In the United States Court of Federal Claims

No. 05-381L

(Filed: July 1, 2009)

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	) Post-trial decision on physical
ARKANSAS GAME AND FISH	) takings claim; superinduced additions
COMMISSION,	) of water to the Black River in
	) Arkansas attributable to deviations
Plaintiff,	) by the Corps of Engineers from the
	) operating plan for the Clearwater
v.	) Dam in Missouri; periodic inundation
	) of Dave Donaldson Black River
UNITED STATES,	) Wildlife Management Area; loss of
	) oak timber; just compensation
Defendant.	)
	)
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OPINION AND ORDER

LETTOW, Judge.

This post-trial decision reprises the circumstances of a line of venerable precedents in the Supreme Court addressing situations where "superinduced additions of water" to rivers impaired the utility of adjacent lands and caused a taking. *Pumpelly v. Green Bay Co.*, 80 U.S. (13 Wall.) 166, 181 (1871) (Miller, J.) (holding that "where real estate is actually invaded by superinduced

additions of water . . . so as to effectively destroy or impair its usefulness, it is a taking, within the meaning of the Constitution"); *see also United States v. Lynah*, 188 U.S. 445 (1903) (the government's construction of dams and other obstructions that raised the level of the Savannah River above its natural height and prevented drainage of a landowner's plantation was a taking requiring compensation under the Fifth Amendment); *United States v. Welch*, 217 U.S. 333 (1910) (Holmes, J.) (holding that a taking arose where a landowner's property was flooded due to the government's dam); *United States v. Cress*, 243 U.S. 316 (1917) (determining that the government's construction and maintenance of locks and dams on the Cumberland and Kentucky Rivers created a backwater which resulted in a taking of a landowner's property); *United States v. Dickinson*, 331 U.S. 745 (1947) (finding a taking where the landowners' property was flooded due to the government's action in raising the level of a river); *United States v. Kansas City Life Ins. Co.*, 339 U.S. 799 (1950) (holding that a taking occurred where the government's action in raising the level of a stream for navigational purposes invaded a landowner's property by percolation of water, raising the water table, saturating the land, and blocking drainage so as to vitiate land's agricultural productivity).

The Arkansas Game & Fish Commission ("Commission") owns approximately 23,000 acres of land along the Black River in northeastern Arkansas that it manages as the Dave Donaldson Black River Wildlife Management Area ("Management Area"). The Commission in essence claims that during the years 1993-2000 the Corps of Engineers deviated from an operating plan for the Clearwater Dam upriver in southeastern Missouri, that these deviations caused greater amounts of water to flow down the Black River during the spring and summer growing seasons, that the increased water flows inundated the Wildlife Management Area for longer periods of time during the growing seasons, and that the sustained flooding and saturated ground during the growing seasons severely damaged the root systems of the oak species prevalent in the Management Area, killing many trees. The government does not deny that the deviations occurred, but it contests any liability, arguing that the harm to timber was attributable to different and intervening causes, among other things. An eleven-day trial was held in Little Rock, Arkansas, commencing on December 1, 2008, and a site visit was made to the Management Area in connection with the trial. Following post-trial briefing, a closing argument was held on April 27, 2009, and the case is ready for disposition.

FACTS[1]

A. Dave Donaldson Black River Wildlife Management Area

The Management Area is a tract of approximately 23,000 acres, *see* PX 500 at 1 (Report of Dr. Mickey Heitmeyer, a wetland ecologist who testified on behalf of the Commission (June 2006)) ("Heitmeyer Report") located along both banks of the Black River in northeastern

[1]This recitation of facts constitutes the court's principal findings of fact in accord with Rule 52(a) of the Rules of the Court of Federal Claims. Other findings of fact and rulings on questions of mixed fact and law are set out in the analysis.

Arkansas, spanning parts of Clay, Greene, and Randolph counties. Stip. ¶ 4.[2] It extends from mile 142 to mile 100 of the Black River, *see* DX 310 at 3 (Expert Report of Dr. Wade L. Nutter, a hydrologist who testified on behalf of the government (Apr. 11, 2008)) ("Nutter Report"), and is situated roughly between the towns of Corning and Pocahontas. Tr. 39:5-7 (Test. of Robert L. Zachary, Wildlife Supervisor for the Arkansas Game & Fish Commission). Much of the land that constitutes the Black River Management Area was purchased by the Commission in the 1950s and 1960s to preserve bottomland hardwood and to provide wintering habitat for migratory waterfowl. PX 37 at AGFC350 (Information about Dave Donaldson/Black River Wildlife Management Area (Jan. 22, 2001)) ("Management Area Information"); *see also Arkansas Game & Fish Comm'n v. United States*, 74 Fed. Cl. 426, 428 (2006).[3] The Commission operates the Management Area as a wildlife and hunting preserve, placing special emphasis on the waterfowl that pass through the area in the late fall and early winter on the Mississippi River flyway. DX 310 at 3 (Nutter Report); Tr. 39:13-17 (Zachary) ("[B]ecause of its proximity to the Mississippi fly[]way and its importance to the waterfowl population in the fly[]way, as well as its importance to the public in terms of recreation, we place heavy emphasis on waterfowl management."). Secondarily, the Management Area serves as a timber resource, with systematic harvests of mature oak and subsequent reforestation to maintain a healthy regenerating forest. *See* PX 37 at AGFC352 (Management Area Information).

The forests in the Management Area are comprised of different hardwood timber species, but the dominant species are nuttall, overcup, and willow oaks, which comprise approximately eighty percent of the trees in the Management Area. PX 268 at AGFC7661B (Mem. from Lou Hausman, Forester, Arkansas Game & Fish Commission, Wildlife Management Division, to Zachary (Mar. 6, 1996)).[4] Bald cypress, tupelo, willow, green ash, and water hickory trees are found along the sloughs, together with, to a lesser extent, pin oak, water oak and cherrybark oak trees, dependent upon the soil composition. PX 37 at AGFC351 (Management Area Information); Tr. 1165:19 to 1166:6 (Hausman). The forests in and adjacent to the Management Area are "among the largest contiguous areas of [bottomland hardwood forest] in any floodplain in the Upper Mississippi Alluvial Valley." PX 500 at 5 (Heitmeyer Report).

A variety of wildlife habitats exist in the Management Area, *see* PX 500 at 5 (Heitmeyer Report), and the Commission's habitat coordinator inventories these habitats, develops

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[2]The parties jointly stipulated to certain facts, and the Joint Stipulation will be cited as "Stip. ¶ __." Citations to the trial transcript are to "Tr. __" and those to the transcript of the closing argument are to "Cl. Tr.__." Plaintiff's exhibits are denoted as "PX __," defendant's exhibits are identified as "DX __," and joint exhibits are represented as "JX __."

[3]The prior decision in this case addressed a dispute that arose during discovery regarding proposed installation of water gauges by government experts at various locations in the Management Area. *Arkansas Game & Fish Comm'n*, 74 Fed. Cl. at 427.

[4]Nuttall and willow oaks are classified as red oak species, and overcup oaks are classified as a white oak species. PX 268 at AGFC7661B (Mem. from Hausman to Zachary).

biological prescriptions for the various compartments, and "optimize[s] those habitats on a sustainable basis." Tr. 47:1-6 (Zachary). The migrating bird flyway is a chief concern of the habitat coordinator and other members of the Commission. *See* PX 37 at AGFC350 (Management Area Information). The Commission seeks, among other things, to manage the forests to provide food essential to the migrating birds' diet. *Id*. Of special concern are the oak trees in the Management Area, which provide hard mast for migratory birds and other wildlife. PX 268 at AGFC7661B (Mem. from Hausman to Zachary) (noting the importance of hardwood trees as contrasted to softwood trees for the reproduction of migratory and native wildlife); *see also* Tr. 613:20 to 614:1 (Test. of Martin Blaney, Statewide Habitat Coordinator for the Arkansas Game & Fish Commission) (describing the condition of the bottomland hardwood forest in the Management Area prior to 1993). In addition, the Commission maintains five diked Green Tree Reservoirs ("GTRs") in the Management Area: the Upper and Lower Island GTRs, the Upper and Lower Reyno GTRs, and the Winchester GTR. Tr. 66:4-7 (Zachary). Each year, the GTRs are artificially flooded to benefit wintering waterfowl and to provide recreational opportunities for waterfowl hunting. Tr. 65:24 to 66:3 (Zachary). Such management practices reflect the Management Area's importance as a premier duck hunting area. *See* PX 37 at AGFC350-51 (Management Area Information).

In July 1984, the Commission issued a Master Plan for the development and management of natural resources in the Management Area. Stip. ¶ 17; JX 23 at AGFC2576 to AGFC2976 (Master Plan for the Dave Donaldson/Black River Wildlife Management Area (July 12, 1984)) ("Master Plan"). Pursuant to the Master Plan, the Management Area was divided into fourteen compartments, or management units, such that the Commission could differentiate areas and engage in a variety of silvacultural and timber management practices in different regions of the forest. Tr. 129:13-21 (Zachary); Stip. ¶ 18. This division of the forest into compartments reflected the Commission's "desire to have an uneven-aged diverse forest. . . . [T]he compartments would . . . be inventoried, and if needed, work would be prescribed as opposed to having no compartments and having to deal with the area as one whole unit." Tr. 129:16-21 (Zachary). The division into compartments thus "provide[d] direction and continuity for habitat management." Tr. 129:2-6 (Zachary).

The management practices employed by the Commission include selective thinning, clear-cutting, removal of undesirable species, and timber-stand improvement. Tr. 130:5-8 (Zachary). The Commission selectively harvests trees for commercial sales and "to stimulate the growth of new timber, to provide a diverse habitat type[,] and to remove unhealthy or unproductive trees from the forest." PX 37 at AGFC352 (Management Area Information). Thinning, for instance,

> produces competition between the older mature trees in the stand [and] . . . allows sunlight to penetrate the forest canopy, hit the forest floor. That stimulates the growth of the young trees and new seedling[s]. It also would stimulate the growth of desirable non-wooded plants within the forest. It would provide essential cover[] and food for various wildlife species.

Tr. 130:14-25 (Zachary). Timber surveys are periodically carried out in compartments in the Management Area to determine which tree species are present, to track the progression of growth, and to analyze the basal structure of timber stands. Tr. 1174:10-19 (Hausman). After an inventory has been completed, the Commission's staff develops a set of prescriptions that summarize the inventory and recommend various management actions that should be undertaken to improve the relevant wildlife habitats, which can include the sale of timber. *See* Stip. ¶ 21.

B. Clearwater Dam

In southeastern Missouri, upstream from the Management Area and approximately 32 miles northwest of Poplar Bluff, Missouri, Clearwater Lake and Dam is located at mile 257 on the Black River. Stip. ¶¶ 7, 9. Construction on the Clearwater Dam began in 1940, two years after the passage of the Flood Control Act of 1938, Pub. L. No. 75-761, 52 Stat. 1215, 1218, which approved flood control projects for regions of the country that included the White River Basin in Missouri and Arkansas. DX285 at US783 (Water Control Manual for Clearwater Lake (July 1995)) ("Clearwater Lake Manual"); Stip. ¶ 8.[5] Construction of the dam was completed and the conservation pool was filled by autumn of 1948, at which point the Corps of Engineers began to control releases of water from the Clearwater Dam, regulating the flow of the Black River and reducing flooding of agricultural lands along the river. *See* DX285 at US783-84 (Clearwater Lake Manual). The Corps of Engineers is responsible for the operation of the Clearwater Lake and Dam as a flood control project. Stip. ¶ 3.

In developing a plan to regulate the amount of water that should be released from Clearwater Lake into the Black River, the Corps of Engineers was attentive to differences in the agricultural season from April through November – which roughly corresponds to the growing season for bottomland hardwood trees – and the non-agricultural season from December through March. *See* DX285 at US784 (Clearwater Lake Manual). The Corps "timed and sized" the water releases from Clearwater Lake "such that [these] releases, when combined with uncontrolled flow entering the Black River from tributaries below Clearwater Dam," would not exceed certain predetermined target water stages at various gauges along the river. Stip. ¶ 13. Initially, in 1948, the Corps of Engineers regulated the flow of the river to ensure that the gauging station at Poplar Bluff would not exceed a level of twelve feet during the agricultural season from April through November, and fourteen feet during the remainder of the year. DX285 at US784 (Clearwater Lake Manual). Two years later, the Corps of Engineers adjusted the Poplar Bluff regulating stage to 10.5 feet during the agricultural season and 11.5 feet during the non-agricultural season. *Id*. The Clearwater Lake Water Control Manual was originally published in 1953 and later revised in July 1995. *See* Stip. ¶ 12; DX285 at US764 (Clearwater Lake Manual). The Manual notes that "[t]he primary purpose of Clearwater Dam is to provide flood protection below the dam and to maintain a permanent conservation pool for recreation, fish and wildlife, and other incidental uses." DX285 at US817 (Clearwater Lake Manual).

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[5]The Black River eventually flows into the White River near Jacksonport, Arkansas. Tr. 88:18-24 (Zachary).

The modified water control plan implemented in 1950 for Clearwater Lake was still in effect in 1993, at which point the Corps of Engineers implemented a series of deviations from the plan regarding water releases from Clearwater Dam. *See* Stip. ¶ 15. The deviations entailed new water-level targets at the Poplar Bluff gauge. *Id*. These deviations were approved at various times from 1993 to 2000, typically on an interim basis. *Id.*; *see* PX 266 at AGFC7657 (Mem. from Zachary to Don Akers, Chief of Arkansas Game & Fish Commission, Wildlife Management Division (Feb. 22, 1996)).[6] The interim deviations initially permitted releases from Clearwater Lake such that the Poplar Bluff gauge would measure 10.5 feet during the winter and early spring, eight feet from April 15 to May 15, and six feet from May 15 to November 15. PX 268 at AGFC6771 (Mem. from Hausman to Zachary). These interim deviations were modified at various times in the late 1990s; for instance, in 1999 and 2000, the water level at Poplar Bluff was set at a level of 11.5 feet from December to mid-May and at four feet from mid-May to November. *See* JX 14 at AGFC272 (Draft Environmental Assessment for Revision of Clearwater Lake Black River Water Control Manual (Sept. 1999)) ("Clearwater Lake Environmental Assessment"); DX 310 at Table 1 (Nutter Report) (listing the implemented deviations to the water control plan from 1993 to 2000); Tr. 208:4-8 (Test. of Roger Chris Hicklin, Chief of the Planning and Environmental Office of the Corps of Engineers).

Numerous interest groups were concerned with these modifications to the 1950 water control plan, including the Commission, the Corps of Engineers, the United States Fish and Wildlife Service, the Missouri Conservation Department, dock owners and campsite operators at Clearwater Lake, and drainage district members. *See* Tr. 81:13 to 82:2 (Zachary); PX 266 at AGFC7657 (Mem. from Zachary to Akers). At various times, these groups participated in the White River Reauthorization Ad Hoc Work Group, and later in a spinoff of that group termed the Black River subcommittee. Tr. 81:2-8 (Zachary). This subcommittee was moderated by Gary Cristoff, a representative from the Missouri Department of Conservation. Tr. 104:13-16 (Zachary).

At the subcommittee's meetings and at meetings of the White River group during the mid-1990s, employees of the Commission raised numerous objections to the Corps of Engineers' alterations of the water control plan. *See*, *e.g.*, Tr. 83:24 to 84:7 (Zachary); PX 266 at AGFC7657-58 (Mem. from Zachary to Akers). In particular, the Commission's staff noted that the Management Area had begun to experience flooding during the growing season; they ascribed this type of flooding to the Corps of Engineers' interim deviations from the water control plan. *See* Tr. 83:15 to 84:7 (Zachary); PX 268 at AGFC7661 (Mem. from Hausman to Zachary). The Commission was concerned with the effect that higher river levels would have on "bottomland hardwood resources on Black River" near the Corning gauge. Tr. 84:4-7 (Zachary). The Commission's baseline argument was that the river level must be "no higher than 6 feet" at the Corning gauge and under 4.5 feet at other lower elevations, such as the Poplar Bluff gauge, to sufficiently dewater the GTRs in the Management Area during the growing season. PX 266 at

[6]As a news release issued by the Corps in 2001 stated, "[f]or years, farmers who plant low-lying acreage downstream of Clearwater Dam sought and were granted numerous deviations from the water control plan." PX 575 at US33 (Corps' News Release (Apr. 9, 2001)).

AGFC7657 (Mem. from Zachary to Akers). In early 1996, the Commission pointed out that the previous year's heightened river level, in combination with above-normal rainfall, had "prevented drainage of the [Management Area]" and had been "detrimental to the water intolerant oak tree species over thousands of acres." *Id.* at AGFC7658. The Commission was concerned with the effects of "a much longer duration of stagnant water being held on the biologically and economically valuable hard mast bearing species of trees." PX 268 at AGFC7661B (Mem. from Hausman to Zachary).

At various times, members of the Commission attempted to persuade the Corps of Engineers to return to the original water control plan, which the Commission argued would more promptly evacuate water from the Management Area. *See* PX 268 at AGFC7661B (Mem. from Hausman to Zachary); PX 270 at AGFC7664 (Mem. from Zachary to Akers and Mike Armstrong, Assistant Chief, Fisheries Division) (Apr. 5, 1996)) (noting that the original plan would "permit[] the earlier passage of stored flood water within Clearwater Lake and consequently reach[] a level of 6 [feet] or less at Corning, at an[] earlier date, thus enabling drainage of [the Management Area] at a much earlier date"). However, the Black River subcommittee was never able to reach a consensus on an acceptable alternative plan, and the interim deviations from the authorized water control plan continued through the late 1990s. *See* Tr. 84:8-12 (Zachary); Stip. ¶ 15.

The Corps then considered adopting a permanent revision to the water control plan that would "modify the stages on the Black River at Poplar Bluff, Missouri to which flood control releases from Clearwater Dam would be regulated." JX 14 at AGFC268 (Clearwater Lake Environmental Assessment); Tr. 80:17-22 (Zachary). This revision, if adopted, would have kept the target river stage at Poplar Bluff from December through mid-May at 11.5 feet, but would have set the target stage from mid-May to November at 4, 6, 8, or 10.5 feet, depending on the water elevation at Clearwater Lake. JX 14 at AGFC268 (Clearwater Lake Environmental Assessment). Contrary to the Commission's representations to the Black River subcommittee, the Corps of Engineers did not contemplate that its deviations, as implemented in the 1990s or as proposed, would have much of an effect in the portion of the river located downstream in Arkansas. *See id*. In a draft version of the environmental assessment performed to evaluate these revisions, the Corps of Engineers found that "[t]he effect of Clearwater Dam diminishes at approximately the Missouri/Arkansas state line . . . due to the increased size of the watershed." *Id*. The draft environmental assessment summed the Corps of Engineers' results of its research into the effects of the proposed revisions to the initial water control plan as a "FINDING OF NO SIGNIFICANT IMPACT." *Id*.

Following a meeting held in Jonesboro, Arkansas, on August 18, 1999, both the Commission and the United States Fish and Wildlife Service raised objections and comments to the proposed permanent revision and to the Corps of Engineers' finding of no significant impact. *See* Tr. 527:15-19 (Test. of Robert Leonard, River Basins and Government Organizations Division of the Arkansas Game & Fish Commission); PX 66 at AGFC866 (Mem. from Field Supervisor, Arkansas Field Office of the Fish and Wildlife Service, to Field Supervisor, Columbia Field Office (Nov. 1, 1999)); PX 67 at AGFC872 (Letter from Leonard to Jim Ellis, Corps of Engineers (Oct. 23, 1999)). The Fish and Wildlife Service maintained that the Corps of

Engineers had provided insufficient drainage data to support its contention that the effect of releases from Clearwater Lake diminished beyond the Missouri-Arkansas state line. PX 66 at AGFC867 (Mem. from Field Supervisor, Fish and Wildlife Service). In recommending that the Corps return to the authorized water control plan pending further study in the White River basin, the Fish and Wildlife Service cited the potential for damage to the floodplain forest in the Management Area, which it described as a "valuable resource." *Id*. at AGFC870. Separately, the Commission reiterated that it had "significant problems" with the new plan for water releases. PX 67 at AGFC872 (Letter from Leonard to Ellis). As the Corps of Engineers weighed these arguments, it continued to implement interim deviations from the water control plan through November 2000. *See* DX 310 at Table 1 (Nutter Report).

C. Tree Mortality and Injury

1. Mortality and injury developed gradually.

Tree mortality and injury in the Management Area developed gradually in the late 1990s. *See* Tr. 64:9-18 (Zachary).[7] Shortly after the initiation of the deviations to the water control plan, in August 1994, Martin Blaney visited parts of the bottomland hardwood forest in the Management Area and observed that these areas were "intact forests." Tr. 628:23 to 629:5 (Blaney). Yet some injury to trees in the Management Area may have been occurring by this time, as Mr. Zachary reports that he "began to see some signs of stress beginning about 1993 when [the Commission] began to notice that we were experiencing flooding of the area during the growing season." Tr. 61:9-12 (Zachary). Mr. Hausman reports that in the period between 1993 and 1999, some parts of the forests were beginning to exhibit signs of stress: in particular, certain inundated nuttall oak trees were "starting to lose a few leaves from the tips, from the ends of the twigs." Tr. 1237:17-23 (Hausman). By the early part of the growing season in 1999, the Commission noticed evidence of increased mortality and water stress of the nuttall oaks in the Management Area, including tip die-back and swelling of the trees' basal areas. PX 500 at 30 (Heitmeyer Report). Then, in July 1999, Mr. Hausman observed many trees with brown leaves, and reported to Mr. Zachary evidence of a large brownout of dead or dying trees in the area of Schaeffer's Eddy and Gar Slough, and on the GTR impoundments. Tr. 1240:12-20 (Hausman); PX 90 (Mem. from Hausman to Zachary (July 29, 1999)). Upon receiving this report of a "dramatic change in the forest's health over a large portion of the area where [the Commission] had previously been concerned about flooding," Mr. Zachary toured the forest and observed

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[7]Photographs of the bottomland forest provide graphic evidence of the mortality and injury to the dominant oak species that occurred during the period of the deviations. PX 562 consists of aerial photographs taken by the Arkansas State Highway Department in 1983 and 1986, *see* Tr. 1194:2 to 1198:18, 1202:18 to 1203:15 (Hausman), that show a full unbroken canopy of trees extending throughout the Management Area, excepting only Lake Ashbaugh, the Black River, and roads and dikes. By contrast, PX 53 is a set of photographs taken in April 2000, showing the results of the "big brown out in 1999." Tr. 1271:25 (Hausman). Those photographs, particularly PX53-A, C, D, E, F, I, and N, show substantial areas of dead trees and debris from fallen dead trunks.

several thousand acres over which this tree mortality and decline had occurred. Tr. 61:21 to 62:23 (Zachary). Mr. Blaney, too, testified that when he visited the Management Area in 1999, he observed "a massive die-off of oak timber" that was "a stark contrast from the healthy forest that [he had] seen before." Tr. 612:2-17 (Blaney).

Mr. Zachary ascribed this damage to "stress caused by water, stagnant water being in the area during the growing season for consecutive years beginning in '93 that led to a decline, gradual decline, and then finally a drastic change due to conditions in 1999." Tr. 64:14-19 (Zachary). He noted that with respect to the flooding during the late 1990s, "the water stayed in the management area during the growing season whereas natural flooding would tend to -- you would see a sudden rise and then water would drain from the area as soon as the river went back down to within [the] bank." Tr. 72:18-25 (Zachary). When the water did not drain from the Management Area, under Mr. Zachary's characterization, the river would be "h[e]ld[] . . . at an artificially high level during the growing season, causing inundation to a lot of . . . nuttall/over-cup oak sites on the wildlife area." Tr. 1234:3-6 (Hausman).

2. Water-stage testing.

To determine the cause of the widespread tree mortality and injury, and to analyze the effects of the new water control plan proposed in the 1999 draft environmental assessment, the Corps of Engineers, working with the Commission, engaged in water-stage testing in 2000 and 2001. JX 5 at AGFC116 (Mem. from Hausman to Zachary (June 5, 2000)); Tr. 1254:15-25 (Hausman); PX 575 at US34 (Corps' News Release). The goal of the first test, performed on May 22-25, 2000, was to release sufficient water from Clearwater Lake to reach a six-foot level at the Corning gauge, and to observe what effects this level would have in the Management Area. JX 5 at AGFC116 (Mem. from Hausman to Zachary); Tr. 1255:1-10 (Hausman). However, due to drought conditions, there was not enough water in the lake at the time to reach the desired level, and instead the water level crested at 4.7 feet on May 22. *See* Tr. 1255:1-16 (Hausman); JX 5 at AGFC116 (Mem. from Hausman to Zachary). Even with this lower-than-planned water level, some water began to enter the Upper Island area and flood the GTR at that location. JX 5 at AGFC116 (Mem. from Hausman to Zachary). Members of the Corps' staff, however, doubted that this incomplete test result was indicative of flooding of the Management Area and damage to the oak stands. Mr. Mike Hendricks, the local Chief of Reservoir Control for the Corps, opined that "AG&FC's claims that this plan [to make the deviations permanent] will destroy the hardwoods is, in my opinion, unfounded." JX 187 at US00570 (E-mail from Hendricks to Michael Miller (Feb. 26, 2001)). Nonetheless, Mr. Hendricks and the Commission's staff had agreed to conduct further testing: "if water was on the hardwoods on a certain date [in the Spring of 2001] and [the Corps] still had flood storage to evacuate, we would provide reduced release for 4 to 5 days to allow the water to drain, then we would increase releases for 4 or 5 days." *Id*.

The additional testing and site visit to the Management Area was conducted on March 19-20, 2001, this time after sufficient water had been released from Clearwater Lake to attain a level of six feet at the Corning gauge from March 13-19, 2001. PX 76 at AGFC1167 (Corps of Engineers' Briefing on Black River Water Control Issue with Arkansas Game & Fish

Commission)) ("Corps' Briefing"); Tr. 760:24 to 761:5 (Blaney). Under these conditions, personnel from the Corps of Engineers were able to "confirm that significant amounts of tree roots were flooded and could, under certain conditions, remain flooded long enough to damage or destroy the trees at the regulating stages under the new plan." PX 575 at US34 (Corps' News Release); *see also* PX 76 at AGFC1183 (Corps' Briefing) (finding that the observed six-foot stages were "negatively impacting [the Management Area] during [the] growing season"). Mr. Hicklin and Mr. Glen Raible, Senior Hydraulic Engineer in the Hydrology and Hydraulics Section of the Corps of Engineers, were present during the site visit, and found that the river was about one foot below the top bank in most of the areas visited. PX 637 at US545 (E-mail from Raible to Hendricks (Mar. 21, 2001)); Tr. 228:4-11 (Hicklin). However, in other parts of the surveyed area, water was overtopping the levees and flooding parts of the forest. PX 637 at US545 (E-mail from Raible to Hendricks). Based upon this evidence, the Corps of Engineers determined that the four-foot stage called for in the new plan would "inundate[] the roots of the hardwood trees in the wildlife management area." PX 575 at US35 (Corps' News Release). Accordingly, Colonel Tom Holden, the district engineer for the Corps, concluded that the deviations recommended in the proposed growing season plan "would unacceptably extend the duration of water inundation on bottomland hardwoods" in the Management Area. PX 576 at US38 (Colonel Holden's Remarks to the Black River Operations Public Meetings (Apr. 25-26, 2001)).

3. Cessation of deviations.

In April 2001, the Corps of Engineers ceased all deviations from the 1950 water control plan and returned to the releases specified in that original plan. *See* PX 575 at US33 (Corps' News Release). In describing why it was abandoning the plan proposed in its earlier environmental assessment, the Corps stated its concern for "potential for damage to bottomland hardwoods in the Dave Donaldson Black River Wildlife Management Area." *Id*. The Corps noted that because the alternative water control plan endorsed in the draft environmental assessment "could cause significant changes to the environment of the wildlife management area, the National Environmental Policy Act blocks its implementation unless an Environmental Impact Statement is prepared to ensure adequate environmental safeguards are put in place." *Id.* at US34. These statements reflected the conclusions reached in the Corps of Engineers' final environmental assessment, in which the Corps reported that the earlier finding of no significant impact could not be supported. PX 76 at AGFC1166 (Corps' Briefing).

4. Water-gauge data.

Both prior to and after the dispute over growing-season inundation arose, the Commission used water gauges at various locations in the Management Area to monitor water depths, analyze which areas were covered by water, and determine the river levels at which nuttall and cherry bark oak tree communities would become inundated. Tr. 77:21 to 78:7, 78:20-25 (Zachary). Water gauges are located in each of the GTRs, and at the Brookings and Hubbell Bridge access points. Tr. 74:7-14 (Zachary). The Brookings and Hubbell gauges were installed in 1994, Tr. 78:10-11 (Zachary), and the other reservoir gauges were established in 2004. Tr.

1385:6-8, 1388:10-12 (Hausman).[8] Other gauges previously had been installed and maintained by the United States Geological Survey, with a gauge at Corning having been established in 1939, PX 500 at 12 (Heitmeyer Report), and another at Poplar Bluff having been in use since at least 1980. *See* JX 20 at AGFC2169 (ATOKA Draft Review of Available Data and Recommendations (Apr. 20, 2001)).

In addition, the government caused its experts to install eleven water-level recorders at various locations in the Management Area in November 2006, and they remained in place throughout the 2007 growing season. *See Arkansas Game & Fish Comm'n*, 74 Fed. Cl. at 434 (concluding that the Commission had "to permit the government's experts to install seven to ten piezometers"); DX 310 at 19 & Figure 21 (Nutter Report) (depicting eleven piezometers). The recorders were set to measure water levels twice a day, at 7:00 a.m. and 7:00 p.m., and to store those data pending removal of the device and transfer of the information. Tr. 3091:22 to 3093:13 (Nutter). Roughly eleven months of water level data were obtained, commencing in November 2006. Tr. 3092:25 to 3093:4 (Nutter).

The parties focused on hydrological data obtained particularly from the water-gauge station in Corning to analyze dynamics in the water levels of the Black River in the Management Area. *See* PX 507 at 2 (Supplemental Report of Dr. Heitmeyer (May 7, 2008)); DX 310 at 14, 26-27 & Figures 22-26 (Nutter Report). The Corning gauge is the closest river gauge upstream of the Management Area. Tr. 2785:23-25 (Heitmeyer). Actual gauge readings of the stage-levels at the Corning gauge were available starting in December 1973, *see* JX 266 (Corning Gauge Data from 1973 to 2008), and daily discharge levels from Clearwater Lake, which became available starting in 1939, can be used to correlate Corning stage levels prior to 1973. PX 507 at 2 (Supplemental Report of Dr. Heitmeyer); Tr. 2783:9-19 (Heitmeyer) (explaining the process by which discharge levels are extrapolated to river stage levels).

In describing historical, unmanaged flooding patterns in the Management Area, Dr. Heitmeyer testified that there was typically "increased overbank flooding and runoff some time in late fall, early winter" and that this "flooding would continue on a periodic dynamic basis throughout some time in spring, late spring, occasionally into early summer." Tr. 2773:12-17 (Heitmeyer). He emphasized the seasonal dynamic of the floods, stating that the Management Area "[w]ould dry out during the summertime period, and into early fall, and then start to reflood, or reincrease precipitation again that coming fall." Tr. 2773:17-20 (Heitmeyer); PX 500 at 11-13 (Heitmeyer Report) ("Seasonal flooding is a dominant feature of the hydrology that controls the habitat community structure of the Black River floodplain in the [Management Area] region.").

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[8]In 2001, the Commission had commissioned a study to develop recommendations for installation of water gauges and piezometers in the Management Area, *see* Tr. 763:25 to 769:3 (Blaney); JX 17 (Work Plan and Cost Estimates for Staff Gauge and Piezometer Installations, prepared by ATOKA, Inc. (June 2001)), but the Commission was unsuccessful in obtaining funding for the installation, either from the Corps or from its own resources. Tr. 769:2 to 770:1 (Blaney).

By contrast, an analysis of the water-gauge data from 1993 to 1999 reveals that the Black River was above five feet at the Corning gauge for an average of 97.43 days during each year's growing season, April 4 through October 11, and above a level of six feet at the Corning gauge for an average of 91.14 days each growing season. PX 500 at 13 (Heitmeyer Report) (Table 3); *see* JX 266 (Corning Gauge Data). When compared with the historical data for the Corning gauge during the growing seasons from 1949 to 1992, the period from 1993 to 1999 reflects an average annual increase of 26.44 days at which the gauge exceeded five feet during the growing season, and an increase of 28.98 days at which the gauge exceeded six feet during the growing season. PX 500 at 13 (Heitmeyer Report) (Table 3); Tr. 2823:18-21 (Heitmeyer).[9]

In addition, from 1993 to 1998, the water level at the Corning gauge exceeded five feet for at least 65 days during every year's growing season, ranging from 65 days in 1993 up to 166 days in 1997. PX 500 at 14 (Heitmeyer Report) (figure 10); JX 266 (Corning Gauge Data).[10] In no prior six-year time span had the water level at the Corning gauge exceeded five feet for that many days in each growing season. Tr. 2781:17-20 (Heitmeyer). In his report, Dr. Heitmeyer stated that when the Black River was at a level of five feet, as measured at the Corning gauge, surface water would inundate more than thirty percent of the nuttall oaks in the Management Area, and at a level of six feet, more than fifty percent of the nuttall oaks would be inundated. PX 500 at 30 (Heitmeyer Report).

Dr. Overton, an expert in hydrology and hydrogeology, who testified on behalf of the Commission, also compared the number of days the Black River had reached certain river level ranges from 1981 to 1992 with the number of days it reached those ranges from 1993 to 1999. *See* PX 506 at Figure 3 (Report of Dr. Jerry Overton (May 7, 2008)) ("Overton Report"). This comparison indicated that the river level at Corning reached and sustained elevated levels during the deviation period compared to prior, non-deviation years. *See id*. The Corning gauge registered a range of five to six feet, at which levels parts of the Management Area would be inundated, an average of 19.91 days during the April-to-October growing season from 1981 to 1992, whereas it was in that range for an average of 12.58 days for the April-to-October growing seasons from 1993 to 1999. PX 506 at Table 2 (Overton Report). From 1981 to 1992, the Corning gauge reached a range of six to eight feet an average of 30.16 days during the growing seasons and 30.72 days from 1993 to 1999, an insignificant difference. *Id*. However, significantly, it reached eight to 10.5 feet for an average of 24.58 days during the growing seasons from 1981 to 1992, and 46.58 days from 1993 to 1999. *Id*. Finally, the gauge at Corning reached a range of 10.5 to 11.5 feet for an average of 17.26 days during the growing

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[9]Levels above five feet at Corning during the growing season averaged 54.30 days from 1939-48, 68.45 days from 1949-92, and 58.80 days from 2000-04. PX 500 at 13 (Heitmeyer Report) (Table 3). Levels above six feet at Corning during the growing season averaged 50.60 days from 1939-48, 64.70 days from 1949-92, and 55.60 days from 2000-04. *Id*.

[10]1999 and 2000 were years of moderate drought, in which a level of five feet was exceeded at Corning only 22 days in 1999 and 19 days in 2000. PX 500 at 14 (Heitmeyer Report) (figure 10); JX 266 (Corning Gauge Data).

seasons from 1981 to 1992, and 16.14 days from 1993 to 1999, also an insignificant difference. *Id*.

In addition, the government also made use of a computerized modeling system to simulate the flows of the Black River based on reservoir operating data. Tr. 2927:21 to 2928:14 (Raible). The hydrological model was a "feedback model," DX 310 at 15 (Nutter Report), which relied upon three different inputs: first, the volume of the reservoir, in this case, Clearwater Lake, and the releases it makes; second, "a downstream regulating control point that sets the limits on the amount of flow that [the] reservoir can release," in this instance at Poplar Bluff; and finally, any "intervening flows" in the river, which consist of the tributaries that enter the river downstream of the reservoir but before Poplar Bluff. Tr. 2931:8 to 2932:12 (Raible). The Corps used its modeling system to determine the expected flows of the river at various downstream control points, including the Corning gauge, based on the reservoir operations at Clearwater Lake from 1993 to 2000. *See* Tr. 2932:20 to 2933:16 (Raible); DX 310 at 16-17 (Nutter Report). The model was run both with and without the Corps' deviations from the authorized water control plan. DX 310 at 16 (Nutter Report). From the results of this modeling, the Corps concluded that even without the deviations from the authorized water control plan, there would have been significant periods of timber stress and inundation, particularly from 1994 to 1996. Tr. 3358:4-12 (Test. of Dr. Sammy L. King, an expert in wetlands and forest ecology and management, who testified on behalf of the government). In all, the modeling predicted that there would have been flooding in the Management Area for 72.8% of the days during the growing seasons from 1994 to 1999. Tr. 3361:12-18 (King).

5. The Commission's timber surveys.

After receiving Mr. Hausman's report addressing damage in the Management Area in 1999, the Commission approached Kingwood Forestry Services, a timber consultant, and asked for a resource appraisal and evaluation and an inventory of damages on the affected areas. Tr. 753:2-6 (Blaney). In October to December 2000, employees of Kingwood Forestry Services, including Dr. James Baker, James Foster, and Phillip Livingston, performed a survey and timber inventory of several compartments in the Management Area, covering a total of 6,990 acres of forested land, or approximately five percent of the Little River GTR, Reyno GTR, and Winchester GTR, as well as the Gar Slough and Schaeffer's Eddy areas. PX 80 at 1-8 (Resource Evaluation and Damage Appraisal by Kingwood Forestry Services (Jan. 2001)) ("Kingwood Report I"); Tr. 753:12-18, 755:14-22 (Blaney). Dr. Baker performed field studies in five different sections of the Management Area, plus two control areas at slightly higher elevations where no damage was expected, measuring mortality and injury rates in the seven areas. PX 80 at 1, 7 (Kingwood Report I). In addition, he reviewed the Commission's hydrology and timber-stand records to determine the potential causes of mortality in the Management Area. *Id*. at 1.[11]

[11]The government criticized the Kingwood Timber Survey in 2000 and a later survey conducted in 2001 on the grounds that the cruise maps for the surveys were not preserved and the results were not audited. Def.'s Post-Trial Br. at 59. However, testimony at trial covered in considerable detail the methodology, instructions, and directional orientation of each of the

As a final task, Dr. Baker and Kingwood sought to appraise any losses in terms of the economic value of timber and land value in the Management Area. *Id*. at 2.

Oak trees exhibit various responses to stress, including epicormic branching, where branches form "underneath the bark in the sapwood;" stag heading and dieback in the crown where branches or "whole segments of the crown" die; and phloem necrosis "where the bark of a tree begins to die" and loosen and fungal growth appears on the branches or main stem of the tree. Tr. 2077:1-25 (Foster). In addition, if a tree contains lesions or is leaking sap, it is generally considered to be stressed. *See* Tr. 1956:7-15 (Livingston). Kingwood Forestry Services classified a tree as "declining," when it was exhibiting one or more of these symptoms, although it was also required to be sufficiently alive to have at least one green leaf. *See* Tr. 2076:13-16 (Foster); Tr. 1956:15-19 (Livingston). If the tree lacked any green leaves, it was considered to be dead. Tr. 1956:5-6 (Livingston).

In the areas sampled, Kingwood calculated that the mortality rate for red oaks, primarily nuttall oaks, was 15% in the Little River Island GTR, 32.8% in the Reyno GTR, 8.9% in the Winchester GTR, 12.3% in Gar Slough, and 58.6% in Schaeffer's Eddy. PX 485 at AGFC11549 (Kingwood Report of Hardwoods in Black River Wildlife Management Area (Oct. 2000)).[12] Given that a tree was determined to be dead if it had died within the past three years, Tr. 2075:20-23 (Foster), the approximate annual mortality rate in these areas was calculated by dividing the above percentages by three. Additionally, Kingwood reported that thirty to forty percent of the red oaks in the GTRs were in a declining state, demonstrating signs of "severe die-back in their crowns" or other symptoms of decline in health and vigor, along with ten to fifteen percent of the red oaks in Gar Slough and Schaeffer's Eddy. PX 80 at 7 (Kingwood Report I); PX 485 at AGFC11549 (Kingwood Report of Hardwoods in Black River Wildlife Management Area); Tr. 2076:13-16 (Foster). Of the trees in the sampled areas that were dead or declining, Kingwood found evidence in their increment cores of "dead cambium and decaying sapwood," which Kingwood described as "unusual for oaks, since they normally decay from the pith outward as a result of internal pathogens." PX 80 at 8 (Kingwood Report I). A darkening of the cambium layer was indicative of anaerobic activity and general tree decline. Tr. 2386:13-19 (Baker). Mr. Foster estimated that approximately half of the declining trees would die, and that the other half would "live out . . . a normal lifespan in a degraded, devalued condition." Tr. 2226:5-11 (Foster). By contrast, of the ten thousand red oaks analyzed in the two control areas,

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cruises. Tr. 1942:12 to 1946:18, 1948:13 to 1964:18 (Livingston). The persons conducting the cruise survey were registered foresters, and they followed protocols and instructions that comported with accepted forestry practices. Tr. 1964:5-13 (Livingston). The government's critique is not well founded.

[12]Some of the data that Kingwood used to extrapolate to these and other measures of injury and mortality was characterized by a high statistical confidence interval, due to both the relatively small sample size of particular species of trees in some sample areas and the "irregular, scattered pattern of [dead] trees through the woods." Tr. 2217:2-8 (Foster); Tr. 2218:24 to 2219:1 (Foster).

no trees were dead and only 150 trees were in a declining state. PX 485 at AGFC11549 (Kingwood Report of Hardwoods in Black River Wildlife Management Area).

Based on this first examination, Dr. Baker described the affected parts of the Management Area as "a bottom[]land hardwood ecosystem in a state of collapse. Most of the nuttall oak, most of the red oaks were dead or dying. Many of the white oaks were dead or dying. Most of the sweetgum were dead or dying." Tr. 2400:2-6 (Baker). Dr. Baker characterized the change in the ecosystem as a transition from a "riverine, bottom[]land hardwood community" towards a "headwater swamp" condition. Tr. 2400:11-16 (Baker).

In seeking to explain the "rapid degradation of the oak dominated forests," Kingwood proffered three possible explanations: first, that the oak stands had reached maturity and were simply dying of old age, second, that the bottomland hardwood forests in the Management Area were suffering from a more general decline common to many GTRs in the southern United States, and third, that a change in soil or site conditions had resulted in timber-stand degradation. PX 80 at 8 (Kingwood Report I). In rejecting the first explanation, Kingwood noted that many young trees in the affected areas were dying and older trees on sites not flooded during the growing season were still healthy. *Id*. at 9. Kingwood rejected the second possible explanation on a similar ground – trees were undergoing excessive mortality only on the sites that were flooded during the growing season, regardless of whether or not those sites were GTRs. *Id*. Kingwood settled on the third possible explanation, ascribing the "rapid degradation . . . of the oak stands . . . to the 1993 change in the water control plan for Clearwater Lake and the Black River." *Id*. Kingwood noted that the Corps' deviations from the authorized water control plan "subjected the oak forest communities in the [Management Area], and possibly elsewhere along the river, to abnormal and extended flooding and saturated soils during much of the growing season for five consecutive years." *Id*. Kingwood concluded that

> [e]ven though the oak forests that exist in the Black River flood plain are tolerant of dormant season flooding and wet soils, they cannot tolerate repeated growing season floods and saturated soils. The prolonged growing season flooding (June – August) that occurred in 1994-1998 undoubtedly resulted in saturated soils, inadequate oxygen levels in the water and the soil, increased root respiration, and significant root mortality and die-back in many of the less water tolerant trees such as [n]uttall oak and sweetgum.

Id. Kingwood appraised the losses of dead and declining timber from excessive mortality in this study area at $4,516,000. *Id*. at 19; PX 505 at 3 (Supplement to Kingwood Report I (May 8, 2008)) (adjusting appraised value in first report to account for background mortality rate); Tr. 2244:2-13 (Foster).

Kingwood performed a second study in the summer of 2001, examining approximately 5,776 additional acres of bottomland hardwood forest in the Management Area that had not been analyzed in the first study. PX 79 at 4 (Resource Evaluation and Damage Appraisal by Kingwood Forestry Services (Dec. 2001)) ("Kingwood Report II"); *see* Tr. 1981:17 to 1983:9 (Livingston). Of the approximately 15,935 acres that had not been examined during the first

study, Kingwood used aerial photography and verification on the ground to determine that 4,302 of those acres had "little or no timber damage" above the typical annual background mortality rate of 0.5%. PX 79 at 4 (Kingwood Report II); *see* Tr. 1983:17 to 1984:20 (Livingston) ("We did what we call ground-truthing to verify the areas that we thought to have no mortality or low mortality . . . and the areas that were thought to have mortality . . . ."). Kingwood selected 5,776 acres to be examined in its second study to be representative of the entire remaining 11,633 acres that comprised the secondary damage area. PX 79 at 4 (Kingwood Report II). During this study, Kingwood again found levels of mortality in the affected regions of the Management Area that were greater than those levels found in the control areas or those levels typically found in bottomland hardwood forests. Tr. 2428:10 to 2429:1 (Baker). The mortality levels in the additional area were lower than those measured in Kingwood's first study, but the appearance of the mortality in the two areas studied was "very similar." Tr. 2395:6-14 (Baker). Dr. Baker found that "there was excessive or elevated mortality in the Part 2 study area on an order of magnitude of about one-fourth in value per acre." Tr. 2240:19-25 (Baker). Kingwood completed its study in December 2001 and determined that the value of the economic damages related to the timber loss in this secondary area was $1,961,000. PX 79 at 15 (Kingwood Report II).

In earlier years prior to timber harvests, the Commission had also caused surveys to be performed. *See* Tr. 1175:3-10 (Hausman). Even during 1993 through 2000, which was the period of deviations from the operating plan at Clearwater Dam, the Commission continued to perform, albeit in a narrower summer window of time, "forestry work like timber inventories [and] timber markings for timber sale activities." Tr. 1236:18 to 1237:5 (Hausman).[13] These timber inventories, performed approximately every ten years on each compartment, were either provided by contractors with the Commission or by the staff of the Arkansas Forestry Commission. Tr. 1174:23 to 1175:11 (Hausman).

6. The government's surveys.

On the same five affected sections and two control sections of the Management Area analyzed by Kingwood, the government performed a different type of survey, collecting and analyzing tree cores from nuttall and overcup oak trees within various fifty-acre clusters in those sections. Tr. 3187:17 to 3188:13 (Test. of Wayne Williams, Second Vice President and Forest Management Operations Coordinator, Sizemore & Sizemore).[14] A total of 62,000 tree cores were collected over the course of the survey. Tr. 3252:1-2 (Test. of Dr. Henry Grissino-Mayer, a

[13]The Commission had adopted the practice of conducting logging operations in the Management Area from July 1 to September 30. *See* Tr. 1188:17-22 (Hausman).

[14]The Commission criticized the sampling methodology employed by Mr. Williams on the grounds that tree cores were collected outside planned plot boundaries when no living trees were present on particular plots and that cores were collected from clustered samples within plots. *See*, *e.g.*, Tr. 2445:3 to 2447:4 (Baker). In addition, the core samples were taken in the summer of 2007, which manifestly excluded trees that had died in 1999 and 2000.

dendrochronologist who testified on behalf of the government). Dr. Grissino-Mayer analyzed the width and density of the rings within the cores and compared the density of the "early wood" portions of each ring, which are formed "early in the growing season," with the density of the "late wood" portions, which are formed late in the growing season. Tr. 3230:7-12, 3251:14-19 (Grissino-Mayer). The purpose of Dr. Grissino-Mayer's analysis was to "determine if we could actually see the effects of [the] flooding [of the Management Area] in the tree growth record." Tr. 3241:17-19 (Grissino-Mayer). Because flooding will often lead to stunted tree growth and "the loss of crown mass" when a tree is inundated by water, "it will produce a very characteristic narrow set of tree rings." Tr. 3239:19-23 (Grissino-Mayer).

Dr. Grissino-Mayer compared tree-core data from 1980 to 1992 with tree-core data from 1993 to 1999, and found "no statistical difference in tree growth . . . [;] if anything, there were a few instances where it showed that tree growth [wa]s actually statistically greater in the 1993 to 2000 period." Tr. 3281:18 to 3282:1 (Grissino-Mayer); *see* DX 309 at 22 (Analyses of Tree Growth for Two Oak Species Growing in the Management Area (Apr. 9, 2008)) ("Grissino-Mayer Report"). Similarly, he found no statistical difference in tree growth from 1993 to 2000 when comparing the high-mortality sites of Gar Slough and Schaeffer's Eddy with lower-mortality sites. DX 309 at 23 (Grissino-Mayer Report). In addition, Dr. Grissino-Mayer sought to determine whether the cores contained any "flood rings" – malformed tree rings that are indicative of tree growth under conditions of inundation. Tr. 3301:21-25 (Grissino-Mayer). Dr. Grissino-Mayer "never found a single flood ring in any of the cores, not just during the '93 to 2000 period, but anywhere in the[] cores." Tr. 3302:14-16 (Grissino-Mayer).

7. Susceptibility of oak trees to harm from standing water and saturated soil.

The presence of standing water or saturated soil can adversely affect the feeder roots of oak trees to the point where the tree can be injured or killed. PX 80 at 9 (Kingwood Report I). Although bottomland hardwood trees are adapted to develop under wintertime flooding regimes where the water is cold and adequately oxygenated, these same trees are less well equipped to cope with summertime flooding, where warm air temperatures dissipate the oxygen in the water and saturated soil and cause the trees to switch to anaerobic respiration. Tr. 2392:13 to 2393:5 (Baker). The toxic byproducts of anaerobic respiration, along with the inability of the affected trees to produce adequate energy, often lead to tree mortality. Tr. 2393:5-9 (Baker). "Under . . . prolonged flooded conditions, . . . the roots begin to die, and it can begin to affect [the oak tree's] ability to pull in nutrients, and water, and be able to photosynthesize." Tr. 3345:4-7 (King). Red oaks have some degree of flood tolerance; as both parties' expert witnesses agreed, one year of flooding-induced anaerobic respiration during the growing season is insufficient to kill nuttall and overcup oaks. Tr. 2393:21 to 2394:1 (Baker); Tr. 3344:21-24 (King). However, because the effects of flooding are cumulative, nuttall oak trees are likely to die when forced to switch to anaerobic respiration for three or more growing seasons in a row, as are overcup oak trees when faced with the same situation for four or more growing seasons in a row. Tr. 2393:21 to 2394:10 (Baker); Tr. 3344:25 to 3345:2 (King); *see also* PX 80 at 9 (Kingwood Report I) ("Loss of oxygen associated with increased water temperature in stagnate water during the summer months is a common cause of root mortality in flooded timber.").

Nuttall, overcup, and other oak trees have a fibrous root system composed of surface feeder roots, typically located within the first twelve inches of soil, along with other roots that are located within the first thirty-six inches of soil. Tr. 2391:18 to 2392:8 (Baker). When an oak tree's root system is damaged, it often responds by trying "to recover" its root system as quickly as possible. Tr. 2390:18-22 (Baker). One manner in which it can quickly recover its roots in wet conditions is by developing relatively small carrot-like roots – called root suckers – that attach to the base of its larger primary roots in an epicormic fashion. Tr. 2390:22 to 2391:15 (Baker). These root suckers are essentially a means by which the oak tree attempts to develop new "feeder root mass" after it has suffered damage. Tr. 2460:16-25 (Baker).

However, when flooding is followed by drought conditions, the trees often suffer mortality due to their loss of the normal feeder roots. *See* Tr. 3345:14-20 (King). The death of the tree's roots leads to an imbalance in the tree's top-to-root ratio, such that the reduced root mass can no longer support the crown; in this situation, the tree will shed part of its canopy and initiate die-back in its crown to rebalance its root system. PX 80 at 9 (Kingwood Report I); Tr. 2408:12 to 2409:8 (Baker). This die-back recovery mechanism then renders the tree more susceptible to attack from insects and other pathogens, as well as to mortality from wind throw and drought. PX 80 at 9-10 (Kingwood Report I); Tr. 3345:8-11 (King).

8. Invasion of wetland species.

Kingwood Forestry Services also reported that as the tree canopy was disintegrating, various wetland species were beginning to invade the forest floor. Tr. 754:10-12 (Blaney). Dr. Baker observed that the bottomland hardwood trees "were being replaced by wetland species in the understory -- buttonbush, smartweed, lizard tail, cyprus seedlings, black willow -- species that can tolerate a saturated soil condition throughout the year." Tr. 2399:25 to 2400:10 (Baker). In comparing the understory of the nuttall oaks to a "swamp situation," Dr. Baker testified that "[t]hroughout all five of those areas that were being impacted by the flooding, there was unusual density and abundance of wetland vegetation that I have never seen growing in [a] bottom-land hardwood stand." Tr. 2397:22 to 2398:9 (Baker). This testimony reflected Kingwood's findings that

> wetland indicator species were invading and occupying the understory, particularly underneath dead and dying trees where sunlight was sufficient. Except for the two control stands, little or no reproduction of overstory tree species were present in the understory, even in stands that had been thinned in the last 10 to 15 years for the specific purpose of promoting establishment of reproduction.

PX 80 at 8 (Kingwood Report I).

The wetland species are more adept than bottomland hardwood trees at surviving in saturated soil conditions because they have metabolic pathways that enable them to operate under anaerobic conditions. Tr. 2389:7-13 (Baker). In 2000, Dr. Baker estimated that most of the buttonbush trees he observed were five to six years old, meaning that they had started to grow in the mid-1990s. Tr. 2398:16-20 (Baker); PX 80 at 8 (Kingwood Report I). He also

observed that these and other wetland species were far more dominant in the areas that had been flooded than in the two control stands. Tr. 2398:21 to 2399:10 (Baker). Mr. Hausman testified that germinated acorns had been the only ground cover in the forest when he began working for the Commission in 1984, but that the forest floor had "changed drastically" since then and was "now covered with a lot of undesirable wetland species . . . [such as] buttonbush and smartweed, wetland plants, cardinal, [and] cutgrass." Tr. 1191:13 to 1192:20 (Hausman); *see also* Tr. 63:4-11 (Zachary).

D. Drought, Beaver Dams

The years of 1999 and 2000 were moderate drought years, with annual precipitation approximately ten inches below the normal rainfall of fifty inches per year during both years. Tr. 2351:16-21, Tr. 2444:1-6 (Baker); Tr. 2702:6-10 (Overton). Much of the drought occurred during the growing season. *See* Tr. 2351:19-21 (Baker); PX 419 at AGFC10594 (Field Notebook of Baker) (Oct. 10, 2000). As a result, there was less water in Clearwater Lake, and less water to be released via the Clearwater Dam into the Black River south of Clearwater Lake. Tr. 1234:12-15 (Hausman).

Dr. Baker testified that "the summer drought in 1999 and 2000 was kind of the thing that tilted the scale." Tr. 2437:22-23 (Baker); *see* Tr. 3371:21-24 (King) (testifying that "the drought made that mortality acute in terms of the percentage of trees that were killed or the number of trees that were killed"). The drought "resulted in unusual drying of soils and water stems because of an imbalance of tips/roots . . . [which] results in rapid and excessive mortality of low vigor trees." PX 419 at AGFC10594 (Field Notebook of Baker). Accordingly, when the drought occurred,

> those huge nut[t]all oak trees, something 36, 48 inches in diameter with crowns almost as big as this courtroom, but root systems not much larger than this desk, they could not support that crown, and that's why you had your brownout. . . . [T]hey would run out of nutrients because those roots could not supply those big tops, and those leaves would brown out or die.

Tr. 2438:5-15 (Baker).

On the other hand, the trees likely would not have seen significant increases in their mortality as a result of the drought "if they had not . . . been subjected to the flooding." Tr. 2444:6-9 (Baker); *see* Tr. 3359:2-5 (King). Dr. Baker ascribes the trees' inability to survive the drought to the fact that they had already "lost half of their root systems or more" due to the flooding. Tr. 2444:6-9 (Baker). By contrast, the trees in the control stands, which had not suffered similar damage to their root systems, were able to survive the drought. Tr. 2444:10-14 (Baker).

As a separate matter, the increasing presence of beaver dams in the Management Area has resulted in the occasional blockage of the water-control systems that are used to drain the GTRs. *See* PX 500 at 27 (Heitmeyer Report); *see also* JX 23 at AGFC2963 (Master Plan)

(describing impacts on Arkansas farmers "from the rapidly expanding beaver population"). In response, the Commission has employed various techniques to manage the beaver population, including trapping and shooting. Tr. 112:17-20 (Zachary); Tr. 1266:4-18 (Hausman). It has also sought to "locate and breach the largest of beaver dams and obstructions," typically by using dynamite to destroy these impediments to surface flows of water. PX 500 at 27 (Heitmeyer Report); Tr. 1267:2-25, 1854:16-20 (Hausman) (stating that roughly twenty-five to fifty beaver dams were dynamited each year); *see* JX 94 to JX 101 (Log Books of Clinton Hancock from 1993 to 2000) (indicating beaver management practices).

In 2001, the Commission initiated a more intensive eradication program by contracting with Nuisance Animal Control, Inc. DX 310 at 22 (Nutter Report); JX 72 at AGFC3928 (Sealed Bid Approval/Waiver Form Between the Commission and Nuisance Animal Control, Inc. (Sept. 24, 2001)); Tr. 113:19-25 (Zachary); Tr. 1037:13-21 (Test. of Mr. Hugh Durham, Director of the Arkansas Game & Fish Commission from June 2000 to March 2003). The beaver locations observed by the Commission's contractor were later plotted on an aerial photo of the Management Area by Dr. Nutter. DX 310 at Figure 27 (Nutter Report). Dr. Nutter testified that the concentrations of timber damage "appear[ed] in many places to be right in the locations where [the contractor] found the preponderance of beaver activity." Tr. 3116:6-9 (Nutter). Dr. Nutter's report concluded that the drainage problems caused by beavers "extended the period of standing water in the GTRs and the flood plain sites where beaver were know[n] to have occurred." DX 310 at 23 (Nutter Report).

STANDARDS FOR DECISION

The Takings Clause of the Fifth Amendment provides that "private property [shall not] be taken for public use, without just compensation." U.S. Const. amend. V. The inquiry into whether a compensable taking has occurred requires this court to resolve "a question of law based on factual underpinnings." *Wyatt v. United States*, 271 F.3d 1090, 1096 (Fed. Cir. 2001) (citations omitted); *see Ruckelshaus v. Monsanto Co.*, 467 U.S. 986, 1005 (1984) (stating that courts perform "an 'ad hoc, factual' inquiry" in analyzing whether a compensable taking has occurred (quoting *Kaiser Aetna v. United States*, 444 U.S. 164, 175 (1979))).[15] In this case, the Commission, as plaintiff, bears the burden of proving the relevant factual underpinnings of its claim against the United States, and must generally proffer "'evidence which is more convincing than the evidence which is offered in opposition to it.'" *Jazz Photo Corp. v. United States*, 439 F.3d 1344, 1350 (Fed. Cir. 2006) (quoting *Hale v. Department of Transp., Fed. Aviation Admin.*, 772 F.2d 882, 885 (Fed. Cir. 1985)).

[15]The Tucker Act, providing that "[t]he United States Court of Federal Claims shall have jurisdiction to render judgment upon any claim against the United States founded . . . upon the Constitution," 28 U.S.C. § 1491(a), grants this court subject matter jurisdiction to evaluate takings claims against the United States and its agencies. *See Preseault v. Interstate Commerce Comm'n,* 494 U.S. 1, 12 (1990).

To establish a viable takings claim, the Commission must prove two things. First, the Commission must establish that it had "a property interest for purposes of the Fifth Amendment." *Members of the Peanut Quota Holders Ass'n v. United States*, 421 F.3d 1323, 1330 (Fed. Cir. 2005); *Wyatt*, 271 F.3d at 1096 ("[O]nly persons with a valid property interest at the time of the taking are entitled to compensation."). Second, the Commission must establish that the government's actions "amounted to a compensable taking of that property interest." *American Pelagic Fishing Co., L.P. v. United States*, 379 F.3d 1363, 1372 (Fed. Cir. 2004).[16] In clarifying this standard, this court has held that a plaintiff, to prove a compensable taking, must demonstrate that the government's actions were the "direct and proximate cause" of the harms to its property interest. *See Loesch v. United States*, 645 F.2d 905, 913 (Ct. Cl. 1981) (finding no such causation in the context of governmental action *vis-a-vis* a raised level of water on a landowner's property).[17]

In an inverse condemnation case such as this, where the landowner seeks to "recover[] just compensation for a taking of his property when condemnation proceedings have not been instituted," *United States v. Clarke*, 445 U.S. 253, 257 (1980), the Federal Circuit has added an intent-based test to the traditional inquiry into causation and imposed a stricter standard as to what constitutes an "appropriation" of plaintiff's property interest. *See*, *e.g.*, *Ridge Line*, 346 F.3d at 1355. Under the intent-based test, a plaintiff must demonstrate either that "the government intend[ed] to invade a protected property interest" or that "the asserted invasion [was] the direct, natural, or probable result of an authorized activity and not the incidental or consequential injury inflicted by the action." *Cary v. United States*, 552 F.3d 1373, 1377 (Fed. Cir. 2009) (quoting *Ridge Line*, 346 F.3d at 1355). With respect to the appropriation of plaintiff's property interest, the Federal Circuit has stated that "to constitute a taking, an invasion must appropriate a benefit to the government at the expense of the property owner, or at least preempt the owner[']s right to enjoy his property for an extended period of time, rather than

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[16]As the Federal Circuit has noted, "'the Constitution does not itself create or define the scope of "property" interests protected by the Fifth Amendment. Instead, "existing rules and understandings" and "background principles" derived from an independent source, such as state, federal, or common law, define the dimensions of the requisite property rights for purposes of establishing a cognizable taking.'" *Schooner Harbor Ventures, Inc. v. United States*, __ F.3d __, __, 2009 WL 1668504, at *3 (Fed. Cir. 2009) (quoting *Air Pegasus of D.C., Inc. v. United States*, 424 F.3d 1206, 1213 (Fed. Cir. 2005)).

[17]The Federal Circuit has additionally required victims of government-induced flooding to "establish that treatment under takings law, as opposed to tort law, is appropriate under the circumstances." *Ridge Line, Inc. v. United States*, 346 F.3d 1346, 1355 (Fed. Cir. 2003) (citing *Barnes v. United States*, 210 Ct. Cl. 467 (1976), for the proposition that "[g]overnment-induced flooding not proved to be inevitably recurring occupies the category of mere consequential injury, or tort").

merely inflict an injury that reduces its value." *Ridge Line*, 346 F.3d at 1356.[18] Finally, the plaintiff must demonstrate that there are no intervening causes that would break the "chain of causation" between the governmental action and plaintiff's injury. *Cary*, 552 F.3d at 1380; *Moden v. United States*, 404 F.3d 1335, 1344 (Fed. Cir. 2005) ("[I]njury may not be foreseeable if any intervening cause breaks the chain of causation.").

The Commission has acknowledged that it bears the burden of proof in this case, and correctly states that it must prove by a preponderance of the evidence the following factual elements

> 1. The United States released water from Clearwater Lake Dam that proximately and directly caused [the Commission's] timber property to be subject to flooding;
>
> 2. The resulting flooding produced substantial damage to [the Commission's] timber property; and
>
> 3. The United States (*i.e.*, through its actions deviating from the Authorized Water Control Plan for the Black River) either intended to and did take [the Commission's] property, or it performed actions the natural consequence of which were to take [the Commission's] property.

Pl.'s Post-Trial Br. at 4-5.

ANALYSIS

I. Property Interest at Issue

"[P]rivate property" for purposes of the Fifth Amendment may take many forms. Among other things, such property includes "property [that] has been dedicated by the State to public use." *California v. United States*, 395 F.2d 261, 264 (9th Cir. 1968) (citing *United States v. Carmack*, 329 U.S. 230, 242 (1946); *City of St. Louis v. Western Union Tel. Co.*, 148 U.S. 92, 101 (1893)). In this instance, it is uncontested that the Commission, an entity of the State of Arkansas, held a valid property interest in the Management Area, including timber on that land, at the time of the alleged taking. Stip. ¶ 4. There thus is no question but that the Commission held "'a protectable property interest in what it alleges the government has taken.'" *Moden*, 404 F.3d at 1342 (quoting *Ridge Line*, 346 F.3d at 1355). Additionally, the parties concur, as they must, given the facts, that the superinduced flows of water would constitute a physical, not a regulatory, taking, and that the flows were temporary in the sense that they occurred during each growing season from 1993 through 2000.

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[18]These foreseeability and appropriation requirements go above and beyond plaintiff's obligation to prove causation. *Moden*, 404 F.3d at 1343 ("In addition to causation, an inverse condemnation plaintiff must prove that the government should have predicted or foreseen the resulting injury.").

Here, the Commission refers to its "timber resources on [the Management Area]" as the property which was taken in contravention of the Fifth Amendment. Compl. ¶¶ 27-28. However, the contours of the relevant property interest in this case are a matter of some complexity, given the parties' lengthy debate over the effect of the Corps of Engineers' releases of water into a river flowing through the Management Area. Thus the court will first analyze the scope of the property interest at issue by addressing the parties' arguments about the relationship between the water releases and the timber in the Management Area. Thereafter, the court will address the "intent to invade" and "appropriation of a benefit" tests for an inverse condemnation claim. *See infra*, at Parts I.B and I.C (addressing questions of appropriation and foreseeability as a preamble to the inquiry into causation).

A. The Scope of the Property Interest at Issue

In relation to its claim of taking of its property interest in timber, the Commission asserts that "it has alleged and proven that the Corps' actions took a temporary flowage easement over the [Management Area]." Pl.'s Reply at 6. Courts have been in agreement that the taking of a flowage easement without just compensation can constitute a violation of the Fifth Amendment. *See Pumpelly*, 80 U.S. (13 Wall.) at 172 ("The backing of water so as to overflow the lands of an individual . . . if done under statutes authorizing it for the public benefit, is such a taking as by the constitutional provision demands compensation."); *Dickinson*, 331 U.S. at 748 ("Property is taken in the constitutional sense when inroads are made upon an owner's use of it to an extent that, as between private parties, a servitude has been acquired either by agreement or in course of time."); *Ridge Line*, 346 F.3d at 1353 ("[G]overnment actions may not impose upon a private landowner a flowage easement without just compensation."). Yet, the Commission avers that it "is *not* seeking compensation for the taking of a flowage easement over the Black River WMA, but instead, similar to the plaintiff in *Cooper* [*v. United States*, 827 F.2d 762, 762 (Fed. Cir. 1987)], . . . is seeking compensation for the destruction and taking of its timber, plus for the necessary silvacultural restoration." Pl.'s Post-Trial Br. at 3; *see* Cl. Tr. 18:2-3 (setting out an argument by plaintiff's counsel that "[t]he Corps committed a taking of the Commission's valuable timber resource").

If construed in an overly simplistic way, *Cooper* could be a confusing precedent. In effect, it applies the longstanding *Pumpelly* line of cases from the Supreme Court, but it does so by discounting a flowage-easement claim. *See Cooper*, 827 F.2d at 763-64. In *Cooper*, the Corps of Engineers in the course of construction activities on a river in Mississippi created an obstruction that flooded plaintiff's land. *Id*. at 762. By the time the blockage was removed, plaintiff's land, and the timber on that land, had been inundated for long periods of time during five consecutive growing seasons. *Id*. The trial court in that case identified a temporary flowage easement as the relevant property interest that the government had taken from the landowners. *Cooper v. United States*, 11 Cl. Ct. 471, 475 (1987). On appeal, however, the Federal Circuit rejected the trial court's conclusion, observing instead that "although the government may have taken a flowage easement, the plaintiff does not seek compensation for it. Therefore, this case is not controlled by . . . cases . . . dealing with flowage easements." *Cooper*, 827 F.2d at 763. In short, because the plaintiff in *Cooper* did not seek to measure compensation based upon the taking of a flowage easement, but rather upon the timber destroyed and damaged by the flowage

easement, the court found no basis for describing a flowage easement as the locus of the taking. *Id*. at 763. Instead, the court stated that "the taking under consideration is a taking of timber." *Id.* at 764.

Manifestly, in this case, *Cooper* guided the Commission's focus on the timber taken as the measure of the compensation due, even though a temporary flowage easement was the root cause for, and embedded within, the Commission's claim. Now, somewhat disingenuously, the government argues that the Commission, correlatively with the plaintiff in *Cooper*, "waived its claim for [a] flowage easement" and that "timber . . . was the only property interest claim ever identified that the United States may have taken." Cl. Tr. 45:14-20; Def.'s Post-Trial Br. at 10 (arguing that the Commission "waived any claim that the United States acquired a flowage easement" over its property). This argument is sophistic. Certainly, no *permanent* flowage easement in the Management Area was taken by the flooding attributable to the Corps' deviations from the operating plan for the Clearwater Dam. And, a temporary flowage easement is not invoked by the Commission as the relevant property interest for purposes of measuring compensation. Nonetheless, a *temporary* flowage easement is a necessary foundation for the Commission's takings claim, as has always been evident from the Commission's pleadings and proofs.

The government acknowledges that the existence of additional water released downstream from Clearwater Dam by the Corps of Engineers during the deviations from the water control plan – in short, the flowage easement – represents "the factual underpinnings of the claimed taking of the timber." *See* Cl. Tr. 46:10-14. At the outset of this litigation, the Commission alleged that the Corps of Engineers "authorized and directed a pattern of water releases from Clearwater Lake that caused repeated flooding of bottomland hardwood timber during the growing season on [the Management Area]" and that this sustained inundation "caused extensive death and destruction of timber." Compl. ¶¶ 25-26. At trial, analogously to the facts in the *Pumpelly* line of precedents, the Commission then sought to prove that its property was inundated by excessive flows caused by upstream governmental action. The recent decisions by the Federal Circuit are fully in concord in this respect. *See Cary*, 552 F.3d at 1380 (restating the holding in *Ridge Line* that sporadic inundation of a plaintiff's land through increased storm water runoff caused by governmental development gives rise to the acquisition of a flowage easement).

As *Cooper* indicates, the Commission could look to timber as a measure of what was taken, even though a flowage easement over its property was the underlying progenitor. *See* Pl.'s Reply at 6. It is evident that the Corps of Engineers took a temporary flowage easement over the Commission's property as demonstrated by water gauge levels from 1993 to 1999 indicating higher-than-normal levels in the river, *see* PX 500 at 13 (Heitmeyer report) (summarizing Corning gauge data), and evidence concerning the Corps of Engineers' deviations from the original water control plan from 1993 to 2000 indicating higher-than-originally-planned releases of water into the river. Stip. ¶ 15. In the circumstances, the Commission's failure specifically to use the words "flowage easement" to describe what was taken has no magical effect. Superinduced additions of water and a resulting temporary flowage easement have always been embedded within the Commission's claim for the taking of its timber. Accordingly,

because the character of the alleged taking – along with the Commission's claim for additional damages, addressed *infra* in Part IV – hinges upon the effect of the Corps of Engineers' temporary flowage easement on timber within the Management Area, the court will address these property interests in tandem in analyzing the character of the taking.

B. Character of the Taking

The government questions whether the character of the Corps' flows from the Clearwater Dam interfered with the Commission's property to the point where the resulting flooding constituted an appropriation. Def.'s Post-Trial Br. at 9. The controlling standard for this threshold inquiry into the character of a taking is whether the government appropriated a benefit at the expense of the Commission "or at least preempt[ed] the [Commission's] right to enjoy [its] property for an extended period of time." *Ridge Line*, 346 F.3d at 1356. To satisfy this standard, the Commission's complaint "must allege that 'the government's interference with any property rights of [the Commission] was substantial and frequent enough to rise to the level of a taking.'" *Cary*, 552 F.3d at 1380 (quoting *Ridge Line*, 346 F.3d at 1357). Although "[o]ne flooding does not constitute a taking," *Hartwig v. United States*, 485 F.2d 615, 620 (Ct. Cl. 1973) (internal quotation and citations omitted), compensation is permitted where a landowner can demonstrate that governmental actions subjected his or her land "to intermittent, frequent, and inevitably recurring floodings." *Fromme v. United States*, 412 F.2d 1192, 1196 (Ct. Cl. 1969); *see also Ridge Line*, 346 F.3d at 1357 ("'[I]solated invasions, such as one or two floodings . . ., do not make a taking . . ., but repeated invasions of the same type have often been held to result in an involuntary servitude.'" (quoting *Eyherabide v. United States*, 170 Ct. Cl. 598, 604 (1965))).

1. "[I]ntermittent, frequent, and inevitably recurring floodings."

As a starting point, the circumstances of the *Pumpelly* line of precedents provide useful benchmarks. In *Pumpelly*, the Supreme Court found a constitutional taking "where real estate [was] actually invaded by superinduced additions of water . . . so as to effectively destroy or impair its usefulness." 80 U.S. (13 Wall.) at 181. Subsequently, in *Lynah*, the Supreme Court held that a taking occurred "where the government by the construction of a dam or other public works so floods lands belonging to an individual as to substantially destroy their value." 188 U.S. at 470. Although these early takings cases involved permanent flooding of the plaintiffs' property, *e.g.*, the landholder in *Lynah* saw his rice field transformed by flooding into "an irreclaimable bog," 188 U.S. at 469, the same principles were applied in later cases to situations involving intermittent or temporary flowage easements. Entitlement to compensation for a taking of an easement was granted in *Dickinson* where plaintiff's land was subject to intermittent flooding over and above a level at which the river abutting plaintiff's property had previously been flooded. 331 U.S. at 751. Citing *Dickinson*, the Federal Circuit has held that a plaintiff need not show that its property "suffer[ed] an effectual destruction or a permanent and exclusive occupation by government runoff" to recover on a takings claim based on a flowage easement. *Ridge Line*, 346 F.3d at 1358. Rather, recovery based on a government's taking would be permitted even if the landowner eventually was able to reclaim his land or the intrusions of water were halted. *Id*. at 1353.

In this instance, the evidence adduced at trial shows that the Corps' deviations from the operating plan for the Clearwater Dam led to flows from the Dam that regularly inundated portions of the Management Area during the growing season to an extent not experienced previously. Water-level gauge data from Corning, located just upstream of the Management Area, provide explicit evidence in this regard. For six years, from 1993 through 1998, flows at Corning were higher, and stayed higher, during the growing season than during prior years. *See supra*, at 11-12 (describing Corning water-level gauge data analyzed by Dr. Heitmeyer). These water-gauge results at Corning can be correlated to the inundation of portions of the Management Area by looking to observations made during the Corps' test releases from the Clearwater Dam in March 2001. At a six-foot level on the water gauges at Corning, substantial parts of the forest in the Management Area were flooded. *See supra*, at 10 (discussing the results reported in PX 637 at US 545 (E-mail from Raible to Hendricks)). Dr. Heitmeyer's analysis of the gauge data at Corning and the inundation of portions of the Management Area was persuasive and instructive, showing that when the Black River was at a level of five feet as measured at the Corning gauge, thirty percent of the nuttall oaks in the Management Area would be inundated, and at a level of six feet at the Corning gauge, fifty percent of the nuttall oaks could be flooded. PX 500 at 30 (Heitmeyer Report). And, because of the sustained nature of the releases from Clearwater Dam in growing seasons during the deviation years, the flood waters would stay on the affected portions of the Management Area for an extended period. *See supra*, at 12-13 (discussing Dr. Overton's analysis of the Corning water-gauge data, reflected in PX 506 at Figure 3 & Table 2 (Overton Report)).

Accordingly, the Commission has met its burden of proving that the Corps' releases were "intermittent, frequent, and inevitably recurring floodings" that support a taking, *Fromme*, 412 F.2d at 1196, rather than "'isolated invasions'" that might merely constitute a tort. *Ridge Line*, 346 F.3d at 1357 (quoting *Eyherabide*, 17 Ct. Cl. at 604).

2. Appropriation of aspects of the Commission's property.

In focusing the court's attention on the property interest in its timber, the Commission argues that "the present action has important factual and legal similarities to *Cooper*," in which recovery was based on a taking of timber. Pl.'s Reply at 5. The government responds by contending that the Commission was able to "access[] the [Management Area] throughout the period of dispute, and could have harvested its trees." Def.'s Post-Trial Br. at 11. On this basis, the government would distinguish *Cooper* where the United States "continuously inundated the timber for five years, preventing access to, and harvesting of, the trees." *Id.*; *see* Cl. Tr. 41:14-17. The government adds that the Commission was able to conduct timber sales during the years in which the taking allegedly occurred, and that any deficiency as to timber harvesting during those years "was based on [p]laintiff's management priorities, not the Corps' deviations." Def.'s Post-Trial Br. at 11 (citing DX 308 at 43 (listing timber sales)). Accordingly, argues the government, the Corps never appropriated the Commission's property interest in its timber. Cl. Tr. 41:12-14; *see* Def.'s Post-Trial Br. at 11 (citing *Cary*, 552 F.3d at 1381, for the principle "that floods that do not appropriate the landowner's property do not rise to the level of a taking even if the flood causes permanent damage.").

In this regard, the government's argument misconstrues and misapplies the principle invoked by the Federal Circuit's decision in *Cary*. That decision involved a claim that a forest fire that damaged landowners' properties was caused by the government's land management policies. *Cary*, 552 F.3d at 1375. In addressing the appropriation prong of *Ridge Line*, the *Cary* court looked to flooding cases. *Id*. at 1380-81. It commented that "floods that visit once and then recede" were insufficiently permanent to represent an appropriation of the landowner's property, in contrast to flooding that "creates a 'permanent liability' because of 'intermittent but inevitably recurring overflow.'" *Id*. at 1381 (quoting *Cress*, 243 U.S. at 328). For the Management Area, the inundations during growing seasons from 1993 through 1999 were recurrent and constituted an appropriation, albeit a temporary rather than permanent one because the Corps terminated its deviations. Reflecting the persistence of the Corps' temporary flowage easement, the damage done to the Commission's property interest in its timber was permanent rather than temporary, and the Commission was preempted from exercising its property rights over its timber during and after the Corps' deviations. Plaintiff offered copious evidence of this appropriation. The timber affected by the flowage easement saw a marked decline in its value due to mortality and rapid degradation. Tr. 2287:13-21 (Foster); PX 80 at 18 (Kingwood Report I). In addition, the dead and declining timber was distributed irregularly throughout the Management Area, which "ma[de] salvage logging inefficient and, therefore, unusually expensive." Tr. 2288:13-25 (Foster). Moreover, although the affected areas were showing a decline in timber during the early years of the deviations, the moderate drought in 1999 and 2000 led to a relatively sudden collapse; the adverse effect of persistent flooding and saturated soil during growing seasons damaged root systems to the point that the advent of dry weather rendered the roots incapable of supporting trees. *See supra*, at 17-18 (discussing die-back of surface feeder roots in flooded or saturated soils and the formation of small, carrot-like root suckers in epicormic fashion from larger primary roots). Thus, despite the government's objections that some timber was still harvestable during the period of the deviations, in general, the government's superinduced flows so profoundly disrupted certain regions of the Management Area that the Commission could no longer use those regions for their intended purposes, *i.e.*, providing habitat for wildlife and timber for harvest. *See* PX 80 at 18 (Kingwood Report I) (assessing significant losses to merchantable value of declining timber).

Instructive as to appropriation are two other takings cases, *United States v. Causby*, 328 U.S. 256 (1946); and *Reed Island-MLC, Inc. v. United States*, 67 Fed. Cl. 27 (2005). In *Causby*, low-flying Army aircraft flew directly above plaintiffs' land, causing many of plaintiffs' chickens to fly into walls from fright and be killed. 328 U.S. at 259. The government's actions were held to amount to a compensable taking despite the fact that "enjoyment and use of the land [was] not completely destroyed." *Id*. at 262. The Supreme Court reasoned that

> [t]he path of glide for airplanes might reduce a valuable factory site to grazing land, an orchard to a vegetable patch, a residential section to a wheat field. Some value would remain. But the use of the airspace immediately above the land would *limit the utility of the land and cause a diminution in its value*.

328 U.S. at 262 (emphasis added). Similarly, in *Reed Island*, this court found a taking where a government-imposed geographic margin of safety attendant to active operation of a munitions-loading facility "effectively forestalled" habitation on the landowner's property, and thus took the intended use, namely, the sale of lots for homes on that property to third parties, even though the property could still be put to other limited uses. *See* 67 Fed. Cl. at 35 & n.12.

Here, as in those cases, the government, by persistent flows affecting the Management Area, disrupted the Commission's uses and thereby appropriated a property interest. Accordingly, the government's contention that the Commission "continued to use its property as the [Management Area] as they had before the deviations and after the deviations," Cl. Tr. 50:19-21, is not accepted. Instead, the Commission was effectively deprived of its right to full enjoyment of its property during the period of the deviations.

As the Supreme Court observed in *Pumpelly*,

> [i]t would be a very curious and unsatisfactory result, if . . . it shall be held that if the government refrains from the absolute conversion of real property to the uses of the public it can destroy its value entirely, can inflict irreparable and permanent injury to any extent, can, in effect, subject it to total destruction without making any compensation, because, in the narrowest sense of that word, it is not taken for the public use. Such a construction would pervert the constitutional provisions into a restriction upon the rights of the citizen, as those rights stood at the common law, instead of the government, and make it an authority for invasion of private right under the pretext of the public good, which had no warrant in the laws or practices of our ancestors.

80 U.S. (13 Wall.) at 177-78.

C. Foreseeability

Notably, the Federal Circuit has held that "proof of causation, while necessary, is not sufficient for liability in an inverse condemnation case." *Moden*, 404 F.3d at 1343. As part of the threshold demonstration of whether a plaintiff in an inverse condemnation claim has stated a takings claim as contrasted to a claim sounding in tort law, a landowner must demonstrate "that the government intended to invade a protected property interest." *Cary*, 552 F.3d at 1377. In this respect, it is not necessary to show that the government specifically intended to invade and injure the property; rather, the standard for intent allows recovery based on injuries that are the direct, natural, predictable, or probable result of governmental action. *See Cary*, 552 F.3d at 1377; *Ridge Line*, 346 F.3d at 1356. That is, a court can infer governmental intent to invade a property interest where the plaintiff proves that "'the government *should have* predicted or foreseen the resulting injury.'" *Cary*, 552 F.3d at 1377 (quoting *Moden*, 404 F.3d at 1343) (emphasis added). On the other hand, if landowners suffered "an incidental or consequential injury . . . caused, for example, by improvident conduct on the part of the government in managing its property," such landowners are more suited to plead for recovery under tort law. *Ridge Line*, 346 F.3d at 1356. In applying this distinction between a foreseeable injury and a

merely incidental injury, the Federal Circuit has required plaintiffs to demonstrate that their injury was "the likely result of the [government's] act, not that the act was the likely cause of the injury." *Cary*, 552 F.3d at 1377 (citing *Moden*, 404 F.3d at 1343). Accordingly, these foreseeability elements will be addressed before determining the strength of the causative links between the government's deviations and the Commission's claimed taking.

1. Predictability of downstream flooding.

The Corps of Engineers did not actually know in 1993 that the increased river levels caused by deviations from the water control plan would cause additional flooding in the Management Area. Indeed, the Corps' staff believed as late as February 2001 that the deviations had no effect on the Black River beyond the Missouri-Arkansas boundary. *See supra*, at 7, 9 (addressing JX 14 at AGFC298 (Clearwater Lake Environmental Assessment), JX 187 at US570 (E-mail from Hendricks to Miller (Feb. 26, 2001)). The question thus presented becomes whether such flooding *should* have been foreseen, based, for instance, on information that the Corps had or could have gathered prior to initiating the deviations from the authorized water control plan. *See Moden*, 404 F.3d at 1343 ("[A]n inverse condemnation plaintiff must prove that the government should have predicted or foreseen the resulting injury."); *Cary*, 552 F.3d at 1379-80 (accord). On the point of foreseeability of governmental action, the Federal Circuit has approvingly quoted the analysis offered by the Court of Claims in *Cotton Land Co. v. United States*, 75 F. Supp. 232 (Ct. Cl. 1948):

> "If engineers had studied the question in advance they would, we suppose, have predicted what occurred. If they had studied the question in advance and had said, in a report, 'If you build Parker Dam to a crest of 450.4 feet, the pool will cover the land described below. The effect of the flow of the river into the pool will be to form a delta which, within approximately three years will raise the bed and the surface of the river, will cause it to overflow its banks and will thus inundate the lands described below,' would the fact of that formal forewarning be a decisive fact in such a suit as this? Should the fact that the engineering study was not so complete as to include a prediction as to lands beyond the bed of the reservoir prevent a court from looking at the actual and natural consequences of the [g]overnment's act?"

Ridge Line, 346 F.3d at 1357 (quoting *Cotton Land Co.*, 75 F. Supp. at 233-34). As applied in *Cotton Land*, this analysis led the court to find a taking where the government's construction and operation of a dam did not directly result in flooding but instead initiated "a succession of events . . . which . . . in their natural order, deprived the company of the beneficial use of its land." 75 F. Supp. at 233 (rejecting a defense that the cause of the taking was too remote).

Here, the Commission argues that the Corps had the responsibility for "determin[ing] whether the deviation changes in the Black River regulating stages and durations would produce negative impacts," and the Corps should have been able to "predict[] the downstream flooding with specificity" based on an evaluation of the hydrologic effects of deviations from the water control plan. Pl.'s Reply at 9-10. The Commission contends that "the direct, natural, and

probable impact of the Corps' authorized actions . . . was to artificially sustain the Black River at levels sufficient to inundate significant portions of the bottomland areas that exist along the Black River, including the [Management Area], for extended periods during the critical growing season." *Id*. at 10. Finally, the Commission concludes that the foreseeable result of "[s]ubjecting the [Management Area] to multiple consecutive years of such flood conditions" was an increase in timber mortality and growth of hazardous wetland species. *Id*. at 10-11.

The commonly held view in 1993, and up until at least 1996, was that deviations from the authorized water control plan at Clearwater Lake would not affect locations so far downstream the Black River as the Management Area. Tr. 209:11-20 (Hicklin) (acknowledging the opinion of the Corps that the influence of releases from Clearwater Dam would diminish before the state line between Missouri and Arkansas); JX 14 at AGFC278 (Clearwater Lake Environmental Assessment) (stating "the influence of Clearwater Dam is diminished by the time the Black River reaches the Missouri/Arkansas State line"); Tr. 211:13-19 (Hicklin) (indicating that the Corps had no knowledge prior to the draft environmental assessment "that a four-foot Poplar Bluff regulating stage would cause backwater flooding at the [Management Area]"); *see also* Cl. Tr. 89:9-13 (plaintiff's acknowledgment that this view was widespread). As a result, the draft version of the Corps' environmental impact statement would have found "no significant impact" based on the proposed revisions to the authorized water control plan. JX 14 at AGFC292 (Clearwater Lake Environmental Assessment).

However, by the late 1990s, as deviations continued, the Corps of Engineers had been repeatedly warned by members of the Commission that the ongoing deviations were causing flooding in the Management Area that could potentially damage the bottomland hardwood trees owned by the Commission. *See*, *e.g.*, PX 266 at AGFC7657-58 (Mem. from Zachary to Akers). In its participation in the Black River subcommittee meetings, the Commission informed Mr. Hendricks, the Corps' representative, that the "Management Area was experiencing flooding during the growing season," and the Commission expressed its belief "that the deviations from the original authorized plan [were] the primary cause for that type [of] flooding." Tr. 84:1-4 (Zachary). In March 1996, Mr. Hendricks was copied on a letter indicating that the Commission had informed the Corps that it "supported evacuation of the flood pool as quick[ly] as possible to eliminate higher May and June flows which were damaging the bottomland hardwoods." JX 223 at US1603 (Letter from Gary T. Christoff, Policy Coordinator of the Missouri Department of Conservation, to Earl T. Smith, Arkansas Soil & Water Conservation Commission (Mar. 19, 1996)). Then in September 1996, the Commission expressed further concern that "the deviations from the authorized plan of operation of Clearwater Lake w[ere] the direct cause of the growing season flooding and incurred damages on the [Management Area]." Tr. 105:1-7 (Zachary) (citing PX 262 (Letter from Mike Armstrong to Gary Christoff (Sept. 6, 1996))). Mr. Zachary testified that Mr. Christoff, the moderator of the Black River subcommittee meetings, was "concerned with the welfare of the bottomland hardwood forest along the basis [that they] were being affected by the growing season flooding." Tr. 107:8-11 (Zachary).

By March 2001, after acknowledging that "[t]he flooding is more extensive than our modeling predicted and the duration is probably more," Colonel Holden stated that "anyone could challenge us in that deviations are not in compliance with NEPA and enjoin us. Blissful

ignorance of the preceding 25+ years no longer applies." PX 632 at US477 (Letter from Col. Holden (Mar. 30, 2001)); *see* Tr. 233:20 to 234:18 (Hicklin). Accordingly, although the Corps was not aware and not on actual notice in 1993 that its deviations from the water control plan would result in damage to the timber in the Management Area, if it had performed a reasonable investigation of the effects the deviations would have on downstream water levels, it would have been able to predict both that the deviations would increase the levels of the Black River in the Management Area and that the flooding caused by these increased levels would damage timber in the Management Area. Indeed, the Corps had available to it a computerized modeling system that could have been used to evaluate potential hydrological effects of its deviations from the water control plan, *see* Tr. 2927:21 to 2928:14 (Raible); DX 310 at 15 (Nutter Report), but that model was not employed until well after the deviations had ceased – indeed, not until the Corps' staff and the government's experts were preparing for trial in this case. *See* DX 310 at 15 (Nutter Report). In short, the effect of deviations in the Management Area was predictable, using readily available resources and hydrologic skills.

2. No intervening cause.

Tangentially related to predictability, the government contends that the damage to oak trees in the Management Area was not due solely to flooding during growing seasons attributable to the Corps' deviations, but instead "depended on other conditions, which no one could have predicted." Cl. Tr. 34:2-5. Primary among these "other conditions" were the summer droughts in 1999 and 2000, which the government claims represented a "naturally occurring intervening event that breaks the causal chain between the Corps' actions and the timber mortality." Def.'s Post-Trial Br. at 9. Citing Dr. Baker's testimony that the drought "was kind of the thing that tilted the scale," Tr. 2437:22-23 (Baker), the government identifies the summer drought from 1999 to 2000 as an intervening cause that breaks the link between the increased flooding probability and the damage to the trees. Cl. Tr. 34:25 to 35:4. The government acknowledges Dr. Baker's testimony that the root systems of trees in portions of the Management Area were severely damaged by flooding during consecutive growing seasons, but argues that it was the drought itself "that caused the massive, the devastating mortality" claimed by the Commission. Cl. Tr. 37:15-17.

Conceptually, an intervening or contributing cause can break the chain of foreseeable causation, although the existence of an "incidental intervening or contributing cause between [the government's] authorized action and the alleged injury" does not necessarily preclude a finding of foreseeability. *Cary*, 552 F.3d at 1379. "Wherever there is an authorized action, the causation prong is satisfied for any injury which is the direct, natural, and probable result of that action." *Id*. In *Cary*, a recent decision where the invasion of a property interest was found not to be foreseeable, the Federal Circuit offered the following contrasting hypothetical:

> [H]ad the government action been to accumulate fuel loads in the [fire zone], even without knowledge that such fuel loads would become a large conflagration upon any ignition, then any ignition, even one negligently started by unauthorized human hands, would be adequate for that government act to satisfy the causation prong. This is because an ignition is the direct, natural and probable result

> of the government intentionally allowing fuel loads to accumulate in a fire zone, and a conflagration is the direct, natural, and probable result of this ignition in a forest with high fuel loads.

552 F.3d at 1379 (holding that the government "did not need to light the match to be liable, but to be a taking, it must have at least authorized supplying the fuel").

In the present situation, the decision to deviate from the water control plan from 1993 to 2000 was certainly an authorized act. Consequently, the question before this court is whether there was a "direct, natural, and probable path[]" between the authorized act of releasing additional water and the flooding of the Management Area, or whether this authorized act was only "converted into a damaging event" due to the presence of an intervening cause. *Cary*, 552 F.3d at 1379. It is evident that here there was a "direct, natural, and probable path[]." *Id*. The drought may have been a contributing factor to timber mortality, and even a necessary factor to the catastrophic losses that occurred in 1999 and 2000, but as Dr. Baker and Dr. King testified at trial, the root systems of bottomland hardwood trees in the Management Area had already been severely damaged by excess inundation during the growing seasons from 1993 to 1999, thus rendering them more susceptible to drought than they would have been otherwise. *See supra*, at 17-18. The fact that trees in control stands suffered no harm from the 1999 and 2000 drought indicates that the distinguishing factor that engendered mortality of trees that had been regularly inundated was the damage that had occurred to their root systems during the years of growing season flooding from 1993 to 1999. *See* Tr. 2444:10-14 (Baker); *see also* Tr. 2444:5-9 (Baker) (ascribing trees' inability to survive the drought to the fact that they had already "lost half of their root systems or more" due to consecutive years of summertime flooding); Tr. 3359:25 to 3360:3 (King) ("I think any of the trees that were really stressed from the flooding during that period would -- a lot of them would have been pushed over the edge with the drought.").

Because the government set this chain of events into motion through authorized deviations from the water control plan, the fact that there was some later incident that may have "tilted the scale," Tr. 2437:22-23 (Baker), or "li[t] the match," *Cary*, 552 F.3d at 1379, does not break the chain of foreseeable results of the government's authorized action.

D. Measure of Damages Based on Taking of Timber

The Supreme Court permits recovery based on temporary takings. After reviewing relevant precedents on this point, the Supreme Court stated that "[t]hough the takings were in fact 'temporary,' . . . there was no question that compensation would be required for the government's interference with the use of the property. *First English Evangelical Lutheran Church of Glendale v. County of Los Angeles*, 482 U.S. 304, 318 (1987) (summarizing the decisions in *Kimball Laundry Co. v. United States*, 338 U.S. 1, 4-21 (1949); *United States v. Petty Motor Co.*, 327 U.S. 372, 377-81 (1946); and *United States v. General Motors Corp.*, 323 U.S. 373, 379-384 (1945)). In this range of temporary takings cases, the Supreme Court "was concerned in each case with determining the proper measure of the monetary relief to which the property holders were entitled." *First English Evangelical Lutheran Church*, 482 U.S. at 318.

The Commission's theory of recovery is not based on a temporary appropriation of a flowage easement, likely in deference to the Federal Circuit's decision in *Cooper*, which measured compensation in terms of timber destroyed. 827 F.2d at 763-64. Indeed, here, as in *Cooper*, the flowage easement was not taken on a permanent basis. 827 F.2d at 762-63.[19] Instead, the court will assess the government's acquisition of the flowage easement as a predicate closely attendant to the Commission's property interest in timber. In effect, the temporary taking of a flowage easement resulted in a permanent taking of timber and thus timber value serves best as the measure of monetary relief to which the Commission is entitled.

II. Causation

The conclusion that an injury caused by governmental action was foreseeable "does not mean that issues surrounding causation are irrelevant. On the contrary, causation must be shown." *Moden*, 404 F.3d at 1343 (citations omitted). In proving causation, "[i]t is well established that a taking occurs when a government action causes groundwater levels to rise and destroy surface agricultural use." *Alost v. United States*, 73 Fed. Cl. 480, 506 (2006) (citations omitted). However, the Commission, as plaintiff, must demonstrate that the government's actions were "the direct and proximate cause" of the harms to its property interest. *See Loesch*, 645 F.2d at 913.

In this case, two sets of causal premises must be established by the Commission. First, the Commission must show that the Corps' deviations from the authorized water control plan caused increased flooding in the Management Area, and second, that this flooding caused significant damage to bottomland hardwood timber in the Management Area. Additionally, as the government points out, two causal links are embedded within this first set of premises: the Commission must prove both that the Corps' deviations resulted in increased levels of the Black River as compared to historical averages and that the increased river levels resulted in increased flooding in the Management Area. *See* Cl. Tr. 51:16-24.

Regarding the first of these causal links, the government contends that the Management Area "would have flooded even if the Corps had not deviated from 1993-2000." Def.'s Post-Trial Br. at 15. Regarding the second causal link, the government argues that the Commission "failed to present any reliable or meaningful evidence about how the 1993-2000 deviations actually impacted timber on the [Management Area]." *Id*. Finally, in critiquing the alleged link between the flooding caused by the Corps and the damage to timber in the Management Area, the government resists reliance on the Commission's use of post-1999 mortality rates obtained from the Kingwood cruises to prove that the deviations were the cause of the increased timber

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[19]In concert with *Kimball Laundry*, *Petty Motor*, and *General Motors*, *Cooper* serves as a guiding precedent for "determining the proper measure of the monetary relief to which the property holder[] [subject to a temporary taking] [is] entitled." *First English Evangelical Lutheran Church*, 482 U.S. at 318. *See Huntleigh USA Corp. v. United States*, 525 F.3d 1370, 1382 n.3 (Fed. Cir. 2008) (commenting on *Kimball Laundry* and *Cooper* as precedents for different measures of damages for "a temporary, . . . not a permanent, taking").

mortality. *Id*. at 35. As a corollary to this final critique, the government additionally argues that the timber in the Management Area was not completely damaged, contending that flooding during the years of the deviations "narrowed, but did not prevent, [the Commission's] ability to conduct 'forestry work like timber inventories, [and] timber markings for timber sale activities.'" *Id*. at 34 (quoting Tr. 1236:18 to 1237:5 (Hausman)).

A. Water Levels on the Black River

The water gauges in place at various points along the Black River indicate water levels of the Black River before, during, and after the period of the Corps' deviations. *See e.g.*, JX 266 (Corning Gauge Data); DX310 at 15 (Nutter Report). The water gauge immediately upstream from the Management Area in Corning is particularly useful in this regard, because it gives a daily snapshot of the breadth and depth of water coverage relatively close to the Management Area. Based on these and other data, the Commission and the government "agree that the [Corps of Engineers'] deviations between 1993 and 2000 impacted Black River [water] levels." Def.'s Post-Trial Br. at 15. The parties also agree that the Management Area has experienced varying degrees of seasonal flooding since its inception; the Commission recognizes such flooding to be "'a dominant feature of the hydrology that controls the habitat community structure of the Black River floodplain in the [Management Area] region.'" Pl.'s Reply at 15 (quoting PX 500 at 11 (Heitmeyer Report)). Where the parties differ in their analysis of water level data is both in their characterization of the frequency of growing season flooding from 1993 to 1999 when compared with earlier time periods, and in their description of the particular pattern of growing season flooding that emerged from 1993 to 1999.

The government cites to Dr. Overton's comparison of water gauge data from 1981-1992 with data from 1993-1999, and argues that this comparison indicates that "there were periods before 1993, before the deviations, . . . when the Black River was 'high.'" Cl. Tr. 53:3-11 (discussing PX 506 at Figure 3 (Overton Report)). From this factual premise, the government argues that the flooding events during the mid- to late-1990s were thus not out of the ordinary. Cl. Tr. 53:3-11. Dr. Overton's comparison of the two time periods indicates that the Black River reached certain ranges of heights either as frequently, or more frequently, during the period from 1981 to 1992 than during the period from 1993 to 1999. *See* Def.'s Post-Trial Br. at 23 (citing PX 506 at Table 2 (Overton Report) (finding that there were more days from 1981 to 1992 when the Corning gauge reached levels of 5 to 6 feet, 6 to 8 feet, and 10.5 to 11.5 feet). Yet under the comparison of water gauge data offered by the government, the Black River reached a height of 8 to 10.5 feet for an average of just 24.58 days during the April-to-October growing seasons from 1981 to 1992, versus 46.58 days from 1993 to 1999. PX 506 at Table 2 (Overton Report). The government also acknowledges that when compared to the period from 1981 to 1992, the Corning gauge exceeded five feet for a seasonal average of approximately 8.5 additional days during the growing seasons from 1993 to 1999. *See* Def.'s Br. at 23 (citing PX 506 at Table 2 (Overton Report)). Furthermore, a broader comparison between the growing seasons from 1949 to 1992 and the growing seasons from 1993 to 1999 indicates that the water level reached five feet for a seasonal average of over 26 days more during the latter period, and the water level reached six feet for a seasonal average of nearly 29 days more during the latter period. PX 500 at 13 (Heitmeyer Report) (Table 3). The simplest conclusion to draw from these varied analyses

of the frequency of growing-season water levels is that the Black River experienced more high water during the growing seasons from 1993 to 1999, *i.e.*, the period of years during which the Corps of Engineers deviated from the authorized water control plan, than it experienced during previous time periods.

B. Increased Flooding of the Management Area

Additionally, in the context of the historical flooding patterns, the particular pattern of flooding and high water levels recorded in the Management Area from 1993 to 2000 stands out as unique. During 1993 to 2000, the Management Area experienced six consecutive years of growing-season flooding, with water levels in excess of five feet for at least 65 days during each year; in 1997, the river level exceeded five feet for 166 days. PX 500 at 14 (Heitmeyer Report) (figure 10); JX 266 (Corning Gauge Data). Such a sustained period of consecutive years of growing-season flooding was unprecedented. Tr. 2781:17-20 (Heitmeyer).[20] In "normal" years, the Black River would rise rapidly during rain events and then fall rapidly. *See supra*, at 11.

Consequently, in addition to the increase in the number of days of flooding from 1993 to 2000, the Commission contends that "the flooding observed during the period was to a greater extent and duration than had previously been the case under the authorized plan." Cl. Tr. 6:20-22. This contention is verified by the letter from Colonel Holden, stating from the perspective of the Corps that "[t]he flooding is more extensive than our modeling predicted and the duration is probably more." PX 632 at US476 (Letter from Col. Holden).

To these proofs of the increased frequency and duration of flooding, the government responds that even if the Black River reached higher levels during the period of the Corps' deviations, the Commission "presented no evidence correlating river stages with flooding on particular portions of the [Management Area]; describing how much water floods the [Management Area] at particular river stages; explaining how many trees are impacted by particular river stages; . . . showing how long any portion of the [Management Area] stays flooded[;] . . . [or establishing] what areas on the [Management Area] drain at specific river stages." Def.'s Post-Trial Br. at 16. Because the Management Area is heterogeneous, and is comprised of different areas with different populations of trees and different mortality rates, the government argues that the Commission was required to present more than "*general* beliefs that the [Management Area] begins to flood, or begins to drain at certain river levels." Cl. Tr. 56:21-23 (emphasis added). Rather, to account for the significant variation between mortality rates in different parts of the Management Area, the government argues that the Commission should have presented specific evidence concerning the particular river stages at which particular areas in the Management Area begin to flood. Cl. Tr. 56:24 to 57:6.

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[20]The cumulative impact of six years of growing-season flooding was crucial, as will be explained below, to the decline of the root structure of timber in the Management Area. *See infra*, at __.

The government acknowledges that the Commission compiled specific evidence concerning the river level at which the Upper Island GTR floods, but notes that timber mortality was actually lower at Upper Island than elsewhere in the Management Area. Cl. Tr. 57:15 to 58:22. More particularized evidence of this sort, suggests the government, would have enabled the court to perform "specific assessment[s] as to whether the high timber mortality corresponded to the flooding and draining" of certain areas. Cl. Tr. 57:1-6. The government cites Dr. Nutter's testimony at trial for the broad argument that the "'lack of specific elevational information within [the Management Area]' rendered meaningless [p]laintiff's imprecise assertions about river stages." Def.'s Post-Trial Br. at 16 (quoting Tr. 3054:16-17 (Nutter)). However, this contention is unavailing.

The Commission adduced reliable evidence from a variety of sources, including data from foresters who had worked in the Management Area for long periods of time and records kept to accommodate duck hunters, that the Management Area begins to flood when water levels at the Corning gauge reach a range of 4.5 to 5 feet, and that there is extensive flooding when the water level reaches six feet at the Corning gauge. *See, e.g.*, Tr. 74:1-3 (Zachary); Tr. 2825:21 to 2826:1 (Heitmeyer) (stating that although there is "not just one point, one level at which [water] enters the woods," water "enters at least some parts of the floodplain as low as 4.5 [feet]"); PX 436 at 10779, 10797 (photographs indicating flooding in the Management Area when the Corning gauge was at 5.03 feet (Apr. 17-22, 2001)); Tr. 2787:10 to 2789:3 (Heitmeyer) (indicating range of evidence relied upon in determining flooding levels); *see also* Tr. 3056:9-13 (Nutter) (acknowledging that flooding would occur when the water level at the Corning gauge was between 4.5 and 6 feet). Such evidence also indicated that the water does not drain from the Management Area until the Black River falls below a level of 4.5 feet at the Corning gauge. *See* Tr. 73:16-22 (Zachary). In addition, proofs at trial showed that soil saturation and flooding of timber root zones can persist even after surface flooding has ceased. Mr. Baker testified that "once the water was released, it still takes those soils sometimes three or four weeks to actually dry out, to dry to the point that they are not saturated." Tr. 2341:10-13 (Baker); *see* Cl. Tr. 114:23-24 (government acknowledging that after a flooding event "it takes four to five weeks for the [Management Area] to drain down below the root[s]"). Finally, Dr. Heitmeyer testified and indicated in his report that when the Corning gauge "is five feet, [water] floods greater than 30 percent of the nuttall oaks on the [Management Area], and [at] a six-feet reading[,] over 50 percent of the nuttall [oaks] were flooded." Tr. 2805:6-9 (Heitmeyer); PX 500 at 30 (Heitmeyer Report).

The Commission thus argues that it "presented substantial and convincing evidence that the [Management Area] suffered significant additional flooding as a direct, natural[,] and foreseeable result of the Corps' deviations." Pl.'s Reply at 15. Perhaps the most dramatic evidence in this regard came from the testimony of one of the government's own experts, Dr. King, who acknowledged that "[t]he Corps' deviations resulted in substantial additional flooding on the [Management Area]" and that "[t]he deviations caused flooding that covered more surface on the [Management Area] than . . . would have been covered under the original plan." Tr. 3367:10-14, 3367:22 to 3368:2 (King). Dr. King also agreed that at times, "[t]he Corps' deviations caused flooding that lasted longer than would have occurred under the original, authorized plan." Tr. 3368:3-6 (King).

However, the government objects to the causal link between the Corps' deviations and the flooding based on its use of its river-basin model to analyze what would have happened to water levels on the Black River from 1993 to 2000 had the Corps not implemented its deviations to the authorized water control plan. Based on results from this model, the government argues that

> if one accepts [p]laintiff's assumptions that extensive flooding occurs when the Corning gauge reaches 4.5 feet, that the surface remains flooded until the Corning gauge falls below 4 feet, and that [bottomland hardwood] roots remain saturated until the Corning stage falls below 3 feet, the SUPER model shows that trees on the [Management Area] would have been significantly inundated even without the deviations.

Def.'s Post-Trial Br. at 28. The model predicted that the river level in the Management Area would have reached at least 5.5 feet for over 72 percent of the days during the growing seasons from 1994 to 1999, and that the growing seasons with the most flooding would have been those from 1994 to 1996. Tr. 3358:4-7, 3361:12-20 (King). From this application of the model, the government concludes that "there would have been significant periods of timber inundation" even in the absence of the Corps' deviations. Def.'s Post-Trial Br. at 30.

The government's objection, however, is unpersuasive given the problems that were identified with the government's modeling and comparison of the growing seasons from 1993 to 2000. First, the reliability of the model is far from unassailable. Certainly, "it would be unreasonable to conclude that the subject of scientific testimony must be known to a certainty." *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 590 (1993) (internal quotation and citations omitted); *see also Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137, 152 (1999) (clarifying the standard set forth in *Daubert* for admission of expert evidence as requiring "the same level of intellectual rigor that characterizes the practice of an expert in the relevant field"). However, the fact that the model was "very reliable and more accurate than [other] simulation models" and offered output that was "far better than what you would typically expect" from river modeling, Tr. 3064:22 to 3065:8 (Nutter), does not indicate that results from its use should be employed to displace actual observations. *See* Tr. 2956:7-22 (Raible) (noting that the model was never calibrated to actual observed data from the Corning gauge).

Second, the government engages in a faulty assumption regarding drainage levels of the Management Area when it compares the number of days at which the model and the actual Corning gauge readings measured water levels at three feet. *See* Def.'s Post-Trial Br. at 28. Although the government contends that plaintiff has assumed that "[bottomland hardwood] roots remain saturated until the Corning stage falls below 3 feet," Def.'s Post-Trial Br. at 28, the Commission rejects this attribution of such an assumption, pointing out that "effective groundwater drainage will only occur once the surface begins to be dewatered[,] [which] occurs between 4.5 and 5 feet at Corning." Pl.'s Reply at 17. The Commission is correct on this point: testimony indicates that drainage begins to occur once water is cleared from the surface, which occurs when water levels are between 4.5 and 5 feet at the Corning gauge. *See supra*, at 9-12. It is true that the roots on bottomland hardwood trees can extend approximately twenty-four inches below the surface, Tr. 2391:18-25 (Baker), but this fact does not imply that these roots will

remain saturated until the water level at the Corning gauge is a full twenty-four inches below the five-foot level at which groundwater begins to drain. The government's comparison of days at which the model and the Corning gauge reached three feet is thus irrelevant to any determination of how frequently root-system flooding would have occurred in the real versus the modeled world. A more practical comparison, based on how frequently the model and the Corning gauge reached a level of *five* feet, indicates that there would have been a total additional 123 days of growing-season flooding at the five-foot stage at Corning during the period of deviations from 1993 to 2000. *See* PX 492 (Comparison of Corning Observed and Model Data from 1993 to 2000).

Accordingly, based on the increased frequency and uniquely sustained pattern of flooding in the Management Area during growing seasons in the years from 1993 to 2000, which would not have occurred in the absence of the Corps of Engineers' deviations, the court finds that the Commission has successful demonstrated that the Corps' deviations from the authorized water control plan resulted in increased flooding in the Management Area.

C. Effect on Oak Trees

The next question in the chain of causation, then, is whether the Commission established that the increased flooding caused by the Corps of Engineers' deviations was the actual and proximate cause of increased damage to bottomland hardwood timber in the Management Area. There are, again, two causal premises embedded within this inquiry. The first is whether the mortality rate of bottomland hardwood timber in the Management Area actually increased from its normal background mortality rate. The second question is whether the flooding caused by the Corps of Engineers was the cause of this increase in mortality.

1. Increased mortality.

The Commission argues that an increase in damage to bottomland hardwood timber in the Management Area can be demonstrated through a comparison of mortality rates before and after the period of the Corps' deviations. The Commission argues that "[t]he mortality observed and measured by Kingwood in 2000 and 2001 was clearly in excess of normal . . . background mortality." Cl. Tr. 7:18-20. The Commission averred that the normal background mortality rate was in the range of 0.5 to 2%, based on the testimony of Dr. Baker, Dr. King, and Mr. Foster, *see* Pl.'s Reply at 27, and that the post-deviation mortality rate was in the range of 3 to 19.5%, based on Kingwood's evaluation. *Id*. at 20. Because the mortality rate reported by Kingwood was "greatly in excess" of the normal background rate, *id*. at 27, the Commission argues that the Management Area experienced an increase in mortality after the period of the Corps of Engineers' deviations from the authorized water control plan.

The government resists the Commission's claim that an increase of timber mortality can be proven through this comparison of mortality rates. First, the government argues that the Commission engaged in an "apples-to-oranges comparison" by "compar[ing] mortality rates on different areas at different times" rather than measuring mortality rates on the same portions of the Management Area across different times. Cl. Tr. 60:10-20. Due to the somewhat different

composition of the tree stands in the Management Area, varying by elevations and site conditions, the government contends that "the only legitimate comparison of pre- and post-deviation mortality rates must focus on the exact same geographic area." Def.'s Post-Trial Br. at 35-36. The government also criticizes the high confidence intervals present in the Kingwood studies. Cl. Tr. 66:18-20.

Although the Commission did not perform periodic forest inventories that would have enabled the measurement of mortality rates on the same areas at different times, the Commission did, through Kingwood, perform two cruises of the Management Area, which resulted in a thorough assessment of 18,623 acres, or roughly 75 percent, of the entire Management Area. *See* PX 80 at 15 (Kingwood Report I) (addressing 6,990 acres); PX 79 at 4 (Kingwood Report II) (addressing 11,633 acres); *see infra*, at 46-48. The type of cruise design employed by Kingwood is "generally accepted in the forestry industry." Tr. 1942:6-11 (Livingston). In addition, through the use of control areas which were not subject to increased inundation, the Commission was able to provide a fair approximation of the differential between areas that were and were not subject to increased growing-season flooding during the 1990s. *See* Tr. 2432:7-10 (Baker) (stating the "two control stands . . . averaged [0].13 percent" annual mortality); PX 485 at AGFC11549 (Kingwood Report of Hardwoods in Black River Wildlife Management Area) (finding a per-acre average of zero dead red oaks and less than one declining red oak in the control stands).[21] On this point, Dr. Baker testified that when one examined the control stands, one would find that they "were not flooded. There was no mortality in them. They went through the same drought [in 1999 and 2000], but there was not a damaged root system there, and they didn't die." Tr. 2444:10-14 (Baker). Accordingly, the Kingwood studies were sufficiently rigorous to result in a reasonable assessment of changing mortality rates in the Management Area.

The government's objection to high confidence intervals present for single sample plots in the Kingwood studies is equally unavailing, given that high confidence intervals are a common statistical artifact of the small individual sample sizes employed in the studies, *see* Tr. 2219:3-16 (Foster) (explaining that the average sample size in the second Kingwood study area was 150 sample plots), and thus should not be treated with suspicion. When aggregated into a single study, as occurred here, these confidence intervals dropped significantly. *See* Tr. 2219:22 to 2220:1 (Foster) ("As our sample gets bigger and goes up to the 1,400 sample plots for the whole, then we have a very much more credible estimate.").

Relatedly, the government argues that in actually compiling the post-deviation mortality rate for the Management Area, the Commission erred by conducting the Kingwood study "on areas of highest mortality . . . [and] on areas with significant preexisting conditions." Cl. Tr. 65:23 to 66:1. The government contends that a large portion of the Kingwood study mapped

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[21]The government objects that these were not appropriate control areas because they were primarily upland areas that "don't ever flood," Cl. Tr. 62:10-14, but that in fact was the purpose of establishing control areas: to provide a comparison of mortality on areas that did flood with those that did not.

"areas of high risk, poor hardwood reproduction, significant water stress, significant timber mortality, and a change to more water-tolerant species." Def.'s Post-Trial Br. at 44. Such a comparison, suggests the government, "guarantees a high differential because the Kingwood cruisers collected data only from high mortality areas, while the 'normal' background mortality rate is based on data from a more heterogeneous (though hypothetical) [bottomland hardwood] forest." *Id*. at 43.

However, although regions with pre-existing conditions certainly existed in the Management Area at the time of the Kingwood study, *see* DX 334 (Map of Management Area shaded by Mr. Hausman to indicate areas with pre-existing problems), there is no strong indication that these conditions actually resulted in significant timber mortality. Dr. King did attest that in "trying to piece together what . . . the [Management Area] look[ed] like prior to the deviation period, . . . there were numerous documents that spoke about drainage problems or beaver damage or presence of beaver within those sites, and bottomland hardwoods being flooded." Tr. 3354:18-23 (King). But these problems regarding drainage, beaver dams, insect infestations, and other conditions were established to be insignificant in the context of the larger mortality caused by flooding in the Management Area. *See* Tr. 2389:18-24, 2434:3 to 2437:21 (Baker).

Separately, the government spends a detailed portion of its post-trial brief arguing that the background timber mortality rates offered by the Commission and its experts are irrelevant to the actual history of mortality in the Management Area and unsupported by other research data about the Management Area. Def.'s Post-Trial Br. at 36-41. The government argues that "there is no basis to conclude that the pre-1993 mortality rate on the [Management Area] bears any resemblance to mortality rates on other properties." *Id*. at 37 (citing Tr. 3530:19 to 3531:3 (Test. of Dr. Steven Burak, President of Sizemore & Sizemore, Inc., who appraised the value of the Commission's timber interest as an expert for the government)). The government suggests that Dr. Baker and Mr. Foster "speculated about a mortality rate one might expect on some imaginary [Management Area]." *Id*. at 36. As a result of these alleged problems with the Commission's establishment of a background timber mortality rate, there is, the government suggests, "no evidence before the [c]ourt about what an actual normal mortality rate is for this [Management Area]." Cl. Tr. 64:10-12.

However, the evidence presented by the Commission regarding the history of mortality in the Management Area indicates that a forest that was once "in very healthy condition . . . [with] no obvious signs of sickness or problems with the forest's health," Tr. 60:18 to 61:4 (Zachary) (regarding forest condition in 1978); *see also* Tr. 1190:20 to 1191:6 (Hausman) (describing his amazement at the size and population of nuttall oak trees in the Management Area in the early 1980s); Tr. 613:20-24 (Blaney) ("[I]t was the most beautiful intact bottomland hardwood forest that I've ever seen . . . . All the trees were so large and healthy."), degraded rapidly during the 1990s. Although areas of the forest containing nuttall oaks were intact in 1994, Tr. 628:25 to 629:5 (Blaney), the Commission first began to observe stress in approximately 1993, "particularly [in the areas] that were flooded during the growing season." Tr. 61:9-14 (Zachary). Mr. Foster testified that by 2000, the Management Area was experiencing "excessive mortality of nearly catastrophic proportions" on the first area studied by Kingwood, and "excessive or

elevated mortality" in the second Kingwood study area. Tr. 2240:19-24 (Foster). Mr. Foster and Dr. Baker agreed that the ecosystem was in a state of collapse. Tr. 2080:21-23 (Foster) ("[W]e were looking at the early stages of an ecosystem collapse for this bottomland hardwood ecosystem."); Tr. 2400:2-7 (Baker) ("It was a bottom-land hardwood ecosystem in a state of collapse. Most of the nuttall oak, most of the red oaks were dead or dying. Many of the white oaks were dead or dying. Most of the sweetgum were dead or dying, and they were being replaced by wetland species in the understory."). Dr. Baker testified that in comparison, in a healthy, bottomland hardwood stand, he would "expect to see one dead tree maybe every five or ten acres . . ., maybe four dead trees in a 40-acre block. Probably two of those would be lightning strike, and two of them would be wind throw." Tr. 2374:18-23 (Baker). Such observations add depth and context to the background mortality rate proffered by the Commission. *See also* PX 53A-N (aerial photographs taken in April 2000, showing large numbers of dead trees).[22]

The government's description of plaintiff's expert evidence concerning mortality rates as "contradictory and biased" is baseless, given that many of these expert estimates fall consistently within a general range of 0.5 to 2 percent. *See, e.g.*, PX 504 at 3 (Submission of Supplemental Information to Kingwood I by Dr. Baker (Apr. 11, 2008)) (citing a background mortality rate of one to two percent); PX 505 at 2 (Supplement to Kingwood Report I) (citing a background rate of 0.75% in GTRs and 0.5% in other areas). There is no reason to suspect that Dr. Baker and Mr. Foster engaged in what the government describes as "obvious coordination of their testimony." Def.'s Post-Trial Br. at 38. Dr. Baker did put forward a lower rate of background mortality at trial, *see* Tr. 2430:1-21 (Baker), although that rate remained within the range established by prior reports and testimony. He testified that he came to this new conclusion "after doing some additional study, investigation, looking at publications, [and] looking at data." Tr. 2521:5-9 (Baker). The opinions are reliable and not marred by bias.

As to the government's argument that the background mortality rate was purely speculative, Dr. Baker did acknowledge that "background mortality is kind of an average because background mortality is going to be a little bit different on different stands, different sites, different land forms, [and] different plant communities," Tr. 2429:12-16 (Baker), but this acknowledgment of variation and heterogeneity is not a sufficient reason to discard the Commission's estimate of mortality. Dr. Baker's estimate was not based on speculation; rather, he relied upon "experience with stand situations similar to what's growing on the [Management Area], with the green tree reservoirs associated here" to develop a mortality rate that would fairly represent an overall cross-section of such situations. *See* Tr. 2429:21 to 2430:1 (Baker). In developing his conclusion, Dr. Baker justifiably relied on a variety of inventories and research studies that had been performed in the Management Area and other similarly situated forests. *See* Tr. 2431:7 to 2432:17 (Baker); PX 504 (Submission of Supplemental Information to Kingwood I by Dr. Baker).

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[22]Questions about the particular background mortality rates are addressed in the damages section, below. *See infra*, at 49.

Consequently, the court finds that the Commission's sampling methodology and evidence of general background mortality withstand the government's objections and serve as persuasive proofs of increased mortality resulting from increased inundation of parts of the Management Area during growing seasons from 1993 to 2000.

2. Causal links between die-back of feeder roots due to flooding and subsequent mortality.

As to the second causal premise, the government contends that even if the Commission successfully demonstrated that there was an increase in flooding in the Management Area during the growing seasons from 1993 to 2000, it "failed to present any meaningful data about the relationship between the flooding and draining amount from the [Management Area] and timber health." Cl. Tr. 56:13-15. The government suggests that the Commission, as a matter of logic, has "confuse[d] sequence with causation" in its use of a mortality rate from 2000 to conclude that the cause of this elevated mortality rate must have been the deviations. Cl. Tr. 59:16-24.

However, the Commission's causal argument in this regard does not rely on a mere correlative conjecture that the presence of higher mortality after 2000 indicates that the Corps' deviations were the cause of the increase in mortality. Rather, the Commission has offered significant and persuasive evidence drawing links between the Corps' deviations and the die-back of feeder roots, the consequence for trees during the moderate drought of 1999 and 2000 of the die-back of feeder roots, and the resulting catastrophic mortality in the sections of the Management Area that were subject to flooding and saturated soils during the growing seasons from 1993 to 2000.

The cumulative impact of six years of growing-season flooding was crucial, according to many sources, to the decline of the root structure of timber in the Management Area. *See, e.g.*, PX 575 at US34 (Corps' News Release) (stating that testing by the Corps "confirm[ed] that significant amounts of tree roots were flooded and could, under certain conditions, remain flooded long enough to damage or destroy the trees at the regulating stages under the new plan"). Dr. King, a witness for the government, testified that

> as Dr. Baker pointed out, one of the most important factors that begins to happen under these flooded -- prolonged flooded conditions is the roots begin to die, and it can begin to affect their ability to pull in nutrients, and water, and be able to photosynthesize. And so you wind up with degradation of the tree crown, and it also can make them susceptible to drought in the future if they lose enough of those roots.

Tr. 3345:2-11 (King).

In ascribing the degradation of timber stands to the Corps' decision to deviate from the authorized water control plan, the Kingwood study noted that "[e]ven though the oak forests that exist in the Black River flood plain are tolerant of dormant season flooding and wet soils, they cannot tolerate repeated growing season floods and saturated soils." PX 80 at 9 (Kingwood

Report I). The Kingwood study stated that "prolonged growing season flooding . . . undoubtedly resulted in saturated soils, inadequate oxygen levels in the water and the soil, increased root respiration, and significant root mortality and die-back in many of the less water tolerant trees such as [n]uttall oak and sweetgum." *Id*.

In turn, the trees that had suffered die back of feeder roots were not able to withstand the drought of 1999 to 2000. Dr. Baker testified that "if [the trees] had not . . . been subjected to the flooding and lost half of their root systems or more, they would have survived that drought very easily." Tr. 2444:7-9 (Baker). As it happened, the drought following the years of increased inundation during the growing seasons led to the death and injury of trees that was dramatically higher than would have occurred in normal conditions. *See supra*, at 17-18. This chain of causation followed Dr. King's formulation that "if you have a really wet period and then you follow by a severe drought, it can lead to acute mortality because of the fact that the trees have lost a lot of their smaller feeder roots, . . . and they just simply can't pull in the resources necessary to sustain them." Tr. 3345:15-20 (King).

In short, evidence put forward by the Commission and admissions by the Corps of Engineers indicate the significant impact of flooding on the bottomland hardwood timber in the Management Area. The parts of the Management Area that were subject to saturated soils during the growing seasons from 1993 to 2000 suffered catastrophic mortality and loss. The Corps acknowledged the dangers of the flooding when Colonel Holden wrote that the Corps was "not able to continue moving the proposed 4-[foot] seasonal Clearwater Lake deviation. Our regulating stage is at Poplar Bluff and under this deviation we extend the duration of lower releases from Clearwater Lake which has significant impacts to the bottomland hardwoods in the Donaldson/Black River Wildlife Management Area." PX 632 at US476 (Letter from Col. Holden). Later in that same memo, Colonel Holden noted that "[the Commission] has objected in the past because they contend that we increase the flood duration of hardwoods and kill more trees this way, particularly during the growing season. They now have a study that shows this *and we acknowledge the validity of their concerns*." *Id*. (emphasis added). At a later public meeting of the Corps of Engineers, in April 2001, Colonel Holden stated that the Corps found it unacceptable to adopt the proposed deviation plan on a permanent basis "because of the clear potential for damage to bottomland hardwoods in the Dave Donaldson Black River Wildlife Management Area." PX 576 at US39 (Colonel Holden's Remarks to the Black River Operations Public Meetings). The evidence in the record supports Dr. Baker's opinion that "[t]he cause [of tree mortality and decline] was some severe physiological problems resulting from four or five successive years of summertime flooding, particularly during the hot summer months when anaerobic water and soil conditions developed in these stands." Tr. 2433:24 to 2434:7 (Baker).

Further evidence of the causal relationship between flooding and increased mortality is provided by the lack of such increased mortality at higher elevations in the Management Area. Because these higher elevations were not subject to the same degree of growing-season flooding during the period of the Corps' deviations, they provide a control stand by which to compare the mortality of trees that were and were not directly subjected to the effects of the Corps' deviations from the water control plan. Tree stands at the higher elevations, which were never flooded

from 1993 to 2000, *see* Tr. 2506:24 to 2507:3 (Baker), were in markedly better condition than those at lower elevations. *See* Tr. 2445:19-23, 2446:7-8 (Baker).

D. Alternative Causes

Finally, the government argues that even if the Commission can show an increase in mortality due to the deviations at the Clearwater Dam, "that would not prove that the deviations, as opposed to some other event, the naturally occurring flooding or the naturally occurring flooding plus the drought, might have caused the damage that [p]laintiff now complains about." Cl. Tr. 59:18-24. The government contends that the flooding was not predictable solely on the basis of the Corps of Engineers' deviations, and instead "depended on other conditions, which no one could have predicted." Cl. Tr. 34:2-5. Primary among these "other conditions" were the summer droughts in 1999 and 2000, which the government claims represent a "naturally occurring intervening event that breaks the causal chain between the Corps' actions and the timber mortality." Def.'s Post-Trial Br. at 9.

The government bases much of its rebuttal argument on the tree-core analyses performed by Dr. Grissino-Mayer and Mr. Williams. The government suggests that the tree-core data demonstrates "that the deviations did not correspond to decreased growth rates in these trees," which in turn shows that "there is no evidence of unusual flooding during the deviated years." Cl. Tr. 71:11-19. The government concludes that these analyses "support the conclusion that the most likely explanation for the elevated tree mortality was not unusual flooding, but summer drought in 1999-2000, which may have quickly damaged trees in certain areas." Def.'s Post-Trial Br. at 58.

However, these various alternative causes suggested by the government do not withstand scrutiny. The tree cores were taken from stands of trees that were living in the summer of 2007, *see* DX 209 at 6 (Grissino-Mayer Report), not those that had died in and around 2000. As established above, the chain of foreseeable results set into motion by the Corps of Engineers' deviations from the authorized water control plan was not broken by any intervening event such as the drought in 1999 and 2000, even if such an event may have "tilted the scale" into excessive mortality. *See supra*, at 17-19, 32; Tr. 2437:22-23 (Baker). Nor was the chain of causation broken by any of these proffered alternative causes, because neither the drought nor the construction of beaver dams, considered either together or apart, can be said to have been the independent cause of the dramatically elevated timber mortality. Tr. 2443:23 to 2444:14 (Baker). The government represents that "[t]he critical difference between the pre-1993 and post-1999 conditions was not unusually high Black River flows or flooding events on the [Management Area] – it was the naturally-occurring summer drought in 1999 and 2000." Def.'s Post-Trial Br. at 34. But at many times prior to 1999, the Management Area had withstood multi-year droughts. In addition, the government avers "that the tree cores were collected from the exact same 6,990 acres that [p]laintiff contends were the most heavily impacted by the flooding," Cl. Tr. 72:6-9, but the Commission identified various problems with the government's sampling methodology that render the government's tree-core study unfit to rebut plaintiff's causation argument. *See, e.g.*, Tr. 2445:3 to 2447:4 (Baker) (identifying problems regarding location of sample collection of data from outside plot boundaries where no living trees were

present within plots, and use of data from intermediate and suppressed trees). Consequently, it is evident that the distinguishing factor producing the excessive mortality in 1999 and 2000 was the trees' roots' inability to withstand the moderate drought in those years after the extensive damage they suffered during the floods from 1993 to 1999.[23]

III. Damages Measured by Timber Loss

The just compensation requirement of the Fifth Amendment requires that an aggrieved property owner "be put in as good a position pecuniarily as if his property had not been taken." *Olson v. United States*, 292 U.S. 246, 255 (1934). Typically, courts measure just compensation by reference to the fair market value of the property taken. *See, e.g.*, *United States v. Fifty Acres of Land*, 469 U.S. 24, 30 (1984); *United States v. Chandler-Dunbar Water Power Co.*, 229 U.S. 53, 81 (1913). "Under [the fair-market-value] standard, the owner is entitled to receive 'what a willing buyer would pay in cash to a willing seller' at the time of the taking." *United States v. 564.54 Acres of Land*, 441 U.S. 506, 511 (1979) (quoting *United States v. Miller*, 317 U.S. 369, 374 (1943)). And, "since a transfer brought about by eminent domain is not a voluntary exchange, this amount can be determined only by a guess, as well informed as possible, as to what the equivalent would probably have been had a voluntary exchange taken place." *Kimball Laundry*, 338 U.S. at 6. Here, the government's temporary taking of a flowage easement over the Management Area resulted in a permanent taking of timber from that property, and the value of the timber thus serves as the basic measure of monetary relief to which the Commission is entitled.

In assessing fair compensation for the value of the timber taken by the government, the parties offer vastly different analyses of the effects of the Corps' deviations on the amount of timber lost by the Commission. The government and the Commission come to different conclusions regarding both what a normal background mortality rate would be and what the post-deviation mortality rate actually was in the Management Area.

A. Methodology

In addressing value, the Commission's experts started with the amount of timber that had died and subtracted the amount of timber that would have been expected to die using background mortality rates. *See* PX 79 at 9 (Kingwood Report II); PX 505 at 3 (Supplement to Kingwood

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[23]Beavers did not have a significant impact on timber mortality or decline in the Management Area. Despite the theory advanced in Dr. Nutter's report that drainage problems caused by beaver dams "extended the period of standing water in the GTRs and the flood plain sites where beaver were know[n] to have occurred," DX 310 at 23 (Nutter Report), there was little evidence advanced at trial of an increased beaver population or an increase in beaver levees in the Management Area during the period of the deviations. In addition, as Dr. Heitmeyer pointed out, the presence of high water in the Management Area would have rendered negligible the effect of any beaver dams during the period of the Corps' deviations. Tr. 2833:5-10 (Heitmeyer).

Report I). The Commission's experts also sought to identify the amount of timber that had entered a high-risk or declining state as a result of the Corps' deviations. PX 80 at 14 (Kingwood Report I). Then, by multiplying the volume loss of dead and potentially dying timber by the per-unit value of various timber species, the Commission's experts developed an appraisal of "[t]he loss in market value of merchantable timber and of potentially merchantable timber." PX 80 at 12 (Kingwood Report I); *see* PX 79 at 7 (Kingwood Report II).

Dr. Baker, Mr. Foster, and Mr. Livingston, working for Kingwood, performed two surveys and timber inventories on the Management Area. PX 79 at 1 (Kingwood Report II). The first of these surveys assessed Little River GTR, Reyno GTR, Winchester GTR, Gar Slough, and Schaeffer's Eddy, which have a combined area of 6,990 acres. PX 80 at 15 (Kingwood Report I). The second Kingwood survey assessed nine additional units in the Management Area, with a combined area of approximately 5,776 acres. PX 79 at 4 (Kingwood Report II). Because these nine additional units "were judged to be representative of the [entire] 11,633[-acre] secondary damage area" surveyed in the second study, the data from these nine cruised units was "extended to [an] additional 5,857 acres on an average per acre basis for damage appraisal purposes." *Id.*; *see* Tr. 2053:4-7 (Livingston) (remarking that Kingwood "cruised 5,700 acres because we felt like the 5,[7]00 was representative of the whole 11,000").

Within the five compartments on the first study area and the nine compartments on the second study area, Kingwood systematically distributed a series of circular plots, each measuring one-fifth of an acre. PX 80 at 13 (Kingwood Report I); PX 79 at 4 (Kingwood Report II). These plots were distributed so as to constitute a five percent sample of the entire survey area. PX 79 at 4 (Kingwood Report II). Then, in performing surveys on these plots, employees of Kingwood recorded their determinations regarding the species, size, and condition of all merchantable trees within each plot. PX 80 at 14 (Kingwood Report I); PX 79 at 4 (Kingwood Report II). The sawtimber species groups identified by Kingwood included red oak timber, white oak timber, and miscellaneous timber. PX 80 at 14 (Kingwood Report I); PX 79 at 5 (Kingwood Report II). Kingwood identified the height and diameter of the trees, and then calculated the volume of the trees using the Mesavage Girard Form Class Volume Tables, Doyle Rule. *Id.*; *see* PX 80 at App. B (listing estimated tree count and volume in compartments of first study area); PX 79 at App. A (listing estimated tree count and volume in compartments of second study area). Finally, Kingwood divided the trees into three different condition classes: dead, declining, and healthy. PX 80 at 14 (Kingwood Report I); PX 79 at 5 (Kingwood Report II). A tree was classified as dead if it had died within the past three years. Tr. 2075:17-23 (Foster). A tree was deemed to be declining if it was exhibiting "signs of loss of health and vigor" such as "'die back' in tree tops, necrotic lesions in the main stem or branches, and epicormic branching" that were sufficient to place the tree in "high risk status." PX 80 at 14 (Kingwood Report I); PX 79 at 5 (Kingwood Report II).

Kingwood appraised the per-unit value of dead timber by referring to "actual timber sale transactions involving timber of a similar character with adjustments to account for differences." PX 80 at 16 (Kingwood Report I). This was in keeping with the Supreme Court's instruction that where "exchanges of similar property have been frequent," as is the case here, just compensation is based upon the typical prices for the property "arrived at by the haggling of the

market." *Kimball Laundry*, 338 U.S. at 6. Kingwood evaluated four timber-sale transaction records from the Management Area from 1998 to 2000, and one timber-sale record from the Shirey Bay Wildlife Management Area in 1999. PX 80 at 16 (Kingwood Report I). The four sales in the Management Area registered an overall unit value average of $372.33 per thousand board feet ("MBF") based on an overall sale volume of 3,708.3 MBF, while the Shirey Bay sale registered a unit value average of $524.15 per MBF based on a sale volume of 1,175.3 MBF. *Id*. at 16. Factoring in the consensus of buyers and appraisers that timber from the Management Area was valued at seventy percent of the value of Shirey Bay timber, Kingwood concluded that the average value for timber in the Management Area would be $370 per MBF. *Id.* at 17. Kingwood further refined this analysis to account for the different unit values of different species, and concluded based on intuition and "oral interviews with buyers and p[ro]spective buyers of the subject timber" that red oak timber would be worth $464.38 per MBF, white oak timber would be worth $266 per MBF, and other miscellaneous timber would be worth $140 per MBF. *Id*. at 17.[24] In addition, Kingwood calculated damage to pulpwood based on what it characterized as the "reasonable value" of $9 per cord. *Id*. at 17, 23. The government raised no significant objections to this method of per-unit valuation in its briefs or at trial,[25] and the court accordingly accepts plaintiff's valuations.

Once Kingwood had calculated the per-unit value of the timber it appraised, it multiplied this value by total volume lost to determine the total loss in merchantable value of trees, and applied various algorithms to account for whether a tree was classified as dead or declining. In assessing the value of dead trees, Kingwood based its per-unit valuation on "the total tree merchantable value as it existed prior to the death of the tree." PX 80 at 18 (Kingwood Report I). In ascertaining the value of declining trees, Kingwood based its valuation on its estimate that half of the declining trees would be dead within five years, and half would "recover and live a normal life span in a degraded condition." *Id*. Accordingly, Kingwood assessed a full-value loss for the half of the trees identified as declining, and assessed a fifty percent value loss for the other half of the trees identified as declining that would recover to a degraded condition. *Id*.

In addition, Kingwood imputed a background mortality rate of 0.5 or 0.75% to the areas it surveyed, which it attributed to "normal occurrences such as windthrow, light[]ning strikes, and etc." PX 79 at 4 (Kingwood Report II); *see* PX 505 at 2 (Supplement to Kingwood Report I). Kingwood subtracted this rate of background mortality from the rate of mortality it observed in the Management Area to derive the volume of trees lost as a result of the Corps' deviations.

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[24]In its second report, Kingwood adjusted the price of red oak timber to $462.13 per MBF, based upon an additional timber sale in the Management Area that was factored into its appraisal methods. *See* PX 79 at 8 (Kingwood Report II).

[25]Dr. Steven Burak, who testified as an expert on behalf of the government, indicated in his report that an average of $380 per MBF would be appropriate, based on "adjustments for market conditions or changes in price levels between the date of sale and date of appraisal." DX 308 at 54 (A Retrospective Appraisal of Before and After Values of Timber in the Management Agrea (Apr. 11, 2008)) ("Burak Retrospective").

See PX 505 at 2 (Supplement to Kingwood Report I). Finally, Kingwood added the merchantable value of this volume of dead trees (as the value existed prior to the trees' death) to the pre-decline value of the volume of dying or degraded trees, and reached a total summary of the appraised value of losses in merchantable timber as a result of the Corps' deviations. PX 80 at 19 (Kingwood Report I); PX 505 at 3 (Supplement to Kingwood Report I); PX 79 at 10 (Kingwood Report II).

Based upon the two cruises and its appraisals of the per-unit value of timber in the Management Area, Kingwood concluded that the value lost for dead and declining timber in the first study area would be $4,516,000, PX 505 at 3 (Supplement to Kingwood Report I); Tr. 2244:11-13 (Foster), and that the value lost for dead and declining timber in the second area would be $1,961,000. PX 79 at 13 (Kingwood Report II); Tr. 2245:19-21 (Foster).

The government contends that Mr. Foster, on behalf of Kingwood, "ignored the extraordinarily high C[onfidence] I[nterval]s in the Kingwood data, did not consider the volume of timber that would have died even if the Corps had not deviated, utilized an unsupportable background mortality rate that is irrelevant to the pre-1993 mortality rate on the [Management Area], and relied upon an erroneous theory of liability." Def.'s Post-Trial Br. at 60. The government additionally avers that "the Kingwood data showed there was no additional mortality resulting from the deviations." *Id*.

Most of these contentions have already been addressed. The high confidence intervals in the Kingwood data were an artifact of the small sample sizes of Kingwood's plots; once these samples were aggregated, the confidence interval substantially decreased. *See supra*, at 39-40. The Commission's experts used background mortality rates to consider the volume of timber that would have died in the absence of the Corps' deviations. *See supra*, at 38-39. Additionally, proofs at trial amply demonstrated that there was significant timber mortality resulting from the Corps' deviations. *See supra*, at 38-42.

More specifically, respecting damages, however, the government argues that the Commission's experts "presented no evidence to support th[e] highly unusual assumption" that the second Kingwood cruise of 5,700 acres would be representative of 11,000 acres. Def.'s Post-Trial Br. at 62. The government claims that "Mr. Livingston's guess that the 5,700 acres actually cruised was somehow 'representative' of the entire 11,633 acres is plainly wrong," given the diversity of trees in the Management Area and the range of three-year mortality, from 0.67% to 3.33%, found by Mr. Livingston during the second Kingwood cruise. *Id*. (citing DX 308 at 34 (Burak Retrospective) (listing mortality findings from second Kingwood cruise)). However, as established above, the Kingwood study followed generally accepted industry standards, and the government did not successfully substantiate its allegations that the study was based on unrepresentative samples. *See supra*, at 15-16, 40; *see also* Tr. 1982:19 to 1983:9, 1984:9 to 1986:4 (Livingston) (establishing use of aerial photography and ground truthing to establish representative cruise areas); PX 53A, B, G, H, K, L, and M (aerial photographs taken in April 2000 showing dead trees throughout substantial portions of the Management Area). Accordingly, the court accepts the estimates of volume of dead and declining timber offered by Kingwood in its two studies.

B. Mortality Rate

As to the government's objection to the background mortality rate invoked by the Commission, the rates established by the Commission's experts are certainly not irrelevant to the pre-1993 mortality rate in the Management Area. *See supra*, at 40-41 (discussing the substance and context behind Dr. Baker's and Mr. Foster's analysis of mortality, and rejecting the government's argument that Commission experts were merely "speculat[ing] about a mortality rate one might expect on some imaginary [Management Area]" (quoting Def.'s Post-Trial Br. at 36)). However, the background rate used by Kingwood to measure valuation of timber losses may be slightly deflated from the actual background rate in the Management Area, given that these experts' estimates are at the lower end of the range of possible background mortality rates acknowledged by the Commission.

The Commission's experts, Dr. Baker and Mr. Foster, cite an average annual background mortality rate in the GTRs of 0.75% and 0.75 to 1%, respectively, and an average annual background mortality rate in non-GTRs areas of 0.5% and less than 1%, respectively. *See* Tr. 2099:21 to 2100:9 (Foster); Tr. 2430:1-21 (Baker). The Commission acknowledges that based on all expert analysis, the average annual mortality rate might be "0.5% or 2% or somewhere in-between," but that in any case, "the mortality reported by [Kingwood] is greatly in excess of these values." Pl.'s Reply at 27.

However, although this estimated level of annual background mortality reflected the mortality rate of 0.5% in the control stands surveyed by Kingwood, *see* Tr. 3528:6-9 (Burak), it is evident that a mortality rate of 0.5% is not sufficient to account for the inherent variability in mortality rates on a heterogeneous forest. Nonetheless, the normal mortality rate in the Management Area is not as high as the government avers; the 2 to 6% mortality rate cited by Dr. Burak, Tr. 3529:13-16 (Burak), is far out of proportion to the mortality rates cited by other experts in this case, including Dr. King, another expert called by the government. *See* Tr. 3373:24 to 3374:5 (King) (averring that a 2 to 6% background mortality rate would be inappropriate, and agreeing with Dr. Baker's characterization of background mortality). The court finds that a background mortality rate of 1.25% for non-GTR units and 1.75% for GTRs units is a fair estimate, based upon the evidence presented at trial, the higher acknowledged background rate of mortality in GTR, and the Commission's acknowledgment of a potential range of background mortality from 0.5% to 2% percent.

C. Dead and Impaired Trees

The government raises two sets of objections to the Commission's estimates regarding declining timber. First, the government argues that Mr. Foster wrongly assumed that the deviations were the sole cause of the decline in timber, and consequently "ignored the[] pre-existing conditions and overstated any damage arising from the deviations." Def.'s Post-Trial Br. at 60. On this point, it has already been established that the pre-existing conditions in the Management Area played little role in causing the increases in timber mortality compared to the Corps' deviations, *see supra*, at 19-20, and the same can be said of their role in causing increases in timber decline.

Relatedly, the government argues that Mr. Foster "based his estimated value of 'Declining Timber' on the unsupported assumption" that half of the declining trees would be dead within five years, and the other half would live a normal life span in a degraded condition. Def.'s Post-Trial Br. at 60-61 (citing PX 80 at 18 (Kingwood Report I)). The government further contests Mr. Foster's assumption that this latter half of the declining trees, the group that would eventually recover into a degraded condition, should be valued at one-half the value of the healthy timber. *Id*. at 61. However, the court finds that Mr. Foster was warranted in making his assumptions regarding the impaired value of declining trees, based on observed qualitative losses to the trees, irregular distribution of declining timber, and other constraints that stand in the way of efficient salvage of a forest with declining timber. *See* PX 80 at 18 (Kingwood Report I); Tr. 2287:9 to 2290:10 (Foster).

Kingwood's appraisal of the value lost must be adjusted for a higher background mortality rate of 1.25% for non-GTRs units and 1.75% for GTR units. The three units in GTRs were Little River, Reyno, and Winchester. In inventorying the first study area, Kingwood found a total of 14,355.1 MBF of red oak timber, 5,562.2 MBF of white oak timber, and 5,025.8 MBF of miscellaneous timber in these green tree units. PX 505 at 5 (Supplement to Kingwood Report I). Based on its analysis of the previous three-year period, Kingwood found that within these three units, 3,322.2 MBF of red oak timber had died, 474.3 MBF of white oak timber had died, and 576.6 MBF of miscellaneous timber had died. PX 80 at 15 (Kingwood Report I). Applying a three-year background mortality rate of 5.25%, the following volumes of timber would have died under normal conditions: 753.6 MBF of red oak timber, 292.0 MBF of white oak timber, and 263.9 MBF of miscellaneous timber. Accordingly, the amount of timber lost as a result of the Corps' deviations in GTRs units in the first study area is as follows: 2568.6 MBF of red oak timber, 182.3 MBF of white oak timber, and 312.7 MBF of miscellaneous timber.

The two units not in GTRs were Gar Slough and Schaeffer's Eddy. In inventorying these two areas, Kingwood found a total of 3,528.5 MBF of red oak timber, 2,749.6 MBF of white oak timber, and 1,690.6 MBF of miscellaneous timber. PX 505 at 5 (Supplement to Kingwood Report I). Based on its analysis of the previous three-year period, Kingwood found that within these two units, 872.9 MBF of red oak timber had died, 380.7 MBF of white oak timber had died, and 206.9 MBF of miscellaneous timber had died. PX 80 at 15 (Kingwood Report I). Applying a three-year background mortality rate of 3.75%, the following volumes of timber would have died under normal conditions: 132.3 MBF of red oak timber, 103.1 MBF of white oak timber, and 63.4 MBF of miscellaneous timber. Accordingly, the amount of timber that died as a result of the Corps' deviations in GTRs in the first study area is as follows: 740.6 MBF of red oak timber, 277.6 MBF of white oak timber, and 143.5 MBF of miscellaneous timber.

In summary, based on the first Kingwood study, a total of 3309.2 MBF of red oak timber, 459.9 MBF of white oak timber, and 456.2 MBF of miscellaneous timber died as a result of the Corps' deviations. Based on valuations of $464.38 per MBF for red oak timber (for a total lost of $1,536,726.30), $266 per MBF for white oak timber (total of $122,333.40), and $140 per MBF for miscellaneous timber (total of $63,868.00), the total value of dead timber lost based on this first study is $1,722,927.70.

As to the value of declining timber identified in the first study, based on the same valuations, 5,730.5 MBF of declining red oak (total of $2,661,129.59), 1,348.3 MBF of declining white oak (total of $358,647.80), and 1,606.4 MBF of declining miscellaneous timber ($224,896.00) yields a total of $3,244,673.39. With Mr. Foster's estimate of the value of declining timber, which assumes a full value loss for half of declining trees and a 50% value loss for the other half of declining trees, adding one-half plus one-fourth, 50% of one-half, of each of these totals yields $2,433,505.04. Thus the total value of dead plus declining timber on the first study area is $4,156,432.74.

Turning to the second study area, Kingwood found a total of 20,031.9 MBF of red oak timber, 9,442.2 MBF of white oak timber, and 8,281.9 MBF of miscellaneous timber in the nine units it surveyed. PX 79 at 6 (Kingwood Report II).[26] Based on its analysis of the previous three-year period, Kingwood found that within these three units, 1,104.3 MBF of this red oak timber had died, 182.2 MBF of white oak timber had died, and 436.7 MBF of miscellaneous timber had died. *Id*. Applying a three-year background mortality rate of 3.75%, the following volumes of timber would have died under normal conditions: 751.2 MBF of red oak timber, 354.1 MBF of white oak timber, and 310.6 MBF of miscellaneous timber. Accordingly, the amount of timber that died as a result of the Corps' deviations in the second study area is as follows: 353.1 MBF of red oak timber, and 126.1 MBF of miscellaneous timber.[27] Extrapolating directly from the 5,776 acres surveyed in the second study to the 11,633 acres for which the surveyed area was deemed to be representative, approximately 711.2 MBF of red oak timber and 254.0 MBF of miscellaneous timber died as a result of the Corps' deviations in the complete second study area. Based on valuations of $462.13 per MBF for red oak timber (or a total of $328,666.86) and $140 per MBF for miscellaneous timber (total of $35,560), the total value of dead timber based on the second study is $364,226.86.

As to the value of declining timber identified in the second study, 1,239.8 MBF of red oak, 183.7 MBF of white oak, and 673.4 MBF of miscellaneous timber were identified as declining. PX 79 at 6 (Kingwood Report II). Again, extrapolating from the acres actually surveyed in the second study to the 11,633 acres for which the surveyed area was deemed to be representative, approximately 2,497.0 MBF of red oak (total of $1,153,938.61), 370.0 MBF of white oak ($98,420.00), and 1356.2 MBF of miscellaneous timber (total of $189,868.00) were declining as a result of the Corps' deviations. *See id*. at 6. With Mr. Foster's estimate of the value of declining timber, which assumes a full value loss for half of declining trees and a 50%

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[26]The second area surveyed by Kingwood appeared to include few if any plots that were contained within a GTR, *see* PX 79 (Kingwood Report II) (map of areas surveyed during second Kingwood study), and Mr. Foster's application of a lower background mortality rate to this entire study area reflects the circumstance that this survey was composed principally if not entirely of non-GTR units. *See id*. at 9.

[27]In this situation, 171.9 *fewer* MBF of white oak timber died than would have been expected under the three-year background mortality rate of 3.75 percent. This circumstance suggests that the court's use of a 1.25% mortality rate might be too high, at least for white oak.

value loss for the other half of declining trees, adding one-half plus one-fourth, 50% of one-half, of each of these totals yields $1,081,669.96. Thus the total value of dead plus declining timber in the second study area is $1,445,896.82.

Accordingly, the fair market value of damages to timber in the Management Area caused by the Corps of Engineers amounts to a total of $5,602,329.56. The Commission is entitled to this amount as just compensation for the taking of its property interest in timber.

IV. Additional Damages

The Commission seeks additional damages for the expenses that it would incur in "removing extensive, invasive wetlands vegetation, [and] . . . remediating the soil and habitat, so that the same type of bottomland timber that was taken by [the] Corps can be restored." Pl.'s Post-Trial Br. at 8. Although the parties have generally referred to this aspect of the Commission's claim as one for "restoration" costs, that term is inaccurate in this context because the costs are not intended as a means of restoring contemporaneously the forest that was destroyed. Rather, the costs would be incurred to enable the forest to regenerate itself over a considerable period of time. Hence, the claimed costs will be termed "regeneration" costs or damages.

In support of its claim for regenerative damages, the Commission relies on the Supreme Court's decision in *Dickinson*, 331 U.S. 745, and the Federal Circuit's decision in *Cooper*, 827 F.2d 762. The Commission asserts that these precedents support its claim for regenerative damages because the government's taking "left the . . . [property] devalued, . . ., in the sense that there is groundcover that did not exist, and the forest is unable to regenerate the species of hardwoods naturally that had been present." Cl. Tr. 20:19-23. The Commission seeks approximately $5,000,000 in these costs, comprised of expenses to remove wetland species and of plantings to regenerate a forest cover. Pl.'s Post-Trial Br. at 32. The Commission seeks to recover $2,158,585 for treatment to "control the [growth of] undesirable species and allow regeneration of the desired species." *Id.*; *see* Tr. 1630:11 (Test. of Rick Watts, Territory Manager for UAP Distribution, Inc. ("UAP")). Additionally, the Commission claims that "[a]rtificial restoration is necessary because with the vegetation taking over the forest floor in most areas and the additional release of shade tolerant species," the natural regeneration of oak trees is not feasible. Pl.'s Post-Trial Br. at 30. The Commission presented an estimate for projected plantings costing between $2,813,475 and $3,564,900. PX 501 at 3 (Recommendations and Cost Estimates to Reestablish Oak-Dominated Forests on Damaged Areas on the Dave Donaldson/Black River WMA prepared by Martin Blaney, Habitat Coordinator (Nov. 20, 2007)).

The government resists this claim on three distinct grounds. First, the government argues that the Commission is unable "to show that the restoration costs directly resulted from the taking of [the] timber." Cl. Tr. 76:7-9. Secondly, the government asserts that the Commission failed to establish that the government's actions resulted in the devaluation of the affected areas of plaintiff's property by invasive growth. Cl. Tr. 76:20-25. Lastly, the government claims that the regenerative damages the Commission seeks to recover are, at best, consequential damages

and thus cannot be recovered in this inverse condemnation proceeding. Def.'s Post-Trial Br. at 12.

A. Regeneration Damages

The Fifth Amendment requires the United States to pay "just compensation" whenever it takes private property for public use. U.S. Const. amend. V. The Supreme Court has explained that the Fifth Amendment's just compensation requirement dictates that "[t]he owner is to be put in as good [a] position pecuniarily as he would have occupied if his property had not been taken." *Miller*, 317 U.S. at 373. In most cases, just compensation is measured by reference to the fair market value of the property taken. *See, e.g.*, *Fifty Acres of Land*, 469 U.S. at 30; *Chandler-Dunbar Water Power Co.*, 229 U.S. at 81. Thus, in many takings cases, the fair-market-value standard does not require the government to compensate certain losses that the property owner may experience. *See, e.g.*, *Kimball Laundry*, 338 U.S. at 5 (stating that the "loss to the owner of nontransferable values deriving from his unique need for property or idiosyncratic attachment to it, like loss due to an exercise of the police power, is properly treated as part of the burden of common citizenship").

The Commission relies on the Supreme Court's decision in *Dickinson* to support its claim for regeneration damages. In *Dickinson*, the government sought "to improve the navigability of the Kanawha River" by constructing a dam. 331 U.S. at 746. By raising the water level, the dam caused the surrounding land to be permanently flooded. *Id*. at 746-47. The district court awarded damages for the flowage easement taken by the United States and for the erosion caused by the flooding, and the Court of Appeals for the Fourth Circuit affirmed the district court's decision. *Id*. at 747. The Supreme Court affirmed the award of damages for erosion, ruling against the government's contention that such damages were consequential, citing the principle that "'[w]hen the part not taken is left in such shape or condition as to be in itself of less value than before, the owner is entitled to additional damages on that account.'" *Id*. at 750 (quoting *Bauman v. Ross*, 167 U.S. 548, 574 (1897)). In the instant matter, the Commission seeks to draw "an analogy between the erosion in *Dickinson* and the adjunct of invasive species that are extraordinarily difficult to remove." Cl. Tr. 24:14-16. Thus, the Commission is claiming "additional damages" under the regeneration rubric and is not putting forth an alternative means of measuring damages in the place and stead of the timber measure previously addressed.[28]

[28]For these reasons, the "cost of cure" cases are not pertinent because that mode of recovery has been viewed as an alternative to a fair-market-value basis for determining just compensation. *See*, *e.g.*, *Vaizburd v. United States*, 384 F.3d 1278, 1286 (Fed. Cir. 2004). There, the court of appeals observed that "[c]ost of cure is not a separate claim but merely a separate theory for computing the amount of takings liability." *Id*. at 1285 n.8 (citing *Ridge Line*, 346 F.3d at 1358-59); *see also* 4A *Nichols on Eminent Domain* § 14A.04[2][a] (stating "that the cost to cure, while admissible for the purpose of establishing just compensation, does not create individual rights to damages"). In *Vaizburd*, the costs at issue were the expenses of removing sand that was accreting annually on portions of plaintiffs' property. *See* 384 F.3d at

Besides *Dickinson*, the most relevant precedents regarding the Commission's claim for additional regeneration costs are the Supreme Court's temporary takings cases decided during and after World War II: *Kimball Laundry*, 338 U.S. at 3; *Petty Motor*, 327 U.S. at 374; and *General Motors*, 323 U.S. at 379-84. In both *Kimball Laundry* and *Petty Motor*, the Supreme Court was concerned with determining the proper measure of monetary relief that the property owners were entitled to receive due to the government's temporary taking. *Kimball Laundry*, 338 U.S. at 4-21; *Petty Motor*, 327 U.S. at 377-81; *see also General Motors*, 323 U.S. at 380-81 (setting forth factors that could be utilized to determine the value of the property taken when the government only temporarily takes the property). In *Petty Motor*, the Supreme Court explained that "[t]here is a fundamental difference between the taking of a part of a lease and the taking of the whole lease. That difference is that the lessee must return to the leasehold at the end of the [g]overnment's use." 327 U.S. at 379.

In both *Kimball Laundry* and *Petty Motor*, the Supreme Court ruled that when the government's actions constitute a temporary taking, the plaintiff's measure of recovery was not limited to the fair market value of property established in an arms-length transaction. *Kimball Laundry*, 338 U.S. at 15; *Petty Motor*, 327 U.S. at 379-80. In *Kimball Laundry*, the Supreme Court was confronted with the temporary taking of a laundry business that prevented it from operating during that period. 338 U.S. at 3. In this context, the Supreme Court found that the owners of the business were subject to a temporary taking and were entitled to receive compensation for rental value, damage to plant and equipment beyond ordinary wear and tear, and the going-concern value and goodwill which were rendered useless during the duration of the taking. 338 U.S. at 10-11, 14. In *Petty Motor*, the Supreme Court found that the cost of temporary removal could factor into determining the value of a tenant's leasehold interest in a property because of the lessee's "continuing obligation" towards the premises. *Petty Motor*, 327 U.S. at 379-80.

These temporary takings cases from World War II provide support for the Commission's claim for regeneration damages. In the context of a permanent taking, such costs are not normally appropriate because the owner or occupant of the property will not have the ability to use or occupy the property in the future. Here, the government's actions resulted both in the destruction of timber and in the substantial alteration of the condition of some of the property from its original state. The flooding caused by the government's deviations from the operating plan for the Clearwater Dam and the vanishing overstory due to the high mortality rate of the trees in the affected areas have combined to created an environment that was hospitable for the

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1285. Correlatively, the cost at issue in *Ridge Line* was "Ridge Line's cost in constructing prudent flood control measures," which might serve as an alternative to "the price the government has paid for flowage easements in comparable situations." 346 F.3d at 1359. Here, the Commission is not seeking to recover such costs, *e.g.*, for levees to prevent future flooding during growing seasons, which would not be needed because the Corps has ceased its deviations. Moreover, costs actually to restore dead and damaged mature oaks on a contemporaneous basis would be wholly impracticable.

development of invasive species, like buttonbush and smartweed, that inhibit or prevent the natural regeneration of oak trees. *See* Tr. 2401:22 to 2402:18 (Baker); *see also* Tr. 620:21-23 (Blaney); Tr. 1192:16-20, 1238:12-13 (Hausman); Tr. 1592:12-14 (Watts) (stating that natural regeneration of nuttall and overcup oaks would not be possible at the present time because sprouting acorns would have to compete for sunlight with the invasive species). Dr. Baker explained that in his opinion buttonbush presented more difficult problems for forest regeneration than the typical "understory vegetation" that is present in bottom-land hardwood stands. Tr. 2402:15-18 (Baker).[29] Furthermore, Dr. Baker explained that "[s]martweed makes a mat" that would prevent "an oak seedling . . . [from] grow[ing] through it." Tr. 2402:6-9 (Baker).

Because of the presence of invasive species, especially bottonbush and smartweed, an award of regeneration costs would not constitute an impermissible double recovery. If the Commission had merely engaged in clear cutting, the invasive species would not have been able to establish such a foothold because saturated soil conditions necessary for their growth would not have been present. *See, e.g.*, Tr. 1192:4-8 (Hausman); 2401:22 to 2402:18 (Baker); *see also* Tr. 1667:11-22 (Watts) (explaining that clear cutting will "promote some of the less[] desirable[]" species but the quantity of invasive wetland species in the affected portion of the Management Area greatly exceeds that which would result from controlled harvesting of timber). Dr. Baker explained that he had never seen such an expansive amount of wetland species "in [a] bottom-land hardwood stand." Tr. 2397:22 to 2398:9 (Baker). The presence of these wetland species has resulted in competition in the understory between them and bottomland hardwood trees, such "that [the Commission has] to control [the wetland species] in order to promote the growth and development of oak regeneration." Tr. 2401:22 to 2402:5 (Baker). In operating the Management Area, the Commission seeks to promote sustainability. To achieve that goal, the Commission periodically harvests selected mature trees by a process of thinning that allows for the natural regeneration of the trees to occur. *See* Tr. 130:5-8, 14-25 (Zachary). However, the presence of invasive species has prevented the natural regeneration of timber from occurring. Tr. 620:21 to 621:4 (Blaney); 2397:22 to 2398:9 (Baker).

Given the pervasive nature of the unwanted wetland vegetation in portions of the affected area, and the concomitant need to eradicate and remove those unwanted species and employ planting of seedlings to regenerate the forest, the Commission has sustained its burden of proving that it suffered additional damages beyond the destruction of trees as a result of the government's deviations from the operating plan for the Clearwater Dam. *See Fifth Third Bank v. United States*, 518 F.3d 1368, 1379 (Fed. Cir. 2008) (stating that the Federal Circuit has "interpreted the 'reasonable certainty' standard to apply only to the fact of damages, after which the court "may make a fair and reasonable approximation of the damages'" (citing *Bluebonnet Sav. Bank, F.S.B. v. United States*, 266 F.3d 1348, 1356-57 (Fed. Cir. 2001))). Thus, the court

[29]Buttonbush is a large shrub that has dense foliage, which creates "a lot of shade on the ground." Tr. 2402:10-12 (Baker). According to his observations, Dr. Baker believed that the majority of the buttonbush trees began to take hold in the mid-1990s. Tr. 2398:16-20 (Baker).

will turn to determining the amount of restoration damages that the Commission is entitled to recover.

B. Measurement of Regeneration Damages

The Commission seeks to recover regeneration costs for approximately 6,990 acres located in the Management Area. *See* PX 476 at 1 (UAP's Evaluation of Vegetation Management Requirements for Control of Invasive Species); PX 501 at 1 (Recommendations and Cost Estimates). According to the estimates provided by Commission, as of 2007, $2,158,585 would be required to remove invasive wetland species. *See, e.g.*, PX 476 at 4 (UAP's Evaluation); Tr. 1630:11 (Watts).[30] The Commission also proffered evidence that planting of seedlings as of 2007 would have cost between $2,813,475 and $3,564,900. PX 501 at 3 (Recommendations and Cost Estimates).

The government claims that the court should ignore the estimates provided by the Commission for treatment and planting costs. Def.'s Post-Trial Br. at 64-68. Among other things, the government contends that the Commission's projections "includ[e] the cost to remove all invasive species – including those plants that were present . . . before 1993." *Id*. at 68. The government also objects to the sampling method used by Mr. Watts and the Commission to develop the proffered cost projections. *Id*. at 67. The government relies on the fact that Martin Blaney, the individual who prepared the cost estimate, lacked experience with reforestation efforts through underplanting, that the Commission had never previously utilized his method of underplanting, that his estimates did not account for natural regeneration, and that he failed to collect "any data to inform or support his opinion about the volume of seedlings needed." *Id*. at 64-65. The problems that the government has identified relate more to the weight the court will accord the estimates in determining the proper amount of regeneration damages than to the court's consideration of them *vel non*.

The acreage for which the Commission seeks to recover restoration costs includes parts of five distinct parcels: the Little River Island GTR, the Reyno GTR, the Winchester GTR, Gar Slough, and Schaeffer's Eddy. *See, e.g.*, PX 476 at 2 (UAP's Evaluation); PX 80 at 5-7 (Kingwood Report I). The program outlined by the Commission envisions employing herbicides to control and eliminate invasive wetland species and then planting seedlings. PX 476 at 2-3 (UAP's Evaluation). The Commission supplied Mr. Watts with information regarding which areas of the Management Area had been impacted and the severity of damage those areas had sustained. Tr. 1585:13-16, 1603:10 to 1604:10 (Watts). Two potential methods were considered for determining the severity of the growth of invasive species. Tr. 1586:12 to 1587:9 (Watts). "[D]etailed plot data" could be generated, or a less rigorous visual examination could be used. Tr. 1586:12 to 1587:9 (Watts). In the instant case, Mr. Watts and the Commission relied on a

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[30]The evaluation by UAP stated that the treatment regiment would cost approximately $2,472,063.94. PX 476 at 4 (UAP's Evaluation). At trial, Mr. Watts of UAP stated that the cost of treatment program was $2,158,585 and that the estimate in PX 476 was incorrect due to clerical errors. Tr. 1630:11-20 (Watts).

visual evaluation. Tr. 1587:12-13 (Watts). Mr. Watts relied on the Commission's staff to take him to areas in each of the five tracts that were representative of the growth of invasive wetland species. Tr. 1596:16-19 (Watts).

In formulating his report, Mr. Watts classified the areas examined into three categories of damage. PX 476 at 2 (UAP's Evaluation). At the trial, Mr. Watts explained that areas were classified as severe if "nothing was there but buttonbush and . . . herbaceous material." Tr. 1596:25 to 1597:1 (Watts). Areas that had a substantial population of arborescent brushy material and undesirable trees were considered to have suffered heavy damage. Tr. 1597:3-6 (Watts). Areas that still had a rather significant population of oak trees coexisting with the invasive wetland species were classified as having sustained moderate damage. Tr. 1597:6-9 (Watts). The Commission provided Mr. Watts with the number of acres that it believed should be included in each category. 1597:9-14 (Watts). Mr. Watts explained that the Commission informed him that five percent of the 6,990 acres should be classified as severe, thirty-five percent should be classified as heavy, and sixty percent should be classified as moderate. 1635:14-21, 1636:8-16 (Watts).

After completion of the treatment portion of the project to eliminate the wetland species, the Commission proposes to plant advanced nuttall and overcup oak seedlings. PX 501 at 1 (Recommendations and Cost Estimates). This planting regimen was developed after consultation with an outside expert. *See* Tr. 865:16-19 (Blaney); PX 501 at 2 (Recommendations and Cost Estimates). The Commission decided to plant "a mix ([o]vercup/[n]utall oaks) of 15-20 seedlings per acre (ave. 17.5) throughout the disturbed sites. The percentages by species will be 75% [n]uttall oak and 25% [o]vercup oak." PX 501 at 2 (Recommendations and Cost Estimates). The Commission estimated that it would cost between fifteen and twenty dollars to plant each seedling because each of the advanced seedlings would need a tree shelter and could only be planted by using "a tractor and auger." *Id*. The Commission estimated that it would need to plant approximately 122,325 seedlings at a cost of between $1,834,875 and $2,446,500. *Id*. at 3. A further phase of the Commission's program involves "[h]and planting miscellaneous tree species, indigenous to these damaged sites (persimmon, green ash, sugarberry, etc.) with bare-root stock seedlings on a grid of 12' [by] 12' or 302 seedlings per acre throughout the disturbed sites." *Id*. at 2. This phase of the reforestation plan would have an estimated cost between $140 and $160 per acre. *Id*. The Commission projects that the hand planting would have a total cost between $978,600 and $1,118,400. *Id*. at 3.

The Commission has not proved that it is entitled to recover all of its projected regeneration costs. The court's site visit to the Management Area confirmed that discrete portions of the Management Area require regenerative work due to the proliferation of invasive wetland species like buttonbush and the absence of any bottomland hardwood timber. However, the Commission has failed to submit adequate evidentiary materials regarding certain areas where it seeks to recover regeneration costs and the prevailing conditions in those places. The court accordingly must parse the Commission's claims to sift those areas as to which there is proof to a reasonable certainty and those areas as to which proof is inadequate.

The Commission has provided sufficient evidence to demonstrate that it is entitled to recover regeneration costs for the 349 acres that were classified as "severe." PX 476 at 2 (UAP's Evaluation). These 349 acres are effectively devoid of any oak trees and populated by invasive wetland species. *See, e.g.*, Tr. 1192:12-20 (Hausman); Tr. 2225:7-21 (Foster). Many of the witnesses at trial confirmed that "there was [an] unusual density and abundance of wetland vegetation that [they had] never seen growing in [a] bottom-land hardwood stand." Tr. 2397:22 to 2398:9 (Baker); *see* Tr. 1192:4-8 (Hausman); Tr. 1591:14-19 (Watts). Due to the site visit, the court was able to confirm the pervasiveness of invasive wetland species and the scarcity of oak trees in portions of the Management Area.

However, the Commission has not established to a reasonable certainty the need for regeneration damages for the remaining 6,641 acres. Undoubtedly parts of that acreage contain clusters of invasive wetland species, some of which may be sizeable. Nonetheless, there is no basis in the record to differentiate the areas that would require regenerative work from others which retain some oak stands of significance and which may well regenerate themselves, albeit over the course of many years. Thus, the Commission can only recover regeneration costs for the 349 acres that were classified as severe by Mr. Watts and which the court in a reasonable way confirmed by the site visit.

It is well-established that property is to be valued on the date the taking occurred. *See, e.g.*, *564.54 Acres of Land*, 441 U.S. at 511-13. Here, the Commission's witnesses based their costs for treatment and planting on the state of the affected portions of the Management Area in 2007. *See, e.g.*, Tr. 1585:8-10 (Watts); Tr. 964:1-5 (Blaney). However, the Corps ceased deviating from the operating plan for the Clearwater Dam in 2001. PX 575 at US33 (Corps' News Release). Thus, the Commission's proposed reforestation and treatment costs are based upon the circumstances in the Management Area after the government had ceased causing a superinduced flow of water to flood the area.

The Supreme Court in *Dickinson* set forth the controlling principle that when a taking occurs through a continuous process the claim for compensation does not arise "until the situation becomes stabilized." 331 U.S. at 749 (stating that "when the [g]overnment chooses not to condemn land but to bring about a taking by a continuing process of physical events, the owner is not required to resort either to piecemeal or to premature litigation to ascertain the just compensation for what is really 'taken'"). In *Cooper*, the Federal Circuit applied the principle articulated in *Dickinson* to determine when the government's taking of the timber occurred. *See* 827 F.2d at 764. The Federal Circuit explained that "the critical question is: when did the destruction of trees become sufficiently stabilized so that the owner could determine the amount of timber taken?" *Id*. In *Cooper*, the Federal Circuit stated that although trees began to die on the plaintiff's property in 1979, "the extent of the destruction was not ascertainable until 1984, when J.R. Cooper filed suit." *Id*.

Here, the first deviations from the Corps' management plan occurred in 1993 and inundation of portions of the Management Area ceased in 2000. Stip. ¶ 15. However, although the situation began to stabilize in 2000, insofar as invasive wetland species were concerned, the cessation of deviations did not complete that process. Areas where wetland vegetation had

gained primacy continued to mature and close out natural regenerative growth on the part of the previously existing oak trees. Moreover, in 2000 and 2001, Kingwood Forestry Services conducted an extensive survey and timber inventory in numerous sections of the Management Area. *See supra*, at 14-16. These developments would have allowed the Commission to determine with sufficient precision the amount of timber that was taken due to the government's actions and the areas that were severely affected by invasive wetland species. Thus, the appropriate year for determining the cost of the treatment programs for regeneration was 2001, not 2007.

The government asserts that the Commission's failure to present its estimates for regeneration costs based on the situation as it existed in 2000 or 2001 should prevent the Commission from recovering those costs. *See* Def.'s Post-Trial Br. at 62. The government's argument is misplaced. The Federal Circuit has explained that "[t]he ascertainment of damages is not an exact science, and where responsibility for damage is clear, it is not essential that the amount thereof be ascertainable with absolute exactness or mathematical precision." *Bluebonnet Sav. Bank*, 266 F.3d at 1355. It is apparent that the need and cost for treatment and reforestation would be different in 2001 and 2007, given the time value of money and resources. The Commission, however, was able to produce sufficient evidence such that the court is able to conclude that the condition of the 349 acres of property, for which the Commission can receive regeneration costs, was substantially stabilized in 2001. *See, e.g.*, Tr. 2345:4-24 (Baker). Given the similar conditions of the property in 2001 and 2007, the 2007 projections relied upon by the Commission do not have to be disregarded. However, the estimates provided by the Commission do need to be modified to reflect what it would have cost in 2001 to undertake the treatment and planting programs for the 349 acres.

In 2007, based on the estimates provided by the Commission, it would have cost approximately $206,555.65 to implement the regeneration program for the 349 acres that were labeled as having severe damage. It would cost $66,083.15 to employ the Commission's treatment regime and $140,472.50 to implement its planting program. *See* PX 476 at 4 (UAP's Evaluation); PX 501 at 2 (Recommendations and Cost Estimates) (based on 17.5 seedlings per acre at $15 per seedling). Adjusting those numbers to reflect the passage of six years from the date of stabilization to when the Commission prepared its cost estimates, using the comparative purchasing power of the dollar in 2001 and 2007, is appropriate in the circumstances. With this adjustment, based on the Consumer Price Index, the Commission is entitled to recover $176,428.34, the equivalent in 2001 of $206,555.65 in regeneration costs measured at 2007.

V. Interest

"If the Government pays the owner before or at the time the property is taken, no interest is due on the award . . . [b]ut if disbursement of the award is delayed, the owner is entitled to interest thereon." *Kirby Forest Indus., Inc. v. United States*, 467 U.S. 1, 10 (1984) (internal citation omitted). Accordingly, if the government does not pay compensation at the time of the taking, the Takings Clause requires a payment of interest. *Seaboard Air Line Ry. v. United States*, 261 U.S. 299, 306 (1923); *see also Library of Cong. v. Shaw*, 478 U.S. 310, 317 n.5, (1986), *superseded on other grounds by statute*, Civil Rights Act of 1991, Pub. L. No. 102-166,

105 Stat. 1071. Because the government did not compensate the Commission at the time of the taking, the just compensation award due to the Commission should include interest on the present value of the damages it suffered from and after October 11, 2000, the end of the temporary taking of timber, and from and after October 11, 2001, the end of the taking period for regeneration damages.[31]

In its complaint, the Commission sought an award of just compensation, *see* Compl. at 10, which would include interest, and the government answered the complaint with a general denial. *See* Answer at 7. However, neither party adduced evidence at trial related specifically to interest. The court accordingly is in a position where it is obliged under the teachings of *Kirby Forest Industries* and *Seaboard Air Line Railway* to incorporate interest in the award of just compensation, but it must do so on a barren record.

The determination of an appropriate interest rate is based on the so-called "prudent investor rule," which measures "how 'a reasonably prudent person' would have invested the funds to 'produce a reasonable return while maintaining safety of principal.'" *Tulare Lake Basin Water Storage Dist. v. United States*, 61 Fed. Cl. 624, 627 (2004) (quoting *United States v. 429.59 Acres of Land*, 612 F.2d 459, 464-65 (9th Cir. 1980)). In this instance, the ten-year Treasury STRIPS rate[32] will be applied for three key reasons: (1) Treasury STRIPS reflect minimal risk, (2) ten-year STRIPS roughly approximate the length of time from the end of the taking to the date of judgment, and (3) the court has a judicial policy favoring generally comparable interest rates for similarly situated plaintiffs. *See Georgia-Pacific Corp. v. United States*, 640 F.2d 328, 365-66 (Ct. Cl. 1980) (favoring uniform interest rates).[33]

For a taking that occurred a considerable time before judgment, as here where the taking took place between nine and sixteen years ago, the court would ordinarily consider application of

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[31]The growing season for the Management Area extends from approximately April 4 to October 11. *See* PX 500 at 11 (Heitmeyer Report); Tr. 2672:17-25 (Overton).

[32]"STRIPS" is the acronym for "Separate Trading of Registered Interest and Principal of Securities." *See* U.S. Dep't of the Treasury, *Treasury Strips*, at http://www.treasurydirect.gov/instit/marketables/strips/strips.htm (last accessed June 30, 2009).

[33]The court has considered the use of the interest rate specified in 40 U.S.C. § 3116 that applies to just compensation attendant to a declaration of taking. Under this statute, the rate applicable for a period of more than one year is specified as, for the first year, the "annual rate equal to the weekly average one-year constant maturity Treasury yield," and, for the next year and each subsequent year, at the one-year Treasury rate for "the calendar week preceding the beginning of each additional year." 40 U.S.C. § 3116(a). That rate, however, does not apply to inverse condemnation cases such as this one, and it is not structured to pertain to such a long period as that which will occur in this case between the date of taking and the entry of judgment. Accordingly, the court has looked to a Treasury rate that more closely approximates the delay evident here.

compound interest. The Federal Circuit has said that in some cases compound interest may be necessary "'to accomplish complete justice'" under the Takings Clause. *Dynamics Corp. of Am. v. United States*, 766 F.2d 518, 520 (Fed. Cir. 1985) (quoting *Waite v. United States*, 282 U.S. 508, 509 (1931)). In this instance, however, there is no evidence that compounding is necessary to satisfy the mandate of the Takings Clause beyond that provided by the Treasury STRIPS themselves, for which interest accrues daily and is added every six months to the security's principal.

CONCLUSION

For the reasons stated, the court finds that the Commission has suffered a temporary taking for which just compensation is due. The court awards the Commission as of the end of the takings period, October 11, 2000 (the end of the growing season), $5,602,329.56, measured by timber lost and destroyed, and $176,428.34 in additional damages for a regeneration program to address areas severely affected by invasive wetland species, as of October 11, 2001. The court also awards interest on those amounts at the ten-year Treasury STRIPS rate from these dates to the date the judgment is actually paid.

Final judgment to this effect shall be issued under Rule 54(b) of the Rules of the Court of Federal Claims because there is no just reason for delay. The clerk shall enter final judgment as specified.

In due course, the Commission may apply for an award of attorneys' fees and expenses under Section 304(c) of the Uniform Relocation Assistance Act, 42 U.S.C. § 4654(c). Proceedings related to any such request for attorneys' fees and costs shall be deferred until after any appellate process has been concluded or, alternatively, after the time for taking an appeal has expired.

It is so ORDERED.

s/ Charles F. Lettow
Charles F. Lettow
Judge