462:22-6463:4 (Engel Testimony). Indeed, under natural rainfall conditions, concentrations of nonpoint source soluble reactive phosphorus can be equal to or greater than such concentrations from wastewater treatment plants. *See* Daily Trans., 9412:24-9413:7 (Connolly Testimony).

284. Dr. Engel's poultry house density analysis investigation revealed that two thirds of the total phosphorus in the tributaries of the Illinois River <u>not</u> impacted by wastewater treatment plant discharges at base flow is soluble reactive phosphorus. *See* Daily Trans., 11370:4-11372:10; 11374:5-13; 11381:5-10 (Engel Testimony) (concluding that nonpoint sources are contributing soluble reactive phosphorus at base flow conditions). The average base flow soluble reactive phosphorus in such tributaries was found to be 0.027 mg/L. *See* Daily Trans., 11371:11-20 (Engel Testimony).

285. Nonpoint source loadings of soluble reactive phosphorus at baseflow occurs primarily in two ways. The first way is from rainfall that has infiltrated, moved as shallow groundwater through the soil and picked up soluble reactive phosphorus. This shallow groundwater containing soluble reactive phosphorus seeps out and reenters the rivers and streams during dry days. *See* Daily Trans., 11372:17-25 (Engel Testimony). The second way is during

runoff events, in which runoff containing soluble reactive phosphorus recharges the alluvium. During base flow, this water containing soluble reactive phosphorus comes out of the alluvium and reenters the rivers and streams. *See* Daily Trans., 11373:1-22 (Engel Testimony); *see also* Daily Trans., 5778:11-18 (Engel Testimony); Daily Trans., 2071:1-16 (Fisher Testimony).

286. In sum, both point sources and nonpoint sources contribute all three types of phosphorus to the total phosphorus loading of the waters of the IRW.

F. Environmental Impacts of Point Source Phosphorus Loading vs. Nonpoint Source Phosphorus Loading

287. Defendants' retained expert Dr. Connolly opines that point source phosphorus loading is having the "dominant" impact on water quality in the IRW, and that nonpoint source phosphorus loading is not having a "significant" impact on water quality in the IRW. *See* Daily Trans., 8924:22-24 (Connolly Testimony) ("[W]astewater treatment plants are the dominant source of phosphorus controlling water quality"); Daily Trans., 9437:18-21 (Connolly Testimony) ("[Phosphorus from nonpoint sources is] not a significant impact. In other words, if you cut off the nonpoint sources, in my view you wouldn't dramatically improve the water quality in Lake Tenkiller or the Illinois River.").

288. With respect to the rivers and streams of the IRW, Dr. Connolly bases his opinion principally on the contention that the rivers and streams of the IRW flow too quickly for the phosphorus loading from nonpoint sources to have a significant impact on water quality. *See* Daily Trans., 8904:19-8906:12 (Connolly Testimony). And with respect to Lake Tenkiller, Dr. Connolly bases his opinion principally on the contention that the phosphorus from nonpoint sources plunges into the metalimnion before algae can form. *See* Daily Trans., 8988:22-8996:5 (Connolly Testimony).

289. Dr. Connolly states that his opinion that point source phosphorus contributions are having the dominant impact on water quality vis-à-vis nonpoint source phosphorus contribution does not differentiate between soluble reactive phosphorus and other forms of phosphorus. *See* Daily Trans., 9412:9-23 (Connolly Testimony).

290. Upon close examination, this Court concludes that Dr. Connolly's opinion cannot be credited and should not be accorded any weight. First, Dr. Connolly's contention is entirely out of the mainstream of accepted science. The IRW is the most studied watershed in Oklahoma. *See* Daily Trans., 399:18-400:5 (Tolbert Testimony) (testifying to dozens and dozens of studies by federal and state agencies and universities into problem of phosphorus impairment); *see also* Daily Trans., 7420:13-7421:1 (Cooke Testimony) (testifying the data for Lake Tenkiller "represents possibly the largest dataset for evaluation of trophic state in North America. There may be some as good, but few, if any, better than this one."). Despite this fact, Dr. Connolly is aware of <u>no other investigator</u> who has reached the conclusion he has reached -- namely, that phosphorus from nonpoint sources is having no significant impact on Lake Tenkiller. *See* Daily Trans., 9165:12-9166:18 (Connolly Testimony); *see also, e.g.,* Daily Trans., 9189:22-9190:4 (Connolly Testimony) (testifying that he disagrees with the conclusion of the Clean Lakes Study that "[n]onpoint source phosphorus loading was found to be <u>the</u> cause of eutrophication of Lake Tenkiller") (emphasis added); Daily Trans., 9197:21-9198:10 (Connolly Testimony) (testifying that he disagrees with the conclusion of the Illinois River Cooperative River Basin Basin Resources Base Report that "[a] significant part of the water quality problems in the basin appear to be a precipitate of the large volume of poultry waste generated and disposed of in the basin each year").

291. With regard to whether nonpoint source phosphorus is impacting the rivers and streams of the IRW, the probative value of Dr. Connolly's opinion is further undercut by the limited scope of his investigation. For instance, Dr. Connolly's opinion regarding the bioavailability of phosphorus in rivers and streams of the IRW due to flow times is in reality limited to only the Illinois River:

> The Court: So it's still possible that in a watershed with a relatively high gradient, you're going to have these low-gradient portions where the water doesn't move very fast; right?
> Dr. Connolly: Yes, you will. So I'm sort of speaking in general. You know, there are, I'm sure, some tributaries in this system that are low gradient, and even under a high-flow event, water will move slow enough to allow some algae growth. But in terms of the larger Illinois River, which is what I was referring to, there really is very little time during a high-flow event to allow algae to grow.

See Daily Trans., 8905:25-8906:12 (Connolly Testimony) (emphasis added). Moreover, Dr. Connolly admits that his flow analysis of whether there is sufficient residence time for phosphorus to cause the growth of algae in the rivers and streams was limited to only a single geographical point on the Illinois River at Tahlequah. *See* Daily Trans., 9130:18-9131:19 (Connolly Testimony). Dr. Connolly also admits that he did no analysis of any other points on the Illinois River or on any points on any other rivers and streams in the IRW. *See* Daily Trans., 9131:20-9132:3 (Connolly Testimony); *see also* Daily Trans., 9136:15-17 (admitting that he did not study the time of travel of phosphorus in tributaries to the Illinois River); Daily Trans., 9315:20-22 (Connolly Testimony) (admitting that "[t]here are certainly locations [on tributaries] that were sampled that do have algae at nuisance levels . . .").

292. Further, it is difficult to reconcile the initial vigor of Dr. Connolly's opinion regarding nonpoint source phosphorus residence time in the Illinois River elicited in his direct examination with his later testimony on cross-examination:

> Mr. Page: So you concede there's an opportunity then for dissolved organic or other forms, maybe some even particulate phosphorus, that could have an impact based on phosphorus cycling on the water quality of the IRW?
> Dr. Connolly: At some locations in the IRW, yes.
> Mr. Page: Okay. And, in fact, sir, even in the Illinois River, aren't there locations where there are pools, or maybe when it turns a bend where the -- where there can be pockets where the water slows down enough for algae to form even in the IRW; that is, the Illinois River itself?
> Dr. Connolly: Yes, I'm sure there are.

See Daily Trans., 9137:3-15 (Connolly Testimony) (emphasis added); *see also* Daily Trans., 9321:15-21 (Connolly Testimony) (acknowledging that Dr. Stevenson's data "showed one or two stations in the Illinois River that would have met his criteria for nuisance"); Daily Trans., 9330:10-11 (Connolly Testimony) ("There may be some locations where the river is moving slower [such that algae can grow]"); *see also* State's Ex. 3116 at OK0003578 ("The Illinois is a succession of alternating deep pools and swift shallows flowing over beds of gravel. The average drop is 5 feet per mile and the normal speed of river flow is 13 miles per hour -- much faster over shoals and in narrow channels and almost at a standstill on the mile-long deep holes."); State's Ex. 3089 ("For the 'Illinois' is a clear, spring-fed stream, flowing through the oak and hickory clad Ozark hills in a succession of sparkling riffles and long, quiet pools . . .").

293. Yet further, Dr. Connolly admits that forms of phosphorus other than soluble reactive phosphorus have an impact on water quality in the IRW where there are relatively quiescence conditions that would allow for a long enough residence time for conversion into forms of phosphorus that can be used by algae, *see* Daily Trans., 9135:24-9136:14 (Connolly Testimony), and that such conditions exist both in the tributaries of the Illinois River, as well as in locations on the Illinois River itself. *See* Daily Trans., 9136:18-9137:15 (Connolly Testimony).

294. The reliability of Dr. Connolly's opinion also comes into question when one takes into account that there are significant numbers of locations on the rivers and streams of the IRW where high phosphorus concentrations are found. *See* Daily Trans., 9217:3-9218:10 (Connolly Testimony) (agreeing that there are a substantial amount of locations in the IRW not influenced by wastewater treatment plant discharges where total phosphorus levels in the water are greater than 0.050 mg/L); Daily Trans., 9222:3-9224:7 (Connolly Testimony) (agreeing that there are a lot of locations in the IRW not influenced by wastewater treatment plant discharges where total phosphorus levels in the water are greater than 0.037 mg/L.). These concessions by Dr. Connolly are corroborated by the testimony of Dr. Olsen who testified that the small tributaries in the IRW have very high concentrations of phosphorous in base flows which he found to be above 0.300 mg/L total phosphorous and that most of this phosphorous is soluble reactive phosphorous (orthophosphate). *See* Daily Trans., 5355:3-6; 5369:7-10 (Olsen Testimony); State's Ex. 3590. Compounding this issue is the fact that Dr. Connolly did not look at any specific sources other than wastewater treatment plant discharges in the course of his investigation of what was having an impact on phosphorus concentrations in the waters of the IRW. *See* Daily Trans., 9215:5-16 (Connolly Testimony).

295. There are serious questions with respect to the reliability of Dr. Connolly's opinion regarding Lake Tenkiller as well. Dr. Connolly initially opined that the degree of the nonpoint source phosphorus "plunge" occurring in Lake Tenkiller was "a significant fraction" and "a great extent" of nonpoint source phosphorus was entering the bottom waters of the lake and being stored in the sediment. *See* Daily Trans., 8989:7-18; 8997:23 -8998:4 (Connolly Testimony). Upon cross-examination, however, Dr. Connolly softened his contention regarding the degree that nonpoint source phosphorus plunges into the metalimnion before algae can form.

Specifically, he conceded that "not all of the phosphorus dives," that "there is some phosphorus that is not plunged," and that "the plunging effect isn't a hundred percent." *See* Daily Trans., 9421:6-9422:11 (Connolly Testimony).

296. Finally, Dr. Connolly was careful to state that his opinion was not that nonpoint source soluble reactive phosphorus was having no impact on water quality in the IRW; rather his opinion was that nonpoint source soluble reactive phosphorus is having only a "minor impact" on water quality in the IRW. *See* Daily Trans., 9129:20-9130:6 (Connolly Testimony). However, Dr. Connolly did not undertake to quantify, and cannot quantify, the amount of impact he contends that soluble reactive phosphorus from nonpoint sources is having. *See* Daily Trans., 9130:7-17 (Connolly Testimony). Nor did Dr. Connolly do any calculations to determine what quotient or impact a cut off of nonpoint source phosphorus contributions would have. *See* Daily Trans., 9447:21-23 (Connolly Testimony). Thus, even were Dr. Connolly's opinions to be credited -- which for all the reasons cited above they cannot -- they would be of limited value to the Court due to this lack of specificity.

G. Summary of Findings

297. Based upon the foregoing factual findings, the Court finds that all forms of phosphorus have an environmental impact.

298. Based upon the foregoing factual findings, the Court finds that nonpoint source contributions of phosphorus loading to the rivers and streams of the IRW are far greater than point source contributions.

299. Based upon the foregoing factual findings, the Court finds that nonpoint source contributions of phosphorus loading to Lake Tenkiller are far greater than point source contributions.

300. Based upon the foregoing factual findings, the Court finds that nonpoint source phosphorus is a significant source of the phosphorus that is causing injuries to the rivers and streams of the IRW.

301. Based upon the foregoing factual findings, the Court finds that nonpoint source phosphorus is a significant source of the phosphorus that is causing injuries to Lake Tenkiller.

* * *

302. It is the State's contention that land-applied poultry waste generated by Defendants' birds is a significant contributor to the phosphorus loading of the waters of the IRW, and that the phosphorus in these waters is causing injuries to the rivers and streams of the IRW in Oklahoma and to Lake Tenkiller. As such, the Court will now evaluate the facts underpinning the State's claims.

X. Overview of the Poultry Industry in the IRW

A. The Players

303. Defendants in this case fall into six groupings: the Tyson Defendants (Tyson Foods, Inc., Tyson Poultry, Inc., Tyson Chicken, Inc. and Cobb-Vantress, Inc.),[52] the Cargill Defendants (Cargill, Inc. and Cargill Turkey Production, LLC),[53] the George's Defendants

---

[52] Defendant Tyson Foods, Inc. controls Defendant Cobb-Vantress, Inc. Defendant Tyson Chicken, Inc. and Defendant Tyson Poultry, Inc. *See* Court's Ex.4 at pg. 8 (Hudson Depo.). (Mr. Read Hudson is vice president, associate general counsel and corporate secretary of Defendant Tyson Foods. *See* Court's Ex. 4 at p. 1 (Hudson Depo.)).

[53] Defendant Cargill, Inc. is a privately owned corporation. *See* Daily Trans., 4645:16-18 (Maupin Testimony). Defendant Cargill Turkey Production, LLC is a limited liability company. *See* Daily Trans., 4645:13-15 (Maupin Testimony). Defendant Cargill Turkey Production, LLC is a wholly-owned subsidiary of Cargill Meat Solutions, which in turn is a wholly-owned subsidiary of Defendant Cargill, Inc. *See* Daily Trans., 4648:3-7; 4648:25-4649:4 (Ehrich Stipulation). Defendant Cargill Turkey Production, LLC was created June 1, 2004, and Defendant Cargill, Inc.'s turkey operation and live production assets were transferred

(George's, Inc. and George's Farms, Inc.),[54] Defendant Simmons Foods, Inc., Defendant Peterson Farms, Inc., and Defendant Cal-Maine Foods, Inc.

304. Each Defendant in this case is a corporation. *See* Daily Trans., 7925:16-25 (George Stipulation); Daily Trans., 4645:11-15 (Maupin Testimony);[55] Daily Trans., 3028:6-8 (Henderson Testimony);[56] Daily Trans., 4119:11-12 (Simmons Testimony);[57] Daily Trans., 7926:2-7 (McDaniel Stipulation); Daily Trans., 4411:3-4 (Storm Testimony).[58]

---

to Defendant Cargill Turkey Production, LLC. *See* Daily Trans., 4649:21-4651:7 (Maupin Testimony).

[54] Defendant George's, Inc. controls Defendant George's Farms, Inc. *See* Daily Trans., 3022:7-9 (Henderson Testimony).

[55] Mr. Timothy Maupin has been vice president of agricultural operations at Defendant Cargill Turkey Production for three years, before which time he was an agricultural operations manager at the company for 2 years. *See* Daily Trans., 4643:21-4644:18 (Maupin Testimony). Prior to that, Mr. Maupin was Defendant Cargill Turkey Products' environmental affairs manager (from 2001-2004) and the director of environmental affairs for Rocco, Inc., where he worked for 11 years before it was purchased by Defendant Cargill, Inc. in 2001. *See* Daily Trans., 4640:24-4643:17 (Maupin Testimony).

[56] Mr. Monty Henderson served as president and chief operating officer for the George's Defendants from March 1994 to August 2009. *See* Daily Trans., 3022:4-6 (Henderson Testimony). Mr. Henderson has also served on the board of the National Chicken Council, and currently serves on the board of the U.S. Poultry and Egg Association. *See* Daily Trans., 3033:14-21 (Henderson Testimony).

[57] Mr. Mark Simmons has been chairman of Defendant Simmons since the 1980s. *See* Daily Trans., 4119:9-15 (Simmons Testimony). He began working for the company in different areas of operations while in college and took over the management of the organization after his father passed away in 1974. *See* Daily Trans., 4120:2-8 (Simmons Testimony). He was a founding board member of the Illinois River Watershed Partnership in Arkansas. *See* Daily Trans., 4178:19-23 (Simmons Testimony).

[58] Mr. Stephen Storm is vice president of operations at Defendant Cal-Maine where he has worked since 1972. *See* Daily Trans., 4410:25-4411:11 (Storm Testimony). He supervises the company's egg production facilities in North Carolina, Kentucky, Arkansas and Texas. *See* Daily Trans., 4411:14-16 (Storm Testimony).

305. Defendants currently own poultry feeding operations and / or have contract poultry feeding operations in the IRW, or until recently owned poultry feeding operations and/or had contract poultry feeding operations in the IRW:

1. The Tyson Defendants

306. The Tyson Defendants have and have had poultry operations in both the Oklahoma and Arkansas portions of the IRW. *See* State's Ex. 855; State's Ex. 954; State's Ex. 950; State's Ex. 939. The Tyson Defendants began poultry operations in the IRW in 1947. *See* Daily Trans., 75:16 20 (Tyson Opening). Between 2000 and 2007, more than 703,000,000 birds belonging to the Tyson Defendants were raised in the IRW. *See* State's Ex. 2528; *see also* State's Ex. 857; State's Ex. 956; State's Ex. 937; State's Ex. 951.

2. The Cargill Defendants

307. The Cargill Defendants have and have had poultry operations in both the Oklahoma and Arkansas portions of the IRW. *See* State's Ex. 847; State's Ex. 838; State's Ex. 6127; State's Ex. 6219-A. The Cargill Defendants began poultry operations in the IRW in the mid-1960s. *See* Daily Trans., 4659:5-9 (Maupin Testimony). Between 2000 and 2007, more than 23,000,000 birds belonging to the Cargill Defendants were raised in the IRW. *See* State's Ex. 2528; *see also* State's Ex. 847; State's Ex. 883.

3. The George's Defendants

308. The George's Defendants have and have had poultry operations in both the Oklahoma and Arkansas portions of the IRW. *See* State's Ex. 879; State's Ex. 883. The George's Defendants began poultry operations in the IRW in the 1950s. *See* Daily Trans., 198:3-4 (George's Opening). Between 2000 and 2007, more than 105,000,000 birds belonging to the

George's Defendants were raised in the IRW. *See* State's Ex. 2528; *see also* State's Ex. 882; State's Ex. 883.

4. Defendant Simmons

309. Defendant Simmons has and has had poultry operations in both the Oklahoma and Arkansas portions of the IRW. *See* Daily Trans., 4122:1-3; 4122:19-22 & 4123:2-6 (Simmons Testimony); State's Ex. 2722. Defendant Simmons began poultry operations in the IRW in the early 1970s. *See* Daily Trans., 4121:17-22 (Simmons testimony). Between 2000 and 2007, more than 162,000,000 birds belonging to Defendant Simmons were raised in the IRW. *See* State's Ex. 2528; *see also* State's Ex. 6405.

5. Defendant Peterson

310. Defendant Peterson has had (but no longer has) poultry operations in both the Oklahoma and Arkansas portions of the IRW. *See* State's Ex. 913. Defendant Peterson began poultry operations in the IRW in the mid-1970s or early 1980s. *See* Daily Trans., 4787:8-20 (Houtchens Testimony).[59] Defendant Peterson ceased poultry operations in the IRW in July 2008. *See* Daily Trans., 4793:16-23 (Houtchens Testimony). Between 2000 and 2007, more than 121,000,000 birds belonging to Defendant Peterson were raised in the IRW. *See* State's Ex. 2528; *see also* State's Ex. 830; State's 827.

6. Defendant Cal-Maine

311. Defendant Cal-Maine has had (but no longer has) poultry operations in both the Oklahoma and Arkansas portions of the IRW. *See* State's Ex. 6062; State's Ex. 6059; State's Ex.

---

[59] Mr. Kirk Houtchens is currently the assistant broiler production manager for the George's Defendants. *See* Daily Trans., 4784:9-15 (Houtchens Testimony). Prior to joining the George's Defendants, Mr. Houtchens worked for Defendant Peterson for 21 years (from 1987-2008) in breeder research and development, purchasing, broiler production, and feed milling. *See* Daily Trans., 4784:16-4785:4 (Houtchens Testimony). His final position at Defendant Peterson was as live production manager. *See* Daily Trans., 4785:5-16 (Houtchens Testimony).

6060; State's Ex. 6061; State's Ex. 6062; State's Ex. 6063B; Daily Trans., 4412:4-4413:15; 4434:1-4; 4460:13-4461:1 (Storm Testimony). Defendant Cal-Maine began poultry operations in the IRW in 1989. *See* Daily Trans., 4412:4-10 (Storm Testimony). Defendant Cal-Maine ceased poultry operations in the IRW in "roughly 2005." *See* Daily Trans., 4412:4-10 (Storm Testimony). Between 2000 and 2007, more than 4,000,000 birds belonging to Defendant Cal-Maine were raised in the IRW. *See* State's Ex. 2528; *see also* State's Ex. 6082.

B. Integrated Poultry Production in the IRW and the Integrator-Grower Relationship

312. Poultry is not raised in a classic, old-fashioned barnyard manner in the IRW. *See* Daily Trans., 343:5-6 (Tolbert Testimony). In the poultry industry, birds are typically raised in one of two ways. One way is that the birds are raised by the poultry company itself at company-owned operations; the other is that the birds are raised by growers under a contract with a poultry company. *See* Daily Trans., 6767:9-14 (Taylor Testimony).[60] The predominant manner in which birds have historically been raised, and are raised, in the IRW is by growers under a contract with a poultry company. *See* Daily Trans., 6767:22-6768:2 (Taylor Testimony).

313. Vertical integration, at its full extent, involves a business model wherein a company takes a product from raw material production to processing, to marketing, to wholesaling, to retailing. *See* Daily Trans., 6764:15-19 (Taylor Testimony).

---

[60] Dr. Robert Taylor earned a Ph.D. in agricultural economics in 1972. *See* Daily Trans., 6759:4-9 (Taylor Testimony). He currently holds the endowed chair entitled the Alfa Eminent Scholar of Agricultural Economics and Agricultural Policy at Auburn University. *See* Daily Trans., 6758:20-6759:3 (Taylor Testimony). He has served on the editorial board of the *American Journal of Agricultural Economics*, the top journal in the field of agricultural economics, as well as the editorial boards of *Agricultural Systems*, the *Southern Journal of Agricultural Economics*, the *Journal of Agricultural and Applied Economics*, and the *Review of Agricultural Economics*. *See* Daily Trans., 6760:24-6761:12 (Taylor Testimony). Dr. Taylor has also testified before congressional committees on issues pertaining to competition in agricultural markets. *See* Daily Trans., 6762:5-14 (Taylor Testimony).

314. Defendants operate on what, for all practical purposes, can be described as a vertically-integrated business model in the IRW. *See* Daily Trans., 6766:25-6767:8 (Taylor Testimony); Daily Trans., 10115:3-10116:8 (Rausser Testimony) (describing industry as "vertically coordinated"); Daily Trans., 3370:5-12 (Pilkington Testimony);[61] Daily Trans., 4652:23-4653:18 (Maupin Testimony); Daily Trans., 3028:9-11 (Henderson Testimony); Daily Trans., 4165:24-4168:25 (Simmons Testimony); Daily Trans., 4009:4-14 (Henderson Testimony);[62] Court's Ex. 6 at p. 5(Wear Depo.).[63]

315. This vertically-integrated business model manifests itself in the details of the integrator-grower relationship, as set forth below.

316. Each Defendant owns the birds it places with its growers in the IRW. *See* Daily Trans., 6770:3-11 (Taylor Testimony); State's Ex. 4957; Daily Trans., 3372:23-3373:1 (Pilkington Testimony); Daily Trans., 3753:18-20 (Pigeon Testimony);[64] Daily Trans., 4066:24-

---

[61] Patrick Pilkington, D.V.M., is vice president of state government relations and regulatory affairs at Tyson Foods, Inc. *See* Daily Trans., 3367:6-8; 3411:14-25 (Pilkington Testimony). Previously, Dr. Pilkington was vice president of live production operations. *See* Daily Trans., 3367:9-10 (Pilkington Testimony). He has been with the company for about 13 years. *See* Daily Trans., 3367:11-12 (Pilkington Testimony).

[62] Mr. Dan Henderson was president and chief operating officer of Defendant Peterson for three years (until 2000). *See* Daily Trans., 3953:23-3954:2; 3954:11-17 (Henderson Testimony). Mr. Henderson joined the company as an accountant in 1972, was a controller in the early 1990s and later a financial vice president. *See* Daily Trans., 3954:11-3955:7 (Henderson Testimony). As president and chief operating office, most of the company divisions other than the breeder division reported to him. *See* Daily Trans., 3955:8-14. He is currently employed at Twin Rivers Foods in Fayetteville, which is a deboning and further processing facility. *See* Daily Trans., 3954:3-10 (Henderson Testimony).

[63] Mr. Ray Wear is on the board of Defendant Peterson. *See* Court's Ex. 6 at p. 6 (Wear Depo.).

[64] Mr. Jim Pigeon is the general manager of Green Country Farms in northeastern Oklahoma, which is a contract grower for Defendant Tyson Poultry. *See* Daily Trans., 3719:19-3720:6, 3720:19-3721:4 (Pigeon Testimony). Mr. Pigeon has been a contract grower for Defendant Tyson since 2004, and a grower and service technician for Defendant Peterson from

25, 4067:11-13, 4072:6-8 (Anderson Testimony);[65] Daily Trans., 4534:15-17 (Saunders Testimony); Court's Ex. 7 at p.3 (Butler Depo.);[66] Daily Trans., 4668:19-21, 4681:24-4682:4 (Maupin Testimony); Daily Trans., 4942:1-16 (Alsup Testimony);[67] State's Ex. 6269-A4 at ¶ 12; Daily Trans., 3028:12-16 (Henderson Testimony); State's Ex. 3051 at ¶ I.A; Daily Trans., 3897:16-21 (Collins Testimony);[68] Court's Ex. 6 at p. 8 (Wear Depo.); Daily Trans., 4416:1-10 (Storm Testimony); State's Ex. 6062 at ¶ 5.

317. Each Defendant supplies / owns the feed consumed by its birds in the IRW. *See* Daily Trans., 6770:12-19 (Taylor Testimony); State's Ex. 4957; Daily Trans., 3373:2-4 (Pilkington Testimony); Daily Trans., 3757:9-13, 3757:17-20 (Pigeon Testimony); Daily Trans., 4067:6-8, 4067:14-15, 4071:2-5, 4071:9-10 (Anderson Testimony); Daily Trans., 4537:23-24

1995-2004. *See* Daily Trans., 3722:19-3723:17 (Pigeon Testimony). He obtained an animal science degree from Oklahoma State University in 1992. *See* Daily Trans., 3719:9-14 (Pigeon Testimony).

[65] Mr. Bill Anderson has been a poultry grower for Defendant Cobb-Vantress for 22 years in the northeastern Oklahoma portion of the IRW. *See* Daily Trans., 4044:10-4046:7 (Anderson Testimony).

[66] Ms. Leasea Butler has worked for Defendant Cobb-Vantress for nine years, and has been the director of GP production there for two years. *See* Court's Ex. 7 at p. 1 (Butler Depo.).

[67] Mr. Timothy Alsup has been employed by Defendant Cargill in various positions since 1986 and is presently serving as the company's agricultural coordinator. *See* Daily Trans., 4850:8-13; 4851:8-13; 4855:2-4; 4853:15-4854:3 (Alsup Testimony). From 2001 to 2003, Mr. Alsup served as the company's environmental coordinator. *See* Daily Trans., 4854:22-4855:1 (Alsup Testimony). In addition, Mr. Alsup was an Arkansas certified nutrient management plan writer from 2003 to 2004. *See* Daily Trans., 4848:19-4849:4 (Alsup Testimony). Mr. Alsup holds a degree in poultry science from the University of Arkansas. *See* Daily Trans., 4848:11-15 (Alsup Testimony).

[68] Mr. Roger Collins was a poultry grower for Defendant Simmons from 1995 to 2005 in the northeastern Oklahoma portion of the IRW. *See* Daily Trans., 3889:7-25 (Collins Testimony). He has been a licensed poultry waste applicator for 6-7 years during which time he has hauled poultry waste from the Tyson Defendants' complexes. *See* Daily Trans., 3891:7-14, 3918:25-3919:3 (Collins Testimony).

(Saunders Testimony); Court's Ex. 7 at p. 4 (Butler Depo.); Daily Trans., 4668:22-23, 4683:25-4684:2 (Maupin Testimony); Daily Trans., 4942:1-16 (Alsup Testimony); State's Ex. 6269-A4 at ¶¶ 10-12; Daily Trans., 3028:17-3029:3 (Henderson Testimony); State's Ex. 3051 at ¶ I.A; Daily Trans., 4125:1-3 (Simmons Testimony); Daily Trans., 3915:14-23 (Collins Testimony); Daily Trans., 4271:7-11, 4271:24-25 (Murphy Testimony);[69] Daily Trans., 4416:1-10, 4417:21-23 (Storm Testimony); State's Ex. 6062 at ¶¶ 4-5.

318. Each Defendant determines / mixes the feed constituents in the feed consumed by its birds in the IRW. *See* Daily Trans., 3373:5-6 (Pilkington Testimony); Daily Trans., 3757:14-16 (Pigeon Testimony); Daily Trans., 4071:6-8 (Anderson Testimony); Daily Trans., 4737:12-4738:18 (Maupin Testimony); Daily Trans., 4942:1-16 (Alsup Testimony); State's Ex. 6269-A4 at ¶ 10; Daily Trans., 3028:25-3029:3 (Henderson Testimony); Daily Trans., 4272:22-24 (Murphy Testimony); Daily Trans., 4808:17-25 (Houtchens Testimony); Court's Ex. 6 at p. 8 (Wear Depo); Daily Trans., 4417:24-4418:8 (Storm Testimony); Daily Trans., 3915:22-23.

319. Each Defendant provides all veterinary services required for its birds in the IRW. *See* Daily Trans., 6770:20-6771:2 (Taylor Testimony); State's Ex. 4957; Daily Trans., 3373:7-9 (Pilkington Testimony); Daily Trans., 3759:4-6 (Pigeon Testimony); Daily Trans., 4071:20-21 (Anderson Testimony); Daily Trans., 4538:5-7 (Saunders Testimony); Daily Trans., 4942:1-16 (Alsup Testimony); DJX-2655 at p. 34; Daily Trans., 3916:8-10 (Collins Testimony); Daily Trans., 4272:4-6 (Murphy Testimony); Daily Trans., 4417:12-15 (Storm Testimony).

---

[69] Mr. Gary Murphy has been president of poultry operations for Defendant Simmons for 7 years. *See* Daily Trans., 4253:20-4254:2 (Murphy Testimony). He began employment with Defendant Simmons in 1991 as a director of special projects and was promoted to manager of the Southwest City complex and to manager of the slaughter operations. *See* Daily Trans., 4254:5-12 (Murphy Testimony).

320. Each Defendant provides the medications required for its birds in the IRW. *See* Daily Trans., 6770:20-6771:2 (Taylor Testimony); State's Ex. 4957; Daily Trans., 3373:10-12 (Pilkington Testimony); Daily Trans., 4067:9-10, 4071:14-19 (Anderson Testimony); Daily Trans., 4537:25-4538:4 (Saunders Testimony); Court's Ex. 7 at p. 3 (Butler Depo.); Daily Trans., 4668:24-4669:2 (Maupin Testimony); State's Ex. 6269-A4 at ¶ 10; DJX-2655 at p. 34; State's Ex. 3051 at ¶ I.A; Daily Trans., 3915:24-3916:4 (Collins Testimony); Daily Trans., 4272:1-3 (Murphy Testimony); Court's Ex. 6 at p. 8 (Wear Depo); Daily Trans., 4417:16-20 (Storm Testimony).

321. Defendants decide when they will place birds with their growers in the IRW. *See* Daily Trans., 3373:13-15 (Pilkington Testimony); Daily Trans., 3753:21-23 (Pigeon Testimony); Daily Trans., 4072:9-11 (Anderson Testimony); Daily Trans., 4537:18-19 (Saunders Testimony); Daily Trans., 4682:18-20 (Maupin Testimony); State's Ex. 6269-A4 at ¶ 1; State's Ex. 3051 at ¶ I.A; Daily Trans., 3917:1-3 (Collins Testimony); Daily Trans., 4272:7-9 (Murphy Testimony); Court's Ex. 6 at p. 7 (Wear Depo).

322. Defendants decide how many birds they will place with their growers in the IRW. *See* Daily Trans., 3753:21-23 (Pigeon Testimony); Daily Trans., 4537:15-17 (Saunders Testimony); State's Ex. 6269-A4 at ¶¶ 1 & 10; State's Ex. 3051 at ¶ I.A; State's Ex. 6419 at Reed.0001; Court's Ex. 6 at p. 7(Wear Depo); Daily Trans., 3373:13-15 (Pilkington Testimony); Daily Trans., 4272:7-9 (Murphy Testimony).

323. Each Defendant decides when it will pick up the birds it places with its growers in the IRW. *See* Daily Trans., 3373:16-17 (Pilkington Testimony); Daily Trans., 3753:24-3754:1 (Pigeon Testimony); Daily Trans., 4067:3-5, 4072:9-11 (Anderson Testimony); Daily Trans., 4537:20-22 (Saunders Testimony); Daily Trans., 4683:1-4 (Maupin Testimony); State's Ex.

6269-A4 at ¶ 5; State's Ex. 3051 at ¶ I.B; DJX-2655 at p. 39; Daily Trans., 3917:4-5 (Collins Testimony); Daily Trans., 4272:13-15 (Murphy Testimony); Court's Ex. 6 at p. 8 (Wear Depo); State's Ex. 6062 at ¶ 1 (molting);[70] Daily Trans., 4426:18-20 (Storm Testimony) (Cal-Maine determines when to induce molting).

324. Defendants supply the trucks and catchers when they pick up their birds in the IRW. *See* Daily Trans., 3759:10-12 (Pigeon Testimony); Daily Trans., 4686:10-12 (Maupin Testimony); DJX-2655 at p. 39; Daily Trans., 3916:16-18 (Collins Testimony); Daily Trans., 4272:16-21 (Murphy Testimony); Daily Trans., 4534:6-8 (Saunders Testimony).

325. Defendants set minimum specifications for the house where they place their birds in the IRW. *See* Daily Trans., 6771:3-12 (Taylor Testimony); State's Ex. 4957; Daily Trans., 3373:19-3374:3 (Pilkington Testimony); Court's Ex. 7 at p. 11 (Butler Depo.); Daily Trans., 4664:25-4665:8 (Maupin Testimony); State's Ex. 6269-A4 at ¶ 6; State's Ex. 3051 at ¶ I.C; Daily Trans., 4277:17-19 (Murphy Testimony); Daily Trans., 3727:8-13 (Pigeon Testimony).

326. Each Defendant regularly visits its growers to inspect and supervise / give advice and recommendations to the growing operations where it places its birds in the IRW. *See* Daily Trans., 6771:13-6772:6 (Taylor Testimony); State's Ex. 4957; Daily Trans., 3374:4-20, 3417:17-3419:2 (Pilkington Testimony); Daily Trans., 3759:7-9, 3762:24-3763:1, 3763:17-24; 3723:24-3724:8 (Pigeon Testimony); Daily Trans., 4067:23-4068:3, 4071:23-4072:2, 4073:14-4074:17, 4076:5-9 (Anderson Testimony); Daily Trans., 4538:11-18, 4539:8-4540:19 (Saunders Testimony); Court's Ex. 7 at 15-16, 21-23 (Butler Depo.); Daily Trans., 4684:3-6, 4684:17-4685:5, 4685:16-19, 4686:2-9 (Maupin Testimony); Daily Trans., 4942:1-16, 4943:16-18 (Alsup

[70] Molting extends the productive life of the Cal-Maine laying hen, but at the expense of the contract producer who loses "egg-pay" income during the molting period as the hen produces no eggs while molting. When molting is induced the entire flock is taken out of production. *See* Daily Trans., 4424:20-4426:20 (Storm Testimony).

Testimony); Daily Trans., 3041:14-16, 3042:7-8, 3042:14-21 (Henderson Testimony); Daily Trans., 3916:11-15, 3917:22-24 (Collins Testimony); Daily Trans., 4267:23-4268:21, 4269:20-25 (Murphy Testimony); Daily Trans., 4430:21-4431:5 (Storm Testimony); State's Ex. 6062 at ¶ 2.

327. Defendants inspect the grow houses in the IRW before they place a flock of their birds. *See* Daily Trans., 3376:10-13 (Pilkington Testimony); Daily Trans., 3756:12-24, 3757:5-8 (Pigeon Testimony); Daily Trans., 4070:24-4071:1 (Anderson Testimony); Daily Trans., 4673:15-18 (Maupin Testimony); Daily Trans., 4273:10-20 (Murphy Testimony).

328. Defendants specify / make recommendations regarding clean-outs and cake-outs of their growers' houses in the IRW. *See* Daily Trans., 3376:20-3377:9, 3420:19-3421:5 (Pilkington Testimony); Court's Ex. 7 at p. 6 (Butler Depo.); State's Ex. 6472B at ¶ 8 ("The Producer shall be responsible for removing all dead birds and litter and shall dispose of such in accordance with the Company's specifications and applicable laws"); Daily Trans., 4695:7-4696:16 (Maupin Testimony); Daily Trans., 4954:15-17 (Alsup Testimony); State's Ex. 6269-A4 at ¶ 7 ("Grower will be required to remove and replace litter; if and when Cargill, in its discretion, deems it necessary to protect the health of any subsequent flocks"); State's Ex. 6109A at CARTP000057 ("We recommend cleaning the brood barn to the ground after each flock"); Daily Trans., 4311:23-4312:22 (McClure Testimony);[71] DJX2655 at 007 ("Perform a complete clean-out at least once each year."); Daily Trans., 4277:4-16, 4302:13-16 (Murphy Testimony); Daily Trans., 4549:22-4550:3 (Saunders Testimony); Daily Trans., 4837:7-9 (Houtchens Testimony).

---

[71] Mr. Benny McClure has been employed as the live production manager for the George's Defendants since 2002, and prior to that he was broiler manager for five years. *See* Daily Trans., 4304:3-4305:7 (McClure Testimony).

329. Defendants retain discretion to terminate contracts with their growers, not deliver birds, and / or take care of the birds that they place in the IRW themselves. *See* Daily Trans., 6772:7-12 (Taylor Testimony); Daily Trans., 3430:2-18 (Pilkington Testimony); Court's Ex. 7 at p. 2 (Butler Depo.); Daily Trans., 4686:13-18 (Maupin Testimony); State's Ex. 6269-A4 at ¶¶ 19-21; Daily Trans., 3047:1-3049:9 (Henderson Testimony); Daily Trans., 4272:10-12 (Murphy Testimony); Daily Trans., 4422:17-4423:6 (Storm Testimony); State's Ex. 6062 at ¶ 10.

330. Defendants' contracts with their growers in the IRW are non-negotiable. *See* Daily Trans., 6775:5-8 (Taylor Testimony); Daily Trans., 3756:13-16 (Pigeon Testimony); Daily Trans., 4060:25-4061:3, 4063:4-7, 4065:5-8, 4069:22-24, (Anderson Testimony); Daily Trans., 4781:13-17 (Maupin Testimony); Daily Trans., 3114:8-12, 3115:5-7 (Henderson Testimony); Daily Trans., 3915:11-13 (Collins Testimony); Daily Trans., 4276:24-4277:3 (Murphy Testimony); Court's Ex. 6 at pp. 10-11 (Wear Depo).

331. Each Defendant sets the payment schedule for the birds it places with its growers in the IRW. *See* Daily Trans., 4072:3-5 (Anderson Testimony); Daily Trans., 4538:19-24 (Saunders Testimony); Daily Trans., 4686:19-21 (Maupin Testimony); State's Ex. 3051 at ¶ I.C; Daily Trans., 4273:7-9 (Murphy Testimony); Court's Ex. 6 at p. 14 (Wear Depo); State's Ex. 6062 at ¶ 5.

332. Defendants' contracts with their growers in the IRW are typically short-term (year-to-year or flock-to-flock). *See* Daily Trans., 6772:13-6774:2 (Taylor Testimony); State's Ex. 4957; Daily Trans., 4070:3-8 (Anderson Testimony); State's Ex. 6269-A4 at ¶ 2; State's Ex. 3051 at ¶ I.A; Daily Trans., 3915:8-10 (Collins Testimony); Daily Trans., 4289:6-10 (Murphy Testimony); Daily Trans., 4537:10-12 (Saunders Testimony); Daily Trans., 4423:7-15, 4424:9-16 (Storm Testimony); State's Ex. 6062 at ¶ 1.

333. The Tyson Defendants, the Cargill Defendants, the George's Defendants and Defendant Peterson provide their growers in the IRW with a grower and / or environmental handbook. *See* Daily Trans., 4073:2-5 (Anderson Testimony); Daily Trans., 3344:25-3345:10 (Keller Testimony);[72] State's Ex. 1283; State's Ex. 6269-A4 at ¶ 8; State's Ex. 6131A; Daily Trans., 4676:13-4677:10; 4697:22-4698:9; 4767:6-16; 4774:11-4775:6 (Maupin Testimony); Daily Trans., 4864:12-21 (Alsup Testimony); Daily Trans., 4310:3-14 (Murphy Testimony); Daily Trans., 4548:5-7; 4542:21-4543:3 (Saunders Testimony).

334. Defendants provide signage for the growing operations in the IRW where their birds are raised. *See* Daily Trans., 3378:7-3379:8 (Pilkington Testimony); State's Ex. 6924-OKPL0007130; Daily Trans., 4051:11-12 (Anderson Testimony); Daily Trans., 4687:1-4 (Maupin Testimony); Daily Trans., 3049:18-3050:4 & 3056:24-3057:2 (Henderson Testimony); State's Ex. 6923-STOK0043577; State's Ex. 6924-OKPL0012227; State's Ex. 6924-OKPL0006069; State's Ex. 6924-OKPL0006301; Daily Trans., 4464:24-4465:1 (Reed Testimony);[73] Daily Trans., 3767:15-20 (Pigeon Testimony); Daily Trans., 4838:4-12 (Houtchens Testimony).

* * *

---

[72] Preston Keller held various positions at Defendant Tyson. He started his employment with Tyson in approximately 1998 as a nutrient management specialist, providing regulatory training and education for Tyson's contract growers. *See* Daily Trans., 3311:12-14 & 3312:5-11 (Keller Testimony). About two years later, Mr. Keller was promoted to regional director of the environment, during which time he dealt with a wider realm of environmental issues. *See* Daily Trans., 3313:23-3314:10 (Keller Testimony). About a year and a half later, Mr. Keller became director of environmental agriculture, overseeing all the environmental issues dealing with the animal side of production for beef, pork and poultry. *See* Daily Trans., 3314:11-15 & 3315:2-5 (Keller Testimony). Mr. Keller held that position until his departure from Tyson in 2005. *See* Daily Trans., 3314:23-3315:1 (Keller Testimony).

[73] Mr. Joel Reed was a grower for the George's Defendants from 1987 to 1990, and since 1990 has been a grower in the northeastern Oklahoma portion of the IRW for Defendant Simmons. *See* Daily Trans., 4464:10-4465:23 (Reed Testimony).

335. The costs for a grower to enter the poultry growing business are significant. A typical growing operation in the IRW has about four growing houses. *See* Daily Trans., 1779:4-5 (Fisher Testimony); Daily Trans., 6777:3-6 (Taylor Testimony). The typical cost for a grow house and equipment in the IRW is in the low- to mid-$200,000 range. *See* Daily Trans., 6777:15-6778:2 (Taylor Testimony). Thus, a typical grower in the IRW has an investment between one-half to three-quarters of a million dollars invested in grow houses and equipment. *See* Daily Trans., 6778:5-6 (Taylor Testimony). Loans are typically twelve to fifteen years on grow houses and seven years on equipment, but because of house and equipment upgrades over the life of the house, the typical economic payback period on a grower's investment is 20 to 30 years. *See* Daily Trans., 6778:7-16 (Taylor Testimony).

336. There are currently very few integrators operating in the IRW: only three defendant groups involved in broiler production and only one defendant group involved in turkey production. *See* FOF, ¶¶ 303-311.

337. There is no open market in the IRW for commercial broilers, turkeys or eggs. *See* Daily Trans., 6779:12-6780:1 (Taylor Testimony).

338. As noted above, Defendants' contracts with their growers are typically short-term, *see* FOF, ¶¶ 332, and growers have no assurance that they will continue to receive birds from Defendants for a long enough time to cover the 20- to 30-year economic payback period on their investment in grow houses and equipment. *See* Daily Trans., 6778:17-6779:3 (Taylor Testimony).

339. Changing from one integrator to another integrator in the IRW would not materially change a grower's circumstance because, as Dr. Taylor -- who reviewed several hundred IRW contracts in formulating his opinion -- explained, "it would be changing from one

contract to a similar contract with a different integrator." *See* Daily Trans., 6776:3-21; 6768:10-23 (Taylor Testimony). Dr. Rausser, who critiques Dr. Taylor's conclusion and opines that the existence of the option for a grower to switch integrators is "critical," did not, however, review any IRW contracts and did not evaluate if grower pay was more or less following a switch. *See* Daily Trans., 10146:3-22; 10181:14-19; 10183:19-22 (Rausser Testimony). In fact, the Court is aware of no evidence in the record reflecting where an actual grower in the IRW switched from one Defendant to another and was paid more following the switch. In any event, as Dr. Taylor testified, the ability to switch integrators is of "no significance" with respect to evaluating bargaining power. *See* Daily Trans., 6954:25-6955:5 (Taylor Testimony).

340. There appears to be no dispute between the two sides that Defendants' vertical integration business model has resulted in certain market risks -- *e.g.*, fluctuations in prices of chicks, feed and mature birds -- being transferred from the growers to the poultry integrators. *See* Daily Trans., 10117:17-10118:9 (Rausser Testimony).[74] However, at the same time, growers must make significant long-term investments to raise birds for which there is no open market, no guarantee of long-term continued placement of birds such that the long-term investment can be recaptured, and only a very limited number of integrators with which to deal. *See* FOF, ¶¶ 335.

---

[74] Dr. Gordon Rausser holds Ph.D.s in agricultural and resource economics and in mathematical statistics. *See* Daily Trans., 10107:18-23 (Rausser Testimony). He currently holds the position of Robert Gordon Sproul Distinguished Professor at the University of California at Berkeley. *See* Daily Trans., 10108:5-8 (Rausser Testimony). Dr. Rausser has previously served as editor of the *American Journal of Agricultural Economics*, as well as an associate editor of the *Journal of the American Statistical Association* and the *Journal of Economic Dynamics and Control*. *See* Daily Trans., 10110:1-8 (Rausser Testimony). He is currently serving as editor of the *Annual Reviews of Resource Economics*. *See* Daily Trans., 10110:9-11 (Rausser Testimony). He has published over 250 journal articles and authored or edited 15 books. *See* Daily Trans., 10111:17-20 (Rausser Testimony). Dr. Rausser also has previously served as a senior economist on the President's Council of Economic Advisors and chief economist of the Agency for International Development from 1988 to 1990. *See* Daily Trans., 10111:1-14 (Rausser Testimony). Dr. Rausser testified as a retained expert for Defendants.

Simply put, the transfer of market risks in favor of a vertically-integrated business model comes at the price of a sacrifice of independence for the grower.

341. As cogently explained by Dr. Taylor, from a descriptive economic viewpoint,[75] Defendants have and exercise control over all essential aspects of poultry production in the IRW:

> Mr. Riggs: To sum up, then, how would you characterize this economic relationship which exists between the integrators and their growers in the IRW?
> Dr. Taylor: It's one where the integrator controls almost all aspects of production and largely controls the economic fate of the grower.
> Mr. Riggs: How much independence do growers actually have in this relationship?
> Dr. Taylor: Very little.
> * * *
> Mr. Riggs: . . . Can vertical integration actually work if a truly independent contractor controls one phase of the production?
> Dr. Taylor: No. That would not be full vertical integration.

See Daily Trans., 6780:2-10, 6780:20-24 (Taylor Testimony); *see also* Daily Trans., 4187:24-25 (Simmons Testimony) ("I have tremendous influence over an individual grower and their chicken barns.").

342. A close analysis of the testimony by Defendants' expert Dr. Rausser reveals that he does not necessarily disagree that Defendants have market power or potential leverage over growers because growers undertake long-term investments in building houses and acquiring equipment while having contracts that only guarantee a single flock of birds. *See* Daily Trans., 10139:6-18; 10185:21-22 (Rausser Testimony) ("It is true, as your question suggests, that once I make these commitments, I am locked in --"). Rather, Dr. Rausser simply concludes that he has seen no evidence that such control has not been <u>actually</u> exercised, and that in fact actual exercise of that control would be counter to Defendants' economic interests. *See* Daily Trans.,

---

[75] Descriptive economics is viewed as positive economics and describes what is actually happening, which is in contrast to normative economics, which describes what should happen. *See* Daily Trans., 6763:18-6764:5 (Taylor Testimony).

10185:25-10186:16; 10139:16-10140:1; 10125:15-10126:2 (Rausser Testimony) ("[T]he question is, is it in the interest -- the economic interest of the integrator to exercise that power? This is referred to in the economic literature as hold-up. Once you get the grower locked in to the investment and having external financing, you can suddenly exercise some power over that grower because he or she are locked in because of their external commitments beyond the contract, another contract with regard to a financier. But now, what is the economic incentive? If I've got good growers that are providing very effective management skills, it's not in my economic interest to harm them because I want that volume, I need that throughput because I've got to manage my economics downstream as well."). Simply because economic power has not necessarily been exercised, however, does not mean it does not exist or cannot be exercised in the future.

343. This Court finds that Defendants have and exercise control over all essential aspects of poultry production in the IRW, including the activities of their contract growers.

344. This finding is not changed by grower professions of independence, *see, e.g.*, Daily Trans., 4598:15-4599:10 (Saunders Testimony); Daily Trans., 3926:22-3927:4 (Collins Testimony), inasmuch as the nature of the relationship between integrators and growers is not determined by how the parties characterize it but rather by the objective facts taken as a whole.

C. Characteristics, Concentration and Locations

345. Broilers, breeders, layers, pullets and turkeys are raised in the IRW, with the overwhelming majority of the birds being broilers. *See* Daily Trans., 1779:12-1780:9 (Fisher Testimony).

346. As noted above, a typical growing operation in the IRW has about four grow houses. *See* Daily Trans., 1779:4-5 (Fisher Testimony); Daily Trans., 6777:6-7 (Taylor

Testimony). A grow house in a typical broiler operation houses approximately 20,000 birds. *See* Daily Trans., 1781:2-9 (Fisher Testimony). A typical broiler grow house is used to raise between five and six flocks per year. *See* Daily Trans., 1781:10-15 (Fisher Testimony). Thus, at any given time during the year, a typical broiler operation is housing 80,000 birds, and over the course of the year housing 400,000 to 480,000 birds. *See* Daily Trans., 1781:20-1782:5 (Fisher Testimony).

347. The IRW has a high concentration of poultry feeding operations. *See* Daily Trans., 6765:3-11, 6765:20-24 (Taylor Testimony); Daily Trans., 4734:11-13 (Maupin Testimony); Daily Trans., 3068:16-18 (Henderson Testimony); Daily Trans., 354:14-19 (Tolbert Testimony). Indeed, between 2000 and 2007, more than 1.1 billion birds belonging to Defendants were raised in the IRW. *See* State's Ex. 2522.

348. There are approximately 1,900 active poultry houses in the IRW. *See* Daily Trans., 1723:24-1724:6 (Fisher Testimony) (testifying to 1,917 active poultry houses in the IRW). The majority of these poultry houses are located in the Arkansas portion of the IRW. *See* State's Ex. 5665 at pp. 8 & 11 (stating that there are 425 poultry houses in the Oklahoma portion of the IRW and 1455 poultry houses in the Arkansas portion of the IRW); *see also* State's Ex. 913; State's Ex. 883; State's Ex. 6124; State's Ex. 847; State's Ex. 939; State's Ex. 855; State's Ex. 954; State's Ex. 950; State's Ex. 879; State's Ex. 2722.

349. The locations of poultry growing operations affiliated with Defendants in the IRW are dictated largely by the locations of Defendants' respective feed mills and processing plants. *See* Daily Trans., 6781:11-6782:13 (Taylor Testimony); Daily Trans., 6781:24-6782:7 (Taylor Testimony); Daily Trans., 3038:4-3039:2 (Henderson Testimony); Daily Trans., 4256:8-

22 (Murphy Testimony); Daily Trans., 3978:4-17-3979:2 (Henderson Testimony); Daily Trans., 4798:3-6, 4798:21-4 (Houtchens Testimony).

350. Environmental concerns are not a factor in Defendants' selection of the locations of their growers. *See* Daily Trans., 6782:14-17 (Taylor Testimony). Rather, the dense concentrations of growers in the IRW results from decisions made by Defendants for purely economic reasons. *See* Daily Trans., 6782:8-13 (Taylor Testimony). In fact, having too many growers in a concentrated area has never been a concern expressed by Defendants in locating their growers. *See* Daily Trans., 6783:11-13 (Taylor Testimony).

351. Growers have no control over how many other growers are located near them. *See* Daily Trans., 6783:11-13 (Taylor Testimony).

D. Summary

352. Based upon the foregoing factual findings, the Court finds that each Defendant has or has had significant poultry operations in the IRW.

353. Based upon the foregoing factual findings, the Court finds that Defendants have and exercise control over all essential aspects of poultry production in the IRW, including the activities of their contract growers.

XI. Poultry Waste and Its Generation

354. Poultry waste is a combination of poultry litter and poultry excrement. *See, e.g.*, 2 Okla. Stat. 10-9.1(B)(21) ("Poultry waste" means poultry excrement, poultry carcasses, feed wastes or any other waste associated with the confinement of poultry from a poultry feeding operation"). Poultry litter is a particulate matter that is used to absorb liquids from poultry excrement; it is generally made of wood shavings or rice hulls. *See* Daily Trans., 1802:15-19

(Fisher Testimony). Wheat straw is also sometimes used. *See* Daily Trans., 3843:25-3844:5 (Pigeon Testimony).

355. "Poultry waste 'necessarily follows' from the 'growing' of poultry." *See City of Tulsa v. Tyson Foods, Inc.*, 258 F.Supp.2d 1263, 1296-97 (N.D. Okla. 2003), *vacated in connection with settlement*; *see also* Daily Trans., 4127:20-4128:5 (Simmons Testimony); Daily Trans., 3385:8-13 (Pilkington Testimony).

356. Poultry waste is periodically removed from the grow houses through procedures called "cake-out" or "clean-out." A cake-out is "a process that's done between flocks. There's a machine that goes through -- it's a tractor-drawn machine that you pull through the house, and it removes a layer of crusted, damp litter that's on the top of the bedding. It removes that and sifts the dry litter back onto the floor." *See* Daily Trans., 3729:19-24 (Pigeon Testimony); Daily Trans., 3376:24-3377:1 (Pilkington Testimony). A clean-out is "the removal of all litter from [one's] poultry houses." *See* DJX 2654 at p. 3-1.

357. Once poultry waste is removed from the grow house, it has no further role in growing poultry. *See* Daily Trans., 3385:14-18 (Pilkington Testimony); Daily Trans., 4077:1-7 (Anderson Testimony); Court's Ex. 7 at 65 (Butler Depo.); Daily Trans., 4687:24-4688:2 (Maupin Testimony); Daily Trans., 3077:24-3078:3 (Henderson Testimony); Daily Trans., 4128:8-11 (Simmons Testimony); Daily Trans., 3903:7-10 (Collins Testimony); Daily Trans., 3735:18-22 (Pigeon Testimony); Daily Trans. 4454:19-22 (Storm Testimony).

358. Defendants' contracts with their growers, with the exception of Defendant Peterson's contracts after 1999, do not transfer ownership of the poultry waste to the growers. *See* Daily Trans., 6774:7-18 (Taylor Testimony); Court's Ex. 7 at p. 4 (Butler Depo.); Daily Trans., 4687:12-23 (Maupin Testimony); State's Ex. 6269-A4; Daily Trans., 3027:2-12

(Henderson Testimony); State's Ex. 3051; Daily Trans., 4518:21-4519:7 (Bronson Stipulation); State's Ex. 6062. As noted above, however, the terms of Defendant Peterson's contracts with its growers are non-negotiable -- even as to responsibility for poultry waste. *See* FOF, ¶¶ 330-358; Court's Ex. 6 at p. 14 (Wear Depo.) ("Q: Can [the grower] negotiate who has responsibility for the poultry litter produced in the growing operation? A: No. Q: Has that ever been negotiated with any grower? A: It's -- not to my knowledge, no."). Moreover, Defendant Peterson's employee assigned to environmental issues wrote that he believed that irrespective of ownership, poultry integrators would be found liable for the effect it has on the environment. *See* State's Ex. 6378 (3/27/98 Mullikin to Henderson memo) ("I personally have no opinion on whether or not the integrator or the grower owns the litter. I do feel, without any doubt, that as time passes, we the integrator will be found to be liable for it and the affect [sic] it has on our environment. . . . Dan, I feel the direction Peterson Farms and all integrators would be best served to focus its resources towards, would be alternative uses. Things such as using litter as bedding, feed, fertilizer, and fuel are just a few of the uses I've found some information on. Each of these uses has it's [sic] own set of benefits and short-comings. But they all address the environmental need to stop applying litter to our local pasture lands.").

A. Constituents of Poultry Waste

359. The constituents of poultry waste are a function of what is fed to the poultry. *See* Daily Trans., 1800:9-18 (Fisher Testimony).

360. Defendants' poultry feed contains a number of constituents. The two largest constituents contained in poultry feed are corn and soybeans. *See* Daily Trans., 1795:17-18 (Fisher Testimony). Poultry feed also contains milling and baking waste. *See* Daily Trans., 1795:18-19 (Fisher Testimony). In addition to whatever might exist in these grains, Defendants

also add fats to the feed (*e.g.*, poultry fat that has been recycled from processing), phosphorus compounds (*e.g.*, defluoridated phosphate, calcium phosphate),[76] sodium chloride, potassium salts (*e.g.*, potassium sulfate, potassium chloride), amino acids, and trace minerals, including copper compounds (e.g., copper sulfate, copper chloride), zinc compounds (*e.g.*, zinc oxides, zinc proionate). *See* Daily Trans., 1795:24-1796:9 & 1797:1-23 (Fisher Testimony). Arsenic compounds (*e.g.*, roxarsone) are also added to some Defendants' feed. *See* Daily Trans., 1798:22-1799:12 (Fisher Testimony). Defendant Tyson discontinued adding arsenic compounds several years ago. *See* Daily Trans., 1799:16-20 (Fisher Testimony). Defendant Cal-Maine never added arsenic compounds to its feed. *See* Daily Trans., 2694:20-22 (Fisher Testimony).

361. Virtually all the feed that is fed to Defendants' birds in the IRW, as well as the phosphorus supplements added to that feed, is imported into the IRW. *See* Daily Trans., 5838:2-9; 5838:16-5839:16 (Engel Testimony); Daily Trans., 1796:12-17 (Fisher Testimony); Daily Trans., 3428:25-3429:4; 3434:12-24 (Pilkington Testimony); Daily Trans., 4737:12-4738:2 (Maupin Testimony); Daily Trans., 3039:20-3041:2; (Henderson Testimony); Daily Trans., 4125:18-4126:14 (Simmons Testimony).

362. Poultry waste generated by Defendants' birds in the IRW contains, among other things, phosphorus, zinc, copper and arsenic. *See* Daily Trans., 1808:19-1809:1 (Fisher Testimony); State's Ex. 2523; *see also* State's Ex. 6506 at p. 3 ("Poultry manure is also composed of relatively large amounts of phosphorus"); Daily Trans., 1521:16-18 (Phillips Testimony) (testifying that poultry waste contains a high amount of soluble phosphorus). Samples of poultry waste generated by Defendants' birds in the IRW were analyzed, and the average concentration

[76] Phosphorus compounds are added to the feed for the purpose of maintaining bone-strength in the poultry. *See* Daily Trans., 1796:12-17 (Fisher Testimony). Because they grow very quickly, poultry can outstrip their ability to produce strong bones and the birds bones can break during their growth cycle. *See* Daily Trans., 1796:18-24 (Fisher Testimony).

of total phosphorus in this poultry waste is 19,723.31 mg/Kg (or approximately two percent of the total weight of poultry waste on a dry weight basis); the average concentration of water soluble phosphorus is 1,699.11 mg/Kg; the average concentration of zinc is 488.47 mg/Kg; the average concentration of copper is 420.16 mg/Kg; the average concentration of arsenic is 19.75 mg/Kg. *See* State's Ex. 2523; Daily Trans., 1812:14-1813:4 (Fisher Testimony). These values compare favorably with literature values, as well as with an analysis of a large set of poultry waste samples from the neighboring Eucha-Spavinaw Watershed. *See* Daily Trans., 1817:6-14 (Fisher Testimony).

363. A comparison of the concentrations, as well as the concentration ratios, of phosphorus, copper, zinc and arsenic found in poultry waste with the concentrations and concentration ratios of such chemicals found in cattle manure and wastewater treatment plant discharges, reveals that they are distinctly different from one another. *See* Daily Trans., 1824:20-1837:24; 1815:24-1816:13 (Fisher Testimony); State's Ex. 2518; State's Ex. 2525.

B. Amounts

364. The dense concentration of poultry production in the IRW, *see* FOF, ¶ 347-350, which occurs due to the economic considerations of Defendants, *see* FOF, ¶ 350, necessarily leads to a dense concentration in the production of poultry waste in the IRW. *See* FOF, ¶ 355.

365. Various estimations of the aggregate amount of poultry waste generated by Defendants' birds in the IRW were offered by the State and Defendants. For instance, using various methodologies, the State's experts arrived at estimates ranging from 354,000 tons/yr. to 528,000 tons/yr. *See* State's Ex. 1227. The State and the State's experts used the most conservative of these estimates -- 354,000 tons/yr., and given that Defendants never seriously

disputed the accuracy of this figure, the Court finds this figure to be a credible estimate of the amount of poultry waste generated annually in the IRW by Defendants' birds.

366. Broken down by Defendant group, this translates to approximately 167,000 tons having been generated annually by the Tyson Defendants' birds, approximately 18,000 tons having been generated annually by the Cargill Defendants' birds, approximately 60,000 tons having been generated annually by the George's Defendants' birds, approximately 66,000 tons having been generated annually by Defendant Simmons' birds, approximately 37,000 tons having been generated annually by Defendant Peterson's birds, and approximately 3,000 tons having been generated annually by Defendant Cal-Maine's birds. *See* State's Ex. 2532.

367. The poultry waste being generated by Defendants' birds in the IRW contains substantial amounts of phosphorus. Between 2001 and 2006, the poultry waste generated by Defendants' birds contained an average of 8.7-10 million lbs. of phosphorus annually. *See* Daily Trans., 5685:19-5686:5 (Engel Testimony). From 2001 to 2006, the poultry waste generated by the Tyson Defendants' birds contained between 4,0881,52 and 4,461,513 lbs. of phosphorus annually. From 2001 to 2006, the poultry waste generated by the Cargill Defendants' birds contained between 1,118,799 and 1,720,395 lbs. of phosphorus annually. *See* State's Ex. 1223. From 2001 to 2006, the poultry waste generated by the George's Defendants' birds contained between 1,404,951 and 1,658,320 lbs. of phosphorus annually. *See* State's Ex. 1223. From 2001 to 2006, the poultry waste generated by Defendant Simmons' birds contained between 768,007 and 1,575,910 lbs. of phosphorus annually. *See* State's Ex. 1223. From 2001 to 2006, the poultry waste generated by Defendant Peterson's birds contained between of 543,414 and 858,725 lbs. of phosphorus annually. *See* State's Ex. 1223. From 2001 to 2005, the poultry

waste generated by Defendant Cal-Maine's birds contained between 71,837 and 396,398 lbs. of phosphorus annually. *See* State's Ex. 1223.

368. Based upon data provided by BMPs, Inc. and the George's Defendants, in 2003 approximately 8,877 tons (or 2.51 percent) of the poultry waste generated in the IRW was hauled out of the watershed. *See* Ex. 2535. In 2004 the amount was 12,312 tons (or 3.48 percent), in 2005 the amount was 34,437 tons (or 9.73 percent), and in 2006 the amount was 69,019 tons (or 19.50 percent). *See* Ex. 2535. The average amount removed during these four years was 8.80 percent. *See* Ex. 2535. Defendants did not present evidence disputing the State's expert's calculation of the amount of poultry waste being hauled out of the IRW annually.

369. In addition to these exports, it should not be overlooked that poultry waste generated by Defendants' birds outside the IRW is imported to and land applied in the IRW. *See* Daily Trans., 1930:10-14 (Fisher Testimony); Daily Trans., 6603:1-6604:15 (Engel Testimony); *see also* Daily Trans., 9849:23-25 (Clay Testimony)[77] (Defendants' retained expert agreeing that it is possible that some poultry waste may have been imported into the IRW).

C. Summary

370. Based upon the foregoing factual findings, the Court finds that each Defendant's birds have generated, and with the exception of Defendant Peterson and Defendant Cal-Maine, are generating, enormous quantities of phosphorus-rich poultry waste in the IRW.

XII. Poultry Waste Land Application

[77] Dr. Billy R. Clay received a DVM from Oklahoma State University and is board certified in veterinarian toxicology. *See* Daily Trans., 9802:11-16 (Clay Testimony). He is a member of numerous professional societies and has performed work for the Oklahoma Agricultural Experiment Station, pharmaceutical companies and many private enterprise entities. *See* Daily Trans., 9804:24-9805:15 (Clay Testimony). Dr. Clay testified as a retained expert for Defendants.

371. Poultry waste generated by birds owned by each Defendant has been land applied in the IRW. *See* Daily Trans., 1929:1-10; 1930:4-9 (Fisher Testimony) ("I found that in the case of all integrator defendants that poultry waste from operations that are associated with them were disposed of in the Illinois River Watershed").

A. Manner

372. It is the common practice to apply poultry waste generated in the IRW on land in the IRW. *See* Daily Trans., 3428:11-20 (Pilkington Testimony); Daily Trans., 4688:12-17 (Maupin Testimony); Daily Trans., 4864:3-8 (Alsup Testimony); Daily Trans., 3057:10-20 (Henderson Testimony); Daily Trans., 4128:12-20 (Simmons Testimony); Daily Trans., 4292:12-14 (Murphy Testimony); Daily Trans., 3959:4-8 (Henderson Testimony).

373. Application is typically done by a spreader truck that broadcasts the poultry waste over the land. *See* Daily Trans., 359:5-13 (Tolbert Testimony).

374. Land application of poultry waste occurs almost exclusively on grassland. *See* State's Ex. 3351 at OSU0005155.

375. Poultry waste generated by Defendants' birds that has been land applied in the IRW is spread on the surface without being incorporated into the soil. *See* Daily Trans., 1852:13-1853:3 (Fisher Testimony); Daily Trans., 959:8-12 (Fite Testimony); Daily Trans., 5184:14-16 (Johnson Testimony); Daily Trans., 4864:9-11 (Alsup Testimony); Daily Trans., 4292:15-16 (Murphy Testimony); Daily Trans., 3903:22-24 (Collins Testimony); Daily Trans., 4128:21-25 (Simmons Testimony); Daily Trans., 4803:11-14 (Houtchens Testimony); Daily Trans., 3965:20-23 (D. Henderson Testimony); Daily Trans., 3726:6-8 (Pigeon Testimony).

B. Timing

376. Although it occurs throughout the year, land application of poultry waste is concentrated in late winter and spring -- a time that coincides with significant rainfall in the IRW. *See* Daily Trans., 1960:12-17; 1961:15-1962:6 (Fisher Testimony); *see also* Daily Trans., 776:18-21 (Fite Testimony) (testifying that most land application occurs in March, April and early May and in the fall).

C. Location

377. Poultry waste generated by birds owned by Defendants has been land applied throughout the IRW. *See* State's Ex. 2516; Daily Trans., 1935:15-17 & 1954:9-17 (Fisher Testimony) ("I concluded that open spaces, that is pastures and grass lands, within the Illinois River Watershed had been almost all applied with poultry waste"); Daily Trans., 1269:8-25; 1270:14-19 (Phillips Testimony) (testifying that the Oklahoma Conservation Commission was unable to locate substantial pasture area within the IRW where poultry waste had not been land applied).

378. Poultry waste generated by Defendants' birds that is land applied in the IRW is generally applied in close proximity to where it is generated. *See* Daily Trans., 356:10-20 (Tolbert Testimony). Approximately 80 percent of the poultry waste that is land applied in the IRW is land applied within four miles of where it is generated, just a little less than 70 percent of such poultry waste is land applied within two miles of where it is generated. *See* Daily Trans., 1883:2-16; 1888:8-15 (Fisher Testimony); State's Ex. 2515.

379. By virtue of the fact that they have concentrated poultry growing operations in the IRW, *see* FOF, ¶¶ 347-350, the fact that they determine where poultry growing operations will be located in the IRW, *see* FOF, ¶¶ 349-350, and the fact that land application generally occurs

in close proximity to poultry growing operations, *see* FOF, ¶¶ 378, it necessarily follows that Defendants strongly influence the distribution of poultry waste disposal in the IRW.

D. Behavior of Phosphorus in the Soil and STPs

380. Poultry waste contains organic and inorganic phosphorus. *See* State's Ex. 3145; Daily Trans., 4988:7-21 (Johnson Testimony). The organic phosphorus in land-applied poultry waste is mineralized as microorganisms decay the organic matter, releasing water soluble phosphorus. *See* Daily Trans., 4988:17-21 (Johnson Testimony). The inorganic phosphorus in land-applied poultry waste initially is highly soluble and available to plants, but as it reacts with the soil, it becomes less soluble and less available to plants. *See* State's Ex. 3145. Specifically, phosphorus ions react with soil in one of two general ways: being adsorbed onto soil particles or forming compounds that are solids. *See* State's Ex. 3145.

381. In very basic terms, the water-soluble phosphorus from land-applied poultry waste enters the pool of phosphorus in the soil and establishes an equilibrium with the various forms of other phosphorus in the soil. *See* Daily Trans., 4988:23-4989:6 (Johnson Testimony). As plants absorb water soluble phosphorus, the natural equilibrium in the soil between water soluble phosphorus and other forms replenishes water soluble phosphorus from the other forms. *See* Daily Trans., 4990:7-17 (Johnson Testimony). In this situation, the equilibrium moves phosphorus from a bound form to a water soluble form. *See* Daily Trans., 4991:11-13 (Johnson Testimony). Conversely, if more water soluble phosphorus comes from an external source, the equilibrium moves water soluble phosphorus to the adsorbed form. *See* Daily Trans., 4991:21-4992:4 (Johnson Testimony). This equilibrium goes on all the time. *See* Daily Trans., 4992:5-8 (Johnson Testimony). If water soluble phosphorus, for instance, leaves in runoff the equilibrium

reaction makes more water soluble phosphorus available from other phosphorus in the soil. *See* Daily Trans., 4996:10-13 (Johnson Testimony).

382. Soil test phosphorus ("STP") relates soil phosphorus to crop response. *See* Daily Trans., 4992:19-24 (Johnson Testimony).

383. The principle pasture grasses grown in the IRW are fescue and bermuda grasses. *See* Daily Trans., 9864:23-9865:1; 9884:25-9885:2 (Clay Testimony). At an STP of 40 lbs. / acre, there is a 95 percent sufficiency of the phosphorus requirements for the growth of these grasses, while at an STP of 65 there is a 100 percent sufficiency.[78] *See* State's Ex. 3169; State's Ex. 3168; State's Ex. 3145 at p. 2 (Oklahoma Cooperative Extension Service reporting that "[s]cience-based fertilizer recommendations used by Oklahoma State University, based on decades of field and laboratory research, show a STP value of 65 is adequate for production of most crops"); Daily Trans., 5001:9-12 (Johnson Testimony); *see also* Daily Trans., 916:16 (Fite Testimony) (testifying that "[g]rass is not a real good user of phosphorus").

384. A field-average soil test of 120 (based on 15 to 20 cores per field) can be used to ensure that 95 percent of the area of a field has sufficient P with soil test levels of 65+ and to prevent any localized deficiencies due to soil variability. *See* State's Ex. 3145 at p. 2; Daily Trans., 5020:19-5022:1 (testifying that "if you have a large field and you sample, getting 20 cores from that field to get a bucket of soil, and if the average soil test for that bucket is 65, it will have been some cores of soil from some parts of the field where the soil test would have been less than 65. So we calculated that in order to eliminate all of those, you would have to have an average soil test of 100 to 110. So we suggested that if you use the soil test of 120, then

[78] Arkansas employs an STP of 100 lbs. / acre as the agronomic critical level; however, there is no research supporting this higher level. *See* Daily Trans., 5187:7-11 (Johnson Testimony).

even in these cases of spatial variability out in the field, you would have corrected all the places where you might get a response to fertilizer.").

385. Significantly, however, there would be no noticeable difference in crop response between a field-average soil test of 120 and a field-average soil test of 65. *See* Daily Trans., 5174:3-16; 5022:2-6 (Johnson Testimony) ("I don't think the farmer would ever see it. If he had careful precise ways of measuring the yield, he might be able to detect the difference in yield, but it's not the kind of response that you would see or that would be economical.").

386. Put another way, at land application rates in excess of agronomic need for phosphorus, there is no crop benefit and such application constitutes waste disposal. *See* Daily Trans., 5174:4-8 (Johnson Testimony); Daily Trans., 5022:7-9 (Johnson Testimony) (testifying that there is no realistic possibility for an increase in plant response above 120 STP); Daily Trans., 5022:19-5023:9 (Johnson Testimony) (testifying he would characterize additional land application of phosphorus from poultry waste at levels above 120 STP as "waste disposal" and in fact has done so in a January 1998 published report); Daily Trans., 5093:24-5094:5; 5094:16-22 (Johnson Testimony) (testifying that overwhelming majority of poultry waste land application in the IRW has been such disposal). Accordingly, the Oklahoma Cooperative Extension Service states that "nutrient utilization standards that are protective of the environment would require that animal manure applications do not result in soil test phosphorus levels that exceed 120." *See* State's Ex. 3145 at p. 2.

387. Elevated STPs decline slowly. If a field has an STP of 200 and forage removes 50 pounds of phosphorus, the STP does not go back to 150. This is in part because of the chemistry in the soil, and in part because roots only absorb phosphorus from a thin layer of soil

right next to them (positional availability). The soil between plant roots is not affected by the fact that a crop is growing there. *See* Daily Trans., 4992:24-4993:12 (Johnson Testimony).

388. Haying forage and removing it from the field reduces STP values more quickly than grazing the field. *See* Daily Trans., 5042:10-15 (Johnson Testimony); *see also* State's Ex. 3163 (illustrating differences in phosphorus reductions between haying and grazing based upon STP data for Benton and Washington Counties).

E. Not-Well Balanced / Over-Application

389. Poultry waste, unlike commercial fertilizer, is not a well-balanced fertilizer. *See* Daily Trans., 5023:17-5024:13 (Johnson Testimony) (poultry waste does not provide nutrients in the ratios one would find efficient in soils); Daily Trans., 3075:5-7 (Henderson Testimony); Daily Trans., 4214:23-4215:4 (Rutherford Testimony);[79] Daily Trans., 4150:10-15 (Simmons Testimony); Daily Trans., 518:4-5 (Tolbert Testimony). When poultry waste is applied to meet the nitrogen needs of forage, more phosphorus -- by a factor of about four -- is applied than plants will need. *See* Daily Trans., 5025:2-6 (Johnson Testimony).

390. Neither is poultry waste a soil amendment. *See* 2 Okla. Stat. § 8-85.3(14) (excluding from definition of soil amendments "unmanipulated manures"); Daily Trans., 5091:11-17 (Johnson Testimony) (explaining that unmanipulated manure is manure that has not been composted, palletized or somehow manipulated to change its physical and chemical characteristics from those it has when it is fresh).

---

[79] Mr. Claud Rutherford worked at Defendant Simmons from 1977 to 2003. *See* Daily Trans., 4201:4-10 (Rutherford Testimony). From 1977 to 1996 he served as Defendant Simmons' live production manager. *See* Daily Trans., 4201:11-19 (Rutherford Testimony). From the late 1980s until 2000, he primarily worked on environmental issues. *See* Daily Trans., 4201:20-4202:2 (Rutherford Testimony). He is currently a contract grower for the Tyson Defendants in Waldron, Arkansas (which is outside of the IRW). *See* Daily Trans., 4245:9-18 (Rutherford Testimony).

391. The poultry waste generated by Defendants' birds in the IRW is far in excess of that which can be agronomically used in the IRW. *See* Daily Trans., 5092:25-5093:5 (Johnson Testimony); Daily Trans., 1536:12-16 (Phillips Testimony); State's Ex. 4977; State's Ex. 3312 at ADEQ-225-226 ("[Wastes from animal production in Benton and Washington counties] are high in nitrogen and phosphorus and may contribute nutrients to groundwater or surface water via percolation and runoff. . . . In terms of a human population equivalency based on typical domestic wastewater values, these values [of amounts of nitrogen and phosphorus from animal wastes] would equal a population of <u>over 8 million people</u>. Since production has been expanding, current rates are expected to be higher. . .") (emphasis added). In fact, as noted above, the Oklahoma portion of the IRW has been designated a "nutrient limited watershed" by the Oklahoma Water Resources Board. *See* Okla. Admin. Code § 785:45-5-29.[80] Likewise, the Arkansas portion of the IRW has been designated a "nutrient surplus area[] for phosphorus and nitrogen" by the Arkansas legislature. *See* Ark. Code § 15-20-1104(a)(1).[81]

---

[80] A "nutrient-limited watershed" means "a watershed of a waterbody with a designated beneficial use which is adversely affected by excess nutrients as determined by Carlson's Trophic State Index (using chlorophyll-a) of 62 or greater, or is otherwise listed as 'NLW' in Appendix A of [Chapter 45 of the Oklahoma Administrative Code]." *See* Okla. Admin. Code § 785:45-1-2.

[81] A "nutrient surplus area" means "an area declared by [Ark. Code] § 15-20-1104 in which the soil concentration of one (1) or more nutrients is so high or the physical characteristics of the soil or area are such that continued application of the nutrient to the soil could negatively impact soil fertility and the waters within the state." *See* Ark. Code § 15-20-1103(12).

392. At land application rates in excess of agronomic need for phosphorus, STP is elevated. *See* Daily Trans., 5093:14-23 (Johnson Testimony). High STPs in the IRW are indicative of over-application of poultry waste.[82] As explained by Dr. Johnson:

> Mr. Nance: Do you recall yesterday some testimony about high STPs in some crops rather than forage in Arkansas?
> Dr. Johnson: Yes.
> Mr. Nance: Are the sort of high STPs that counsel indicated to you typical for the use of commercial fertilizer?
> Dr. Johnson: No, they're not.
> Mr. Nance: And why do you say that?
> Dr. Johnson: Well, because to apply enough commercial fertilizer to elevate the level of the soil test to 400 or 300 or even 7- or 800, I think, in some of those cases, would be an extremely expensive proposition, and farmers wouldn't be able to do that and continue to farm.
> Mr. Nance: Are those sort of ratings more typical of values arising from use of poultry litter?
> Dr. Johnson: Yes, they are.

See Daily Trans., 5176:18-5177:7 (Johnson Testimony); Daily Trans., 5719:6-12 (Engel Testimony) ("[I]f we look at the soil test phosphorus values, the high values occur where the largest amounts of poultry production occurs within – within the IRW").

393. Poultry waste generated by Defendants' birds has been land applied in the IRW at rates greater than agronomic rates for phosphorus. Dr. Johnson calculated that in 2006-07, fields in Benton County had an average STP of 453 with 95 percent of the fields having greater than 65 STP and fields in Washington County had an average STP of 426 with 91.7 percent of the fields having greater than 65 STP. *See* Daily Trans., 5059:20-5060:4 (Johnson Testimony). Dr. Johnson further calculated that the four counties in the Oklahoma portion of the IRW had an average STP of 102 with 41 percent of the fields having greater than 65 STP. *See* Daily Trans., 5057:24-5058:5 (Johnson Testimony). Yet further, Dr. Johnson calculated that 90 percent of

---

[82] As Defendants' expert Dr. Rausser testified, persons who are having soil test samples analyzed are, generally speaking, persons who are applying poultry waste. *See* Daily Trans., 10155:6-8 (Rausser Testimony).

fields in the IRW applied with poultry waste generated by the Tyson Defendants' birds had greater than 65 STP. *See* Daily Trans., 5078:20-5079:9 (Johnson Testimony). While Dr. Rausser was critical of Dr. Johnson's methodology in calculating these averages, Dr. Rausser prepared an exhibit that demonstrates that both the median -- STP of 292 -- and the mean -- STP of 402 -- of STP values in Benton and Washington Counties far exceeded <u>any</u> recognized agronomic limit, *see* DJX 3125, whether using the Oklahoma Agronomic Critical Level of STP 65, the Arkansas Agronomic Critical Level of STP 100, or the OSU level of STP 120 that assures 95 percent of a field will be at or above STP 65.

394. STP values at Defendants' own growing operations confirm that poultry waste generated by Defendants' birds has been land applied in the IRW at rates greater than agronomic rates for phosphorus. For instance, a 2003 soil test report for the George's Defendants' Ritter Farm (located in Arkansas) reflects STP values of 1213, 1689, and 2166. *See* State's Ex. 2790B. A 1999 nutrient management plan for the George's Defendants' Morrison Farm (located in Arkansas) reflects STP values of 790, 671, 948, 700, 770 and 657. *See* State's Ex. 6287. A 2000 document containing soil tests for the Tyson Defendants' Tyson Research Farm (located in Arkansas) reflects STP values of 717, 462, 321, 726, 506, 320, 386 and 338. *See* State's Ex. 6535. And soil tests for the Cargill Defendants' Cargill Breeder Farms (located in Arkansas) reflects STP values of 797, 972, 958 and 600. *See* State's Ex. 3337.

395. A selection of ODAFF records similarly reflect a significant number of fields with STP values in excess of both 120 and 65. *See* Appendix A (chart reflecting STP values over 65); Daily Trans., 8134:3-8144:6; Daily Trans., 8625:4-8630:13. The association between Defendants and the growers shown in Appendix A is reflected in the record at, for example, Daily Trans., 8134:3-8149:6 (integrator-by-integrator admission of ODAFF records),

Daily Trans., 8625:4-8630:13 (admission of Cal-Maine / Lois Hampton ODAFF records), State's Ex. 0855, State's Ex. 0879, State's Ex. 0939, State's Ex. 0954, and as identified under the grower names shown on Appendix A.

396. Defendants make no provision for the appropriate handling or management of the poultry waste generated at their growers' grow houses. For instance, before Defendant Simmons contracts with a poultry grower, the company does nothing to determine whether that grower has any appropriate land on which to dispose of the poultry waste generated by Simmons' birds. *See* Daily Trans., 4192:4-23 (Simmons Testimony). Simmons believes that the "extent of [its] authority" to control the waste management practices of its growers is to simply ask that they adhere to state law. *See* Daily Trans., 4191:3 (Simmons Testimony).

397. When asked whether the Tyson Defendants have ever investigated the land application practices associated with the poultry waste generated by the Tyson Defendants' birds, Mr. Pilkington simply responded, "I don't know." *See* Daily Trans., 3428:7-10 (Pilkington Testimony). For a period of time, the Tyson Defendants actually did require their contract growers to submit litter usage reports, and the Tyson Defendants maintained that information on a nutrient management spreadsheet. *See* Daily Trans., 3336:22-3337:16 (Keller Testimony). However, the Tyson Defendants ceased collecting this information because it was purportedly an "overwhelming task for the live production managers." *See* Daily Trans., 3340:8-19 (Keller Testimony). Currently, the Tyson Defendants place all responsibility for the disposal of poultry waste on their contract growers. *See* Daily Trans., 3377:23-3379:1 (Pilkington Testimony).

398. Defendant Peterson never tracked what its growers did with the poultry waste generated by its birds and generally disclaims any knowledge of what the growers did with the poultry waste. *See* Daily Trans., 4802:7-12 (Houtchens Testimony). Defendant Peterson states

that it did not "direct what [its growers] did with the litter after they took it out of the houses." *See* Daily Trans., 3969:21-25 (Henderson Testimony).

399. From 2002 to 2004, the Cargill Defendants worked on a project -- referred to as the "Precision Ag" project -- which was aimed at potentially moving poultry waste out of their Springdale complex to southeast Kansas. *See* Daily Trans., 4704:20-23, 4705:1-3 (Maupin Testimony). More generally, one of the stated "Litter Management Objectives" of the Precision Ag project was to "[r]emove the litter from sensitive areas." *See* Daily Trans., 4714:21-24 (Maupin Testimony); *see also* State's Ex. 6168-A. As part of the Precision Ag project, the Cargill Defendants conducted a search and comparison of soil test phosphorus levels in northwest Arkansas and surrounding areas. *See* State's Ex. 6138-A2. A map generated by the Cargill Defendants in connection with the Precision Ag project clearly shows that northwest Arkansas/northeast Oklahoma is an area with high soil test phosphorus levels. *See* State's Ex. 6138-A2 at CARTP121968. While some amount of poultry waste was transported as part of the Precision Ag project, the Cargill Defendants discontinued the project when it became apparent that it would not be financially profitable. *See* Daily Trans., 4707:1-14 (Maupin Testimony). Currently, despite the fact that they place a "large number" of birds in the IRW that generate a "large quantity" of poultry waste, the Cargill Defendants do not manage that waste and maintain that the "growers themselves are responsible for the nutrient management". *See* Daily Trans., 4756:12-4757:24 (Maupin Testimony).

400. While the George's Defendants now transport all of the poultry waste generated at its company-owned farms out of the IRW, they do not transport any of the waste generated on their contract grower farms. *See* Daily Trans., 3058:19-22 (M. Henderson Testimony). The George's Defendants do not know whether any of their contract growers actually comply with

their nutrient management plans and take no responsibility for the poultry waste land application practices of their contract growers. *See* Daily Trans., 3026:18-3027:1, 3079:5-8 (M. Henderson Testimony).

401. The Cal-Maine Defendants placed all responsibility for poultry waste disposal on their contract growers. *See* Daily Trans., 4421:7-11 (Storm Testimony). Despite being the largest egg-producing company in the country, Cal-Maine has never had an environmental division or any employee in charge of environmental matters. *See* Daily Trans., 4454:3-12 (Storm Testimony).

F. Summary

402. Based upon the foregoing factual findings, the Court finds that poultry waste generated by each Defendants' birds has been land applied in the IRW.

403. Based upon the foregoing factual findings, the Court finds that the overwhelming majority of poultry waste generated by Defendants' birds in the IRW is land applied in the IRW, and that land application occurs in close proximity to where the poultry waste is generated.

404. Based upon the foregoing factual findings, the Court finds that land application of poultry waste has caused the soils of the IRW to have STP values elevated in excess of any agronomic need for phosphorus.

405. Based upon the foregoing factual findings, the Court finds that Defendants have made and continue to make no provision for the appropriate handling or management of the poultry waste generated at their growers' poultry houses.

XIII. Regulation of Poultry Waste

A. Oklahoma

406. Phosphorus runoff from land-applied poultry waste has been and is of significant concern to ODAFF. *See* Daily Trans., 2901:12-15 (Gunter Testimony).[83]

407. Dry-litter poultry growing operations in Oklahoma, such as those at issue in this case, are typically not regulated under the State's Concentrated Animal Feeding Operations Act. *See* Daily Trans., 2892:15-2893:12 (Gunter Testimony). Thus, in the latter half of 1997, following the issuance of an attorney general opinion stating that ODAFF had jurisdictional authority to promulgate rules to regulate dry-litter poultry growing operations irrespective of whether such operations were subject to the Oklahoma Concentrated Animal Feeding Operations Act, ODAFF drafted emergency rules addressing such operations.[84] *See* Daily Trans., 2890:14-2891:8 (Gunter Testimony); Atty. Gen. Op. 97-95. At the time these emergency rules were drafted, ODAFF did not know how many poultry growing operations were located in Oklahoma or how much poultry waste was being generated in Oklahoma. *See* Daily Trans., 2891:9-16 (Gunter Testimony).

408. Following the promulgation of these emergency rules, in 1998, the Oklahoma Legislature enacted the Oklahoma Registered Poultry Feeding Operations Act (the "ORPFOA"). *See* 2 Okla. Stat. § 10-9, *et seq.* Passage of the ORPFOA was politically difficult. *See* Daily Trans., 3162:17-21 (Strong Testimony). The ORPFOA is the primary statute pertaining to the management of poultry waste in Oklahoma. The purpose of the ORPFOA is to prevent pollution

---

[83] Teena Gunter has been the deputy general counsel for the Oklahoma Department of Agriculture, Food and Forestry since 2002. *See* Daily Trans., 2887:18-21; 2888:10-16 (Gunter Testimony). Ms. Gunter received a J.D. from the University of Arkansas, as well as an LL.M in Agricultural Law. *See* Daily Trans., 2888:2-5 (Gunter Testimony). Ms. Gunter was heavily involved as a technical advisor to the Oklahoma Legislature during the time the Oklahoma Registered Poultry Feeding Operations Act was enacted in 1998. *See* Daily Trans., 2895:8-21; 2978:1-6 (Gunter Testimony).

[84] "Emergency Rules" become effective immediately upon signature by the Oklahoma governor. *See* Daily Trans., 2891:7-8 (Gunter Testimony).

from land applied poultry waste. *See, e.g.*, Okla. Admin. Code § 35-17-5-1 ("These rules shall serve to control nonpoint source runoff and discharges from poultry waste application of poultry feeding operations").[85]

409. Under the ORPFOA, all "poultry feeding operations" in Oklahoma must register with the State. *See* 2 Okla. Stat. § 10-9.3; Daily Trans., 2898:13-18 (Gunter Testimony). A "poultry feeding operation" is "a property or facility where the following conditions are met: (a) poultry have been, are or will be confined and fed or maintained for a total of forty-five (45) days or more in any twelve-month period, (b) crops, vegetation, forage growth or post-harvest residues are not sustained in the normal growing season over any portion of the property or facility, and (c) producing over ten (10) tons of poultry waste per year." *See* 2 Okla. Stat. § 10-9.1(B)(20).

410. Registration entails providing ODAFF with specified information, including (1) the name and address of the owner and operator of the facility, (2) the name and address of the poultry feeding operation, (3) the number and type of poultry housed or confined, (4) the name and address of the integrator whose poultry will be raised by the poultry feeding operation, (5) a diagram or map and legal description showing the geographical location of the facility, nearby waters of the State, and poultry waste storage facilities and land application sites owned or leased by the applicant or which the applicant has contracted with for the application of poultry waste, (6) a copy of the Animal Waste Management Plan, or proof of application for such plan, and (7) an environmental history from the past three years of any poultry feeding operation established and operated by the applicant. *See* 2 Okla. Stat. § 10-9.5(B); *see also* Daily Trans. 2898:19-

---

[85] Okla. Admin. Code § 35-17-5-1, *et seq.*, are the implementing regulations for the ORPFOA.

2899:6 (Gunter Testimony). So long as the statutory prerequisites to registration are met, ODAFF has no discretion in approving a poultry feeding operation registration. *See* Daily Trans., 2902:11-2903:12; 2991:21-24 (Gunter Testimony). As such, mere registration under the ORPFOA does not equate to compliance with all the requirements of the ORPFOA. *See* Daily Trans., 2917:15-18 (Gunter Testimony).

411. Registered poultry feeding operations are required to utilize best management practices in managing poultry waste. *See* 2 Okla. Stat. § 10-9.7(A). Best management practices are defined in the ORPFOA as "schedules of activities, prohibitions of practices, maintenance procedures and other practices which prevent or reduce the pollution of waters of the state . . . ." *See* 2 Okla. Stat. § 10-9.1(B)(2). Included among the required criteria of the best management practices are that "[p]oultry waste handling, treatment, management and removal shall[] not create an environmental or a public health hazard, [and] not result in the contamination of waters of the state . . . ." *See* 2 Okla. Stat. § 10-9.7(B)(4)(a) & (B)(4)(b); *see also* Daily Trans., 2901:1-4 (Gunter Testimony) (testifying that the ORPFOA specifically provides that discharge or runoff of poultry waste is prohibited).

412. Best management practices are to be accomplished, in part, but by no means exclusively, by an animal waste management plan. *See* 2 Okla. Stat. § 10-9.7(C). Under the ORPFOA, an animal waste management plan is "a written plan that includes a combination of conservation and management practices designed to protect the natural resources of the state . . . ." *See* 2 Okla. Stat. § 10-9.1(B)(1); *see also* Daily Trans., 2899:15-2900:5 (Gunter Testimony) (describing contents of a typical AWMP). An animal waste management plan by itself, however, does not guarantee that the State's natural resources will be protected from pollution from poultry waste. In fact, the conservation and management practices of an animal waste

management plan are all subject to the overarching best management pollution prohibitions and the requirement that, in any application of poultry waste, "[d]ischarge or runoff of waste from the application site is prohibited." *See* 2 Okla. Stat. § 10-9.7(C)(6)(c); *see also* Okla. Admin. Code § 35-17-5-5(a)(7)(C) ("Runoff of poultry waste from the application site is prohibited");[86] *see also* Daily Trans., 2903:14-18 (Gunter Testimony) (testifying that under the ORPFOA, AWMPs absolutely prohibit any discharge or runoff of poultry waste from application sites).

413. AWMPs are drafted based upon form documents. *See* Daily Trans., 2909:17-2910:3 (Gunter Testimony). AWMPs were historically drafted by the NRCS. *See* Daily Trans., 2907:2-4 (Gunter Testimony); *see also* Okla. Admin. Code § 35-17-5-2 ("The [animal waste management] plan shall be prepared by the USDA NRCS or an entity approved by the State Department of Agriculture"). Currently, ODAFF has contracted with two former NRCS employees to draft AWMPs on a part-time basis. *See* Daily Trans., 2907:2-11 & 2909:11-16 (Gunter Testimony). These plan writers are independent contractors. *See* Daily Trans., 2986:10-13 (Gunter Testimony).

414. The maximum poultry waste land application rates set forth in AWMPs in Oklahoma are determined with reference to the United States Department of Agriculture Natural Resources Conservation Service Waste Utilization Standards (the so-called "Code 590"), unless ODAFF approves other standards. *See* 2 Okla. Stat. § 10-9.7(D)(3); 2 Okla. Stat. § 10-9.19(3); Daily Trans., 2910:16-2911:2 (Gunter Testimony). To date, ODAFF has not approved other standards.[87] *See* Daily Trans., 2909:17-2910:3; 2914:21-2915:6 (Gunter Testimony).

---

[86] "Runoff" is defined under Okla. Admin. Code § 35-17-5-2 as "any release by leaking, escaping, seeping, or leaching of poultry waste into waters of the State."

[87] Any modification of such land application rates would be subject to review by both houses of the Oklahoma legislature, as well as the Oklahoma governor. *See* Daily Trans.,

415. Code 590 sets forth a maximum land application rate of 300 lbs./acre STP in a nutrient limited watershed such as the IRW. *See* Daily Trans., 2911:3-7 (Gunter Testimony); Daily Trans., 3570:5-8 (Strong Testimony); DJX Ex. 3916. Prior to the IRW being designated a nutrient limited watershed in 2006, the maximum land application rate provided for in Code 590 was 400 lbs./acre STP. *See* Daily Trans., 3669:6-3670:21 (Strong Testimony); DJX 3916. The maximum land application rate of 300 lbs. / acre STP in a nutrient limited watershed set forth in Code 590 is not scientifically based. *See* Daily Trans., 3688:24-3689:5 (Strong Testimony); Daily Trans., 5088:5-8 (Johnson Testimony). Significantly, nothing in Code 590 (or the ORPFOA) requires that poultry waste be land applied at the maximum land application rate of 300 lbs./acre STP. *See* Daily Trans., 2911:8-11 (Gunter Testimony); Daily Trans., 3575:21-3576:7 (Strong Testimony) (testifying that there are restrictions that go beyond merely the land application rate). If discharge or runoff from a land application site occurs, even if the application was within the limits of the maximum land application rate provided for in the applicable AWMP, that person would not be complying with his/her AWMP or the ORPFOA. *See* Daily Trans., 2903:23-2904:7; 2911:21-24 (Gunter Testimony).

416. ODAFF does <u>not</u> view AWMPs as permits. *See* Daily Trans., 2902:1-3 (Gunter Testimony); *see also* Daily Trans., 435:23-24 (Tolbert Testimony) (testifying that ODAFF does not issue permits for the land application of poultry waste).

417. Registrants under the ORPFOA are required to complete annual educational training on poultry waste management. *See* 2 Okla. Stat. § 10-9.5(F); Daily Trans., 2917:23-25

2909:17-2910:3; 2914:21-2915:6 (Gunter Testimony). Mr. Strong testified that, based upon what he witnessed firsthand when the Oklahoma Legislature passed the ORPFOA, adopting standards more stringent than those set forth in Code 590 would be difficult to achieve politically. *See* Daily Trans., 3162:13-21 (Strong Testimony).

(Gunter Testimony). These programs emphasize the no run-off, no discharge requirements of the ORPFOA. *See* Daily Trans., 2918:20-2919:4 (Gunter Testimony); Defendants' Ex. 1191A.

418. The Oklahoma Poultry Waste Applicators Certification Act (the "OPWACA") provides for the licensing of persons land applying poultry waste in Oklahoma. *See* 2 Okla. Stat. § 10-9.16, *et seq.* All persons engaged in land application of poultry waste in Oklahoma must get a certificate (*i.e.,* a license) from the State Board of Agriculture. *See* 2 Okla. Stat. § 10-9.17(A) & (B). In order to get a license, a candidate must meet the applicable certification standards and pay a licensing fee. *See* 2 Okla. Stat. § 10-9.17(D) & (E).

419. The OPWACA places restrictions on the rates of application of poultry waste by certified poultry waste applicators. Applications must comply with AWMPs, or for applications conducted on land operated by entities not regulated pursuant to the ORPFOA that are located in a nutrient-limited watershed (like the IRW), with conservation plans. *See* 2 Okla. Stat. § 10-9.19(2) & (3); 2 Okla. Stat. § 10-9.19a(1) & (2); *see also* Daily Trans., 2912:6-2913:25; 2914:11-16 (Gunter Testimony). Nothing in the OPWACA relieves an applicator from the requirements of the ORPFOA, including those requirements that "[p]oultry waste handling, treatment, management and removal . . . not create an environmental or a public health hazard, [and] not result in the contamination of waters of the state . . ." and "[d]ischarge or runoff of waste from the application site is prohibited." *See* 2 Okla. Stat. 10-9.7(B).

420. The OPWACA requires certified poultry waste applicators to make annual reports to the ODAFF. *See* 2 Okla. Stat. § 10-9.18(A). Among the information required in these reports is (1) the legal description and conservation district where the poultry waste was produced, (2) the legal description and conservation district where the poultry waste was land applied, (3) the date of each application, (4) the total and per acre amount of each application, (5) name and

address of the person for whom poultry waste was applied, and (6) the most recent soil test results. *See* 2 Okla. Stat. § 10-9.18(A).

421. These reports are due at the end of each calendar year, and cover the preceding July 1 to June 30 timeframe. *See* 2 Okla. Stat. § 10-9.18(A); Daily Trans., 2927:1-20 (Gunter Testimony). As such, ODAFF does not have real-time notice of where and when poultry waste is being land applied in the IRW. *See* Daily Trans., 2927:1-4 (Gunter Testimony).

422. During a typical annual inspection by an ODAFF inspector of a poultry growing operation, the inspector will visit with the grower, discuss any issues the grower might have, check the growers' records, and review the property. *See* Daily Trans., 2925:1-18 (Gunter Testimony).

423. Statewide, ODAFF has five poultry inspectors; two of them -- David Berry and John Littlefield -- work in portions of the Oklahoma part of the IRW. *See* Daily Trans., 2923:16-21 (Gunter Testimony). Fifty three of the 112 poultry operations assigned to Mr. Berry are located in the IRW, and 24 of the 209 poultry operations assigned to Mr. Littlefield are located in the IRW. *See* Daily Trans., 2924:3-7 (Gunter Testimony).

424. ODAFF neither has sufficient personnel to monitor the entire IRW and all of the application sites in it, *see* Daily Trans., 2928:18-20 (Gunter Testimony), nor has sufficient personnel to determine whether runoff of land-applied poultry waste is widespread in the IRW. *See* Daily Trans., 2928:3-5 & 2928:11-13 (Gunter Testimony). Runoff of poultry waste from a land application site is not easy to see or detect on an annual inspection, *see* Daily Trans., 2928:14-17 (Gunter Testimony), and ODAFF does not have enough personnel to take runoff samples from fields when it rains or to observe where poultry waste is land applied. *See* Daily Trans., 2925:19-24 (Gunter Testimony). Additionally, ODAFF does not have sufficient

personnel to match up the annual poultry waste application reports to determine if the land application sites have AWMPs or conservation plans. *See* Daily Trans., 2914:1-10 (Gunter Testimony).

425. The State does not promote or encourage the land application of poultry waste in the IRW as evidenced by the Oklahoma Poultry Waste Transfer Act (the "OPWTA"). *See* 2 Okla. Stat. § 10-9.13, *et seq.* The purpose of the OPWTA is "to encourage the transfer of poultry waste out of designated nutrient-limited watersheds and nutrient vulnerable groundwater as designated in the most recent Oklahoma's Water Quality Standards." *See* 2 Okla. Stat. § 10-9.13(A) (emphasis). To that end, the Oklahoma Legislature directed ODAFF to "develop a plan to encourage the transfer of poultry waste out of designated nutrient-limited watersheds and nutrient-vulnerable groundwater as designated by the most recent Oklahoma's Water Quality Standards." *See* 2 Okla. Stat. § 10-9.13(B).

B. Arkansas

426. While the regulation of poultry waste by the State of Arkansas is not relevant to determination of Defendants' liability here, such regulation may bear on issues pertaining to remedy and therefore a brief findings are warranted.

427. The "Arkansas Soil Nutrient Application and Poultry Litter Utilization Act" was enacted by the Arkansas Legislature in 2003. *See* Ark. Code. Ann. § 15-20-1101, *et. seq.* However, as amended in 2005, the Act provided that "[a]pplication of poultry litter to soils or associated crops within a nutrient surplus area shall be done in accordance with a nutrient management plan or poultry litter management plan after January 1, 2007." Ark. Code. Ann. § 15-20-1106(f). Thus, it was not until January 2, 2007, that poultry growers were actually required by Arkansas law to comply with nutrient management plans. In addition, while the

Arkansas Natural Resource Commission ("ANRC") promulgated certain "Rules Governing the Arkansas Soil Nutrient and Poultry Litter Application and Management Program," those Rules did not become effective until January 1, 2006. *See* State's Ex. 5914 (Former ANRC Rules, Tit. XXII, § 2201.1(B)). In any event, at no time prior to the enactment of the 2003 legislation did Arkansas place any restriction on the amount of poultry waste that could be applied on a field. *See* Daily Trans., 9515:2-8; 9598:17-23 (Smith Testimony).

428. Following the enactment of the legislation in 2003, ANRC did provide for a "protective rate" to be used as an interim measure. *See* Daily Trans., 9514:7-23 (Smith Testimony). Specifically, this "protective rate" provided an amount of nutrients from either poultry litter or commercial fertilizer that could be applied to crops in nutrient-limited areas when land owners had not yet obtained nutrient management plans for their land. *See* State's Ex. 5914 (Former ANRC Rules, Title XXII, § 2202.3(A)). However, that protective rate for poultry litter application expired January 1, 2007. *See* State's Ex. 5914 (Former ANRC Rules, Title XXII, § 2202.3(A)(1)). Despite the expiration of the protective rate, there is currently no assurance that all Arkansas poultry growers have nutrient management plans. *See* Daily Trans., 9596:10-14 (Smith Testimony).

429. The ANRC Rules Governing the Arkansas Soil Nutrient and Poultry Litter Application and Management Program also provide for a "Phosphorus Index" to be referenced in all nutrient management plans and to "govern the terms and conditions under which Nutrients may be land-applied." *See* ANRC Rules, Title XXII, § 2201.4(B). ANRC recently revised its Rules, effective January 1, 2010, to replace the original Phosphorus Index (developed in 2001) with a new Phosphorus Index (developed in 2009). *Compare* DJX 8133 (New ANRC Rules, Title XXII, § 2201.4(B)) *with* State's Ex. 5914 (Former ANRC Rules, Title XXII, § 2201). The

revised Rules also delete all mention of the protective rate as it once pertained to the land application of poultry litter. *Compare* DJX 8133 (New ANRC Rules, Title XXII, § 2202.3, Appendix B) *with* State's Ex. 5914 (Former ANRC Rules, Title XXII, § 2202.3, Appendix B).

1. The Protective Rate

430. With respect to commercial fertilizer, the protective rate under the former ANRC Rules did not recommend any land application on fields having an STP value more than 100 lbs./acre. *See* State's Ex. 5914 (Former ANRC Rules, Title XXII, Appendix B (Table 3)); Daily Trans., 5018:8-10 (Johnson Testimony). By contrast, the protective rate treated poultry waste differently. For instance, for fields in the moderate runoff class, the protective rate under the former ANRC Rules allowed for the application of 3 tons of poultry waste if the STP was between 0 and 100 lbs./acre, and the application of 1.5 tons of poultry waste if the STP was between 1000 and 1100 lbs./acre. *See* State's Ex. 5914 (Former ANRC Rules, Title XXII, Appendix B, Table 1); Daily Trans., 5018:18-5019:10 (Johnson Testimony). Viewed another way, this protective rate allowed land application of waste up to 11 times the Arkansas agronomic critical level of 100 STP. *See* Daily Trans., 5019:25-5020:3; 5006:3-6 (Johnson Testimony).

2. The Phosphorus Index

431. A phosphorus index is a nutrient management tool that operates on the principle of relative risk rather than absolute risk of nonpoint source pollution from phosphorus. *See* Daily Trans., 5088:13-17; 5190:20- 5191:10 (Johnson Testimony). A phosphorus index does not scientifically determine how much nonpoint source pollution from phosphorus will reach streams from individual sites and waste applications. *See* Daily Trans., 5088:19-23 (Johnson Testimony). Nor does a phosphorus index identify the actual risk associated with how much

phosphorus is going to make it all the way to a stream. *See* Daily Trans., 5088:24-5089:3 (Johnson Testimony). A phosphorus index thus allows land application of poultry waste in excess of the agronomic critical level, and contributes to the elevation of STPs in areas where it is used. *See* Daily Trans., 5089:4-10 (Johnson Testimony).

432. The Arkansas phosphorus index applies either to individual farms or individual fields. *See* Daily Trans., 9597:1-5 (Smith Testimony). The index is not applied at the watershed level. *See* Daily Trans., 9597:9-14 (Smith Testimony).

433. Significantly, the Arkansas protective rate was by and large more restrictive than the Arkansas phosphorus index. *See* Daily Trans., 9515:9-12; 9599:7-14 (Smith Testimony). Indeed, Defendants themselves have recognized that the Phosphorus Index was not restrictive enough. Mr. Monty Henderson, former President of Defendant George's, testified that he became concerned that the Phosphorus Index was not restrictive enough after attending a February 16, 2006 BMPs, Inc. board meeting. *See* Daily Trans., 3121:22-3122:11 (Henderson Testimony). Minutes from that meeting -- which was attended by representatives of the Tyson Defendants, the George's Defendants, Defendant Simmons, the Cargill Defendants and Defendant Peterson -- provide a summary of discussion concerning the Arkansas Phosphorus Index:

> Contract growers in the Nutrient Surplus watersheds are following new Arkansas regulations and getting plans using the Arkansas phosphorus index, <u>which allows them to put out more litter per acre than they had in the past.</u> Most contract growers will continue to be allowed to apply litter to their land under the new regulations. Therefore, there's little pressure on the producers in Arkansas to export their litter.

See State's Ex. 3041 (emphasis added).

434. Several years before this BMPs, Inc. board meeting took place, Mr. Preston Keller, then Defendant Tyson Foods, Inc.'s Director of Environmental Agriculture, wrote an

email to a superior voicing his concerns about the then newly-developed Arkansas Phosphorus Index. *See* State's Ex. 3187. In that email, dated June 18, 2002, Mr. Keller wrote:

> The phosphorus index that Arkansas developed is a very good management tool. Their application rates are somewhat questionable. Example: A farmer's field with zero to five percent slope, good forage coverage and soil test of 800 pounds per acre of P could apply two tons per acre of manure. A little high, in my opinion. Are we helping the farmers or not?"

See State's Ex. 3187.

435. Not surprisingly, Arkansas admits that the Arkansas phosphorus index has not stopped nonpoint source pollution from poultry waste. *See* Daily Trans., 9597:15-25 (Smith Testimony).

436. Finally, it should be noted that a phosphorus index is a field management tool, not a watershed management tool. *See* Daily Trans., 9597:1-5; 9597:9-14 (Smith Testimony); Daily Trans., 6654:9-17 (Engel Testimony) (testifying that NMPs are "absolutely site specific" and that they are not written with a view to protecting the watershed as a whole, but rather to attempt to reduce phosphorus running off from a specific field").

3. 2010 Amendments

437. As noted above, ANRC revised Title XXII of its Rules effective January 1, 2010. *See* DJX 8133 (New ANRC Rules, XXII). These revised Rules continue to characterize the Arkansas portion of the IRW as a nutrient surplus area. *See* DJX 8133 (New ANRC Rules, Appendix A). These revised Rules still use a protective rate, but only for commercial fertilizer. *See* DJX 8133 (New ANRC Rules, Appendix B). The revised Rules define the "protective rate" as "the application rate for commercial fertilizers approved by the Commission for designated Nutrients that provides for proper Crop utilization and prevention of significant impact to the Waters Within the State." *See* DJX 8133 (New ANRC Rules, Title XXII, § 2201.4(X)). The

protective rate for commercial fertilizer continues to recommend no additional phosphorus for soils having STP values greater than 100 lbs./acre (the Arkansas agronomic critical value). *See* DJX 8133 (New ANRC Rules, Appendix B). The obvious corollary to these last two points is that Arkansas deems prohibitions on the application of phosphorus above STP 100 as preventing significant impact to waters of that state.

438. Again, the 2010 revised Rules also replace the original Arkansas Phosphorus Index with a new Phosphorus Index. *See* DJX 8132 . The revised Arkansas Phosphorus Index is a risk assessment tool to determine the maximum manure application rates on pastures. *See* DJX 8132 at p. 1. The revised Arkansas Phosphorus Index assigns to fields a "P index risk class" based upon the estimated phosphorus loads of runoff for each field. *See* DJX 8132 at p. 2.. The revised Arkansas phosphorus index provides increasingly restrictive management recommendations as risk from application sites increases. *See* DJX 8132 at p. 2. However, the revised Arkansas phosphorus index also contemplates some degree of runoff from land applied fields, *see* DJX 8132 at pp. 5-6 & 13-20, and allows for land application of poultry waste in excess of any agronomic need for phosphorus. *See* DJX 8132 at p. 15 (showing example of field with STP value to 500 and "moderate" runoff potential, but no recommendation to cease land application).

XIV. Land-Applied Poultry Waste is a Source of the High Phosphorus Loadings to the Waters of the IRW

439. The State has made no secret that it intends to carry its burden of proof not only by direct evidence, but also by circumstantial evidence. *See* Daily Trans., 1155:20-23 (Nance Statement). Consistent with this approach, at trial the State advanced multiple lines of evidence supporting its contention that phosphorus from poultry waste generated by Defendants' birds that has been land applied in the IRW is running off and leaching into the waters of the State.

Viewed separately -- and particularly when viewed together -- these lines of evidence present an overwhelming case that land-applied poultry waste is a source of the high phosphorus loadings to the waters of the IRW.

440. Defendants are critical of the State's proofs, contending that they are not a "traditional fate and transport" study. *See e.g.* Daily Trans., 8220:16-8221:10 (Todd Argument). Preferring not to be pinned down, however, Defendants have not only never adequately defined what they contend a "traditional fate and transport" study would actually consist of in the context of a nonpoint source pollution case, but also never articulated what proofs they contend would be sufficient to prove that poultry waste generated by their birds was running off and leaching into the waters of the State. In any event, Defendants' criticisms are of no moment because the Court agrees with the testimony of Dr. Indrajeet Chaubey, a non-retained expert. Dr. Chaubey testified that "[t]here are many different ways" to study fate and transport. *See* Daily Trans., 5993:20-5994:21 (Chaubey Testimony). It is through this lens that the Court evaluates the evidence.

A. Government Findings

441. The first of these lines of evidence is government findings. Not only have the State's agencies themselves found that phosphorus from poultry waste generated by Defendants' birds that has been land applied in the IRW is running off and leaching into the waters of the State, but also the United States Geological Survey, the United States Department of Agriculture, the National Park Service and the State of Arkansas have made similar findings.

1. Oklahoma Office of the Secretary of the Environment

442. In its 2008 report entitled "Coordinated Watershed Restoration and Protection Strategy for Oklahoma's Impaired Scenic Rivers" issued pursuant to 82 Okla. Stat. § 1457, the Office of the Oklahoma Secretary of the Environment reported that "[t]he single largest

contributor of nonpoint source phosphorus pollution is surplus poultry litter generated by the integrators' flocks." *See* State's Ex. 5662 at p. 3; *see also* State's Ex. 5665; State's Ex. 5664; State's Ex. 5666.

2. Oklahoma Conservation Commission

443. In its 1999 report entitled "Comprehensive Basin Management Plan for the Illinois River Basin in Oklahoma," the Oklahoma Conservation Commission wrote:

> Land use analysis correlated this decline in water quality to dramatic changes in land use in the basin. Agriculture increased substantially in the basin in the form of confined animal feeding operations (CAFOs), primarily poultry operations, and forest land continues to be cleared for pasture and hay production. Overall, these land use changes resulted in a net increase in the amount of nutrients entering the watershed (primarily through animal feed) without a concomitant increase in the amount being exported from the watershed. The resulting imbalance in the nutrient import / export cycle is manifested in the water quality of the basin.

See DJX-0640 at p. iii.

3. Oklahoma Scenic Rivers Commission, Oklahoma State University and the National Park Service

444. In their report entitled "The Illinois River Management Plan 1999," the Oklahoma Scenic Rivers Commission, Oklahoma State University and the National Park Service wrote:

> In recent years, there has been significant expansion of confined animal production, particularly broilers, in the Illinois River Corridor. . . . Poultry wastes are typically applied to nearby pasture land. Mismanagement of these applications can result in runoff of nutrients (nitrogen and phosphorus) to streams in the watershed. These occur in rainfall runoff as well as in shallow groundwater flow. <u>Increased nutrient loading in tributaries impacted by poultry production, as well as, downstream effects are documented</u>.

See DJX 0147 at p. 67 (emphasis added).

4. United States Geological Survey

445. In its 2006 report entitled "Phosphorus Concentrations, Loads, and Yields in the Illinois River Basin, Arkansas and Oklahoma, 2000-2004," the USGS concluded that:

> Phosphorus concentrations in Ozark streams are typically greater in streams draining agricultural lands than in those draining forested lands (Petersen and others, 1998; 1999) because runoff from pastures fertilized with animal manure are probably substantial sources of phosphorus to the rivers in this basin (Arkansas Department of Environmental Quality, 2000).

See State's Ex. 5862 at p. 4 (emphasis added); *see also* State's Ex. 5861 at p. 2.

5. United States Department of Agriculture

446. In its 1992 Report entitled "Illinois River Cooperative River Basin Basin Resource Base Report," the USDA concluded that:

> A significant part of the water quality problems in the basin appear to be a precipitate of the large volume of poultry waste generated and disposed of in the basin each year.

See State's Ex. 3351 at OSU0005179 (emphasis added).

6. State of Arkansas

447. The long-serving chief of the Water Management Division of the Arkansas Natural Resources Commission, Mr. Earl Smith, Jr., testified as follows:[88]

> Mr. Nance: Let's turn to the next page, sir, if you would. Let's look at about the middle of the second paragraph on that page. I'm going to read a sentence that begins -- one, two, three, four, five -- six lines down over at the right-hand side beginning "nonpoint source." Do you see that?
> Mr. Smith: I do.
> Mr. Nance: Let me see if you agree with the truth of that statement that Arkansas has made to the federal government. "Nonpoint source impacts affecting waters in this segment are primarily from pastureland that is also used for application of poultry litter as fertilizer." Is that a true statement, sir?
> Mr. Smith: It certainly is, ...
> * * *
> Mr. Nance: . . . [L]et me ask you if nonpoint source impacts affecting waters in the Illinois River are primarily from pastureland that's also used for application of poultry litter as fertilizer?
> Mr. Smith: I'd say it's a significant -- certainly not the only contribution to that. It's certainly one of the significant contributions to nonpoint.

---

[88] The Arkansas Natural Resources Commission has legal authority and jurisdiction in Arkansas over agricultural nonpoint source discharges in nutrient-sensitive watersheds. *See* Daily Trans., 9559:19-24 (Smith Testimony).

See Daily Trans., 9603:24-9604:13 & 9609:24-9610:5 (Smith Testimony) (emphasis added).

448. Aside from contending that the findings of the State's agencies should not be credited because the agencies are self-interested, Defendants have advanced no valid grounds why the findings of these other agencies should not be credited. Moreover, given that the State's agencies' findings are consistent with those of these other agencies, the Court finds that weight should be assigned to these findings as well.

B. Mass of Poultry Waste Generated & Method of Disposal

449. The State's second line of evidence focuses on the mass of poultry waste generated in the IRW and the manner in which that poultry waste is managed. As noted above, Defendants' birds generate an enormous quantity of phosphorus-laden poultry waste in the IRW. *See, supra*, FOF, ¶¶ 365-367. This poultry waste generated by Defendants' birds is land-applied throughout the IRW. *See, supra*, FOF, ¶ 371-378. It is not incorporated into the soil on which it is spread. *See, supra*, FOF, ¶ 375. Further, poultry waste generated by Defendants' birds in the IRW is typically land applied in close proximity to where it is generated. *See, supra*, FOF, ¶ 378. Yet further, poultry waste generated by Defendants' birds has been land applied in the IRW in excess of agronomic need. *See, supra*, FOF, ¶ 393-395. These factors support the State's contention that land-applied poultry waste is a source of phosphorus loading to the waters of the State in the IRW.

450. For example, the fact that poultry waste generated by Defendants' birds that is land applied in the IRW is not incorporated into the soil on which it is spread is significant in terms of fate and transport because "the surface of the land is where the rain lands, so that's where runoff is generated." *See* Daily Trans., 1852:16-1853:10 (Fisher Testimony); *see also* Court's Ex. 11 at pg. 9 (Edward's Depo.) (testifying that the traditional method of land

application without incorporation is a practice that is potentially detrimental to the quality of ground and surface water); Court's Ex. 11 at pp. 6 & 17 (Edwards Depo.)[89] (testifying that first rainfall after land application has highest run-off).

451. Similarly, it is a well-established scientific fact that the amount of dissolved phosphorus in runoff increases with STP values. *See* Daily Trans., 5028:3-9 (Johnson Testimony); *see also* Daily Trans., 5029:19-22 (Johnson Testimony) (testifying that "[i]f the STP doubled, then the concentration of phosphorus would quadruple"); Daily Trans., 5719:13-25 (Engel Testimony) ("[S]oil test phosphorus is vital to the amount of phosphorus that is going to run off of fields. So even at very low soil test phosphorus levels, one gets some phosphorus running off, but even as they increase, there's a linear increase, or an even more pronounced increase potentially, in the amount of phosphorus running off due to elevated soil test phosphorus levels"); Daily Trans., 9209:1-6 (Connolly Testimony) (agreeing that elevated STP levels increase the concentrations of phosphorus in runoff); State's Ex. 3312 at ADEQ-225 ("Nitrogen and phosphorus should be applied at a rate not greater than what cover plants can assimilate. . . . Excess values built up in the soil will be washed into surface waters whenever erosion occurs").

---

[89] Dr. Dwayne Edwards holds a Ph.D. from Oklahoma State University. *See* Court's Ex. 11 at p. 2 (Edwards Depo.).has been a professor in the biosystems agricultural engineering department at the University of Kentucky since 1994. *See* Court's Ex. 11 at p. 2 (Edwards Dep.). Prior to moving to the University of Kentucky, Dr. Edwards was an assistant professor from 1988-1993 and an associate professor from 1993-1994 in the department of biological and agricultural engineering at the University of Arkansas. *See* Court's Ex. 11 at p. 2(Edwards Testimony). He was a recipient of the New Holland young researcher award from the American Society of Agricultural and Biological Engineers. *See* Court's Ex. 11 at p. 3(Edwards Depo.). Dr. Edwards research has included study of land use practices and their effect on water quality in northwest Arkansas. *See* Court's Ex. 11 at pp. 9-10. Dr. Edwards is a retained consultant by one of the Defendants' counsel. *See* Court's Ex. 11 at p. 1(Edwards Depo.). Dr. Edwards testified at trial as a nonretained expert.

452. The concentration of poultry operations also figures into the phosphorus loading analysis. As explained in OCC's Comprehensive Basin Management Plan, "[t]he disposal of wastes produced by these facilities provides a serious management dilemma for landowners as the amount of animal wastes produced exceeds the amount of land available for waste application. . . . [T]he soils in the watershed are becoming phosphorus-saturated. Additional applications of litter result merely in higher concentrations of nutrients in runoff, rather than increased forage growth." *See* DJX-640 at p. 89.

453. In fact, "[b]ecause of the phosphorus that can be stored in soils, you can still have increased concentrations in the runoff water [years after cessation of broiler litter application]." *See* Court's Ex. 8 at pg. 9 (Haggard Deposition Testimony). Runoff water from soil will contain water soluble phosphorus that will leave the soil with runoff water. *See* Daily Trans., 5027:21-23 (Johnson Testimony). As explained by Dr. Johnson, water soluble phosphorus is removed by moisture at the soil surface and travels with runoff. *See* Daily Trans., 5037:9-12 (Johnson Testimony). As water soluble phosphorus is removed from the soil surface, it is replaced by de-adsorbed phosphorus from soil surface particles and also by dissolving of solid phase phosphorus. *See* Daily Trans., 5037:12-14 (Johnson Testimony). The soil keeps putting out more and more water soluble phosphorus at the surface where it can become part of the water moving down the slope and be transported. *See* Daily Trans., 5037:15-17 (Johnson Testimony). This equilibrium reaction that causes water soluble phosphorus to be maintained at the soil surface in the soil solution will be influenced by soil very near the surface, in the top two inches predominantly. *See* Daily Trans., 5037:23-5038:3 (Johnson Testimony).

C. Phosphorus Loadings from Nonpoint Sources

454. The State's third line of evidence focuses on the uncontroverted fact that the overwhelming majority of phosphorus loadings to the waters of the IRW are from nonpoint sources rather than point sources. Again, it is undisputed in the record that point sources account for less than 20 percent of the phosphorus load reaching Lake Tenkiller. *See* Daily Trans., 8922:8-20 (Connolly Testimony); Daily Trans., 10907:23-10908:1 (Sullivan Testimony). In fact, as shown *supra*, Defendants' expert Dr. Connolly calculates that 82 percent of the phosphorus load reaching Lake Tenkiller is from nonpoint sources. *See* Daily Trans., 9141:15-9142:8 (Connolly Testimony). Additionally, the vast majority of the phosphorus loading to the Illinois River and its tributaries is from nonpoint sources. *See, e.g.*, State's Ex. 5862 at p. 11.

455. The phosphorus in nonpoint source runoff is mostly dissolved phosphorus. *See* Daily Trans., 9298:11-9299:4 (Connolly Testimony). Nonpoint sources directly contribute soluble reactive phosphorus to the waters of the IRW. *See* Daily Trans., 9134:24-9135:16; 9129:12-17; 9133:24-9134:8 (Connolly Testimony). Indeed, under natural rainfall conditions, concentrations of nonpoint source soluble reactive phosphorus can be equal to or greater than such concentrations from wastewater treatment plants. *See* Daily Trans., 9412:24-9413:7 (Connolly Testimony).

456. Significantly, poultry waste leachate contains high concentrations of soluble reactive phosphorus and the State's edge-of-field sampling data show that about 50 percent of the phosphorus in nonpoint runoff from fields that have received land applied poultry waste is soluble reactive phosphorus. *See* Daily Trans., 5233:2-5235:25, 5258:4-11, 5356:17-19 (Olsen Testimony).

D. Mass Balance Analysis

457. For the State's fourth line of evidence, the State retained Dr. Engel to conduct a mass balance analysis. A mass balance analysis is simply a study of the inflows to a watershed and outflows of a constituent of concern from a watershed. *See* Daily Trans., 5978:5-14 (Chaubey Testimony). As Dr. Chaubey explained, a mass balance is like "balancing a checkbook. You look at all the incoming and you look at all the expenses." *Id.* As Defendants' expert Dr. Connolly testified, "[m]ass balance is a tool. Mass balance is used in the context of fate and transport in order to help evaluat[e] fate and transport . . . [a]nd mass balance is all about balancing sources and syncs as you are looking at fate and transport within the environment." *See* Daily Trans., 8842:6-17 (Connolly Testimony).

458. Dr. Engel undertook his mass balance in this case in order to: (a) understand the movement of phosphorus into and out of the IRW, (b) identify the most substantial sources of phosphorus moving in and out of the IRW and (c) identify the sources that would be necessary to include in subsequent analyses, including his watershed modeling analysis. *See* Daily Trans., 5811:14-22 (Engel Testimony). Dr. Engel explained the importance of his mass balance analysis in understanding the fate and transport of phosphorus within the IRW:

> [T]he mass balance indicates an inflow of nutrients into the watershed and many of those are placed on the landscape within the watershed, and as rainfall interacts with them, they're going to move off-site into the streams, rivers, and ultimately to Lake Tenkiller. So myself, as well as others who have done mass balances, have found them to be a very important tool in understanding the potential fate and transport of materials like phosphorus.

See Daily Trans., 6621:11-25 (Engel Testimony).

459. The mass balance analysis Dr. Engel conducted in this case was similar to other watershed mass balance analyses he had conducted in the past. *See* Daily Trans., 5787:2-11 (Engel Testimony).

460. Dr. Engel selected the following phosphorus input sources for inclusion in his mass balance analysis: humans, poultry, swine, dairy cattle, beef cattle, heifers that calved, commercial fertilizers, golf courses, urban runoff, wholesale nurseries, recreational users and industrial users. *See* Daily Trans., 5823:18-5824:16 (Engel Testimony). With respect to the removal of phosphorus, Dr. Engel evaluated the Lake Tenkiller spillway, harvested crops, harvested deer and beef cattle sold. *See* Daily Trans., 5825:1-15 (Engel Testimony). Dr. Engel selected these input and removal sources based upon his experience in doing mass balance analyses, published literature that have identified sources of phosphorus in the IRW and his own personal experience with the IRW. *See* Daily Trans., 5824:7-16; 5825:9-15 (Engel Testimony).

461. The data sets that Dr. Engel relied upon in conducting his mass balance analysis are of the type typically relied upon by other experts. For instance, Dr. Engel utilized the United States census to determine the number of humans within the IRW, which is the "gold standard" data source for determining human population impacts. *See* Daily Trans., 5812:23-5813:15 (Engel Testimony). Dr. Engel's livestock population data were derived from the Unites States agricultural census, which is typically relied upon by scientists in evaluating the nutrient impacts of livestock. *See* Daily Trans., 5813:22-5814:18 (Engel Testimony). Dr. Engel's land use / land cover data were taken from the USGS national land cover data set which is also traditionally used by scientists to perform mass balance analysis of watersheds. *See* Daily Trans., 5814:19 – 5815:2 (Engel Testimony).

462. Once the sources were selected and data were assembled, Dr. Engel made calculations for each of the identified sources. *See* Daily Trans., 5823:18-5824:16 (Engel Testimony).

463. With respect to livestock animals, Dr. Engel utilized historical data going back to 1949 and was able to determine historical phosphorus inputs in five year increments. *See* Daily Trans., 5827:5-5828:11 (Engel Testimony). In calculating the phosphorus inputs for livestock, Dr. Engel first identified the life cycle of each animal group, identified the weights of each animal group and obtained phosphorus information from the USDA waste characterization handbook. *See* Daily Trans., 5835:25-5836:15 (Engel Testimony). Next, Dr. Engel took all of this data and used a mathematical equation that enabled him to calculate the phosphorus inputs for each of the livestock animal groups. *Id.*

464. In calculating phosphorus inputs from livestock animals, cattle were treated somewhat differently than the other animal groups. Specifically, Dr. Engel determined that cattle are mostly recycling phosphorus in the IRW. *See* Daily Trans., 5836:23-5837:20 (Engel Testimony). That is, because cattle are largely consuming grass and hay, most phosphorus excreted by cattle already existed within the IRW, and is simply being recycled. *Id.* The only true phosphorus additions from beef cattle come from feed supplements. *See* Daily Trans., 5794:9-5795:12 (Engel Testimony). Thus, cattle are not "net creators or excretors" of phosphorus in the IRW. *Id.* By contrast, the phosphorus in feed consumed by other livestock animal groups -- such as poultry, swine and dairy cattle -- is imported into the IRW. *See* Daily Trans., 5838:2-9 (Engel Testimony). Dr. Engel's "recycling" opinion is supported by published literature as well as his own experience. *See* Daily Trans., 6623:22-6624:16 (Engel Testimony) (testifying that other scientists have similarly concluded that cattle are P recyclers); *see also* Daily Trans., 916:9-10 (Fite Testimony) ("The cows are eating the grass that the poultry waste grew, passing through the cow, putting it back on the ground"); Daily Trans., 545:13-546:14 (Tolbert Testimony); Daily Trans., 9907:9-19 (Clay Testimony).

465. Dr. Engel's calculations for urban runoff and wholesale nurseries also differed from the calculations of the other sources. Dr. Engel concluded that the best way to determine the net movement of phosphorus from urban runoff and wholesale nurseries was to examine the amount of expected water actually leaving those areas and the concentration of phosphorus in that runoff. *See* Daily Trans., 6622:9-6623:21 (Engel Testimony).

466. Dr. Engel identified urban runoff areas from the national land cover data, utilized a value of phosphorus in urban runoff and ran the LTHIA model to calculate the amount of phosphorus that would actually runoff from urban areas in the IRW. *See* Daily Trans., 5845:13-24 (Engel Testimony). The LTHIA model was developed by Dr. Engel primarily to look at the impacts of urbanization of land uses on runoff and nonpoint source pollution. *See* Daily Trans., 5657:9-17 (Engel Testimony). The LTHIA model has been used by other scientists whose work with the model has been published in peer-reviewed journals. *See* Daily Trans., 5657:18-22 (Engel Testimony). This methodology employed for calculating urban runoff is a standard methodology used by Dr. Engel and other scientists to determine phosphorus contributions from urban runoff. *See* Daily Trans., 5846:20-5847:1 (Engel Testimony).

467. With respect to wholesale nurseries, Dr. Engel made an assumption that 20 inches of water ran off from the nurseries per year -- "which is a rather large number." *See* Daily Trans., 5847:4-7 (Engel Testimony). Dr. Engel also obtained and utilized a report that identified the concentrations of phosphorus being discharged from nurseries with the IRW. *See* Daily Trans., 5847:9-12 (Engel Testimony). An equation that relates area, runoff and concentration was used to calculate the mass of phosphorus entering the waters of the IRW from nurseries. *See* Daily Trans., 5847:12-15 (Engel Testimony). Dr. Engel's nurseries input analysis was a standard

method used by scientists to measure the nutrient contribution of nurseries in a watershed mass balance. *See* Daily Trans., 5847:22-5848:2 (Engel Testimony).

468. After making his phosphorus input calculations for each identified source, Dr. Engel conducted his phosphorus removal analysis. For his harvested crops removal calculation, Dr. Engel obtained agricultural census data by area of the crops produced for the amounts produced historically. *See* Daily Trans., 6196:12-19 (Engel Testimony). For the cattle removal, Dr. Engel again relied on agricultural census data for sales of cattle outside of the IRW. *See* Daily Trans., 6196:20-22 (Engel Testimony). Values that describe phosphorus within cattle flesh were obtained from the American Society of Agricultural Engineers. *See* Daily Trans., 6196:23-6197:3 (Engel Testimony). Dr. Engel made a similar calculation for the deer removal category. *See* Daily Trans., 6197:4-8 (Engel Testimony). Lastly, for phosphorus leaving Lake Tenkiller through the power generation portion of the spillway, Dr. Engel took data as to the amount of water leaving the spillway, modeled phosphorus content of the depth at which that phosphorus would be removed and conducted simple multiplication to get the mass of phosphorus removed by that source. *See* Daily Trans., 6197:9-15 (Engel Testimony).

469. After Dr. Engel had his final phosphorus input and removal calculations, he combined the calculations to obtain net phosphorus flows into the IRW. *See* Daily Trans., 6197:24-6198:4 (Engel Testimony).

470. Ultimately, Dr. Engel's mass balance analysis concluded that the percentage of current net phosphorus additions to the IRW by source breaks down as follows: poultry -- 76.2 percent; human -- 3.2 percent; swine -- 2.9 percent; dairy cattle -- 5.2 percent; beef cattle -- 1.7 percent; commercial fertilizer -- 7.5 percent; urban runoff -- 0.5 percent; industrial sources -- 2.7 percent; and all other sources (including wholesale nurseries and golf courses) -- 0.2 percent.

See Daily Trans., 6202:21 - 6203:18 (Engel Testimony); State's Ex. 1154; *see also* State's Ex. 1164; State's Ex. 1157; State's Ex. 1217; State's Ex. 4320.

471. Using his historical data, Dr. Engel was also able to determine that net phosphorus inputs to the IRW have changed over time. *See* Daily Trans., 6200:15-6201:23 (Engel Testimony); State's Ex. 1217. Specifically, net phosphorus inputs from poultry began at about 9 percent in 1949, increased to 55 percent by 1964, increased again to 70 percent by 1969 and remained at about that level until reaching the current level of 76.2 percent. *Id.*

472. Based upon his mass balance analysis, Dr. Engel arrived at the overall opinion that -- both historically and presently -- poultry production has been and is "the major contributor of phosphorus" to the IRW. *See* Daily Trans., 6207:13-6209:23 (Engel Testimony)(emphasis added).

473. Dr. Engel's conclusion with respect to poultry's contribution to phosphorous loading in the IRW is consistent with at least one other mass balance analysis of the IRW. Prior to Dr. Engel's mass balance analysis, the Arkansas Water Resources Center conducted a mass balance analysis of the IRW. *See* Daily Trans., 5984:4-5990:1 (Chaubey Testimony). The researchers conducting the mass balance analysis on behalf of the Arkansas Water Resources Center determined that poultry broilers were the most significant contributor of phosphorus loading to the IRW. *See* Daily Trans., 5990:3-16; 5978:15-5982:10 (Chaubey Testimony).

474. Defendants did not conduct any mass balance analysis of their own or offer any IRW phosphorus loading contrary to Dr. Engel's mass balance analysis. Instead, Defendants provide only a targeted critique of the mass balance, challenging some of the methods and assumptions. For instance, Defendants suggest that Dr. Engel did not actually conduct the mass balance analysis himself, but merely relied upon an assistant, Ms. Meagan Smith, to do the

analysis. This critique cannot be credited. It was Dr. Engel who decided to conduct the mass balance analysis and Dr. Engel who identified the process that would be used in conducting the mass balance -- including the data to be used, the sources to evaluate and the equations to be used. *See* Daily Trans., 5789:2-24 (Engel Testimony). Ms. Smith primarily assisted Dr. Engel with collection of the data and doing the computations. *See* Daily Trans., 5787:12-19 (Engel Testimony). Dr. Engel himself spent approximately 150 to 200 hours working on the mass balance analysis. *See* Daily Trans., 5798:19-23 (Engel Testimony). Dr. Engel reviewed Ms. Smith's work multiple times and determined that it was reliable and consistent with his directions. *See* Daily Trans., 5798:24-5799:21 (Engel Testimony). Overall, Ms. Smith worked under the direction of Dr. Engel, and Dr. Engel supervised her work through frequent communication. *See* Daily Trans., 5789:25-5790:9 (Engel Testimony).

475. More globally, Defendants' retained expert Dr. Sullivan criticized Dr. Engel's mass balance analysis for focusing on phosphorus inputs to the watershed rather than phosphorus actually entering streams through drainage water. *See* Daily Trans., 10659:17-10662:2 (Sullivan Testimony). On direct examination, Dr. Sullivan analogized Dr. Engel's mass balance to a warehouse containing 10 million tons of phosphorus: "If I built a warehouse in Fayetteville and I put 10 million tons of phosphorus in my warehouse and then lock the door, by the lines of argument that I've seen from the plaintiffs in this case, their conclusion would be, therefore, I'm polluting the Illinois River with phosphorus because I am the largest source of phosphorus coming into the watershed." *See* Daily Trans., 10661:16-23 (Sullivan Testimony). Dr. Sullivan's critique on this front ignores reality. Indeed, on cross examination, Dr. Sullivan admitted that poultry waste in the IRW is not locked up in a warehouse, that poultry waste is actually spread

on the soils of the IRW and that those soils are not properly described as a warehouse. *See* Daily Trans., 10884:5-10885:4 (Sullivan Testimony).

476. The Court finds that the conclusions of Dr. Engel's mass balance analysis are probative on the issue of phosphorus contribution to IRW waters and should be credited. The mass balance analysis is an important aspect of the State's overall circumstantial causation case. One simply cannot ignore the fact that poultry waste is by far the largest source of phosphorus additions to the IRW. This fact, coupled with the reality that most of this poultry waste is land applied in close proximity to where it is generated -- and is completely exposed to precipitation -- is important evidence of source in a watershed where over 80 percent of the phosphorus loading which ultimately reaches Lake Tenkiller is from nonpoint sources. The Court also finds it noteworthy that Defendants offered no alternative mass balance data to dispute that put forward by the State. Thus, Defendants have failed to rebut the State's evidence that poultry production accounts for 76.2 percent of the phosphorus loading to the IRW.

E. Geology of the IRW

477. The State's fifth line of evidence focuses on the geology of the IRW. The topography, hydrology, geology and soils of the IRW plainly influence fate and transport of contaminants in the IRW. *See* Daily Trans., 1593:13-20 (Fisher Testimony) (it is "the stage upon which the contaminants will be playing").

478. For instance, the topography of the IRW is higher in the east and lower in the west and southwest. *See* State's Ex. 3351 at OSU0005148; Daily Trans., 1594:25-1595:1 (Fisher Testimony). There is very little flat land in the IRW. *See* Daily Trans., 1598:3-7 (Fisher Testimony). Surface hydrology in the IRW is determined by topography of the IRW. *See* Daily Trans., 1594:2-3 (Fisher Testimony). Additionally, groundwater flow follows underlying

fractures in IRW. *See* Daily Trans., 1604:25-1605:21 (Fisher Testimony). Surface water and groundwater in the IRW are "fairly closely linked." *See* Daily Trans., 1606:14-21 (Fisher Testimony). The geology of the IRW is one of mantled karst. *See* Daily Trans., 1608:12-15 (Fisher Testimony). Soluble reactive phosphorus "moves through the karst pretty easily unchanged." *See* Daily Trans., 5369:12-24 (Olsen Testimony). The soils in the IRW generally have intermediate to high run-off potential. *See* State's Ex. 3351 at OSU0005159-60; Daily Trans., 1609:18-22 (Fisher Testimony). Activities on the soil surface affect ground water because rainfall will mobilize soluble materials as well as small particulates and move them downward to infiltrate groundwater. *See* Daily Trans., 1625:19-1626:3 (Fisher Testimony). And, because this karst geology is characterized by fractures, faults and joints, there is very little soil filtering if groundwater in the IRW. *See* Daily Trans., 1626:4-10 (Fisher Testimony). In fact, there is no area within the IRW that would not generate runoff. *See* Daily Trans., 1598:8-16 (Fisher Testimony).

479. Dr. Dwayne Edwards testified that "the potential for water quality degradation from eutrophying nutrients (nitrogen and phosphorus) . . . is particularly high, especially in areas such as northwest Arkansas where shallow, cherty soils and karstic geology greatly increase interaction between surface and ground water." *See* Court's Ex. 11 at 9 (Edward's Depo.).

F. Chemical Ratio Analysis

480. For the State's sixth line of evidence supporting its contention that phosphorus from land-applied poultry waste is running off and leaching into the waters of the State, the State retained Dr. Bert Fisher to conduct a chemical ratio analysis. In general terms, Dr. Fisher analyzed constituents in poultry waste, cow manure and wastewater treatment plant discharges, and concluded that, with respect to a number of factors, poultry waste differs chemically from

cow manure and wastewater treatment plant discharges, and that those differences can be expressed in ratios of phosphorus, copper, zinc and arsenic. *See* Daily Trans., 1824:20-1837:24 (Fisher Testimony); State's Ex. 2518; State's Ex. 2525. Dr. Fisher then examined the chemical concentrations and ratios found in the State's soil, edge-of-field, stream sediment, groundwater and lake sediment samples and was able to identify or track the presence of poultry waste through each of those environmental media. *See, e.g.*, Daily Trans., 1976:14-1977:23; 1996:22-1997:16 (Fisher Testimony) (soils); Daily Trans., 2036:10-18 (Fisher Testimony) (edge-of-field); Daily Trans., 2057:25-2058:7 (Fisher Testimony) (stream sediments); Daily Trans., 2083:18-2084:14 (Fisher Testimony) (groundwater); and Daily Trans., 2146:20-2147:2; 2164:19-2166:8 (Fisher Testimony) (lake sediments).

481. As Dr. Fisher testified, in attempting to track any source of contamination, it is important to determine whether there are any chemical characteristics that make that source unique. *See* Daily Trans., 1821:22-1822:1 (Fisher Testimony); *see also* Daily Trans., 1834:4-6 (Fisher Testimony) ("looking at the concentrations and concentration ratios in environmental phases . . . allows the identification of a source for that material"). In the present case, this analysis:

> allows you to identify poultry waste present in the environment both in terms of what's a reasonable source as it relates to the concentrations of materials that are found in the environment. In addition, it allows you to make some statements concerning the origin of that material once you account for any changes due to transportation. It would be part of a transport and fate analysis.

See Daily Trans., 1832:17-1833:8 (Fisher Testimony).

482. Because an animal's waste is a function of its diet, "[p]oultry waste will reflect the feeds that they're given." *See* Daily Trans., 1800:12-13, 17-18 (Fisher Testimony). And, as previously discussed, each Defendant supplies / owns the feed consumed by its birds in the IRW.

See supra, FOF, ¶ 317; *see also* Daily Trans., 1794:1-5 (Fisher Testimony). Therefore, Dr. Fisher, began his analysis by sampling Defendants' feed and reviewing their feed formulas. *See* Daily Trans., 1793:12-25 (Fisher Testimony); *see also* Daily Trans., 1821:22-24 (Fisher Testimony) ("In looking at your ability to track a source, you want to establish that there are chemical characteristics of that source that make that source unique."). He testified that Defendants' feeds "may differ a bit, but they're all pretty much the same." *See* Daily Trans., 1800:14-15 (Fisher Testimony).

483. Comparing the feeds with the nutritional requirements for poultry, Dr. Fisher found, among other things, that "the feeds are compounded with very high levels of copper and zinc. . . ." *See* Daily Trans., 1794:12-21 (Fisher Testimony). He testified that Defendants add phosphorus to their feeds for the purpose of maintaining the bone strength necessary to support rapid growth. *See* Daily Trans., 1796:10-24 (Fisher Testimony). And Defendants -- with the exceptions of Defendant Cal-Maine and, recently, the Tyson Defendants -- also have included an organic arsenic compound. *See* Daily Trans., 1794:24-1795:3, 1799:2-12, 2694:13-22 (Fisher Testimony).

484. Presumably because they are fed to poultry in excess of the poultry's dietary needs, *see* Daily Trans., 1794:12-1795:3, 1814:18-21 (Fisher Testimony), these elements end up in poultry waste. *See* Daily Trans., 1815:22-1816:3 (Fisher Testimony); State's Ex. 2523. As Dr. Fisher testified: "A compounded feed that is high in phosphorus, zinc, copper, and frequently arsenic is fed to chickens. The chickens produce a waste, and that waste is also very high in phosphorus, very high in zinc and copper, and — and high in arsenic." *See* Daily Trans., 1822:2-12 (Fisher Testimony).

485. Dr. Fisher's analysis of these constituents of poultry waste -- namely, phosphorus, copper, zinc and arsenic -- is comparable with analyses in other published materials. *See* Daily Trans., 1823:4-1824:7 (Fisher Testimony). For instance, Dr. Fisher relied upon a 2003 article by author B.P. Jackson entitled "Trace Element Speciation in Poultry Litter" ("Jackson article"), which was published in the *Journal of Environmental Quality*, a peer reviewed scientific journal. *See* Daily Trans., 2812:13-2813:4 (Fisher Testimony). The abstract of the Jackson article provides that "[t]race elements are added to poultry feed for disease prevention and enhanced feed efficiency. High concentrations are found in poultry litter (PL), which raises concerns regarding trace element loading of soils." *See* Daily Trans., 2818:9-16 (Fisher Testimony). This was important to Dr. Fisher because he was interested in determining the chemical composition of certain trace elements in poultry waste. *See* Daily Trans., 2818:17-2819:7 (Fisher Testimony). The Jackson article was also important to Dr. Fisher because the researchers found values for phosphorus, copper, zinc and arsenic in poultry waste that were comparable with the values that Dr. Fisher found in this case. *See* Daily Trans., 2825:6-2827:13; 2828:2-2829:9 (Fisher Testimony). As Dr. Fisher explained, the Jackson article helped him choose phosphorus, copper, zinc and arsenic as the constituents he would use to track poultry waste contamination through various environmental media:

> [P]hosphorus is a material that's very, very high in poultry litter. Arsenic is -- is not present in the environment typically at these concentrations [found in poultry waste]; [poultry waste] is the only major source of arsenic. And copper and zinc are not -- and copper and zinc are generally not present in these levels in soils and other normal environment phases.

See Daily Trans., 2828:2-21 (Fisher Testimony).

486. Dr. Fisher next compared the chemical composition of poultry waste with that of cattle waste and wastewater treatment plant effluent. *See* Daily Trans., 1824:8-11 (Fisher

Testimony). He selected cattle waste for comparison because there is a large population of cattle in the IRW and because cattle waste is deposited on fields. *See* Daily Trans., 1824:12-16 (Fisher Testimony). He selected wastewater treatment effluent for a comparison because that material is discharged directly into streams in the IRW. *See* Daily Trans., 1824:17-19 (Fisher Testimony). Dr. Fisher found that, "with respect to a number of factors, cattle waste . . . and wastewater treatment plant waste differ from poultry waste." *See* Daily Trans., 1829:17-19 (Fisher Testimony). He expressed these differences in ratios of total zinc to total phosphorus (Zn:P), total copper to total phosphorus (Cu:P), total arsenic to total phosphorus (As:P), and total zinc to total copper (Zn:Cu). *See* State's Ex. 2525 (table documenting same); Daily Trans., 1834:23-1835:23 (Fisher Testimony) (explaining table).

487. "Cattle eat grass. And as a consequence, their waste should reflect the grass." *See* Daily Trans., 1800:16-17 (Fisher Testimony); *see also* Daily Trans., 1801:5-9 (Fisher Testimony) ("the waste streams from cattle and from poultry should be different as a function of what they eat, in that poultry eat compounded feeds that contain high levels of phosphorus, copper, zinc and frequently arsenic, and cattle eat grass").

488. Indeed, Dr. Fisher found that cattle waste is "distinctly different" from poultry waste in that cattle waste has a "much lower concentration of phosphorus, extremely low concentrations of zinc and copper, and almost no arsenic present in it." *See* Daily Trans., 1824:20-25 (Fisher Testimony); *see also* State's Ex. 2518.

489. Likewise, the chemical compositions of wastewater treatment plant effluents differ significantly from poultry waste. Specifically, Dr. Fisher found that wastewater treatment plant effluent has "low levels of phosphorus" and "significantly a very different zinc-to-copper ratio." *See* Daily Trans., 1825:2-8 (Fisher Testimony); *see also* Daily Trans., 1833:15-16 (Fisher

Testimony) ("wastewater treatment plant waste is much richer in zinc or much more depleted in copper than poultry waste"); State's Ex. 2518 (graphically comparing data for samples of poultry waste, cattle waste and wastewater treatment effluent).

490. In conjunction with the concentration comparison, the ratio analysis assisted Dr. Fisher with source identification through various environmental media because the closer one is to the source, the more conserved the ratios should be. *See* Daily Trans., 1837:1-4 (Fisher Testimony); *see also* State's Ex. 2525. First, because copper salts are more soluble than zinc salts, with transport, the ratios can change; "that is, that will become more enriched in zinc with respect to copper, but we still should have quite a bit of zinc and copper present and we should always have quite a bit of phosphorus present." *See* Daily Trans., 1837:4-10 (Fisher Testimony). Second, Dr. Fisher expected to see a "clear and distinct relationship between phosphorus and zinc, phosphorus and copper, as well as phosphorus and arsenic maybe to a lesser extent, if there's a poultry waste source, because the concentrations of phosphorus are so high in poultry waste, 19,700 on average, around 20,000, compared to cattle waste, which is around 6,000." *See* Daily Trans., 1837:11-17 (Fisher Testimony). Third, because the "the concentrations of zinc and copper are 400-plus milligrams per kilogram in poultry waste and only tens of milligrams per kilogram in cattle waste," the chemical signal from cattle waste with respect to copper and zinc will be "lost quickly as it pollutes, but that [signal] from poultry waste will not." *See* Daily Trans., 1837:18-23 (Fisher Testimony). Lastly, the presence of arsenic in environmental media indicates poultry waste versus cattle waste because cattle waste simply "does not contain arsenic." *See* Daily Trans., 1837:23-24 (Fisher Testimony).

491. In analyzing various environmental media, Dr. Fisher first looked at soil samples taken from fields within the IRW where poultry waste had been land applied. *See* Daily Trans.,

1976:14-18 (Fisher Testimony). In analyzing the soil sampling data, Dr. Fisher concluded that poultry waste contaminates the land applied fields with phosphorus, copper, zinc and arsenic. *See* Daily Trans., 1976:19-22 (Fisher Testimony). Dr. Fisher reached that conclusion by examining the concentrations in the top two inches of the soil and comparing those to the deeper depths that resemble control soils (*i.e.*, have much lower phosphorus, copper, zinc and total arsenic concentrations). *See* Daily Trans., 1976:23-1977:5 (Fisher Testimony). The data show that the ratio of copper to zinc in the upper two inches of soil to which poultry waste had been applied is consistent with the ratios that Dr. Fisher found in poultry waste. *See* Daily Trans., 1977:6-9 (Fisher Testimony). Dr. Fisher further found a pattern in the soil data of contamination at the surface and lesser or none at depth, which is consistent with surface application of poultry waste. *See* Daily Trans., 1977:9-12 (Fisher Testimony). Additionally, Dr. Fisher found that the concentrations of phosphorus, copper and zinc and arsenic on the surface of the fields to be inconsistent with contamination from cattle waste. *See* Daily Trans., 1977:13-23 (Fisher Testimony). Simply stated, Dr. Fisher concluded that he could not "make the concentrations of phosphorus, copper, zinc and arsenic that [he] observe[d] in the top two inches of the 73 sample fields by mixing cattle waste into those soils." *See* Daily Trans., 1977:18-23 (Fisher Testimony).

492. Based on the foregoing analysis, Dr. Fisher further concluded that the constituents of poultry waste present on land-applied fields (*i.e.*, phosphorus, copper, zinc and arsenic) are "available for transportation," meaning that they could exit the field in runoff or infiltrate as dissolved constituents in water. *See* Daily Trans., 1997:3-11 (Fisher Testimony).

493. Next, Dr. Fisher analyzed the edge-of-field runoff samples collected by the State. *See, e.g.*, State's Ex. 2500. Dr. Fisher selected the edge-of-field sampling locations according to historical land application records, eyewitness reports of land application, aerial photograph

review and topographic infradata. *See* Daily Trans., 2708:7-2709:20 (Fisher Testimony). In analyzing the edge-of-field data, Dr. Fisher concluded that runoff from fields where poultry waste had been land applied contains constituents from poultry waste -- namely, phosphorus, zinc, copper, and arsenic. *See* Daily Trans., 2033:22-2043:2 (Fisher Testimony). Particularly, Dr. Fisher determined that compositions in edge-of-field runoff with respect to phosphorus and zinc, phosphorus and copper, and phosphorus and arsenic are consistent with contamination by poultry waste. *See* Daily Trans., 2033:12-21 (Fisher Testimony). Dr. Fisher further concluded that high concentrations of phosphorus, copper, zinc and arsenic found in the edge-of-field sampling data could not be explained by any source other than poultry waste. *See* Daily Trans., 2714:1-15 (Fisher Testimony).

494. After analyzing the edge-of-field data, Dr. Fisher examined the State's stream sediment sampling data. *See, e.g.*, State's Ex. 2503. Dr. Fisher chose to perform an analysis of stream sediment data because stream sediments are downgradient from edge-of-field runoff sites and because streams contain sediments that have moved from areas at higher elevations, upgradient. *See* Daily Trans., 2037:2-6 (Fisher Testimony). This stream sediment analysis was important in the evaluation of the fate and transport because the chemical composition of the sediments could be examined: (a) in comparison with poultry waste; and (b) for the transport history. *See* Daily Trans., 2037:7-14 (Fisher Testimony). Dr. Fisher and the State's field team undertook a calculated effort to identify appropriate stream sediment sampling locations based primarily on gradient changes that might result in the accumulation of finer-grain material. *See* Daily Trans., 2037:15-2038:12 (Fisher Testimony). Once the stream sediments were sampled, they were sent to laboratories for analysis. *See* Daily Trans., 2038:13-18 (Fisher Testimony). In examining the stream sediment sampling data, Dr. Fisher concluded that poultry waste is

contaminating stream sediments in the IRW. *See* Daily Trans., 2057:25-2058:7 (Fisher Testimony). Dr. Fisher based this conclusion upon the observation of fairly substantial enrichments in phosphorus and zinc, and some enrichment in copper compared to control soils. *See* Daily Trans., 2057:14-18 (Fisher Testimony). Dr. Fisher found the stream sediment data to be consistent with the constituents of poultry waste and the leaching away of copper. *See* Daily Trans., 2057:18-21 (Fisher Testimony). The data further suggest that arsenic is accumulating in stream sediments. *See* Daily Trans., 2057:22-24 (Fisher Testimony).

495. Dr. Fisher also employed an analysis of groundwater within the IRW. *See* Daily Trans., 2059:20-24 (Fisher Testimony). Dr. Fisher chose to investigate groundwater because groundwater is susceptible to contamination from surface contaminants in the IRW due to the relatively thin and permeable soils and karst-type geology with large conduits to move contaminants. *See* Daily Trans., 2060:7-13 (Fisher Testimony). As part of this groundwater investigation, the State sampled springs (*i.e.*, natural resurgences of underground water), wells and shallow alluvial aquifers (by geoprobe sampling). *See* Daily Trans., 2060:1-6 (Fisher Testimony). In examining the data, Dr. Fisher found that with respect to zinc and copper concentrations, "the edge-of-field samples truly do blend seamlessly . . . with samples collected from the geoprobes and from the springs." *See* Daily Trans., 2079:17-25 (Fisher Testimony); *see also* State's Ex. 2502. Because cattle waste contains low levels of zinc and copper, Dr. Fisher determined that "the only reasonable source for high levels of zinc and copper" found in the springs and alluvium is poultry waste. *See* Daily Trans., 2080:4-2082:12 (Fisher Testimony). The copper and zinc data coupled with elevated phosphorus levels in groundwater and high levels of arsenic in one stream suggest that poultry waste is entering the groundwaters of the IRW. *See* Daily Trans., 2082:24-2083:25 (Fisher Testimony).

496. Lastly, Dr. Fisher performed an evaluation of Lake Tenkiller sediments. *See* Daily Trans., 2084:17-19 (Fisher Testimony). Dr. Fisher describes Lake Tenkiller as a "big bathtub" or "sediment sink" that accumulates sediment. *See* Daily Trans., 2085:3-4 (Fisher Testimony). Dr. Fisher chose to evaluate Lake Tenkiller sediments because Lake Tenkiller is the "end of the line" for sediments; in other words, the Lake sediments reflect "materials that are placed on the land and end up in the streams and ultimately end up in Lake Tenkiller." *See* Daily Trans., 2084:20-2085:8 (Fisher Testimony). In addition, the Lake sediments reflect dissolved materials because: (a) when sediments are deposited, they entrain water and necessarily contain some dissolved material; and (b) biological processes ensure that sediments contain chemicals derived from the surface water. *See* Daily Trans., 2085:17-2086:1 (Fisher Testimony). In investigating the Lake sediments, Dr. Fisher took core samples from four locations, cut the cores into depth segments, analyzed the depth segments chemically and -- by looking at the content of lead-210 -- was able to obtain the date of deposition for each sediment integral. *See* Daily Trans., 2086:2-10 (Fisher Testimony).[90]

497. In analyzing the Lake core sampling data, Dr. Fisher found that concentrations of zinc increased with concentrations of total phosphorus, that the concentration of total copper increased with the total concentration of phosphorus, and that as copper increased, zinc increased. *See* Daily Trans., 2146:15-19 (Fisher Testimony). Dr. Fisher concluded that the source of contamination in the Lake Tenkiller sediments is poultry waste. *See* Daily Trans., 2146:20-2147:2 (Fisher Testimony). Dr. Fisher based this conclusion on the fact that he observed similar chemical relationships in poultry waste, soils from land-applied fields, edge-of-field runoff and stream sediments. *See* Daily Trans., 2145:7-2146:11 (Fisher Testimony). Dr.

---

[90] Dr. Fisher's lead-210 analysis is discussed in detail in Section XIV (H), *infra*.

Fisher further found that the increase in poultry population in the IRW over time correlates with the overall changes in phosphorus concentrations in Lake Tenkiller sediments. *See* Daily Trans., 2164:19-2166:8 (Fisher Testimony). This is additional evidence that the source of contamination in Lake Tenkiller sediments is poultry waste. *See* Daily Trans., 2166:2-8 (Fisher Testimony).

498. Defendants are critical of several aspects of Dr. Fisher's ratio analysis. For instance, Defendants' expert Dr. Connolly rejects both Dr. Fisher's ratio analysis and Dr. Olsen's pathway analysis as attempts to "track [poultry waste] using chemicals that are ubiquitous in the watershed." *See* Daily Trans., 9002:2-8 (Connolly Testimony). However, the constituents that Dr. Fisher and Dr. Olsen were measuring are not "ubiquitous in the watershed" at the <u>concentrations</u> found in poultry waste. Again, as Dr. Fisher explained, "phosphorus is a material that's very, very high in poultry litter. Arsenic is -- is not present in the environment typically at these concentrations [found in poultry waste]; [poultry waste] is the only major source of arsenic. And copper and zinc are not -- and copper and zinc are generally not present in these levels in soils and other normal environment phases." *See* Daily Trans., 2828:2-21 (Fisher Testimony). Neither Dr. Connolly -- nor any of Defendants' other experts -- has offered any plausible explanation for the <u>concentrations</u> of -- including, concentrations of dissolved -- copper, zinc and arsenic found in the State's sampling data. As an illustration, Dr. Connolly asserts that chemical changes in the relationships between phosphorus, copper, zinc and arsenic in poultry waste versus edge-of-field samples make copper, zinc and arsenic poor tracers for poultry waste in the environment. *See* Daily Trans., 9018:1-9021:2 (Connolly Testimony). However, as Dr. Olsen testified, "[w]hat's unique about the edge-of-field samples is that there's a large fraction of that total copper, arsenic, zinc that is dissolved and that's only characteristic of poultry waste." *See* Daily Trans., 5420:20-23 (Olsen Testimony). Dr. Sullivan, who was also critical of the State's

edge-of-field sampling, admitted that he conducted no evaluation of the levels of copper, zinc and arsenic found in poultry waste, cattle waste or in the State's edge-of-field sampling data. *See* Daily Trans., 10916:16 – 10917:15 (Sullivan Testimony).

499. Defendants have also criticized the State's edge-of-field sampling program. Particularly, Defendants have asserted that the edge-of-field sampling is not representative of what actually runs off of fields. As an example, Dr. Sullivan testified as follows:

> The edge-of-field samples were collected largely from ditches. . . . And by and large, those samples were not collected from flowing water; they were collected from a ditch that was convenient to the road where the samplers could get without having permission to get onto the land. So there's no way to know where that water came from. . . . And if it did come off the field, we don't know what the source of phosphorus on the field was that may have contributed the phosphorus to the edge-of-field water.

See Daily Trans., 10751:7-23 (Sullivan Testimony).

500. With respect to taking samples of ponded water on the side of a road, Dr. Fisher explained that such samples are representative of what runs off of fields because the waters have interacted with local soils and because the concentrations of copper, zinc and arsenic found in the edge-of-field samples cannot be explained by any source other than poultry waste. *See* Daily Trans., 2712:8-2713:13; 2714:1-15 (Fisher Testimony). At one point, counsel for Defendants even suggested that copper found in edge-of-field data could be explained by residue from automobile brakes. As Dr. Fisher explained, cars are not big sources of phosphorus, copper, zinc or arsenic and could not explain the concentrations of these constituents found in the edge-of-field data. *See* Daily Trans., 2712:8-2713:13; 2714:1-15 (Fisher Testimony); *see also* Daily Trans., 5492:22-5493:10 (Olsen Testimony) (Mr. Green: . . . Now, out of curiosity, Doctor, do you know that studies have shown that a substantial amount of copper in surface water derives from car brakes given off as friction material when the brakes are engaged? Have you heard

that? Dr. Olsen: Yes. Mr. Green: And if that's correct, then water running off a road into a puddle, such as this, may well contain, well, copper from brakes? Dr. Olsen: Yes. I was actually involved in that study in California, it was from major, major highways in California, and this certainly isn't a major highway in California. And it was also total copper versus dissolved copper.").

501. As to the issue of "flowing water," the State did take some edge-of-field samples where water was flowing and all of the State's edge-of-field samples where taken within a reasonable time after a rain event, and thus represent runoff. *See* Daily Trans., 2717:8-2718:5 (Fisher Testimony).

G. Pathway Concentration Analysis

502. For the State's seventh line of evidence supporting its contention that phosphorus from land-applied poultry waste is running off and leaching into the waters of the State, the State retained Dr. Roger Olsen, who conducted a pathway concentration analysis. Dr. Olsen's pathway concentration analysis involved the evaluation of constituent concentrations in samples from each environmental component -- every media and every sequential transport step -- from the source to its ultimate location to determine whether there is a complete pathway or not. *See* Daily Trans., 5265:8-22 (Olsen Testimony). More specifically, this pathway concentration analysis was what other scientists would call a "traditional gradient fate and transport analyses, where [one] look[s] at concentrations along pathway steps from the source to the ultimate location where it will be deposited, and determine[s] the concentrations to see if the concentrations differences decrease in a logical manner from upgradient to downgradient, from start to finish, consistent with [one's] understanding of the fate and transport of those contaminants." *See* Daily Trans., 5212:4-18 (Olsen Testimony). As Dr. Olsen explained, when

one observes a decrease in contaminants along transport steps, the logical conclusion is that the contaminants came from the identified source -- here, poultry waste. *See* Daily Trans., 5212:19-25 (Olsen Testimony).

1. Dr. Olsen's "Leachate" Test

503. Underpinning Dr. Olsen's pathway concentration analysis is his "leachate" test. Specifically, Dr. Olsen utilized EPA's Synthetic Participation Leachate Procedure or "SPLP" test, which is a traditional method by which the EPA and other scientists evaluate the mobility of wastes that are subject to rainfall. *See* Daily Trans., 5210:7-11, 5227:13-17 (Olsen Testimony). It was Dr. Olsen's intent to compare poultry waste and cattle waste leachate and use the results of that comparison to identify and distinguish the wastes in the environment. *See* Daily Trans., 5210:7-14, 5227:18-5228:4 (Olsen Testimony). In conducting his leachate test, Dr. Olsen first compared poultry waste and cattle waste leachates and evaluated whether there were any differences in the concentrations of certain constituents -- namely, copper, zinc, arsenic, potassium, total dissolved phosphorus and soluble reactive phosphorus. *See* Daily Trans., 5210:7-14, 5233:2-9 (Olsen Testimony). Dr. Olsen also coupled his leachate test with Dr. Engel's mass balance analysis to determine "potentialable" leachable masses of contaminants from poultry waste. *See* Daily Trans., 5258:4-11 (Olsen Testimony).

504. As a result of his leachate test, Dr. Olsen found that the concentrations of copper, zinc, arsenic, potassium, total dissolved phosphorus and soluble reactive phosphorus are much higher in poultry waste than in cattle waste. *See* Daily Trans., 5233:2-5235:25 (Olsen Testimony). As Dr. Olsen testified, comparing leachate concentrations in this manner is "one of the most important comparisons to do because this is actually what's being potentially mobilized into the water, so that water ends up as runoff or it ends up as infiltration." *See* Daily Trans.,

5236:21-5237:2 (Olsen Testimony). Dr. Olsen also determined that "the 'potentialable' leachable masses of copper, potassium, zinc, and arsenic from poultry are much, much higher than that from cattle, and also that the potential leachable masses from poultry for soluble reactive P and dissolved reactive P is significantly higher than that from cattle, almost five times." *See* Daily Trans., 5258:4-11 (Olsen Testimony).

505. Overall, as a result of his leachate test, Dr. Olsen concluded that the "composition of . . . of poultry waste and cattle manure [are] distinct and that [one] should be able to observe these distinct differences in environmental samples." *See* Daily Trans., 5303:16-24 (Olsen Testimony).

2. Pathway Concentration Analysis Study Design, Methodology and Results

506. In order to conduct the pathway analysis, the State's experts employed a component pathway sampling approach. *See* Daily Trans., 5265:1-5 (Olsen Testimony). That is, in the sampling campaign, the focus was on collecting samples from every pertinent environmental component in the IRW for every transport step from the potential source to Lake Tenkiller. *See* Daily Trans., 5265:6-13 (Olsen Testimony). As Dr. Olsen explained:

> [W]e would sample the poultry waste, we would sample the soils where it had been disposed, we would sample the edge-of-field runoff, we would sample small tributaries where that would end up and larger tributaries, and then finally we would sample Lake Tenkiller. So it's a whole set of sequential transport steps to determine whether there's a complete pathway or not.

See Daily Trans., 5265:15-22 (Olsen Testimony).

507. For his analysis, Dr. Olsen divided the sampling data into "logical groups." *See* Daily Trans., 5318:9-10 (Olsen Testimony). Specifically, Dr. Olsen analyzed: (a) solid samples (poultry waste, soils on the fields, sediments in the rivers, and sediments in Lake Tenkiller; reference samples); (b) surface water samples (water in edge of field, water in small tributaries,

water in larger rivers, and water in Lake Tenkiller; reference samples); and (c) groundwater samples (alluvial waters, springs, and residential wells). *See* Daily Trans., 5318:9-5319:4 (Olsen Testimony).

508. In conducting this pathway analysis with respect to phosphorus in solid media, Dr. Olsen found concentration changes that were consistent with his understanding of the fate and transport of phosphorus in the environment. *See* Daily Trans., 5335:2-7 (Olsen Testimony). As a starting point, Dr. Olsen determined that the concentrations of phosphorus in all solid media in the IRW exceed reference soil concentrations. *See* Daily Trans., 5339:2-8 (Olsen Testimony). Dr. Olsen additionally observed that phosphorus concentrations start out higher on the fields at about 1,050 (which is the highest solids component in the data besides the poultry waste itself). *See* Daily Trans., 5335:11-13 (Olsen Testimony). Then, in river sediments, Dr. Olsen found phosphorus concentrations decreased to 522. *See* Daily Trans., 5335:14-16 (Olsen Testimony). Lastly, the Lake Tenkiller sediment sampling data showed an increase up to 967. *See* Daily Trans., 5335:16-17 (Olsen Testimony). The increased concentrations in the lake sediments is attributable to the large amount of phosphorus transported into Lake Tenkiller and processes that phosphorus undergoes -- including uptake with the algae and settling in the Lake -- which cause additional phosphorus to become incorporated in the upper sediments. *See* Daily Trans., 5336:20-5337:7 (Olsen Testimony).

509. Dr. Olsen found the same phenomena occurring in the solids media with respect to concentrations of copper, zinc and arsenic. *See* Daily Trans., 5341:8-5342:7; 5343:25-5344:13 (Olsen Testimony). In other words, the concentrations of copper, zinc and arsenic found in the samples collected from solid media were consistent with known fate and transport processes showing that poultry waste from land applied fields was being transported into the

river sediments and Lake sediments. *See* Daily Trans., 5341:8-5342:7; 5343:25-5344:13 (Olsen Testimony).

510. With respect to surface water media analysis, Dr. Olsen found phosphorus concentrations exceeded reference levels in each of the environmental media -- edge-of-field, water in small tributaries, water in larger rivers, and water in Lake Tenkiller. *See* Daily Trans., 5350:9-22. Indeed, the edge-of-field data show "extremely high concentrations" of phosphorus (over 8,000 micrograms per liter). *See* Daily Trans., 5353:13-24 (Olsen Testimony). Similarly, the small tributaries data show "very large concentrations" of phosphorus, both in high-flow and base-flow. *See* Daily Trans., 5354:25 – 5355:7 (Olsen Testimony). The data also demonstrate that there is a gradient between the small tributaries into the medium and large size and finally the lowest concentration in Lake Tenkiller. *See* Daily Trans., 5355:8-18 (Olsen Testimony). Overall, Dr. Olsen concluded that for the key constituents -- phosphorus, copper, zinc and arsenic -- "there was a logical connection between the edge-of-field and the ultimate deposition in Lake Tenkiller and there was a completed pathway and that that contamination was being completely transported throughout the IRW from the source location; that is, the edge-of-field, into Lake Tenkiller." *See* Daily Trans., 5352:8-14 (Olsen Testimony).

511. Additionally, Dr. Olsen found that about half of the phosphorus found in the State's edge-of-field sampling data was soluble-reactive phosphorus. *See* Daily Trans., 5362:22 – 5363:3 (Olsen Testimony). What is more, the data show that in the surface water media components as a whole, most of the phosphorus is soluble-reactive. *See* Daily Trans., 5363:9-16 (Olsen Testimony). In fact, Dr. Olsen has found that "typically in the IRW waters, the amount of actual soluble-reactive phosphorus is about 80 or more percent of [the] total phosphorus." *See* Daily Trans., 5363:20-22 (Olsen Testimony). Furthermore, the data show a dilution in the

concentrations of soluble-reactive phosphorus downgradient to Lake Tenkiller where it uptakes to algae and becomes a particulate. *See* Daily Trans., 5364:1-9 (Olsen Testimony). Lastly, Dr. Olsen testified that as organic-bound phosphorus moves through the environment, it "breaks down a little bit" and thus, there is more soluble-reactive phosphorus. *See* Daily Trans., 5367:2-24 (Olsen Testimony).

3. Ultimate Conclusions

512. In sum, Dr. Olsen concluded that "[b]ased upon my entire [pathway] analysis of the compositions of the various major sources of waste, the level of contamination, and my fate and transport analysis, I believe that a portion -- a substantial portion of the phosphorus with the IRW waters is a result of runoff from land-applied fields -- poultry land-applied fields." *See* Daily Trans., 5398:5-11 (Olsen Testimony).

4. Defendants' Critique and the State's Response

513. Defendants are critical of several aspects of Dr. Olsen's pathway concentration analysis. Again, Defendants' expert Dr. Connolly rejects both Dr. Olsen's pathway and Dr. Fisher's ratio analysis as attempts to "track [poultry waste] using chemicals that are ubiquitous in the watershed." *See* Daily Trans., 9002:2-8 (Connolly Testimony). However, as explained above in Sections XIV (F) and (G), the constituents that Dr. Olsen and Dr. Fisher were measuring are not "ubiquitous in the watershed" at the <u>concentrations</u> found in poultry waste. As a result of his leachate test, Dr. Olsen found poultry waste to be distinct due to the uncommonly high concentrations of copper, arsenic and phosphorus in particular. And these concentrations logically explain detections in different environmental media. For instance, Dr. Olsen testified that "what's unique about the edge-of-field samples is that there's a large fraction of that total copper, arsenic, zinc that is dissolved and that's only characteristic of poultry waste." *See* Daily

Trans., 5420:20-23 (Olsen Testimony). Defendants have put forth no viable explanation for why the State found such high concentrations of these constituents in different environmental media throughout the IRW. Based on his overall analysis, it was certainly reasonable for Dr. Olsen to conclude that poultry waste was the source.

514. Dr. Connolly also claims that Dr. Olsen fails to show any gradient between poultry waste and elevated phosphorus concentrations in two small tributaries because those small tributaries are downgradient from wastewater treatment plants. *See* Daily Trans., 9393:22-9394:3 (Connolly Testimony). Yet, Dr. Connolly did not consider whether these two small tributaries were impacted solely by wastewater treatment plants or whether they might also be impacted by poultry operations. *See* Daily Trans., 9394:7-21 (Connolly Testimony). In any event, during cross-examination, Dr. Connolly admitted that even if you remove the two small tributaries impacted by wastewater treatment plants from the State's data set, there is still a substantial amount of soluble reactive phosphorus contamination in the small tributaries available for algae growth under base-flow and high-flow. *See* Daily Trans., 9395:6-13 (Connolly Testimony) ("Mr. Page: Even if you take out those two subwatersheds, doesn't there still show a substantial amount of soluble reactive phosphorus in the small tributaries? Dr. Connolly: Yes. Mr. Page: Plenty for algae growth, correct, under both high and base flow? Dr. Connolly: Yes."). This is particularly important in light of the fact that Dr. Connolly admits that: (a) 82 percent of the phosphorus loading to Lake Tenkiller is from nonpoint sources; and (b) <u>phosphorus from land applied poultry waste makes its way to the Illinois River and Lake Tenkiller</u>. *See* Daily Trans., 9142:5-20; 9183:19-22 (Connolly Testimony) ("If you're asking me whether or not any of the phosphorus in poultry litter applied to fields makes its way to the Illinois River or Lake Tenkiller, <u>the answer is obviously yes.</u>")(emphasis added).

515. Defendants also suggest that certain data showing base-flow phosphorous concentrations in IRW streams that are higher than high-flow concentrations indicates that there is no gradient between land-applied poultry waste and phosphorous concentrations. *See* Daily Trans., 9034:25-9035:19 (Connolly Testimony). However, as Dr. Olsen explained, in a basin with a small amount of non-point phosphorus sources, one would expect to see base-flow concentrations that are much higher than the high flow number. *See* Daily Trans., 5398:5-11 (Olsen Testimony). That is not the case in the IRW. On average, the data show that phosphorus concentrations in IRW streams are the same or higher during high-flow events. *See* Daily Trans., 5597:17-21 (Olsen Testimony). Furthermore, in the IRW, there are areas where a large amount phosphorus runs off of fields during rain events and similarly high phosphorus concentrations are maintained during base-flow despite the extra amount of water. *See* Daily Trans., 5398:5-11 (Olsen Testimony).

H. Lake Tenkiller Geochronological Sediment Analysis

516. As previously discussed, Dr. Fisher evaluated Lake Tenkiller sediments as part of his ratio analysis. *See supra* FOF ¶¶ 480-501. Based on the chemistry of Lake Tenkiller sediment samples, Dr. Fisher identified poultry waste as the source of phosphorus contamination in Lake Tenkiller. *See* Daily Trans., 2145:7-2146:11, 2146:20-2147:2 (Fisher Testimony).

517. The State's eighth line of evidence validates this conclusion. Specifically, Dr. Fisher employed a dating method to reconstruct the history of chemical inputs to Lake Tenkiller sediments since the dam was closed in 1954,[91] and he compared that age-dated chemistry to historical animal populations within the IRW. *See* Daily Trans., 1679:7-11, 2086:4-14, 2088:1-5 (Fisher Testimony). Dr. Fisher observed that "the overall change in time of poultry populations

[91] Dr. Fisher explained that sediments from the watershed began accumulating in Lake Tenkiller immediately upon dam closure. *See* Daily Trans., 1679:2-6 (Fisher Testimony).

within the watershed is similar in its functional form, that is how it changes over time, to the overall change in phosphorus concentration in lake sediments." *See* Daily Trans., 2165:22-2166:1 (Fisher Testimony). Based on this analysis, he concluded that "the phosphorus composition of the Lake Tenkiller sediments is driven by the increase in poultry population" in the IRW. *See* Daily Trans., 2088:6-12 (Fisher Testimony).

518. Dr. Fisher's four core sediment samples ranged from closest to the dam to closest to the river. *See* Daily Trans., 2096:5-12 (Fisher Testimony); State's Ex. 2506 (view of Lake Tenkiller representing sample locations LKSED-1, LKSED-2, LKSED-3 and LKSED-4); *see also* Daily Trans., 2096:13-2098:9 (Fisher Testimony) (discussing location selection); Daily Trans., 2098:10-2100:5 (Fisher Testimony) (explaining sampling process). Each core was cut into depth segments, "because depth in the core is a way of keeping track of where you are [in time]." *See* Daily Trans., 2100:16-2101:19 (Fisher Testimony); *see also* Daily Trans., 2101:24-2102:5 (Fisher Testimony) (stating that the top reflects recent sedimentation and deeper portions reflect "earlier and earlier times").

519. The samples were dried and analyzed for "a large list of parameters, including total phosphorus, total zinc, total arsenic, and total copper," as well as lead-210 and cesium-137, two potential age dating methods. *See* Daily Trans., 2102:11-14, 2102:23-2103:1 (Fisher Testimony); *see also* State's Ex. 2507 (graphically representing age of each lake sample based on both dating methods). It is accepted science that, if one can assign the time of deposition based on location in the core and lead-210 and/or cesium-137 analysis, then chemicals like phosphorus, copper, zinc and arsenic that are associated in that slice would have been deposited at the same time. *See* Daily Trans., 2103:10-23 (Fisher Testimony).

520. Lead-210 is a weakly radioactive isotope of lead that is commonly used by scientists to age-date sediments. *See* Daily Trans., 2104:17-18, 2105:3-7 (Fisher Testimony). It results from the decay of radon. *See* Daily Trans., 2104:4-18 (Fisher Testimony); *see also* Daily Trans., 2104:24-2105:2 (Fisher Testimony) ("Radon in the atmosphere decays to lead-210. Lead-210 falls out onto the surface of the land, and when there's runoff it moves into the lake."). Lead-210 is useful for dating because it has a finite rate of decay, with a half life of about 22 years. *See* Daily Trans., 2105:17-19, 2106:10 (Fisher Testimony). It is a natural radioisotope that is constantly produced everywhere. *See* Daily Trans., 2107:12-14 (Fisher Testimony).

521. In contrast, cesium-137 is derived from thermonuclear detonations (*i.e.*, bombs) or reactor accidents (*e.g.*, Chernobyl). *See* Daily Trans., 2107:10-21 (Fisher Testimony). "It's a pulsed input as opposed to a continuous input like lead-210." Daily Trans., 2108:1-3 (Fisher Testimony). "[W]hen you look at cesium-137 in sediments, you're trying to look for a maximum and," based on atmospheric testing in the early 1960s, "that maximum would be interpreted . . . as about 1964." *See* Daily Trans., 2108:12-15 (Fisher Testimony).

522. Dr. Fisher elected to use lead-210 and to reject cesium-137 because the latter's dates were not consistent with a separate, confirmatory total lead analysis.[92] *See* Daily Trans., 2110:19-23 (Fisher Testimony). Specifically, Dr. Fisher compared the total lead in the sediments to known changes in atmospheric inputs of lead based on the historical use and phase-out of leaded gasoline. *See* Daily Trans., 2087:15-21, 2112:4-21 (Fisher Testimony); *see also* Daily Trans., 2113:9-11 (Fisher Testimony) ("In the early 1970s . . . about half of all U.S. lead production went into tetraethyl lead that was then burned and dumped into the atmosphere.").

---

[92] Dr. Fisher hired Dr. Frederick Soster at DePaul University to perform the sediment-core dating. *See* Daily Trans., 2480:2-3 (Fisher Testimony). Although they raised this point on cross examination, *see* Daily Trans., 2479:16-25 (Fisher Testimony), Defendants present no reason to question the integrity of this work.

This total lead analysis provided "an independent check on dating, given that we have a chemical input to the lake, whose timing is known, that is independent of other activity. . . ." *See* Daily Trans., 2112:24-2113:2 (Fisher Testimony); *see also* Daily Trans., 2087:10-13 (Fisher Testimony) (total lead is "a constituent in sediments that has an input that we know has changed over time but has no relationship at all to poultry litter").

523. Because the concentrations of lead in poultry waste are too low for poultry waste to be the source of lead in lake sediments, by comparing concentrations of total lead found in Lake Tenkiller sediment cores with the year of deposition based on lead-210 dating, Dr. Fisher was able to confirm that "lead-210 provides a better coincidence in time with the phase-out of lead in gasoline and the behavior of the lead in the core than cesium-137. . . ." *See* Daily Trans., 2114:12-2115:13, 2115:23-2116:18, 2117:1-20 (Fisher Testimony); *see also* Ex. 2510 (graphically representing same).

524. Dr. Fisher next established that the sedimentation patterns observed in the core sediment samples are consistent with the general expectation that the sedimentation rate will be higher toward the river end of Lake Tenkiller and lower toward the dam end. *See* Daily Trans., 2128:13-2129:18 (Fisher Testimony); *see also* State's Ex. 2526 (table presenting calculations involved in analysis). This variation occurs because sediments fall from suspension as they are transported in water through the lake, and the primary contributors of sediments in Lake Tenkiller are the Illinois River and Caney Creek. *See* Daily Trans., 2129:19-2130:6 (Fisher Testimony).

525. Dr. Fisher then compared the compositions of control soils, *see supra*, FOF ¶ 491, to the total concentrations of phosphorus, copper, arsenic and zinc present in the core sediment samples. *See* Daily Trans., 2130:21-2131:8 (Fisher Testimony); *see also* State's Ex. 2508

(graphically representing same); Daily Trans., 2133:1-2135:24 (Fisher Testimony) (describing State's Ex. 2508). He found that the lake sediment showed contamination relative to the control soils and that the source of phosphorus contamination has been increasing through time. *See* Daily Trans., 2136:5-6, 2136:11-12, 2138:12-14 (Fisher Testimony).

526. Although the most recent samples (*i.e.*, the 2005 samples closest to the river end of Lake Tenkiller) fall off a bit,[93] the overall trend in phosphorus is upward. *See* Daily Trans., 2137:16-25 (Fisher Testimony). Likewise, "[t]he sediments in Lake Tenkiller are much enriched in zinc compared to the control soil," and the upward zinc trend "suggests that the source of contamination of zinc is increasing." *See* Daily Trans., 2139:23-16 (Fisher Testimony). The data also show "that there's a source of arsenic that's present, and that the source seems to be increasing over time." *See* Daily Trans., 2141:20-22 (Fisher Testimony). And the sediments in Lake Tenkiller are contaminated by copper, the concentration of which also is increasing over time. *See* Daily Trans., 2143:11-2144:1 (Fisher Testimony). As Dr. Fisher testified, "lake core samples that are younger have higher phosphorus concentrations and higher zinc concentrations,

---

[93] Dr. Fisher explained that those samples reflect the surface-most sediments, and "[i]t's very hard to capture that material, even with a diver going in. It's very organic rich. They're further uplake, higher sedimentation rates, could have sediment dilution. I wouldn't be overly concerned about that." *See* Daily Trans., 2138:3-8 (Fisher Testimony); *see also* Daily Trans., 2860:5-12 (Fisher Testimony) ("LKSED-2 is further up the lake. It also was collected nearer to shore. Both of those suggest there could be some sediment dilution from local erosion of the shorelines. . . ."); Daily Trans., 2862:16-19 (Fisher Testimony) ("LKSED-3 is much closer to the river, and . . . the best explanation is sediment dilution for that particular circumstance and possibly high organic matter in the surface"); Daily Trans., 2863:10-14 (Fisher Testimony) ("LKSED-4 is . . . closest to the river. I . . . believe this is more likely a result of sediment dilution. . . ."). As Dr. Fisher further explained, the poultry population cannot be expected to mirror every variation in sediment phosphorus. *See* Daily Trans., 2523:6-14 (Fisher Testimony). For these reasons, Defendants' criticism of such discrete variations, *see generally* Daily Trans., 2520:10-2530:21 (Fisher Testimony), are not persuasive. Therefore, the Court rejects the contention of Defendants' retained expert, Dr. Connolly, that Dr. Fisher should have plotted the individual trend of each core sediment sample, rather than aggregating them. *See* Daily Trans., 9081:10-9082:10 (Connolly Testimony).

and that compositional pattern is consistent with contamination of those sediments by poultry waste." *See* Daily Trans., 2154:7-11 (Fisher Testimony).

527. Again, as discussed with respect to Dr. Fisher's ratio analysis, *see supra*, FOF ¶¶ 480-501, based on his observation of similar constituent ratios in poultry waste, soils from land-applied fields, edge-of-field runoff and stream sediments, Dr. Fisher concluded that the source of phosphorus contamination in Lake Tenkiller is poultry waste, *see* Daily Trans., 2145:7-2146:11, 2146:20-2147:2 (Fisher Testimony). Having observed "the changes in concentration in the lake cores over time," Dr. Fisher also was able to "compare those changes in concentration to changes in animal population, since animal populations produce wastes that contain the chemicals of concern in this matter." *See* Daily Trans., 2160:21-2161:4 (Fisher Testimony).

528. Dr. Fisher determined the IRW's poultry population using Defendants' production numbers as well as agricultural census data from the U.S. Department of Agriculture.[94] *See* Daily Trans., 1664:22-1665:3, 1666:22-1667:3, 1668:2-5 (Fisher Testimony); *see also* State's Ex. 2522 (table reflecting watershed bird production by Defendants). From 2000 to 2007, Defendants reported producing an annual average of over 141 million broilers, pullets and turkeys in the IRW. *See* State's Ex. 2522. And from county-wide agricultural census data,[95] Dr.

---

[94] As Defendants noted on cross examination, the exact calculations were performed under Dr. Engel's direction, in consultation with Dr. Fisher. *See* Daily Trans., 2482:18-2484:22 (Fisher Testimony). But Defendants present no reason to question the integrity of this work.

[95] Because county boundaries are not coincident with watershed boundaries, Dr. Fisher apportioned IRW poultry numbers based on land use and land cover. In other words, he determined the percentage of each county's pasture land inside the IRW and assigned that percentage of the county's poultry population to the IRW. *See* Daily Trans., 1675:22-1676:17 (Fisher Testimony). Such an analysis is more refined than simply apportioning the total amount of county land within the watershed, irrespective of whether that land could support poultry production. *See* Daily Trans., 1676:21-1677:9 (Fisher Testimony); *see also* Daily Trans., 1677:5-19 (Fisher Testimony) (explaining that method has been peer reviewed and was employed in consultation with other experts).

Fisher estimated that the total number of poultry in the IRW increased by a factor of almost eight from the date of the dam closure around 1954, and from about 12 million in 1950 to approximately 152 million in 2002. *See* Daily Trans., 1678:19-24, 1679:7-11 (Fisher Testimony); State's Ex. 2529 (table reflecting estimated total IRW poultry production from 1950 to 2002); *see also* State's Ex. 2489 (graphically representing same); Daily Trans., 1680:4-18 (Fisher Testimony) (describing State's Ex. 2489).

529. Using a measure of animal units of 1000 pounds, Dr. Fisher compared the biomass of poultry against the biomass of humans, swine, and cattle, as reported by Dr. Engel. *See* Daily Trans., 1683:22-1684:7 (Fisher Testimony). In other words, Dr. Fisher compared "how many pounds of cows there are versus how many pounds of poultry there are. It's a way to place these individual -- these creatures on a fair comparison basis." *See* Daily Trans., 1684:8-13 (Fisher Testimony); *see also* Daily Trans., 2165:6-8 ("cattle are much larger than chickens, and so it's a way to fairly compare animals of different sizes with respect to waste production"). He found that:

> [T]he number of poultry in terms of their total number of animal units have shown a consistent increase within the Illinois River Watershed, number one. Number two . . . they substantially outweigh any other of the animal units considered here. They outweigh humans, they outweigh swine, they outweigh dairy cattle, outweigh beef cattle. And . . . they've outweighed the sum of all of them for some time. . . . [T]he animal units of poultry present in the Illinois River Watershed are the dominant mass of animal present.

Daily Trans., 1684:14-1685:1 (Fisher Testimony).

530. Finally, Dr. Fisher "compared the number of animal units to the levels of phosphorus present in Lake Tenkiller sediments as a function of time." *See* Daily Trans., 1686:25-1687:2 (Fisher Testimony); *see also* State's Ex. 2513 (graphically representing same);

Daily Trans., 2164:19-2166:1, 2502:7-2503:5 (explaining State's Ex. 2513). Dr. Fisher found that:

> [T]he change in phosphorus that's observed in the lake sediments appears to have a form in time that looks very much like the change in the number of animal units of poultry within the watershed and is dissimilar from the changes over time of the cattle population in terms of animal units, the human population in terms of animal units, the swine population in terms of animal units or any combination thereof. So if I added up humans and cattle or cattle and swine or humans and cattle and swine, I can't generate the same general shape of increase in time in the phosphorus concentrations.

Daily Trans., 2161:15-2162:1 (Fisher Testimony)(emphasis added); *see also* Daily Trans., 2165:20-2166:1 (Fisher Testimony) ("the overall change in time of poultry populations within the watershed is similar in its functional form, that is how it changes over time, to the overall change in phosphorus concentration in lake sediments"); Daily Trans., 2171:23-2172:3 (Fisher Testimony) ("the total poultry animal unit curve . . . and the total phosphorus concentration in the lake sediments, overall, they are very much concordant").

531. The foregoing analysis confirms that "the source of phosphorus contamination in Lake Tenkiller sediments is poultry waste." *See* Daily Trans., 2166:7-8 (Fisher Testimony); *see also* Daily Trans., 2088:6-12 (Fisher Testimony) ("the phosphorus composition of the Lake Tenkiller sediments is driven by the increase in poultry population").

532. In addition to those previously addressed, Defendants advanced several criticisms of Dr. Fisher's geochronological sediment analysis of Lake Tenkiller. For the reasons set forth below, the Court does not assign them weight.

533. First, Defendants noted that in addition to the changes in the poultry population since 1950, feeds and supplements are also different, chickens grow faster, and the life-span of each chicken is shorter. *See* Daily Trans., 2485:9-2487:6 (Fisher Testimony). Thus, on cross examination, Defendants pushed Dr. Fisher to agree that each chicken produces less manure and,

thus, less phosphorus. *See* Daily Trans., 2487:7-9 (Fisher Testimony). And they criticized him for not separately calculating poultry waste production since 1950. *See* Daily Trans., 2487:20-2488:7 (Fisher Testimony). However, by using animal units (*i.e.*, pounds of poultry) based on population counts, Dr. Fisher's analysis did adequately account for differences in lifecycle and manure production. *See* Daily Trans., 2487:13-16 (Fisher Testimony) ("this integrates all of the birds that are grown and takes into consideration lifecycle"); Daily Trans., 2488:21-22 (Fisher Testimony) ("[i]f there's mortality in there, it's already in the census information itself"); Daily Trans., 2490:1-3 (Fisher Testimony) ("waste is an integrated measure, and so you have to consider all the animals that contributed"). Moreover, Defendants' expert, Dr. Connolly, agreed that "there's been increasing amounts of poultry and poultry manures produced in the IRW." *See* Daily Trans., 9178:5-9 (Connolly Testimony).

534. Similarly, Defendants asked Dr. Fisher whether, given that the life of a chicken is approximately 42 days, he erred in counting the animal units of all five flocks of poultry raised in the IRW in a year. *See* Daily Trans., 2536:17-2537:9 (Fisher Testimony). Indeed, this Court asked Dr. Fisher during his redirect examination: "If you have an animal unit that lives for only 42 days, why should you aggregate that animal unit times five, when that animal unit only defecates for 42 days?" *See* Daily Trans., 2737:22-25 (Fisher Testimony). Dr. Fisher responded: "I see exactly what you're saying, Your Honor. It defecates for 42 days." *See* Daily Trans., 2738:1-2 (Fisher Testimony). But the intent is not "to compare animal population -- chicken population to human population. . . ." *See* Daily Trans., 2537:14-18 (Fisher Testimony); *see also* Daily Trans., 2741:22-2742:3 (Fisher Testimony) ("you won't compare one chicken to one cow; you'll compare a thousand pounds of chicken to a thousand pounds of cow"). Rather, it is to compare phosphorus output. *See* Daily Trans., 2738:16-21 (Fisher Testimony). Accordingly,

Dr. Fisher's animal unit calculation is an appropriate surrogate for waste production, especially given that poultry manure contains about three times as much phosphorus. *See* Daily Trans., 2738:3-4, 11-12 (Fisher Testimony).

535. Defendants also challenged Dr. Fisher's use of lead-210 and not cesium-137. *See* Daily Trans., 9077:25-9078:17 (Connolly Testimony). Again, cesium-137 levels reflect fallout from atmospheric nuclear weapons testing that peaked in the mid-1960s. *See* Daily Trans., 9078:21-9079:2 (Connolly Testimony); Daily Trans., 2107:23-25 (Fisher Testimony). With that understanding, Defendants' expert, Dr. Connolly, opined that Dr. Fisher's lead-210 analysis is unreliable because it suggests that peak cesium-137 concentrations occurred in the early 1980s, which is twenty years too late. *See* Daily Trans., 9079:3-13 (Connolly Testimony). Dr. Fisher agreed that "[t]he cesium-137 dates gave some difficulties in interpreting the date," *see* Daily Trans., 2112:10-11 (Fisher Testimony), but he weighed this anomaly against cesium-137 based on the results of his total lead analysis, *see* Daily Trans., 2110:19-23 ("The cesium-137 numbers seem to provide dates that weren't really concordant with other features in the core, <u>like the total lead analysis</u>." (emphasis added)) The Court agrees with Dr. Fisher. Dr. Connolly never addressed Dr. Fisher's total lead analysis, he subjectively eliminated lead-210 data that were inconsistent with his dating model, *see* Daily Trans., 9402:13-24 (Connolly Testimony), and he acknowledged that peak cesium-137 might be delayed in watershed sediments thereby explaining why its peak did not match the lead-210 data. *See* Daily Trans., 9404:2-9405:10 (Connolly Testimony).

536. Finally, Defendants' expert, Dr. Connolly, testified that "the more aluminum and iron hydroxide associated with sediment, the more phosphorus will adsorb onto that sediment." *See* Daily Trans., 9083:2-4 (Connolly Testimony); *see also* Daily Trans., 9083:15-9084:7

(Connolly Testimony) (analogizing aluminum and iron to flypaper). On that basis, Dr. Connolly purported "to account for the different stickiness or absorptive ability" of Dr. Fisher's core sediment samples by "normalizing" them. *See* Daily Trans., 9084:19-25, 9088:2-3 (Connolly Testimony). Specifically, rather than measure total increased phosphorus concentration in the IRW, Dr. Connolly measured increased phosphorus concentration per unit of iron and aluminum (*i.e.*, the ratio of phosphorus to aluminum and iron). *See generally* Daily Trans., 9084:8-9091:21 (Connolly Testimony). Dr. Connolly then plotted these "normalized" concentrations against Dr. Fisher's poultry population figures. *See* Daily Trans., 9096:12-9097:10 (Connolly Testimony). And, he opined that phosphorus concentrations have risen much more modestly than the poultry population. *See* Daily Trans., 9097:22-9098:8 (Connolly Testimony). The Court, however, rejects Dr. Connolly's "normalization" analysis because it rests on a false premise, namely, that aluminum and iron concentrations in the IRW have remained constant. To the contrary, given that phosphorus concentrations in Lake Tenkiller sediments are clearly higher than background level concentrations in IRW soils, *see* Daily Trans., 5322:3-5323:16 (Olsen Testimony) (testifying that background concentration is 311 mg/Kg but Lake Tenkiller's is 967 mg/kg) -- which even Dr. Connolly's analysis confirms, *see* Daily Trans., 9097:23-24 ("the phosphorus concentrations in the sediment are . . . higher than they were in the '60s") -- the relative stability of the ratio of phosphorus to iron and aluminum merely demonstrates that iron and aluminum loading to the IRW also has increased, and at roughly the same rate.

I. Poultry House Density Analyses

537. For the State's ninth line of evidence, two of the State's experts performed separate and independent poultry house density analyses.

1. Dr. Engel

538. As Dr. Chaubey testified, one of the ways to determine the fate and transport of a pollutant is to "look at different land use activities and land management activities, and look at the water quality in those land use and land management activities and try to determine the mathematical relationship between the two, cause and effect relationship." *See* Daily Trans., 5993:20-5994:21 (Chaubey Testimony). The State performed such a study as part of its investigation of the IRW in this case. Specifically, Dr. Engel examined the relationship between measured phosphorus concentrations in IRW streams and poultry house density. *See* Daily Trans., 5738:2-6 (Engel Testimony).

539. Dr. Engel focused this portion of the State's investigation on poultry house density because: (a) poultry waste is produced by poultry operations; (b) that waste contains phosphorus; (c) that poultry waste is disposed on the land near these poultry houses; (d) when that poultry waste is disposed of, some portion of the phosphorus from that poultry waste runs off; (e) poultry waste disposal increases soil test phosphorus; and (f) soils with high soil test phosphorus (*i.e.*, banked phosphorus) also contribute to phosphorus in runoff. *See* Daily Trans., 5769:4-15 (Engel Testimony). Based on all the foregoing, Dr. Engel hypothesized that there should be a relationship between the presence of poultry houses (poultry house density) -- whether active or inactive -- and phosphorus concentrations found in IRW streams. *See* Daily Trans., 5769:14-5770:3 (Engel Testimony).

540. In designing the poultry house density study, 14 sub-watersheds within the IRW were instrumented with automatic samplers at the sub-watershed outlets so that water quality data could be obtained. *See* Daily Trans., 5738:8-10 (Engel Testimony). Samples were collected during both high-flow (runoff events) and base-flow. *See* Daily Trans., 5739:6-8 (Engel

Testimony).[96] That data could then be analyzed to identify phosphorus in the surface water in the streams. *See* Daily Trans., 5738:10-12 (Engel Testimony). The 14 sub-watersheds were selected based on a range of poultry house densities within the sub-watersheds. *See* Daily Trans., 5738:12-14 (Engel Testimony). The poultry house densities were based upon Dr. Fisher's work in identifying the locations of active and total poultry houses within the IRW plus a two-mile buffer area. *See* Daily Trans., 5739:14-17; 6630:1-17 (Engel Testimony).

541. The intent behind the study design was to avoid any point source influence within the selected sub-watersheds. *See* Daily Trans., 5738:15-16 (Engel Testimony). In fact, after the study began, two of the sub-watersheds were excluded from the analysis upon discovery of a point source influence. *See* Daily Trans., 5738:16-19 (Engel Testimony); *see also* Daily Trans., 6620:11-6621:3 (Engel Testimony) (". . . the purpose of this study was to examine nonpoint-source contributions to runoff and to base flow . . . so . . . as soon as it was identified that there was a presence of point sources . . . it was most expedient to not use those locations in the study.").

542. Based on this study design, Dr. Engel was able to determine whether there is any relationship between poultry density and phosphorus concentrations found in IRW streams. *See* Daily Trans., 5738:20-24 (Engel Testimony).

543. As an example of the data gathered, the 2005-2006 data show a total phosphorus concentration of over 0.180 mg/L in a sub-watershed with seven poultry houses per square mile. *See* Daily Trans., 5770:7-20 (Engel Testimony). In contrast, the expected total phosphorus

---

[96] Dr. Engel was interested in base-flow data for two reasons: (a) as water infiltrates soils on fields where poultry waste has been land-applied, some phosphorus enters into the shallow groundwater and reaches the streams; and (b) during surface runoff, some of that water reaching the stream moves into the alluvium in and around and along the stream and re-enters the streams during base-flow. *See* Daily Trans., 5778:1-18; 11372:17-25; 11373:1-22 (Engel Testimony) (Engel Testimony).

concentration in small watershed streams with no poultry houses is 0.0170 mg/L. *See* Daily Trans., 5773:16-21 (Engel Testimony).

544. After the data were gathered, Dr. Engel first looked at the average total phosphorus concentrations and total poultry house density (plus poultry houses within a two-mile buffer) in each sub-watershed and attempted to determine whether there was a linear relationship between the data. *See* Daily Trans., 5767:8-5768:13 (Engel Testimony). Dr. Engel used an equation to explain such a linear relationship and any variability in the observed relationship between poultry house density and increased phosphorus concentrations. *See* Daily Trans., 5772:17-5773:12 (Engel Testimony). The calculations Dr. Engel performed are a "standard approach" for examining relationships between environmental data. *See* Daily Trans., 5773:7-12 (Engel Testimony). The equation used by Dr. Engel was $y=0.0184x + 0.0171$. *See* Daily Trans., 5772:17-5773:1 (Engel Testimony). The "y" represents total phosphorus concentrations for each sub-watershed, the "0.184" value is the increase in phosphorus concentrations expected per the addition of each poultry house per square mile, the "x" is the number of poultry houses per square mile for each sub-watershed, and the "0.0171" value represents the expected phosphorus concentrations in small sub-watershed streams with no poultry houses. *See* Daily Trans., 5772:17-5773:1, 5773:16-21, 5774:14-17 (Engel Testimony). After running his calculations, Dr. Engel arrived at an R^2 value to describe the "goodness of fit;" that is, how much the observed variability in the data is explained by the equation. *See* Daily Trans., 5775:8-12 (Engel Testimony). The R^2 value for Dr. Engel's poultry house density analysis is 0.74 which Dr. Engel testified is "an excellent relationship." *See* Daily Trans., 5775:13-19 (Engel Testimony). Dr. Engel further found a "p value" of 0.0007 which shows that there is a statistically significant relationship described by the equation. *See* Daily Trans., 5775:20-5776:6 (Engel Testimony).

545. Overall, with respect to his poultry house density analysis, Dr. Engel concluded as follows:

> Well, first, I conclude that there is this statistically significant relationship between poultry house density and phosphorus in both surface runoff and in base flow. And from that, because I've excluded other sources, I further conclude that this relationship demonstrates a cause-and-effect relationship.
> ***
> So this indicates that the presence of the poultry house operations and the activities that go with those is responsible for the increased phosphorus that one observes in these small watersheds within the Illinois River Watershed. As we increase poultry house density, we see corresponding increases in phosphorus from those watersheds.

See Daily Trans., 5786:5-19 (Engel Testimony) (also testifying that the relationship existed not only with respect to edge-of-field field phosphorus, but also in-stream phosphorus).

2. Dr. Stevenson

546. Dr. Stevenson performed a poultry house density analysis similar to that performed by Dr. Engel. In setting up his poultry house density study, Dr. Stevenson employed a "conceptual model" that: (a) human activities -- including poultry operations -- affect nutrient concentrations in streams; (b) nutrient concentrations in streams affect algal biomass; and (c) algal biomass affects dissolved oxygen and pH. *See* Daily Trans., 7110:21-7111:3 (Stevenson Testimony). Dr. Stevenson's hypothesis was that there would be a direct relationship between poultry house density in the IRW and phosphorus concentrations in streams. *See* Daily Trans., 7111:9-15 (Stevenson Testimony).

547. Dr. Stevenson's poultry house density study design is consistent with "a whole discipline in science that's developed in the last ten, fifteen, twenty years" -- that is, relating environmental changes to human activities by way of land use and land cover data. *See* Daily Trans., 7114:16-25 (Stevenson Testimony). In fact, Dr. Stevenson is currently working with the EPA on assessments of all the lakes and all the streams in the country using similar data in a

similar manner to which he used the data for his poultry house density study. *See* Daily Trans., 7115:2-7 (Stevenson Testimony).

548. In all, there were 70 IRW stream sampling sites included in Dr. Stevenson's study. *See* Daily Trans., 6991:18-19 (Stevenson Testimony). Dr. Stevenson chose 70 as the number of sampling sites because that is a number he had used in previous studies that provided the "statistical power" to observe relationships between nutrients, algae and invertebrates. *See* Daily Trans., 6991:20-25 (Stevenson Testimony).

549. Sampling sites were selected based on a random stratified sampling design. *See* Daily Trans., 6991:3-6 (Stevenson Testimony). A random stratified sampling design is necessary for a regression approach because of the need for even numbers of sites with low levels of phosphorus and low levels of poultry house density and also intermediate and high levels. *See* Daily Trans., 6991:6-11 (Stevenson Testimony). After stratifying the 70 sampling sites into 5 groups by the density of poultry houses, Dr. Stevenson then randomly selected 12 to 15 sites out of each of those strata for the purposes of his analysis. *See* Daily Trans., 6991:12-17 (Stevenson Testimony).

550. Dr. Stevenson relied upon the State's poultry house density data using the 2-mile buffer. *See* Daily Trans., 7113:18-7114:2 (Stevenson Testimony). Dr. Stevenson also looked at topographic maps as part of his analysis. *See* Daily Trans., 7113:8-17 (Stevenson Testimony). Use of topographic maps enables the researcher to "delineate a watershed" by showing where water will flow into a stream channel "either across the surface of the land or through the groundwater when it's penetrated and moved through the groundwater." *See* Daily Trans., 7113:8-17 (Stevenson Testimony).

551. During the summer of 2006 and the spring of 2007, nutrient data and algal biomass data were collected from the 70 streams sampling sites. *See* Daily Trans., 6988:21-6989:3, 6993:22-6995:12, 7140:3-12 (Stevenson Testimony); *see also* State's Exs. 4508 and 4468. To account for nutrient concentration and algal biomass variations which occur as a result of weather-related events, sampling was conducted over a two-month time frame with each sampling site being sampled eight times for many of the parameters (*e.g.*, each of the sites was sampled eight times for nutrients and filamentous green algal cover). *See* Daily Trans., 6995:18-6996:19 (Stevenson Testimony). There was also a sampling campaign in the summer of 2007 of 37 sites. *See* Daily Trans., 6996:20-6998:3 (Stevenson Testimony). Only 37 sites were sampled in the summer of 2007 due to the more time-consuming fish sampling that was conducted in the summer of 2007. *See* Daily Trans., 6996:20-6998:3 (Stevenson Testimony).

552. Once all the data were gathered and stratified, Dr. Stevenson conducted a regression analysis to determine whether there was any relationship between poultry density, phosphorus concentrations and algal biomass in the streams of the IRW. *See* Daily Trans., 7140:8-12 (Stevenson Testimony). In conducting this regression analysis, Dr. Stevenson found that phosphorus concentrations in IRW streams increased with the density of poultry houses. *See* Daily Trans., 7146:21-7147:4 (Stevenson Testimony). In addition, during the spring of 2007, Dr. Stevenson found a correlation between poultry house density and algal biomass. *See* Daily Trans., 7147:11-16 (Stevenson Testimony). Overall, Dr. Stevenson concluded as follows:

> [I]n looking at the relationships between poultry house density, that basically it followed the causal chain in a way that you would expect, that there was a correlation between poultry houses and phosphorus and poultry houses and algal biomass. There's a relationship between nutrient concentrations, phosphorus and algal biomass, that affected DO and pH, and then -- then we could observe an effect on fish biodiversity that was related to indications of nutrient availability and of poultry house density.

See Daily Trans., 7147:22-7148:9 (Stevenson Testimony).

553. As Dr. Engel eliminated wastewater treatment impacts from his analysis, Dr. Stevenson was able to find the correlation between poultry house density and increased phosphorus concentrations independent of any wastewater treatment plant influence. *See* Daily Trans., 7151:14-7152:8 (Stevenson Testimony). Using his regression analysis, Dr. Stevenson was able to isolate poultry house density impacts by looking only at the data that can be assigned to poultry house density versus percent urban land use. *See* Daily Trans., 7151:18-25 (Stevenson Testimony). Dr. Stevenson found that -- when looking only at this data -- there is an independent poultry house density impact on phosphorus concentrations, algal biomass and biodiversity of fish. *See* Daily Trans., 7152:1-4 (Stevenson Testimony).

554. Dr. Stevenson also did an analysis to differentiate between general agricultural use impacts and poultry house density impacts. *See* Daily Trans., 7153:17-22 (Stevenson Testimony). Specifically, Dr. Stevenson performed a multiple regression analysis as to the amount of variation that can be explained by total phosphorus concentrations as a function of poultry house density versus total phosphorus concentrations as a function of agriculture generally. *See* Daily Trans., 7153:17-7154:6 (Stevenson Testimony). This analysis led Dr. Stevenson to conclude that "something associated with the density of poultry houses in the watershed must be causing the increases in phosphorus concentration and the increases algal biomass and the reductions in fish biodiversity associated with -- in the streams of the Illinois River Watershed." *See* Daily Trans., 7154:14-7155:1 (Stevenson Testimony).

3. Defendants' Critique and the State's Response

555. Defendants attempt to undermine the reliability of Dr. Engel's poultry house density analysis by noting that the State's consultants found a cross-correlation between poultry

house density and septic tanks within the sub-watersheds included in Dr. Engel's analysis. *See, e.g.*, Daily Trans., 10713:2-20 (Sullivan Testimony). Dr. Engel has never denied that such a cross-correlation exists. In fact, an appendix attached to Dr. Engel's expert report expressly provided that there are "strong cross-correlations observed between septic tanks and total poultry house density; in other words, in areas with high poultry house development, human dwellings are also relatively high." *See* Daily Trans., 6378:17-6379:5 (Engel Testimony). However, any importance of these cross-correlations is mitigated -- if not eliminated completely -- by the relative unimportance of septic tanks as a source of phosphorus in the IRW. For instance, Dr. Engel eliminated septic tanks from his modeling analysis based on the followings considerations:

> [T]he analysis that I conducted looked at potential impacts of septic tanks in the high-flow, small watersheds that were studied. So that analysis indicated that there was far more phosphorus being exported from those watersheds in a fewer number of events that can be explained by septics. Also, based on again my experience with septic systems, the way that they put phosphorus into the environment, it's applied underground, and so it provides numerous opportunities for that phosphorus to be absorbed to soil. So it would not behave as a surface-based, nonpoint-source pollution so it wouldn't run off the surface. And based on analysis of nonpoint-source contributions in the watershed, nonpoint-sources from the surface runoff are the dominant sources of phosphorus in the watershed.

Daily Trans., 6663:24-6664:15 (Engel Testimony). Indeed, Defendants' own expert, Dr. Sullivan, conceded that -- even assuming arguendo that all septic systems in the IRW were to discharge directly into streams -- the <u>total</u> amount of phosphorus contributed by septic systems would be approximately the equivalent of just 16 poultry houses (in a watershed with approximately 1,800 active poultry houses). *See* Daily Trans., 10906:12-10907:14 (Sullivan Testimony).

556. Defendants have also criticized Dr. Engel and Dr. Stevenson for not including cattle in their analysis. *See, e.g.*, Daily Trans., 10729:2-29 (Sullivan Testimony). However, as established, Dr. Engel determined that cattle were largely recycling phosphorus. *See, e.g.*, Daily

Trans., 5836:23-5837:20 (Engel Testimony); *see also* Daily Trans., 6380:20-6381:1 (Engel Testimony) ("Mr. George: Now, what else could be related to the presence of poultry houses that could be a source of phosphorus in these subwatersheds? Dr. Engel: . . . We have septic systems that we've just talked about. Cattle; but cattle are recycling phosphorus, so they're not putting new phosphorus into those watersheds."). In any event, as shown, Dr. Stevenson found a correlation between poultry house density and phosphorus concentrations independent of agricultural influences as a whole. *See* Daily Trans., 7153:17-7155:1 (Stevenson Testimony). Moreover, while Dr. Sullivan attempted to conduct his own study as to any relationship between cattle and poultry house density, his cattle population data was aggregated by zip code rather than by the sub-watersheds from Dr. Engel's poultry house density study. *See* Daily Trans., 10913:20-10914:10 (Sullivan Testimony). Dr. Sullivan acknowledges that zip codes in rural areas are much larger than the sub-watersheds from Dr. Engel's study; and thus, Dr. Sullivan's cattle study was much larger than Dr. Engel's poultry house density study. *See* Daily Trans., 10913:20-10914:22; 10916:7-9 (Sullivan Testimony).

557. Dr. Sullivan also criticizes the State for not considering dirt roads as a source of phosphorus as part of its investigation. *See* Daily Trans., 10708:17-25 (Sullivan Testimony). Dr. Sullivan specifically conducted an analysis where he found a correlation between poultry house density and dirt roads within the sub-watersheds studied by Dr. Engel. *See* Daily Trans., 10760:11-22 (Sullivan Testimony). Dr. Sullivan asserts that the presence of dirt roads in these sub-watersheds is a "confounder" in Dr. Engel's poultry house density analysis. *See* Daily Trans., 10760:23-10761:2 (Sullivan Testimony). As Dr. Engel testified, however, dirt roads were not considered in the poultry house density analysis because: (a) dirt roads are not an independent source of phosphorus beyond background; (b) the amount of any phosphorus that

would be lost from dirt roads would be small; and (c) if there is any phosphorus beyond natural background on the dirt roads in the IRW, one of the sources of that phosphorus would be poultry waste. *See* Daily Trans., 6628:22-6629:19 (Engel Testimony). In fact, on cross-examination, Dr. Sullivan conceded the possibility that poultry waste from spreader trucks could wind up on dirt roads within the IRW. *See* Daily Trans., 10913:8-19 (Sullivan Testimony).

558. Lastly, Defendants have asserted that it was improper for Drs. Engel and Stevenson to use the two-mile buffer in calculating poultry house density. Dr. Sullivan claims that the two-mile buffer renders the poultry house density analysis unreliable by "double and triple" counting poultry houses within the sub-watersheds. *See* Daily Trans., 10765:14-17767:5 (Sullivan Testimony). As Dr. Engel explained, the two-mile buffer was based on the analysis he did with Dr. Fisher and review of IRW-specific scientific reports and materials finding that the majority of poultry waste is land-applied within about two miles of poultry houses. *See* Daily Trans., 6630:1-12 (Engel Testimony). Based on this analysis and review, Dr. Engel determined that it was logical to consider poultry houses near watersheds -- within two miles -- as having the potential to contribute some phosphorus to the waters being sampled. *See* Daily Trans., 6630:13-17 (Engel Testimony); *see also* Daily Trans., 7257:8-7258:23 (Stevenson Testimony). Nonetheless, Dr. Engel also performed the poultry house density analysis without the two-mile buffers and found that the results did not significantly change. *See* Daily Trans., 6630:18-6631:18 (Engel Testimony).

J. Modeling Analysis

1. Dr. Engel's Nonpoint Source Field Model and Routing Model

559. As Dr. Chaubey testified, one of the ways to determine the fate and transport of a pollutant is to "do mathematical modeling to look at elective contribution of different areas in

terms of nutrients and how those nutrients then move through the stream system." *See* Daily Trans., 5993:20-5994:21 (Chaubey Testimony). In this case, Dr. Engel employed a computerized watershed model to evaluate phosphorus contamination in the IRW. *See* Daily Trans., 6216:2-4 (Engel Testimony). In particular, Dr. Engel conducted his modeling analysis in order to: (a) understand the fate and transport of phosphorus within the IRW system, (b) analyze current conditions in the IRW and conditions under certain hypothetical scenarios (such as cessation of poultry), and (c) allocate phosphorus contributions among different sources. *See* Daily Trans., 6216:5-19 (Engel Testimony).

560. Generally, a computerized watershed model will compute runoff. *See* Daily Trans., 6216:23-24 (Engel Testimony). In this case, Dr. Engel employed: (a) a nonpoint source field model -- the GLEAMS model -- to predict phosphorus runoff to the edge-of-field, and (b) a "routing" model to route the movement of phosphorus from the edge-of-field -- combined with wastewater treatment phosphorus -- to determine the amount and timing of phosphorus arriving at three gauging stations within the IRW. *See* Daily Trans., 6219:14-6220:3; 6231:22-6232:6 (Engel Testimony). A modeler can be confident in the reliability of this method -- *i.e.*, combining a nonpoint source field model with a routing model -- because in a region such as the IRW, once phosphorus begins moving "in runoff and . . . to the edge of the field and beyond that joins additional waters running off other fields, that joins more flowing waters and streams and ultimately rivers." *See* Daily Trans., 6220:4-20 (Engel Testimony).

561. The nonpoint source field model that Dr. Engel selected for his analysis is known as the "GLEAMS" model. *See* Daily Trans., 6229:23-24 (Engel Testimony). Dr. Engel selected the GLEAMS model because: (a) it is a model with which he has a great deal of experience, (b) it represents nonpoint source pollution processes and runoff from areas like the IRW, (c) it

allows one to readily describe the management systems that were being used, and (d) of previous modeling work in the IRW and experiences others had with other models. *See* Daily Trans., 6230:4-16 (Engel Testimony).

562. GLEAMS is a reliable, established and well-accepted model that has been featured in many peer-reviewed publications. *See* Daily Trans., 6230:17-23 (Engel Testimony). Dr. Engel and other modelers have applied GLEAMS on a watershed-wide basis in the past. *See* Daily Trans., 6231:3-7 (Engel Testimony). Indeed, Dr. Engel has published papers in peer-reviewed journals regarding studies where GLEAMS has been applied on a watershed-wide basis. *See* Daily Trans., 6231:8-14 (Engel Testimony).

563. In arriving at a runoff computation, the GLEAMS model employed the National Resources Conservation Service ("NRCS") curve number method. *See* Daily Trans., 6216:23-6217:7 (Engel Testimony). The NRCS curve number method is used to identify the runoff and movement of the constituent of concern within a field to the edge of that field. *See* Daily Trans., 6219:14-19 (Engel Testimony). The NRCS curve method uses data describing the land use, soil characteristics, water movement characteristics and management conditions. *See* Daily Trans., 6218:14-6219:1 (Engel Testimony). That data is then used to arrive at a curve number value taken from a well-established set of publications that identify such curve number values. *See* Daily Trans., 6219:2-3 (Engel Testimony). That curve number value, along with daily rainfall data, is then used to calculate runoff. *See* Daily Trans., 6219:3-5 (Engel Testimony).

564. The land use data for the GLEAMS model were obtained from the National Land Cover Dataset ("NLCD"). *See* Daily Trans., 6242:15-19 (Engel Testimony). The soil data for the GLEAMS model were obtained from the "definitive source," the STATSGO soils database. *See* Daily Trans., 6242:20-23 (Engel Testimony). This soil data includes the soil properties and

spatial locations of different soil types, which assisted Dr. Engel in modeling the water balances, runoff potential and phosphorus retention in the soils. *See* Daily Trans., 6242:20-6243:5 (Engel Testimony). The rainfall and temperature data used by the GLEAMS model were obtained from the National Climate Data Center. *See* Daily Trans., 6243:6-13 (Engel Testimony). These weather data were used by the model to describe the amount of runoff expected to occur, and therefore, movement of constituents with that runoff. *See* Daily Trans., 6243:10-13 (Engel Testimony). Dr. Engel used USGS digital elevation model ("DEM") data to define the sub-watershed boundaries (both within the IRW and bordering the IRW). *See* Daily Trans., 6243:14-19 (Engel Testimony). The GLEAMS model also used Dr. Fisher's poultry waste number (354,000 tons annually) and poultry house locations to identify varying zones in which varying amounts of poultry waste were applied to the landscape. *See* Daily Trans., 6243:20-6244:13 (Engel Testimony). Lastly, the GLEAMS model used data of non-poultry nutrient applications from Dr. Engel's mass balance, historical poultry waste applications from the mass balance, and soil test phosphorus data from Dr. Johnson. *See* Daily Trans., 6244:15-6245:14 (Engel Testimony).

565. After selecting GLEAMS as the nonpoint source field model, Dr. Engel formulated his routing model. *See* Daily Trans., 6231:15-18 (Engel Testimony). Dr. Engel chose to use an "empirical" routing model. *See* Daily Trans., 6232:14-25 (Engel Testimony). An empirical model is one that is based on actual observed data. *See* Daily Trans., 6233:12-15 (Engel Testimony). Dr. Engel chose to use an empirical routing model because: (a) there was a great deal of observed data in the IRW available to create a routing equation, (b) other modelers had experienced problems in the past in attempting to use mechanistic routing models in the IRW, and (c) the constituent of concern -- phosphorus -- is a conservative substance that is not

going to be "volatized and lost" (*i.e.*, "once the phosphorus is input into the streams, it really is a matter of time before it's going to be delivered to a point of interest"). *See* Daily Trans., 6232:17-6233:15 (Engel Testimony). Other modelers have used empirical routing models in other watershed studies. *See* Daily Trans., 6235:4-8 (Engel Testimony). In fact, the form of the routing equation that Dr. Engel used in this case is one of the forms that USGS uses as part of its "LOADEST" software. *See* Daily Trans., 6235:8-14 (Engel Testimony).

566. The routing model was used to route the GLEAMS runoff output and wastewater treatment plant discharges to the three gauging stations: Baron Fork, Caney Creek and Tahlequah. *See* Daily Trans., 6231:19-6232:13 (Engel Testimony).

567. For the purposes of his routing model, Dr. Engel used USGS flow data to describe the amount of flow to the three gauging stations. *See* Daily Trans., 6233:23-25; 6243:20-23 (Engel Testimony). The routing model also utilized USGS and OWRB phosphorus concentration data for each of the three gauging stations. *See* Daily Trans., 6243:24-6244:6 (Engel Testimony). The wastewater treatment plant phosphorus discharge data were derived from the NPDES permit compliance system. *See* Daily Trans., 6245:15-19 (Engel Testimony). The data sources that Dr. Engel used for both the GLEAMS model and routing model are of the type typically used by scientists to conduct watershed modeling. *See* Daily Trans., 6245:20-6246:1 (Engel Testimony).

568. The routing model equation utilized three coefficients (A, B and C) that were obtained by identifying a relationship between the routing equation and the observed phosphorus load data. *See* Daily Trans., 6239:8-16 (Engel Testimony). Dr. Engel's routing equation provides that the phosphorus load equals coefficient A -- which describes the amount of phosphorus one would expect to reach that gauge when there is no flow -- plus coefficient B

times actual flow (represented by Q) times phosphorus accumulation in the stream network. *See* Daily Trans., 11311:17-24 (Engel Testimony). The last term in the routing equation is coefficient C times flow squared times phosphorus accumulation in the stream network. *See* Daily Trans., 11312:4-9 (Engel Testimony). The concept behind the last portion of the routing equation is that on days in which there are very high flows, there will be substantially more phosphorus transported to the gauging stations. *See* Daily Trans., 11312:4-9 (Engel Testimony).

569. Dr. Engel used this same routing equation for all of his modeling processes. *See* Daily Trans., 11312:10-12 (Engel Testimony).

570. Once the data were input and the model was running, Dr. Engel conducted calibration and validation of the model. *See* Daily Trans., 6246:2-8 (Engel Testimony). The model calibration/validation process allows the model to identify and test how well the model is performing for the particular location to which it is being applied. *See* Daily Trans., 6246:9-15 (Engel Testimony). Through the calibration process, Dr. Engel was able to determine whether the model's predictions matched the observed data and adjust the model coefficients where necessary to better match those predictions to the observed data. *See* Daily Trans., 6246:22-6247:13 (Engel Testimony). The validation process provided an additional check on the reliability of the model. Specifically, through the validation process, a portion of the observed flow and phosphorus load data was reserved (independent of the data used for calibration) without making any coefficient adjustments. *See* Daily Trans., 6248:2-8 (Engel Testimony). Then, predictions were made for the conditions represented by this independent observed data and compared with the observed data to determine how well the predicted values and data match. *See* Daily Trans., 6248:9-14 (Engel Testimony). This same validation approach used by Dr.

Engel has been described "hundreds of times in the . . . peer-reviewed journals [regarding] watershed models . . . ." *See* Daily Trans., 6247:24-6248:2 (Engel Testimony).

571. As a result of the calibration/validation process, Dr. Engel found that the nonpoint source runoff and phosphorus loading portions of the model performed "above levels that would be deemed acceptable by the watershed modeling scientific literature." *See* Daily Trans., 6248:23-6249:12 (Engel Testimony).[97] Further, the calibration/validation process led Dr. Engel to conclude that the model would "certainly . . . provide reliable estimates" of phosphorus loading to Lake Tenkiller. *See* Daily Trans., 6251:9-16 (Engel Testimony).

2. Modeling Results

572. With respect to total phosphorus loading, Dr. Engel's model calculates that approximately 505,000 pounds of phosphorus reaches Lake Tenkiller each year. *See* Daily Trans., 6225:6-17 (Engel Testimony). Of those 505,000 pounds of phosphorus, before 2003, 300,000 pounds per year were from nonpoint sources. *See* Daily Trans., 6225:6-17 (Engel Testimony). Post 2003, Dr. Engel calculates that approximately 410,000 pounds of phosphorus reaching Lake Tenkiller is from nonpoint sources. *See* Daily Trans., 6225:6-17 (Engel Testimony). In other words, Dr. Engel estimates that approximately 80 percent of the phosphorus load to Lake Tenkiller is from nonpoint sources, which is comparable with other

---

[97] As discussed in more detail in sections that follow, after the initial calibration of the GLEAMS model, Dr. Engel discovered that a number of hydrologic response units ("HRUs") had been inadvertently omitted. *See* Daily Trans., 6292:8-6293:25 (Engel Testimony). Dr. Engel corrected the HRU error and recalibrated and reran the model, which produced new results. *See* Daily Trans., 6294:21, 11287:14-25 (Engel Testimony). Dr. Engel subsequently corrected his expert report -- by way of an "errata" -- to reflect the HRU-related changes. *See* Daily Trans., 6294:21-6295:10; 6295:22-6296:17 (Engel Testimony).

Dr. Engel made corrections to his report and submitted a second errata after discovering that some observed phosphorus load data in his expert report was in error. *See* Daily Trans., 6294:5-13, 6295:5-10 (Engel Testimony).

All of Dr. Engel's opinions offered at trial were based upon his corrected expert report. *See* Daily Trans., 6296:13-17 (Engel Testimony).

studies of the IRW (*e.g.*, USGS found nonpoint source loading to be in the 80% range). *See* Daily Trans., 6225:25-6226:4 (Engel Testimony). Indeed, Defendants' own expert, Dr. Connolly, estimates that 82 percent of the phosphorus reaching Lake Tenkiller is from nonpoint sources. *See* Daily Trans., 9142:5-8 (Connolly Testimony).

573. Dr. Engel was also able to use his model to evaluate hypothetical land use scenarios. *See* Daily Trans., 6253:24-6254:4 (Engel Testimony). First, Dr. Engel used the model to characterize and evaluate future conditions if nutrient management remains the same in the IRW. *See* Daily Trans., 6254:7-12 (Engel Testimony). In evaluating this "status quo" future scenario, weather data from 1997 through 2006 was used and repeated in 10-year increments and projected forward for the next 100 years. *See* Daily Trans., 6254:13-16 (Engel Testimony). With respect to phosphorus inputs under the status quo scenario, the model assumed that Defendants would continue to generate 354,000 tons of poultry waste per year. *See* Daily Trans., 6254:17-20 (Engel Testimony). Similarly, for other phosphorus input sources, the model assumed that the loading numbers would remain constant for the next 100 years. *See* Daily Trans., 6254:22-6255:1 (Engel Testimony).

574. The model results for the status quo scenario are that phosphorus loads would: (a) be roughly 500,000 pounds per year for the first ten years, (b) increase over the next 20 years to about 600,000 pounds per year, and (c) then oscillate at a little less than 600,000 pounds. *See* Daily Trans., 6260:1-18 (Engel Testimony); *see also* State's Ex. 1100.

575. Second, Dr. Engel used the model to characterize and evaluate future conditions if all land application of poultry waste applications ceased. *See* Daily Trans., 6255:3-5 (Engel Testimony). For this "cessation" scenario, the same assumptions were made as with the status

quo scenario, with the exception that poultry waste application was set at zero going forward for the next 100 years. *See* Daily Trans., 6255:6-11 (Engel Testimony).

576. The model results for the cessation scenario are that: (a) phosphorus loads would decrease by about 18 percent in the first 10 years, (b) phosphorus loads would continue to decline over time until becoming somewhat stable in years 71 through 100, and (c) soil test phosphorus levels from historic land application of poultry waste (*i.e.*, banked phosphorus) would continue to contribute to phosphorus runoff for about 70 years after cessation. *See* Daily Trans., 6260:19-6261:5; 6261:10-25 (Engel Testimony); *see also* State's Ex. 1100.

577. Third, Dr. Engel used the model to characterize and evaluate future conditions if, in addition to the cessation of the land application of poultry waste, vegetative buffer strips were added along all third-order and larger streams and along all streams within the IRW. *See* Daily Trans., 6266:8-16 (Engel Testimony). Vegetative buffer strips are a best management practice used to mitigate the impacts of phosphorus by removing a portion of the phosphorus as it flows across the buffer strip. *See* Daily Trans., 6266:17-25 (Engel Testimony). To calculate the impact of vegetative buffer strips, Dr. Engel used a buffer strip reduction coefficient (0.5) from the published literature and applied that to the GLEAMS model. *See* Daily Trans., 6267:7-22, 6268:3-16, 6270:14-15 (Engel Testimony).

578. Fourth, Dr. Engel used the model to characterize and evaluate future conditions if phosphorus inputs from land applied poultry waste were increased due to continued growth of the poultry industry in the IRW. *See* Daily Trans., 6262:1-8 (Engel Testimony). This "growth" scenario was based taking IRW poultry industry growth data from 1982 through 2002 and projecting phosphorus growth at that same rate into the future. *See* Daily Trans., 6262:9-14 (Engel Testimony). That data show the growth in phosphorus in that 20-year period due to

poultry was from 3800 to 4600 tons. *See* Daily Trans., 6263:8-14 (Engel Testimony). The model then took that phosphorus growth rate and projected 50 years into the future. *See* Daily Trans., 6263:8-14 (Engel Testimony). The other model inputs and processes for the growth scenario were the same as with the other model scenarios. *See* Daily Trans., 6262:15-20 (Engel Testimony).

579. The model results for the vegetative buffer strip scenario are that: (a) phosphorus loads would decrease by an additional 10 to 13 percent -- above the cessation scenario alone -- if vegetative buffer strips were installed along all IRW streams, and (b) phosphorus loads would decrease by an additional 5 to 8 percent -- above the cessation scenario alone -- if vegetative buffer strips were installed along third order and larger streams within the IRW. *See* Daily Trans., 6273:5-6274:4 (Engel Testimony); *see also* State's Ex. 1105; State's Ex. 1106.

580. The model results for the growth scenario are that with continued growth of the poultry industry in the IRW -- and associated increases in phosphorus from the land application of poultry waste -- phosphorus loading to Lake Tenkiller will increase by about 70 percent over a 40 to 50 year period. *See* Daily Trans., 6262:1-6266:7 (Engel Testimony); *see also* State's Ex. 1100.

581. Fifth, Dr. Engel used the model to characterize and evaluate phosphorus loads if no poultry waste had ever been land applied within the IRW. *See* Daily Trans., 6274:5-8 (Engel Testimony). Under this "no poultry waste" scenario, soil test phosphorus levels in IRW pastures were set at background levels and the model run for 100 years with the assumption of no poultry waste land application. *See* Daily Trans., 6274:9-14 (Engel Testimony).

582. The model results for the no poultry waste scenario show that if no poultry waste had ever been land applied in the IRW, the phosphorus load to the Tahlequah gauging station

would be 275,000 pounds less per year than the current phosphorus load. *See* Daily Trans., 6277:1-6278:3 (Engel Testimony); *see also* State's Ex. 1108.

583. Dr. Engel also used the model to characterize and evaluate historical phosphorus loads to Lake Tenkiller. *See* Daily Trans., 6279:18-23 (Engel Testimony). For the historical scenario, rainfall data and phosphorus input data for 1950 through 1999 were run through the GLEAMS model. *See* Daily Trans., 6279:24-6280:5 (Engel Testimony). Additionally, wastewater treatment plant discharges were adjusted based upon historical data. *See* Daily Trans., 6280:6-13 (Engel Testimony). That set of results was then run through the modeling system. *See* Daily Trans., 6280:14-16 (Engel Testimony).

584. The model results for the historical scenario show that -- since 1954 -- phosphorus loads to Lake Tenkiller from nonpoint sources have increased at a rate of about 8,000 pounds per year. *See* Daily Trans., 6283:7-6284:8 (Engel Testimony); *see also* State's Ex. 1114.

3. Defendants' Critique and the State's Response

585. Defendants have offered a number of criticisms of Dr. Engel's modeling analysis, largely through their expert, Dr. Victor Bierman.[98] Overall, Dr. Bierman opines that Dr. Engel's

[98] Dr. Victor Bierman is a consultant at Limno-Tech where he conducts applied research on water quality and watershed models for government agencies and serves as a scientific peer reviewer for government agencies. *See* Daily Trans., 10228:19-10229:6 (Bierman Testimony). He received a Ph.D. in environmental engineering from Notre Dame after which he became a systems ecologist for the EPA contractor Cranbrook Institute of Science. *See* Daily Trans., 10225:12-16, 10226:21-25 (Bierman Testimony). He was an environmental scientist at EPA for 13 years. *See* Daily Trans., 10226:25-10227:5 (Bierman Testimony). He was an associate professor of civil engineering at Notre Dame for 4 years and remained as an adjunct professor for several years while he worked for Limno-Tech. *See* Daily Trans., 10227:15-22 (Bierman Testimony). He was an adjunct professor at the EPA lab in Narragansett. *See* Daily Trans., 10228:10-15 (Bierman Testimony). Dr. Bierman testified as a retained expert for Defendants.

model is purely result-driven and will produce the same results regardless of what data go in. The primary basis for Dr. Bierman's critique stems from the fact that -- during the initial calibration of Dr. Engel's model -- Dr. Engel inadvertently included only 27 of 50 total hydrologic response units ("HRUs")[99] in the calibration.[100] *See* Daily Trans., 11285:3-20, 11286:3-9 (Engel Testimony). Dr. Bierman asserts that Dr. Engel "independently confirmed that his models give the same answer whether he includes the entire watershed or leaves half of it out." *See* Daily Trans., 10264:23-25 (Bierman Testimony). Contrary to Dr. Bierman's opinion, however, the omission of 23 HRUs from the calibration did, in fact, affect the modeling results. *See* Daily Trans., 11286:10-25 (Engel Testimony). After the HRU omission was discovered, Dr. Engel recalibrated the model to include the 23 HRUs, which changed the way that the other 27 HRUs were calibrated. *See* Daily Trans., 11287:14-25 (Engel Testimony). Additionally, the recalibration resulted in changing the GLEAMS phosphorus output predictions; thus, Dr. Engel had to adjust the routing model coefficients accordingly. *See* Daily Trans., 11288:15-19 (Engel Testimony).

---

[99] An HRU is a unique combination of land use, soils, land management and weather that is modeled as part of GLEAMS. *See* Daily Trans., 6292:10-13 (Engel Testimony).

[100] Again, once this mistake was identified, Dr. Engel corrected his expert report by way of an errata. *See* Daily Trans., 6294:21-6295:10; 6295:22-6296:17 (Engel Testimony). The Court notes that it is well-established that "[t]here is no stigma attached to [expert report] error correction. If anything, it strengthens the quality of the expert report." *Crowley v. Chait*, 322 F. Supp. 2d 530, 540 (S.D. Ohio 2004); *see also Primavera Familienstiftung v. Askin*, 130 F. Supp. 2d 450, 527 (S.D.N.Y. 2001) ("[T]he fact that [the expert] reviewed his original report and made certain corrections to it does not show that his methodology was unreliable -- revisions are consistent with the scientific method"); *In re Commercial Financial Services, Inc.*, 350 B.R. 520, 557-58 (Bkrtcy. N.D. Okla. 2005) ("Unexplainable or unjustifiable revisions to reports, calculations or opinions may warrant caution in evaluating the reliability of the expert's work, but when mistakes are made, caught, corrected and satisfactorily explained by the expert in a supplemental report, as required by the Rule 26(e), no adverse inference as to the reliability of the expert's opinion need be drawn") (emphasis removed).

586. Importantly, despite the adjustments to the routing model coefficients during recalibration, Dr. Engel was not free to simply change the coefficients when he pleased. Indeed, the only time that Dr. Engel changed the coefficients was after the recalibration of, and resulting changed phosphorus output data from, the GLEAMS model. *See* Daily Trans., 11289:14-24, 11291:4-11 (Engel Testimony) ("Mr. Page: Now, Dr. Engel, I just want to make sure this is perfectly clear. After you discovered the HRU mistake and you recalibrated the GLEAMS model . . . did you ever recalibrate or in any way change the coefficients for the routing model for the rest of the work you did in this case? Dr. Engel: No."). Still, based on this single instance of changed coefficients to correct for previously omitted data, Dr. Bierman believed he was free to -- and in fact did -- alter the routing model coefficients at will during his analysis of Dr. Engel's model. *See* Daily Trans., 10379:10-17 (Bierman Testimony). Based upon an apparent misunderstanding, Dr. Bierman testified that one of the reasons he felt free to alter the routing model coefficients was because Dr. Engel did not have "specific numerical values attached" to the coefficients. *See* Daily Trans., 10363:16-10364:10 (Bierman Testimony). However, Dr. Engel's expert report did, in fact, set forth specific numerical values for each of the routing model coefficients. *See* Daily Trans., 11293:24-11295:1 (Engel Testimony). As shown in detail below, it was Dr. Bierman's own repeated adjustment of the routing model coefficients that created nearly all of the bases for his critique of Dr. Engel's model.

587. In particular, Dr. Bierman ran four "sensitivity tests" where he would input wildly different data into Dr. Engel's model -- "recalibrate" the model -- and always claim to find results similar to those found by Dr. Engel. In reality, though, Dr. Bierman did much more than simply recalibrate Dr. Engel's model. Dr. Bierman often greatly altered the model coefficients; that is, Dr. Bierman altered the model itself. For instance, as part of his sensitivity tests, Dr.

Bierman used fictional wastewater treatment plant phosphorus load data that was 345 times greater, and nonpoint source load data that was 15 times greater, than the load data used by Dr. Engel. *See* Daily Trans., 10259:1-17 (Bierman Testimony). Despite the vast difference in the data, Dr. Bierman claimed that he was able to "recalibrate" Dr. Engel's model and reach "R values" that were equal to or greater than Dr. Engel's. *See* Daily Trans., 10259:1-17 (Bierman Testimony).

588. There are significant problems with Dr. Bierman's wastewater treatment plant and nonpoint sensitivity tests that are emblematic of all of his sensitivity tests. First, Dr. Bierman greatly altered the inputs into the routing model and then changed the coefficients in ways that did not reflect reality. *See* Daily Trans., 11300:25-11301:5 (Engel Testimony). As Dr. Engel explained:

> [Dr. Bierman] had to alter the coefficients to the routing model in ways that didn't make sense. So with these greatly increased phosphorus loads, in order to make small amounts relative to the inputs continue to come out at Barren Fork, Caney Creek, and Tahlequah, it was necessary to make a substantial amount of phosphorus essentially disappear. There was a term in the model that allowed that phosphorus to disappear, if you will, by forcing it to be accumulated in the stream system. . . . So by making these . . . unrealistic coefficients and forcing things to be unrealistic, he was able to produce similar results but for a situation that no longer represents the Illinois River Watershed.

Daily Trans., 11303:7-21 (Engel Testimony). By altering the routing model coefficients, <u>Dr. Bierman did not merely recalibrate the model, he actually changed Dr. Engel's model</u>. *See* Daily Trans., 11304:16-24 (Engel Testimony) ("He altered the routing model, he changed the coefficients so that he could lose phosphorus and force that phosphorus to accumulate in the stream network, and in other instances he had to use coefficients that didn't make sense physically"); *see also* Daily Trans., 11305:16-19 (Engel Testimony) ("Mr. Page: Now, Dr. Engel,

do you agree with Dr. Bierman's opinion that changing the coefficients did not change your model? Dr. Engel: No. It changed the model.").

589. Perhaps the starkest example of how Dr. Bierman's manipulation of the coefficients changed the model was his alteration of routing model coefficient A. As Dr. Engel explained, coefficient A describes the case when there is no flow; "[s]o if there's no flow reaching one of the gauging stations, physics and logic would dictate that the phosphorus load would need to be awfully close, if not zero, so it should be very close to zero." *See* Daily Trans., 11306:10-21 (Engel Testimony). Yet, in conducting his sensitivity tests, Dr. Bierman changed coefficient A in several instances to reflect values as high as 140 kilograms per day. *See* Daily Trans., 11306:22-11307:4 (Engel Testimony). Altering coefficient A in this manner "would indicate, if one believed [Dr. Bierman's] made-up model, that phosphorus was being delivered when there was no flow on the -- of the magnitude of 140 kilograms per day. So physics and logic again would dictate that that simply doesn't make sense." *See* Daily Trans., 11307:5-9 (Engel Testimony). In other instances, Dr. Bierman radically altered the B and C coefficients. For example, under his nonpoint sensitivity test, the difference between the value attached to coefficient C by Dr. Engel and Dr. Bierman was "approximately three orders of magnitude or nearly a thousand percent." *See* Daily Trans., 11314:9-13 (Engel Testimony).

590. As another example of how Dr. Bierman's radical alteration of Dr. Engel's model coefficients yielded patently unrealistic results, under the nonpoint sensitivity test, Dr. Bierman's model predicted that by December 31, 2006, nearly 589 million kilograms of phosphorus had accumulated in the Baron Fork. *See* Daily Trans., 11317:19-22 (Engel Testimony). As Dr. Engel testified, "that represents about five percent of the phosphorus that's mined globally on an annual basis." *See* Daily Trans., 11317:23-25 (Engel Testimony).

591. To further illustrate how dramatically Dr. Bierman altered the model to arrive at his ultimate results and opinions, Dr. Engel ran his own tests using Dr. Bierman's made up data but without altering the coefficients as Dr. Bierman did. *See* Daily Trans., 11318:17-11319:5 (Engel Testimony). For instance, using Dr. Bierman's nonpoint source loading data to Baron Fork -- without changing the model coefficients as Dr. Bierman had done -- the resulting predicted loads differed by as much as 250 million pounds of phosphorus a year. *See* Daily Trans., 11319:2-18 (Engel Testimony). Dr. Engel also ran the same test using Dr. Bierman's fictional wastewater treatment plant discharge data. *See* Daily Trans., 11325:4-10 (Engel Testimony). Dr. Engel found that -- again, without changing the model coefficients as Dr. Bierman had done -- the wastewater treatment plant phosphorus loading results are vastly different. *See* Daily Trans., 11325:19-11326:8 (Engel Testimony).

592. In one of the other sensitivity tests he ran, Dr. Bierman input numbers from the S&P 500 stock index into the routing model. *See* Daily Trans., 10252:6-10 (Bierman Testimony). Dr. Bierman ran this S&P 500 test in a stated attempt to demonstrate that Dr. Engel's routing model cannot "tell the difference between phosphorus loads that are realistic and numbers that are completely made up." *See* Daily Trans., 10261:22-10262:2 (Bierman Testimony). However, as he had done with the wastewater treatment plant and nonpoint sensitivity tests, Dr. Bierman altered the routing model coefficients in conducting his S&P 500 sensitivity test. *See* Daily Trans., 11326:14-11327:22 (Engel Testimony). As he had with the wastewater treatment plant and nonpoint sensitivity tests, Dr. Engel also ran a test using Dr. Bierman's S&P 500 data -- but without changing the model coefficients as Dr. Bierman had done -- and once again found that the results were different. *See* Daily Trans., 11326:14-11327:22 (Engel Testimony). While the differences were not as marked as they had been with the other

sensitivity tests -- because the S&P 500 inputs were similar in magnitude to the actual wastewater treatment plant and nonpoint source load data -- there were significant differences nonetheless. *See* Daily Trans., 11327:1-11 (Engel Testimony). Indeed, Dr. Engel found that the average daily difference between his results and the Dr. Bierman's S&P 500 results was 187 percent. *See* Daily Trans., 11328:15-11329:4 (Engel Testimony); *see also* Daily Trans., 11329:9-11331:1 (Engel Testimony) (Dr. Engel found an average daily difference of 77 percent between his model results and those of Dr. Bierman using Dr. Bierman's "reverse" sensitivity test data).

593. Overall, Dr. Engel demonstrated that -- in fact -- his model does not always produce the same results no matter what data is put into the model. *See* Daily Trans., 11331:2-14 (Engel Testimony).

594. Moreover, in conducting his nonpoint sensitivity test, Dr. Bierman "uncoupled" the GLEAMS model from the routing model. *See* Daily Trans., 11301:19-11302:7 (Engel Testimony). That is, while Dr. Bierman altered the nonpoint source pollution load to be 15 times the actual nonpoint source load data used by Dr. Engel, Dr. Bierman failed to rerun the GLEAMS model. *See* Daily Trans., 11302:5-7 (Engel Testimony). Had he rerun the GLEAMS model, Dr. Bierman would have had "a very difficult time" getting the model to predict the output of so much additional phosphorus. *See* Daily Trans., 11302:8-12 (Engel Testimony). In sum, by "uncoupling" the model in this fashion, Dr. Bierman created an unrealistic model that does not reflect reality. *See* Daily Trans., 11302:13-17 (Engel Testimony).

595. For the foregoing reasons, the Court cannot credit Dr. Bierman's critiques of Dr. Engel's modeling work. Dr. Engel is an experienced, well-qualified watershed modeler. *See supra* note 15. The model employed was reliably chosen and properly run. Dr. Bierman's

opinion that the model is purely result-oriented is belied by the evidence. Dr. Bierman's opinion in this regard is based upon his own manipulation of the model coefficients to account for his unrealistic hypothetical data. It is clear that had Dr. Bierman not changed Dr. Engel's model in such fundamental ways, his results would have been vastly different. Dr. Engel's model is based upon sound data and reliable methodology. As such, the Court will accord weight to the modeling results and conclusions reached by Dr. Engel. The model demonstrates not only the respective phosphorus loading to waters of the IRW from nonpoint and point sources generally; but also, by delineating the estimated impact that the land application of poultry waste has had -- and will have -- on phosphorus loading, the model shows that runoff from land-applied poultry waste is a significant contributor to phosphorus loading to the waters of the IRW.

K. Upstream - Downstream Sampling

596. In the course of its sampling program, the State's experts established a high flow automatic sampling station. *See* Daily Trans., 5599:2-3 (Olsen Testimony). It was the State's experts' intention to locate this high flow automatic sampling station where there were no poultry houses. *See* Daily Trans., 5599:3-5 (Olsen Testimony). To the surprise of the State's experts, the samples from this station revealed high concentrations of phosphorus during high flow events. *See* Daily Trans., 5599:5-7 (Olsen Testimony). Upon further investigation, the State's experts discovered that just upstream from the sampling station there was a pasture that had had poultry waste applied to it. *See* Daily Trans., 5599:7-12 (Olsen Testimony).

597. During two separate storm events, the State's experts were able to take water samples upgradient of the land-applied field, and then compared the sampling results with the sampling results from water collected from the down-gradient high flow automatic sampling station. *See* Daily Trans., 5599:13-22 (Olsen Testimony).

598. The results from the upgradient sampling were near background for phosphorus (approximately 0.02 mg/L). *See* Daily Trans., 5599:24-5600:3 (Olsen Testimony). The results for the downgradient sampling were approximately 0.4 mg/L and .07 mg/L respectively. *See* Daily Trans., 5600:3-5 (Olsen Testimony). According to the State's experts (and Defendants offered no conflicting evidence), there was only one source between the two sampling stations -- a pasture with land-applied poultry waste -- to which the substantial increase in phosphorus could be attributed. *See* Daily Trans., 5600:6-10 (Olsen Testimony).

L. Direct Observation

599. A twelfth line of evidence supporting the State's contention that phosphorus from land-applied poultry waste is running off and leaching into the waters of the State is the testimony of Dr. Caneday. Dr. Caneday testified that he has directly observed not only poultry waste flowing off a field in the IRW, but also poultry waste in the Illinois River.

600. With respect to the former, Dr. Caneday testified that in September 2007, while driving on the east side of Chewey Bridge in the Oklahoma portion of the IRW during a rainfall, he observed poultry waste running off a field and that "it looked like the field was actually moving across the road as litter was washed off the field, across the road, down toward the river." *See* Daily Trans., 4366:24-4367:4; 4369:25-4370:1 (Caneday Testimony).

601. With respect to the latter, Dr. Caneday testified to seeing poultry waste floating on the surface of the Illinois River, together with straw and feathers. *See* Daily Trans., 4365:25-4366:23; 4367:5-8; 4403:23-4405:13 (Caneday Testimony). Dr. Caneday testified that he was

familiar with what poultry waste is and that chicken feathers are easily identifiable. *See* Daily Trans., 4365:25-4366:8; 4405:4-8 (Caneday Testimony).[101]

M. Defendants' Expert

602. The very first witness called by Defendants in their case -- retained expert Dr. Connolly -- readily admitted that phosphorus in general runs off the land in the IRW and gets in the waters of the State:

> Mr. Page: Okay. Now, doesn't that amount of phosphorus that by definition -- that is, nonpoint-source phosphorus -- by definition runs off the land indicate to you, sir, that there is a transport pathway of phosphorus from the land to the rivers and streams of the IRW?
> Dr. Connolly: Yes.
> Mr. Page: So you're not suggesting that phosphorus does not run off of fields and forests and urban areas of the IRW and enter the streams of the IRW, are you, sir?
> Dr. Connolly: I'd be pretty silly to do that.

See Daily Trans., 9142:9-20 (Connolly Testimony) (emphasis added).

603. Furthermore and highly significantly, Dr. Connolly readily admitted that phosphorus from poultry waste specifically runs off the land in the IRW and gets in the waters of the State:

> Mr. Page: Oh. So you believe there is evidence, then, of a pathway of manures applied to fields within the IRW flowing -- their constituents flowing into the streams of the IRW?
> Dr. Connolly: If you're asking me whether or not any of the phosphorus in poultry litter applied to fields makes its way to the Illinois River or Lake Tenkiller, the answer is obviously yes. . . .

Daily Trans., 9183:19-22 (Connolly Testimony) (emphasis added).

N. Defendants' Admissions

---

[101] As noted above, *see* FOF, ¶ 354, wheat straw is one of the materials used as bedding. *See* Daily Trans., 3843:25-3844:5 (Pigeon Testimony).

604. Defendants, with the exception of Defendant Cal-Maine, have run advertisements in Oklahoma newspapers admitting that phosphorus from land-applied poultry waste is a contributing source to phosphorus loading in the waters of the IRW.

605. For example, in a December 5, 2004 advertisement, the Tyson Defendants, the Cargill Defendants, the George's Defendants, Defendant Simmons and Defendant Peterson stated: "Lately, a good deal of concern has been raised about the effect of excess nutrients on the land and waters of Eastern Oklahoma. So where do these nutrients come from? Nutrients can come from many sources, one of which is the use of poultry litter as an organic fertilizer. . . ." *See* State's Ex. 336.

606. And in a September 10, 2004 advertisement, the Tyson Defendants, the Cargill Defendants, the George's Defendants, Defendant Simmons and Defendant Peterson stated: "[W]e have been working with the State of Oklahoma on a multi-million-dollar voluntary proposal to improve the management of poultry-related nutrients that might find their way into Eastern Oklahoma's Scenic River Watersheds. . . . We are prepared to do our part to take care of the poultry portion of the nutrient equation." *See* State's Ex. 335.

607. More generally, certain Defendants have admitted to the fate and transport of phosphorus from land-applied poultry waste. For example, Mr. Henderson of the George's Defendants has written that:

> Litter Management has become a major issue in the Poultry industry. There has been a lot of scientific work done in the past few years that shows high phosphorus levels in rivers, streams and lakes causes an increase in algae growth which can adversely affect water quality and recreational use. . . . The problem comes when more litter is used then the crops need and phosphorus levels become too high in the soil. . . . During major rain events some of the phosphorus becomes soluble and washes off into the streams and lakes.

See State's Ex. 3043. And that "[o]ver the years, however, studies indicate that continuous use [of poultry waste] on the same land can increase the phosphorus levels in the soil to levels higher than annual crops can utilize. These studies indicate that in certain watersheds the excess can dissolve into run-off rainwater and get into the streams creating an imbalance in streams and rivers." *See* State's Ex. 3045.

608. Likewise, the Cargill Defendants have admitted that:

> Poultry manure is also composed of relatively large amounts of phosphorus. . . . Phosphorous laden soils can be eroded by rainfall and the particles can then be transported into surface water sources. Excessive phosphorus in surface waters can cause excessive plant and algae growth. Excessive algae growth can contribute to fish kills by depleting the dissolved oxygen content of the water. . . . Producers should . . . implement an annual soil-sampling program for application fields to determine nutrient concentration and to help calculate application rates. Further applications should not be made to soils containing excessive phosphorus amounts.

See State's Exhibit 6131-A at CARTP000010. And that "[p]hosphorus can contaminate water when there is run off after the litter is spread on fields." *See* State's Ex. 6218.

609. The Tyson Defendants have admitted that:

> Poultry production has become one of the major agricultural endeavors in the US. Poultry producing areas are generally located in those parts of the country that are not conducive to traditional row crop agriculture. Examples of these areas include Northwest Arkansas . . . . The main use of poultry litter (poultry manure and bedding material) nutrients has been as a fertilizer for application to field crops and pasture grasses. . . . Over the years, higher phosphorus levels have been noted in some application area soils. Excess phosphorous can be eroded from the soil and washed into nearby waterways. Higher concentrations of phosphorous in surface waters can result in creation of algal blooms. . . . Poultry manure has a high concentration of phosphorous when compared to the concentration of nitrogen. The phosphorous requirements of most plants are less than the nitrogen requirements. If application rates are calculated to meet the nitrogen nutrient requirements of most crops and pasture grasses it is possible to land apply more phosphorus than is needed. Excess soil phosphorous could then be removed by runoff and transported to water sources. . . . Excess amounts of soluble phosphorous are also easily incorporated into precipitation and could leave the litter application area.

See State's Ex. 1283 at TSN0075CORP-TSN0076CORP. And that "[p]hosphorus . . . is mobile[,] . . . "causes water quality problems[,] . . . [and] accumulates in the soil." *See* State's Ex. 3207 at TSN117466SOK.

610. Meanwhile, Defendant Peterson wrote in 1998 that:

> Time continues to pass with no new solutions of dealing with excess animal waste and environmental problems it is creating. . . . I realize once again I've come with no new solutions, but we continue to look at anything that may solve all or part of our problem. The solution may be one or a combination of these technologies. Or it may mean our industry must make some changes in the way we do business.

See State's Ex. 3034.

O. Some Fraction of Phosphorus from All Poultry Waste that Is Land-Applied in the IRW Runs Off and Ends Up in the Waters of the IRW

611. As noted above, poultry waste generated by each Defendant's birds has been land applied on fields in the IRW. *See* FOF, ¶ 371. Such waste behaves similarly in the IRW environment. *See* Daily Trans., 1859:14-1860:1 (Fisher Testimony) ("Because the wastes were all similar and the behavior of that waste under the influence of rainfall and gravity is all similar or the same, the waste is fungible, there's no reason to do a site-specific analysis of fate and transport in the Illinois River Watershed. If the waste is put on the ground, it will end up in the streams.").

612. Specifically, some fraction of the phosphorus in each such land application will run off and end up in the waters of the IRW. For instance, Dr. Johnson testified:

> Mr. McDaniel: So if there's any surface fertilizer or amendment or something placed on the surface of the field and it rains hard enough and long enough to create some runoff at the edge of the field, it's inevitable that you're going to detect some evidence of it in the runoff; do you agree?
> Dr. Johnson: Yes.

See Daily Trans., 5172:1-6 (Johnson Testimony).

613. Likewise, Dr. Engel testified that "based upon my analysis . . . poultry waste when land-applied becomes a substantial contributor to phosphorus runoff and approximately five percent of the phosphorus in that waste would be expected to run off in an average or typical year." *See* Daily Trans., 5712:4-9 (Engel Testimony); *see also* Daily Trans., 6619:11-6620:3 (Engel Testimony) (testifying that he has not seen any studies that contradict the fact that when poultry waste gets land applied it increases the runoff from that field, and that that makes sense because "if there's more phosphorus available, and in the manner that it's applied, it's applied to the surface of the soil and it's not incorporated. And so, therefore, as rainfall occurs and generates runoff and that runoff is interacting with this phosphorus that's readily available on the surface, some of it is going to run off with the water that leaves that area").

614. Dr. Engel is not alone in his analysis that approximately 5 percent of the phosphorus in any given land application can be expected to run off. *See, e.g.,* Court's Ex. 11 at 7 (Edwards Depo.) (testifying that some studies had 5 percent phosphorus runoff); Court's Ex. 11 at pp.23-24 (Edward's Depo.) (testifying as to study he conducted showing that with surface-applied litter, 2.2 to 7.3 percent of total phosphorus applied was lost in runoff, with 80 percent or more of the phosphorus in runoff in dissolved form); State's Ex. 3285 at pp. 42-45 (OWRB / OSU / USACE "Clean Lakes" Report) (discussing run-off coefficients and utilizing coefficient of 0.2-0.65 kg/ha/yr for pasture in the IRW and using assumption "that all wastes produced at these locations are susceptible to transport due to rainfall events and erosion").

615. The Cargill Defendants agree. In its Contract Grower Environmental Best Management Practices Guide, Defendant Cargill Turkey Products states that "[i]t should be recognized that some level of nutrient loss to surface and groundwater <u>will</u> occur despite following the recommendations in this manual; however, these losses should be lower than

would occur without nutrient management." *See* State's Ex. 6131A at CARTP000009 (emphasis added).

616. Ms. Phillips' testimony perhaps captures the concept on a micro (*i.e.*, field runoff) and macro level (*i.e.*, watershed level) most simply:

> Mr. Elrod: And will you also agree with me that by its very nature, ipso facto, as we lawyers say, [a] farm pond is a catchment basin, has its own catchment basin?
> Ms. Phillips: Yes.
> Mr. Elrod: It has its own little miniwatershed.
> Ms. Phillips: Yes, it does.
> Mr. Elrod: So that the water that flows into the farm pond would define the boundaries of its watershed, if one wanted to take the time to go try to do that; right?
> Ms. Phillips: Yes. And that's important in design of the pond.
> Mr. Elrod: <u>So the nutrients that would be within that little miniwatershed of a particular pond are going to end up in that pond; correct</u>?
> Ms. Phillips: <u>Yes</u>.
> * * *
> Mr. Nance: Do you recall talking to Mr. Elrod about nutrients flowing through a miniwatershed into a pond?
> Ms. Phillips: Yes.
> Mr. Nance: Does the same – and ending up in the pond. Do you recall that?
> Ms. Phillips: Yes.
> Mr. Nance: <u>Does the same thing happen for the entire watershed where nutrients flow from upland down into Lake Tenkiller</u>?
> Ms. Phillips: <u>Yes</u>.

See Daily Trans., 1478:18-1479:8; 1511:7-17 (Phillips Testimony)(emphasis added).

P. Phosphorus Concentrations in Other Watersheds Do Not Negate the Fact that Poultry Waste Is Impacting Phosphorus Concentrations in the IRW

617. Defendants point to elevated phosphorus concentrations in Oklahoma lakes and rivers outside of the IRW -- as well as lakes and rivers in other areas of the country -- in an effort to suggest that elevated phosphorus concentrations in these other lakes or rivers tend to negate the State's claim that land applied poultry waste is responsible for elevated phosphorus concentrations in the IRW. *See, e.g.*, Daily Trans., 9122:23-9123:10 (Connolly Testimony)

("There are also a number of . . . hypereutrophic lakes throughout the state and they tend to be on the western half of the state in an area that's, from my understanding, not an area of poultry production."); Daily Trans., 10596:18-10957:2 (Sullivan Testimony) (phosphorus concentrations in the IRW are "in the same range of what we find many places"); Daily Trans., 10615:5-8 (Sullivan Testimony) ("[W]here there is evidence that there are particularly high concentrations [of phosphorus], they're not in the IRW but, rather, in the central part of the state").

618. However, Defendants' expert, Dr. Sullivan, admitted when an analysis was performed comparing the phosphorus concentrations in other streams within the Ozark and Ouachita ecoregions, the median values for phosphorus concentrations for those streams were lower than those found in the IRW. *See* Daily Trans., 10603:23-10604:7 (Sullivan Testimony). Dr. Sullivan suggested possible reasons why other Ozark and Ouachita streams had lower phosphorus concentrations than those found in the IRW. For instance, Dr. Sullivan noted that urban areas of the IRW are in the upper reaches of the watershed and the more heavily forested areas are found in the lower reaches and such land use patterns are not typical. *See* Daily Trans., 10607:3-13 (Sullivan Testimony). However, Dr. Sullivan did not perform any analysis to determine the extent to which these differences in land use patterns account for the admitted differences in phosphorus concentrations. *See* Daily Trans., 10621:4-10622:7, 10920:6-10923:8 (Sullivan Testimony).

619. In any event, evidence of elevated phosphorus concentrations in other watersheds does not suggest that land applied poultry waste is not a source of the elevated phosphorus concentrations found in the waters of the IRW. As Dr. Sullivan testified, when making comparisons between different watersheds, it is important that one compare the land uses between those watersheds, including the number of people, poultry, cattle, and differences in

geology. *See* Daily Trans,. 10623:14-23 (Sullivan Testimony). Defendants conducted no such comparison here.

620. Additionally, any comparison between watersheds requires an analysis of streams or lakes which can be used as reference streams or lakes. *See* Daily Trans., 10624:16-21 (Sullivan Testimony). Dr. Sullivan has acknowledged that while natural background phosphorus concentrations in the waters of the IRW are probably as low as 0.010 or 0.020 mg/L, the concentrations currently found in the IRW exceed those background levels. *See* Daily Trans., 10624:21-10625:3 (Sullivan Testimony). Indeed, Dr. Sullivan did not challenge data gathered by the State's experts demonstrating phosphorus concentrations as high as 0.600 mg/L in the waters of the IRW. *See* Daily Trans., 10599:17-21 (Sullivan Testimony).

Q. Summary

621. Based upon the foregoing factual findings, the Court finds that phosphorus from land-applied poultry waste runs off and leaches into the rivers and streams of the IRW and into Lake Tenkiller.

622. Based upon the foregoing factual findings, the Court finds that some fraction of phosphorus from all poultry waste that is land applied in the IRW runs off and leaches into the rivers and streams of the IRW and into Lake Tenkiller.

XV. Phosphorus that Has Run Off from Land-Applied Poultry Waste Is a Significant Source of the Phosphorus Causing the Injuries to both the Rivers and Streams of the IRW in Oklahoma and Lake Tenkiller

623. As detailed above, the evidence that phosphorus in land-applied poultry waste can, and does, run-off into the waters of the IRW is overwhelming. As detailed below, the evidence is likewise overwhelming that this phosphorus is a significant source of the phosphorus causing the injuries to both the rivers and streams of the IRW in Oklahoma and Lake Tenkiller.

624. Importantly, even small-amounts of phosphorus running off from a given field are environmentally significant. *See* State's Ex. 3145 at 2249-2 ("[I]ncreasing the amount of P in soils results in increased levels of P in soil solutions (Figure 3). Generally, this will result in small, but environmentally important, increases in the amount of dissolved P in water that passes over or through soils.") (emphasis added); Court's Ex. 8 at p. 21 (Haggard Deposition Testimony) (testifying that he agrees that there is a need to carefully manage poultry waste because small losses of nutrients compared to the total amount of nutrients produced in a watershed may still impact stream nutrient concentrations).

625. As demonstrated by the Clean Lakes study, phosphorus loading attributable to confined animal feeding operations (of which poultry is one)[102] accounts for approximately 63 percent of the total phosphorus loading to Lake Tenkiller. *See* State's Ex. 3285 at p. 46 (Table XVII) & p. 55 (Table XXIV).[103]

626. Similarly, by simply observing the Δ (delta) between the phosphorus loadings to Lake Tenkiller from continued poultry waste application and poultry waste application cessation reflected on State's Ex. 1126, and discussed in detail, *infra*, FOF, ¶¶ 628-635, it is evident that land-applied poultry waste in the IRW is a significant source of the phosphorus loading to Lake Tenkiller.

627. Although some (though not all) of the following evidence has been cited and discussed in a different context, further review is warranted inasmuch as it speaks directly to the

---

[102] Other confined feeding operations in the IRW are dairy and swine. *See* State's Ex. 3285 at p. 43 ("Confined animal operations, which includes all poultry rearing, dairy, and hog rearing operations, comprise a relatively small percentage of the total basin area (0.38%), but the quantities of litter and waste produced by the animals present significant sources of nutrients which become susceptible to transport to waterways.").

[103] The 63 percent figure is arrived at by simply multiplying the total nonpoint source phosphorus loading to Lake Tenkiller (83 percent) by the confined animal operations share of total nonpoint source phosphorus loading to Lake Tenkiller (76.73 percent).

fact that poultry waste is a substantial source of the phosphorus that is causing injury to the waters of the State in the Oklahoma portion of the IRW.

628. For instance, in its 2008 "Coordinated Watershed Restoration and Protection Strategy for Oklahoma's Impaired Scenic Rivers," the Office of the Oklahoma Secretary of the Environment reported that "[t]he single largest contributor of nonpoint source pollution is surplus poultry litter generated by the integrator's flocks." *See* State's Ex. 5662 at p. 2 (emphasis added); *see also* State's Ex. 5665; State's Ex. 5664; State's Ex. 5666.

629. In its 2006 report entitled "Phosphorus Concentrations, Loads, and Yields in the Illinois River Basin, Arkansas and Oklahoma, 2000-2004," the USGS concluded that:

> Phosphorus concentrations in Ozark Streams are typically greater in streams draining agricultural lands than in those draining forested lands (Petersen and others, 1998; 1999) because runoff from pastures fertilized with animal manure are probably substantial sources of phosphorus to the rivers in this basin (Arkansas Department of Environmental Quality, 2000).

See State's Ex. 5862 at p. 4 (emphasis added); *see also* 5861 at pg. 2.

630. In its 1992 Report entitled "Illinois River Cooperative River Basin Resource Base Report," the USDA concluded that:

> The river is not as clear as in earlier times, and algae blooms are quite common along some parts of the river system. Substrate rocks along the lower stretches of the Illinois River are coated with black slime. Late in summer, the upper end of Lake Tenkiller resembles a pea soup color. The sources of pollution entering the watershed include animal waste, septic systems, urban runoff, erosion, and municipal effluent.
> * * *
> A significant part of the water quality problems in the basin appear to be a precipitate of the large volume of poultry waste generated and disposed of in the basin each year.

See State's Ex. 3351 at OSU0005162 & OSU0005179 (emphasis added).

631. In his testimony, Mr. Smith, chief of the Water Management Division of the Arkansas Natural Resources Commission, stated that:

Mr. Nance: Is it true that excessive buildup of phosphorus over the years has polluted the receiving waterbodies to the point they're now considered impaired by nutrients?
Mr. Smith: I would agree.
Mr. Nance: And would you agree that phosphorus and pathogenic bacteria now impair many of the area's streams, including the Illinois River?
Mr. Smith: I would.
Mr. Nance: Let's turn to the next page, sir, if you would. Let's look at about the middle of the second paragraph on that page. I'm going to read a sentence that begins -- one, two, three, four, five -- six lines down over at the right-hand side beginning "nonpoint source." Do you see that?
Mr. Smith: I do.
Mr. Nance: Let me see if you agree with the truth of that statement that Arkansas has made to the federal government. "Nonpoint source impacts affecting waters in this segment are primarily from pastureland that is also used for application of poultry litter as fertilizer." Is that a true statement, sir?
Mr. Smith: It certainly is, ...
* * *
Mr. Nance: And the next paragraph down, sir, again about halfway down the paragraph, six lines down, there's a sentence that begins toward the left "Land use in the watershed." Do you see that?
Mr. Smith: I do.
Mr. Nance: Let's look at the truth of these representations made by the State of Arkansas. "Land use in the watershed is probably the best indicator of where nutrients have the greatest potential to impact water quality." Is that true?
Mr. Smith: It is.
Mr. Nance: You next said to the federal government, "Potentially, confined animal operations in high concentrations within a watershed can result in application of animal manures at nutrient rates greater than can be assimilated, resulting in nutrients being transported to adjacent streams during storm events." Is that true, sir?
Mr. Smith: It is. . . .
* * *
Mr. Nance: . . . [L]et me ask you if nonpoint source impacts affecting waters in the Illinois River are primarily from pastureland that's also used for application of poultry litter as fertilizer?
Mr. Smith: I'd say it's a significant -- certainly not the only contribution to that. It's certainly one of the significant contributions to nonpoint.

See Daily Trans., 9603:15-9604:13; 9604:21-9605:16 & 9609:25-9610:5 (Smith Testimony) (emphasis added).

632. In her testimony, Ms. Phillips, the Director of the Water Quality Division at the Oklahoma Conservation Commission, stated:

Mr. Nance: . . . [D]o you have an opinion, to a reasonable degree of scientific certainty, about whether or not nutrients from land-applied poultry waste contribute to the nonpoint source pollution of the waters of the IRW?
* * *
Ms. Phillips: Yes.
Mr. Nance: Okay. And what is your opinion, ma'am?
Ms. Phillips: My opinion is that they contribute to nutrient loading in those systems.
* * *
Mr. Nance: Ms. Phillips, would you agree that poultry waste adversely affects water quality in the basin?
Ms. Phillips: Yes.

See Daily Trans., 1384:2-7; 1384:21-25; 1532:6-9 (Phillips Testimony).

633. In his testimony, Dr. Stevenson stated:

Mr. Page: Dr. Stevenson, did you reach a conclusion based on this analysis concerning the biodiversity of streams being affected by poultry house density or the multi-metric nutrient index?
Dr. Stevenson: Yeah. It's my opinion that there's -- that poultry houses and nutrients associated with the poultry house operations are affecting the biodiversity of fish.
Mr. Page: Dr. Stevenson, what did you find with respect to -- or did you find any relationship between phosphorus concentrations and poultry house operations?
Dr. Stevenson: Yes, I did.
Mr. Page: What did you find?
Dr. Stevenson: That phosphorus concentrations increased with the density of poultry houses within the watershed.
* * *
Mr. Page: Did you find any relationship between algal biomass and poultry house density?
Dr. Stevenson: During the -- during the spring of 2007, yes, there was a relationship between algal biomass and poultry house density but not during the summer of 2006.
* * *
Mr. Page: Okay. Did you find any other correlations in your evaluation?
Dr. Stevenson: Yes. So in looking at the relationships between poultry house density, that basically it followed the causal chain in a way that you would expect, that there was a correlation between poultry houses and phosphorus and poultry houses and algal biomass. There's a relationship between nutrient concentrations, phosphorus and algal biomass, that affected DO and pH, and then -- then we could observe an effect on fish biodiversity that was related to indications of nutrient availability and of poultry house density.

See Daily Trans., 7130:10-18; 7146:21-7148:9 (Stevenson Testimony).

* * *

634. Based upon the foregoing factual findings, the Court finds that the amount of phosphorus that has run off from individual fields on which poultry waste generated by Defendants' birds has been land applied is environmentally significant.

635. Based upon the foregoing factual findings, the Court finds that phosphorus that has run off from poultry waste generated by Defendants' birds that has been land applied in the IRW is a significant source of the phosphorus causing the injuries to both the rivers and streams of the IRW in Oklahoma and Lake Tenkiller.

XVI. Continued Land Application of Poultry Waste in the IRW Will Result in Continued Injuries to the Waters of the IRW in Oklahoma

636. As indicated below, there is substantial and compelling evidence that if poultry waste continues to be land applied in the IRW, the waters of the IRW in Oklahoma will continue to suffer from phosphorus-related injuries.

A. Phosphorus Loading

637. Dr. Engel modeled several different future poultry waste land application scenarios -- a status quo scenario, a cessation scenario, a cessation with buffer strips scenario, and a growth scenario -- to determine what effect these scenario would have on phosphorus loading to Lake Tenkiller.

638. With continued land application of poultry waste in the IRW at current rates, Dr. Engel's modeling of phosphorus loading to Lake Tenkiller reveals that phosphorus loads would be roughly 500,000 pounds per year for the first ten years, increase over the next 20 years to

about 600,000 pounds per year, and then oscillate at a little less than 600,000 pounds. *See* Daily Trans., 6260:1-18 (Engel Testimony).

639. With a cessation of poultry waste application in the IRW, Dr. Engel's modeling of phosphorus loading to Lake Tenkiller reveals that phosphorus loads would decrease by about 18 percent in the first 10 years and continue to decline over time until stabilizing in years 71-100. *See* Daily Trans., 6260:19-6261:5. Following cessation, phosphorus from historic land application of poultry waste would continue to contribute to runoff even with cessation until it stabilizes at about 70 years after cessation. *See* Daily Trans., 6260:19-6261:5; 6261:10-25 (Engel Testimony).

640. This continued runoff from historic land applications of poultry waste is a result of the consequence of a phenomenon known as phosphorus banking. *See* Court's Ex. 8 at p. 9 (Haggard Deposition Testimony) ("Because of the phosphorus that can be stored in soils, you can still have increased concentrations in the runoff water [years after cessation of broiler litter application]."); Daily Trans., 6278:4-23 (Engel Testimony) ("[A]ssuming cessation of poultry waste application, it would take on the order of 90 to 100 years before we would see nonpoint-source loads of phosphorus reaching . . . expected levels if poultry waste had never been applied in this watershed . . . due to soil test phosphorus continuing to provide phosphorus in the form of nonpoint-source loads to these gauges into Lake Tenkiller."); Daily Trans., 6261:22-25 (Engel Testimony) ("So the STP continues to contribute to phosphorus in runoff, even with cessation here, until we get some stabilization in the out years here, in the 70-plus-year time horizon").

641. With cessation of poultry waste application and installation of buffer strips along all streams, Dr. Engel's modeling of phosphorus loading to Lake Tenkiller reveals that phosphorus loads would be reduced by about 10-13 percent during in the early periods in

addition to the above-mentioned reductions from cessation. *See* Daily Trans., 6266:8-16; 6273:14-6274:4 (Engel Testimony). The impact of the buffers would decline in the years out toward year 100. *See* Daily Trans., 6266:8-16; 6273:5-13 (Engel Testimony).

642. With projected growth of the poultry industry and associated increases in phosphorus from poultry waste application, Dr. Engel's modeling of phosphorus loading to Lake Tenkiller reveals that phosphorus loads would increase by about 70 percent in the 40-50 year period as a result of growth of poultry waste application. *See* Daily Trans., 6262:1-6266:7 (Engel Testimony).

643. As a point of comparison, Dr. Engel's modeling of phosphorus loading to Lake Tenkiller reveals that if no poultry waste had ever been land applied in the IRW, phosphorus loads to Lake Tenkiller would be 275,000 pounds per year less than current levels. *See* Daily Trans., 6277:10-6278:3 (Engel Testimony).

B. Injuries to IRW Rivers and Streams

644. Dr. Stevenson evaluated similar scenarios for their impact on the rivers and streams of the IRW.

645. With continued land application of poultry waste in the IRW at current rates, the conditions of the rivers and streams of the IRW would change little: there would still be 83 percent of third order streams injured for aesthetics and 47 percent of third order streams injured for fish biodiversity. *See* Daily Trans., 7159:11-17 (Stevenson Testimony).

646. With a cessation of poultry waste application in the IRW, there would be a decrease in the number of streams injured for aesthetics from 83 to 47 percent over the next 50 years, and there would be a decrease in streams injured for fish biodiversity from 47 to 26 percent. *See* Daily Trans., 7160:13-17 (Stevenson Testimony).

647. With projected growth of the poultry industry and associated increases in phosphorus from poultry waste application, there would be an increase in the number of streams injured for aesthetics from 83 to 96 percent, and there would be an increase in the number of streams injured for fish biodiversity from 47 to 78 percent. *See* Daily Trans., 7159:25-7160:7 (Stevenson Testimony).

C. Lake Tenkiller

648. Drs. Cooke and Wells evaluated future scenarios for Lake Tenkiller.

649. Because phosphorus is the limiting nutrient in Lake Tenkiller, Dr. Cooke concluded that the trophic state of Lake Tenkiller "would improve dramatically" if there were a large and permanent reduction in the phosphorus concentrations in the reservoir. *See* Daily Trans., 7382:20-7383:4 (Cooke Testimony). Specifically, Dr. Cooke testified that Lake Tenkiller could return to a mesotrophic state (or possibly even better). *See* Daily Trans., 7441:13-21 (Cooke Testimony); *see also* Daily Trans., 7445:7-8 (Cooke Testimony).

650. Dr. Cooke also concluded that the abundance of blue-green algae in the genus *Cylindrospermopsis* would be less if the phosphorus concentrations in Lake Tenkiller were reduced. *See* Daily Trans., 7475:19-7476:10 (Cooke Testimony).

651. Dr. Wells calculated that with continued land application of poultry waste in the IRW at current rates, the average summer flow-weighted dissolved oxygen in Lake Tenkiller over the next 50 years would be 1.36 mg/L. *See* State's Ex. 5475.

652. With a cessation of poultry waste application in the IRW, Dr. Wells calculated that the average summer flow-weighted dissolved oxygen in Lake Tenkiller over the next 50 years would be 2.44 mg/L *See* State's Ex. 5475.

653. With projected growth of the poultry industry and associated increases in phosphorus from poultry waste application, Dr. Wells calculated that the average summer flow-weighted dissolved oxygen in Lake Tenkiller over the next 50 years would be 1.25 mg/L. *See* State's Ex. 5475.

654. For reference, natural levels of dissolved oxygen in Lake Tenkiller should be 6.10 mg/L. *See* State's Ex. 5475.

D. Summary

655. Based upon the foregoing factual findings, the Court finds that unless land application of poultry waste in the IRW is dramatically reduced, the waters of the IRW in Oklahoma will continue to suffer from phosphorus-related injuries.

XVII. Defendants' Awareness that Phosphorus from Land-Applied Poultry Waste Is Contributing to Water Pollution in the IRW

A. Known or Knowable

1. Known

656. From the admissions by Defendants contained in the evidence cited above (which need not be repeated here), *see* FOF, ¶¶ 604-610, the Court finds that the environmental consequences of phosphorus in land-applied poultry waste in the IRW were long known to Defendants.

2. Knowable

657. Even assuming for the sake of argument that the Court were unable to conclude from the admissions by Defendants contained in the evidence cited above that the environmental consequences of phosphorus in land-applied poultry waste in the IRW were long <u>known</u> to Defendants, the State presented substantial notice evidence that the environmental consequences of phosphorus in land-applied poultry waste in the IRW were long <u>knowable</u> to Defendants, as

the following sampling makes clear.

658. Mr. Simmons acknowledged that in the 1980s the poultry industry recognized that poultry waste could have environmental impacts if it was not handled correctly. *See* Daily Trans., 4133:1-2 (Simmons Testimony). Nitrogen was initially the primary concern, but by the mid-1990s there was more concern about phosphorus impacts. *See* Daily Trans., 4133:11-24 (Simmons Testimony).

659. In 1988, Martin Maner[104] issued a paper from his agency involving the impacts to water quality in Benton and Washington counties from land applied manure. *See* State's Ex. 3312. In that paper, Mr. Maner wrote:

> [Wastes from animal production in Benton and Washington counties] are high in nitrogen and phosphorus and may contribute nutrients to groundwater or surface water via percolation and runoff. Benton and part of Washington County are largely underlain by fractured limestone of the Boone formation. The soils overlying the Boone are moderately to excessively well drained. Because of these features, rainfall percolates readily through the soil and into the shallow groundwater aquifer. Therefore soluble materials placed on the surface enter the groundwater with relative ease. . . . Nitrogen and phosphorus should be applied at a rate not greater than what cover plants can assimilate. . . . Excess values built up in the soil will be washed into surface waters whenever erosion occurs. . . . If the application of [chicken manure] is based on its nitrogen content, an excess of phosphorus will build up.

State's Ex. 3312 at ADEQ-225-226. This paper was widely disseminated. *See* Daily Trans., 659:13-661:19 (Fite Testimony); Court's Ex. 3 at pp. 12-13 (Maner Depo.).

660. Also in 1988, the first National Poultry Waste Management Symposium

---

[104] Mr. Martin Maner began employment with the Arkansas Department of Environmental Quality in 1970 and was the chief of the water division from 2004 to 2008. *See* Court's Ex. 3 at p. 2 (Maner Depo.). Mr. Maner became the director of watershed management for the Central Arkansas Water Utility in 2009. *See* Court's Ex. 3 at p. 2 (Maner Depo.). Mr. Maner graduated from the University of Arkansas in Fayetteville in 1970 with a bachelor's degree in civil engineering and a masters degree in natural science in 1974. *See* Court's Ex. 3 at p. 1 (Maner Depo.).

(NPWMS) was conducted. *See* Court's Ex. 1 at p. 2 (Blake Depo.);[105] State's Ex. 3391. As reported in the proceedings:

> [T]he Symposium was organized to discuss the issues, problems, and potential solutions to problems with poultry waste management and utilization. Growth and concentration of the poultry industry has resulted in large volumes of manure, used litter, hatchery wastes, dead birds, offal and wash water that need to utilized or disposed of in way[s] that minimize undesirable environmental impacts.

See State's Ex. 3391 at p. iii. Presentations at the symposium included one entitled "Runoff Potential from Poultry Manure Applications," which discussed phosphorus runoff from land-applied poultry waste. *See* State's Ex. 3391 at pp. vi & 102-106.

661. In 1990, the second National Poultry Waste Management Symposium (NPWMS) was conducted. *See* State's Ex. 3393. As reported in the proceedings:

> The demand for poultry and poultry products continues to increase rapidly, and is being supplied by very large integrated organizations which are concentrated on relatively small areas of the nation's land mass. The development of these large organizations has resulted in a wealth of sophisticated, uniform, low-cost, highly nutritious poultry products for our nation's consumers; but, the concentration of poultry production and processing has also resulted in the production of huge amounts of by-products including manure, farm mortalities, feathers, processing plant offal, and hatchery wastes which must be managed on a daily basis.

See State's Ex. 3393 at p. 1; *see also* State's Ex. 3393 at p. 20 ("The two primary nutrients in manure which cause pollution problems, nitrogen and phosphorus, have different transport mechanisms. . . . [P]hosphorus is almost exclusively a surface water pollution problem."). Significantly, one of the presentations at the symposium was entitled "How Poultry Waste Management Can Prevent Contamination of Ground and Surface Water," and explained that "the owner of the flock, generally a feed company and/or processor, can exercise control over

---

[105] Dr. John Blake has a Ph.D. in animal science from Virginia Polytechnic and State University. *See* Court's Ex. 1 at p. 1 (Blake Depo.). Dr. Blake is a professor and poultry extension scientist in the Department of Poultry Science at Auburn University. *See* Court's Ex. 1 at p. 1 (Blake Testimony).

individual growers via the contract between the two parties. Contract requirements could be expanded to include environmental concerns." *See* State's Ex. 3393 at pp. 15 & 17.

662. In 1992, the third National Poultry Waste Management Symposium (NPWMS) was conducted. *See* State's Ex. 3395. As reported in the proceedings:

> Chief among the problems facing the poultry industry are those of waste management and associated environmental issues. Practically all of these problems are addressed in-depth by the wide range of speakers and poster presentations scheduled for this Symposium.

See State's Ex. 3395 at p. 1.

663. Many poultry industry representatives, including those of several defendants, have participated and attended this bi-annual symposium to share information about, among other things, the handling, storage and disposition of poultry waste. For instance, in 1988, Defendant Cargill was an acknowledged sponsor and had two representatives listed as in attendance that year. *See* State's Ex. 3391 at pp. iv & 194. Indeed, the Cargill Defendants each admit their employees routinely attend meetings and seminars hosted by NPWMS. *See* State's Ex. 860 at Resp. 8; Daily Trans., 4725:17-23 (Maupin Testimony); Daily Trans., 4926:22; 4927:4 (Alsup Testimony). Likewise, Mr. Rutherford of Defendant Simmons testified to attending several of the symposia beginning in 1990, chaired one of its committees, and made a presentation at the NPWMS in 1992. *See* Daily Trans., 4226:6-12 (Rutherford Testimony); State's Ex. 3395. Employees of the Tyson Defendants have been attendees at one or more NPWMS. *See* State's Ex. 0944 at Resp. 8; State's Ex. 3393; State's Ex. 3395. In fact, an employee of the Tyson Defendants made a presentation at the 1992 symposium entitled "Corporate Management Commitment to Waste and Environmental Management." *See* State's Ex. 3395 at p. 25. In that presentation, the employee stated: "Even though we lack a good environmental 'yard stick,' just about every decision we make on a daily basis whether it involves

growout or processing, requires that we evaluate its impact on the environment." *See* State's Ex. 3395 at p. 25. An employee of Defendant Cal-Maine was identified as having attended the NPWMS in 1996 during which local environmental challenges, new methods of waste management and nutrient management plans were some of the topics presented. *See* State's Ex. 3399 at p. iv; State's Ex. 0893 at Resp. 8. Finally, Mr. Fite testified that he attended the 1998 National Poultry Waste Management Symposium in Springdale, Arkansas, where he observed poultry industry representatives from the Tyson Defendants, the Cargill Defendants and Defendant Simmons in attendance. *See* Daily Trans., 648:8-11; 650:7 (Fite Testimony).

664. Meanwhile, in 1990, the Governor Clinton Animal Waste Management Task Force convened, and in 1993 it issued its final report. *See* State's Ex. 5573. The stated purpose of the Clinton Task Force was to "advance solutions to animal waste disposal problems." *See* State's Ex. 5573 at OSRC00001607. The Tyson Defendants, the Cargill Defendants and Defendant Simmons each had representatives serving on the Clinton Task Force. *See* State's Ex. 5573 at p. OSRC0001617.

665. In fact, Mr. Rutherford of Defendant Simmons was the vice-chair of the task force and chaired the "Problems and Issues Committee," which recognized the environmental degradation and water quality problems presented by animal waste. *See* State's Ex. 5573 at pp. OSRC0001626-1627. In the Clinton Task Force's January 1993 report, a chart was included by the Problems and Issues Committee which identified and listed problems from animal waste as including: (1) "environmental degradation," (2) "water quality (fishable and swimable)," (3) "possible health risks," (4) "body contact (pathogens in surface water)," and (5) "drinking water: increase risk of pathogens, violations of MCLs, increased treatment for palatability." *See* State's Ex. 5573A at p. OSRC0001627.

666. Mr. Rutherford also chaired the "Voluntary Approach Evaluation Committee" of the Clinton Task Force, which prepared a voluntary program for "the prevention of nonpoint source pollution as [it] relates to animal waste" and urged that it should be given a chance to succeed. *See* State's Ex. 5573 at p. OSRC0001610.

667. In 1990, a research project was funded by Southeastern Poultry and Egg Association to support the work of Dr. Dwayne Edwards at the University of Arkansas. *See* Court's Ex. 11 at p. 32 (Edwards Depo.). According to Dr. Edwards, the poultry industry was interested in obtaining data regarding poultry industry impacts on the environment. *See* Court's Ex. 11 at p. 32 (Edwards Depo.). One of the findings made from the study was that "masses of litter constituents transported off the plots via runoff significantly increased with both litter application rate and rainfall intensity." *See* Court's Ex. 11 at p. 10 (Edwards Depo.).

668. The U.S. Poultry and Egg Association (formerly the Southeastern Poultry and Egg Association),[106] headquartered in Decatur, Georgia, is a trade group formed in 1947 by individuals and companies in the poultry industry. *See* Court's Ex. 2 at p. 6 (Dalton Deposition).[107] The U.S. Poultry and Egg Association was a member of the Poultry Water

---

[106] The Tyson Defendants, *see* State's Ex. 0944 at Resp. 9; State's Ex. 0802 at pp. USPEA003202, 3206, 3208 & 3210-11, 3214, the Cargill Defendants, *see* State's Ex. 0862 at Resp. 9; State's Ex. 0802 at pp. USPEA003180, 3182 & 3184, the George's Defendants, *see* State's Ex. 0883 at Resp. 9; State's Ex. 0802, pp. USPEA003191, 3193, 3195; Defendant Simmons, *see* State's Ex. 0802 at pp. USPEA003226, 3228, 3230 & 3259, Defendant Peterson, *see* State's Ex. 0909 at Resp. 9; State's Ex. 0802 at pp. USPEA003186, 3188, 3200-01 & 3204-05; and Defendant Cal-Maine, *see* State's Ex. 0893 at Resp. 9; State's Ex. 0802 at pp. USPEA003235, 3237, 3239, 3241 & 3259 have all, at various times, been members of the U.S. Poultry and Egg Association and / or the Southeastern Poultry and Egg Association.

[107] Mr. Don Dalton served as chairman and on the board of directors of the U.S. Poultry and Egg Association during the late 1970s. *See* Court's Ex. 2 at p. 11 (Dalton Depo.). Additionally, Mr. Dalton was employed by the U.S. Poultry and Egg Association from 1989 to 1992 as vice president of exposition and was charged with running its annual trade show. *See* Court's Ex. 2 at pp. 11-12 (Dalton Depo.). Mr. Dalton served as president of the U.S. Poultry and Egg Association from 1992 to 2007. *See* Court's Ex. 2 at pp. 12-13 (Dalton Depo.).

Quality Consortium together with the Soil Conservation Service (later known as the Natural Resource Conservation Service), the Tennessee Valley Authority, and the Environmental Protection Agency. *See* Court's Ex. 2 at pp. 23 & 27 (Dalton Depo.). The Poultry Water Quality Consortium was formed in about 1992. *See* Court's Ex. 2 at p. 23 (Dalton Depo.). The purpose of the Poultry Water Quality Consortium was to collect information on the current state of knowledge of poultry water quality and to disseminate that information. *See* Court's Ex. 2 at pp. 23-27 (Dalton Depo.). The work of the Poultry Water Quality Consortium resulted in the publication of the Poultry Water Quality Handbook in 1994. *See* Court's Ex. 2 at p. 28 (Dalton Depo.); State's Ex. 800. The Poultry Water Quality Handbook reported, among other things, that the manner in which poultry waste is disposed of has a direct influence on surface and groundwater, *see* State's Ex. 800 at p. Pigeon 0498; that poultry waste contains significant amounts of phosphorus and when used improperly the phosphorus can contribute to water quality problems, *see* State's Ex. 800 at pp. Pigeon 0514-0515; and that "[w]hen nitrogen and phosphorus concentrations in waterbodies rise too high, algae and rooted aquatic plants take over, prematurely aging and choking the waterbody and creating undesirable conditions. . . [and that] these eutrophic conditions can kill fish, clog water treatment plant filters, and lead to the growth of blue-green algae, a species that can be fatal to livestock." *See* State's Ex. 800 at p. Pigeon 0508.

669. The Poultry Water Quality Handbook was widely distributed by the Water Quality Consortium, including at the U.S. Poultry and Egg Association's annual trade show. *See* Court's Ex. 2 at pp. 36-37, 40-42 (Dalton Depo.). For instance, it was acquired by Mr. Pigeon at a conference he attended as a field man for Defendant Peterson. *See* Daily Trans., 3825:7-3838:7 (Pigeon Testimony).

670. A second edition of the Poultry Water Quality Handbook was published in 1998. *See* State's Ex. 801. It reported, among other things, that how poultry waste is disposed of "will directly influence the cleanliness and safety of surface and groundwater," that when too much poultry waste is applied to the land it can move with the soil into surface water or through soil into groundwater impairing water quality, that "[p]hosphorus has become a major cause of water quality degradation," that applying poultry waste at rates based on nitrogen needs can lead to phosphorus buildup in the soil, that "[p]hosphorus-laden soils or dissolved phosphorus can move via runoff into rivers, lakes, and streams, where it causes excessive plant and algae growth, which in turn depletes the dissolved oxygen content in the water," and that "[t]he potential for adverse environmental impacts appears greater as a result of the industry's trend to grow ever larger numbers of birds on smaller areas of land." *See* State's Ex. 801 at CARTP220108, CART220119 & CARTP2220132-0134.

671. The second edition of the Poultry Water Quality Handbook was provided by Defendant Peterson to its field men (service techs) and distributed to its growers. *See* Daily Trans., 3825:7-3828:7 (Pigeon Testimony). The second edition of the Poultry Water Quality Handbook was also produced by the Cargill Defendants from their files. *See* State's Ex. 801.

672. In 1997, the Governor Keating Animal Waste and Water Quality Protection Task Force convened, and presented its final report after conducting its study of animal waste handling, storage and disposition practices in Oklahoma. *See* DJX 2757. According to Mr. Hilsher, a member of the Keating Task Force, its purpose, as it related to the poultry industry, was in part to focus on the parameters of how the industry is dealing with land application of litter and the concern that poultry litter was a primary cause for degradation of water. *See* Daily Trans., 588:17-589:4 (Hilsher Testimony). Representatives of the Tyson Defendants and

Defendant Simmons were present at Keating Task Force meetings. *See* Daily Trans., 651:16-25 (Fite Testimony); Daily Trans., 601:10-15 (Hilsher Testimony).

673. Mr. Fite testified that he has had conversations with representatives of various Defendants to this action about the practices of poultry waste application and its effect on water quality in the IRW. *See* Daily Trans., 740:18-741:8 (Fite Testimony). Mr. Fite testified that he has spoken to representatives of the Tyson Defendants and Defendant Simmons regarding moving poultry waste out of the IRW and suggesting that they add a ½ to 1 cent charge per bird to fund movement of the waste. *See* Daily Trans., 742:19-743:7 (Fite Testimony); *see also* Daily Trans., 744:4-745:3; 745:20-746:4; 746:10-747:10 (Fite Testimony).

674. In 1998, the Oklahoma Legislature enacted the Oklahoma Registered Poultry Feeding Operations Act. *See* 2 Okla. Stat. § 10-9.1, *et seq.*

675. In 2001, the City of Tulsa sued a number of the defendants to this lawsuit alleging that those defendants' poultry waste management practices were polluting the City's water supply in the adjoining watershed. *See City of Tulsa v. Tyson Foods, Inc.*, Case No. 01-CV-0900-B(C), N.D. Okla.

B. Investigations by Defendants

676. Despite the fact that there has been an on-going concern with phosphorus pollution from poultry waste in the IRW, *see, supra,* FOF, ¶ 441-448, Defendants have made no effort to investigate whether land-applied poultry waste in the IRW is causing pollution.

1. The Tyson Defendants

677. Dr. Pilkington testified that:

Mr. Bullock: Mr. Pilkington, has poultry waste run off - - poultry waste from Tyson chickens run off in the IRW?
* * *
Dr. Pilkington: By "poultry waste," do you mean poultry litter?

Mr. Bullock: The components of poultry litter.
Dr. Pilkington: Whether they have - -
Mr. Bullock: Run off into the water.
Dr. Pilkington: I don't know. I don't know.
Mr. Bullock: Okay. Have you done anything to find out?
Dr. Pilkington: No, I have not.
Mr. Bullock: Are you aware of whether Tyson has done anything to determine that?
Dr. Pilkington: I'm not aware.

See Daily Trans., 3409:12-3410:5 (Pilkington Testimony); *see also* Daily Trans., 3329:11-15; 3353:14-19 (Keller Testimony); Daily Trans., 4626:16-21 (Patrick Testimony).[108]

2. The Cargill Defendants

678. Mr. Maupin testified that:

Mr. Garren: Does Cargill or CTP, L.L.C. know if poultry waste generated by its birds in the IRW that has been land-applied is contributing to the water quality problems in the IRW?
Mr. Maupin: I don't know of any case that that's happened.
Mr. Garren: Generally speaking, do you know whether it's occurring?
Mr. Maupin: No.
Mr. Garren: What have you done to find out if it is occurring or to -- well, just let me ask you that. What has Cargill done to determine if it is occurring?
Mr. Maupin: We haven't undertaken scientific research studies on that matter. Those are handled by state and federal agencies. They're experts, we rely on their judgment.
Mr. Garren: So I take that to mean that Cargill has not done anything independently to determine whether or not the waste generated by its birds is contributing to the water quality problems in the IRW; correct?
Mr. Maupin: Yes.

See Daily Trans., 4734:14-4735:10 (Maupin Testimony); *see also* Daily Trans., 4722:16-19 (Maupin Testimony); Daily Trans., 4884:15-23 (Alsup Testimony).

3. The George's Defendants

---

[108] Mr. Steven Patrick has been employed by Defendant Tyson Foods for six and a half years, and has served as that company's operations director for environmental health and safety for three years. *See* Daily Trans., 4617:6-21, 4618:14-21 (Patrick Testimony). He is responsible for the environmental and safety programs of the food service division, renewable products division, and refrigerated and deli business units. *See* Daily Trans., 4617:23-4618:2 (Patrick Testimony).

679. Mr. McClure testified that:

Mr. Bullock: Has George's ever attempted to determine if poultry waste or the constituents of poultry litter are running off of farms and getting into the waters of the IRW?
Mr. McClure: We -- George's has never taken on those as a research project. We're not a scientific group. We try to handle those matters in a more practical way.
Mr. Bullock: So that the record is clear, you're not denying here that constituents of poultry litter from George's birds is, in fact, getting into the waters of the IRW?
Mr. McClure: I don't know that they are getting into the rivers of the IRW. We don't know that. So we would deny that they are.

See Daily Trans., 4308:3-14 (McClure Testimony).

4. Defendant Simmons

680. Mr. Simmons testified that:

Mr. Bullock: The constituents of waste from your chickens, it does, in fact, get into the waters of the IRW, doesn't it?
Mr. Simmons: I don't know that. I don't -- I don't think it does. I think our Nutrient Management Plans are designed so that it will not do that.
Mr. Bullock: Have you ever investigated that?
Mr. Simmons: Not specifically.
Mr. Bullock: Well, have you ever investigated that generally?
Mr. Simmons: No, sir.
Mr. Bullock: Have you ever investigated whether the constituents of waste from your chickens infiltrates into the waters of the IRW in light of the karst geology that we spoke of earlier?
Mr. Simmons: I have not investigated that.

See Daily Trans, 4146:12-4147:2 (Simmons Testimony); *see also* Daily Trans., 4288:23-4289:5; 4294:24-4296:5 (Murphy Testimony).

5. Defendant Peterson

681. Mr. Houtchens testified that:

Mr. Riggs: Has Peterson ever done anything to find out if any of the constituents from the waste generated by Peterson's chickens have contaminated the waters of the IRW?
* * *

Mr. Houtchens: No, we haven't, because we believe that the proper utilization and management of a grower's litter through his state-approved litter management, Nutrient Management Plans would negate or -- would keep that from happening, that pollution.
Mr. Riggs: You're so confident that that's a perfect system, you don't ever do anything to find out whether it's working or not, right?
* * *
Mr. Houtchens: In the course of our normal business at Peterson Farms, our expertise is not in soil science or --
Mr. Riggs: So, sir, is your answer, no, we've never done anything to find that out?
Mr. Houtchens: My answer is that we still rely on our state --

See Daily Trans., 4839:5-25 (Houtchens Testimony).

6. Defendant Cal-Maine

682. Mr. Storm testified that:

Mr. Riggs: Has Cal-Maine ever tried to determine whether or not any of the poultry waste it was land-applying ran off from the field it was applied to?
Mr. Storm: Not that I'm aware of.

See Daily Trans., 4453:4-7 (Storm Testimony); *see also* Daily Trans., 4453:8-10; 4454:8-12; 4456:23-4457:6; 4457:13-18 (Storm Testimony).

C. Summary

683. Based upon the foregoing factual findings, the Court finds that each Defendant has known that injuries to the waters of the IRW were and continue to be substantially certain to result from the land application of poultry waste in the IRW.

684. Based upon the foregoing factual findings, the Court finds that each Defendant has known that injuries to the waters of the IRW were and are resulting from the land application of poultry waste in the IRW.

685. Based upon the foregoing factual findings, the Court finds that each Defendant has failed to investigate the environmental consequences of the land application of poultry waste in the IRW.

XVIII. Other Possible Contributors to Phosphorus Loading to the Waters of the IRW

686. A number of other possible contributors to phosphorus loading to the waters of the IRW have been identified over the course of the trial. Each will be briefly reviewed.

A. Waste Water Treatment Plants

687. As shown above, *see* FOF, ¶ 268, it is undisputed in the record that all point sources in the IRW account for less than 20 percent of the phosphorus load reaching Lake Tenkiller. *See* Daily Trans., 8922:8-20, 9141:15-9142:8 (Connolly Testimony); Daily Trans., 10907:23- 10908:1 (Sullivan Testimony). Similarly, USGS has found that the vast majority of the phosphorus loading to the Illinois River and its tributaries comes from nonpoint -- as opposed to point -- sources. *See* State's Ex. 5862 at 11 ("Runoff components" account for: 68 to 84 percent of the annual phosphorus loading to Flint Creek; 75 to 88 percent of the annual phosphorus loading to the Illinois River; and 91 to 96 percent of the annual phosphorus loading to Baron Fork). At trial, Defendants offered no evidence contrary to the findings of USGS.

B. Urban Runoff

688. Urban areas make up approximately six percent of the IRW. *See* State's Ex. 3351 at OSU0005156. Defendants concede that urban land use accounts for "[a]bout seven percent" of the overall land use in the IRW. *See* Daily Trans., 10927:23-10928:8 (Sullivan Testimony).

689. As part of his mass balance analysis, Dr. Engel found that urban runoff amounts to approximately 0.5 percent of the phosphorus loading in the IRW. *See* FOF, ¶ 270; *see also* Daily Trans., 6202:21-6203:18 (Engel Testimony); State's Ex 1154. Dr. Engel's urban runoff calculation is based upon an estimate of the amount of phosphorus actually running off from urban landscapes within the IRW. *See* Daily Trans., 6622:9-6623:21 (Engel Testimony); *see also* Daily Trans., 6657:7-14 (Engel Testimony) (testifying that because the phosphorus runoff

from pastures per unit area is greater than the phosphorus runoff from urban areas in the IRW, covering pastures with parking lots would actually decrease the amount of phosphorus entering streams). Defendants have provided no calculation contrary to Dr. Engel's urban runoff calculation.

C. Commercial Fertilizers

690. Based upon commercial fertilizer sales data by county that was allocated to the IRW, *see* Daily Trans., 5844:14-23 (Engel Testimony), Dr. Engel calculated that phosphorus contributions to the IRW from commercial fertilizer were 7.3 percent of all phosphorus contributions. *See* Daily Trans., 6194:13-25 (Engel Testimony).

691. Application of commercial fertilizer is not regulated in Oklahoma, but is regulated in Arkansas. *See* Daily Trans., 1445:24-1446:7 (Phillips Testimony); Daily Trans., 518:12-16 (Tolbert Testimony). Significantly, in Arkansas the protective application rate for phosphorus in commercial fertilizer where the STP level is below 50 lbs./acre is 80 lbs./acre, where the STP level is between 50 and 100 lbs./acre is 40 lbs./acre, and where the STP is above 100 lbs./acre is no application. *See* 5018:1-10 (Johnson Testimony).

D. Cattle

692. Defendants have contended that there is a symbiotic relationship between growing poultry and raising cattle. *See, e.g.*, Daily Trans., 10460:2-3 (Clay Testimony). Specifically, Defendants contend that certain growers enter the poultry growing business in order to secure a ready supply of poultry waste that can be land applied to the growers' fields, thereby enabling the growers to raise more cattle on these fields. *See, e.g.*, Daily Trans., 198:16-23 (George's Opening) ("The evidence in this case, Your Honor, will show, I think, that cattle and chickens have gone together like hand and glove since the origins of poultry operations in this area. The

first chicken growers were actually cattle farmers. The cattle farmers wanted chickens for a couple reasons. Chickens provided a cash crop and chickens provided poultry litter."); Daily Trans., 223:22-224:3 (Peterson Opening) ("By purchasing the poultry farm, in addition to obviously the income from raising the chickens, [Peterson grower Al Saunders] could afford to fertilize and improve these pastures, improve his stocking rates, improve his cow farm, and finally fulfill his dream of making enough money to quit his job in town and stay and make a living on the farm.").

693. Unfenced cattle have access to the rivers and streams of the IRW. *See, e.g.,* Daily Trans., 801:19-802:2, 804:25-805:15 (Fite Testimony). It is well known that such cattle sometimes defecate directly into such waters. *See, e.g.,* Daily Trans., 6605:14-17 (Engel Testimony); Daily Trans., 10472:25-10473:13 (Dicks Testimony).[109] As explained above, it is uncontested that cattle are principally recyclers of pre-existing phosphorus in the IRW -- phosphorus that originates overwhelmingly from poultry waste. *See* FOF, ¶¶ 464-470. Thus, cattle are an entirely foreseeable means for the fate and transport of the phosphorus contained in land-applied poultry waste generated by Defendants' birds.

---

[109] Dr. Michael Dicks received a Ph.D. in agricultural economics from the University of Missouri. *See* Daily Trans., 10440:21-25 (Dicks Testimony). Dr. Dicks has been a professor in the area of agricultural policy and land use at Oklahoma State University since 1989 where he holds the Lou and Wes Watkins Endowed Chair of International Trade and Development and co-founded the Great Plains Agricultural Policy Center in 1990. *See* Daily Trans., 10441:15-10442:3, 10443:7-17 (Dicks Testimony). From 1984-1989 he was employed by the USDA Economic Research Service as a natural resource policy analyst. *See* Daily Trans., 10443:21-10444:7 (Dicks Testimony). He advised Congress on farm bills in 1981, 1985, 1990, 1996, 2002, 2008 and has provided oral and written testimony before Congress. *See* Daily Trans., 10444:21-10445:20 (Dicks Testimony). He helped develop the CREP program and several economic models including IMPLAN and POLYSIS. *See* Daily Trans., 10445:21-10446:16, 10447:4-23, 10448:16-23 (Dicks Testimony). He has published over 100 peer-reviewed articles. *See* Daily Trans., 10448:24-10449:8 (Dicks Testimony).

694. Yet further, cattle often "loaf" in riparian areas. *See* Daily Trans., 9861:3 – 9863:1 (Clay Testimony) ("[A loafing area is] a place where [cattle] spend their time lounging. . . . The loafing area tends to be, as I said, close to where water is."). Even when cattle do not directly defecate in the rivers and streams of the IRW, cattle are here again acting as an entirely foreseeable means facilitating the fate and transport of the phosphorus contained in land-applied poultry waste generated by Defendants' birds. This is because cattle trample and compact riparian areas, thereby increasing the risk and likelihood of runoff occurring -- including the runoff of poultry waste. *See* Daily Trans., 9881:10-21 (Clay Testimony); Daily Trans., 10526:8-17 (Dicks Testimony); Daily Trans., 10877:16-23; 10875:14-20 (Sullivan Testimony); *see also* Daily Trans., 523:20-25 (Tolbert Testimony) (discussing overgrazing). In fact, Defendants' expert Dr. Sullivan admits that this phenomenon of cattle creating "compaction" is foreseeable. *See* Daily Trans., 10875:14-25; 10877:16-23 (Sullivan Testimony) ("Mr. Bullock: Okay. You posit that there may be some infiltration, but absolutely there's added compaction which facilitates overland flow? Dr. Sullivan: The added compaction increases the risk of overland flow…if the storm is large enough. . . . Mr. Bullock: Okay. Now, the channelization, the reduction in vegetation, and the compaction, Doctor, those are all well-understood phenomena, are they not? Dr. Sullivan: That's my understanding, yes. Mr. Bullock: Okay. And, in fact, in terms of nutrient usage on pastures, those are foreseeable risks, are they not? Dr. Sullivan: I would think so.").

E. Streambank Erosion

695. Defendants' retained expert Mr. Grip opined as to streambank erosion in the IRW. Specifically, Mr. Grip, using aerial photography, documented the channel shifts in the Illinois River over the past 30-40 years. *See* Daily Trans., 10007:11-22 (Grip Testimony). Mr. Grip,

using photogrammetry, further calculated that from 1972 to 2008 -- a 36-year period -- approximately 15,500,000 cubic yards of streambank had eroded from the streambanks of the Oklahoma portion of the Illinois River. *See* Daily Trans., 10081:18-23; 10091:18-25 (Grip Testimony).

696. Rivers, including the Illinois River, are, of course, dynamic geological systems that naturally shift channel courses over time. *See* Daily Trans., 10045:23-10046:3; 10095:6-13 (Grip Testimony). Neither Mr. Grip nor any of the other expert witnesses called by Defendants (a) quantified what amount of channel shifts in the Illinois River had been caused by these natural causes as opposed to anthropogenic causes, *see, e.g.*, Daily Trans., 10096:1-9 (Grip Testimony), (b) determined what the course of the Illinois River channel would have been absent any anthropogenic causes, *see, e.g.*, Daily Trans., 10096:16-25 (Grip Testimony), or (c) determined how the amount of streambank erosion on the Illinois River compares with amounts of streambank erosion on other comparable Ozark streams. *See, e.g.*, Daily Trans., 10097:17-22 (Grip Testimony).

697. Moreover, and significantly, neither Mr. Grip nor any of the other experts called by Defendants (a) determined the phosphorus content of the soils comprising the streambank area Mr. Grip calculated to have been eroded, (b) determined whether the soils comprising the streambank area that Mr. Grip calculated to have eroded contained merely background amounts of phosphorus or soils that have been contaminated with elevated levels of phosphorus, or (c) analyzed or calculated the amount of phosphorus being contributed to the Illinois River by streambank erosion. *See, e.g.*, Daily Trans., 10096:23-10097:20 (Grip Testimony). As explained by Dr. Engel, "[phosphorus in erosion is] not considered a separate source. Because the phosphorus that's in erosion originated from a source, whether it be commercial fertilizer,

poultry, or background phosphorus. . . . I mean, the phosphorus just doesn't exist in the erosion from nowhere. . . . [I]t has to originate someplace." *See* Daily Trans., 6664:16-6665:5 (Engel Testimony). Thus, streambank erosion is more appropriately viewed as a fate and transport process for phosphorus, not a source of phosphorus.

F. Roads

698. As one might expect, there are a number of dirt roads within the IRW. Defendants estimate that there are approximately 2,600 miles of unpaved roads within the IRW. *See* Daily Trans., 10708:14-16 (Sullivan Testimony).

699. Dr. Engel considered dirt roads and found them to be unimportant in his phosphorus source analysis. Specifically, Dr. Engel determined that: (a) dirt roads are not an independent source of phosphorus beyond background; (b) the amount of any phosphorus running off from dirt roads would be small; and (c) if there is any phosphorus beyond natural background on the dirt roads in the IRW, one of the sources of that phosphorus would be poultry waste. *See* Daily Trans., 6628:22-6629:19 (Engel Testimony). Indeed, on cross-examination, Dr. Sullivan conceded the possibility that poultry waste from spreader trucks could wind up on dirt roads within the IRW. *See* Daily Trans., 10913:8-19 (Sullivan Testimony).

G. Septic

700. Septic systems are more common in rural areas. *See* Daily Trans., 2460:5-6 (Fisher Testimony). About 73,000 persons in the IRW are on septic systems. *See* Daily Trans., 6532:4-11 (Engel Testimony); 10709:6-12; 10710:19-24 (Sullivan Testimony) . On average, the amount of phosphorus contributed to a septic system by an individual is approximately 1.1 lb./yr. *See* Daily Trans., 6594:5-14 (Engel Testimony).

701. Dr. Engel conducted an analysis of sub-watersheds within the IRW with cross-correlations between septic systems and poultry operations and found that "there was far more phosphorus being exported from those watersheds in a fewer number of events that can be explained by septics." *See* Daily Trans., 6663:24-6664:15 (Engel Testimony). Likewise, Defendants' expert, Dr. Sullivan, conceded that -- even assuming arguendo that all septic systems in the IRW were to discharge directly into streams -- the total amount of phosphorus contributed by septic would be approximately the equivalent of just 16 poultry houses (in a watershed with approximately 1,800 active poultry houses). *See* Daily Trans., 10906:12-10907:14 (Sullivan Testimony).

702. In any event, septic systems do not discharge directly into streams. Indeed, septic systems tend to have more of an impact on groundwater than surface water. *See* Daily Trans., 6533:2-11 (Engel Testimony); Daily Trans., 6664:5-11 (Engel Testimony) ("[B]ased on again my experience with septic systems, the way that they put phosphorus into the environment, it's applied underground, and so it provides numerous opportunities for that phosphorus to be absorbed to soil. So it would not behave as a surface-based, nonpoint-source pollution so it wouldn't run off the surface.").

703. If it is not malfunctioning or improperly located, then a septic system is not likely to be contributing much, if any, phosphorus to surface waters. *See* Daily Trans., 10711:22-24 (Sullivan Testimony). There has been no actual sampling or quantification of the extent to which septic systems in the IRW are either performing or failing. *See* Daily Trans., 1521:25-1522:4 (Phillips Testimony).

704. Defendants did not independently study phosphorus contributions from septic systems in the IRW. *See, e.g.*, Daily Trans., 9154:24-9155:5 (Connolly Testimony); Daily

Trans., 9755:20-24 (Larson Testimony);[110] Daily Trans., 10712:20-10713:20 (Sullivan Testimony).

H. Nurseries

705. There are three large nursery operations in the IRW. *See* Daily Trans., 834:1-4 (Fite Testimony). Nurseries are not a significant contributor of phosphorus to the IRW. *See* Daily Trans., 6203:12-18 (Engel Testimony) (Dr. Engel placed nurseries into the "other sources" category of his mass balance analysis -- meaning that nurseries account for less than 0.2 percent of the phosphorus loading in the IRW).

706. In any event, steps have been taken to address any phosphorus that may run off from nurseries in the IRW. A voluntary sampling and reporting regime for these nurseries was instituted in the 1980's. *See* Daily Trans., 789:11-16; 835:5-9 (Fite Testimony). Further, these nurseries have voluntarily agreed to reduce their phosphorus discharges to 1.0 mg/L. *See* Daily Trans., 519:2-8 (Tolbert Testimony); Daily Trans., 3536:23-3537:6 (Strong Testimony). At least one nursery has gone to a total retention system for its irrigation waters. *See* Daily Trans., 788:23-789:5 (Fite Testimony). Yet further, these nurseries have switched from fertilizing through overhead irrigation systems to the placement of slow-release fertilizer in the pots. *See* Daily Trans., 789:6-10 (Fite Testimony).

I. Golf Courses

---

[110] Mr. Stephen P. Larson holds a masters degree in civil engineering from the University of Minnesota. *See* Daily Trans., 9678:18-25 (Larson Testimony). Mr. Larson is the vice president of S.S. Papadopulos & Associates where he has been a hydrologist specializing in groundwater, water resources issues, and soil and groundwater contamination since 1979. *See* Daily Trans., 9677:17-9678:13 (Larson Testimony). He is certified by the American Institute of Hydrology and is a member of the Association of Groundwater Scientists and Engineers. *See* Daily Trans., 9683:8-23 (Larson Testimony). Mr. Larson testified as an retained experts for Defendants.

707. There is no clear testimony as to the number of golf courses within the IRW, but it appears that there are only one or two. *See* Daily Trans., 518:23-519:1 (Tolbert Testimony); Daily Trans., 833:12-25 (Fite Testimony); Daily Trans., 9651:7-12 (Duncan Testimony).[111] Golf courses are not a significant contributor of phosphorus to the IRW. *See* Daily Trans., 6203:12-18 (Engel Testimony) (Dr. Engel placed golf courses into the "other sources" category of his mass balance analysis -- meaning that golf courses account for less than 0.2 percent of the phosphorus loading in the IRW).

J. Gravel Mining

708. The State has adopted rules to regulate gravel mining in scenic rivers. *See* Daily Trans., 3538:18-21 (Strong Testimony); Daily Trans., 940:21-24 (Fite Testimony); *see also* Daily Trans., 942:2-3 (testifying that OSRC has brought actions against persons within its jurisdiction for violating graveling rules). There are no longer any gravel mining operations on rivers and streams in the IRW within the jurisdiction of the OSRC. *See* Daily Trans., 790:14-19 (Fite Testimony). There is one gravel mining operation on rivers and streams in the IRW outside the jurisdiction of the OSRC -- one on the Baron Fork at Baron, Oklahoma. *See* Daily Trans., 790:20-791:4; 791:11-20 (Fite Testimony); *see also* Daily Trans., 941:8-12 (Fite Testimony) ("There is a very limited permit. I don't know what the modifications have been since the court case, but Jock Worley['s] operation to the east of the Barren, Oklahoma area is still located there, and he can remove a certain amount of gravel per year on an annual basis."); Daily Trans.,

---

[111] Mr. Ronald Duncan has been a counselor at Central Junior High School in Springdale, Arkansas for 26 year where he started the Hooked on Fishing Not on Drugs organization in 1982. *See* Daily Trans., 9614:19-9616:6 (Duncan Testimony). He was appointed in 2008 to the Arkansas Game and Fish Commission. *See* Daily Trans., 9616:14-17 (Duncan Testimony). He was named to the Arkansas Outdoor Hall of Fame in 2004. *See* Daily Trans., 9617:8-9 (Duncan Testimony).

970:19-24 (Fite Testimony) (testifying that there is an ongoing civil action to enjoin Mr. Worley's graveling operation).

709. Based upon his review of prior work, reports and literature regarding the IRW, Dr. Engel saw fit to exclude gravel mining -- as a source of phosphorus loading -- from his modeling analysis. *See* Daily Trans., 6564:11-20 (Engel Testimony).

K. Human Recreational Activities

710. As discussed above, significant recreational activities occur in the IRW. *See* FOF, ¶¶ 90-96 .

711. When Mr. Fite became administrator at the OSRC in 1983, there were only a few restroom facilities along the Illinois River for recreators to use, and as a result many recreators relieved themselves within the waters and on the banks of the Illinois River. *See* Daily Trans., 921:16-922:15 (Fite Testimony).

712. In 1988, two of these restroom facilities were replaced. *See* Daily Trans., 924:19-925:1 (Fite Testimony). Furthermore, in 1991, OCC funded the construction of 10 new restroom facilities at public access points along the river. *See* Daily Trans., 923:5-8 (Fite Testimony). Those facilities came online in 1994, and since then two additional facilities have come online. *See* Daily Trans., 923:21-25 (Fite Testimony). Additionally, the OSRC has placed 17 portable toilets at various locations along the River. *See* Daily Trans., 925:13-926:19 (Fite Testimony).

713. In addition to these restroom facilities provided by the OSRC, there are restroom facilities at the sites of commercial flotation device operators. *See* Daily Trans., 926:9-16 (Fite Testimony).

714. Defendants appear to be suggesting that the amount of waste removed from these restroom facilities is equivalent to the amount of human waste that was historically directly

deposited into the Illinois River environment prior to the construction of these restroom facilities. *See* Daily Trans., 930:2-15 (Fite Testimony). Defendants' suggestion, however, cannot be credited for multiple reasons, including that it fails to take into account, for example, disinfecting and smell abatement liquids that are included in the waste removal figures, *see, e.g.*, Daily Trans., 949:1-4; 949:10-20 (Fite Testimony), and that it does not follow that all recreators will necessarily relieve themselves in the environment in the absence of a restroom facility.

L. State Conduct

715. There is scant evidence in the record that the State has contributed to phosphorus loading to the waters of the State in the Oklahoma portion of the IRW. In fact, the issue came up only twice at trial. The first occasion was in testimony by Mr. Fite wherein he testified to having applied a single pickup load to four contained flower beds at the OSRC office. *See* Daily Trans., 736:3-737:3 (Fite Testimony). The second occasion was on Defendants' cross-examination of the state's recreational use expert, Dr. Caneday. Dr. Caneday testified that he was aware that there had been sewage overflows from Tenkiller State Park's waste management system that had occurred during flooding events in the early- to mid-1990s, that the sewage overflows "would potentially have had" a direct pathway to Lake Tenkiller, and that the ODEQ had ordered that Tenkiller State Park overhaul its waste management system. *See* Daily Trans., 4394:13-4401:16 (Caneday Testimony).

716. There has been no evidence demonstrating that either of these situations has had any impact on phosphorus loading to the waters of the State in the Oklahoma portion of the IRW, and thus the Court finds that the State has not contributed to the phosphorus loading of the waters of the IRW.

M. Summary

717. Defendants have criticized the State for not adequately considering other potential sources of phosphorus as part of its investigation. But the Court is satisfied that the State's experts were careful in evaluating other sources and putting each source in proper perspective. In this regard, it is noteworthy that the State and Defendants agree that wastewater treatment plant discharges actually account for less than 20 percent of the phosphorus load reaching Lake Tenkiller.

718. While there are a number of potential and actual sources of phosphorus in the IRW, many of these sources are clearly insignificant. In any event, the mere existence of other sources of phosphorus in the IRW in no way negates or minimizes the significance of poultry waste as a source of phosphorus contamination.

719. Based upon the foregoing factual findings, the Court finds that each of these other potential sources of phosphorus loading to the IRW, either standing alone or taken together and to the exclusion of land-applied poultry waste, are not responsible for the entirety of the injuries to the waters of the State.

XIX. Efforts by the State to Address Phosphorus Loading in the IRW

720. The State has taken numerous steps, individually and with Arkansas, to address phosphorus loading in the IRW. For example, in 1997, at the request of the State, the Compact Commission adopted a nutrient-reduction goal of reducing the annual loading of phosphorus in the IRW by 40 percent. *See* Daily Trans., 9467:1-25 (Smith Testimony).

721. In the late 1990s, Governor Keating's Animal Waste Task Force, which included poultry growers and representatives of the poultry industry, began investigating the relationship between poultry waste and water quality. *See* Daily Trans., 2891:25-2892:8; 2893:17-2894:5 (Gunter Testimony). As a result of the findings of the task force, the State legislature passed the

ORPFOA in 1998. *See* Daily Trans., 2895:19-2896:9 (Gunter Testimony). The ORPFOA requires poultry operations to register with ODAFF and to have animal waste management plans, and prohibits the discharge or runoff of poultry waste from the land application sites. *See* Daily Trans., 2989:13-18; 2900:11-2901:11 (Gunter Testimony); 2 Okla. Stat. § 10-9.7.

722. In 2003, Arkansas and the State signed a "Statement of Joint Principles and Actions," in which both states agreed, among other things, to coordinate water quality monitoring efforts and to work on a comprehensive watershed management plan. *See* State's Ex. 5666 at attachment C. Arkansas also agreed to work with its dischargers to lower phosphorus discharges. *See* State's Ex. 5666 at attachment C. However, missing from this agreement was a commitment from poultry integrators to remove excess poultry litter from farms operating in the watershed. *See* State's Ex. 5666 at attachment C. "While Oklahoma endeavored to secure this commitment, the integrator companies failed to a deliver a commitment comparable to that which was made by the major dischargers in the watershed." *See* State's Ex. 5666 at p. 2.

723. In addition, ODEQ has worked to reduce phosphorus discharges from Oklahoma wastewater treatment plants, reducing limits for phosphorus in new permits and assisting with improvements to plants. *See* State's Ex. 5664 at p. 5; State's Ex. 5665 at p. 5. ODEQ also investigated complaints and took enforcement actions against several gravel mining operations in the IRW. *See* State's Ex. 5664 at p. 6; State's Ex. 5665 at p. 5.

724. The State has also participated in the USDA's Comprehensive Reserve Enhancement Program (CREP) and the EPA's § 319 program to address phosphorus issues in the IRW. *See* Daily Trans., 976:16-977: 3; 1299:22-1302:2 (Phillips Testimony). These programs include various projects to prevent nonpoint source contributions of phosphorus to IRW waters, including projects involving riparian buffers, riparian exclusion of cattle, pasture management

and planting to prevent overgrazing, septic system upgrades to replace inadequate septic systems, and programs for hauling litter out of the IRW. *See* Daily Trans., 1351:3-15; 1357:10-23; 1361:22-1362:20; 1362:21- 1363:2; 1368:20-25; 1370:13-25 (Phillips Testimony).

XX. Fixing the Problem

725. Broadly speaking, the State is seeking an injunction making Defendants responsible for waste generated by their birds and precluding the land application of poultry waste in the IRW at rates greater than the agronomic rate. *See* Daily Trans., 540:13-15 (Tolbert Testimony); Daily Trans., 3640:1-8 (Strong Testimony). Further, the State is seeking an injunction requiring remediation of the IRW. Yet further, the State is seeking an injunction requiring Defendants, at their expense, to undertake an investigation of remedial actions (*e.g.*, buffer strips, drinking water wells, public water supplies, bank stabilization, man-made wetlands, and aeration of Lake Tenkiller) to address the effects of the land application of poultry waste in the IRW, and to pay for the costs of implementing those remedial actions that the investigation determines are appropriate. Additionally, the State is seeking the monitoring of Defendants' compliance with the terms of an injunction to be entered by the Court.

726. The standard approach to solving pollution problems in Oklahoma is to order a Defendant to investigate the extent of the problem and propose remedies to be reviewed for the remediation plan. *See* Daily Trans., 311:9-25 (Tolbert Testimony). It is common practice in dealing with environmental pollution problems to adopt an adaptive management approach. *See* Daily Trans., 7989:15-7990:11 (King Testimony).[112] "[A]daptive management means

[112] Mr. Todd King is a principal engineer with CDM where he has worked from 1990-1993 and 1996 to date. *See* Daily Trans., 7984:25-7985:9 (King Testimony). Mr. King holds a B.S. in chemical engineering in 1985 and an M.S. in engineering and environmental engineering in 2000 from the University of Michigan. *See* Daily Trans., 7983:19-7984:3 (King Testimony). He is a licensed professional engineer in Michigan and is a board certified

continuing to develop hypotheses [to address the pollution] and test those hypotheses and improve the remediation as you go forward." *See* Daily Trans., 7990:9-11 (King Testimony). Further, "monitoring is a key component of any remedial operation." *See* Daily Trans., 8120:11-12 (King Testimony).

727. The State retained Mr. King to undertake a preliminary investigation of remedial options raised by the issues in this case. *See* Daily Trans., 7990:12-7991:7 (King Testimony) ("The scope of my assignment was to develop kind of a preliminary engineering assessment or preliminary feasability study . . . ."). As Mr. King explained, his work was "a[n] identification and evaluation of remedial alternatives as it relates to poultry waste application in the Illinois River Watershed." *See* Daily Trans., 8125:12-16 (King Testimony).

728. Mr. King's investigation identified and retained the following remedial options: (1) cessation, (2) buffer strips, and (3) increased treatment of drinking water. *See* Daily Trans., 7996:1-7997:22; 7998:10-8001:5; 8007:1-8008:13 (King Testimony).

729. Additionally, Mr. King's investigation suggested that the following remedial options be investigated and assessed further: (1) excavation, (2) alum application to fields, (3) crop and nutrient management with nitrogen supplementation, (4) bank stabilization, (5) constructed wetlands, (6) alum application to Lake Tenkiller, (7) sediment removal from Lake Tenkiller, and (8) layered aeration of Lake Tenkiller. *See* Daily Trans., 8001:6-8006:25; 8008:14-8011:15 (King Testimony).

730. By his own admission, Mr. King's preliminary investigation was just that -- preliminary. *See* Daily Trans., 8011:23-8012:8 (King Testimony).

---

environmental engineer for the American Academy of Environmental Engineers. *See* Daily Trans., 7984:15-19 (King Testimony). He has worked on remediation and feasibility remedial design projects on Superfund sites with the EPA and state agencies. *See* Daily Trans., 7985:15-7986:2, 7986:18-7987:19 (King Testimony). Mr. King testified as a retained expert for the State.

731. In addition to Mr. King's preliminary investigation and recommendations, over the course of the trial the Court also heard testimony from other witness about remedial options. For instance, Ms. Phillips testified as follows:

> Mr. Nance: If you were queen of the watershed, in general terms, what kind of category of land would you move the litter to?
> Ms. Phillips: I would move the litter to cropland.
> Mr. Nance: In the watershed or outside the watershed?
> Ms. Phillips: Outside of the watershed.

See Daily Trans., 1514:7-12 (Phillips Testimony). Ms. Phillips further testified in relation to waste management practices in the IRW that because historically poultry waste has been "reapplied over and over in the same locations" leading to the build up of phosphorus in soils it would be a better practice environmentally to distribute poultry waste to sites where soil phosphorus concentrations were not as high if they could be identified and it would be an improved management practice to remove poultry waste from the watershed completely. *See* Daily Trans., 1216:1-1217:4 (Phillips Testimony). Ms. Phillips has significant experience in poultry waste transport and has identified nearby areas outside of the IRW that are phosphorus deficient where poultry waste could be more safely used. *See* Daily Trans., 1547:2-7; 1547:14-18 (Phillips Testimony). These areas include areas around the Arkansas River, areas in Adair and Cherokee Counties, and areas in the surrounding counties as well. *See* Daily Trans., 1547:9-13 (Phillips Testimony); *see also* Daily Trans., 1547:22-1548:3 (Phillips Testimony) (also testifying that it has been demonstrated that poultry waste can be economically transported to farther locations).

732. Mr. Fite testified that riparian buffers have proven to mitigate the influence to water quality degradation from upland activities. *See* Daily Trans., 773:9-12 (Fite Testimony). Further, Mr. Fite testified that:

> Mr. Garren: . . . What is the goal for the Scenic Rivers in this program with regard to the number of acreage it would attempt to acquire [for buffer strip easements]?
> Mr. Fite: With the conservation reserve enhancement program included, it's 9,000 acres on the Oklahoma side of the basin.
> Mr. Garren: Do you have any way to put that in perspective of how many miles of river that might equate to?
> Mr. Fite: All – all of the scenic river and its tributaries –
> Mr. Garren: All right.
> Mr. Fite: -- above Lake Tenkiller to the state line.

See Daily Trans., 753:20-754:7 (Fite Testimony); *see also* Daily Trans., 773:13-18 (Fite Testimony); *See* Daily Trans., 1476:22-1477:19 (Phillips Testimony) (testifying that $20.6 million Oklahoma CREP fund would cover only about 10 percent of the riparian areas up and down the main stem and the principal tributaries that are in need of improvement).

733. Dr. Wells testified concerning alum flocking. Flocking with alum is a lake restoration technique to inhibit the constant recycling of phosphorus from the sediments by binding the phosphorus in the sediments. *See* Daily Trans., 6748:9-25; 6749:24-6750:8 (Wells Testimony). Dr. Wells is not aware of whether flocking has ever been done on a lake as large as Lake Tenkiller. *See* Daily Trans., 6748:19-25 (Wells Testimony). Dr. Wells testified that flocking "cleans up the water like you could't believe." *See* Daily Trans., 6749:16-21 (Wells Testimony). Flocking, according to Dr. Wells, can be costly and is "not a trivial prospect." *See* Daily Trans., 6749:10-13 (Wells Testimony). With regard to phosphorus being released from sediments in Lake Tenkiller, Dr. Welch testified that alum would be a ". . .binder to take up the phosphorus in the sediment." *See* Daily Trans., 7743:17-7745:9 (Welch Testimony). The alum starts at the surface and works its way down through the sediments. *See* Daily Trans., 7745:11-21 (Welch Testimony).

734. Lake aeration is a remedial technology to address low dissolved oxygen levels affecting a fishery. *See* Daily Trans., 7897:14-22 (Welch Testimony). Dr. Welch testified with

regard to water quality impacts in Lake Tenkiller that the production per unit area for smallmouth bass would be higher if more habitat with oxygen was available so that there is more space. *See* Daily Trans., 7896:20-7897:18 (Welch Testimony). He further testified that is the ". . . -- that is the basis for which -- from the standpoint of fisheries aeration is applied in bodies of water that don't have enough oxygen. The justification is, you're increasing the habitat in which these fish can survive." *See* Daily Trans., 7897:18-22 (Welch Testimony).

A. Restrictions on the Land Application of Poultry Waste

735. Though not binding on the Court as factors to be considered, it is convenient to examine restrictions on land application of poultry waste using the factors of effectiveness, implementability, and cost.

1. Effectiveness

736. There is no observable agronomic benefit from having an STP level greater than 65 lbs./acre. *See* FOF, ¶ 386; Daily Trans., 5001:2-15 (Johnson Testimony). Application of poultry waste on fields with an STP level greater than 120 lbs./acre constitutes waste disposal. *See* Daily Trans., 5022:19-5023:9 (Johnson Testimony).

737. Elevated STP levels result in greater amounts of phosphorus runoff. *See* FOF, ¶¶ 386; Daily Trans., 5028:3-10 (Johnson Testimony); 5736:5-5737:9 (Engel Testimony).

738. Every year Defendants' birds produce substantially more waste in the IRW than can be agronomically used for phosphorus fertilizer within the watershed. *See* FOF, ¶ 391; Daily Trans., 5092:25-5093:5 (Johnson Testimony). There is no widespread need to use poultry waste as a phosphorus source in the IRW. *See* Daily Trans., 5093:6-13 (Johnson Testimony).

739. If land application continues at current rates, phosphorus loading to the IRW is estimated to increase by 100,000 lbs over the next 20 years. *See* Daily Trans., 6260:1-18 (Engel

Testimony). Restrictions on the land application of poultry waste would result in significantly lower levels of phosphorus loading to the rivers and streams of the IRW and to Lake Tenkiller. Daily Trans., 7160:13-17 (Stevenson Testimony); Daily Trans., 7382:20-7383:4 (Cooke Testimony); Daily Trans., 7441:13-21 (Cooke Testimony); Daily Trans., 7445:7-8 (Cooke Testimony); Daily Trans., 7475:19-7476:10 (Cooke Testimony); State's Ex. 5475.

740. Lower phosphorus loadings will improve water quality in the rivers and streams of the IRW and in Lake Tenkiller. *See* Daily Trans., 1234:2-1235:15 (Phillips Testimony), 6737:22-6738:12 (Wells Testimony).

2. Implementability

741. All registered poultry feeding operations in Oklahoma must have animal waste management plans, which include, among other things, all nutrient analysis data, for soil and poultry waste testing. *See* 2 Okla. Stat. § 10-9.7(C)(3). In addition, prior to any land application of poultry waste by a certified poultry waste applicator in Oklahoma, the applicator is required to obtain the most recent soil and poultry waste tests as required by the Oklahoma Poultry Waste Applicators Certification Act. *See* 2 Okla. Stat. § 10-9.19(1).

742. The Revised Arkansas Phosphorus Index also considers both the STP of the field being tested and the phosphorus contained in the waste to be applied. *See* DJX 8132, pp. 4-5.

743. The Court received considerable evidence about STP ratings in the IRW from both the Oklahoma State University and University of Arkansas soil laboratories. *See* FOF ¶¶ 393-395. Thus, the regulatory schemes and university laboratories of both Oklahoma and Arkansas commonly deal with testing of both soil and poultry waste to determine nutrient need and availability. The Court finds that means are readily available for the accurate determination of field STPs and the nutrient content of poultry waste.

744. Each Defendant owns the birds it places with its growers in the IRW. *See* FOF ¶ 316. Defendants retain discretion to terminate contracts with their growers, or not deliver birds. *See* FOF ¶ 329. Defendants' contracts with their growers in the IRW are typically short-term (year-to-year or flock-to-flock). *See* FOF ¶ 332. Defendants' contracts with their growers in the IRW are non-negotiable. *See* FOF ¶¶ 330, 358. Consequently, by virtue of Defendants' control over their birds, the delivery of those birds to contract growers, as well as Defendants' ability to terminate contracts and dictate contract terms, Defendants can effectively control the poultry waste generated at the farms of contract growers.

745. Using funding from the EPA's Section 319 program, the Oklahoma Conservation Commission (OCC) has demonstrated that poultry waste can be moved from the IRW to other areas where it will present less environmental risk. The OCC transported litter out of the Peach Eater and Beatty Creek sub-watersheds as a part of EPA Section 319 projects. *See* Daily Trans., 1365: 1-8 (Phillips Testimony). Later, as a result of interest in litter hauling expressed by the Poultry Federation, the OCC used an Arkansas program as a pattern and applied to the EPA for a Section 319 grant to haul litter and received that grant. *See* Daily Trans., 1369:3-1370:12 (Phillips Testimony). The first program based on a Section 319 grant began in 2002 or 2003. *See* Daily Trans., 1368:20-24 (Phillips Testimony). Poultry integrators provided the matching funds necessary to obtain Section 319 funds from the federal government. *See* Daily Trans., 1377:2-10 (Phillips Testimony). The first litter hauling program moved a little under 50,000 tons in a nineteen month period. *See* Daily Trans., 1377:13-18 (Phillips Testimony). Thereafter, Mr. Patrick of the Tyson Defendants approached the OCC and encouraged it to continue to try to find funding for the program. *See* Daily Trans.,1378:2-10 (Phillips Testimony). The second program

was funded under a 2008 Section 319 grant and will run until 2011. *See* Daily Trans., 1380:3-11 (Phillips Testimony).

746. The point of such litter hauling programs is to move waste out of sensitive watersheds like the IRW and the Eucha-Spavinaw watershed, and not to promote the use of poultry waste in all times and all places. *See* Daily Trans., 1368:11-19 (Phillips Testimony).

747. The Court finds that litter hauling programs have been implemented in the past, and could be implemented prospectively to remove excess poultry waste from the IRW.

3. Cost

748. Although neither side did a comprehensive evaluation concerning the economics / economic impacts of imposing further restrictions on the land application of poultry waste in the IRW, certain evidence was presented over the course of the trial bearing on these issues.

a. Poultry Waste Transport

749. Dr. Taylor did an analysis of the viability of transporting poultry waste from the IRW to the rice fields of eastern Arkansas (200+ miles). The IRW has a high number of poultry animal units from which manure is recoverable. *See* State's Ex. 4969. Dr. Taylor concluded that, due primarily to the increase in the cost of commercial fertilizer, it was economically feasible to remove almost all of the poultry waste generated in the IRW in 2007, and all of the poultry waste generated in the IRW in 2008, and haul it to eastern Arkansas. *See* Daily Trans., 6805:8-6906:7 (Taylor Testimony).

750. Corroborating Dr. Taylor's analysis, Mr. Roger Collins has testified that he has a business in which he profitably hauls poultry waste from the IRW to locations as far away as 200 miles. *See* Daily Trans., 3932:13-3933:10 (Collins Testimony) (testifying that he hauls poultry waste to 200 miles west to Enid, 125+ miles into Kansas, Stuttgart, Arkansas, and to the Texas

state line); *see also* Daily Trans., 1547:22-1548:3 (Phillips Testimony) (testifying that it has been demonstrated that poultry waste can be economically transported to locations outside of the IRW).

b. Impact on Hay and Cattle Producers

751. Dr. Michael Dicks, meanwhile, did an analysis of the economic impacts of the removal of poultry waste within the IRW on hay and cattle producers and the economy of the IRW. *See* Daily Trans., 10452:14-16; 10544:18-24 (Dicks Testimony). Regrettably, however, Dr. Dicks' analysis is of little value because it is based upon a fundamentally flawed premise and is overly narrow in the economic impacts it evaluated.

752. The fundamentally flawed premise upon which Dr. Dicks' analysis is based is the assumption that poultry waste is spread uniformly across <u>all</u> pastureland in the entire IRW. *See* Daily Trans., 10452:17-10453:22; 10506:5-8 (Dicks Testimony). Yet Dr. Dicks correctly admits that this assumption is uncharacteristic. *See* Daily Trans., 10641:3-7 (Dicks Testimony) ("Mr. Garren: You admit that many of your assumptions as to the land use, soil uniformity, livestock and agronomic practices are uncharacteristic of the IRW? Dr. Dicks: I would say that the statistical approximations are certainly uncharacteristic, yes."); Daily Trans., 10525:4-6 (Clay Testimony) (admitting that it is "possible" that there are a lot of people in the IRW who do not want poultry waste spread on their fields).

753. It is telling, moreover, that even in the counterfactual scenario Dr. Dicks used for his analysis, some 19 percent of all poultry waste would have to be hauled out of the IRW. *See* Daily Trans., 10490:8-10491:12 (Dicks Testimony).

754. Dr. Dicks' analysis focused narrowly on the supposed effects on agriculture in the IRW. Dr. Dicks' analysis did not take into account, for example, any environmental effects or

water quality issues, *see* Daily Trans., 10544:14-17;10511:14-20 (Dicks Testimony), the value of tourism and recreation in the IRW, *see* Daily Trans., 10516:3-11; 10548:21-24 (Dicks Testimony), costs saved by Defendants by not having to deal with the handling of the poultry waste, *see* Daily Trans., 10532:10-17 (Dicks Testimony), economic effects outside the five county area, *see* Daily Trans., 10544:4-6; 10546:4-10; 10545:7-18 (sale of cattle); 10545:25-10546:3; 10546:11-20; 10548:25-10549:3 (sale of poultry waste) (Dicks Testimony), or economic activity associated with any environmental cleanup, *see* Daily Trans., 10550:4-10 (Dicks Testimony). Moreover, Dr. Dicks' analysis did not account for the economic effect of use of poultry waste by farmers and ranchers outside the IRW who could use the waste to meet both nitrogen and phosphorus needs.

c. Recreational Impacts

755. As discussed above, the USGS has noted that "[t]he recreation-based economy of the area relies on maintenance of aesthetically pleasing water quality in the Illinois River basin." *See* State's Ex. 5862 at p. 3. The USGS reported that visitors spend about $12 million in the IRW, and another $16.5 million is generated by the visitors to the Lake Tenkiller area. *See* State's Ex. 5862 at p. 3; *see also* DJX 0147 at pp. 32-33 ("The Oklahoma Scenic Rivers Commission (OSRC) estimates that recreation has a total economic impact in excess of $11 million in 1997 in the region around the Illinois River. This figure is conservative since it includes only the estimated expenditures of river floaters and not fishermen, campers, and other visitors."); DJX 0147 at p. iv ("The river basin is also a vital economic resource for many businesses in the City of Tahlequah and along the scenic State Highway 10 corridor.").

756. And although not quantified in dollar terms, the OWRB, USACE and OSU pointed out in the Clean Lakes study that:

> Further degradation would directly impact water supply users, users of hydroelectric power, and recreationalists. Water supply users would have to bear the cost of additional treatment. Users of hydroelectric power would have to bear the cost of foregone generation. Because Tenkiller Lake offers unique recreation opportunities within the region, water based recreationalists would experience a decline in quality of the recreation experience. Further degradation would indirectly impact those who have an economic interest in the recreation industry in the areas surrounding Tenkiller Lake. Users would most likely seek out alternate recreation areas and activities, and those individuals and businesses providing goods and services to Tenkiller Lake recreationalists would experience a loss in income as fewer people visited the lake.

See State's Ex. 3285 at p. 34; *see also* Daily Trans., 4365:5-18 (Caneday Testimony) (testifying as to scuba business).

d. Coexistence

757. The Court has also been presented evidence that agricultural activity and protection of the environment are not mutually exclusive. For instance, Mr. Fite testified as follows:

> Mr. Elrod: . . . It is your view, is it not, that production, agriculture, and the needs of the environment can walk hand in hand successfully in the IRW?
> Mr. Fite: Yes.

See Daily Trans., 824:3-7 (Fite Testimony). Ms. Phillips testified similarly:

> Mr. Nance: In the lower right-hand corner of [page 49 of USDA's Illinois River Cooperative River Basin Report], talking about economic growth versus environmental protection, there is a quote, and I'll just read it and then let's talk about it briefly. "Governor Bill Clinton in speaking to the Animal Waste Task Force said, 'I just don't accept the fact that you have to kill the economy to clean up the environment.'" Do you agree with that sentiment?
> Ms. Phillips: Yes.

See Daily Trans., 1543:18-1544:3 (Phillips Testimony) & State's Ex. 3351.

4. Summary regarding restricting land application to areas with STP not greater than 65 lbs/acre.

758. Based upon the foregoing factual findings, the Court finds that restricting the land application of poultry waste in the IRW to rates not greater than 65 lbs./acre would be effective

in addressing the injuries to the waters of the State, would be implementable, and would be economically viable.

B. Remedial Investigation and Implementation of Recommendations

759. The Court has heard considerable testimony about the effectiveness of some Best Management Practices in reducing phosphorus loading, and for other purposes. *See e.g.*, Daily Trans.. 1352: 18- 1353: 5 (effectiveness of buffer strips) (Phillips Testimony). The Court finds that remediation of the watershed and appropriate water quality monitoring should be undertaken.

760. The Court finds that the remedial alternatives mentioned by Mr. King are appropriate for further investigation. The Court finds that a remedial investigation of the following options should be undertaken: (1) buffer strips, (2) increased treatment of drinking water, (3) excavation, (4) alum application to fields, (5) crop and nutrient management with nitrogen supplementation, (6) bank stabilization, (7) constructed wetlands, (8) alum application to Lake Tenkiller, (9) sediment removal from Lake Tenkiller, and (10) layered aeration of Lake Tenkiller.

761. Additionally, the Court finds that monitoring is a key component of any remedial operation.

XXI. Summary of Findings of Fact

762. The IRW is an environmentally-fragile watershed. Each Defendant has had, and with the exception of Defendant Peterson and Defendant Cal-Maine who recently exited the Watershed, continues to have significant poultry operations in the IRW. These poultry operations require the importation of large quantities of phosphorus-rich feeds and phosphorus supplements. Enormous quantities of phosphorus-laden poultry waste has been generated by

each Defendants' birds. Poultry waste generated by each Defendant's birds has been land applied in the IRW. An environmentally-significant amount of phosphorus from each such land application in the IRW has, and will continue to, run off into the waters of the IRW. This phosphorus from poultry waste is a significant source of the phosphorus causing the injuries to the rivers and streams of the IRW in Oklahoma as well as to Lake Tenkiller. Substantial restrictions on the land application of poultry waste in the IRW are necessary to reverse these injuries.

CONCLUSIONS OF LAW

I. Introduction

1. Still remaining for adjudication in this case are the State's claims against Defendants for injunctive relief under Oklahoma common law nuisance, injunctive relief under federal common law nuisance, injunctive relief under trespass, injunctive relief and penalties under violations of 27A Okla. Stat. § 2-6-105 and injunctive relief under violations of 2 Okla. Stat. § 2-18.1.[113] In response to these claims, Defendants have asserted various affirmative defenses. An analysis of the State's claims and Defendants' affirmative defenses, viewed in light of the facts, follows.

II. Standing

2. Defendants continue to contend that the State lacks standing to pursue its remaining claims. *See* DKT #2641 at p. 3 (¶ 3). The State's standing is an issue that was extensively litigated in the pretrial proceedings. *See, e.g.*, DKT #1076, DKT #1187, DKT

[113] As noted above, the Court granted Defendants' Rule 52(c) motion with respect to the State's RCRA claim. Separate findings and conclusions will be entered with respect to that claim.

#1235, DKT#1435, DKT #1439, DKT #1790 & DKT #2362.[114] Defendants' standing challenges have centered on whether the State has the requisite legal interests in the natural resources at issue in this case to press its claims. *See id.*

3. With respect to its remaining claims, the State claims standing on the basis of its sovereign and quasi-sovereign interests. *See* FOF, ¶ 40. As to its claimed sovereignty interests, the State, relying in part on 60 Okla. Stat. § 60(A), asserts that it owns "water running in a definite stream, formed by nature over or under the surface" located within Oklahoma. 60 Okla. Stat. § 60(A) provides that such water is "public water and is subject to appropriation for the benefit and welfare of the people of the state."[115] According to the State, such water remains state-owned unless and until it is actually appropriated and beneficially used by another. *See, e.g., City of Stillwater v. OWRB*, 524 P.2d 938, 944 (Okla. App. 1974); *OWRB v. Central Oklahoma Master Conservancy District*, 464 P.2d 748, 753 (Okla. 1969). As such, the State asserts that it maintains "actual and exclusive" possession of the waters at issue. *See, e.g., City of Stillwater*, 524 P.2d at 944 ("[T]he state as original owner still owns the water and will continue

---

[114] The dismissal of the State's claims for CERCLA and common law damages, CERCLA response costs, and unjust enrichment / restitution / disgorgement pursuant to Fed. R. Civ. P. 19 and/or on standing grounds, *see* DKT #2362 (July 22, 2009 Order), was not on the merits and was without prejudice. Under the plain language of Fed. R. Civ. P. 41(b), a dismissal for failure to join a party under Fed. R. Civ. P. 19 does not operate as an adjudication on the merits. *See* Fed. R. Civ. P. 41(b). Similarly, a dismissal for lack of standing is a dismissal for lack of jurisdiction and is without prejudice. *See Brereton v. Bountiful City Corp.*, 434 F.3d 1213 (10th Cir. 2006); *see also McCarney v. Ford Motor Co.*, 657 F.2d 230, 234 (8th Cir. 1981) ("it is clear that for purposes of rule 41(b) a dismissal for lack of standing is a dismissal for lack of jurisdiction"); *Maupin v. Yamamoto*, 2000 U.S. Dist. LEXIS 18598 (W.D. Va. Dec. 19, 2000) ("That a dismissal for want of standing shall be considered a dismissal for lack of jurisdiction as contemplated by Rule 41(b) was made clear by the Supreme Court in *Costello v. United States*, 365 U.S. 265, 285, 5 L. Ed. 2d 551, 81 S. Ct. 534 (1961)").

[115] Case law holds that the term "water running in a definite stream" includes lakes. *Depuy v. OWRB*, 611 P.2d 228, 231-32 (Okla. 1980).

to do so until it transfers it to some other person or entity"); *Central Oklahoma Master Conservancy District*, 464 P.2d at 753 ("The state may either reserve to itself or grant to others its right to utilize these streams for beneficial purposes").[116] *See, e.g.*, DKT #1822 (outlining basis of claimed sovereignty interests).

4. With respect to its claimed quasi-sovereign interests, the State asserts that it has legally protected interests in all the land, water and other natural resources located within Oklahoma, and that these legally protected interests are not dependent on ownership or title. *See, e.g.*, DKT #1822 (outlining basis of claimed quasi-sovereign interests). Analyzing the latter first, the United States Supreme Court has explained:

> This is a suit by a state for an injury to it in its capacity of quasi-sovereign. In that capacity the state has an interest independent of and behind the titles of its citizens, in all the earth and air within its domain. It has the last word as to whether its mountains shall be stripped of their forests and its inhabitants shall breathe pure air.

State of Georgia v. Tennessee Copper Co., 206 U.S. 230, 237 (1907); *see also Massachusetts v. Environmental Protection Agency*, 549 U.S. 497, 518 (2007); *Hudson County Water Co. v. McCarter*, 209 U.S. 349, 355 (1908) ("[I]t is recognized that the state, as quasi-sovereign and representative of the interests of the public, has a standing in court to protect the atmosphere, the water, and the forests within its territory, irrespective of the assent or dissent of the private owners of the land most immediately concerned").

5. "The Supreme Court has recognized the 'right of a State to sue as *parens patriae* to prevent or repair harm to its 'quasi-sovereign' interests.'" *Satsky v. Paramount Communications, Inc.*, 7 F.3d 1464, 1469 (10th Cir. 1993) (quoting *Hawaii v. Standard Oil Co.*

---

[116] Notably, "[b]oth riparian and appropriative rights are usufructuary only and confer no right of private ownership in the watercourse." *People v. Shirokow*, 605 P.2d 859, 864 (Cal. 1980). Moreover, "[a]n appropriation is not complete until the water is put to beneficial use." Dan Turlock, Law of Water Rights and Resources, § 5:49.

of California, 405 U.S. 251, 258 (1972)). "Although the Supreme Court has not expressly defined what is a 'quasi-sovereign' interest, it is clear that a state may sue to protect its citizens against 'the pollution of the air over its territory; or of interstate waters in which the state has rights.'" *Satsky*, 7 F.3d at 1469 (quoting 12 Moore's Federal Practice, ¶ 350.02[3] at 3-20 (1993)); *see also Alfred L. Snapp & Son, Inc. v. Puerto Rico ex rel. Barez*, 458 U.S. 592, 607 (1982) (a state "has a quasi-sovereign interest in the health and well-being -- both physical and economic -- of its residents in general"); *Spiva v. State*, 584 P.2d 1355, 1359 (Okla. Crim. App. 1978) ("That the State has a valid interest in matters which affect the public health, safety and general welfare is undisputed . . . "); *State ex rel. Pollution Control Coordinating Board v. Kerr-McGee Corp.*, 619 P.2d 858, 861 (Okla. 1980) ("the state's common-law right to sue for wrongful destruction of wildlife is not dependent on ownership but rather on the sovereign power to regulate, preserve and protect wild animals and fish for the common enjoyment of its citizenry"); *Hughes v. Oklahoma*, 441 U.S. 322, 337 (1979) ("We consider the State's interests in conservation and protection of wild animals as legitimate local purposes similar to the States' interests in protecting the health and safety of their citizens").

6. "For over a century, states have been accorded standing in common law nuisance causes of action when suing as *parens patriae*." *See State of Connecticut v. American Electric Power Co., Inc.*, 582 F.3d 309, 339 (2d Cir. 2009). And when suing in its quasi-sovereign or *parens patriae* capacity, a state may seek injunctive relief. *See, e.g., Alfred L. Snapp & Son*, 458 U.S. at 602-606 (discussing cases where states have sued to enjoin public nuisances). There can be no doubt, therefore, that the State has standing to pursue its common law public nuisance claims for injunctive relief on the basis of its quasi-sovereign interests; there is no need to reach the State's sovereign interests with respect to these claims.

7. The State's Oklahoma statutory claims similarly sound in public nuisance and similarly raise quasi-sovereign interests. *See* 27A Okla. Stat. § 2-6-105(A) ("It shall be unlawful for any person to cause pollution of any waters of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any . . . waters of the state. Any such action is hereby declared to be a public nuisance"); 2 Okla. Stat. § 2-18.1(A) ("It shall be unlawful and a violation of the Oklahoma Agricultural Code for any person to cause pollution of any air, land or waters of the state by persons which are subject to the jurisdiction of the Oklahoma Department of Agriculture, Food, and Forestry pursuant to the Oklahoma Environmental Quality Act").[117] Thus, for reasons set forth above, the Court concludes that the State has standing to pursue its claim under 27A Okla. Stat. § 2-6-105(A) for injunctive relief and penalties, as well as its claim under 2 Okla. Stat. § 2-18.1 for injunctive relief.

8. The State's trespass claim is not founded on quasi-sovereign interests, however. Rather, a claim for trespass rests on "an actual physical invasion of the real estate of another without the permission of the person lawfully entitled to possession." *Bennett v. Fuller*, 2008 U.S. Dist. LEXIS 58198, *16 (N.D. Okla. July 31, 2008). As noted above, the State claims a possessory property interest in waters flowing in definite streams in the Oklahoma portion of the IRW.

---

[117] Significantly, with respect to these Oklahoma statutory claims, the statutes themselves make clear the State has standing to pursue the relief sought. *See* 27A Okla. Stat. § 2-3-504(F)(1) & (2) ("Any action for injunctive relief to redress or restrain a violation by any person of this [Environmental Quality] Code . . . or for recovery of any . . . civil penalty assessed pursuant to this Code may be brought by: . . . the Attorney General on behalf of the State of Oklahoma; . . ."); 2 Okla. Stat. § 2-16(B) ("Any action to redress or restrain a violation of the Oklahoma Agricultural Code . . . may be brought by: . . . [t]he Attorney General on behalf of the State of Oklahoma; . . .").

9. For purposes of determining whether the State has the requisite possessory property interest in such waters to have standing to pursue its trespass claim, however, the Court need not resolve the question of the State's ownership of the water in the IRW. Defendants have plainly misapprehended and overstated the meaning of "exclusive" in the context of trespass law. A possessory property interest need not be "exclusive" to support a trespass claim. Instead, a trespass claim may be brought by a person with a possessory interest against anyone with any inferior possessory property right (or no possessory property right at all). *See Cooperative Refinery Association v. Young*, 393 P.2d 537, 540 (Okla. 1964); *Lambert v. Rainbolt*, 250 P.2d 459, 461 (Okla. 1952). Stated another way, any so-called "exclusivity" must merely be as to persons with no possessory interest or a lesser possessory interest in the property.

10. The record reflects ample evidence that the State, at a minimum, regulates, manages and controls the waters of the IRW within Oklahoma. *See* FOF, ¶¶ 45-46. The record is devoid of evidence that Defendants have any possessory property interest in the waters of the IRW within Oklahoma. *See* FOF, ¶ 44. The Court concludes as a matter of law that the State's interests in the water are most assuredly superior to and exclusive as to Defendants and, therefore, the State has the requisite possessory property interest to press its trespass claim for injunctive relief against Defendants.

III. Circumstantial Evidence

11. It is well-established that a plaintiff may prove its claims by direct evidence, circumstantial evidence or any combination of the two. Indeed, "circumstantial evidence is not only sufficient, but may also be more certain, satisfying and persuasive than direct evidence." *Desert Palace, Inc. v. Costa*, 539 U.S. 90, 100 (2003); *see also Dillon v. Fibreboard Corp.*, 919 F.2d 1488, 1490 (10th Cir. 1990) ("It is acceptable for a party bearing the burden of proof to

utilize sufficient circumstantial evidence to support his or her position"); *California Oil Co. v. Davenport*, 435 P.2d 560, 563 (Okla. 1967); *Harper-Turner Oil Co. v. Bridge*, 311 P.2d 947, 950-51 (Okla. 1957); *Peppers Refining Co. v. Spivey*, 285 P.2d 228, 231-32 (Okla. 1955).

IV. The Causation Standard

12. An injury is indivisible when it is incapable of apportionment. *See Johnson v. Ford Motor Co.*, 45 P.3d 86, 91 (Okla. 2002).

13. "With respect to environmental nuisances, such as pollution of a stream or pollution of the air surrounding a community, courts have commonly found that such pollution constitutes an indivisible injury." *Herd v. Asarco, Inc.*, 2003 U.S. Dist. LEXIS 27381, at *41 (N.D. Okla. July 11, 2003), *vacated in part by Herd v. Blue Tee Corp.*, 2004 U.S. Dist. LEXIS 30673 (N.D. Okla. Jan. 13, 2004)[118] (citing *Union Texas Petroleum Corp. v. Jackson*, 909 P.2d 131, 149-50 (Okla. Civ. App. 1995)).

14. The burden of proof of proving an injury is not indivisible is on the party seeking to prove that the harm is divisible. *See* Restatement (Second) of Torts, § 433B(2) ("Where the tortious conduct of two or more actors has combined to bring about harm to the plaintiff, and one or more of the actors seeks to limit his liability on the ground that the harm is capable of apportionment among them, the burden of proof as to the apportionment is upon each such actor."); *Union Texas Petroleum*, 909 P.2d at 149-50.

---

[118] After a settlement was entered between the *Herd* plaintiffs and the defendants Blue Tee Corp. and Gold Fields Mining Corp., the July 11, 2003 order was vacated as to those two defendants only. *See Herd v. Blue Tee Corp.*, 2004 U.S. Dist. LEXIS 30673 (N.D. Okla. Jan. 13, 2004); and 01-CV-891-H(C), DKT #737. The vacation order was entered pursuant to unopposed motion. *See Herd*, 01-CV-891-H(C), DKT #747. The July 11, 2003 order regarding causation was not withdrawn nor its legal reasoning altered in any way as to the remaining defendants.

15. There is no evidence in the record that the injuries to the waters of the State from phosphorus are capable of apportionment. In fact, the evidence is to the contrary. *See* Daily Trans., 1492:11-13 (Phillips Testimony) ("When the phosphorus is in the river, it doesn't have a logo on it that tells you where it came from, no."); Daily Trans., 8770:5-9 (Tyson Admission) ("Once it's all the way downstream, you can't assign -- figure out where the phosphorus came from."); Daily Trans., 9130:7-17; 9447:21-23 (Connolly Testimony) (no calculation or quantification of impacts from nonpoint source phosphorus undertaken). Therefore, this Court concludes as a matter of law these injuries are indivisible.

16. It is well-established that when multiple tortfeasors' acts concur, combine, or commingle to produce an indivisible injury, they may be held jointly and severally liable even in the absence of concerted action. *See Boyles v. Oklahoma Natural Gas*, 619 P.2d 613, 617 (Okla. 1980); *Harper-Turner Oil*, 311 P.2d at 952; *Union Texas Petroleum*, 909 P.2d at 149-50. In *Union Texas Petroleum*, for example, the Oklahoma Court of Civil Appeals held that the defendants were jointly and severally liable for an indivisible injury contaminating an aquifer underlying the town of Cyril. In this regard, the Court reasoned:

> The single, indivisible injury at issue in this case is the contamination of the town of Cyril's water supply by saltwater used in oil and gas operations. The general rule is that where several persons are guilty of separate and independent acts of negligence which combine to produce directly a single injury, the courts will not attempt to apportion the damage, especially where it is impracticable to do so, but will hold each joint tort-feasor liable for the entire result.

Union Texas Petroleum Corp., 909 P.2d at 149-50.

17. It is likewise well-established that even though its act alone might not have caused the indivisible injury, a defendant can nonetheless be held jointly and severally liable for the entirety of that injury. *See Northrup v. Eakes*, 178 P. 266, 268 (Okla. 1918) ("Where, although concert is lacking, the separate and independent acts or negligence of several combine

to produce directly a single injury, each is responsible for the entire result, even though his act or neglect alone might not have caused it."); *Texaco v. Berry Petroleum*, 869 F. Supp. 1523, 1528 (W.D. Okla. 1994); *Phillips v. Vandergriff*, 122 P.2d 1020, 1022 (Okla. 1942) (upholding jury instruction). Chief Judge Claire Eagan reiterated this principle of law in the *City of Tulsa* poultry waste pollution case:

> The injury alleged herein is a single, indivisible injury -- the eutrophication of the lakes from excess phosphorus loading. Under Oklahoma and Arkansas law, regardless of whether the claim is one of negligence or intentional tort, where there are multiple tortfeasors and the separate and independent acts of codefendants concurred, commingled and combined to produce a single indivisible injury for which damages are sought, each defendant may be liable even though his/her acts alone might not have been a sufficient cause of the injury.

City of Tulsa v. Tyson Foods, Inc., 258 F. Supp. 2d 1263, 1297 (N.D. Okla. 2003), *vacated in connection with settlement* (citations and internal quotations omitted).[119]

18. Defendants do not disagree that a defendant may be liable even though his/her acts alone might not have been a sufficient cause of the injury. *See* Daily Trans., 11241:15-11242:8 ("The Court: . . . If you've noticed over the last few days, [the State's counsel] has focused -- and I think properly so -- that the plaintiff's burden is not to show that the land application of poultry litter is the primary source of phosphorus, but rather that it is a significant source. Mr. Jorgensen: Indeed, Your Honor. That's true."). Thus, the existence of other sources

[119] The *City of Tulsa* summary judgment order should be viewed as persuasive authority. That order was vacated by unopposed motion solely as part of the settlement of that action. *See City of Tulsa*, 01-CV-0900-EA(C), DKT #472 and DKT #473 ¶ 8. It was not vacated as a result of a motion for reconsideration or any stated need to correct or negate the substance of the opinion. The *City of Tulsa* opinion is a public act of the government, which cannot be expunged by private agreement. *See Oklahoma Radio Assocs. v. Magnolia Broadcasting Co.*, 3 F.3d 1436, 1444 (10th Cir. 1993) (citations omitted). The order is a reported decision, contains extensive reasoning on issues pertinent to this action, and the Court finds the reasoning contained therein well-researched, reliable and persuasive.

of the injury is relevant only to show a complete want of causation on the part of the defendant being sued. *See, e.g., City of Tulsa*, 258 F. Supp. 2d at 1302.

19. Consistent with these principles, Judge Eagan articulated the following causation standard in the *City of Tulsa* case:

> In this case plaintiffs need not prove the portion or quantity of harm or damages caused by each particular defendant. Rather, plaintiffs must show that each defendant contributed to phosphorus loading in the Watershed and that the phosphorus in the Watershed has resulted in the harm and damages sustained by plaintiffs.

City of Tulsa, 258 F. Supp. 2d at 1300.

20. That the relief at issue in this trial is injunctive in nature rather than damages does nothing to change the foregoing analysis. The law is clear that where injunctive relief is sought, the defendant may not avoid liability on the basis that other contributing causes exist. *See, e.g., Siciliano v. Barbuto*, 164 N.E. 467, 469 (Mass. 1929); *Parker v. Am. Woolen Co.*, 81 N.E. 468, 471 (Mass. 1907); *Woods v. Khan*, 420 N.E.2d 1028, 1031 (Ill. App. Ct. 1981); *W. Arlington Imp. Co. v. Mount Hope Retreat*, 54 A. 982, 985-86 (Md. 1903).

21. Not only does a plaintiff need not prove the portion or quantity of harm of damages caused by each particular defendant, but also a plaintiff need not "track" the contaminant from its source to the site of injury. *Herd*, 2003 U.S. Dist. LEXIS 27381, at *41-42. As explained in *Herd* -- a case involving lead-laden dust allegedly blown from the defendants' chat piles and tailings ponds that commingled in the air and contaminated the community causing an indivisible injury:

> Once the lead-laden dust reaches the air stream, it is impossible to trace its precise source. The Court therefore finds that the alleged injury is indivisible and that the . . . legal principles regarding joint and several liability apply. To the extent Defendants argue that they are entitled to summary judgment on grounds that Plaintiffs have failed to allege facts that 'trace' or 'quantify' the lead-laden dust causing the alleged nuisance in this case as to each individual Defendant's chat

> pile(s) or tailing pond(s), the Court finds that, under the facts present here, such tracing or quantification is not required.

Herd, 2003 U.S. Dist. LEXIS 27381, at *41-42; *see also id.* at 45-46 ("Plaintiffs' allegations are not merely 'you mined and therefore you caused the injury,' but instead 'you mined and left waste materials very near the contaminated community and such waste materials have been shown to contain the type of contamination that occurred in the community.' The Court does not view the latter claims as requiring a legally impermissible leap on the causation continuum.").

22. The *Herd* Court also found the sheer mass of a mobile substance generated by joint tort-feasors to be relevant to the issue of causation:

> The record before the Court indicates that Defendants collectively deposited over seventeen million tons of lead-laden mining waste in the Ottawa County area. Although these collective numbers are not conclusive as to any one Defendant's contribution, they clearly inform the issue of contribution, when combined with evidence of the location of Defendant's mining activities in relation to the Picher community. This case is not about a single particle from a chat pile that is miles away from Picher. Therefore, the Court finds that Plaintiffs have met the requisite threshold amount with respect to these Defendants.

Herd, 2003 U.S. Dist. LEXIS 27381, at *44-45. Accordingly, it is proper for this Court to give weight to the State's evidence of the massive quantities of phosphorus-laden poultry waste generated by Defendants' birds (*e.g.*, Dr. Engel's mass balance analysis) in concert with evidence that most of this poultry waste is land applied within the environmentally-sensitive IRW and that a significant portion of phosphorus from that poultry waste enters the waters of the IRW.

23. The Court concludes that the causation principles articulated in *City of Tulsa* and *Herd* are correct statements of the applicable law. Thus, in order to establish causation with respect to a defendant in this case, the State must prove that such defendant contributed to phosphorus loading in the waters of the IRW and that phosphorus in the waters of the IRW has resulted in the injuries sustained by the State. The State need not prove the portion or quantity of

the injuries caused by each particular defendant. Nor does the State need to track phosphorus from any particular field to the waters of the IRW.

V. The State's Causes of Action

A. State Law Public Nuisance & Federal Common Law Nuisance

1. Introduction

24. The State asserts a state law nuisance claim against Defendants for conduct occurring in Oklahoma and causing harm in Oklahoma, as well as a federal common law nuisance claim against Defendants for conduct occurring in Arkansas and causing harm in Oklahoma.

2. Elements of State Law Public Nuisance

25. A public nuisance is "an unreasonable interference with a right common to the general public." *See* Restatement (Second) of Torts, § 821B; *see also B.H. v. Gold Fields Mining Corp.*, 506 F. Supp. 2d 792, 800 (N.D. Okla. 2007) (common law nuisance is the "'unwarrantable, unreasonable or unlawful use by a person of his own property to the injury of another'") (quoting *Lyons v. McKay*, 313 P.2d 527, 529 (Okla. 1957)); 50 Okla. Stat. § 1 ("[a] nuisance consists in unlawfully doing an act, or omitting to perform a duty, which act or omission either . . . [a]nnoys, injures or endangers the comfort, repose, health, or safety of others; or . . . [i]n any way renders other persons insecure in life, or in the use of property . . ."); 50 Okla. Stat. § 2 (public nuisance is "one which affects at the same time an entire community or neighborhood, or any considerable number of persons . . ."). "Pollution of waters of the state constitutes a public nuisance under Oklahoma law." *Fischer v. Atlantic Richfield Co.*, 774 F. Supp. 616, 619 (W.D. Okla. 1989) (citing 82 Okla. Stat. § 926.2); *see also* 27A Okla. Stat. § 2-6-105(A).

26. It is not necessary that a plaintiff establish that a defendant's actions were unreasonable, but rather, that the resulting burden on the plaintiff was unreasonable. *See N.C. Corff Partnership v. Oxy USA, Inc.*, 929 P.2d 288, 294 (Okla. Civ. App. 1996) (citing Restatement (Second) of Torts, § 822 cmt b).

27. Otherwise lawful conduct may be a nuisance. *See Winningham v. Rice*, 282 P.2d 742, 744 (Okla. 1955).

28. A person is subject to liability for a nuisance caused by an activity not only when that person carries on the activity, but also when that person participates to a substantial extent in carrying it on. *See* Restatement (Second) of Torts, § 834.

29. There is no prescriptive right to maintain a public nuisance. *See Fischer v. Atlantic Richfield Co.*, 774 F. Supp. 616, 620 (W.D. Okla. 1989) (citing 66 C.J.S. Nuisance § 92). No lapse of time can legalize a public nuisance amounting to an actual obstruction of a public right or the pollution of waters of the State. *See* 50 Okla. Stat. § 7.

30. Possession of a license or a permit issued by a regulatory body is not a defense for that person to avoid liability under nuisance law for interfering with the rights of others. *See Briscoe v. Harper Oil Co.*, 702 P.2d 33, 36 (Okla. 1985); *Union Oil Co. v. Heinsohn*, 43 F.3d 500, 504 (10th Cir. 1994). A license or permit to do a certain act cannot protect the licensee or permittee who abuses the privilege by erecting or maintaining a nuisance. *See Briscoe*, 702 P.2d at 36; *Heinsohn*, 43 F.3d at 504.

3. Elements of Federal Common Law of Nuisance

31. "When we deal with air and water in their ambient or interstate aspects, there is a federal common law, as *Texas v. Pankey*, 441 F.2d 236, recently held." *Illinois v. Milwaukee*, 406 U.S. 91, 103 (U.S. 1972) (*Milwaukee I*); *see also Texas v. Pankey*, 441 F.2d 236, 240 (10th

Cir. 1971) ("[T]he ecological rights of a State in the improper impairment of them from sources outside the State's own territory, now would and should, we think, be held to be a matter having basis and standard in federal common law and so directly constituting a question arising under the laws of the United States.").

32. "[F]ederal courts may draw on state common law in shaping the applicable body of federal common law." *Phoenix Mutual Life Insurance Co. v. Adams*, 30 F.3d 554, 564 (4th Cir. 1994). However, in fashioning federal common law, courts do not look to the law of a particular state, but rather should apply common-law doctrines best suited to furthering the applicable goals. *See id.* "[F]ederal common law should be consistent across the circuits." *Id.*

33. "The elements of a claim based on the federal common law of nuisance are simply that the defendant is carrying on an activity that is causing an injury or significant threat of injury to some cognizable interest of the complainant." *State of Illinois v. City of Milwaukee*, 599 F.2d 151, 165 (7th Cir. 1979), *rev'd on different grounds, Illinois v. Milwaukee*, 451 U.S. 304 (U.S. 1972) (*Milwaukee II*); *see also American Electric Power*, 582 F.3d at 352 ("We believe the Restatement definition provides a workable standard for assessing whether the parties have stated a claim under the federal common law of nuisance. . . . The Restatement definition of public nuisance set out in § 821B(1) has two elements: an 'unreasonable interference' and 'a right common to the general public.'") (citation omitted).

34. Restatement (Second) of Torts, § 821B provides that: "Circumstances that may sustain a holding that an interference with a public right is unreasonable include the following: (a) whether the conduct involves a significant interference with the public health, the public safety, the public peace, the public comfort or the public convenience, (b) whether the conduct is proscribed by a statute, ordinance or administrative regulation, or (c) whether the conduct is of a

continuing nature or has produced a permanent and long-lasting effect, and, as the actor knows or has reason to know, has a significant effect upon the public right."

4. Displacement of the Federal Common Law of Nuisance

35. Defendants maintain that the federal common law of nuisance has been displaced by the Clean Water Act (a/k/a Federal Water Pollution Control Act), 33 U.S.C. 1251, *et seq.* In support of this argument, Defendants rely principally on *Milwaukee II* and *Middlesex County Sewerage Authority, et al. v. National Sea Clammers Association*, 453 U.S. 1 (1981).

36. The displacement standard was set forth in *Milwaukee II*, 451 U.S. at 315 n 8, wherein the Supreme Court explained that "the question whether a previously available common-law action has been displaced by federal statutory law involves an assessment of the scope of the legislation and whether the scheme established by Congress addresses the problem formerly governed by federal common law." The Supreme Court subsequently explained in *United States v. Texas*, 507 U.S. 529, 534 (1993), that:

> Just as longstanding is the principle that "[s]tatutes which invade the common law . . . are to be read with a presumption favoring the retention of long-established and familiar principles, except when a statutory purpose to the contrary is evident." *Isbrandtsen Co. v. Johnson*, 343 U.S. 779, 783, 72 S.Ct. 1011, 1014, 96 L.Ed. 1294 (1952); *Astoria Federal Savings & Loan Assn. v. Solimino*, 501 U.S. 104, 108, 111 S.Ct. 2166, 2169-2170, 115 L.Ed.2d 96 (1991). In such cases, Congress does not write upon a clean slate. *Astoria, supra*, at 108, 111 S.Ct., at 2169-2170. In order to abrogate a common-law principle, the statute must "speak directly" to the question addressed by the common law. *Mobil Oil Corp. v. Higginbotham, supra*, 436 U.S., at 625, 98 S.Ct., at 2015; *Milwaukee v. Illinois*, 451 U.S. 304, 315, 101 S.Ct. 1784, 1791, 68 L.Ed.2d 114 (1981).
>
> Texas argues that this presumption favoring retention of existing law is appropriate only with respect to state common law or federal maritime law. Although a different standard applies when analyzing the effect of federal legislation on state law, *id.*, at 316-317, 101 S.Ct., at 1792-1793, there is no support in our cases for the proposition that the presumption has no application to federal common law, or for a distinction between general federal common law and federal maritime law in this regard. We agree with Texas that Congress need not "affirmatively proscribe" the common-law doctrine at issue. Brief for

> Respondents 3-4; *see Milwaukee, supra,* at 315, 101 S.Ct., at 1791. But as we stated in Astoria, supra, "courts may take it as a given that Congress has legislated with an expectation that the [common law] principle will apply except 'when a statutory purpose to the contrary is evident.'" 501 U.S. at 108, 111 S.Ct. at 2170 (quoting *Isbrandtsen, supra,* 343 U.S. at 783, 72 S.Ct. at 1014).

37. From these cases, the following principles can be discerned. First, there is a presumption favoring the retention of federal common law. Second, in order for a federal statute to displace the federal common law, the statute at issue must "speak directly" to the question addressed by the federal common law. Third, the statute at issue must "address the problem" governed by the federal common law. And fourth, courts may take it as a given that Congress has legislated with an expectation that the common law principle will apply except when a statutory purpose to the contrary is evident.

38. Thus, in order to determine whether the Clean Water Act displaces the federal common law nuisance claim being asserted by the State in this action, it is necessary to determine whether the Clean Water Act "speaks directly" to the question addressed by the federal common law, and if so, whether the Clean Water Act "addresses the problem" governed by the federal common law.

39. The Clean Water Act (a/k/a the Federal Water Pollution Control Act) has its origins in a 1948 enactment. *See* Pub. L. No. 80-845, 62 Stat. 1155 (1948). Interpreting the Clean Water Act as it stood in 1972, the Supreme Court held that: "It may happen that new federal laws and new federal regulations may in time pre-empt the field of federal common law of nuisance. But until that comes to pass, federal courts will be empowered to appraise the equities of the suits alleging creation of a public nuisance by water pollution." *See Milwaukee I,* 406 U.S. at 107.

40. In 1972, Congress adopted the Federal Water Pollution Control Act Amendments of 1972 to the Clean Water Act. *See* Pub. L. 92-500, 86 Stat. 816 (1972) (codified at 33 U.S.C. § 1251, *et seq*.). The 1972 Amendments substantially rewrote the Clean Water Act. "The Amendments established a new system of regulation under which it is illegal for anyone to discharge pollutants into the Nation's waters except pursuant to a permit." *Milwaukee II*, 451 U.S. at 310-11 (citations omitted). Specifically, the Amendments provide that "*[e]very* point source discharge is prohibited unless covered by a permit, which directly subjects the discharger to the administrative apparatus established by Congress to achieve its goals." *Milwaukee II*, 451 U.S. at 318 (emphasis in original); *see also Int'l Paper Co. v. Ouellette*, 479 U.S. 481, 489 (U.S. 1987) ("One of the primary features of the 1972 amendments is the establishment of the National Pollutant Discharge Elimination System (NPDES), a federal permit program designed to regulate the discharge of polluting effluents.").

41. Simply put, the 1972 Amendments to the Clean Water Act addressed point source pollution, not non-point source pollution. A "point source" is defined in the Clean Water Act as "any discernible, confined and discrete conveyance . . . from which pollutants are or may be discharged." 33 U.S.C. § 1362(14). In contrast, "non-point sources" are not defined in the Clean Water Act. *See American Wildlands v. Browner*, 260 F.3d 1192, 1193 (10th Cir. 2001). "Non-point source pollution has been described as nothing more than a water pollution problem not involving a discharge from a point source." *Defenders of Wildlife v. EPA*, 415 F.3d 1121, 1124 (10th Cir. 2005). With the exception of discharges from CAFOs, agricultural storm water discharges are statutorily exempted as point sources under the Clean Water Act. 40 C.F.R. § 122.3(e); *Concerned Area Residents for the Environment v. Southview Farm*, 34 F.3d 114 (2d

Cir. 1994) (agricultural run-off is considered non-point source pollution exempt from the Clean Water Act); *Hiebenthal v. Meduri Farms*, 242 F. Supp. 2d 885, 888 (D. Ore. 2002).

42. Significantly, *Milwaukee II* and *National Sea Clammers*, upon which Defendants rely in support of their contention that the federal common law of nuisance has been displaced, are both point source cases. The claims in *Milwaukee II* principally centered on "overflows occur[ring] at discrete discharge points throughout the system." *See Milwaukee II*, 451 U.S. at 309. The claims in *Nation Sea Clammers* principally centered on "discharges and ocean dumping of sewage and other waste." *See National Sea Clammers*, 453 U.S. at 4.

43. In light of the point source permitting program created by the Federal Water Pollution Control Act Amendments of 1972, the Supreme Court in *Milwaukee II* found displacement of the federal common law as to point source discharges. Specifically, the Supreme Court held:

> We conclude that, <u>at least so far as concerns the claims of respondents</u>, Congress has not left the formulation of appropriate federal standards to the courts through application of often vague and indeterminate nuisance concepts and maxims of equity jurisprudence, but rather has occupied the field through the establishment of a comprehensive regulatory program supervised by an expert administrative agency.

Milwaukee II, 451 U.S. at 317 (emphasis added). The Supreme Court reasoned:

> There is thus no question that <u>the problem of effluent limitations</u> has been thoroughly addressed through the administrative scheme established by Congress, as contemplated by Congress. . . . Federal courts lack authority to impose more stringent <u>effluent limitations</u> under federal common law than those imposed by the agency charged by Congress with administering this comprehensive scheme.

Milwaukee II, 451 U.S. at 320 (emphasis added)[120]

---

[120] The term "effluent limitation" is a defined term in the Federal Water Pollution Control Act Amendments of 1972, meaning "any restriction established by a State of the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged <u>from point sources</u> into navigable waters, the waters of the

44. In *National Sea Clammers* the Supreme Court reaffirmed its holding in *Milwaukee II*:

> The Court has now held that the federal common law of nuisance in the area of water pollution is entirely pre-empted by the more comprehensive scope of the FWPCA, which was completely revised after the decision in [*Milwaukee I*].

National Sea Clammers, 453 U.S. at 21-22. With respect to the Marine Protection, Research and Sanctuaries Act of 1972, Pub. L. 92-532, 86 Stat. 1052, the Supreme Court held:

> To the extent that this litigation involves ocean waters not covered by the FWPCA, and regulated under the MPRSA, we see no cause for different treatment of the pre-emption question. The regulatory scheme of the MPRSA is no less comprehensive, with respect to ocean dumping, than are analogous provisions of the FWPCA.

National Sea Clammers, 453 U.S. at 22.

45. Thus, Defendants' argument that the federal common law of nuisance has been displaced hinges on an overly broad reading of *Milwaukee II* and *National Sea Clammers.* The Supreme Court has long cautioned that its cases must be read in the context of the facts which underlie them. For example, in *Cohens v. Virginia*, 19 U.S. 264, 400 (1821), the Supreme Court stated:

> <u>It is a maxim not to be disregarded, that general expressions, in every opinion, are to be taken in connection with the case in which those expressions are used. If they go beyond the case, they may be respected, but ought not to control the judgment in a subsequent suit when the very point is presented for decision</u>. The reason of this maxim is obvious. The question actually before the Court is investigated with care, and considered in its full extent. Other principles which may serve to illustrate it, are considered in their relation to the case decided, but their possible bearing on all other cases is seldom completely investigated.

(Emphasis added.) Similarly, in *Armour & Co. v. Wantock*, 323 U.S. 126, 133 (1944), the Supreme Court stated:

---

contiguous zone, or the ocean, including schedules of compliance." *See* 33 U.S.C. § 1362(11) (emphasis added).

> It is timely again to remind counsel that words of our opinions are to be read in the light of the facts of the case under discussion. To keep opinions within reasonable bounds precludes writing into them every limitation or variation which might be suggested by the circumstances of cases not before the Court. General expressions transposed to other facts are often misleading.

(Emphasis added.) *See also Webster v. Fall*, 266 U.S. 507, 511 (1925) ("Questions which merely lurk in the record, neither brought to the attention of the court nor ruled upon, are not to be considered as having been so decided as to constitute precedents."); *United States v. London*, 66 F.3d 1227, 1241 (1st Cir. 1995) ("We do not normally take Supreme Court opinions to contain holdings on matters the Court did not discuss and which, presumably, the parties did not argue. *Sweeney v. Westvaco Co.*, 926 F.2d 29, 40 (1st Cir. 1991) (Breyer, C.J.) (citing *Cousins v. Secretary of the U.S. Dep't of Transp.*, 880 F.2d 603, 608 (1st Cir. 1989) (en banc))").

46. The inescapable truth is that the 1972 Amendments to the Clean Water Act neither speak directly to the nonpoint source pollution question nor address the question of nonpoint source pollution, and therefore the federal common law of nuisance as to interstate nonpoint source pollution is not displaced. This conclusion is entirely consistent with the holdings of *Milwaukee II* and *National Sea Clammers*.

47. Moreover, the 1987 Amendments to the Clean Water Act, Pub. L. 600-4, 101 Stat. 60, do not change the analysis. Not only do these amendments not give EPA regulatory authority over non-point source pollution, but also they do not require states to regulate non-point source pollution. As such, the Clean Water Act continues neither to speak directly to the nonpoint source pollution question nor to address the problem of nonpoint source pollution. Simply put, the Clean Water Act does not regulate nonpoint source pollution.

48. As explained by the Tenth Circuit in *American Wildlands*, 260 F.3d at 1197-98, "[N]othing in the CWA demands that a state adopt a regulatory system for nonpoint sources. . . .

In the Act, Congress has chosen not to give the EPA the authority to regulate nonpoint source pollution. . . . [T]he Act nowhere gives the EPA the authority to regulate nonpoint source discharges." *See also Defenders of Wildlife*, 415 F.3d at 1124-25 ("Congress clearly intended the EPA to have a limited, non-rulemaking role in the establishment of water quality standards by states. . . . [T]he CWA does not require states to take regulatory action to limit the amount of non-point water pollution introduced into its waterways.") (citation and quotations omitted); *United States v. Earth Sciences, Inc.*, 599 F.2d 368, 371 (10th Cir. 1979) ("Because nonpoint sources of pollution . . . are virtually impossible to isolate to one polluter, no permit or regulatory system was established as to them [under the CWA]."); 65 Fed. Reg. 43586, 43650 (July 13, 2000) ("The CWA preserves the rights of States to experiment with alternative regulatory (and non-regulatory) approaches to control nonpoint sources of pollution. The CWA does not provide specific legal authority for EPA to regulate nonpoint sources in a way that would assure the attainment of water quality standards. Such authority is reserved for the States."); 133 Cong. Rec. 1568, 1571 (January 21, 1987) (Sen. George Mitchell) ("There is nothing in this bill which requires any State in the country to adopt a program to deal with nonpoint source pollution. The bill provides that each State will make an assessment of the problem. If a State does not make an assessment of the problem, the EPA will make one in that State for the purpose of establishing national data on this problem. . . . After that, no State is compelled to adopt a program to control nonpoint source pollution."); 133 Cong. Rec. 1568, 1591 (January 21, 1987) (emphasis added) (Sen. Alan Simpson) ("For the first time we have included a provision in the Clean Water Act related to non-point source pollution that comes from farm lands, timber operations, and other sources of run-off which are not considered point sources. Western and mid-western Senators worked hard to ensure that we were not beginning a new full fledged regulatory program in this

regard. Instead, we provided for a voluntary program where states may participate if they so desire. When states choose to participate in the non-point source program they will become eligible for grants to carry out non-point demonstration and education programs. If states do not choose to participate in the program the only penalty is a lack of federal funds for non-point demonstration projects."); *see also* Daily Trans., 9610:11-9611:2 (Smith Testimony) (neither the Clean Water Act nor EPA has any jurisdiction over dry poultry litter in the IRW); Daily Trans., 455:2-13 (Tolbert Testimony) (EPA does not regulate nonpoint sources at issue in this action).

49. Although there has been some suggestion by Defendants to the contrary, TMDLs do not constitute regulation of non-point source pollution. TMDLs are planning mechanisms designed to help attain water quality standards. They do not regulate. This was made abundantly clear in *City of Arcadia v. U.S. Environmental Protection Agency*, 265 F. Supp. 2d 1142, 1144-45 (N.D. Cal. 2003):

> TMDLs established under Section 303(d)(1) of the CWA function primarily as planning devices and are not self-executing. *Pronsolino v. Nastri*, 291 F.3d 1123, 1129 (9th Cir. 2002) ("TMDLs are primarily informational tools that allow the states to proceed from the identification of waters requiring additional planning to the required plans.") (*citing Alaska Ctr. for the Env't v. Browner*, 20 F.3d 981, 984-85 (9th Cir. 1994)). A TMDL does not, by itself, prohibit any conduct or require any actions. Instead, each TMDL represents a goal that may be implemented by adjusting pollutant discharge requirements in individual NPDES permits or establishing nonpoint source controls. *See, e.g., Sierra Club v. Meiburg*, 296 F.3d 1021, 1025 (11th Cir. 2002) ("Each TMDL serves as the goal for the level of that pollutant in the waterbody to which that TMDL applies. . . . The theory is that individual-discharge permits will be adjusted and other measures taken so that the sum of that pollutant in the waterbody is reduced to the level specified by the TMDL."); *Idaho Sportsmen's Coalition v. Browner*, 951 F.Supp. 962, 966 (W.D. Wash. 1996) ("TMDL development in itself does not reduce pollution. . . . TMDLs inform the design and implementation of pollution control measures."); *Pronsolino*, 291 F.3d at 1129 ("TMDLs serve as a link in an implementation chain that includes . . . state or local plans for point and nonpoint source pollution reduction . . . ."); *Idaho Conservation League v. Thomas*, 91 F.3d 1345, 1347 (9th Cir.1996) (noting that a TMDL sets a goal for reducing pollutants). Thus, a TMDL forms the basis for further administrative actions that

> may require or prohibit conduct with respect to particularized pollutant discharges and waterbodies.

See also Pronsolino v. Nastri, 291 F.3d 1123, 1140 (9th Cir. 2001) ("States must implement TMDLs only to the extent that they seek to avoid losing federal grant money; there is no pertinent statutory provision otherwise requiring implementation of § 303 plans or providing for their enforcement"); *Sierra Club v. Meiburg*, 296 F.3d 1021, 1026 (11th Cir. 2002) ("The Act generally leaves regulation of non-point source discharges [sic] through the implementation of TMDLs to the states").

50. Defendants have also suggested that section 319 programs constitute federal regulation of non-point source pollution. Again Defendants are incorrect in their analysis. Section 319 is a voluntary program. It merely provides grant money to participating states to assist them in developing and implementing non-point source pollution programs. *See* 33 U.S.C. § 1329(b) (no requirement that a state management program include regulatory limits on non-point sources); *see also Natural Resources Defense Council v. EPA*, 915 F.2d 1314, 1318 (9th Cir. 1990) ("Section 319 does not require states to penalize nonpoint source polluters who fail to adopt best management practices; rather it provides for grants to encourage the adoption of such practices"); *Oregon Natural Desert Association v. Dombeck*, 172 F.3d 1092, 1096-97 (9th Cir. 1998) ("Nonpoint source pollution is not regulated directly by the Act . . . . [T]he Act provides no direct mechanism to control nonpoint source pollution but rather uses the 'threat and promise' of federal grants to the states to accomplish this task") (citations omitted); *Pronsolino*, 291 F.3d at 1140 n. 19 ("In keeping with its broad sweep, § 319's provisions are voluntary. States may choose to participate or not") (citation omitted)).

51. In sum, applying the displacement principles outlined above, with regard to non-point source pollution, there is no federal regulation. Where there is no federal regulation on

point -- let alone "a comprehensive regulatory program" of the sort underlying the holding in *Milwaukee II* or *National Sea Clammers* -- there can be no displacement of federal common law. The Clean Water Act does not regulate non-point source pollution, so there is no basis to suggest that the Clean Water Act "speaks directly to the question addressed by the common law" and "addresses the problem." Displacement is therefore not triggered. The presumption favoring the retention of federal common law should be followed, and the federal common law of nuisance will be applied to conduct occurring in Arkansas and causing harm in Oklahoma.[121]

---

[121] Inasmuch as the Court has determined that the federal rather than the state common law of nuisance applies to conduct in Arkansas causing injury to Oklahoma waters, Defendants' assertion that "the Dormant Commerce Clause preempts or displaces some or all of the State's claims," *see* DKT #2641 at p. 17 (¶ 23), has no traction. *See* U.S. Const., art. I, § 8.

Moreover, it is worth noting that Defendants' dormant Commerce Clause argument would have no traction even were this Court to have determined that the federal common law did not apply to conduct in Arkansas causing injury to Oklahoma waters. First, were the Court to have so determined, a choice of law analysis would have required this Court to apply the Oklahoma common law of nuisance applied to conduct in Arkansas causing injury to Oklahoma waters. This is because Oklahoma applies the "most significant relationship test" set forth in the *Restatement (Second) of Conflict of Laws* in determining choice of law issues. *See Gaines-Tabb v. ICI Explosives, USA, Inc.*, 160 F.3d 613, 619-620 (10th Cir. 1998) *citing Beard v. Viene*, 826 P.2d 990, 995 (Okla. 1999); *Brickner v. Gooden*, 525 P.2d 632, 637 (Okla. 1974). The Supreme Court of Oklahoma has explained that "the rights and liabilities of parties with respect to a particular issue in tort shall be determined by the local law of the state which, with respect to that issue, has the most significant relationship to the occurrence and the parties." *Brickner*, 525 P.2d at 637. The factors to be evaluated, according to their relative importance with respect to a particular tort are: (1) the place where the injury occurred; (2) the place where the conduct causing the injury occurred; (3) the domicile, residence, nationality, place of incorporation and place of business of the parties; and (4) the place where the relationship, if any, between the parties occurred. *See Brickner*, 525 P.2d at 637. Importantly, the Supreme Court of Oklahoma has stated that "we can think of no greater 'significant contact' than where a state or its political subdivision" is involved in a case. *See Beard*, 826 P.2d at 996; *see also* Comment e to *Restatement (Second) of Conflict of Laws*, § 147 ("the local law of the state where the injury occurred to the tangible thing will usually be applied to determine most issues involving the tort . . . on the rare occasions when the conduct and the resulting injury to the thing occur in different states").

Second, it is doubtful that the dormant Commerce Clause analysis even has applicability to state common law causes of action (as opposed by state statutes or regulations). *See CTS Corp. v. Dynamics Corp. of America*, 481 U.S. 69 (1987) ("The principal objects of dormant Commerce Clause scrutiny are statutes that discriminate against interstate commerce.")

5. Substantive Similarity of State Law Nuisance and Federal Common Law of Nuisance

52. The State's Oklahoma state law nuisance claim pertains to conduct occurring in Oklahoma and causing harm in Oklahoma, while the State's federal common law nuisance claim pertains to conduct occurring in Arkansas and causing harm in Oklahoma. *See* DKT #2641 at pp. 10-13 (¶¶ 55-71).

53. From the caselaw discussed above, it is clear that Oklahoma state law nuisance and federal common law nuisance are substantively similar. As such, with respect to the nuisance claims being asserted in this case, it is unnecessary to distinguish between conduct occurring in Oklahoma and conduct occurring in Arkansas. *Cf. Nuveen Premium Income Mun. Fund 4, Inc. v. Morgan Keegan & Co.*, 200 F. Supp. 2d 1313, 1317 n. 2 (W.D. Okla. 2002) ("[T]he laws of the various jurisdictions which have an arguable connection to the case were

---

(emphasis added); *Camden County Board of Chosen Freeholders v. Beretta U.S.A. Corp.*, 123 F.Supp.2d 245, 254 (D.N.J. 2000) ("The applicability of the dormant commerce clause to causes of action under state tort law is unsettled. Typically, the cases focusing on the commerce clause have considered state statutes or regulations, not lawsuits. . . . [T]he Third Circuit has voiced doubt that suits brought under state common law can ever be subject to dormant commerce clause analysis."); *NAACP v. Acusport, Inc.* 271 F. Supp. 2d 435, 464 (E.D.N.Y. 2003) ("The Commerce Clause is not designed to prevent individual states from protecting those within the state from tortious action by those engaged in commerce whose products or activities put the state's citizens at risk"); *City of New York v. Beretta U.S.A. Corp.*, 315 F. Supp. 2d 256, 285 (E.D.N.Y. 2004) (Commerce Clause "should not be used to immunize out-of-state actors from the legitimate reach of a state's tort and nuisance doctrine") (citations omitted); *Crowley v. Cybersource Corp.*, 166 F.Supp.2d 1263, 1272 (N.D. Cal. 2001) (rejecting argument that state law tort claims violated dormant Commerce Clause).

And third, even were a dormant Commerce Clause analysis applicable, the Oklahoma common law of nuisance would easily survive scrutiny under *Pike v. Bruce Church, Inc.*, 397 U.S. 137 (1970). *Pike* provides that where state law acts "even-handedly to effectuate a legitimate local public interest, and its effects on interstate commerce are only incidental, it will be upheld unless the burden imposed on such commerce is clearly excessive in relation to the putative local benefits." *See Pike*, 397 U.S. at 142. The Oklahoma common law of nuisance acts even-handedly in that it does not distinguish between in-state and out-of-state businesses, it effectuates a legitimate local public interest -- namely the prevention of pollution of the waters of the State, and there is no evidence that any burden that might be imposed on interstate commerce is clearly excessive in relation to the putative local benefits.

substantially similar. Therefore, a conflict of laws determination was not required."). The claims will therefore be treated together.

6. Analysis of Claims

54. The State attempts to impose liability on Defendants for the environmental consequences of poultry waste generated by their birds in the IRW on the basis of direct liability and vicarious liability theories.

a. Direct Liability

i. Defendants' Business Structure and Conduct

55. Each Defendant, through its own independent conduct, is contributing to the phosphorus loading to the waters of the IRW. Thus, Defendants may be held liable in nuisance regardless of the application of any vicarious liability theory. Specifically, each Defendant has structured and conducted its business in the IRW such that pollution of the waters of the IRW is inevitable.

56. Under this business structure each Defendant has consciously concentrated its poultry operations in the environmentally-sensitive IRW. *See* FOF, ¶¶ 15-35, 68-72, 345-352, 477-79. Each Defendant owns the birds it places in the IRW and has placed huge numbers of these birds in the IRW. *See* FOF, ¶¶ 306-11, 316. Moreover, each Defendant has brought enormous amounts of phosphorus into the environmentally-sensitive IRW to feed those birds. *See* FOF, ¶¶ 317-18, 360-61.

57. The generation of enormous quantities of phosphorus-laden poultry waste necessarily follows from the growing of these Defendants' birds in the IRW. *See* FOF, ¶¶ 355, 362, 365-67, 370. Each Defendants knows that it is the common practice to land apply poultry waste in the IRW. *See* FOF, ¶¶ 371-72, 377. And each Defendant knows or should know of the

environmental harms to the IRW posed by the land application of such poultry waste. *See* FOF, ¶¶ 604-10, 656-85. Yet, despite this knowledge, none of the Defendants has made provision for the appropriate management of the enormous amounts of poultry waste generated by their birds in the IRW. *See* FOF, ¶¶ 396-401. On the contrary, Defendants have simply continued placing more birds in the IRW and continued importing the massive quantities of phosphorus into the IRW necessary to feed those birds, with full knowledge that the poultry waste generated by these birds will be spread in the environmentally-sensitive IRW. *See* FOF, ¶¶ 15-35, 68-72, 306-11, 316-18, 360-61, 371-72, 377, 477-79.

58. As a result of this failure by Defendants to make provision for the appropriate management of this poultry waste, the vast majority of this poultry waste has in fact been land-applied to the already phosphorus-saturated soils of the IRW where an environmentally-significant fraction of the phosphorus in this land-applied poultry waste runs off the fields and enters the waters of the IRW. *See* FOF, ¶¶ 365-66, 368, 371-72, 377, 391, 393-95, 439-635. As to all Defendants except Defendant Peterson and Defendant Cal-Maine, which have recently discontinued their poultry operations in the IRW, these practices continue to this day. *See* FOF, ¶¶ 305-11. Significantly, however, because phosphorus from land-applied poultry waste has banked in the soils, phosphorus from even Defendant Peterson's and Defendant Cal-Maine's birds will continue to runoff for years to come. *See* FOF, ¶¶ 453, 576, 639-40.

ii. Company-Owned and Company-Managed Farms

59. In addition, the Tyson Defendants, the Cargill Defendants and the George's Defendants are directly liable due to their facial mismanagement of poultry waste on their respective company-owned and / or company-managed farms within the IRW. *See* FOF, ¶ 394. The evidence shows that some of the highest known STP values in the entire IRW have been

documented at these company-owned and company-managed farms. *See* FOF, ¶ 394. Indeed, one of the highest STP results in the trial record -- 2166 lbs./acre -- was from the Ritter Farm, which is managed by the George's Defendants. *See* FOF, ¶ 394. These high soil test phosphorus levels are compelling evidence of overapplication of poultry waste by these Defendants. *See* FOF, ¶¶ 386, 392. An environmentally-significant fraction of phosphorus in all poultry waste that is land applied in the IRW -- approximately 5 percent -- runs off. *See* FOF, ¶¶ 623-35. What is more, high STP levels increase the likelihood of runoff and contribute to continued phosphorus runoff even after land application ceases. *See* FOF, ¶¶ 451, 453, 576, 639-40.

iii. Defendants' Direct Liability for the State's Injuries

60. The evidence clearly demonstrates that: (a) phosphorus from land-applied poultry waste is a significant source of the increased phosphorus concentrations found in the waters of the IRW, *see* FOF, ¶¶ 439-635; and (b) these increased phosphorus concentrations have resulted in injuries to the waters and streams of the IRW in Oklahoma and Lake Tenkiller. *See* FOF, ¶¶ 101-259.

61. The structure and conduct of each Defendant's business operations in the IRW, together with each Defendant's failure to properly manage the poultry waste generated as a result of those operations, has "contributed to phosphorus loading in the Watershed and that the phosphorus in the Watershed has resulted in the harm and damages sustained by plaintiffs." *See City of Tulsa*, 258 F. Supp. 2d at 1300.

62. Likewise, the land application of poultry waste by the Tyson Defendants, the Cargill Defendants, and the George's Defendants at their respective company-owned / company-managed farms has "contributed to phosphorus loading in the Watershed and that the phosphorus

in the Watershed has resulted in the harm and damages sustained by plaintiffs." *See City of Tulsa*, 258 F. Supp. 2d at 1300.

63. The State's injuries from the phosphorus concentrations in the rivers and streams of the IRW and Lake Tenkiller are significant, *see* FOF, ¶¶ 101-259, and thus constitute an unreasonable interference with a right common to the general public. For the foregoing reasons, each Defendant is directly liable in state and federal common law public nuisance, regardless of the applicability of any vicarious liability theory.

b. Vicarious Liability

64. The State contends that Defendants' liability arises not only from their own direct conduct discussed above, but also from the conduct of others, which can be attributed to Defendants through the application of principles of vicarious liability. Specifically, the State contends that Defendants have vicarious liability for the acts of their respective growers (and of third persons to whom poultry waste is transferred for application on third-party land in the IRW) through application of employer-employee / principal-agent principles and/or Restatement (Second) of Torts, § 427B. Accordingly, an analysis of these theories of liability follows.

i. Employer-Employee / Principal-Agent Liability

65. It is black-letter law that if a person was the employee of a defendant and was acting within the scope of his / her employment at the time of the conduct complained of, then any act or omission of that employee at that time is, as a matter of law, the act or omission of the defendant employing that employee. *See Bierman v. Aramark Refreshment Services, Inc.*, 198 P.3d 877, 879 n.3 (Okla. 2008); Restatement (Third) of Agency, § 2.04. Similarly, it is black-letter law that if a person was the agent of a defendant and was acting within the scope of his / her agency at the time of the conduct complained of, then any act or omission of that agent at

that time is, as a matter of law, the act or omission of that defendant. *See In re Brown*, 412 F. Supp. 1066, 1070-1071 (Bankr. W.D. Okla. 1972); Restatement (Third) of Agency, § 7.04.

66. The determination of whether there has been an employer / employee relationship depends on the facts of the particular case. The following factors are considered in determining whether an employer / employee relationship existed: (a) the nature of the contract between the parties, whether written or oral; (b) the degree of control which, by the agreement, the employer may exercise on the details of the work or the independence enjoyed by the contractor or agent; (c) whether or not the one employed is engaged in a distinct occupation or business and whether he carries on such occupation or business for others; (d) the kind of occupation with reference to whether, in the locality, the work is usually done under the direction of the employer or by a specialist without supervision; (e) the skill required in the particular occupation; (f) whether the employer or the workman supplies the instrumentalities, tools and the place of work for the person doing the work; (g) the length of time for which the person is employed; (h) the method of payment, whether by the time or by the job; (i) whether or not the work is a part of the regular business of the employer; (j) whether or not the parties believe they are creating the relationship of master and servant; and (k) the right of either party to terminate the relationship without liability. *See City of Tulsa*, 258 F. Supp. 2d at 1293 (citing *Page v. Hardy*, 334 P.2d 782, 784-85 (Okla. 1959); *Duncan v. Powers Imports*, 884 P.2d 854, 856 n.1 (Okla. 1994); *Coleman v. J.C. Penney Co.*, 848 P.2d 1158, 1160 (Okla. 1993)); Restatement (Third) of Agency, § 7.07, cmt. f.

67. "A decisive factor is the control exerted by the employer over the work." *City of Tulsa*, 258 F. Supp. 2d at 1293 (citing *Bouziden v. Alfalfa Electrical Cooperative, Inc.*, 16 P.3d 450, 459 (Okla. 2000)); Restatement (Third) of Agency, § 7.07(2).

68. The determination of whether there has been a principal / agent relationship likewise depends on the facts of the particular case. A principal / agent relationship is determined by the parties' status, which is found from surrounding facts and is not dictated by the contract. *See Enterprise Management Consultants, Inc. v. State of Oklahoma ex rel. the Oklahoma Tax Commission*, 768 P.2d 359, 362 n. 12 (Okla. 1988); Restatement (Third) of Agency, § 1.01, cmt. c. In the event of a discrepancy between facts and contract language, facts control over contrary contractual language. *See Enterprise Management Consultants*, 768 P.2d at 362 n.12.

69. "The central factor in determining whether an agency relationship exists is the principal's right to, as well as its exercise of, control over the agent." *See Wathor v. Mutual Assurance Administrators, Inc.*, 87 P.3d 559, 566-67 (Okla. 2004); Restatement (Third) of Agency, § 1.01, cmt. f. The essence of a principal / agent relationship is the principal's power to give directions and the agent's duty to obey them.[122] *See Wathor*, 87 P.3d at 566-67.

---

[122] An agent is acting within the scope of his / her authority if (1) he / she is engaged in the transaction of business that has been assigned to him / her by his / her principal, or (2) if he / she is doing anything that may reasonably be said to have been contemplated as a part of his / her agency. *See Walker Valley Oil & Gas Co. v. Parks & Palmer*, 262 P. 672, 674 (Okla. 1928); Restatement (Third) of Agency, § 2.02. It is not necessary that an act or failure to act must have been expressly authorized by the principal. *See Walker Valley Oil*, 262 P. at 674.

In addition to the express authority conferred on him / her by his / her principal, an agent has the authority to do such acts as are incidental to, or reasonably necessary to accomplish, the intended result. *See Ivey v. Wood*, 387 P.2d 621, 625 (Okla. 1963); Restatement (Third) of Agency, § 2.02 (2). An agent also has the implied authority to do such acts as are usual and customary in the business, and of which the principal has knowledge or should have had knowledge. *See Ocean Acc. & Guarantee Corp. Ltd., v. Denner*, 250 P.2d 217, 220 (Okla. 1952); Restatement (Third) of Agency, § 2.02, cmt. e.

When one person acts or purports to act as an agent for another, but does so without authority, and the person for whom he / she acted thereafter confirms such action, by words or conduct, with knowledge of all the material facts, such words or conduct are a ratification of the act, and are the same as if it had been authorized originally. *See In re Brown, 412* F. Supp. at 1071; Restatement (Third) of Agency, § 4.01. If the principal ratifies any part of the act, it

70. Applying these legal principles to the facts at hand, the Court concludes that the growers are the employees / agents of the respective Defendants for which they grow. For instance, Defendants exercise extraordinary control over the grower. Defendants typically dictate the specifications for the grower's grow houses (*i.e.*, the nature of the facilities where the grower works), *see* FOF, ¶ 325, decide how many birds they will place with the grower (*i.e.*, how much work the grower has), *see* FOF, ¶ 322, decide when they will place those birds with the grower (*i.e.*, when the grower's work begins), *see* FOF, ¶ 321, retain ownership of the birds throughout the growing process (*i.e.*, the work piece), *see* FOF, ¶ 316, dictate the constituents of the feed the birds will be fed (*i.e.*, what the inputs to the work piece will be), *see* FOF, ¶¶ 317-18, own the feed (*i.e.*, the inputs to the work piece), provide the veterinary services and medications required by the birds, *see* FOF, ¶¶ 319-20, regularly visit the growing operations to inspect, supervise and give advice and recommendations to the grower (*i.e.*, how the in-progress work is performed), *see* FOF, ¶ 326, provide manuals and handbooks to the grower (*i.e.*, how the in progress work is performed), *see* FOF, ¶ 333, decide when they will pick up the birds (*i.e.*, when the grower's work is done), *see* FOF, ¶ 323, and specify and make recommendations when to do cake-outs and clean-outs (*i.e.*, when to clean up the facilities), *see* FOF, ¶ 328. Defendants retain discretion to terminate the agreements with the grower, not deliver birds, or take possession of the birds being grown. *See* FOF, ¶ 329. Yet further, Defendants' contracts with the grower are non-negotiable. *See* FOF, ¶ 330.

71. At the same time, to enter the poultry growing business requires a significant long-term capital investment. *See* FOF, ¶ 335. There is no open market for poultry in the IRW.

---

ratifies all of it. *See Bradburn v. McIntosh*, 159 F.2d 935, 938 (10th Cir. 1947); Restatement (Third) of Agency, § 4.01, cmt. b.

See FOF, ¶ 337. There are comparatively few integrators in the IRW. *See* FOF, ¶¶ 303, 306-11, 336. Contracts are typically short-term. *See* FOF, ¶ 338.

72. Thus, the facts as applied to factors (b), (c), (d), (f), (g), (i) and (k) set out above all support the proposition that the integrator-grower relationship is one of employer-employee / principal-agent. Moreover, as the Court has already found, *see* FOF, ¶ 343, Defendants have and exercise control over essential aspects of integrator-grower relationship. This level of control is decisive to the determination. *See City of Tulsa*, 258 F. Supp. 2d at 1293 (citing *Bouziden v. Alfalfa Electrical Cooperative, Inc.*, 16 P.3d 450, 459 (Okla. 2000)); Restatement (Third) of Agency, § 7.07(2); *Wathor*, 87 P.3d at 566-67; Restatement (Third) of Agency, § 1.01, cmt. f. The growers are the employees / agents of the respective Defendants.

73. The proposition that a grower can be the employee or agent of an integrator is not at all novel. *See, e.g., Tyson Foods, Inc. v. Stevens*, 783 So.2d 804, 808-09 (Ala. 2000) ("Tyson also argues that the trial court erred in accepting the jury's finding of an agency relationship between Tyson and Burnett. . . . [T]he trial court did not err in sustaining the jury's verdict as to this issue."); *Sierra Club, Inc. v. Tyson Foods, Inc.*, 299 F. Supp. 2d 693, 719-721 (W.D. Ky. 2003) ("While the *Stevens* case does not address liability under CERCLA or EPCRA, the Court finds that it does adequately describe the Tyson's relationship, or in this case Tyson Chicken's relationship, with its growers. . . . [T]he Court concludes that Tyson Chicken is a 'person in charge' of the Tyson, Adams, and Buchanan Facilities and is subject to the reporting requirements of CERCLA."); Okla. Atty. Gen. Op. 2001-17.

74. Defendants assert that to the extent the growers are found to be Defendants' employees / agents, any tortious conduct would be outside the scope of the agency / employment. *See* DKT #2641 at p. 4 (¶ 13). This assertion must be rejected. Within the

structure of the Defendant-grower relationship, the disposal of poultry waste from the grow house is a necessary part of the grower's task and its disposal by land application by the grower is well-known to Defendants, *see* FOF, ¶¶ 371-72, 377, and thus within the scope of the agency / employment.

75. Because the growers are the employees / agents of the respective Defendants for which they grow, Defendants are liable for acts of their respective growers. *See* COL, ¶ 75.

76. Each Defendant has placed significant numbers of birds with its growers in the environmentally-sensitive IRW. *See* FOF, ¶¶ 15-35, 68-72, 306-11, 477-79. These birds have produced enormous quantities of phosphorus-laden poultry waste. *See* FOF, ¶¶ 355, 362, 365-67, 370. Poultry waste generated by each Defendant's birds has been land applied to the phosphorus-saturated soils of the IRW in close proximity to where it is generated. *See* FOF, ¶¶ 371-72, 377-78, 391, 393-95. Poultry waste generated by each Defendant's birds is fungible in its characteristics and behavior in the environment. *See* FOF, ¶ 611. An environmentally-significant fraction of phosphorus in all poultry waste that is land applied in the IRW -- approximately 5 percent -- runs off. *See* FOF, ¶¶ 611-35.

77. As discussed above, the evidence clearly demonstrates that: (a) phosphorus from land-applied poultry waste is a significant source of the increased phosphorus concentrations found in the waters of the IRW, *see* FOF, ¶¶ 439-635; and (b) these increased phosphorus concentrations have resulted in injuries to the waters and streams of the IRW in Oklahoma and Lake Tenkiller. *See* FOF, ¶¶ 101-259.

78. Land application in the IRW of poultry waste generated by each Defendant's birds that have been placed with growers has "contributed to phosphorus loading in the Watershed and

that the phosphorus in the Watershed has resulted in the harm and damages sustained by plaintiffs." *City of Tulsa*, 258 F. Supp. 2d at 1300.

79. The State's injuries from the phosphorus concentrations in the rivers and streams of the IRW and Lake Tenkiller are significant, *see* FOF, ¶¶ 101-259, and thus constitute an unreasonable interference with a right common to the general public. For the foregoing reasons, each Defendant is vicariously liable in state and federal common law public nuisance under employer-employee / principal-agent theories for the acts of its growers.

ii. Restatement of Torts (Second), § 427B Liability

80. As an additional and alternative ground for holding Defendants responsible for the acts of their growers, the State relies upon Restatement of Torts (Second), § 427B.

81. The law is well established that one is liable for the acts of one's independent contractor if one is aware or should be aware that in the ordinary course of doing the contract work a nuisance or trespass is likely to result. *See, e.g., Weinman v. De Palma*, 232 U.S. 571, 575 (1914) ("the 'independent contractor' doctrine [does not] apply where the work that the contractor is to do of itself amounts to a nuisance or necessarily operates to injure or destroy the property of plaintiff."); *McQuilken v. A&R Development Corp.*, 576 F. Supp. 1023, 1033 (E.D. Pa. 1983) ("An employer or contractor is held liable for "farming out" work which he knows, or has reason to know, will create a nuisance."); *Bleeda v. Hickman-Williams & Co.*, 205 N.W.2d 85 (Mich. App. 1972); *Peairs v. Florida Publishing Co.*, 132 So. 2d 561 (Fla. 1st DCA 1961); *Shannon v. Missouri Valley Limestone Co.*, 122 N.W.2d 278 (Iowa 1963). Furthermore, an employer / contractor with notice of an activity that is likely to cause a trespass or nuisance is itself required to halt or suppress the activity. *See, e.g., Peairs*, 132 So.2d at 565 ("[w]here a company gains knowledge of a dangerous situation created by its independent contractor, it may

incur liability through its failure to halt the operation or correct it . . .") (quotations omitted); *Shannon*, 122 N.W.2d at 281 (it is the duty of the employer / contractor, upon receiving notice, "to take reasonably prompt and efficient means to suppress the nuisance").

82. Restatement (Second) of Torts, § 427B sets forth the principle of liability most clearly:

> One who employs an independent contractor to do work which the employer knows or has reason to know to be likely to involve a trespass upon the land of another or the creation of a public or a private nuisance, is subject to liability for harm resulting to others from such trespass or nuisance.

(Emphasis added.) Comment b to § 427B explains:

> This exception applies to work which involves a trespass on the land of another, or either a public or a private nuisance. It applies in particular where the contractor is directed or authorized by the employer to commit such a trespass, or to create such a nuisance, and where the trespass or nuisance is a necessary result of doing the work, as where the construction of a dam will necessarily flood other land. It is not, however, necessary to the application of the rule that the trespass or nuisance be directed or authorized, or that it shall necessarily follow from the work. It is sufficient that the employer has reason to recognize that, in the ordinary course of doing the work in the usual or prescribed manner, the trespass or nuisance is likely to result.

(Emphasis added); *see also* 58 Am. Jur. 2d, *Nuisances*, § 127 ("Where an independent contractor's work, performed in the ordinary manner, creates a nuisance, the contractor's employer may be held liable for that nuisance. Thus, an employer or contractor who farms out work and who knows or has reason to know that it will create a nuisance is subject to liability for the harm caused others by the nuisance; in such cases it is immaterial whether the employer owns the land from which the nuisance emanates. It is also immaterial in determining liability for nuisance that the employer refrains from directing the employee or contractor in the execution of the work procured to be done.").

83. This mainstream principle of law articulated in Restatement (Second) of Torts, § 427B is entirely consistent with Oklahoma law. *See Tankersley v. Webster*, 243 P. 745, 747 (Okla. 1925) (acknowledging the rule that "where the performance of [a] contract, in the ordinary mode of doing the work, necessarily or naturally results in producing the defect or nuisance which caused the injury, then the employer is subject to the same liability as the contractor."). Moreover, and in any event, courts in Oklahoma routinely look to the Restatement for guidance and apply its principles. *See, e.g., Tansy v. Dacomed Corp.*, 890 P.2d 881, 883-84 (Okla. 1994) (applying Restatement (Second) of Torts § 402A regarding product liability); *Wright v. Grove Sun Newspaper Co.*, 873 P.3d 983, 989 (Okla. 1994) (applying Restatement (Second) of Torts § 611 regarding common-law fair report privilege); *Schovanec v. Archdiocese of Oklahoma City*, 188 P.3d 158, 169-71 (2008) (applying Restatement (First) of Agency § 213 and Restatement §§ 12 & 317 regarding employers' reason to know of employee likely to harm others); *Miller v. Miller*, 956 P.2d 887, 899 (Okla. 1998) (applying Restatement (Second) of Torts § 46 regarding intentional infliction of emotional distress).

84. It is also consistent with the federal common law. *See, e.g., American Electric Power*, 582 F.3d at 327 ("as a general matter, the Supreme Court and this Court have often turned to the Restatement (Second) of Torts for assistance in developing standards in a variety of tort cases").

85. The Court thus concludes as a matter of law that the Oklahoma courts would adopt and apply Restatement (Second) of Torts, § 427B, and that Restatement (Second) of Torts, § 427B is a part of the federal common law.

86. Applying the facts to Restatement (Second) of Torts, § 427B, as well as accepting solely for purposes of this analysis that Defendants' growers were independent contractors, the

Court concludes that each Defendant has employed independent contractors to do work which each Defendant knew or had reason to know was likely to involve the creation of a public nuisance, and as a result each Defendant is subject to liability for harm resulting to the State from such nuisance. *See* Restatement (Second) of Torts, § 427B.

87. Specifically, each Defendant has known (or should have known) that in the ordinary course of its growers performing the work of raising its birds in the IRW, enormous quantities of phosphorus-laden poultry waste are generated, which have no further use in the poultry growing process and which must be disposed of. *See* FOF, ¶¶ 355, 357, 365-67. Each Defendant has known (or should have known) that it is the practice in the IRW that the majority of this poultry waste is applied to the phosphorus-saturated soils in the IRW in close proximity to where it has been generated and in a concentrated time-frame that coincides with the largest amounts of rainfall. *See* FOF, ¶¶ 371-72, 376-78, 391, 393-95. Each Defendant has long known (or should have known) that the practice of land applying this poultry waste in the IRW can, and does, result in the run-off of phosphorus from the land into the rivers and streams of the IRW and Lake Tenkiller. *See* FOF, ¶¶ 604-10, 656-85. Each Defendant has long known (or should have known) that elevated levels of phosphorus cause injuries to the aquatic environment, that the waters of the IRW have been injured by elevated levels of phosphorus, and that land-applied poultry waste is a significant source of these elevated levels of phosphorus. *See, e.g.*, FOF, ¶¶ 101-259, 604-16, 623-33, 656-85. Despite having clear reason to recognize that the past land application of poultry waste from its birds by its growers (and third persons to whom the contracts growers have transferred the poultry waste) has been polluting the waters of the IRW, each Defendant has failed to halt the practice, and in fact -- with the exception of Defendant Peterson and Defendant Cal-Maine who have recently ceased poultry operations in the IRW --

has continued to place new flocks of birds with its growers knowing that the majority of the poultry waste from these birds will continue to be land applied in the IRW, continue to run off into the waters of the IRW, and continue to cause pollution of the waters of the IRW. *See* FOF, ¶¶ 15-35, 68-72, 306-11, 316-18, 360-61, 371-72, 477-79.

88. Not only has each Defendant known (or should have known) the foregoing facts, but also that a nuisance has in fact been created by the performance of the work by the grower. Poultry waste generated by each Defendant's birds has indeed been land applied to the phosphorus-saturated soils of the IRW in close proximity to where it is generated. *See* FOF, ¶¶ 371-72, 377-78, 391, 393-95. Environmentally-significant amounts of phosphorus from each of these land applications of poultry waste has indeed run off in the waters of the IRW. *See* FOF, ¶¶ 439-635. This phosphorus from land-applied poultry waste is a significant source of the increased phosphorus concentrations found in the waters of the IRW. *See* FOF, ¶¶ 611-35. And these increased phosphorus concentrations have resulted in injuries to the waters and streams of the IRW in Oklahoma and Lake Tenkiller. *See* FOF, ¶¶ 101-259.

89. As such, land application in the IRW of poultry waste generated by each Defendant's birds that have been placed with growers has "contributed to phosphorus loading in the Watershed and that the phosphorus in the Watershed has resulted in the harm and damages sustained by plaintiffs." *See City of Tulsa*, 258 F. Supp. 2d at 1300.

90. The State's injuries from the phosphorus concentrations in the rivers and streams of the IRW and Lake Tenkiller are significant, *see* FOF, ¶¶ 101-259, and thus constitute an unreasonable interference with a right common to the general public. For the foregoing reasons, each Defendant is vicariously liable in state and federal common law public nuisance under Restatement (Second) of Torts, § 427B theories for the acts of its growers.

91. The Court notes that its conclusions as to the applicability and actual application of Restatement (Second) of Torts, § 427B are consistent with that of Chief Judge Eagan in the *City of Tulsa* case when faced with a very similar set of facts (recognizing of course that under the posture of that case Chief Judge Eagan did not reach the merits of the nuisance and trespass claims):

> The Court concludes that the exception applies in this case. Poultry waste "necessarily follows" from the "growing" of poultry. *See Bleeda*, 205 N.W.2d at 89. Although Poultry Defendants cite other sources of phosphorus in the Watershed, they admit in their response brief that they were aware in the 1990s that "phosphorus presented potential problems to the Watershed" and, therefore, attempted to address the problem by educating their growers regarding better litter management. Given these admissions, the Court finds Poultry Defendants had "reason to recognize that, in the ordinary course of [the growers] doing the work in the usual or prescribed manner, the trespass or nuisance is likely to result." Restatement (Second) Torts § 427B, cmt. b (1965); *Tankersley*, 243 P. at 747. As the Court concludes that the § 427B exception applies herein, the factual questions regarding the Poultry Defendants' degree of control over their growers need not be addressed at the jury trial. Accordingly, the Court grants plaintiffs' motion for partial summary judgment on the issue of the Poultry Defendants' vicarious liability for any trespass or nuisance created by their growers because they were aware that in the ordinary course of doing the contract work, a trespass or nuisance was likely to result.

See City of Tulsa, 258 F. Supp. 2d at 1296-97.

92. Although not conceding liability under it, Defendants do not seriously appear to contest the applicability of Restatement (Second) of Torts, § 427B to instances where an applicator is applying poultry waste on Defendants' land (*e.g.*, at a company-owned farm) or where a grower (or an applicator acting on the grower's behalf) is applying poultry waste on a grower's land. *See, e.g.,* DKT # 2407. Rather, Defendants argue that Restatement (Second) of Torts, § 427B is inapplicable in those instances where poultry waste is transferred to a third person for land application on a third person's land.

93. The applicability of Restatement (Second) of Torts, § 427B to a set of circumstances is, of course, fact dependent. The analysis of Defendants' argument begins with identifying what the contracted-for "work" is, and then proceeds to an analysis of what the ordinary course of performing that "work" in the usual or prescribed manner is and whether, when that "work" is performed in the usual or prescribed manner, it is known or knowable to the principal that a trespass or nuisance is likely to result. Restatement (Second) of Torts, § 427B & cmt. b.

94. The "work" is growing poultry. Poultry waste necessarily follows from the growing of poultry, as does the need for its disposal. *See* FOF, ¶¶ 357. The removal and disposal -- including the arrangement for the disposal -- of this poultry waste is part and parcel of the ordinary course of the work of growing poultry performed by the poultry grower. *See* FOF, ¶¶ 356-57. Because of the enormous amounts of poultry waste generated in growing poultry and the fact that many growers' lands are over-saturated with phosphorus from previous land disposals of poultry waste, *see* FOF, ¶¶ 355, 365-66, 391, 393-95, the work of disposing of the poultry waste -- part of the ordinary course of growing poultry in the usual or prescribed manner -- plainly and foreseeably can include transferring some portion of such waste to third persons for land application on non-grower / non-integrator property. Finally, it is known or knowable that this transferred poultry waste will be disposed of in the IRW in the same manner as other poultry waste in the IRW, *see* FOF, ¶¶ 372-76, and that such disposal can and does result in runoff of phosphorus into the waters of the State., thereby causing or likely causing a nuisance and/or trespass. *See* FOF, ¶¶ 101-259, 439-635, 656-685. Under the facts of this case, the Court thus concludes that Restatement (Second) of Torts, § 427B is applicable in those instances where poultry waste is transferred to a third person for land application on a third person's land in the

IRW, and, that therefore there is no need to segregate out transferred land-applied waste from land-applied poultry waste as a whole.[123] To adopt Defendants' interpretation of Restatement (Second) of Torts, § 427B would improperly create an unintended safe harbor of allowing one to contract away liability for conduct creating a foreseeable nuisance.

8. The AWMPs and 50 Okla. Stat. § 4

95. As an affirmative defense Defendants argue that runoff and pollution from land application of poultry waste in the IRW made pursuant to an AWMP is immunized from liability on the ground that such land applications are "done or maintained under the express authority of a statute." *See* 50 Okla. Stat. § 4 ("Nothing which is done or maintained under the express authority of a statute can be deemed a nuisance.").

96. Defendants' argument fails for multiple reasons.

97. At the outset, Defendants' argument fundamentally misunderstands the purpose, requirements and operation of the ORPFOA. The purpose of the ORPFOA is to prevent runoff and pollution, not to authorize them. *See* FOF, ¶ 408. The ORPFOA is a registration act, not a permitting act. *See* FOF, ¶¶ 409-10, 416. Nothing in the ORPFOA allows runoff. *See* FOF, ¶¶ 411-12.

98. The ORPFOA could not be clearer that there is to be <u>no</u> runoff of or pollution in the management of poultry waste. Specifically, registered poultry feeding operations in Oklahoma are required to utilize best management practices in managing poultry waste. *See* 2 Okla. Stat. § 10-9.7(A). Best management practices are defined in the ORPFOA as "schedules of activities, prohibitions of practices, maintenance procedures and other practices which prevent or reduce the pollution of waters of the state . . . ." *See* 2 Okla. Stat. § 10-9.1(B)(2). Included

[123] In any event, the Court notes that Defendants offered scant evidence concerning this practice.

among the required criteria of the best management practices are that "[p]oultry waste handling, treatment, management and removal shall[] not create an environmental or a public health hazard, [and] not result in the contamination of waters of the state . . . ." *See* 2 Okla. Stat. § 10-9.7(B)(4)(a) & (B)(4)(b) (emphasis added); *see also* FOF, ¶¶ 411-12 (ODAFF deputy general counsel testifying that the ORPFOA specifically provides that discharge or runoff of poultry waste is prohibited).

99. Further, Defendants' argument fundamentally misunderstands the role of AWMPs under the ORPFOA. Best management practices are to be accomplished, in part but by no means exclusively, by means of an AWMP. *See* 2 Okla. Stat. § 10-9.7(C). Under the ORPFOA, an animal waste management plan is "a written plan that includes a combination of conservation and management practices designed to protect the natural resources of the state . . . ." *See* 2 Okla. Stat. § 10-9.1(B)(1) (emphasis added); *see also* FOF, ¶ 412. An animal waste management plan by itself, however, does not guarantee that the State's natural resources will be protected from pollution from poultry waste. *See* FOF, ¶ 412. In fact, the conservation and management practices of an animal waste management plan are all subject to the overarching best management pollution prohibitions and the requirement that, in any application of poultry waste, "[d]ischarge or runoff of waste from the application site is prohibited." *See* 2 Okla. Stat. § 10-9.7(C)(6)(c); *see also* Okla. Admin. Code § 35-17-5-5(a)(7)(C) ("Runoff of poultry waste from the application site is prohibited"). As cogently explained by ODAFF deputy general counsel, Ms. Gunter, in her testimony:

> Mr. Nance: In ODAFF's view, has the State ever consented to the discharge or runoff of waste from a land application site in an AWMP?
> Ms. Gunter: No, not to my knowledge.
> Mr. Nance: If a grower or an operator under the act did everything to the precise written terms of the AWMP, but discharge or runoff occurred from the application site, would that grower be complying with the act?

Ms. Gunter: No.
Mr. Nance: Would that grower be complying with the requirements of a plan?
Ms. Gunter: No, because just generally incorporated with it -- I mean you're not supposed to have discharge or runoff. That's the overarching theme of all of them.
Mr. Nance: Whose responsibility is it under the act to ensure that there is no discharge or runoff from the application site?
Ms. Gunter: It's the grower's or the applicator.

See Daily Trans., 2903:19-2904:11 (Gunter Testimony) (emphasis added); *see also* FOF, ¶ 416 (testifying that ODAFF does not view an AWMP as a permit).

100. Yet further, Defendants' argument fundamentally misunderstands the role of Code 590. While the ORPFOA, through reference to Code 590, provides that there is a cap on the maximum amount of phosphorus from poultry waste that may be land applied in the Oklahoma portion of the IRW, it is just that -- a cap. *See* 2 Okla. Stat. § 10-9.7(D)(3). Nothing in the ORPFOA or any AWMP requires that one apply poultry waste up to the cap of 300 lbs./acre STP in IRW. *See* FOF, ¶¶ 414-15. The role of Code 590 cannot be divorced from the overarching requirement of the ORPFOA, including the requirement that there be no runoff.

101. The Court thus concludes that under the ORPFOA water contamination from, creation of environmental or public health hazards by, and runoff of poultry waste are strictly prohibited, and nothing contained in the ORPFOA or an AWMP can be construed as consent by the State to pollution. Further, the Court concludes that possession of an AWMP, while a requirement of ORPFOA, is not a permit or authorization to land apply poultry waste. Nor is compliance with an AWMP a guarantee that there will be no runoff, water contamination or hazard prohibited by the ORPFOA.

102. In order to receive the protections of 50 Okla. Stat. § 4, nuisance causing acts must be "authorized by the express terms of the statute." *See Herd*, 2003 U.S. Dist. LEXIS 27381, *35-36 ("finding that "[b]ased on the record, the Court finds that the regulations or leases

are not sufficient to be considered authorization of an 'exact method of operation,' such that Defendants' creation of the chat piles and tailing ponds is immune from a nuisance claim"); *see also Briscoe*, 702 P.2d 3at 36; *Heinsohn*, 43 F.3d at 504 (gas plants releasing hydrogen sulfide permitted by environmental authorities still constituted nuisances). Here, runoff and pollution from land applications of poultry waste in the IRW are clearly not "authorized by the express terms of the statute." Therefore, Defendants' affirmative defense fails.

103. Even assuming arguendo that an AWMP could be construed as a permit, an AWMP that were to allow runoff, environmental or human health hazards or water contamination would be clearly inconsistent with the ORPFOA. As such, this Court would be required to respect and effectuate the terms of the ORPFOA, rather than the flawed terms of an AWMP that is inconsistent with the terms of the ORPFOA. *See Sharp v. 251st Street Landfill, Inc.*, 810 P.2d 1270, 1275-76 (Okla. 1991) (DOH permit for landfill subject to injunction because agency decision did not effectuate legislative purpose to prevent a nuisance or water pollution); *see also Burdick v. Independent School District No. 52 of Oklahoma County*, 702 P.2d 48, 53 (Okla. 1985) ("Generally, Oklahoma jurisprudence does not allow the application of estoppel against the state, the political subdivisions or agencies, unless its interposition would further some principle of public policy or interest. The rationale for recognizing a governmental shield from estoppel is to enable the state to protect public policies and interests from being jeopardized by judicial orders preventing full performance of legally-imposed duties"); *State ex rel. Cartwright v. Dunbar*, 618 P.2d 900, 911 (Okla. 1980) ("it is fundamental that a state and its subdivision cannot be estopped from protecting public rights when public officials have acted erroneously or failed to act"). Moreover, in no circumstances would land applications occurring prior to 1998 -- the enactment of the ORPFOA -- be immunized under Defendants' theory.

104. Defendants' contention that compliance with Arkansas laws and regulations pertaining to poultry waste management fall within the ambit of the protections of 50 Okla. Stat. § 4 can be readily dispatched. As Defendants have argued, Oklahoma statutes have no extraterritorial application in Arkansas, so 50 Okla. Stat. § 4 could not immunize conduct in Arkansas. Further, it is axiomatic that Arkansas cannot enact legislation permitting the creation of a nuisance in Oklahoma. Even assuming arguendo it could, however, only land applications postdating the enactment of and in compliance with the Arkansas laws and regulations pertaining to poultry waste management in 2006 would be immunized.

9. 50 Okla. Stat. § 1.1

105. Defendants have raised as an affirmative defense to the State's nuisance claim 50 Okla. Stat. § 1.1, Oklahoma's right to farm law. *See* DKT #2641 at p. 8 (¶ 32). 50 Okla. Stat. § 1.1(B) provides:

> Agricultural activities conducted on farm or ranch land, if consistent with good agricultural practices <u>and</u> established prior to nearby nonagricultural activities, are presumed to be reasonable and do not constitute a nuisance unless the activity has a substantial adverse affect on the public health and safety. If that agricultural activity is undertaken in conformity with federal, state and local laws and regulations, it is presumed to be good agricultural practice and not adversely affecting the public health and safety.

106. The Court concludes as a matter of law that 50 Okla. Stat. § 1.1(B) does not immunize Defendants' conduct. The conduct at issue neither is consistent with good agricultural practices, nor was established prior to nearby nonagricultural activities. Taking the latter first, it is undisputed that large-scale, vertically-integrated poultry operations did not begin in the IRW until the middle of the twentieth century at the earliest. *See* FOF, ¶¶ 306-311. In contrast -- taking just one of the identified beneficial uses of the IRW as an example -- the undisputed fact is that recreational uses of the Illinois River long predate Defendants' large-scale, vertically-

integrated poultry operations in the Illinois River Watershed. *See* FOF, ¶¶ 91-91 (*e.g.*, Dr. Caneday testifying that recreational activity has been occurring as long as there have been people on the river corridor). With respect to the former, the land application of poultry waste has not been undertaken in conformity with, for example, Oklahoma state laws and regulations, which expressly prohibit runoff of poultry waste. *See* 2 Okla. Stat. § 10-9.7.

10. Summary of Conclusions of Law Regarding Common Law Nuisance Claims

107. Based upon the foregoing findings of fact and the application of those facts to the applicable legal principles, the Court concludes as a matter of law, each Defendant is both directly and vicariously liable to the State in state and federal common law nuisance.

B. Trespass

108. A claim for trespass "involves an actual physical invasion of the real estate of another without the permission of the person lawfully entitled to possession." *Bennett v. Fuller*, 2008 U.S. Dist. LEXIS 58198, *16 (N.D. Okla. July 31, 2008). "One is subject to liability to another for trespass, irrespective of whether he thereby causes harm to any legally protected interest of the other, if he intentionally (a) enters land in the possession of the other, or causes a thing or a third person to do so, or (b) remains on the land, or (c) fails to remove from the land a thing which he is under a duty to remove." *Angier v. Mathews Exploration Corp.*, 905 P.2d 826, 829-30 (Okla. App. 1995) (citation and quotations omitted).

109. Here, the State's claim for trespass is based upon its possessory property interest in waters flowing in definite streams in the Oklahoma portion of the IRW, which, as held above, is a sufficient interest to support the State's claim. *See* COL, ¶¶ 9-10.

110. The theories of direct and vicarious liability with respect to the State's trespass claim are analytically the same as those just discussed at length with respect to the State's

common law public nuisance claims, as are the applicable facts, *see* COL, ¶¶ 55-94, and need not be repeated in any detail again. Suffice it to say, each Defendant is liable for poultry waste causing phosphorus to physically invade the rivers and streams of the IRW in Oklahoma and Lake Tenkiller. Defendants' poultry waste is a significant source of the phosphorus in these rivers and streams of the IRW in Oklahoma and Lake Tenkiller, and phosphorus is causing injuries to these waters of the State.

111. The State has not consented to the pollution of its waters generally, or the pollution of its waters by phosphorus from poultry waste specifically. *See, e.g.*, 27A Okla. Stat. § 2-6-105(A); 27A Okla. Stat. § 2-6-102; 82 Okla. Stat. § 1084.1; Okla. Admin. Code § 785:45-3-2(a); Okla. Admin. Code § 785:45-3-2(b); 2 Okla. St. § 10-9.7(B)(4)(a) & (b); *see also* COL, ¶¶ 95-104.

112. Based upon the foregoing findings of fact and the application of those facts to the applicable legal principles, the Court concludes as a matter of law, each Defendant is both directly and vicariously liable to the State in trespass.

C. Violations of 27A Okla. Stat. § 2-6-105

113. 27A Okla. Stat. § 2-6-105(A) provides that:

> It shall be unlawful for any person to cause pollution of any waters of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any . . . waters of the state. Any such action is hereby declared to be a public nuisance.

This prohibition on conduct causing pollution and conduct likely to cause pollution is both well-established and far-reaching. As explained by the Tenth Circuit, "[t]he Oklahoma Legislature's intent that conduct that causes or is likely to cause pollution be declared a public nuisance is longstanding . . . ." *See Burlington Northern & Santa Fe Railway Co. v. Grant*, 505 F.3d 1013, 1025 (10th Cir. 2007). Further, "[i]t is clear that the intent of subsection A is to deem as a public

nuisance conduct that either has caused or is likely to cause pollution. Accordingly, pollution need not have already occurred before conduct 'likely to cause' pollution can be deemed a public nuisance." *Id.* at 1024.

114. 27A Okla. Stat. § 2-6-105(A) is broader than the common law. *See* 27A Okla. Stat. § 2-6-104 ("It is the purpose of this article [*i.e.*, the article containing 27A Okla. Stat. § 2-6-105] to provide additional and cumulative remedies to prevent, abate and control the pollution of the waters of the state") (emphasis added); 27A Okla. Stat. § 2-3-506(A) ("It is the purpose of this Code to provide additional and cumulative remedies to prevent, abate and control pollution") (emphasis added).

115. There are no conditions precedent to bringing a claim under 27A Okla. Stat. § 2-6-105(A). As explained by the Tenth Circuit:

> We conclude that the district court erred in holding that ODEQ enforcement action was a precondition to the existence of a public nuisance. To begin with, the language of Okla. Stat. tit. 27A, § 2-6-105 is unambiguous. Nothing in the plain language of Okla. Stat. tit. 27A, § 2-6-105 requires an order by the Executive Director of the ODEQ before an act can be declared a public nuisance. Nothing in subsection B purports to limit the scope of subsection A's definition of the term 'public nuisance.' . . . In fact, a reading of subsection A and B indicates subsection B was not intended to limit subsection A.

Burlington Northern, 505 F.3d at 1024-25 (citation omitted). Thus, Defendants' assertion that the State does not have standing or authority to proceed with its claim under subsection A of 27A Okla. Stat. § 2-6-105 until the executive director of ODEQ makes a finding pursuant to subsection B of 27A Okla. Stat. § 2-6-105, *see* DKT #2641 at p. 26 (¶ 82), is without any merit.

116. From the plain language of the statute, there are three independent grounds of liability under 27A Okla. Stat. § 2-6-105(A). They are:

> (1) "It shall be unlawful for any person to cause pollution of any waters of the state . . . ."

> (2) "It shall be unlawful for any person . . . to place . . . any wastes in a location where they are likely to cause pollution of any . . . waters of the state."
>
> (3) "It shall be unlawful for any person . . . to . . . cause to be placed any wastes in a location where they are likely to cause pollution of any . . . waters of the state."

27A Okla. Stat. § 2-6-105(A).

117. For purposes of 27A Okla. Stat. § 2-6-105(A), the term "pollution" is broadly defined. It is a multi-part, disjunctive definition yielding four distinct definitions of pollution. *See* 27A Okla. Stat. § 2-1-102(12). 27A Okla. Stat. § 2-1-102(12) provides:

> "Pollution" means **[1]** the presence in the environment of any substance, contaminant or pollutant, or any other alteration of the physical, chemical or biological properties of the environment or **[2]** the release of any liquid, gaseous or solid substance into the environment in quantities **[A]** which are or will likely create a nuisance or **[B]** which render or will likely render the environment harmful or detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life, or to property[.]

(Numeration inserted to assist in understanding.) Thus each of the following constitutes "pollution" for purposes of 27A Okla. Stat. § 2-6-105(A):

> (1) [T]he presence in the environment of any substance, contaminant or pollutant, or any other alteration of the physical, chemical or biological properties of the environment . . . which are or will <u>likely</u> create a nuisance[;]
>
> (2) [T]he presence in the environment of any substance, contaminant or pollutant, or any other alteration of the physical, chemical or biological properties of the environment . . . which render or will <u>likely</u> render the environment harmful or detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life, or to property[;]
>
> (3) [T]he release of any liquid, gaseous or solid substance into the environment in quantities . . . which are or will <u>likely</u> create a nuisance[; and]
>
> (4) [T]he release of any liquid, gaseous or solid substance into the environment in quantities . . . which render or will <u>likely</u> render the environment

> harmful or detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life, or to property[.]

See 27A Okla. Stat. § 2-1-102(12). These definitions are clearly broader than traditional concepts of pollution in that they include a risk-of-harm concept. Moreover, not too much should be read into term "quantities" found in definition subparts (3) and (4) under the facts of this case inasmuch as it has already been established that an environmentally-significant quantity of phosphorus runs off of each field in the IRW on which poultry waste is land applied. *See* FOF, ¶¶ 611-635. Given the factual record, the Court concludes that the runoff of phosphorus from land-applied poultry waste constitutes "pollution" under each and all of the four definitions set out above.

118. 27A Okla. Stat. § 2-1-102(11)defines "person" as "an individual, association, partnership, firm, company, public trust, corporation, joint-stock company, trust, estate, municipality, state or federal agency, other governmental entity, any other legal entity or an agent, employee, representative, assignee or successor thereof." Each Defendant fits within this definition. *See* FOF, ¶ 304.

119. Contrary to Defendants' assertion, *see* DKT #2641 at p. 25 (¶ 74), 27A Okla. Stat. § 2-6-105 speaks in clear and direct terms and is complementary to and entirely consistent with the State's other pollution control laws, and therefore is not "unconstitutionally void for vagueness."

120. The State's claim for violations of 27A Okla. Stat. § 2-6-105, as limited by the Court, pertains to conduct occurring in Oklahoma. While Arkansas-based conduct cannot itself be a violation of 27A Okla. Stat. § 2-6-105, Arkansas-based evidence can, however, be a basis for finding that Oklahoma-based conduct is a violation of 27A Okla. Stat. § 2-6-105, and

therefore Arkansas-based evidence (including watershed-wide evidence) is relevant to establishing whether there has been a violation of 27A Okla. Stat. § 2-6-105.

121. The State is seeking both injunctive relief and penalties under its 27A Okla. Stat. § 2-6-105 claim. *See* DKT #2641 at pp. 13-14 (¶¶ 76-82); *see also* 27 Okla. Stat. § 2-3-504(A)(2) & (4).

1. Injunctive Claim

122. The State contends that Defendants are liable for violations of 27A Okla. Stat. § 2-6-105(A) both on direct grounds and on vicarious grounds.

a. Direct Liability

123. For much the same reasons they are directly liable under the State's common law claims, so too, Defendants are directly liable under 27A Okla. Stat. § 2-6-105(A). In broad terms, each Defendant has structured and conducted its business in the Oklahoma portion of the IRW such that pollution of the waters of the State in the IRW is inevitable. Defendants' conduct in this regard renders them each directly liable for: (1) "caus[ing] pollution of . . . waters of the state . . ."; and (2) "caus[ing] to be placed . . . wastes in a location where they are likely to cause pollution of . . . waters of the state."[124] *See* 27A Okla. Stat. § 2-6-105(A).

124. First, each Defendant has a direct hand in <u>causing pollution</u> of the waters of the State in the IRW. Again, each Defendant has: consciously concentrated a portion of its poultry operations in the Oklahoma portion of the environmentally-sensitive IRW, *see* FOF, ¶¶ 15-35, 68-72, 345-52, 477-79; placed large numbers of its birds in this concentrated area, *see* FOF, ¶¶ 306-11, 316; and imported enormous amounts of phosphorus into the IRW to feed those birds,

---

[124] As noted above, Defendant Peterson and Defendant Cal-Maine recently exited the Watershed. Thus, unlike the remaining Defendants which the State seeks to hold liable on the basis of both their past and present conduct in the State, the State is seeking to hold these two Defendants liable on the basis of their past conduct in the State.

see FOF, ¶¶ 317-18, 360-61. These birds necessarily generate massive amounts of poultry waste which is enriched by the phosphorus that Defendants have brought into the IRW. *See* FOF, ¶¶ 355, 362, 365-67, 370. Additionally, despite knowledge that the majority of this poultry waste will be land applied in close proximity to where it is generated (*i.e.*, in the Oklahoma portion of the environmentally-sensitive IRW), none of the Defendants has made provision for the appropriate management of the waste. *See* FOF, ¶¶ 15-35, 68-72, 345-52, 371-72, 377-78, 396-401. As a result, the vast majority of this poultry waste has in fact been land applied to the already phosphorus-saturated soils of the Oklahoma portion of the IRW where an environmentally-significant fraction of the phosphorus in this land-applied poultry waste runs off of the fields and enters the waters of the State in the IRW, *see* FOF, ¶¶ 371-72, 377, 391, 393-95, 439-635. Furthermore, the phosphorus from land-applied poultry waste that has entered the waters of the State clearly constitutes "pollution" for the purposes of § 2-6-105. *See* 27A Okla. Stat. § 2-1-102(12). In sum, through their own independent conduct, Defendants have "cause[d] pollution of . . . waters of the state ." 27A Okla. Stat. § 2-6-105(A)(1).

125. Similarly, Defendants are also directly liable under 27A Okla. Stat. § 2-6-105(A)(3). Indeed, because each Defendant is directly liable for causing pollution of the waters of the State in the IRW, it is axiomatic that each Defendant is directly liable under the lesser standard of <u>causing wastes to be placed in a location where they are likely to cause pollution</u> of the waters of the State in the IRW. By the very structure and conduct of Defendants' business operations in the Oklahoma portion of the IRW, it is a certainty that the massive quantities of poultry waste generated by their birds are -- and have been -- placed in locations throughout the Oklahoma portion of the IRW where that waste is <u>likely</u> to cause pollution of the waters of the State.

b. Vicarious Liability

126. Aside from being directly liable under 27A Okla. Stat. § 2-6-105, each Defendant is also vicariously liable for the conduct of its growers.[125] As established *supra*, each Defendant is vicariously liable in tort by application of employee / agency principles. *See* COL, ¶¶ 65, 72. The Court concludes that these same vicarious liability principles apply with respect to liability under 27A Okla. Stat. § 2-6-105. Applying those principles here, each Defendant is liable for: (1) "caus[ing] pollution of . . . waters of the state . . ."; and (2) "plac[ing] . . .wastes in a location where they are likely to cause pollution of . . . waters of the state". *See* 27A Okla. Stat. § 2-6-105(A).

127. Again, each Defendant has placed significant numbers of birds with its growers in the environmentally-sensitive Oklahoma portion of the IRW, *see* FOF, ¶¶ 15-35, 68-72, 306-11, 316, 345-52; these birds have produced enormous quantities of phosphorus-laden poultry waste, *see* FOF, ¶¶ 355, 362, 365-67, 370; the poultry waste generated by each Defendant's birds has been land applied -- by growers and third parties with whom the growers transact -- to the phosphorus-saturated soils of the Oklahoma portion of the IRW, *see* FOF, ¶¶ 371-72, 377; and an environmentally-significant fraction of phosphorus in all poultry waste that is land applied in the IRW -- approximately 5 percent -- runs off. *See* FOF, ¶¶ 611-16. Furthermore, phosphorus from land-applied poultry waste is a significant source of the increased phosphorus concentrations found in the waters of the Oklahoma portions of IRW, *see* FOF, ¶¶ 617-35, and these increased phosphorus concentrations have resulted in "pollution" of the waters of the State. *See* FOF, ¶¶ 101-259, 439-635.

---

[125] *See* previous footnote.

128. Under this formulation, each Defendant is vicariously liable for (a) "caus[ing] pollution of…waters of the state . . ."; and (b) "plac[ing] . . .wastes in a location where they are likely to cause pollution of. . . waters of the state." *See* 27A Okla. Stat. § 2-6-105(A).

129. For the foregoing reasons, the State is entitled to injunctive relief as a remedy for each Defendant's violations of 27A Okla. Stat. § 2-6-105(A).

2. Penalty Claim

130. As noted above, in addition to seeking injunctive relief under 27A Okla. Stat. § 2-6-105, the State is also seeking the imposition of civil penalties for violations of 27A Okla. Stat. § 2-6-105. 27 Okla. Stat. § 2-3-504 provides in pertinent part that:

> (A) Except as otherwise specifically provided by law, any person who violates any of the provisions of, or who fails to perform any duty imposed by, the Oklahoma Environmental Quality Code . . . :
> * * *
> (2) May be punished in civil proceedings in district court by assessment of a civil penalty of not more than Ten Thousand Dollars ($10,000.00) for each violation;
> * * *
> (C) Any person assessed an administrative or civil penalty shall be required to pay, in addition to such penalty amount and interest thereon, attorneys fees and costs associated with the collection of such penalties.
> (D) For purposes of this section, each day or part of a day upon which such violation occurs shall constitute a separate violation.
> * * *
> (H) In determining the amount of a civil penalty the court shall consider such factors as the nature, circumstances and gravity of the violation or violations, the economic benefit, if any, resulting to the defendant from the violation, the history of such violations, any good faith efforts to comply with the applicable requirements, the economic impact of the penalty on the defendant, the defendant's degree of culpability, and such other matters as justice may require.

131. 27 Okla. Stat. § 2-3-504 became effective on July 1, 1993, and the parties agree that the State's claims for penalties are limited to conduct occurring in Oklahoma since July 1, 1993.

132. As a result of each Defendant's direct liability under 27A Okla. Stat. § 2-6-105(A), the State is entitled to an award of penalties. As detailed above, each Defendant has structured and conducted its poultry business in the Oklahoma portion of the IRW such that pollution of the waters of the State in the IRW from poultry waste was and is inevitable.

133. Specifically, at all times since the 1993 enactment of the penalties provision applicable to claims arising under 27A Okla. Stat. § 2-6-105(A), the Tyson Defendants, the Cargill Defendants, the George's Defendants and Defendant Simmons have each structured and conducted their respective poultry businesses in the IRW such that pollution of the waters of the IRW from poultry waste was and is inevitable. *See* FOF, ¶¶ 15-35, 68-72, 306-11, 316-18, 345-52, 355, 360-62, 365-68, 370-72, 377, 391, 393-95, 439-635, 639-40, 656-85. From the 1993 enactment of the penalties provision applicable to claims arising under 27A Okla. Stat. § 2-6-105(A) until 2008, Defendant Peterson had structured and conducted its poultry business in the IRW such that pollution of the waters of the IRW from poultry waste was inevitable. *See id.* & FOF, ¶ 310. From the 1993 enactment of the penalties provision applicable to claims arising under 27A Okla. Stat. § 2-6-105(A) until 2005, Defendant Cal-Maine had structured and conducted its poultry business in the IRW such that pollution of the waters of the IRW from poultry waste was inevitable. *See id.* & FOF, ¶ 311.

134. Defendants' violations of 27A Okla. Stat. § 2-6-105(A) have thus continued for many years and may be properly characterized as ongoing. Defendants' violations have caused substantial injuries to highly-valued State resources. Defendants' violations are the result of having ignored for many years their responsibility to properly manage the enormous quantities of phosphorus-laden poultry waste generated by the birds. The severity of Defendants' violations is underscored by their having continued to have placed birds in the Oklahoma portion of the IRW,

despite the effects the structure and conduct of their respective poultry businesses were having on the waters of the State in the IRW. With due consideration of these factors and the other factors the Court must consider in determining the amount of a civil penalty, *see* 27 Okla. Stat. § 2-3-504(H), and fully cognizant that the maximum penalty under the statute is $10,000 per day per violation, 27 Okla. Stat. § 2-3-504(A)(2) & (D), the Court determines that Defendants' violations are severe in nature and that a penalty in the amount of $_____ per year should be assessed against each Defendant group for the years since 1993 that it has conducted poultry operations in the IRW.

135. In addition, as result of each Defendant's (except Defendant Peterson's) vicarious liability under 27A Okla. Stat. § 2-6-105(A), the State is entitled to an award of penalties.

136. The State's proof with respect to its claim for penalties under 27A Okla. Stat. § 2-6-105 for vicarious liability relies primarily on ODAFF records from IRW grower files. Those records reflect specific fields in the Oklahoma portion of the IRW having STP values of greater than 65 lbs./acre (*i.e.*, the agronomic rate for phosphorus in Oklahoma) after July 1, 1993. *See* FOF, ¶ 395. Elevated STP levels correlate with land application of poultry waste. *See* FOF, ¶ 392. The records also identify the Defendant affiliated with the birds generating the poultry waste that was land applied. *See* FOF, ¶ 395. Elevated STP values -- particularly STP values above the agronomic rate for phosphorus -- translate to elevated runoff levels of phosphorus. *See* FOF, ¶ 451. Such elevated STP also results in the banking of phosphorus in the soils of the IRW, and such banked phosphorus also contributes to phosphorus runoff. *See* FOF, ¶¶ 453, 576, 639-40. Runoff of phosphorus from fields upon which poultry waste has been land applied is contributing to pollution of the waters of the State. *See* FOF, ¶ 439-635. Put in terms of 27A Okla. Stat. § 2-6-105(A), a land application of poultry waste in the Oklahoma portion of the IRW

resulting in an STP value of greater than 65 lbs./acre equates to "caus[ing] pollution of any waters of the state . . . ," and plac[ing] . . . any wastes in a location where they are likely to cause pollution of any . . . waters of the state." *See* 27A Okla. Stat. § 2-6-105(A).

137. For the reasons just discussed, a field having an STP value of greater than 65 lbs./acre constitutes continuing violation of 27A Okla. Stat. § 2-6-105(A). The time between the date of these ODAFF records and the present reflect the minimum number of days a given field has had an STP at a level greater than 65 lbs./acre. Under 27 Okla. Stat. § 2-3-504(A) and (D), each of those days constitutes a separate violation subject to assessment of not more than $10,000 per violation.

138. The same rationale utilized for determining the amount of penalties for each Defendant's direct violations pertains to determining the amount of penalties for each Defendant's vicarious violations. Again, the Court determines that Defendants' violations are severe in nature and that therefore an additional penalty in the amount of $_____ should be assessed against each Defendant group (with the exception of Defendant Peterson, against which the State introduced no pertinent ODAFF records).

139. Pursuant to 27 Okla. Stat. § 2-3-504, the Court also determines that the State is entitled to recover from each Defendant group its attorneys fees and costs associated with the collection of these penalties. A separate proceeding will be held to determine the amount of such attorneys fees and costs.

D. Violations of 2 Okla. Stat. § 2-18.1

140. 2 Okla. Stat. § 2-18.1(A) provides that:

> It shall be unlawful and a violation of the Oklahoma Agricultural Code for any person to cause pollution of any air, land or waters of the state by persons which are subject to the jurisdiction of the Oklahoma Department of Agriculture, Food, and Forestry pursuant to the Oklahoma Environmental Quality Act.

141. 2 Okla. Stat. § 1-3 defines "person" as "the state, any municipality, political subdivision, institution, individual, public or private corporation, partnership, association, firm, company, public trust, joint-stock company, trust, estate, state or federal agency, other governmental entity, or any other legal entity or an agent, employee, representative, assignee or successor thereof." Each Defendant fits within this definition. *See* FOF, ¶ 304.

142. With respect to a claim brought pursuant to 2 Okla. Stat. § 2-18.1, 2 Okla. Stat. § 16(C) provides, in pertinent part, that "[t]he court shall have jurisdiction to determine the action [to redress or restrain a violation of the Oklahoma Agricultural Code], and to grant the necessary or appropriate relief, including but not limited to mandatory or prohibitive injunctive relief . . . ."

143. 27A Okla. Stat. § 1-3-101(D) provides that ODAFF "shall have the following jurisdictional areas of environmental responsibility except as provided in paragraph 2 of this subsection: (a) point source discharges and nonpoint source runoff from agricultural crop production, agricultural services, livestock production, silviculture, feed yards, livestock markets and animal waste . . . ."

144. By its terms, 2 Okla. Stat. § 2-18.1(A) is a statute of general application addressing pollution from all entities which fall under the jurisdiction of ODAFF and is not limited to only the actions of poultry growers. Defendants necessarily fall under the broad sweep of this statute as persons under the jurisdiction of ODAFF. *See, e.g.,* 2 Okla. Stat. § 10-9.5.G. ("No integrator shall enter into any contract with an operator of a poultry feeding operation who is not in compliance with the requirements of subsection F of this section."). Accordingly, the Court concludes that each Defendant is a person which is subject to the jurisdiction of the Oklahoma Department of Agriculture, Food, and Forestry pursuant to the Oklahoma Environmental Quality Act.

145. The State's claim for violations of 2 Okla. Stat. § 2-18.1(A) pertains to conduct occurring in Oklahoma.

146. 2 Okla. Stat. § 2-18.1(A)'s liability provision prohibiting a "person" from "caus[ing] pollution of any . . . waters of the state" is substantively identical to one of 27A Okla. Stat. § 2-6-105(A)'s liability provisions -- that is, the one prohibiting a "person" from "caus[ing] pollution of any waters of the state." Because this Court has determined that each Defendant is liable on direct and vicarious liability grounds under that provision of 27A Okla. Stat. § 2-6-105(A), there is no need to repeat the analysis here. The Court adopts that analysis, *see* COL, ¶¶ 54-107, and concludes that each Defendant is liable on direct and vicarious liability grounds under that provision of 2 Okla. Stat. § 2-18.1.

E. Affirmative Defenses

147. Defendants have raised a number of affirmative defenses. Some of these have already been addressed in the discussions above. The Court addresses the remainder below.

1. Political Question Doctrine

148. Defendants' contention that "some or all of the State's claims present nonjusticiable political questions," *see* DKT #2641 at p. 17 (¶ 25), can be readily dispatched. As recently explained by the Second Circuit:

> The political question doctrine is "primarily a function of the separation of powers," *Baker v. Carr*, 369 U.S. 186, 210, 82 S. Ct. 691, 7 L. Ed. 2d 663 (1962), "designed to restrain the Judiciary from inappropriate interference in the business of the other branches of Government," *United States v. Munoz-Flores*, 495 U.S. 385, 394, 110 S. Ct. 1964, 109 L. Ed. 2d 384 (1990), where that other branch is better suited to resolve an issue. This limitation on the federal courts was recognized in *Marbury v. Madison*, 5 U.S. (1 Cranch) 137, 2 L. Ed. 60 (1803), in which Chief Justice Marshall wrote, "[q]uestions, in their nature political, or which are, by the constitution and laws, submitted to the executive, can never be made in this court." *Id.* at 170. Consequently, "[o]ut of due respect for our coordinate branches and recognizing that a court is incompetent to make final resolution of certain matters, these political questions are deemed

> 'nonjusticiable.'" *Lane ex rel. Lane v. Halliburton*, 529 F.3d 548, 557 (5th Cir. 2008). *See generally Schneider v. Kissinger*, 412 F.3d 190, 194-96, 366 U.S. App. D.C. 408 (D.C. Cir. 2005) (describing Constitution's textual allocation of authority among three branches of government).

American Electric Power Co., 582 F.3d at 321; *see also Alexander v. State of Oklahoma*, 2004 U.S. Dist. LEXIS 5131, *17 (N.D. Okla. March 19, 2004) ("The political question doctrine provides that a federal court, which otherwise has jurisdiction over a dispute, should decline to adjudicate the dispute on the grounds that the case raises questions which should be addressed by the representative branch of our government.").

149. At the outset, it must be acknowledged that "the political question doctrine does not apply to federal-state relations . . . ." *See Alexander*, 2004 U.S. Dist. LEXIS 5131, *19. Rather, "[i]t is the relationship between the judiciary and the coordinate branches of the Federal Government, and not the federal judiciary's relationship to the States, which gives rise to the 'political question.'" *See Alexander*, 2004 U.S. Dist. LEXIS 5131, *19 (quotations and citation omitted). Therefore, the political question doctrine has no applicability to the State's state law claims.

150. The political question doctrine also has no applicability to the State's federal common law nuisance claim as none of the six *Baker* factors apply. *See Baker v. Carr*, 369 U.S. 186, 217 (1962). There is no textually demonstrable constitutional commitment of nonpoint source pollution from poultry waste to a coordinate political department; there is no lack of judicially discoverable and manageable standards for resolving the State's federal common law nuisance claim against Defendants; there is no impossibility of deciding without an initial policy determination of a kind clearly for nonjudicial discretion; there is no impossibility of this Court's undertaking independent resolution without expressing lack of the respect due coordinate branches of government; there is no unusual need for unquestioning adherence to a political

decision already made; and there is no potentiality of embarrassment from multifarious pronouncements by various departments on one question. *See Baker*, 369 U.S. at 217.

151. The simple fact of the matter is that courts routinely handle claims involving claims of nuisance and trespass in the pollution context. *See, e.g., Ohio v. Wyandotte Chemicals Corp.*, 401 U.S. 493, 496 (1971) (noting the justiciability of controversies "between a State and citizens of another state seeking to abate a nuisance that exists in one State yet produces noxious consequences in another," but ultimately denying Ohio's motion for leave to file complaint in Supreme Court without prejudice to its right to commence other appropriate judicial proceedings); *American Electric Power*, 582 F.3d at 321-332 (finding political question doctrine inapplicable, reasoning, *inter alia*, "that federal courts have successfully adjudicated complex common law public nuisance cases for over a century. . . . Federal courts have applied well-settled tort rules to a variety of new and complex problems. . . . Accordingly, we do not agree that there are no judicially discoverable and manageable standards for resolving this case. Well-settled principles of tort and public nuisance law provide appropriate guidance to the district court in assessing Plaintiffs' claims and the federal courts are competent to deal with these issues."); *Comer v. Murphy Oil, USA*, 585 F.3d 855, 869-79 (5th Cir. 2009). Indeed, as Defendants are well aware, this Court was earlier called upon to adjudicate a case against the poultry industry asserting many claims similar to the ones being asserted here. *See City of Tulsa v. Tyson Foods, Inc.*, Case No. 01-CV-0900-B(C), N.D. Okla.

152. In sum, the political question doctrine does not bar any of the claims advanced by the State.

2. The Arkansas-Oklahoma Arkansas River Basin Compact

153. Defendants' contention that "the Arkansas River Basin Compact preempts or displaces some or all of the State's claims," *see* DKT #2641 at p. 17 (¶ 24), can also be readily dispatched. A plain reading of the Arkansas-Oklahoma Arkansas River Basin Compact ("Compact"), 82 Okla. Stat. § 1421, leads to the conclusion that rather than preempt or displace state and federal water pollution laws, the Compact specifically endorses the use of such laws by the State:

> The States of Arkansas and Oklahoma mutually agree to:
> * * *
>
> E. Utilize the provisions of all federal and state water pollution laws and to recognize such water quality standards as may be now or hereafter established under the Federal Water Pollution Control Act in the resolution of any pollution problems affecting the waters of the Arkansas River Basin.

82 Okla. Stat. § 1421 (Art. VII(E)). This endorsement of the use of other federal and state law in 82 Okla. Stat. § 1421 (Art. VII(E)) is entirely consistent with the pertinent stated purpose of the Compact, namely "[t]o encourage the maintenance of an active pollution abatement program in each of the two states and to seek the further reduction of both natural and man-made pollution in the waters of the Arkansas River Basin." 82 Okla. Stat. § 1421 (Art. I(D)) (emphasis added).[126]

154. Moreover, in addition to confirming and encouraging the State's right to utilize the provisions of all federal and state water pollution laws, the Compact also expressly disclaims any requirement that the State proceed before the Commission before asserting its rights in court:

---

[126] The use of the term "to encourage" reflects that this purpose of the Compact is aspirational and hortatory rather than mandatory. A comparison with the language of those portions of the Compact dealing with water apportionment clearly indicates that the authors of the Compact knew how to draft mandatory language when they wanted to. *See, e.g.*, 82 Okla. Stat. § 1421 (Art. I(B) & (C)) ("to provide"). Aspirational or hortatory language is not indicative of a preemptive intent. *See, e.g., Trojan Technologies, Inc. v. Commonwealth of Pennsylvania*, 916 F.2d 903 (3rd Cir. 1990) (aspirational and general language insufficient to justify a finding of preemption).

> . . . The making of findings, recommendations, or reports by the Commission shall not be a condition precedent to instituting or maintaining any action or proceeding of any kind by a signatory state in any court, or before any tribunal, agency or officer, for the protection of any right under this Compact or for the enforcement of any of its provision[.]

82 Okla. Stat. § 1421 (Art. IX(A)(8)) (emphasis added). Reading 82 Okla. Stat. § 1421 (Art. VII(E)) together with this section, there can be no valid contention that the Compact is the exclusive means to combat pollution.

155. Further underscoring this point is the statement in the Compact that "[f]indings of fact made by the Commission shall be admissible in evidence and shall constitute prima facie evidence of such fact in any court . . . ." 82 Okla. Stat. § 1421 (Art. IX(A)(8)) (emphasis added). Obviously, were resort to the Commission a party's sole recourse, there would be no need for this provision.

156. Given the plain language of the Compact, there is no need to delve into a full-blown preemption or displacement analysis. The Compact does not preempt or displace any of the State's claims.

3. Other Affirmative Defenses

157. Defendants have raised a number of other affirmative defenses. *See* DKT #2641 at pp. 3-4. The Court has reviewed these affirmative defenses and concludes that based on the facts and the applicable law they have facially no merit and / or they have been addressed in previous proceedings in this case and there is no need to revisit the decisions made in those previous proceedings.

VI. Intentionality and Joint and Several Liability (Restatement (Second) of Torts, § 825)

158. The State has pled its nuisance and trespass claims as intentional torts. *See* DKT #2641 at pp. 10-13 (¶¶ 55-75).

159. "'When the harm is intentional or the result of recklessness, contributory negligence is not a defense.'"[127] *See City of Tulsa*, 258 F. Supp. 2d at 1302 (quoting Restatement (Second) of Torts, § 840B(2)). The threshold for establishing intentionality is not high. As set forth in Restatement (Second) of Torts, § 825:

> An invasion of another's interest in the use and enjoyment of land or an interference with the public right, is intentional if the actor:
> (a) acts for the purpose of causing it, or
> (b) knows that it is resulting or is substantially certain to result from his conduct.

Comment c to Restatement (Second) of Torts, § 825 further provides that "[i]t is the knowledge that the actor has at the time he acts or fails to act that determines whether the invasion resulting from his conduct is intentional or unintentional."

160. Thus, in order for this rule to apply, it is not necessary for the State to prove that Defendants intended to cause the specific harm that resulted from their conduct, only that the conduct causing the harm is intentional. Whether or not the first invasion is intentional, when the conduct is continued after the party knows that the invasion is resulting or is substantially certain to result from its conduct, further invasions are intentional. *See City of Tulsa*, 258 F. Supp. 2d at 1301. The focus of the Court in this examination of intent is upon the intent of Defendants, not their growers. *See, e.g.*, Daily Trans., 8409:21-8410:2 ("Court: . . . But here, as we discussed yesterday, the intent is that of the integrators. And I think it's sufficiently been hashed out here that the focus is on what the integrators' intent was relative to these matters.").

161. As explained by the Tenth Circuit, "[w]hile negligence is not sufficient to charge a person with knowledge, one may not willfully and intentionally remain ignorant of a fact, important and material to his conduct[,] and thereby escape punishment. The test is whether

---

[127] The Court has found that the State has not contributed to the phosphorus loading of the waters of the IRW. *See* FOF, ¶ 716.

there was a conscious purpose to avoid enlightenment." *FDIC v. Antonio*, 843 F.2d 1311 (10th Cir. 1988) (quotations and citations omitted) (civil RICO case); *see also Tommy Hilfiger Licensing, Inc. v. Goody's Family Clothing, Inc.*, 2003 U.S. Dist. LEXIS 8788, *45-47 (N.D. Ga. May 9, 2003) (Latham Act case) (collecting various cases); *United States v. Francisco-Lopez*, 939 F.2d 1405 (10th Cir. 1991) ("deliberate ignorance" criminal instruction); *United States v. Espinoza*, 244 F.3d 1234, 1244 (10th Cir. 2001). The Court concludes that for purposes of analyzing the knowledge component of Restatement (Second) of Torts, § 825 willful ignorance can equate to knowledge.

162. As found above, the evidence is overwhelming that Defendants have long known that their conduct (and conduct for which they are vicariously liable) was resulting or was substantially certain to result in injury to the rivers and streams of the IRW in Oklahoma and Lake Tenkiller. *See* FOF, ¶¶ 604-610, 656-675. Moreover, against the backdrop of a mountain of information contained in reports, symposia, and task forces putting Defendants on notice of the problem of pollution from phosphorus in land-applied poultry waste in the IRW, Defendants willfully ignored the problem. *See* FOF, ¶¶ 676-682, 685. Thus, even assuming arguendo that Defendants were not to have had actual knowledge of the problem, Defendants engaged in "a conscious purpose to avoid enlightenment." *See Antonio*, 843 F.2d at 1313.

163. In either event, the Court concludes that the principles of Restatement (Second) of Torts, § 825, the threshold for finding Defendants have acted intentionally is satisfied, that Defendants are jointly and severally liable on the State's claims (with the exception of the State's claim for penalties under 27A Okla. Stat. § 2-16-105(A)).

VII. Relief

A. Injunctive Relief Standard and the Equitable Jurisdiction of the Court

164. "For a party to obtain a permanent injunction, it must prove (1) actual success on the merits; (2) irreparable harm unless the injunction is issued; (3) the threatened injury outweighs the harm that the injunction may cause the opposing party; and (4) the injunction, if issued, will not adversely affect the public interest." *See Prairie Band Potawatomi Nation v. Wagnon*, 476 F.3d 818, 822 (10th Cir. 2007) (citation and quotations omitted).

165. "'The essence of equity jurisdiction has been the power of the Chancellor to do equity and to mould each decree to the necessities of the particular case. Flexibility rather than rigidity has distinguished it. . . .' *Hecht Co. v. Bowles*, 321 U.S. 321, 329-30 (1944), cited in *Brown II*, *supra*, at 300." *Swann v. Charlotte-Mecklenburg Board of Education*, 402 U.S. 1, 16 (1971).

166. In addition to its inherent powers, with respect to two of the State's claims -- those under 27A Okla. Stat. § 2-6-105(A) and 2 Okla. Stat. § 2-18.1 -- this Court is statutorily authorized to grant injunctive relief. *See* 27A Okla. Stat. § 2-3-504(A)(4) ("A district court may grant injunctive relief to prevent a violation of, or to compel a compliance with, any of the provisions of this Code . . ."); 27A Okla. Stat. § 2-3-504(F)(2) ("The court shall have jurisdiction to determine said action, and to grant the necessary or appropriate relief, including but not limited to mandatory or prohibitive injunctive relief, interim equitable relief, and punitive damages"); 2 Okla. Stat. § 2-16(B) & (C) ("B. Any action to redress or restrain a violation of the Oklahoma Agricultural Code, any promulgated rule or any order, license, charter, registration, or permit issued pursuant to the Oklahoma Agricultural Code or to recover any administrative or civil penalty or other fine assessed pursuant to the Oklahoma Agricultural Code, may be brought by: . . . 2. The Attorney General on behalf of the State of Oklahoma; . . . C. The court shall have jurisdiction to determine the action, and to grant the necessary or appropriate relief, including but

not limited to mandatory or prohibitive injunctive relief, interim equitable relief, and punitive damages.”).

167. It is well within a court's authority in an environmental case to order a remedial investigation, whether liability is found pursuant to the common law or statute. *See, e.g.*, *Miller v. Cudahy Co.*, 592 F. Supp. 976, 1009 (D. Kan. 1984) (in common law nuisance context, order that defendants “undertake the installation of a monitor well system in consultation with an expert to be designated by the plaintiffs, and possibly an additional expert to be selected by the Court, and forthwith *undertake the assessment and evaluation of the potential clean-up alternatives*” (emphasis added)); *Gail v. New England Gas Co.*, 532 F. Supp. 2d 396, 399-400 (D.R.I. 2008) (discussing common law right to remediation and stating that “principle [that ‘every wrong shall have a remedy’] finds expression in nuisance cases and, more specifically, in nuisance cases involving environmental contamination, where injunctive relief for abatement consistently has been recognized as an appropriate remedy” (collecting cases)); *see also, e.g.*, *Maine People's Alliance v. Holtrachem Mfg. Co., L.L.C.*, 211 F. Supp. 2d 237, 256 (D. Me. 2002) (ordering that the parties in a RCRA case "confer and make genuine, good-faith efforts to agree on a specific plan for an independent study to determine: (1) the extent of the existing harm to the Penobscot River and Bay south of the plant site, (2) the need for a remediation plan, if any, and (3) the elements of, and schedule for, completion of such a remediation plan"); *Maine People's Alliance v. Mallinckrodt, Inc.*, 471 F.3d 277, 284 (1st Cir. 2006) (upholding aforementioned remedial investigation, reasoning that "[t]he fact that the court chose a remedy that aspires to furnish a degree of determinacy before fashioning further relief speaks only to the court's cautious use of discretion in selecting remedies . . ."); *Interfaith Community Organization v. Honeywell Int'l, Inc.*, 399 F.3d 248, 266 (3d Cir. 2005) (upholding order requiring defendant to

study the contamination and allowing for district court to order additional remedial actions only if necessary on the ground that "the injunction is reasonable and narrow, as it requires only what is necessary now to abate the established endangerments").

168. Significantly, although the State has, as concluded above, established that Defendants' conduct has caused the State to suffer and continue to actual injury, this Court need not find actual injury to order injunctive relief; threatened injury can suffice. *See, e.g., Sharp v. 251st Street Landfill*, 925 P.2d 546, 548-49 (Okla. 1996) (relief may be granted under state law nuisance where there is "a reasonable degree of probability" that a defendant's conduct will cause injury to another's interests); *State of Illinois v. City of Milwaukee*, 599 F.2d 151, 165 (7th Cir. 1979) (relief may be granted under federal common law nuisance where a defendant's conduct is causing "a significant threat of injury" to plaintiff's interest); *Texas v. Pankey*, 441 F.2d 236 (10th Cir. 1971) (recognizing that a threatened nuisance could be enjoined); 27A Okla. Stat. § 2-6-105(A) (relief may be granted under 27A Okla. Stat. § 2-6-105(A) where a defendant has "place[d] or cause[d] to be placed any wastes in a location where they are likely to cause pollution of any . . . waters of the state"); *Burlington Northern*, 505 F.3d at 1024 ("pollution need not have already occurred before conduct 'likely to cause' pollution can be deemed a public nuisance [under 27A Okla. Stat. § 2-6-105(A)").

B. Relief Being Sought

169. The State is seeking an injunction prohibiting Defendants from allowing poultry waste generated by birds owned, leased, or controlled by them to be land-applied in the IRW on fields having an STP in excess of 65 lbs/acre based on a Mehlich III six inch sample. The State is further entitled to an order requiring that land application in the IRW be conducted in accordance with this 65 lb/acre limit, as well as an Animal Waste Management Plan or Nutrient

Management Plan. The State further seeks an order requiring Defendants to remove from the IRW and appropriately manage, at Defendants' expense, all poultry waste generated by birds owned, leased, or controlled by them that cannot be land-applied in the IRW under this standard. The State also seeks an order prohibiting Defendants from land-applying poultry waste removed from the IRW on field having an STP in excess of 65 lbs/acre in watersheds located in whole or in part in Oklahoma that are designated nutrient surplus areas, nutrient limited watersheds or nutrient vulnerable groundwater areas. The State additionally seeks an order requiring remediation of the IRW, at Defendants' expense, the exact nature of which would be determined following an investigation of remedial alternatives, also to be funded by Defendants. The State also seeks reporting, monitoring and auditing of Defendants' performance of their obligations under the injunction sought from the Court, and water quality monitoring to assess the impact of relief ordered in this case.

C. No Adequate Remedy at Law

170. In light of this Court's July 22, 2009 Order dismissing all of the State's damages claims based on the Court's finding under Fed. R. Civ. P. 19 that the Cherokee Nation was a required party in order for the State's damages claims to proceed (DKT #2362), the State necessarily lacks an adequate remedy at law in this procedural posture. Thus, the consideration of whether the State has an adequate remedy at law that might impact its request for injunctive relief has no application in the Court's exercise of equity jurisdiction here. Even in the absence of the Court's July 22, 2009 Order, the Court finds that an injunction is necessary here to protect this important Oklahoma natural resource.

D. TMDLs

171. Defendants assert that a Total Maximum Daily Load ("TMDL") that may be developed by a state or federal agency pursuant to Section 303(d) of the CWA, 33 U.S.C. § 1313, is the appropriate remedy for the alleged pollution at issue in this case. The Court does not find Defendants' position persuasive for a variety of reasons.

172. The pollution at issue in the case is nonpoint source water pollution from poultry feeding operations. Section 303(d) of the CWA requires the states to identify those waters within its boundaries for which the effluent limitations required by 33 U.S.C. § 1311(B)(1)(A) and (B)[128] are not stringent enough to implement any water quality standard applicable to such waters. *See* 33 U.S.C. § 1313(d)(1)(A). Effluent limitations under the CWA apply only to point sources of pollution and not to nonpoint sources of pollution such as runoff from land applied animal wastes at issue here. *See, e.g.*, *Pronsolino*, 291 F.3d at 1125-26 (9th Cir. 2001) ("Effluent limitations pertain only to point sources of pollution; point sources of pollution are those from a discrete conveyance, such as a pipe or tunnel. Nonpoint sources of pollution are non-discrete sources; sediment run-off from timber harvesting, for example, derives from a nonpoint source.").

173. For waters identified as impaired on the 303(d) list, a state must determine the total maximum daily load (TMDL) for pollutants at a level necessary to achieve the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. *See* 33 U.S.C. § 1313(d)(1)(C).

---

[128] 33 U.S.C. § 1311(B)(1)(A) and (B) deal with effluent limitations for point sources, other than publicly owned treatment works, and with publicly owned treatment works, respectively.

174. "A TMDL defines the specified maximum amount of a pollutant which can be discharged or 'loaded' into the waters at issue from all combined sources."[129] *Dioxin/Organochlorine Center v. Clarke*, 57 F.3d 1517, 1520 (9th Cir. 1995). Regulations promulgated under the CWA require a TMDL to determine the loading capacity for a pollutant that will support water quality standards, and to apportion that loading capacity between loads from point and nonpoint sources. The implementing regulation divides the loading capacity of a receiving water between nonpoint and point sources. "Load allocations" are calculated for nonpoint sources and "wasteload allocations" are calculated for point sources. *See* 40 C.F.R. 130.2(g) & (h). Wasteload allocations for point sources are water-quality-based effluent limitations, whereas load allocations for nonpoint sources are not effluent limitation but rather ". . . best estimates of the loading, which may range from reasonably accurate estimates to gross allotments. . . ." *Id.*

175. Unlike NPDES permits for point sources that can be modified to include effluent limitations to meet TMDL-based wasteload allocations, neither the CWA nor its implementing regulations contain provisions authorizing or requiring implementation of nonpoint source controls designed to achieve nonpoint source load allocations identified in a TMDL. The CWA does not grant the EPA authority to regulate nonpoint sources of pollution in any manner and does not impose any requirements on States to adopt regulatory schemes to govern nonpoint sources of pollution. *See American Wildlands*, 260 F.3d at 1197-98 ("[N]othing in the CWA demands that a state adopt a regulatory system for nonpoint sources. . . . In the Act, Congress has chosen not to give the EPA the authority to regulate nonpoint source pollution. . . . [T]he Act

[129] The implementing regulation defines "loading" as, among other things, an amount of matter or thermal energy that is introduced into a receiving water. 40 C.F.R. § 130.2(e). Loading capacity is defined as the greatest amount of loading that a water can receive without violating water quality standards. 40 C.F.R. § 130.2(f).

nowhere gives the EPA the authority to regulate nonpoint source discharges."). While the CWA mandates controls on discharges to water from point sources of pollution, it does not provide any "direct mechanism to control nonpoint source pollution but rather uses the 'threat and promise' of federal grants to the states to accomplish this task, thereby "recogniz[ing], preserv[ing], and protect[ing] the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution, [and] to plan the development and use . . . of land and water resources. . . ." in accordance with Section 101(b) of the Act. *See Pronsolino*, 291 F.3d at 1126-27 (citations omitted).

176. Section 303(d) is a part of the CWA's "carrot-and-stick approach to attaining acceptable water quality without direct federal regulation of nonpoint sources of pollution." *See Pronsolino*, 291 F.3d at 1127. States are required to submit a 303(d) list of impaired waters and any associated TMDLs to the EPA for approval or disapproval. *See* 33 U.S.C. § 1313(d)(2). Approved TMDLs are required to be incorporated into the state's continuing planning process which must be approved by the EPA.[130] *See* 33 U.S.C. § 1313(d)(2). "The upshot of this intricate scheme is that the CWA leaves to the states the responsibility of developing plans to achieve water quality standards if the statutorily-mandated point source controls will not alone suffice, while providing federal funding to aid in the implementation of the state plans." *Pronsolino*, 291 F.3d at 1128.

177. A TMDL is a planning tool that does not require or authorize a State to take action to implement the load allocation for nonpoint sources identified in a TMDL. *See Pronsolino*, 291 F.3d at 1129 ("TMDLs are primarily informational tools that allow the states to proceed from the identification of waters requiring additional planning to the required plans.").

---

[130] TMDLs developed by EPA for waters on a state's 303d list are also required to be incorporated into that state's continuing planning process. *See* 33 U.S.C. § 1313(d)(2).

A TMDL does not authorize a State to require any nonpoint source to implement any pollution controls or establish any regulatory or permitting requirement to reduce pollution from nonpoint sources. *See Pronsolino*, 291 F.3d at 1140 ("States must implement TMDLs only to the extent that they seek to avoid losing federal grant money; there is no pertinent statutory provision otherwise requiring implementation of § 303 plans or providing for their enforcement."). While the provision of Section 303(d) of the CWA "directly regulate point sources of pollution, the Act merely requires states to undertake an assessment process to identify waters for which further controls on nonpoint sources of pollution may be needed, and it provides financial incentives to encourage any such further state regulations that may be necessary. The Act makes various federal grants available to the states to aid implementation of the plans and withholds funding for states with inadequate plans." *Barnum Timber Co. v. Environmental Protection Agency*, 2008 WL 4447690, at *3 (N.D. Cal. Sept. 29, 2008) (internal citation omitted).

178. Based upon the forgoing authority, the Court concludes that the CWA with its provisions for TMDLs does not, in and of itself, require the State to reduce load allocations (nonpoint source pollution loads) as a result of a TMDL.

179. While Defendants have suggested that TMDL requirements, and the interplay of the Oklahoma law that requires water quality standards implementations plans, amount to a legal requirement, presumably for ODAFF to enforce nonpoint source load reductions, *see* Daily Trans., 10823:4-13 (McDaniel Argument), the pertinent Oklahoma statute, 27A Okla. Stat. § 1-1-202(B)(3)(f), in fact only establishes the requirements for state agencies to adopt Water Quality Standards Implementation Plans ("WQSIPs") and does not authorize or require that an any agency enforce TMDL nonpoint source loading reductions. Among other things, the statute requires certain state agencies to develop WQSIP plans to:

> detail the manner in which the agency will comply with mandated statewide requirements affecting water quality developed by other statewide environmental agencies including, but not limited to, total maximum daily load development, water discharge permit activities and nonpoint source pollution prevention programs,

See 27A Okla. Stat. § 1-1-202(B)(3)(f). The plain terms of the statute only requires WQSIPs that detail the manner in which each agency -- such as ODAFF --will comply with TMDL "development," not "enforcement" or "implementation." If the legislature had wanted to impose upon state environmental agencies the duty under Section 1-1-202 to enforce nonpoint source loading reductions called for in a TMDL the Court concludes that it could have said so clearly. It has not.

180. ODAFF's WQSIP for its animal waste jurisdictional area is embodied in a regulation, whose sole reference to TMDLs states, "ODAFF will participate in the TMDL process as resources permit. . . ." *See* Okla. Admin. Code § 35:45-1-7(f). This language is consistent with the statutory requirement that state environmental agencies detail how they will comply with "total maximum daily load development." *See* 27A Okla. Stat. § 1-1-202(B)(3)(f). ODAFF's statement in its WQSIP that it will participate in the TMDL process "as resources permit" falls far short of a legal authority or duty to enforce any load allocation identified in a TMDL against Defendants.

181. Ironically, as demonstrated elsewhere in these findings and conclusions, the ORPFOA provides that there should be <u>no</u> loading from poultry feeding operations because that Act provides that discharge or runoff of poultry waste from the application site is prohibited. *See* 2 Okla. Stat. § 10-9.7(C)(5)(c). The Court concludes that Oklahoma law does not prohibit <u>all</u> nonpoint source pollution from poultry operations while simultaneously requiring nonpoint

source pollution from poultry operations (which should not exist) be reduced pursuant to a TMDL.

182. The Court concludes that nothing in the Oklahoma law requiring WQSIPs requires ODAFF to reduce load allocations (nonpoint source loading) pursuant to a TMDL.

183. The Court concludes that, while ODAFF has environmental enforcement tools at its disposal, such as provisions of the ORPFOA that permit injunctions and fines for violations of the Act, *see, e.g.*, 2 Okla. Stat. § 10-9.11, those tools are not mandated as a matter of state law to be used to enforce load allocations identified in a TMDL under the Clean Water Act, nor do they require ODAFF to enforce nonpoint source reductions as might be called for in a TMDL.

184. Further, it is uncertain when an Oklahoma-based TMDL for the Oklahoma portion of the IRW will be completed. *See* FOF ¶ 78. While the EPA has established a target date of September 15, 2011, for the possible completion of one or more TMDLs for the IRW, the EPA's record of meeting its own targets is a poor one. *See* FOF ¶ 81. Consequently, the Court concludes that, ineffective as a TMDL is for reducing nonpoint source loadings, waiting for the completion of a TMDL for the IRW would constitute entirely speculative waiting for a predictably inadequate remedy. This conclusion is buttressed by the fact that the present record contains no basis for concluding that either the EPA or Oklahoma authorities could use a TMDL to reduce load allocations originating in Arkansas, or that Arkansas could or would itself reduce such load allocations pursuant to a TMDL.

E. Irreparable Harm

185. "When a case is brought pursuant to an environmental or public health statute . . . the primary focus shifts from irreparable harm to concern for the public interest." *United States v. Power Engineering Co.*, 10 F. Supp. 2d 1145, 1149 (D. Colo. 1998) (citations omitted).

Moreover, "[w]here a statute authorizes injunctive relief for its enforcement, plaintiffs need not plead and prove irreparable injury." *See Environmental Defense Fund, Inc. v. Lamphier*, 714 F.2d 331, 338 (4th Cir. 1983) (citations omitted) (RCRA context); *accord United States v. Rx Depot, Inc.*, 290 F. Supp. 2d 1238, 1246 (N.D. Okla. 2003) (citations omitted) (Federal Food, Drug and Cosmetic Act context).

F. Balancing of the Equities

186. It is true that in deciding to grant a permanent injunction, courts are, in certain contexts, to consider whether "the threatened injury [to the plaintiff] outweighs the harm that the injunction may cause the opposing party." *See Prairie Band of Potawatomi Nation*, 476 F.3d at 822. Here, however, it is not necessary to undertake a weighing of the equities or make a finding of irreparable harm.

187. First, "it is an accepted equitable principle that a court does not have to balance the equities in a case where the defendant's conduct has been willful." *United States v. Bethlehem Steel Corp.*, 38 F.3d 862, 868 (7th Cir. 1994), quoting *EPA v. Environmental Waste Control*, 917 F.2d 327 (7th Cir. 1990). The Court has found that Defendants' conduct has been willful. COL ¶¶ 162-63.

188. Second, because (1) this case involves an endangerment to health and the environment and (2) the State is a sovereign, a balancing of harms does not enter into the Court's equitable analysis. *Lamphier*, 714 F.2d 331. In *Lamphier*, the Fourth Circuit Court of Appeals stated as follows:

> First, the law of injunctions differs with respect to governmental plaintiffs (or private attorneys general) as opposed to private individuals. Where the plaintiff is a sovereign and where the activity may endanger the public health, 'injunctive relief is proper, without resort to balancing.' *Illinois v. Milwaukee*, 599 F.2d 151, 166 (7th Cir. 1979), *rev'd on other grounds*, 451 U.S. 304, 68 L. Ed. 2d 114, 101

> S. Ct. 1784 (1981). Second, in cases of public health legislation, the emphasis shifts from irreparable injury to concern for the general public interest:
>
> > It is contended that the government has not shown irreparable injury and that it has an adequate remedy at law . . . . The United States, however, is not bound to conform with the requirements of private litigation when it seeks the aid of the courts to give effect to the policy of Congress as manifested in a statute. It is a familiar doctrine that an injunction is an appropriate means for the enforcement of an Act of Congress when it is in the public interest.
>
> *Shafer v. United States*, 229 F.2d 124, 128 (4th Cir. 1956). This rationale applies equally to state enforcement of federal and state health laws.

Lamphier, 714 F.2d at 338.

189. In light of the above, the Court finds Defendants' proffered evidence regarding alleged economic impacts from the issuance of an injunction to be irrelevant.

190. Moreover, even if the Court were to engage in some balancing of harms analysis, evidence as to economic impacts on third parties is nonetheless irrelevant. In those contexts where courts balance the equities, the test is whether "the threatened injury [to the plaintiff] outweighs the harm that the injunction may cause the opposing *party*." *Prairie Band of Potawatomi Nation*, 476 F.3d at 822 (emphasis added). Although Defendants claim that poultry growers would suffer economic impacts from an injunction, the State did not bring this action against any poultry growers and does not seek to hold them liable for pollution caused by Defendants to the waters of the State in the IRW. The growers' status as employees / agents of the respective Defendants does not change the analysis. *See, e.g.*, *El Dorado Irrigation Dist., Inc. v. Traylor Bros., Inc.*, 2007 WL 512428, at *10 (E.D. Cal. Feb. 12, 2007) (employees of party corporation are not "parties" to litigation).

191. And Defendants have submitted no evidence of economic harm *to them* to support any balancing of the harms in this case.

G. Public Interest

192. "It is beyond cavil that the public has a right to soil and water that is free from environmental contamination." *In re Methyl Tertiary Butyl Ether Products Liability Litigation*, 175 F. Supp. 2d 593, 629 (S.D.N.Y. 2001); *accord Power Engineering Co.*, 10 F. Supp. 2d at 1165 (". . . citizens have a right to expect contamination-free groundwater and soils, [and] a clean river . . ."); *Industrial Park Development Co. v. EPA*, 604 F. Supp. 1136, 1144 (E.D. Pa. 1985) ("There is a strong public interest in protecting public health and our environment").

193. "The public interest may be declared in the form of a statute." *Federal Practice & Procedure*, § 2948.4. It is the clear public policy of the State that there be no pollution of the waters of the State. A sampling of such pronouncements may be found in the statutes and regulations of the State. *See* FOF ¶¶ 83-86.

H. Diminution in Value

194. Defendants argue that injunctive relief is unavailable under Oklahoma law "where the cost of any retrospective injunctive relief exceed[s] any diminution in value of the lands of the IRW resulting from any nuisance or trespass." (DKT #2641 ¶ 95.) Citing *Burlington Northern & Santa Fe Railway Co. v. Grant*, 505 F.3d 1013, 1027 (10th Cir. 2007), and *Houck v. Hold Oil Corp.*, 867 P.2d 451, 460 (Okla. 1993), the Cargill Defendants previously asserted that "the Court may not impose a mandatory injunction on Defendants to remediate some or all of the IRW unless the cost of the remediation is less than the demonstrated diminution of value of the land of the IRW caused by Defendants' conduct." *See* DKT #2628 at 18. Neither case stands for this proposition. To the contrary, each addresses the <u>legal</u> relief available to <u>private</u> landowners in a <u>private</u> nuisance action. *See* 505 F.3d at 1018, 1026-27; 867 P.2d at 454, 460. Simply stated, no such limitation applies to the public natural resources at issue here. *See, e.g.*, *Meinders v. Johnson*, 134 P.3d 858, 862 n.1 (Okla. Ct. App. 2005) (affirming order stating that diminution

in value of property is not outer limit on monetary expenditures that Court can require to enjoin public nuisance).

I. Defendant Cargill, Inc., Defendant Peterson Farms, Inc., and Defendant Cal-Maine Foods, Inc.

195. Defendant Cargill, Inc., Defendant Peterson Farms, Inc., and Defendant Cal-Maine Foods, Inc. argue that neither they nor their conduct can be enjoined because they no longer have poultry operations in the IRW and no longer contract with any poultry growers in the IRW. In response, the State makes two arguments. First, the State points out that these Defendants' past conduct in the IRW has caused banked phosphorus, that runoff of this banked phosphorus is causing current harms and will cause future harms, and that therefore these Defendants are liable for participation in any remedial investigation and remediation. And second, the State points out that there is no assurance that complained-of conduct will not be resumed. "Voluntary cessation of unlawful activity does not moot every request for prospective relief; the court must decide whether the complained-of conduct may be resumed." *Vincent v. City Colleges of Chicago*, 485 F.3d 919, 925 (7th Cir. 2007); *Chaffin v. Kansas State Fair Board*, 348 F.3d 850, 865 (10th Cir. 2003) ("When defendants are shown to have settled into a continuing practice . . . , courts will not assume that it has been abandoned without clear proof. It is the duty of the courts to beware of efforts to defeat injunctive relief by protestations of repentance and reform, especially when abandonment seems timed to anticipate suit, and there is a probability of resumption").

196. The Court concludes that, under the circumstances, Defendant Cargill, Inc., Defendant Peterson, and Defendant Cal-Maine may be enjoined.

J. Penalties

197. The State is entitled to civil penalties in connection with its claim under 27A Okla. Stat. § 2-6-105 in the amount of $_____ against each Defendant group for each year since 1993 it has conducted poultry operations in the IRW. *See* COL ¶¶ 130-34. In addition, under its vicarious liability, the State is entitled to an award of civil penalties against each Defendant group in the amount of $_____ (with the exception of Defendant Peterson Farms). *See* COL ¶¶ 135-38. Pursuant to 27 Okla. Stat. § 2-3-504, the Court also determines that the State is entitled to recover from each Defendant group its attorneys fees and costs associated with the collection of these penalties. *See* COL ¶ 139. A separate proceeding will be held to determine the amount of such attorneys fees and costs.

K. 12 Okla. Stat. § 940

198. Defendants claim that, pursuant to 12 Okla. Stat. § 940, they are entitled to recover attorney's fees and costs based on this Court's July 22, 2009 dismissal of the State's claims for damages under Oklahoma common law. (DKT #2641 at p. 28 ¶ 101.) The Court rejects this argument. The Court's July 22, 2009 Order was made without prejudice and was not an adjudication of the merits of the State's claims that were dismissed pursuant thereto. *See supra* note 114. Accordingly, Defendants are not "prevailing parties," as that term is used in 12 Okla. Stat. § 940. *See, e.g., Atwood v. Atwood*, 25 P.3d 936, 948 (Okla. Civ. App. 2001) ("In Oklahoma jurisprudence, the concept of 'prevailing party' is result oriented. A party prevails who succeeds on the merits of the claim.").

L. Summary of Relief to Which the State Is Entitled

199. The State is entitled to an injunction prohibiting Defendants from allowing poultry waste generated by birds owned, leased, or controlled by them to be land-applied in the IRW on fields having an STP in excess of 65 lbs/acre based on a Mehlich III six inch sample.

The State is further entitled to an order requiring that land application in the IRW be conducted in accordance with this 65 lb/acre limit, as well as an Animal Waste Management Plan or Nutrient Management Plan. The State is also entitled to an order requiring Defendants to remove from the IRW and appropriately manage, at Defendants' expense, all poultry waste generated by birds owned, leased, or controlled by them that cannot be land-applied in the IRW under this standard. The State is further entitled to an order prohibiting Defendants from land-applying poultry waste removed from the IRW on fields having an STP in excess of 65 lbs/acre in watersheds located in whole or in part in Oklahoma that are designated nutrient surplus areas, nutrient limited watersheds or nutrient vulnerable groundwater areas. The State is also entitled to an order requiring remediation of the IRW, at Defendants' expense, the exact nature of which would be determined following an investigation of remedial alternatives, also to be funded by Defendants and approved by the Court. The State is also entitled to reporting, monitoring and auditing of Defendants' performance of their obligations under the injunction sought from the Court, and water quality monitoring to assess the impact of relief ordered in this case. The Court shall retain jurisdiction and supervision of these undertakings.

M. A Special Master Should Be Appointed

200. Based upon the foregoing factual findings and conclusions of law, the Court finds that the conduct of a remedial investigation and the necessary monitoring and auditing of Defendants' compliance present post-trial matters that cannot be effectively and timely addressed by an available district judge or magistrate judge of this district. Consequently, pursuant to Fed. R. Civ. P. 53 and the Court's inherent power, the Court concludes that it should appoint a Special Master by separate order.

CONCLUSION

Based upon a full analysis of the facts and the law, the Court concludes that each Defendant is liable under the laws of the State of Oklahoma and the federal common law for the pollution of the waters of the State of Oklahoma. Consistent with these findings of fact and conclusions of law, an order and judgment for an injunction, as well as an award of penalties, costs and attorney fees pursuant to 27A Okla. Stat. § 2-3-504(C), in favor of the State and against Defendants shall follow.

IT IS SO ORDERED.

Respectfully Submitted,

W.A. Drew Edmondson OBA #2628
ATTORNEY GENERAL
Kelly H. Foster OBA #17067
ASSISTANT ATTORNEY GENERAL
State of Oklahoma
313 N.E. 21st St.
Oklahoma City, OK 73105
(405) 521-3921

M. David Riggs OBA #7583
Joseph P. Lennart OBA #5371
Richard T. Garren OBA #3253
Sharon K. Weaver OBA #19010
Robert A. Nance OBA #6581
D. Sharon Gentry OBA #15641
David P. Page OBA #6852
RIGGS, ABNEY, NEAL, TURPEN,
ORBISON & LEWIS
502 West Sixth Street
Tulsa, OK 74119
(918) 587-3161

Louis W. Bullock OBA #1305
Robert M. Blakemore OBA #18656
BULLOCK, BULLOCK & BLAKEMORE
110 West Seventh Street, Suite 707
Tulsa, OK 74119
(918) 584-2001

Frederick C. Baker
(admitted *pro hac vice*)
Elizabeth Claire Xidis
(admitted *pro hac vice*)
MOTLEY RICE LLC
28 Bridgeside Boulevard
Mount Pleasant, SC 29465
(843) 216-9280

/s/ Ingrid L. Moll
William H. Narwold
(admitted *pro hac vice*)
Ingrid L. Moll
(admitted *pro hac vice)*
Mathew P. Jasinski
(admitted *pro hac vice*)
MOTLEY RICE LLC
20 Church Street, 17th Floor
Hartford, CT 06103
(860) 882-1678

Jonathan D. Orent
(admitted *pro hac vice)*
Michael G. Rousseau
(admitted *pro hac vice)*
Fidelma L. Fitzpatrick
(admitted *pro hac vice)*
MOTLEY RICE LLC
321 South Main Street
Providence, RI 02940
(401) 457-7700

Attorneys for the State of Oklahoma

CERTIFICATE OF SERVICE

I hereby certify that on this 5th day of February, 2010, I electronically transmitted the above and foregoing pleading to the Clerk of the Court using the ECF System for filing and a transmittal of a Notice of Electronic Filing to the following ECF registrants:

W. A. Drew Edmondson, Attorney General	Fc_docket@oag.ok.gov
Kelly H. Foster, Assistant Attorney General	kelly_foster@oag.ok.gov
M. David Riggs	driggs@riggsabney.com
Joseph P. Lennart	jlennart@riggsabney.com
Richard T. Garren	rgarren@riggsabney.com
Sharon K. Weaver	sweaver@riggsabney.com
Robert A. Nance	rnance@riggsabney.com
D. Sharon Gentry	sgentry@riggsabney.com
David P. Page	dpage@riggsabney.com
RIGGS, ABNEY, NEAL, TURPEN, ORBISON & LEWIS	
Louis Werner Bullock	lbullock@bullock-blakemore.com
Robert M. Blakemore	bblakemore@bullock-blakemore.com
BULLOCK, BULLOCK & BLAKEMORE	
Frederick C. Baker	fbaker@motleyrice.com
Elizabeth Claire Xidis	cxidis@motleyrice.com
William H. Narwold	bnarwold@motleyrice.com
Ingrid L. Moll	imoll@motleyrice.com
Jonathan D. Orent	jorent@motleyrice.com
Michael G. Rousseau	mrousseau@motleyrice.com
Fidelma L. Fitzpatrick	ffitzpatrick@motleyrice.com
MOTLEY RICE LLC	
Counsel for State of Oklahoma	
Robert P. Redemann	rredemann@pmrlaw.net
PERRINE, MCGIVERN, REDEMANN, REID, BARRY & TAYLOR, P.L.L.C.	
David C. Senger	david@cgmlawok.com
Robert E Sanders	rsanders@youngwilliams.com
Edwin Stephen Williams	steve.williams@youngwilliams.com
YOUNG WILLIAMS P.A.	
Counsel for Cal-Maine Farms, Inc and Cal-Maine Foods, Inc.	
John H. Tucker	jtucker@rhodesokla.com

Theresa Noble Hill	thill@rhodesokla.com
Colin Hampton Tucker	ctucker@rhodesokla.com
Kerry R. Lewis	klewis@rhodesokla.com
RHODES, HIERONYMUS, JONES, TUCKER & GABLE	
Terry Wayen West	terry@thewestlawfirm.com
THE WEST LAW FIRM	
Delmar R. Ehrich	dehrich@faegre.com
Bruce Jones	bjones@faegre.com
Krisann C. Kleibacker Lee	kklee@faegre.com
Todd P. Walker	twalker@faegre.com
Christopher H. Dolan	cdolan@faegre.com
Colin C. Deihl	cdeihl@faegre.com
Randall E. Kahnke	rkahnke@faegre.com
FAEGRE & BENSON, LLP	
Counsel for Cargill, Inc. & Cargill Turkey Production, LLC	
James Martin Graves	jgraves@bassettlawfirm.com
Gary V Weeks	gweeks@bassettlawfirm.com
Woody Bassett	wbassett@bassettlawfirm.com
K. C. Dupps Tucker	kctucker@bassettlawfirm.com
Earl Lee "Buddy" Chadick	bchadick@bassettlawfirm.com
Vincent O. Chadick	vchadick@bassettlawfirm.com
BASSETT LAW FIRM	
George W. Owens	gwo@owenslawfirmpc.com
Randall E. Rose	rer@owenslawfirmpc.com
OWENS LAW FIRM, P.C.	
Counsel for George's Inc. & George's Farms, Inc.	
A. Scott McDaniel	smcdaniel@mhla-law.com
Nicole Longwell	nlongwell@mhla-law.com
Craig A. Merkes	cmerkes@mhla-law.com
MCDANIEL, HIXON, LONGWELL & ACORD, PLLC	
Sherry P. Bartley	sbartley@mwsgw.com
MITCHELL, WILLIAMS, SELIG, GATES & WOODYARD, PLLC	
Counsel for Peterson Farms, Inc.	
John Elrod	jelrod@cwlaw.com

Vicki Bronson	vbronson@cwlaw.com
P. Joshua Wisley	jwisley@cwlaw.com
Bruce W. Freeman	bfreeman@cwlaw.com
D. Richard Funk	rfunk@cwlaw.com
CONNER & WINTERS, LLP	
Counsel for Simmons Foods, Inc.	
Stephen L. Jantzen	sjantzen@ryanwhaley.com
Paula M. Buchwald	pbuchwald@ryanwhaley.com
Patrick M. Ryan	pryan@ryanwhaley.com
RYAN, WHALEY, COLDIRON & SHANDY, P.C.	
Mark D. Hopson	mhopson@sidley.com
Jay Thomas Jorgensen	jjorgensen@sidley.com
Timothy K. Webster	twebster@sidley.com
Thomas C. Green	tcgreen@sidley.com
Gordon D. Todd	gtodd@sidley.com
SIDLEY, AUSTIN, BROWN & WOOD LLP	
Robert W. George	robert.george@tyson.com
L. Bryan Burns	bryan.burns@tyson.com
Timothy T. Jones	tim.jones@tyson.com
TYSON FOODS, INC	
Michael R. Bond	michael.bond@kutakrock.com
Erin W. Thompson	erin.thompson@kutakrock.com
Dustin R. Darst	dustin.darst@kutakrock.com
KUTAK ROCK, LLP	
Counsel for Tyson Foods, Inc., Tyson Poultry, Inc., Tyson Chicken, Inc., & Cobb-Vantress, Inc.	
R. Thomas Lay	rtl@kiralaw.com
KERR, IRVINE, RHODES & ABLES	
Frank M. Evans, III	fevans@lathropgage.com
Jennifer Stockton Griffin	jgriffin@lathropgage.com
David Gregory Brown	
LATHROP & GAGE LC	
Counsel for Willow Brook Foods, Inc.	
Robin S Conrad	rconrad@uschamber.com
NATIONAL CHAMBER LITIGATION CENTER	
Gary S Chilton	gchilton@hcdattorneys.com

HOLLADAY, CHILTON AND DEGIUSTI, PLLC	
Counsel for US Chamber of Commerce and American Tort Reform Association	
D. Kenyon Williams, Jr.	kwilliams@hallestill.com
Michael D. Graves	mgraves@hallestill.com
HALL, ESTILL, HARDWICK, GABLE, GOLDEN & NELSON	
Counsel for Poultry Growers/Interested Parties/ Poultry Partners, Inc.	
Richard Ford	richard.ford@crowedunlevy.com
LeAnne Burnett	leanne.burnett@crowedunlevy.com
CROWE & DUNLEVY	
Counsel for Oklahoma Farm Bureau, Inc.	
Kendra Akin Jones, Assistant Attorney General	Kendra.Jones@arkansasag.gov
Charles L. Moulton, Sr Assistant Attorney General	Charles.Moulton@arkansasag.gov
Counsel for State of Arkansas and Arkansas National Resources Commission	
Mark Richard Mullins	richard.mullins@mcafeetaft.com
MCAFEE & TAFT	
Counsel for Texas Farm Bureau; Texas Cattle Feeders Association; Texas Pork Producers Association and Texas Association of Dairymen	
Mia Vahlberg	mvahlberg@gablelaw.com
GABLE GOTWALS	
James T. Banks	jtbanks@hhlaw.com
Adam J. Siegel	ajsiegel@hhlaw.com
HOGAN & HARTSON, LLP	
Counsel for National Chicken Council; U.S. Poultry and Egg Association & National Turkey Federation	
John D. Russell	jrussell@fellerssnider.com
FELLERS, SNIDER, BLANKENSHIP, BAILEY & TIPPENS, PC	
William A. Waddell, Jr.	waddell@fec.net
David E. Choate	dchoate@fec.net
FRIDAY, ELDREDGE & CLARK, LLP	
Counsel for Arkansas Farm Bureau Federation	

Barry Greg Reynolds	reynolds@titushillis.com
Jessica E. Rainey	jrainey@titushillis.com
TITUS, HILLIS, REYNOLDS, LOVE, DICKMAN & MCCALMON	
Nikaa Baugh Jordan	njordan@lightfootlaw.com
William S. Cox, III	wcox@lightfootlaw.com
LIGHTFOOT, FRANKLIN & WHITE, LLC	
Counsel for American Farm Bureau and National Cattlemen's Beef Association	
Duane L. Berlin	dberlin@levberlin.com
LEV & BERLIN PC	
Counsel for Council of American Survey Research Organizations & American Association for Public Opinion Research	
Diane Hammons	Diane-Hammons@cherokee.org
Sara Hill	Sarah-Hill@cherokee.org
Counsel for the Cherokee Nation	

/s/ Ingrid L. Moll
Ingrid L. Moll