No. 142, Original

In the

Supreme Court of the United States

STATE OF FLORIDA,

Plaintiff,

v.

STATE OF GEORGIA,

Defendant.

Before the Special Master

Hon. Ralph I. Lancaster

PRE-FILED DIRECT TESTIMONY OF FLORIDA WITNESS G. MATHIAS KONDOLF, PH.D

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October 14, 2016

CONTENTS

1. I, G. Mathias Kondolf, Ph.D., offer the following as my Direct Testimony concerning the impact of certain activities undertaken by the United States Army Corps of Engineers ("Corps") on the Apalachicola River.

2. The primary purpose of this testimony is to provide an expert opinion on the historical impacts of Corps activities on the river, and to describe the recovery of impacted stretches of the river since the cessation of Corps activities, based on studies I have reviewed and on observations that I have personally made.

3. I conclude that while the Corps, primarily through damming and a dredging campaign in the late 20th Century, caused impacts to the natural geomorphology of the Apalachicola River – and by extension habitat in the River and floodplain – there are significant portions of the River that were completely unaffected by Corps activities. I also conclude that Florida's efforts to limit the Corps' impacts, mitigate for harm caused by the Corps, and ultimately, stopping all dredging on the River, have allowed a portion of the harm to the River and floodplain to be reversed through natural riverine and fluvial processes.

PROFESSIONAL BACKGROUND

4. I am a fluvial geomorphologist and environmental planner, specializing in environmental river management and restoration. I am a professor of Environmental Planning at the University of California, Berkeley, where I teach courses in hydrology, river restoration, and environmental science. My research focuses on fluvial geomorphology and human-river interactions, with an emphasis on sediment management and river restoration. I have authored over 100 papers in international scientific journals and books, and my book *Tools in Fluvial Geomorphology* is a reference book in the field, and is now in its second edition.

5. I have served as the Clarke Scholar at the Institute for Water Resources of the Corps and two terms on the Environmental Advisory Board to the Chief of the Corps. I am the

recipient of two Fulbright awards and the Merit Award from the Council of Educators of Landscape Architecture.

6. I hold a Ph.D. in Geography and Environmental Engineering from the Johns Hopkins University (1988); a Master's degree in Earth Sciences from the University of California at Santa Cruz (1982); and an undergraduate degree in Geology from Princeton University (1978). My Ph.D. dissertation was a geomorphic analysis of gravels used by salmon for spawning, while my master's thesis was on the instability and historical channel changes of the Carmel River in California.

7. I have been familiar with the Apalachicola River for some time. I have family roots in the area, and have visited the River numerous times since 2007, when the Apalachicola Riverkeeper first took me (with my family) on a tour of the River. I returned several times in 2007-2008 to complete a 2009 report on restoring the Apalachicola for American Rivers, a non-profit environmental organization that works to maintain and restore river systems nationwide, and which has identified the Apalachicola as an important and endangered river. After completing the 2009 report, I returned to the Apalachicola several times, taking the opportunity to visit sites along the river while in the region on family vacations.

8. Since 2015, I have been working with colleagues at the University of Florida, Appalachian State University, and the Apalachicola Riverkeeper on a study of geomorphic changes and implications for freshwater mussel habitat from River Mile (RM) 40 to RM 63, funded by the Florida Fish and Wildlife Conservation Commission (FWC). My most recent visit to the River on this project was on August 27-29 of this year, when I made multiple observations of the river bed, sloughs, and other geomorphic features of the river at low flows, when flows were between 5,870 cubic feet per second (cfs) and 6,680 cfs, as measured at the U.S. Geological

Survey stream gage, the Apalachicola River at Chattahoochee, at the northern end of the Apalachicola, just below Woodruff Dam. USGS Historic Gage Data, JX 128, Attachment A.

GENERAL BACKGROUND

9. Fluvial geomorphology is the study of river channels, floodplains, and the processes that shape and change them over time. Environmental conditions, such as the composition and erodibility of the river beds and banks, along with the power and temporal patterns of river flows affect a river's form. Other factors that often influence a river's pattern and channel form include extent and type of bank vegetation, sediment supply, the size and composition of the sediment transported by the channel, presence of a floodplain and frequency of overflow from the channel onto the floodplain, and patterns of sediment deposition on the floodplain, banks, bars, and bed.

10. Beyond these natural factors, river channels and flood plains are affected by and respond to human activities, as is well documented in many river systems around the country. As a geomorphologist, I try to understand all the factors that affect river geomorphology, including those that are human-induced, which commonly have effects on river ecology. Rivers are fundamentally self-healing, and in fact, the most effective and sustainable method for restoring many rivers is to provide the river with its natural flow regime and sufficient room such that the river can heal itself through the process of flooding, sediment transportation, erosion and channel change that created the river's original, natural form. In other words, for many rivers, anthropogenic changes to a river system are reversible given time and the right river flows in a system. In addition to the natural healing properties of a river, undertaking geomorphic river restoration projects can aid in speeding recovery of historical river channel processes.

11. The Apalachicola River is a river whose channel has been shaped over the years by both natural and human factors. The Apalachicola, Florida's largest river measured by flow,

is formed by the confluence of the Flint and Chattahoochee Rivers, immediately north of the Florida-Georgia border at the Lake Seminole Reservoir formed by Jim Woodruff Dam. The River then flows 106 miles from the Jim Woodruff Dam to its mouth in the Apalachicola Bay. There are four distinct reaches of the river: an upper reach extending from RM 106 to RM 80; a middle reach extending from RM 80 to RM 42; a lower non-tidal reach extending from RM 42 to RM 20; and the tidal reach extending the lowermost 20 miles to the river's mouth at Apalachicola Bay. Figure 1, below, illustrates the Apalachicola and its reaches.

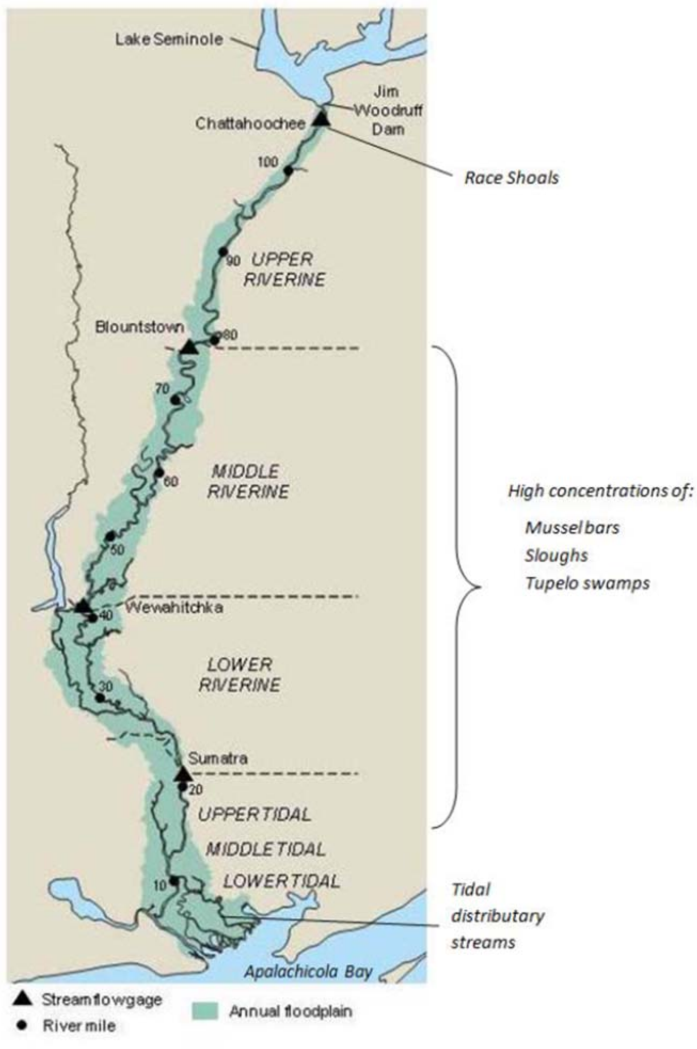


Fig. 1 – Major reaches of Apalachicola River and location of biological habitats harmed by upstream depletions. This is a true and accurate copy of Figure 1 from the Expert Report of Dr.

David Allan, FX-790. It is the kind of figure and report regularly relied upon by experts in my field, and I reviewed and relied on the Expert Report of Dr. Allan and this figure in preparing my own Expert Report and this testimony.

12. One of the factors that makes the Apalachicola unique is that its floodplain is minimally-developed and largely preserved. As part of my work in this case, I reviewed the expert report of Dr. David Allan, Florida's expert on river ecology. As explained by Dr. Allan (Allan Expert Report, FX-790, at 14), as Florida's largest and one of America's most intact floodplains, the Apalachicola gives rise to many unique habitats. From a geomorphic perspective, an intact floodplain also provides advantages for the recovery of historical ecological values in reaches affected by human activities. Because the Apalachicola and its surroundings are almost entirely free from development, the river has more than enough room to recreate a healthy, natural channel through the processes of flooding, bank erosion and channel migration.

HISTORICAL MODIFICATIONS TO THE RIVER BY THE ARMY CORPS OF ENGINEERS

13. Channel changes have been made to the River to improve navigation since the Nineteenth Century, when the Confederate Army during the Civil War attempted to make it more difficult for Union boats to navigate upstream, but by 1880, the Corps initiated small scale dredging to create a 70-foot wide by 6-foot deep channel to facilitate navigation to upstream ports such as Columbus and Bainbridge, Georgia. Kondolf Expert Report, FX-796, at 5. Historical records show that these alterations were intended to facilitate navigation to Georgia ports, including Columbus and Bainbridge. Letter from the Secretary of War to the House Committee on Rivers and Harbors (1939), JX-1. Shipping to these cities flourished in the late Nineteenth and early Twentieth Centuries.

14. However, by the mid to late 1930s, commerce had greatly declined along the Chattahoochee River and was almost nonexistent on the Flint River, due in part to competition from trucking and railroad interests, but also because the rivers were simply too shallow to allow transportation of many of the commodities produced in the area, such as granite, Fuller's earth, bauxite and cotton. As a result, business interests in Southern Georgia lobbied the United States Congress and the Army Corps of Engineers to modify the Apalachicola, Chattahoochee, and Flint Rivers by significantly deepening the channels of the three rivers. The new, deeper channels proposed were of much larger scale than prior dredging efforts, and represented an attempt to create an industrial waterway on a regional scale, to permit shipping to the ports of Columbus on the Chattahoochee and Bainbridge on the Flint. 1939 Letter, JX-1, at 4.

15. The Corps eventually recommended to Congress that the Apalachicola-Chattahoochee-Flint River system project be modified to allow for "full development" so as to "advance industrial development in the region." 1939 Letter, JX-1, at 1. The Corps plainly stated that the commerce it sought to develop and support through the proposal was related to areas along the Flint and Chattahoochee, not the Apalachicola, "as this river is considered to be only a necessary outlet for these two streams and its improvement to a greater depth than now authorized would be dependent on the improvement of one or both of them." 1939 Letter, JX-1, at 39.

16. To further facilitate navigation to Columbus and Bainbridge, the Corps also proposed constructing a series of dams on the Chattahoochee, including one at the river's confluence with the Flint. Congress approved the Corps' recommendation in 1939, and so began a new phase in the evolution of these three rivers.

17. The Corps completed construction of Woodruff Dam in 1957, the southernmost of five federally-constructed dams in the ACF. As would be expected, the dam trapped sediment that was formerly carried downstream by the river, especially the coarser sediments, sand and gravel. The energy of the sediment-free flows coming out of the dam resulted in scouring of the river bed immediately below the dam. In other words, Woodruff Dam caused incision (downcutting) of the Apalachicola River channel bed immediately downstream. As observed on many other rivers worldwide, the dam-induced incision on the Apalachicola was greatest immediately below the dam (RM 106), where the channel bed lowered about five feet, and decreased with distance downstream, disappearing entirely by RM 65 (about 10 miles below Blountstown). Also typical of incision downstream of dams, dam-induced incision on the Apalachicola began immediately upon closure in 1954 and slowed with time, reaching a relative steady state by the early 1980s, with essentially no incision since.

18. The Corps also excavated a navigation channel downstream of the dam, 100-feet wide by 9-feet deep. The attempt to construct this channel prompted a period of dredging beginning in 1956, concentrated in certain reaches of the river that shoaled repeatedly. Other navigation improvements carried out by the Corps included cutting off meander bends and a practice known as "bend easing," in which a new channel was cut through the land at the point of a bend, and the excavated sediment was placed in the abandoned channel. In addition, between 1963 and 1970, the Corps built training dikes, mostly in the upper river. The Corps pumped dredged sand into some sloughs or disposed of dredge spoils upstream of some slough mouths, such that the sand would be carried into the sloughs by inflowing river water. This built up sediment in the entrances to some sloughs, thereby reducing flows of water into them.

19. Snagging was another navigation-driven activity undertaken by the Corps in the Apalachicola River. In rivers used for navigation, large wood can pose hazards to vessels, and is commonly shifted laterally out of the navigation channel or removed from the river entirely. This process is referred to as “de-snagging” or simply “snagging.” This occurred from the 1870s until the 1990s, with the greatest number by far during the period of dredging in the 1950s to 1990s. Kondolf Expert Report, FX-796, at 8-9.

20. The dam and navigation improvements were part of a package to develop commerce along the ACF system, linking upstream ports in Georgia to the Gulf, as reflected in congressional documents I reviewed and relied upon that were related to authorization of the project. Kondolf Expert Report, FX-796, at 5. The Corps’ dredging program was intended to create a deeper, wider channel to allow barges to travel up the river. The excavation of a trench for a 9-foot-deep channel in the sandy bed of the Apalachicola River induced, in certain areas, collapse of the sandy channel walls and led to increased erosion of the river banks, widening the channel further. River widths stabilized from 1979 to 1999, likely resulting in large part from Florida’s prohibition of floodplain spoil disposal in the 1970s, after which dredged sediment was retained within the channel system. Kondolf Expert Report, FX-796, at 7. From 1999 to 2004, the average width for the entire non-tidal river stayed roughly constant.

21. Despite increasingly strenuous objections from Florida, dredging of the River continued until 1999. No dredging occurred in 2000. Dredging began in 2001, but only a smaller volume (less than a fifth of most prior years’ dredging volumes) was dredged before the dredge barge “ran aground due to low flow.” 2012 USFWS Biological Opinion, JX-72, at 75; Kondolf Expert Report, FX-796, at 7.

FLORIDA'S EFFORTS TO HALT & MITIGATE CORPS ACTIVITIES

22. As the environmental impacts of the Corps' navigational improvements to the Apalachicola River became evident, Florida began taking steps to prevent additional harm from channel alterations. Beginning in the mid-1970s, about the time of the birth of the modern environmental law movement and after passage of the nation's important environmental legislation, the Corps, with oversight and monitoring by Florida, began preparing Environmental Assessments prior to conducting works on the river.

23. Florida took opportunities to comment on Corps dredging plans, and Florida agencies found a Corps 1975 Draft Environmental Impact Statement "inadequate," calling for "complete documentation . . . of the contemplated actions and their effects on the river-bay system." Florida Comments to Draft EIS, FX-406, at 2. Florida raised concerns in those same comments over the placement of dredge spoils (primarily sand) in the floodplain. In the late 1970s, the Corps changed its disposal practices to dispose of dredge spoils primarily within the channel banks rather than floodplain disposal. This alternative retained sediment within the channel system and presumably helped to reduce the rate of channel widening. Kondolf Expert Report, FX-796, at 7.

24. In 1980, Florida initiated the Apalachicola River Dredge Disposal Study, which was presented to the Corps by the Florida Department of Environmental Regulation in 1984. The Corps' 1986 Navigational Maintenance Plan responded to a number of the concerns highlighted by the study, stating that "[i]n developing the [Navigational Maintenance Plan], every attempt possible was made to avoid or minimize adverse impacts associated with the maintenance measures considered." 1986 ACF Navigation Maintenance Plan, FX-470, at xii.

25. The Corps also promised that "mitigation [would] be provided in an attempt to yield no net degradation of environmental resources by the navigation project." 1986 Navigation Maintenance Plan, FX-470, at xi.

26. Subsequently, Florida began requiring increased mitigation in addition to changed dredging procedures. For example, Florida required that the Corps create annual plans for the restoration of a minimum of four spring run, tributary, or slough connections to the Apalachicola River. Kondolf Expert Report, FX-796, at 8.

27. In 2005, Florida then moved aggressively to end the Corps' dredging and other practices to improve navigation, and denied a Corps request for a state permit to continue dredging the Apalachicola. The denial cited the history of tension between Florida and the Corps regarding navigation maintenance, noting that historically "permit conditions became progressively more restrictive, particularly for dredged material disposal as evidence of environmental damage became apparent." FDEP Consolidated Notice of Denial, FX-404, at 3.

28. With respect to snagging, no wood removal has occurred since 2005, the year that Florida denied the Corps a permit to maintain the navigation channel. Recently, however, the Corps submitted an application for snag removal that cited public safety concerns, stating that it was "critical to ensuring the [Corps] can respond quickly should emergency situations arise at upstream projects requiring specialized equipment or parts that can only be transported by barge or boat." Kondolf Expert Report, FX-796, at 8.

29. Florida required the Corps to complete an Endangered Species Act Section 7 consultation with the U.S. Fish and Wildlife Service prior to granting a permit to mitigate snags posing a navigational hazard. Snagging was heavily regulated under the permit, which provided that the Corps operations were: limited to the navigation channel, limited to certain months to

avoid fish impacts, and subject to on-site supervision by a biologist to prevent impacts to listed species. Furthermore, snags were not to be removed from the river, but instead the top part to be sheared off and allowed to settle into deep water so as to avoid disturbing mussels and any other species present. This modified snagging took place once in 2014 and affected less than 2 percent of the average number of snags removed annually from 1956 to 1976. Kondolf Expert Report, FX-796, at 9.

FLORIDA'S EFFORTS TO RESTORE THE RIVER

30. Florida has long pursued a policy of protecting lands in the Apalachicola River floodplain from development and degradation, and has undertaken restoration actions to reestablish habitats in and along the Apalachicola River that had been harmed by the Corps' navigation improvements. Over time, those actions have evolved from imposing permit requirements on the Corps to the State of Florida undertaking restoration projects itself.

31. Before Florida began denying the Corps' applications to dredge the River, Florida conditioned the grant of dredging permits on elimination of certain activities and implementation of habitat restoration projects, such as the opening of the mouths of tributaries to the upper reach of the River. These tributaries provide important cold-water habitat for striped bass and other species during the hot summer, but their mouths had largely filled with sediment disturbed and displaced by navigational dredging. Eleven tributaries and sloughs were opened as a result of Florida's requirements. Kondolf Expert Report, FX-796, at 9.

32. The restoration of Battle Bend, an oxbow lake along the eastern side of the River in the non-tidal lower reach, reflects the evolution of Florida's restoration actions over time. Battle Bend was created in 1968 when the Corps artificially cut off a meander bend in the river, shortening the river by about one mile to benefit navigation. The abandoned, cutoff channel subsequently formed an oxbow lake, which still provided important habitat for fish. At first,

only the upstream mouth of the oxbow was blocked by sediment, however, over time the downstream mouth also filled in and the oxbow became disconnected from the river at low flows.

33. In 1989, 2001, and 2002, the Corps, as a dredge permit condition required by Florida, excavated through the sediment plug blocking the lower end of the oxbow. However, the mouth gradually filled in again. The Corps planned to conduct a larger sediment removal project but later backed out. In 2006, Florida undertook the project on its own, excavating 64,000 cubic yards of sediment from the oxbow mouth and reconnecting the oxbow to the river. Florida then went a step further and removed the berm across the upstream mouth as well, thereby improving water flow through the oxbow and reducing the rate of sediment deposition. Kondolf Expert Report, FX-796, at 10.

IMPORTANT REACHES OF THE RIVER HAVE NOT BEEN IMPACTED BY THE ARMY CORPS ACTIVITIES

34. There are long reaches of the River where the geomorphology was not impacted by Army Corps navigational improvements. The most prominent reach of unaffected river extends from Apalachicola Bay through the entire tidal reach and continues three miles into the lower riverine reach. Figure 2 is a true and accurate copy of Figure 4 of my expert report, an map showing the upper tidal and lower riverine reaches.

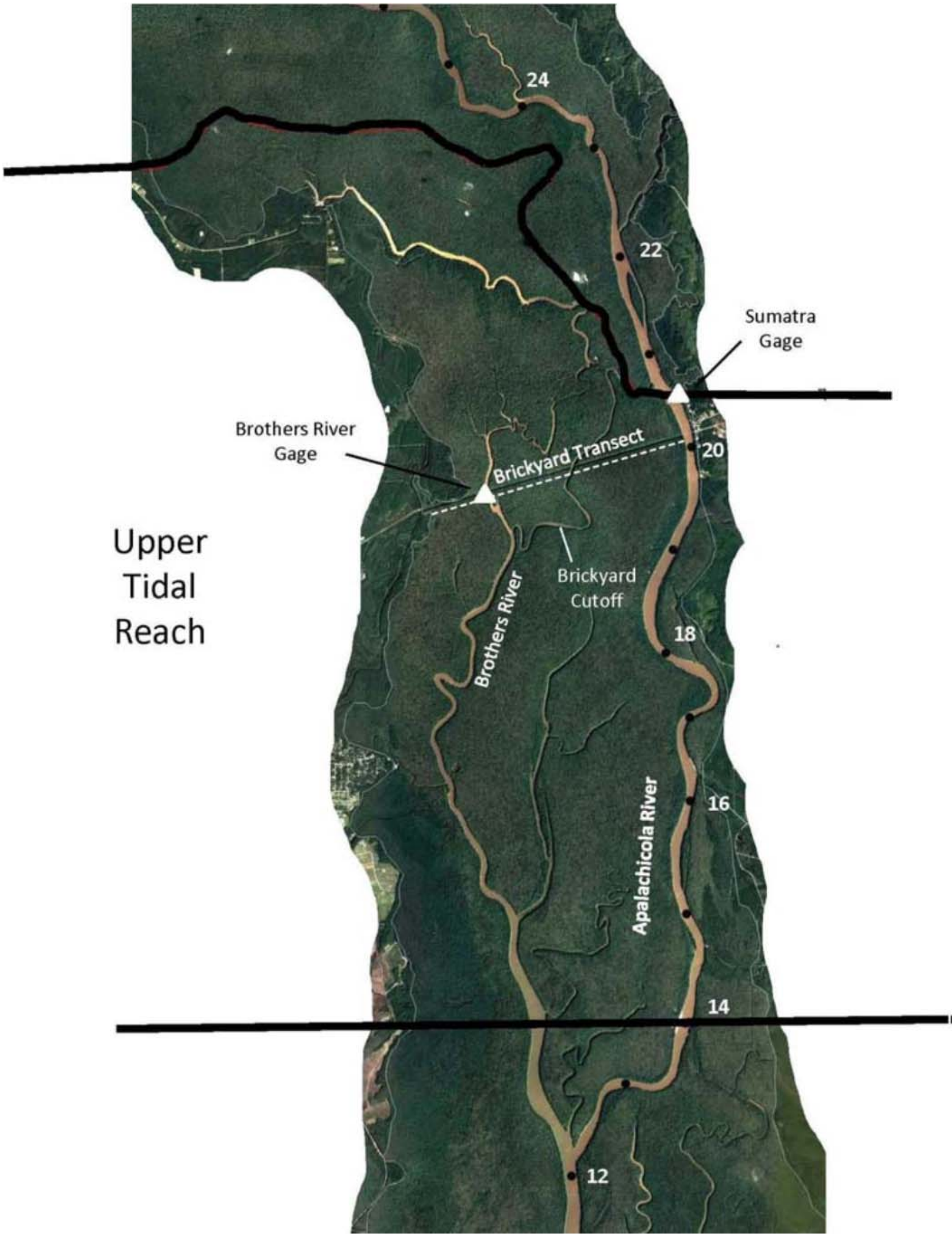


Fig. 2. Aerial photo of upper tidal reach showing reach boundaries, gaging station locations, and streams crossing the Brickyard Transect. Numbers are river miles. This figure was created under my supervision, using generally accepted scientific principles and methodology, based on an aerial photo accessed from Google Earth, dated May 27, 2005. It is the kind of photo regularly relied upon by experts in my field, and I reviewed and relied on this photo to form my opinions in my Expert Report and in this testimony.

35. In my expert report, I created an important figure, which compares the post-dredging (1995) water surface profile of the river with the pre-dredging water surface profile, from RM 42 downstream to RM 14, with both corresponding to flows of approximately 10,000 cfs. Kondolf Expert Report, FX-796, at 12, Figure 5A. Figure 3 below is a true and accurate copy of Figure 5A from my expert report, which demonstrates there was no change in the water levels of the River beginning at RM 23 and continuing south. A water surface profile is simply the elevation of the surface of the River given a particular flow level plotted against river mile (distance upstream from Apalachicola Bay). The superimposed profiles show that upstream of RM 23 the channel had changed such that the water surface profile was lower after the period of intensive dredging. Thus, for the River upstream of RM 23, I conclude that the change in water surface elevation is due to the changes in channel geomorphology.

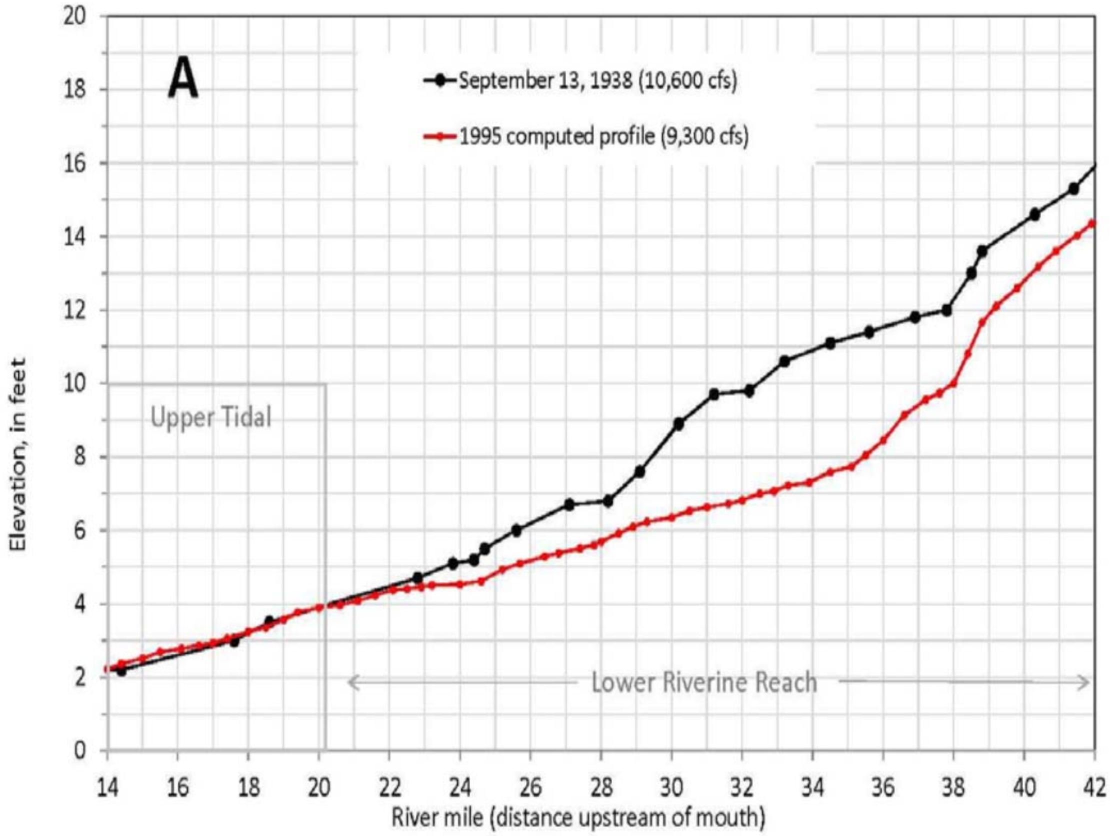


Fig. 3 – Water-surface profiles measured by the Corps in the upper tidal and lower riverine reaches. When flow at the Chattahoochee gage was about 10,000 CFS the 1995 water-surface profile directly superimposes on top of the 1938 water-surface profile from River Mile 23 to the bay. I generated this chart using generally accepted scientific methodology. It accurately represents the source data. The same chart is presented in my Expert Report. This data is the kind of data regularly relied upon by experts in my field, and I reviewed and relied on this data to form my opinions in my Expert Report and in this testimony.

36. The greatest geomorphic change (and thus difference in water surface profile) between the 1938 profile (pre-dredging) and the 1995 profile (post-dredging) is in RM 30-38. However, the difference between the profiles declines downstream and disappears by about RM 23. There was some historical dredging in this reach, but much less occurred than areas further upstream. Therefore, I conclude that the geomorphic changes did not affect river elevation and its ability to connect to the floodplain south of RM 23. Accordingly, the lowest three miles of

non-tidal reach and the entire upper, middle and lower tidal reaches are without navigation-related channel changes.

37. The upper tidal reach in particular hosts unique, significant habitats, including a large swathe of tupelo swamp forests, which are vulnerable to water level decline. Kondolf Expert Report, FX-796, at 13. The reach also provides important access to inundated forests for fish. As flows increase or decrease in the River, water levels in the river and the floodplain and sloughs in this reach directly respond. The tupelo swamp forest in the upper tidal reach is illustrated in Figure 4.

Fig. 4 – Illustration of tupelo swamp forest in the upper tidal reach near Brothers River. I understand this photo was taken by the Florida Fish and Wildlife Conservation Commission on September 15, 2016.

EVIDENCE OF RECOVERY OF IMPACTED RIVER REACHES

38. I have devoted a substantial portion of my career to the study of rivers recovering from artificial, man-made alterations. The most ecologically valuable habitats are those associated with dynamically migrating, flooding river channels. The most effective and sustainable method for restoring the ecological value of these rivers is to allow them to "heal

themselves." This is best done through restoration of the natural processes of flooding, sediment transport, erosion and channel change that originally created and maintained the river's form.

39. The Apalachicola River is an excellent candidate for restoration via the self-healing approach. The river runs almost entirely through a natural, undeveloped area, which provides the river with plenty of room to flood its surroundings and move its main channel. The State of Florida has guaranteed that the river will maintain this room to move through its extensive efforts to preserve the floodplain from development.

40. There is considerable evidence that substantial portions of the Apalachicola River have begun to heal themselves since the Corps ceased dredging operations. One example is the increased bed elevation in the river reach downstream of Gaskins Landing. Kondolf Expert Report, FX-796, at 13. This reflects the reversal of the artificial channel deepening by the Corps. The improved bed elevations are evidenced by the increase in stage from a low level in 1980 to a higher level (for the same flow) by the 1990s.

41. The narrowing of the effective channel upstream of Gaskins Landing through the development of "hooks and bays" is another example of the river's gradual recovery. Moreover, I reviewed 2012 aerial imagery of RM 45-47 that shows that since 2005, willows and other riparian trees have colonized recently deposited surfaces, resulting in re-narrowing of the channel, and partial recovery of the dredging-induced widening.

42. The River's channel margins have stabilized since the cessation of dredging 16 years ago. This has permitted the recovery of geomorphic features that provide suitable habitat for mussels and other organisms. Allan Expert Report, FX-790, at 19, Figure 4. Mussels require a stable substrate, however, during the period of active dredging and spoil disposal, sandy sediments along the channel margin were continually disturbed. The mussels could not establish

themselves in this environment of shifting sands, and they were vulnerable to flood scour and to being smothered by spoil disposal or disturbed sands drifting downstream. The end of dredging has allowed habitats for these endangered mussels to stabilize, promoting the recovery of the species.

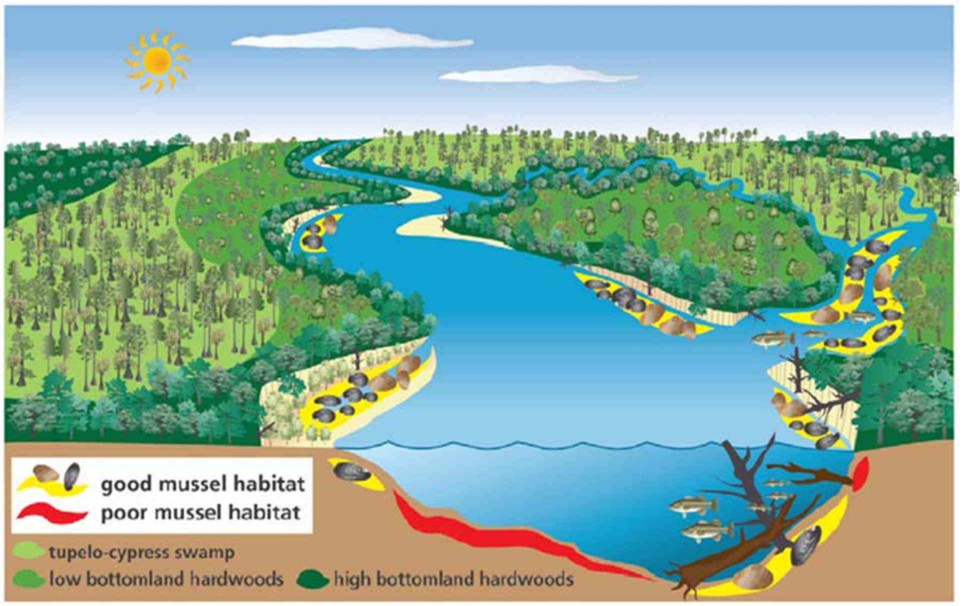


Fig. 5 – A three-dimensional conceptualization of the Apalachicola River, highlighting areas of the river that provide preferred mussel habitat and showing the location of tupelo-cypress swamps in relation to the river. This is a true and accurate copy of Figure 4 from the Expert Report of Dr. David Allan, FX-790. It is the kind of figure and report regularly relied upon by experts in my field, and I reviewed and relied on the Expert Report of Dr. Allan and this figure in preparing my own Expert Report and this testimony.

43. Ecological recovery in the River can also be inferred for fish populations at former in-stream dredge disposal sites. In a 1985 study, fish communities associated with dredge disposal sites were found to recover by approximately 50 percent 10 years after the cessation of dredge disposal. Kondolf Expert Report, FX-796, at 15. The last major dredging of the river was in 1999, so applying the results of this study suggests that fish populations near the former dredge disposal sites should have recovered by more than 50 percent since Florida stopped the Corps dredging.

44. There are also credible reports of significant recovery taking place in the sloughs along the river. Knowledgeable local fishermen report being able to access sloughs by boat that had been previously blocked off by sand during the period of dredging and spoil disposal. Kondolf Expert Report, FX-796, at 15. The mouths of these sloughs are now accessible to fish and other species at lower river levels than had been the case before, creating more flowing water habitat with favorable water temperature and dissolved oxygen conditions for longer periods of the year. These observations are supported by surveys of Swift Slough. The inlet elevation of Swift Slough actively fluctuated between 1993 and 2006, but was at the same level in 2006 and 2013, indicating it had stabilized. Kondolf Expert Report, FX-796, at 15.

45. These trends, some of which I have observed personally, indicate that the Apalachicola River is recovering from the damage caused by dredging and will continue to restore channel functions lost through the Corps activities if allowed to proceed naturally healing itself. High flows on the River, which are often considered to be channel forming flows, have continued to promote healing through channel formation and potential habitat improvements. The winter of 2015/2016 brought high flows for the Apalachicola of over 170,000 cfs, among the highest in the period of record. On my river visits earlier this year, I saw evidence of healthy and natural bank erosion, erosion of sand from point bar disposal sites, and extension of 'hooks' (sand spits) in the reach with many hooks and bays, all indicating the River continues to rework dredged sediments into more natural forms. Within sloughs, I observed evidence of fresh scour of sandy sediment around logs and live plants, indicating that this year's floods mobilized sediments within the sloughs. With flows that high, I would expect movement of the sand.

PRESERVATION OF IMPACTED BUT NEVERTHELESS VALUABLE RIVER REACHES

46. To continue a naturally healing river and to conserve those areas that were impacted by the Corps activities but still have significant ecological value, the River requires the deliveries of sufficient water flow. This depends on flows from the watershed upstream. A sufficiently dynamic flow regime is necessary to ensure that the river has both the power necessary to erode and deposit sediment so as to build natural channel forms, as well as sufficient low flows to support native flora on the floodplains, to keep sloughs inundated at their natural frequency and duration, and to maintain in-channel habitats.

47. As I have described, certain reaches of the River were impacted by channel erosion and lower water levels as a result of the historical channel alterations for navigation, but they still host valuable habitats. One such location is Swift Slough, which has historically provided important habitat for fat threeridge mussels, an endangered species. Located near RM 40, in the lower non-tidal reach of the River, water from the Apalachicola enters Swift Slough, flows along the slough and through the floodplain to the River Styx, which then carries it back to the Apalachicola River. Kondolf Expert Report, FX-796, at 15.

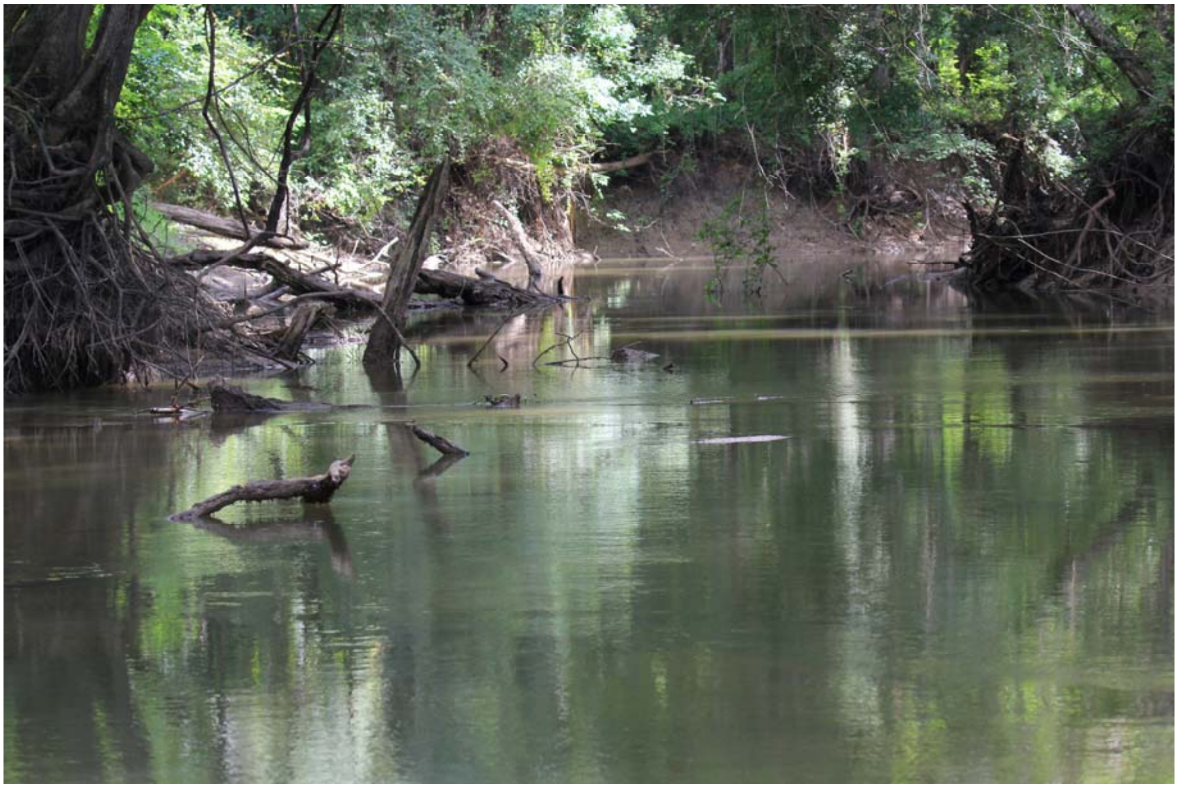


Fig. 6 – Swift Slough. Figure 7 is a true and accurate copy of FX--818g, which I understand was a photograph taken by personnel from the Florida Fish and Wildlife Conservation Commission on August 2, 2016, depicting Swift Slough.

48. Swift Slough is located in an area of the River that experienced significant historical dredging. As noted above, sand put into circulation by the disturbance caused by dredging deposited in Swift Slough, raising its bed elevation and thus increasing the flow needed to connect it to the main river. Even with the partial recovery of the slough in recent years, in many dry months when river elevations are low, the slough is still cut off from river inflow, with serious ecological impacts. As documented in Dr. Allan's expert report, the harm to the mussel populations that make Swift Slough home has increased as upstream depletions have increasingly reduced flows in the Apalachicola. Dr. Allan's report demonstrates that increased flows would significantly reduce the harm to the mussel habitat provided by Swift Slough. The

same can be said of many other impacted but nonetheless valuable habitats in and along the Apalachicola River.

CONCLUSION

49. The Apalachicola River is unique among the rivers I have worked on in the United States and abroad. Like many rivers in our country, it was impacted by the Army Corps of Engineers' plans to create great national waterways to support important interstate channels of commerce. That vision never was realized for the Apalachicola, but damming and navigational improvements did leave a legacy of ecological harm to the River and its floodplain. However, key areas in the River were left unaltered by the Corps, and many of the areas that were altered can and should be preserved through maintenance of adequate flows to protect important habitats. Florida's actions to protect floodplain habitats, to limit and then stop navigational dredging, and its efforts to mitigate impacts, have been the primary factors to speed recovery to a more natural riverine system. Maintaining an adequate flow regime now is needed to keep the River healthy while it continues the natural process of self-healing.

50. In my testimony, I referenced several documents, listed below, all of which were either generated by me according to accepted scientific principles or reviewed and relied upon by me in forming my opinions presented in my Expert Report and this testimony. The following table describes each of the documents and my familiarity with them.

- JX-1: Apalachicola, Chattahoochee, and Flint Rivers, Ga. and Fla., H.R. Doc. No. 342, Letter from the Secretary of War, Referred to House Committee on Rivers and Harbors (1939). This is a true and accurate copy of a 1939 letter from the Secretary of War to Congress, as printed by the U.S. Government Printing Office. This kind of letter is regularly relied upon by experts in my field, and I reviewed and relied on this letter in forming my opinions presented in my Expert Report and this testimony.

- JX-72: USFWS Biological Opinion on the U.S. Army Corps of Engineers, Mobile District, Revised Interim Operations Plan for the Jim Woodruff Dam and Associated Releases to the Apalachicola River (2012). This is a true and accurate copy of the 2012 USFWS Biological Opinion on the Revised Interim Operations Plan as published by the U.S. Fish and Wildlife Service at https://www.fws.gov/southeast/news/2012/pdf/ woodruffBOFinal.pdf. This kind of document is regularly relied upon by experts in my field, and I reviewed and relied on this document in forming my opinions presented in my Expert Report and in this testimony.
- JX-128: USGS Historic Gage Data. This data is compiled, maintained and made publicly available by the United States Geological Survey. The figures provided are derived from the USGS data. Experts in my field regularly rely on such USGS data. I have reviewed and relied upon data from this gage in drafting this testimony. Attachment A is a true and accurate copy of the discharge data from the Chattahoochee gage on the Apalachicola River as reported by the USGS.
- FX-404: FDEP Consolidated Notice of Denial of Wetland Resource Permit and Authorization to Use Sovereign Submerged Lands, Apalachicola River Maintenance Dredging, Applicant Curtis M. Flakes, U.S. Army Corps of Engineers, Mobile, Alabama (2005). This is a true and accurate copy of the 2005 FDEP Notice of Denial, as produced by the State of Florida. This kind of document is regularly relied upon by experts in my field, and I reviewed and relied on this document in forming my opinions presented in my Expert Report and this testimony.
- FX-406: Florida Department of Administration 1975, Division of Planning Comments to Draft Environmental Impact Statement, December 31, 1975. This is a true and accurate

copy of the 1975 Florida comments on the draft EIS, as produced by the State of Florida. This kind of document is regularly relied upon by experts in my field, and I reviewed and relied on this document in forming my opinions presented in my Expert Report and this testimony.

- FX-470: Final Navigation Maintenance Plan for the Apalachicola Chattahoochee Flint Waterway, Volume 1, Main Report (1986). This is a true and accurate copy of the 1986 Corps Final Navigation Maintenance Plan for the ACF System, as produced by the State of Florida. This kind of document is regularly relied upon by experts in my field, and I reviewed and relied on this document in forming my opinions presented in my Expert Report and this testimony.
- FX-790: Allan Expert Report. Dr. Allan drafted his Expert Report for use in this case. This kind of report is regularly relied upon by experts in my field, and I reviewed and relied on his report in forming my opinions presented in my Expert Report and this testimony. FX-790 is a true and accurate copy of his report, as submitted to Georgia on February 29, 2016.
- FX-796: Kondolf Expert Report. I drafted this Expert Report for use in this case. FX-796 is a true and accurate copy of my report, as submitted to Georgia on February 29, 2016.

Attachment A

USGS Gage Data, Apalachicola at Chattahoochee

August 27-29

USGS science for a changing world

USGS Home
Contact USGS
Search USGS

National Water Information System: Web Interface

USGS Water Resources

Data Category: Current Conditions ▼ Geographic Area: Florida ▼ GO

Click to hideNews Bulletins

- **Data formats changed in August 2016, and additional water-data changes will be coming through 2017. Read more here**
- Full News

Click to hide state-specific text

USGS 02358000 APALACHICOLA RIVER AT CHATTAHOOCHEE FLA

PROVISIONAL DATA SUBJECT TO REVISION

Available data for this site Time-series: Current/Historical Observations ▼ GO

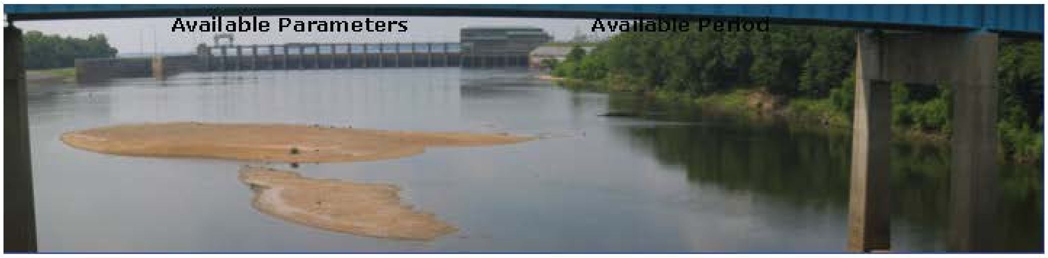
Click to hidestation-specific text

This gage is monitored in cooperation with the Northwest Florida Water Management District and the US Army Corps of Engineers.

NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

US Army Corps of Engineers®

Upstream view.



Downstream view.

Available Parameters	Available Period
☐ All 3 Available Parameters for this site	
☐ 00045 Precipitation	2012-10-01 2016-10-12
☑ 00060 Discharge	2007-10-01 2016-10-12
☐ 00065 Gage height	2007-10-01 2016-10-12

Output format

- ○ Graph
- ○ Graph w/ stats
- ○ Graph w/o stats
- ○ Graph w/ (up to 3) parms
- ◉ Table
- ○ Tab-separated

Days (2)

[Summary of all available data for this site]
[Instantaneous-data availability statement]

GO

-- or --

Begin date
2016-08-27

End date
2016-08-29

Discharge, cubic feet per second

TIME	Aug 27	Aug 28	Aug 29
00:00 EDT	6,200P	6,590P	6,080P
00:15 EDT	6,260P	6,570P	6,060P
00:30 EDT	6,300P	6,610P	6,050P

00:45 EDT	6,330P	6,610P	6,050P
01:00 EDT	6,360P	6,640P	6,030P
01:15 EDT	6,420P	6,620P	6,060P
01:30 EDT	6,460P	6,640P	6,010P
01:45 EDT	6,460P	6,640P	6,080P
02:00 EDT	6,510P	6,640P	6,090P
02:15 EDT	6,520P	6,610P	6,060P
02:30 EDT	6,520P	6,620P	6,030P
02:45 EDT	6,550P	6,650P	6,080P
03:00 EDT	6,550P	6,590P	6,090P
03:15 EDT	6,550P	6,650P	6,100P
03:30 EDT	6,570P	6,650P	6,080P
03:45 EDT	6,550P	6,670P	6,100P
04:00 EDT	6,540P	6,670P	6,100P
04:15 EDT	6,520P	6,670P	6,050P
04:30 EDT	6,550P	6,670P	6,090P
04:45 EDT	6,590P	6,670P	6,100P
05:00 EDT	6,610P	6,680P	6,090P
05:15 EDT	6,620P	6,640P	6,100P
05:30 EDT	6,590P	6,590P	6,100P
05:45 EDT	6,620P	6,570P	6,100P
06:00 EDT	6,620P	6,550P	6,090P
06:15 EDT	6,640P	6,520P	6,080P
06:30 EDT	6,610P	6,480P	6,090P
06:45 EDT	6,620P	6,460P	6,080P
07:00 EDT	6,590P	6,430P	6,050P
07:15 EDT	6,510P	6,430P	6,100P
07:30 EDT	6,520P	6,450P	6,100P
07:45 EDT	6,480P	6,450P	6,090P

08:00 EDT	6,510P	6,430P	6,100P
08:15 EDT	6,490P	6,460P	6,090P
08:30 EDT	6,460P	6,420P	6,090P
08:45 EDT	6,480P	6,420P	6,080P
09:00 EDT	6,640P	6,420P	6,090P
09:15 EDT	6,490P	6,390P	6,060P
09:30 EDT	6,450P	6,380P	6,020P
09:45 EDT	6,420P	6,350P	6,060P
10:00 EDT	6,480P	6,380P	5,990P
10:15 EDT	6,430P	6,320P	5,990P
10:30 EDT	6,360P	6,320P	6,010P
10:45 EDT	6,420P	6,320P	6,050P
11:00 EDT	6,390P	6,280P	6,020P
11:15 EDT	6,360P	6,280P	6,030P
11:30 EDT	6,330P	6,260P	6,020P
11:45 EDT	6,350P	6,320P	6,050P
12:00 EDT	6,350P	6,320P	6,030P
12:15 EDT	6,350P	6,300P	5,960P
12:30 EDT	6,380P	6,330P	5,960P
12:45 EDT	6,320P	6,280P	5,980P
13:00 EDT	6,360P	6,230P	5,960P
13:15 EDT	6,350P	6,230P	5,940P
13:30 EDT	6,320P	6,260P	5,980P
13:45 EDT	6,350P	6,230P	5,980P
14:00 EDT	6,350P	6,200P	5,980P
14:15 EDT	6,320P	6,190P	5,940P
14:30 EDT	6,380P	6,220P	5,940P
14:45 EDT	6,320P	6,190P	5,910P
15:00 EDT	6,320P	6,220P	5,950P

15:15 EDT	6,320P	6,150P	5,920P
15:30 EDT	6,300P	6,190P	5,960P
15:45 EDT	6,320P	6,200P	5,920P
16:00 EDT	6,380P	6,120P	5,950P
16:15 EDT	6,330P	6,130P	5,960P
16:30 EDT	6,360P	6,130P	5,920P
16:45 EDT	6,330P	6,160P	5,940P
17:00 EDT	6,330P	6,130P	5,870P
17:15 EDT	6,320P	6,150P	5,870P
17:30 EDT	6,300P	6,160P	5,950P
17:45 EDT	6,280P	6,180P	5,870P
18:00 EDT	6,300P	6,160P	5,880P
18:15 EDT	6,330P	6,120P	5,880P
18:30 EDT	6,360P	6,100P	5,910P
18:45 EDT	6,330P	6,060P	5,920P
19:00 EDT	6,300P	6,090P	5,950P
19:15 EDT	6,300P	6,100P	5,960P
19:30 EDT	6,320P	6,080P	5,960P
19:45 EDT	6,320P	6,090P	5,950P
20:00 EDT	6,260P	6,090P	5,950P
20:15 EDT	6,330P	6,090P	5,920P
20:30 EDT	6,360P	6,080P	5,950P
20:45 EDT	6,390P	6,060P	5,910P
21:00 EDT	6,420P	6,060P	5,910P
21:15 EDT	6,410P	6,060P	5,940P
21:30 EDT	6,460P	6,060P	5,880P
21:45 EDT	6,490P	6,060P	5,920P
22:00 EDT	6,450P	6,050P	5,910P
22:15 EDT	6,540P	6,050P	5,940P

22:30 EDT	6,550P	6,030P	5,890P
22:45 EDT	6,520P	6,050P	5,950P
23:00 EDT	6,550P	6,050P	5,950P
23:15 EDT	6,580P	6,080P	5,960P
23:30 EDT	6,580P	6,030P	5,960P
23:45 EDT	6,590P	6,050P	5,960P
COUNT	**96**	**96**	**96**
MAX	**6,640**	**6,680**	**6,100**
MIN	**6,200**	**6,030**	**5,870**

Explanation

P	Provisional data subject to revision.