Management Plan for the
Center Hill Tailwater Trout Fishery
2004-2009

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Introduction

In recent years the Tennessee Wildlife Resources Agency (TWRA) has committed substantial resources to manage and evaluate the trout fishery below Center Hill Dam. This fishery serves a unique role in middle Tennessee, being one of few trout fisheries in the area that can accommodate thousands of anglers each year. The purpose of this plan is to identify TWRA's goal, objectives and management strategies for the management of this fishery.

Goal

TWRA seeks to enhance the quality of the trout fishery for the variety of anglers that fish the Caney Fork River downstream of Center Hill Dam (Center Hill Tailwater).

Objectives

1. **Provide fisheries for rainbow trout and brown trout capable of sustaining at least 25,000 trips during March through September annually, 2004-2009.** This would allow for about a 20% increase in fishing pressure compared to recent surveys, which averaged approximately 21,000 trips.

2. **Maintain angler catch rates greater than 1 trout/hour as measured by creel surveys from the dam to Stonewall.** Despite potentially higher use, we would like to maintain this catch rate, which is typical of Tennessee tailwaters.

3. **Increase the abundance of quality (>14 inches) of brown trout by January 2009.** Specifically, this objective will be met when the winter electrofishing capture rate for 14+-inch trout exceeds 2.0 fish per site.

Current Status

Discharge (Flow)

Center Hill Dam was constructed by the U.S. Army Corps of Engineers (USACE) in 1948 for the purpose of flood control and hydroelectric power generation and is located in DeKalb County, Tennessee, about 70 miles east of Nashville. The impounded Caney Fork River, and its tributaries, makes up the 23,606-acre Center Hill Reservoir. The Nashville District of USACE operates the dam. The tailwater section of the Caney Fork flows in a northwest direction for about 26 miles before joining the Cumberland River near Carthage, Tennessee. The Smith Fork is a major tributary that enters about 9 miles below the dam. At base flow the Smith Fork has 30-100 cfs, commonly increasing to 1000-3000 cfs during storm events.

The daily generation schedule typically follows the peak demand for power, which occurs in morning and evening in the winter, and afternoons in the summer. The dam has 3 turbines each providing 3,500 cfs during average loading. With three turbines operating, the water level immediately below the dam can rise about 10 feet within an hour. This effect gradually decreases with distance from the dam; at Stonewall, 16 miles downstream, the river rises only about 5 feet when the pulse arrives. During no generation periods a minimum flow of 60-90 cfs occurs through seepage around the dam.

The leak in the dam does not provide enough minimum flow to cover all channel habitat. Dewatered habitat is essentially out of production. Additional minimum flow would greatly benefit the upper 5 miles of the tailwater where water level fluctuations are the greatest. Invertebrate populations cannot colonize shoal habitats because they dry out almost daily. Those that do become established during wet periods subsequently die during dry spells. Increased minimum flows would provide additional stable habitat for macroinvertebrates and trout, and thereby increase the numbers of both in the river. Minimum flows have improved the macroinvertebrate communities in tailwaters below Tennessee Valley Authority (TVA) projects (Scott et al. 1996).

In the late 1990s, a weir dam was proposed by USACE that would impound 1.5 river miles immediately downstream of the dam and provide an estimated 200 cfs continuous flow. An alternative to the weir was a turbine bypass system, or Valve Engineering System (VES), which would also allow 200 cfs of continuous flow. TWRA favored the VES system, opposing the weir due to concerns of habitat loss. While 200 cfs has been proposed as a target minimum flow, additional work needs to be done to determine the best flow needs for aquatic life and angler access.

Water Temperature

Intermittent generation provides coldwater but also results in substantial temperature fluctuations. During generation, hypolimnetic discharge delivers cold water (10-15 ^{o}C). Despite solar warming and warmer water from the Smith Fork, the first 16 miles below the dam is cool enough for trout (< 18 ^{o}C). The remaining 5 to 10 miles can typically support trout provided that generation frequency or magnitude is sufficient.

During warmer seasons the water temperature can fluctuate drastically with generation, at times fluctuating from 10^{o}C to 20^{o}C and back to 10 ^{o}C (Ramachandran and Gordon 1986). Rainbow trout can acclimate to temperature and survive declines of 12 ^{o}C per hour (Cherry et al. 1975). However two or more days are needed to acclimate to warmer temperatures and acclimation to cold temperatures may take three or more days (Peterson and Anderson 1969; Javaid 1972; Evans 1990). Fluctuations in temperature can adversely affect growth rates of trout (Becker et al. 1977; Hokanson et al. 1977). As temperature approaches these lethal levels, trout can experience reduced growth rates and stress. And over time both can affect the survival of trout. The upper lethal temperature limits for brown trout and rainbow trout are 21 ^{o}C and 25 ^{o}C, respectively (Walburg et al. 1981; Black 1953).

Long periods without discharge could increase temperature above the lethal limits, especially in the lower river. In 2002 USACE modified typical operating procedures to alleviate the potential for warming the lower river. On consecutive summer days when less than 2 hours of generation are scheduled the potential for warming is greatest. To address this issue an additional hour of generation was scheduled to interrupt the long no-generation period. The additional hour of generation was scheduled in the morning (around 7 am) and produced the expected benefit. However the additional generation disrupted fishing plans of many anglers that would otherwise get to fish in the morning. USACE is developing a model to determine on which days the additional pulse is necessary, and at what time of day it would be best to generate the additional pulse.

Dissolved Oxygen (DO)

The Center Hill turbine intakes are located 30 meters below the surface at normal summer pool. Deep reservoirs like Center Hill will thermally stratify during the summer yielding cold water at this depth most of the year. However due to the nutrient loading from five major municipalities combined with the inherent limnology of deep reservoirs, DO concentrations at the turbine intake depth is typically low in the fall. As a result, generation during September through November releases water with DO concentrations that can be less than 2.0 parts per million (ppm) immediately downstream of the dam (Figure 1). Depending on initial DO levels, it can take up to 16 miles to fully recover DO to 6 ppm (Figure 2). Fall anoxic conditions in the tailwater are usually worse in years following heavy late winter or spring rains. High rainfall requires high discharge that depletes the storage of oxygenated water at the intake level.

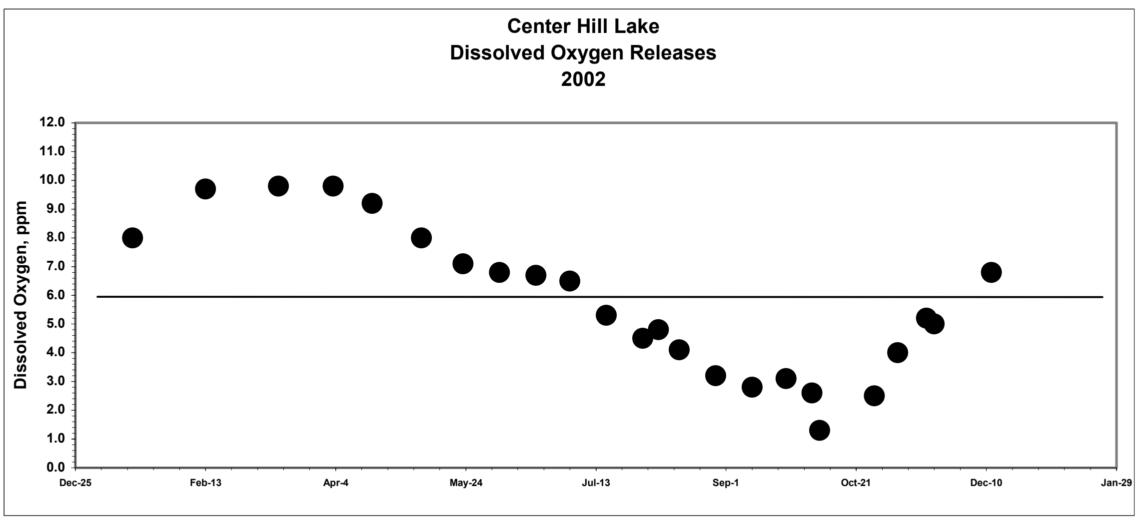

Figure 1. Dissolved oxygen (DO) concentration immediately below Center Hill dam during 3-turbine generation. Data collected in 2002 by USACE.

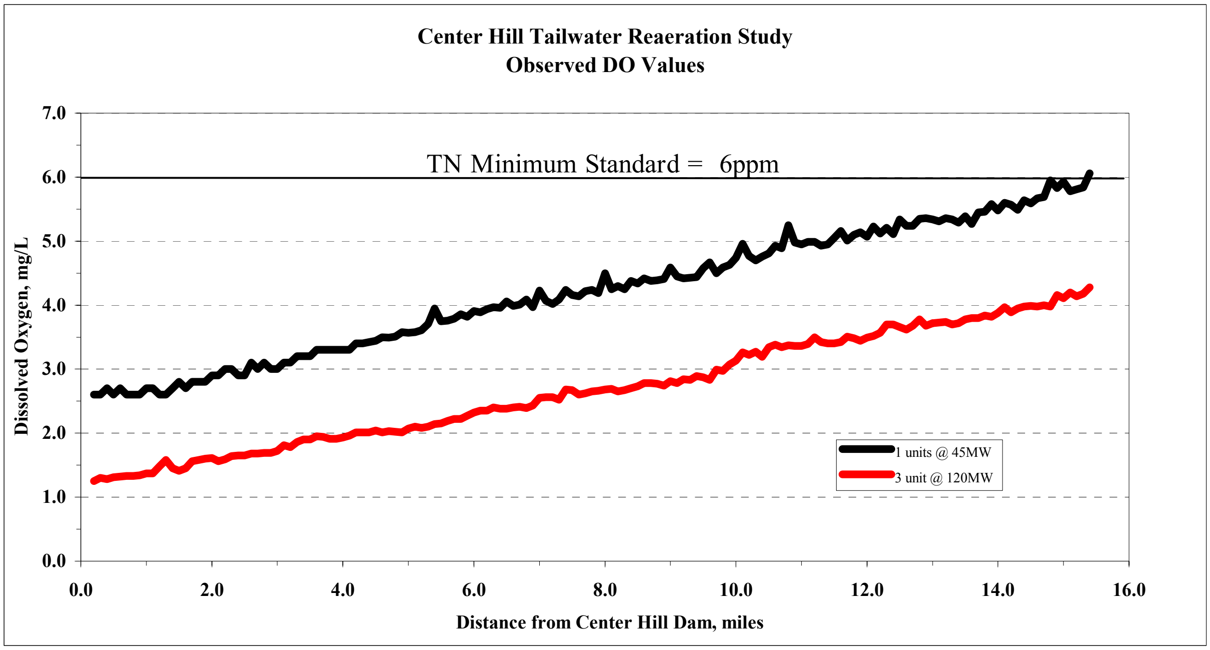

Figure 2. Recovery of dissolved oxygen below Center Hill Dam during 1-turbine and 3-turbine generation, on 10/4/2003 and 10/7/2003, respectively. Data collected by USACE.

Low DO concentrations have adverse impacts on trout survival, health, growth, and catchability. Trout die at DO levels less than 2.5 ppm (Davis 1975), especially when exposure lasts more than 24 hours (Doudoroff and Shumway 1970). In addition to direct mortality, sublethal effects have also been noted on trout populations. Reported minimum threshold levels for rainbow trout range from 4.6 to 8.7 ppm with a median at 6 ppm (Davis 1975). In the Norfolk Tailwater, Arkansas, Todd and Bly (2000) reported poor health and condition of rainbow trout in the upper reaches of the tailwater where DO levels were periodically below 6 ppm. On Lake Taneycomo, Missouri, for each decrease of 1 ppm between 6.0 and 2.4 ppm resulted in a 0.1 trout/hour decrease in angler catch rates (Weithman and Haas 1984). The State water quality standards require 6 ppm of DO for trout waters, even for artificial tailwaters (TDEC 2000).

USACE has taken steps to improve DO below Center Hill Dam by releasing water through the sluiceway, altering the loading on turbines, adding hub baffles, and turbine venting. Diverting some oxygenated water down the sluiceway increased DO but also increased water temperatures to a temperature that was lethal to trout. Operating turbines at ½ and ¾ load did not improve DO levels enough during critical times. By December 2001, all units were equipped with hub baffles and turbine vents. These improvements increased the DO during deficit periods, however it only increased DO by 1.5 ppm at one turbine operation and about 0.5 ppm during three turbines (USACE unpublished data). In the Spring of 2002 extremely high discharge resulted in low DO during the fall ranging from 2 to 4 ppm throughout the tailwater (Figure 2). Clearly more work must be done to maintain the state standard of 6 ppm DO.

Habitat

Devlin and Bettoli (1999) mapped instream habitat from the dam to Stonewall. Pools were the dominant habitat type at baseflow representing 90 % of the area surveyed; riffles and runs both accounted for about 5 % of the area. Instream structures are limited to woody debris, shoals, and riprap. Shoreline cover is limited to root wads and some overhanging vegetation. Early radio telemetry research reported habitat close to the bank is important for trout during peak flows (Niemela 1989). Erosion of the riparian zone is a common site on the Caney Fork. Also its major tributary the Smith Fork has major erosion issues. Storm runoff from the Smith Fork contributes a lot of sediment into the lower Caney Fork. While heavy erosion in the Smith Fork watershed is a problem for the Smith Fork, its effects on the Caney Fork are unknown. As the Caney Fork River is sediment poor due to settling of sediment by the reservoir, some of the sediment from the Smith Fork may be beneficial.

Trout need instream physical habitat to provide cover, especially in tailwaters where peak flows may limit survival if cover is not available. Habitat improvements increased the abundance of trout on the White River, a tailwater in Arkansas (Quinn and Kwak 2000). Recent efforts by TWRA and Trout Unlimited (TU) to add boulders and smaller rocks for habitat have had limited success. Many of these structures disappeared within a year, yielding little structure for trout. New designs should be considered to improve habitat during peak flows.

Fish and macroinvertebrate community

The construction and operation of Center Hill Dam has extirpated many of the native aquatic species in the tailwater. Since the 1950's, TWRA and the U.S. Fish and Wildlife Service have annually provided trout to mitigate for the lost of recreational opportunities in this reach of river. The Caney Fork River has an artificial fish community mostly comprised of trout, shad, and carp. Walleye, white bass, yellow bass, striped bass, redhorse and buffalo are also observed seasonally.

Natural reproduction of trout in the Caney Fork River has been extremely rare, therefore stocking maintains the trout fisheries. In recent years the number of 9-inch rainbow trout stocked averaged 115,000 annually (Figure 3). These "catchable" rainbows are stocked at rate of 3,000 to 15,000 per month and sustain a put-and-take fishery. "Put-and-take" describes a fishery where fish are stocked at a large enough size to be immediately harvested by anglers. Fingerling rainbow trout have also been stocked in recent years (Figure 3). The stocking rate of brown trout has varied from 17,000 to 70,000 (Figure 4). Traditionally brown trout were stocked at 6-8 inches in early summer. In 1999, TWRA shifted to a fall stocking of 4-inch brown trout as suggest by Devlin and Bettoli (1999). Brown trout support a "put-and-grow" fishery as these fish need time to grow into desirable sizes.

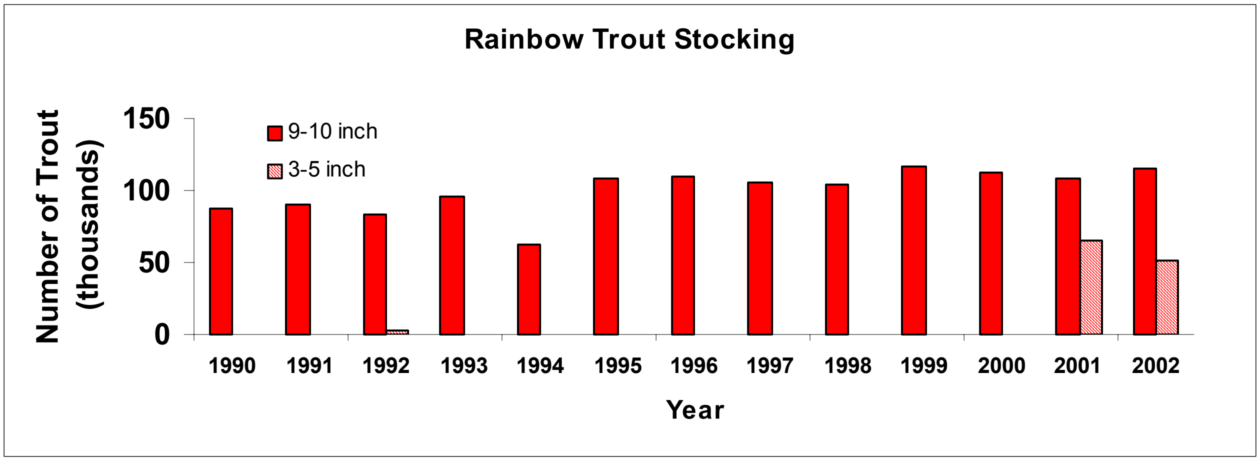

Figure 3. Annual stocking of rainbow trout in Center Hill Tailwater 1990 to 2002.

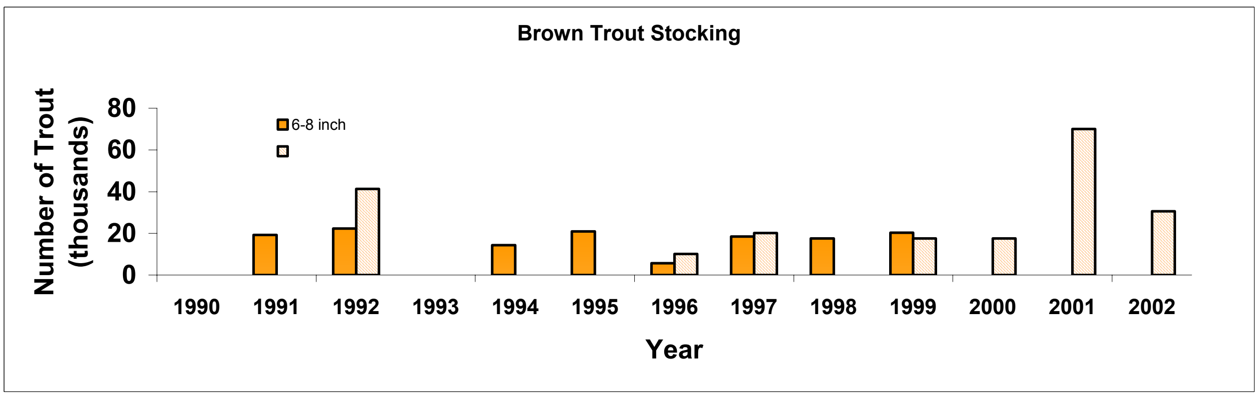

Figure 4. Annual stocking of brown trout in Center Hill Tailwater 1990 to 2002.

During the low DO periods (typically August through November), stocking immediately downstream of the dam is not possible and the trucks are relegated to less desirable downstream locations. The TWRA monitors DO during these critical months to determine when and where stocking is permissible. Although DO may be acceptable during periods when generation is off, managers cannot stock if they suspect that DO will drop that evening during peak power production. During extremely low DO periods, the stocking events must be postponed or even cancelled, effectively shutting down the put-and-take fishery for rainbow trout.

In the Spring of 1996 and 1997 TTU researchers estimated the populations density of trout to be 41 and 74 kg/hectare, respectively in the Caney Fork River. This population density is below average relative to other southeastern tailwaters (Table 1).

Table 1. Trout standing crop of trout in large tailwaters.

River	Standing Crop(kg/ha)	Reference
Caney Fork (TN)	41 –74	Devlin and Bettoli (1999)
Clinch (TN)	112	Bettoli and Bohm (1997)
Hiwassee (TN)	13 – 20	Luisi and Bettoli (2001)
South Fork Holston	170 – 232	Bettoli et al. (1999)
Watauga	122	Bettoli (1999)
Other states:		
White River (AR)	75 – 130 habitat unaltered	Quinn 1988
White River (AR)	155 – 342 habitat improved	Quinn 1988

Survival of stocked trout in the Caney Fork River was investigated by Bettoli and Xenakis (1996), and Devlin and Bettoli (1999). During the 1995 survey 55 to 71 % of the stocked rainbow trout (9-inch) were harvested by fall. During the same season 20 % of the stocked brown trout were harvested and 76 % of the browns were caught and released. In 1997 harvest rates for rainbows were much lower (7 –31 %), and over-winter survival was estimated to be only 2- 8 %. In 1997, the harvest rate for brown trout was 23 %. Over-winter survival of brown trout was 17 %. Relative to rainbow trout, brown trout appear better able to survive the fall and winter seasons.

Devlin and Bettoli (1999) reported that growth of trout varied seasonally and that highest rates were about 0.5 inches/month for rainbow trout and brown trout. These rates were on par with some of the best Tennessee tailwaters. Slower growth rates and poor condition of trout coincided with periods of poor water quality. Kanehl (1999) reported higher growth rates (>0.5 inches/month) for rainbow trout in the Caney Fork River during 1986, a drought year when flows, water temperatures and DO concentration were more favorable.

Little is known about growth rates of larger trout in the river. Biologists collected 3 brown trout that had been stocked (at 8 inches) two years earlier and those fish averaged 19 inches (Devlin and Bettoli 1999). An angler caught a 24-inch rainbow trout in the lower river that had been tagged and stocked (at 9 inches) four years prior. (Nischan, personal communication). Both observations suggest that trout are growing about 4 inches per year.

TWRA conducts electrofishing surveys annually in February to characterize the size structure and relative abundance of trout populations in the Caney Fork River. Twelve fixed sites from the dam to Stonewall are surveyed at night (Figure 7). The USACE provides 2 turbines of generation during the survey to allow for navigation and to keep conditions similar during each sample. Each site is electrofished for ten minutes. TWRA biologists follow the same protocol that was developed by TTU (Devlin and Bettoli 1999). All trout are weighed, measured and released.

Rainbow trout collected during February surveys typically range from 8 to 16 inches, with few fish over 16 inches (Figure 8). The 8-to10-inch rainbow trout collected in 2003 were from the cohort of fingerlings stocked in October of 2002.

The range in length of brown trout observed has varied over the past 7 years (Figure 9). Based on the modes in the length frequency histograms two-year old fish range in length from 10 to 14 inches. In 2000 through 2003 the fish in the 3-to7-inch groups represent fingerlings that were stocked the previous November. As with rainbow trout, brown trout larger than 16 inches were not common.

The catch per unit effort during the electrofishing surveys (CPUE) was highest for rainbow trout in 2000 through 2002, suggesting higher survival of rainbow trout during the 1999 through 2001 seasons (Figure 10). There was a significant decline in CPUE of rainbow trout over 10,12, and 14 inches in length in 2003. CPUE of rainbow trout was negatively correlated to volume of discharge in the previous year (Figure 11). Discharge in the prior year explained 65% of the variability in linear regression model predicting CPUE.

Brown trout comprised 15 to 50 % of the trout over 10 inches in the trout community each survey period. The CPUE of brown trout varied annually with high CPUE observed in 2000 and 2003 (Figure 12). Discharge and CPUE of brown trout was negatively correlated, but discharge only explained 30 % of the variability in CPUE of brown trout (Figure 13).

Some of the variability in CPUE may be explained by varied stocking rates. The switch to stocking all brown trout as fingerlings in the fall (since 1999) appears to have been successful. Since 2000, CPUE of 10+ -inch brown trout was higher than CPUE observed in year's prior, and including the 2003 survey that followed one of the worst water quality years. Despite poor water quality, a doubling of the fingerling stocking rate in fall of 2001 appeared to double the CPUE of brown trout in the 10+ - inch group in February 2003. It is also important to note that despite varied stocking rates and strategies, the number of larger (>14 inches) brown trout has remained steadily low. Suggesting that successful recruitment to 12 inches does not guarantee recruitment to larger sizes.

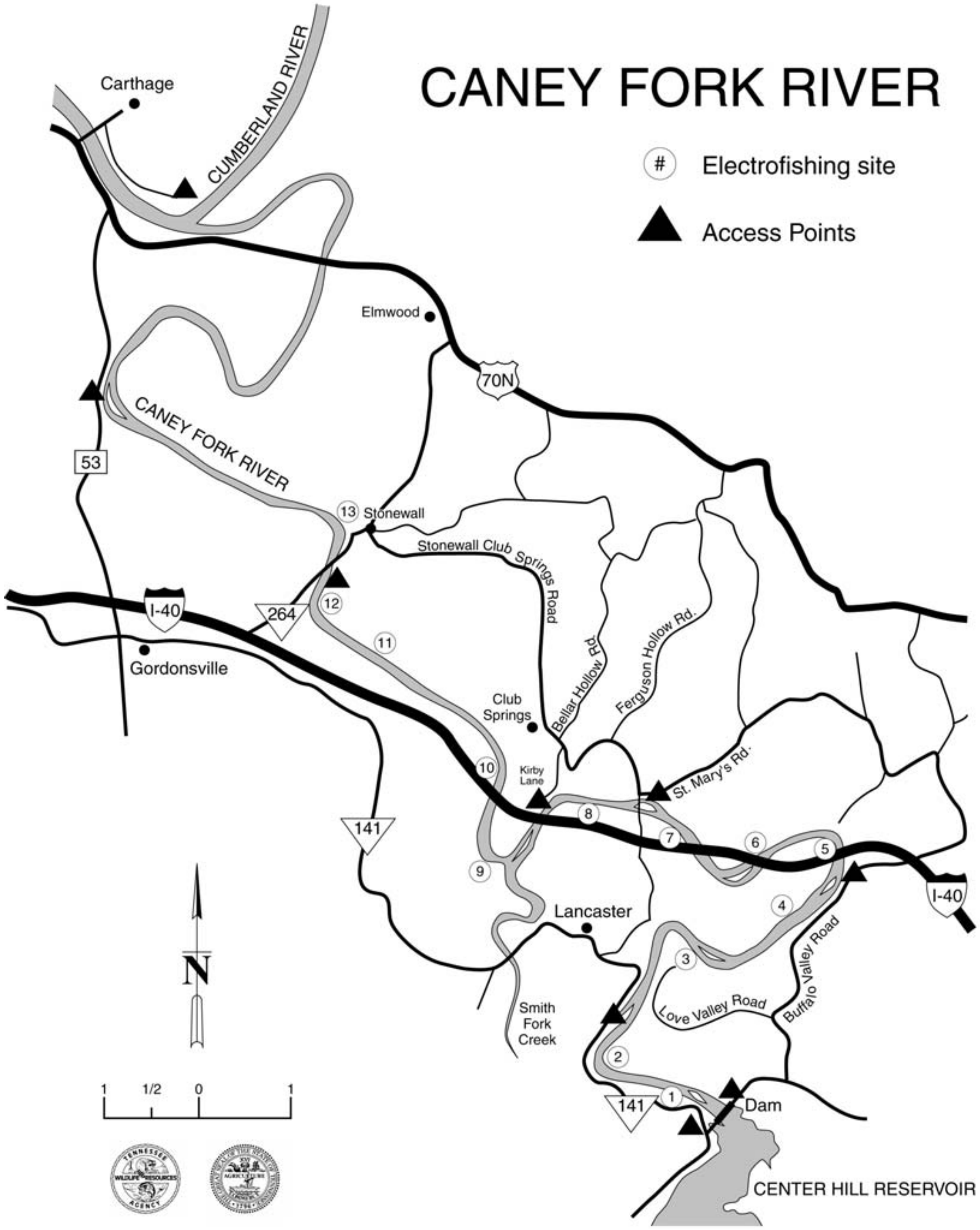

Figure 7. Map of Caney Fork River below Center Hill Dam.

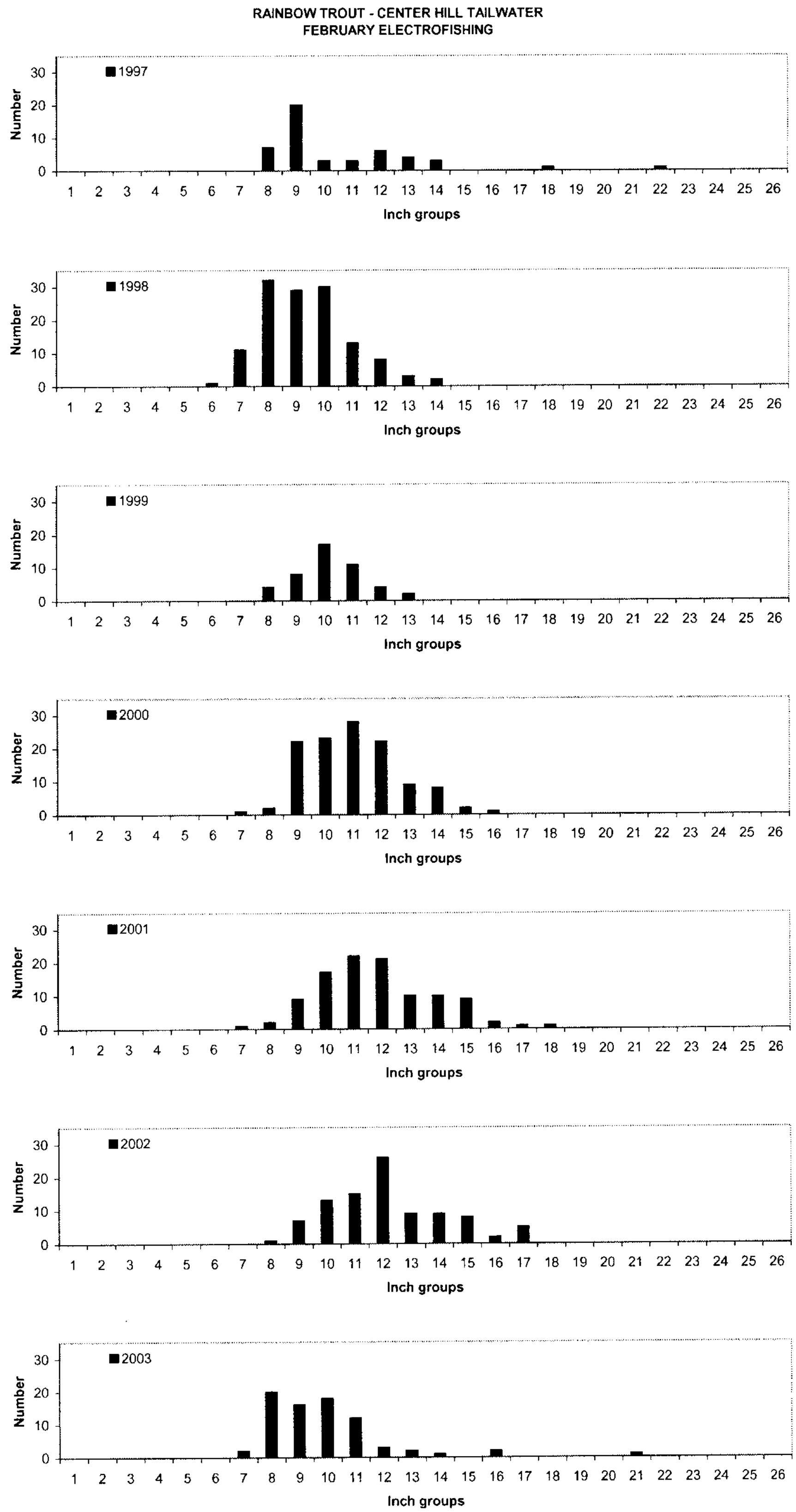

Figure 8. Length frequency distributions of rainbow trout collected by electrofishing in the Caney Fork River below Center Hill Dam.

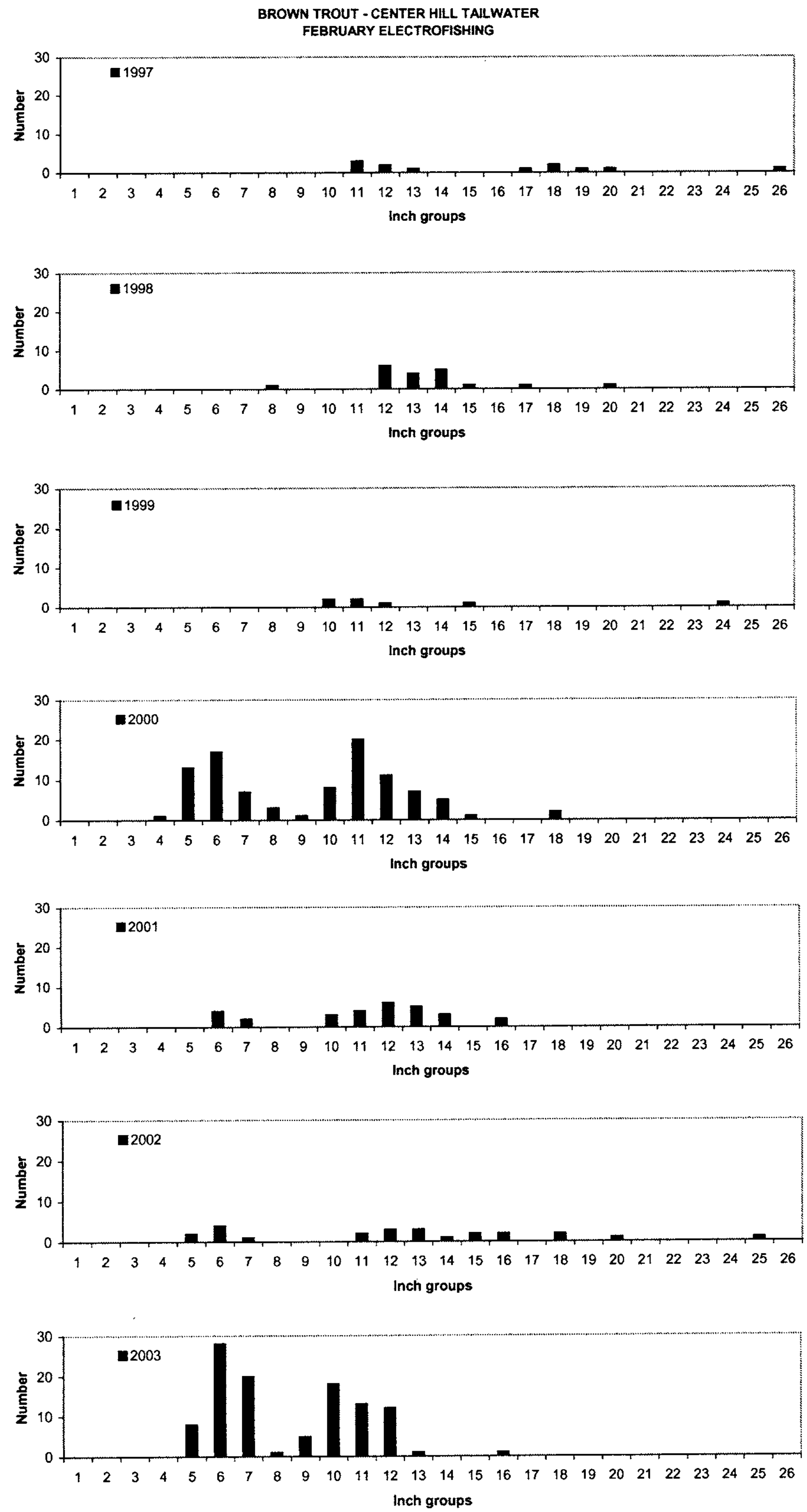

Figure 9. Length frequency distributions of brown trout collected by electrofishing in the Caney Fork River below Center Hill Dam.

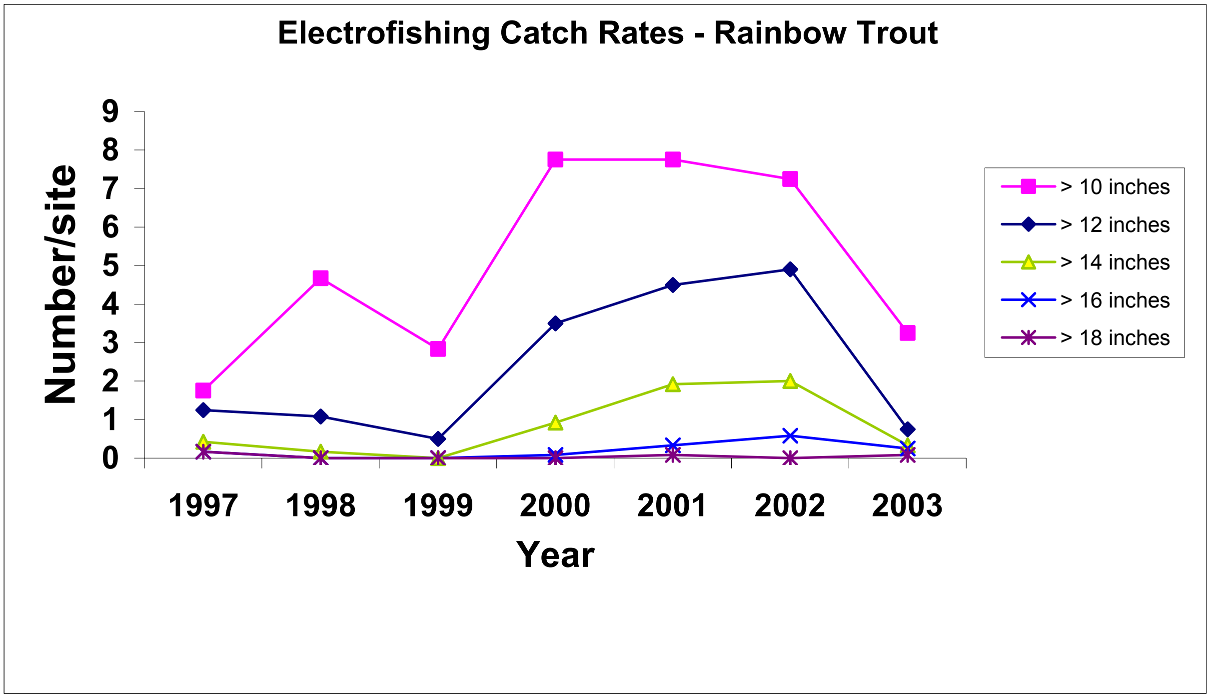

Figure 10. Electrofishing catch rates for rainbow trout at 12 fixed sites during the winter survey, conducted sometime between January 20 and March 10 each year.

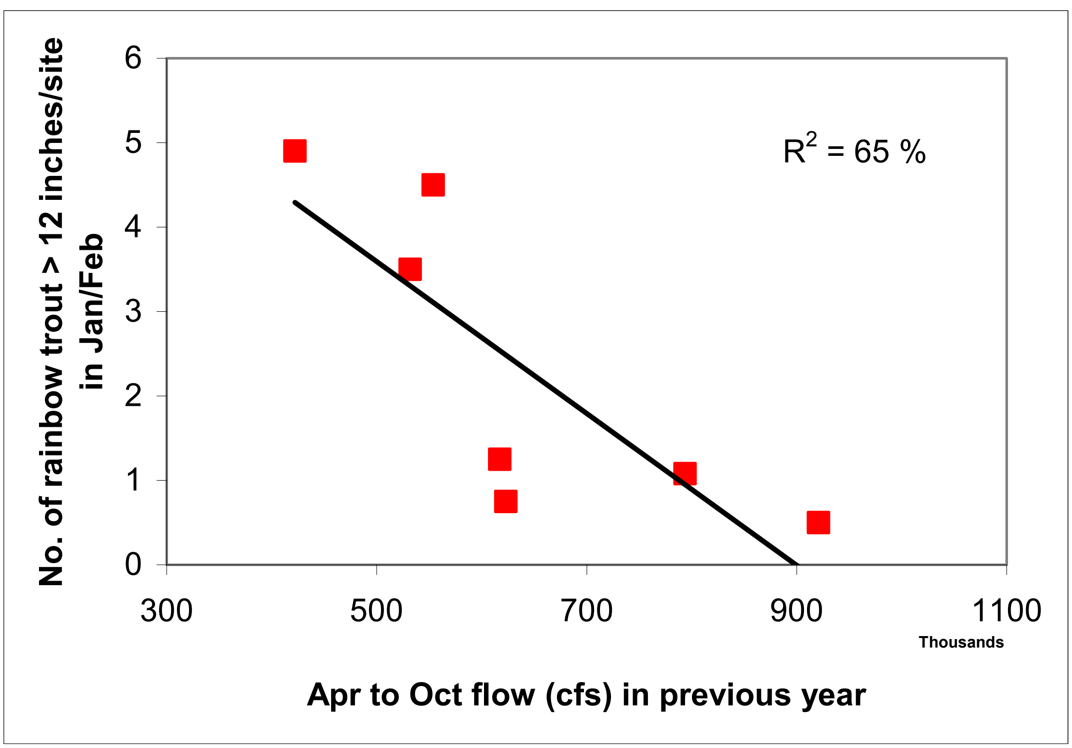

Figure 11. CPUE of rainbow trout collected by electrofishing verses discharge in the prior year.

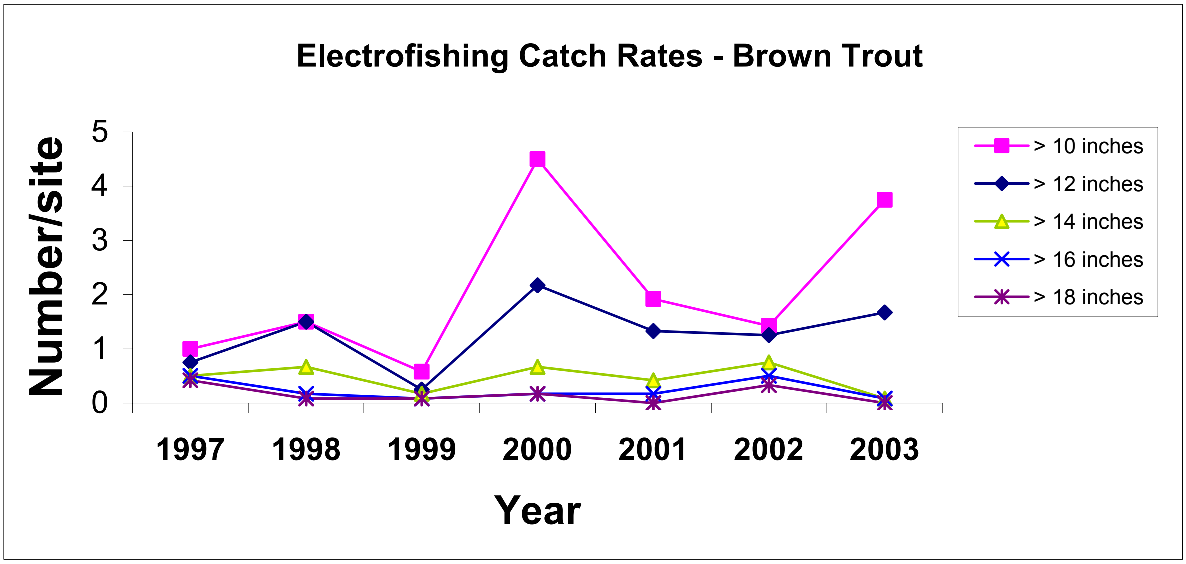

Figure 12. Electrofishing catch rates for brown trout at 12 fixed sites during the winter survey, conducted sometime between January 20 and March 10 each year.

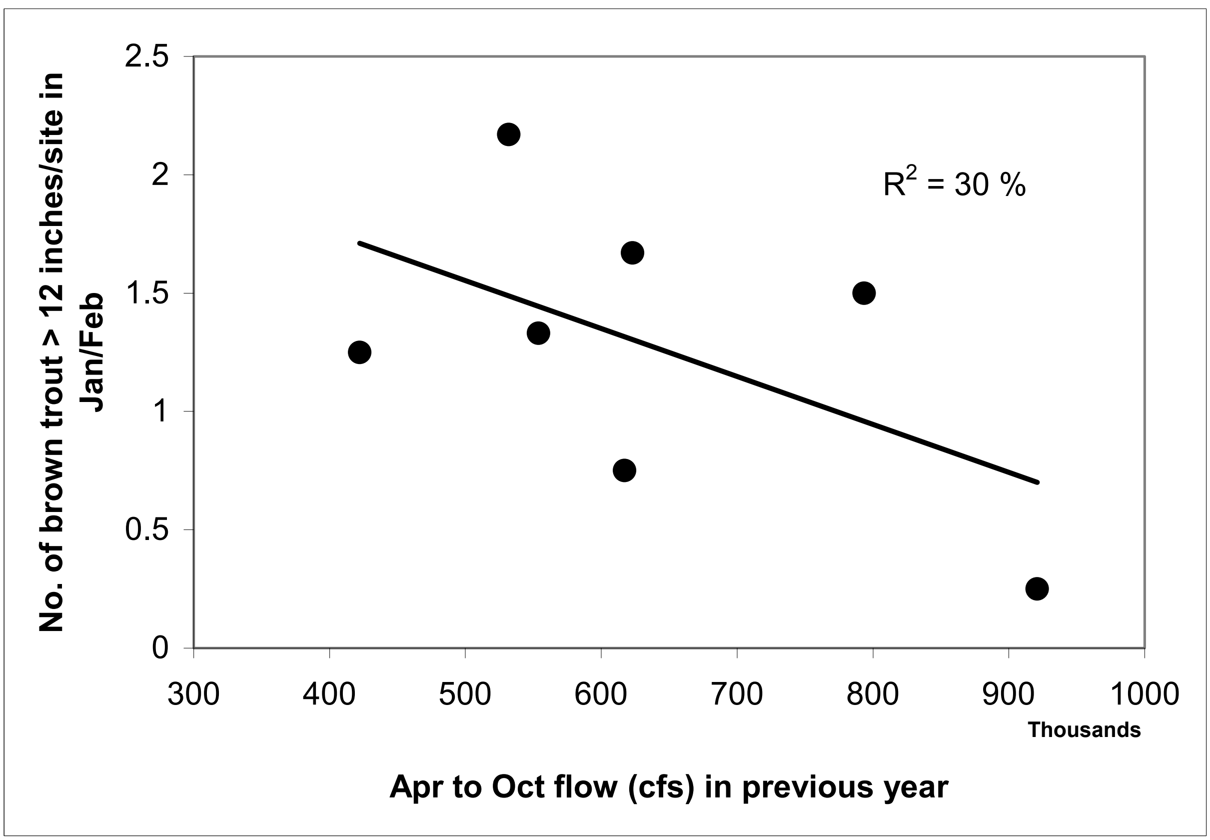

Figure 13. CPUE of brown trout collected by electrofishing verses discharge in the prior year.

The benthic community was surveyed by Odenkirk and Estes (1991) and USACE (1995 to 2002, R. Tippet, personal communication). In the upper reaches of the tailwater the benthic community is limited to scuds, sow beetles, and midge larvae. Diversity improves slightly below Smith Fork additional invertebrate includes caddis and mayflies and stoneflies. EPT ratios and low diversity indicate that the macro-invertebrate fauna are in a stressed condition (R. Tippet, USACE, personal communication). Fresh water mussel surveys have shown that a healthy population of mussels once existed in the Caney Fork River, but presently no native species are reproducing and will eventually disappear (Miller 1984). Benthic habitat is dewatered during extended no-generation periods. This problem is limited to shoal areas and is much worse in the upper reaches compared to lower reaches. We speculate that this dewatering and seasonally low DO levels are limiting survival of benthos in the tailwater. Several of TVA's tailwaters have demonstrated that macro-invertebrate richness has been increased significantly by providing consistent flows and increased dissolved oxygen (Scott et al. 1996).

<u>Trout Fishery</u>

Access to the Caney Fork is limited to roadside turn offs, boat ramps, and from private property (Figure 7). The three boat access areas include one at the dam, another at Happy Hollow, and the last at Betty's Island. Betty's Island access is subject to yearly wash out and boat access is not always possible. Primitive access for canoes and wading is also available adjacent to the South Carthage ballpark. This area is downstream of major trout fishery but it does serve as a good take-out location.

Access to most bank fishing sites are generally inaccessible to the fishing public, due to private ownership of adjacent property. Few anglers venture far from access areas, and most that do use canoes or small boats. Nearly all fishing occurs during no-generation flows. Boat angling accounts for less than one percent of the angling activity.

Creel surveys conducted during 1995 and 1997 describe the average fishing trip to the Caney Fork River (Bettoli and Xenakis 1996; Devlin and Bettoli 1999). In both years there were approximately 21,000 trips to the river, with an average trip length of 3.3 hours. Anglers were comprised of 18% fly, 62% bait, and 20% spin fishermen. Approximately 60% of the anglers were from the Nashville area. In the average trip anglers caught 4 trout and harvested 1.5 trout. Catch rates averaged 0.93 rainbow trout/hour and 0.17 brown trout/hour. The average release rate was 53 % for rainbow trout and 71% for brown trout. Harvest rates averaged 0.53 rainbow trout/hour and 0.07 brown trout/hour. Brown trout were 10-15 % of the harvest. The higher release rate for brown trout was likely due to their smaller size at stocking.

Catch rates on the Caney Fork River are similar to rates reported for the South Fork Holston, Hiwassee, and Obey rivers. The total harvest rate was 0.59 trout/hour and was the second highest rate observed in the state. Obey River had the highest at 0.9 trout/hour, and Norris tailwater had the lowest at 0.27 trout/hour. Most anglers harvest no trout and few harvest the limit of 7 trout (Figure 14).

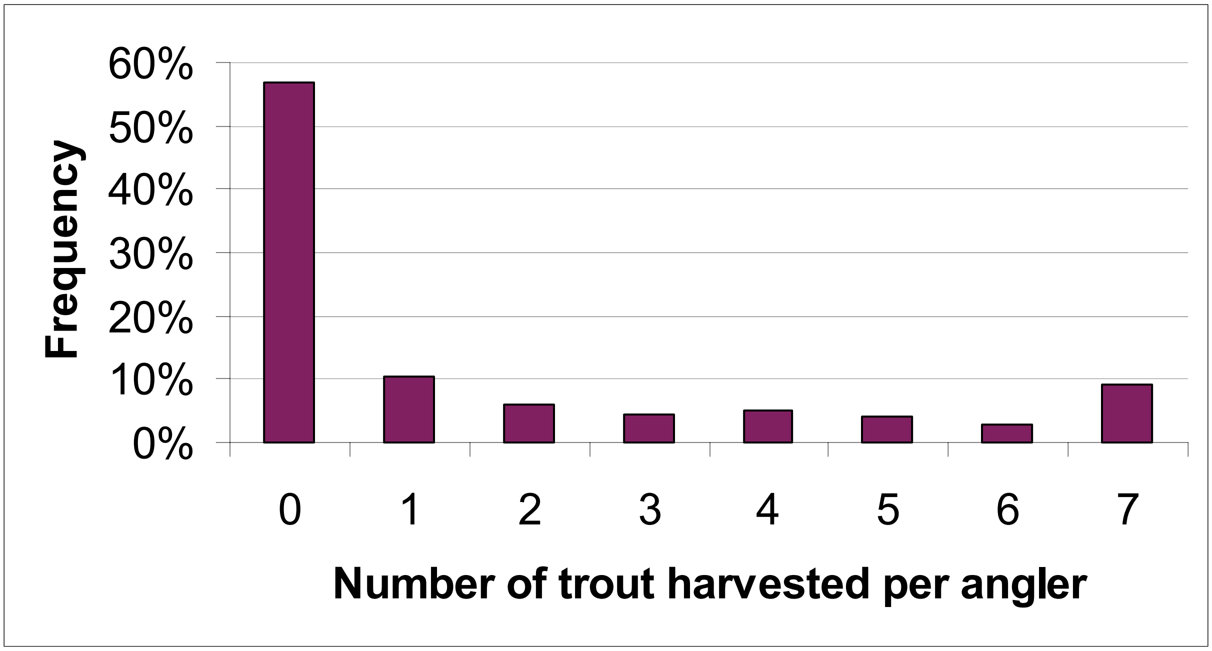

Figure 14. Percent frequency of completed-trip anglers that harvested various numbers of trout (Devlin and Bettoli 1999).

TWRA funded a recent angler survey focused on the specialization, preferences, and management attitudes of trout anglers on the Caney Fork River (Hutt and Bettoli 2003). They identified five equally represented angler groups on the Caney Fork (consumptive to non-consumptive anglers, and occasional to highly specialized anglers). Anglers on the Caney Fork represented the most diverse clientele of any Tennessee trout tailwater. All anglers clearly preferred to catch larger fish relative to higher numbers of smaller fish. Caney Fork anglers supported management options using additional stocking, length restrictions, slot limits, and catch and release areas, but were opposed to bait restrictions and closed seasons. Anglers also identified habitat and water quality as important management issues.

Economic surveys were funded by TWRA and conducted by Williams and Bettoli (2003). Using the contingent valuation method the survey determined how much more anglers were willing to pay (net value) to fish the river under a variety of conditions. Under the current conditions (essentially the 2001 fishing season) the net value was $64/trip. If the opportunity to catch more trout or bigger trout was presented they were willing to pay $91 or $93, respectively. All of these values ranked high relative to other trout tailwaters. The total value of the tailwater was estimated at 1.8 million dollars based on the travel cost method. This represent the highest total value and included the highest willingness-to-pay value all of trout tailwaters in Tennessee.

<u>Fishing Regulations</u>

Results of the 1995 creel study (Bettoli and Xenakis 1996) suggest that harvest of rainbow trout was substantial enough that that fishery could be improved by restrictive regulations if so desired. In contrast a few years later, Devlin and Bettoli (1999), during some a year of poorer water quality, suggested that water quality was limiting the rainbow trout fishery and regulations would not be effective. This fishery can be markedly different from one year to the next, depending on water quality. Neither study was designed to evaluate the harvest and survival of trout that survived more than one season in the tailwater. Therefore, neither study provided much incite into the effects of regulations on older brown trout.

Length restrictions have been used throughout the southeast to improve tailwater fisheries. On Lake Taneycomo, Missouri, a slot limit and gear restriction increased the number of 14-18-inch trout. On the White River, Arkansas, mangers have successfully used catch-and-release zones, and minimum length limits to improve trout fishing. Kentucky observed an increase in the number of large brown trout in the population using a 20-inch minimum length limit. Special regulations have become commonplace throughout the southeast. TWRA uses length restrictions to manage the South Holston, Watauga, and Apalachia tailwaters in Tennessee.

Many anglers have requested a reduction in creel limit as a way to improve the quality of the fishery. A reduced creel would have some value at reducing harvest. For example, a reduction to a 5 fish creel limit would reduce harvest by 15 % (Figure 15). However, creel limits without concurrent length restrictions would likely only redistribute harvest and not increase the abundance of larger trout unless the creel was reduced to one or two trout. Such a creel reduction was not considered a viable management option because most of the anglers on the Caney Fork would consider it to be too extreme.

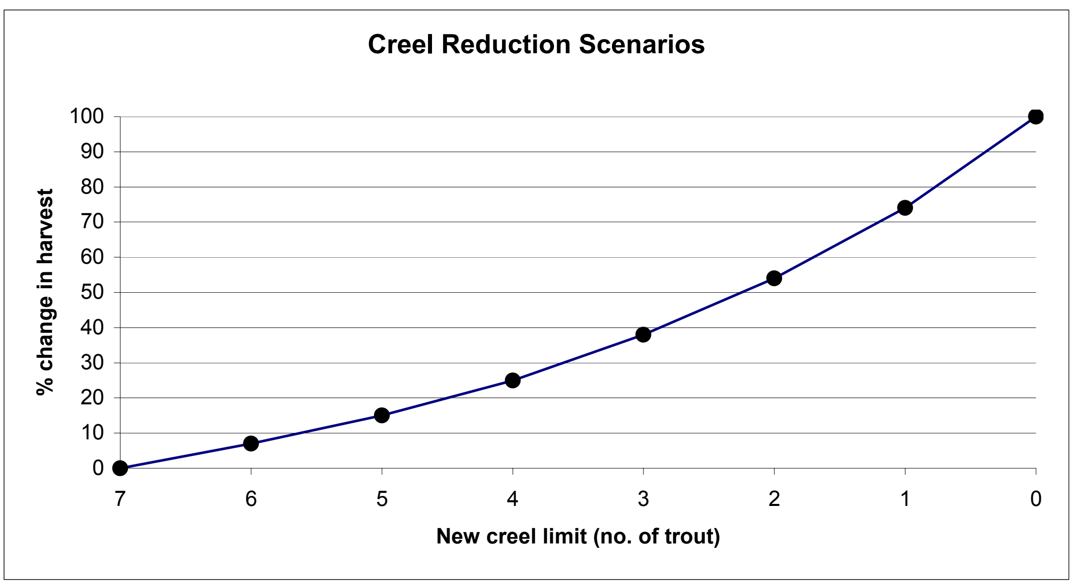

Figure 15. Percent change in harvest at a given creel limit on the Caney Fork River trout fishery. Data based on completed-trip angler harvest (Devlin and Bettoli 1999).

Anglers routinely requested TWRA to change regulations to improve fishing on Center Hill tailwater. In 2001, a year characterized by good fishing and water quality, anglers were generally satisfied with current fishing conditions in the Caney Fork River (Hutt and Bettoli

2003). Even in these “good times” the public requested improvements to regulations to maintain the quality fishing they were experiencing. TWRA managers carefully responded to these requests because the fishery has a very diverse angler community and in these instances the potential for conflict over management decisions would be high (Hutt and Bettoli 2003).

TWRA managers considered regulations designed to improve the fishery by providing more opportunity to catch larger (>14 inch) trout. Managers did not want to affect the rainbow trout fishery, which supports a majority of the angler groups on the river. Also the effectiveness of regulations on the rainbow trout fishery was questionable based on recent creel surveys (Devlin and Bettoli 1999). The best opportunity to improve the fishery and not radically affect anglers was to restrict the harvest of brown trout.

Effective March 1, 2004, new regulations will apply to the Caney Fork River. The new regulation is an 18-inch minimum length limit with a two-fish daily creel limit for brown trout. Statewide regulations remain unchanged for rainbow trout (i.e. harvest will be limited to 7 fish daily creel limit and no length restrictions).

Given water quality limitations it is likely that the effectiveness of the new regulation will vary with water quality. In years that have poor water quality, benefits gained by restricting harvest in that and previous years may be lost. This was yet another reason to develop a quality fishery based on brown trout rather than rainbow trout. Although both species are negatively affected by water quality, brown trout appear to have better survival during poor water quality years compared to rainbow trout. For example, 10 to 14 inch brown trout were relatively abundant in our 2003 survey following the low DO season of 2002 (Figure 12). This suggests that water quality problems may not totally negate benefits of a brown trout regulation.

The brown trout regulation represents a second effort by TWRA to manage the Caney Fork River with more restrictive regulations. In the early 1990’s, the TWRA proposed a quality management zone below the Center Hill Dam, but strong local opposition forced the plan to be abandoned. The quality management zone would have imposed artificials-only gear restrictions, and a 14-inch minimum length limit and 2-trout creel limit on a section of the river near Betty’s Island.

Management Strategies

Water Quality and Instream Habitat

Although the trout fishery at Center Hill owes its existence to hydropower, with it comes obstacles that must be overcome to realize the potential of this fishery. We are confident that the Caney Fork has potential to be a high quality trout fishery. During the drought years, 2000 and 2001, DO levels were much higher than in typical years. Coincidentally those same years TWRA observed high over-winter abundance of trout in surveys, insect hatches were common, and all types of anglers experienced great fishing. This suggests that good DO levels (>6 ppm) and improved minimum flow (~ 200 cfs) would allow this fishery reach it’s full potential, rivaling any trout fishery in the East.

TVA has successfully improved DO, minimum flow, and temperature regimes at a number of their hydropower projects improving the aquatic environment below their dams (Scott et al. 1996). Additional changes to the Center Hill Dam will be required to improve DO and minimum flow. Within the reservoir, DO can be enhanced by direct hypolimnetic oxygenation or localized mixing technology that mixes the water column in the turbine intake area. Treatment in the tailwater section could be done by direct oxygen injection. Minimum flows could be maintained by continuously operating a smaller turbine.

For the past three decades, the Tennessee Wildlife Resources Commission (TWRC) has petitioned the USACE to elevate DO in tailwater releases and improve minimum flows (Appendix A – Commission Resolutions). TWRA will continue to make propose these requests until conditions improve.

TWRA will support any initiatives to improve riparian habitat in Smith Fork Creek and Caney Fork River watersheds. Specifically riparian projects should restore eroding stream banks and provide alternate water sources for livestock.

Instream habitat projects are warranted to improve the survival of trout in the tailwater. These structures should be designed to provide shelter during peak flows.

Stocking

Each year TWRA will stock 114,000 9-inch rainbow trout between March and December. These fish will be stocked at the dam, Happy Hollow, and Betty's Island access areas. Downstream locations (Kirby Lane and Stonewall) should be stocked occasionally, 2-3 times per year with 3,500 trout per stocking. During the fall of the year, when DO is too low (< 4 ppm) to support freshly stocked trout, fish will be stocked downstream where water quality has improved. If the DO is too low at Kirby Lane then stocking may be cancelled for that month.

Each year TWRA will stock approximately 30,000 to 70,000 brown trout per year, depending on availability. These fish will be spread out among the dam, Happy Hollow, Betty's Island, Kirby Lane, and Stonewall access areas. Most of the brown trout will be stocked at 3-4 inches the fall and the remainder will be stocked in the spring a 6-8 inches. This strategy will allow TWRA to determine which strategy is most effective. If one season proves to be substantially more effective, then we will switch to stocking only in that season. If that neither season appears superior, we will adapt a fall-only strategy to reduce hatchery costs.

If available, surplus fingerling rainbow trout will be distributed among all access areas. At present the contribution of fingerlings rainbow trout stocked into the Caney Fork River is questionable. TWRA and TTU are currently evaluating the success of fingerling rainbow trout stocked in fall of 2002 and 2003. This evaluation will determine the effectiveness of fingerling rainbow trout stocking, and determine our need to continue the program.

Access

TWRA or local municipalities should acquire more access to the river. The following access improvements are required to fully develop this fishery. Listed in priority:

1) Public access and ramp in the vicinity of Stonewall

2) A ramp at or near Betty's Island Access
3) Improved access for boats and canoes at South Carthage public access
4) Any additional wading only access points at shallow reaches of the river.

Regulations

Effective March 1, 2004, TWRA will enforce a 18-inch minimum length limit on brown trout, allowing two brown trout over 18 inches to be harvested daily. Educational materials will be prepared to teach anglers to identify brown trout.

Monitoring

Many of the above strategies could greatly change tailwater conditions, hopefully for the better. TWRA and USACE must remain committed to annual surveys to document changes. Specifically, TWRA will continue to conduct electrofishing surveys for trout annually. TWRA will contract or conduct a creel surveys every four years. The last creel survey was conducted during the 2003 season, and final report should be prepared by June 2004. USACE will continue to collect benthic macroinvertebrates. Both TWRA and USACE will monitor flow and temperature as needed to monitor water quality and quantity.

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Appendix A

Resolutions, and letters to USACE regarding Center Hill Tailwater

RESOLUTION

BY

THE TENNESSEE WILDLIFE RESOURCES COMMISSION
RELATIVE TO THE U. S. ARMY CORPS OF ENGINEERS
MANAGEMENT OF THE CUMBERLAND RIVER SYSTEM

WHEREAS, the Tennessee Wildlife Resources Commission has responsibility for the management and protection of wildlife, fish and aquatic life, and their respective habitat; and

WHEREAS, the U. S. Army Corps of Engineers has responsibility for the management of the Cumberland River and its tributaries; and

WHEREAS, the Cumberland River system is a premier aquatic resource absolutely essential to the well-being of the State of Tennessee; and

WHEREAS, the Chief of Engineers for the Corps has recently established that water quality, fish and wildlife, and recreation are authorized elements of project operations; and

WHEREAS, the Corps has further committed to operation of all projects in compliance within the confines of the Federal Clean Water Act, the National Environmental Policy Act, and all other applicable environmental law;

BE IT THEREFORE RESOLVED, the Tennessee Wildlife Resources Commission, on this the 30th day of September 1992, fully endorses the enhancement of water quality, fish and wildlife resources, and recreational opportunity in the Cumberland River system; and

BE IT FURTHER RESOLVED, the Tennessee Wildlife Resources Commission and the Tennessee Wildlife Resources Agency propose to work with the Nashville District of the U.S. Army Corps of Engineers to identify and pursue opportunities to improve water quality, fish and wildlife resources, and recreational opportunity in the Cumberland River System.

Chairman
Tennessee Wildlife Resources Commission

ATTEST:

W B Howard
Secretary
Tennessee Wildlife Resources Commission

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

November 19, 1997

Lt. Colonel Christopher J. Young
District Engineer
U.S. Army Corps of Engineers
Ohio River Division, Nashville District
P.O. Box 1070
Nashville, TN 37202-1070

Dear Lt. Colonel Young

re: Caney Fork River, Center Hill Lake Tailwaters

On September 30, 1992, the Tennessee Wildlife Resources Commission (TWRC) adopted a <u>Resolution</u> relative to the management of the Cumberland River system by the U.S. Army Corps of Engineers (see attachment). The TWRC <u>Resolution</u> was in part a response to the July, 1992 publication by the Corps of expanded project operation guidance entitled "Authorized and Operating Purposes of Corps of Engineers Reservoirs". Under Public Law 85-624 (fish/wildlife) and Public Law 92-500 (water quality), the Corps is authorized by law to give equal consideration, under both operating purposes and authorized purposes, to fish/wildlife and water quality.

Reservoir tailwaters in the Tennessee River system, including the Cumberland River and its tributaries, offer both tremendous opportunity and challenge with regard to water quality, support of fish and aquatic life, and water based recreation. During the past decade, implementation of innovative technology and engineering has resulted in the dramatic restoration of water quality and fisheries in hundreds of miles of tailwaters in the Tennessee River system. These successful tailwater restoration efforts represent long overdue balancing of benefits and burdens relative to Tennessee tailwater resources; the power generated by hydroelectric projects is distributed over a multi-state area, while the adverse environmental impacts of hydroelectric projects are concentrated in waters of the State of Tennessee.

Despite the elevation of water quality and fish/wildlife consideration to equal status with hydroelectric power and flood control, the Corps has yet to fund and implement a significant tailwater restoration project for Center Hill Lake/Caney Fork River tailwaters. The Caney Fork from its confluence with the Cumberland River to river mile 25.4 is classified by the State of Tennessee as trout water; the criteria for fish and aquatic life require in part that the dissolved oxygen concentration of recognized trout waters shall not be less than 6.0 mg/L.

During later summer and fall, the dissolved oxygen depletion in the Caney Fork tailwaters routinely results in dissolved oxygen of less than 2.0 mg/L. Low dissolved oxygen results not only in stress and mortality to fish resources but also disrupts reproduction of benthic food chain organisms. The continued degradation of the Caney Fork tailwaters violates both Tennessee Water Quality Criteria and the intent of the Corps' 1992 declaration of Operating Purposes and Authorized Purposes of the Center Hill Lake Project. This portion of the Caney Fork River is considered by Tennessee to be only partially supportive of its fish and aquatic life use classification.

The Caney Fork tailwater offers tremendous opportunity for sportfishing and water based recreation. The full potential of this resource cannot be realized until the Corps funds and implements a tailwater restoration project which utilizes technology proven elsewhere in the Tennessee River system. Toward this end, the Tennessee Wildlife Resources Agency (TWRA) proposes to request the TWRC adopt an appropriate Resolution relative to the Caney Fork during the next regularly scheduled Commission meeting which will be at Reelfoot Lake on January 28-29, 1998. We would appreciate the opportunity to consult with you and/or your staff concerning this Resolution. Our intent is to provide an appropriate Resolution to Tennessee's Congressional delegation, the Tennessee General Assembly, the Office of the Governor, Tennessee conservation organizations and the Ohio River Division of U.S. Army Corps of Engineers.

We appreciate your time and consideration in this matter. Please contact our Environmental Services Division at 781-6643 should your staff have comments and recommendations or need additional information.

Sincerely,

Gary T. Myers
Executive Director

GTM/bjs
cc: Ms. Ann Murray - Tennessee Conservation League

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

March 2, 1998

Lt. Colonel Christopher J. Young
District Engineer
U.S. Army Corps of Engineers
P.O. Box 1070
Nashville, TN 37202-1070

Dear Colonel Young:

RE: Resolution - Caney Fork River/Center Hill Reservoir Tailwaters

During the February 26, 1998 meeting, the Tennessee Wildlife Resources Commission unanimously adopted the enclosed Resolution relative to the Caney Fork River, Center Hill Reservoir Tailwater as managed by the U.S. Army Corps of Engineers. The Tennessee Wildlife Resources Agency looks forward to working with the U.S. Army Corps of Engineers, Tennessee's Congressional delegation, and the Tennessee General Assembly to assure that a comprehensive tailwater restoration and management project is put in place in a timely manner for the Center Hill/Caney Fork tailwaters. We are convinced that the Caney Fork has the potential to be one of middle Tennessee's premier aquatic resources, offering both an outstanding fishery and water based recreational opportunity. In the near future we will be providing copies of this Resolution to our partners in conservation and would appreciate your guidance as to any particular party to whom we should provide this Resolution.

If you have questions, or need additional information please contact Mr. David McKinney, Chief of Environmental Services, at 615/781-6643.

Sincerely,

Gary T. Myers

Gary T. Myers
Executive Director

GTM/bjs
Enclosure

The State of Tennessee

RESOLUTION

by

The Tennessee Wildlife Resources Commission

Relative To

The Caney Fork River, Center Hill Reservoir Tailwater

As Managed by the U. S. Army Corps of Engineers

WHEREAS, the Tennessee Wildlife Resources Commission has responsibility for the management and protection of wildlife, fish and aquatic life, and their respective habitat; and

WHEREAS, the U.S. Army Corps of Engineers has responsibility of the Cumberland River system including that portion of the Caney Fork River constituting the tailwater of Center Hill Reservoir; and

WHEREAS, the Caney Fork River tailwater is a premier water recreation and fishery resource absolutely essential to the well being of the State of Tennessee; and

WHEREAS, in 1992 the Corps recognized water quality, fish and aquatic life, and water based recreation as authorized elements of the Center Hill Reservoir operation and further committed to operate this project in compliance with the Federal Clean Water Act, The National Environmental Policy Act, and the Tennessee Water Quality Control Act; and

WHEREAS, despite the availability of proven tailwater restoration technology as successfully demonstrated elsewhere in the Tennessee River Valley, the Caney Fork tailwater continues to suffer from low dissolved oxygen, erratic flow release, and significant fish kills; and

WHEREAS, the U.S. Army Corps of Engineers has yet to design and implement a comprehensive tailwater restoration and management project for the Caney Fork River;

BE IT THEREFORE RESOLVED, the Tennessee Wildlife Resources Commission and the Tennessee Wildlife Resources Agency, on this the 26th day of February, 1998, petition the U.S. Army Corps of Engineers to design and implement a comprehensive tailwater restoration project for the Caney Fork River and that such design draw upon technology and expertise as successfully demonstrated elsewhere in the Tennessee River system; and

BE IT FURTHER RESOLVED, the Tennessee Wildlife Resources Commission petitions the Tennessee General Assembly and Tennessee Congressional delegation to fully support the design and implementation of a comprehensive tailwater restoration project for the Caney Fork River by the U.S. Army Corps of Engineers; and

BE IT FURTHER RESOLVED, that copies of this Resolution be provided to the Office of the Governor, the Tennessee Water Quality Control Board, and other partners in conservation for their support.

Bob Sterchi, Chairman
Tennessee Wildlife Resources Commission

Gary T. Myers

Gary T. Myers, Executive Director
Tennessee Wildlife Resources Agency