

Technical Report:

Boating Density Analysis - A Comparison Among Tennessee Valley Authority and Other Federal Agency, State Agency, and An Investor-Owned Utility

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**Prepared by Jerry Fouse
Tennessee Valley Authority
Office of Environment and Research**

Purpose

As part of its stewardship and operational responsibilities, the Tennessee Valley Authority (TVA) administers the 26a (under the *TVA Act*) permitting process and inventories recreational developments along Tennessee Valley streams, rivers, and reservoirs. TVA operates the Tennessee River system based on an integrated method that balances recreation with other demands on the system. TVA does not regulate boating. The U.S. Coast Guard and the Valley states have established recreational boating regulations for public waterways located within their borders. The purposes of this report are (1) to compare approaches and findings of recreational boating capacity studies completed by TVA, federal and state agencies, and investor-owned utilities and (2) to describe an inexpensive, quick assessment method for estimating cumulative impacts to recreational boating.

Introduction

Increasingly, shoreline managers/owners, permitting agencies, and state boating law administrators are asked to provide carrying capacity and cumulative impact analyses of recreational boating densities. The densities are not only those seen under current conditions, but also densities predicted when boat storage and boat access are added to current conditions. Reservoir users and residents often express concern that TVA reservoirs are becoming overcrowded. TVA seeks to address perceived overcrowding by using the assessment method, or tool, described in this document. Depending on the action that TVA is considering approving or taking—such as the approval of boat ramps, marinas, and community docks that have multiple parking spaces or boat slips—understanding potential cumulative boating impacts in more detail may be desirable. This paper provides a methodology for doing this.

Landmark Research

Four sources are universally referenced to support boating density and recreational boat carrying capacity analyses concerning waterway and shoreline management. These include:

- *Guidelines for Understanding and Determining Optimum Recreation Carrying Capacity* (U.S. Department of the Interior, Bureau of Outdoor Recreation [BOR], 1977)

- *Parks, Recreation, and Open Space Guidelines* (National Recreation and Parks Association [NRPA] 1981)
- *Management of Aquatic Recreation Resources* (Warren and Rea 1989)
- *Water Recreation Opportunity Spectrum (WROS) Users' Guidebook* (U.S. Department of the Interior, Bureau of Reclamation, 2004)

A common term used in boat carrying capacity studies is “surface acres.” This term refers to the surface area (or acres of a water body) that is available to boaters. The total surface area of a water body is usually not available to boaters. Boating capacity analysts review the layout of the water body and deduct land that is not available to users, such as islands or restricted areas. That estimate of water body surface area available to boaters becomes the “acres,” “surface acres,” “effective boating area,” or “usable surface acres” value in calculations of boat carrying capacity. The surface acres available to boaters are never greater than the total surface acres of the water body. Table 1 shows the standard boating density (acres/boat) from these four sources. WROS is the most recent of the recreational carrying capacity management methodologies.

Table 1. Recreational Boat Carrying Capacity Standards and References

Source	Standard (Acres per Boat)
Bureau of Outdoor Recreation (BOR)	3-18
National Recreation and Parks Association (NRPA)	4
Warren and Rea	1.3-12
Bureau of Reclamation (WROS)	1-3,200

Sources: BOR (1977); NRPA (1981); Warren and Rea (1989); and WROS (2004)

Table 2 lists the WROS classification system and each setting’s associated summary of recreation experiences and boating density standards. WROS provides the framework for inventorying water-based recreational activities in order to classify waterways into six zones or management compartments. WROS is a planning tool (methodology), based on the standard of quality for the overall biophysical and social inventory of the waterway and/or zone, and aids in managing recreation experiences compatible in defined zones. Zones may be combined/blended to more accurately define the overall character and nature of the waterway being assessed and classified (e.g., Urban-Suburban or Suburban-Rural Developed), thus creating five additional combined/blended zones for a total of 11 zones. The WROS approach provides a means to define transitional areas as they become more developed and/or use increases. Most TVA reservoirs are currently in the “Rural Developed” to “Urban” classifications and are shifting toward the “Suburban” to “Urban” classifications as development increases.

Results from carrying capacity and boating density assessments are dependent on a number of parameters, including the following:

- Usable surface acres
- Numbers of boats stored and vehicle-trailer parking spaces at boat ramps
- Numbers of watercraft in use on the water at one time
- Spatial requirements of each type of boating activity
- Spatial distributions of each type of watercraft
- Percentage of watercraft (by type) in the boating mix
- Social perceptions and tolerances of perceived crowding

**Table 2. Water Recreation Opportunity Spectrum Classification Summary
and Associated Boating Density Standards**

Setting (Classification)	Generalized Description Summary of the Recreation Experiences by WROS Class	Standard (Acres per Boat)
Urban	<p>Limited opportunities to see, hear, or smell the natural resources exist due to the extensive level of development, human activity, and natural resource modification.</p> <p>Meeting other visitors is expected, and socializing with family and friends is important.</p> <p>There is probability for a diverse range of visitors and activities, including groups and special events.</p> <p>Convenience is central and dominant.</p>	1-10
Suburban	<p>Limited or rare opportunities to see, hear, or smell the natural resources exist due to the widespread and prevalent level of development, human activity, and natural resource modification.</p> <p>Meeting other visitors is expected, and socializing with family and friends is important.</p> <p>There is probability for a diverse range of visitors and activities.</p> <p>Convenience is central and dominant.</p>	10-20
Rural Developed	<p>Occasional or periodic opportunities to see, hear, or smell the natural resources exist due to the common and frequent level of development, human activity, and natural resource modification.</p> <p>Brief periods of solitude are likely, although the presence of other visitors is expected.</p> <p>There is probability for a diverse range of visitors and activities.</p> <p>Moderate levels of comfort and convenience are expected.</p>	20-50
Rural Natural	<p>Frequent opportunities exist to see, hear, or smell the natural resources due to an occasional or periodic level of development, human activity, and natural resource modification.</p> <p>Independence and freedom with a moderate level of management presence are important.</p> <p>There is probability for a diverse range of visitors and activities, although experiences tend to be more resource-dependent.</p> <p>Comfort and convenience are not important or expected.</p>	50-110
Semiprimitive	<p>Widespread and prevalent opportunities exist to see, hear, or smell the natural resources due to a rare or minor level of development, human activity, and natural resource modification.</p> <p>Solitude through the lack of contact with other visitors and managers is important.</p> <p>Opportunities exist for more adventure-based enthusiasts and overnight visitors.</p> <p>Sensations of challenge, adventure, risk, and self-reliance are important.</p>	110-480
Primitive	<p>Extensive opportunities abound to see, hear, or smell the natural resources due to the rare and very minor level of development, human activity, and natural resource modification.</p> <p>Solitude and lack of the site, sound, and smells of others are important.</p> <p>Opportunities are plentiful for human-powered activities (e.g., canoeing, fly-fishing, backpacking, etc.).</p> <p>Sensations of solitude, peacefulness, tranquility, challenge, adventure, risk, testing skills, orienteering, and self-reliance are important.</p>	480-3,200

Source: WROS 2004

Tims Ford Land Management and Disposition Plan Final Environmental Impact Statement and Tims Ford Boating Capacity Study

Following the TVA 2000 final environmental impact statement for the *Tims Ford Reservoir Land Management and Disposition Plan* (TFLP), TVA and the Tennessee Wildlife Resources Agency (TWRA) worked together to develop guidelines for a pilot study to better define and understand boat carrying capacity. The pilot study (TVA 2002), commonly referred to as the Tims Ford Boating Capacity Study (TFBCS), was planned for a single reservoir of midrange size in terms of surface acres. Twenty-seven reservoirs in the Tennessee River drainage basin were compared for summer pool surface acres (inclusive of Tims Ford Reservoir [TFR]) and recreational boating opportunities. This comparison revealed 13 with surface acres larger than that of TFR at 10,680 surface acres and 13 with surface acres less than that of TFR. The purpose of the TFBCS was to determine whether the assessment could be:

- (1) Applied to land use requests and permitting on all TVA tributary and main stem reservoirs
- (2) Easily executed by watershed teams
- (3) Cost effective in terms of dollars and human resources
- (4) Completed in a short period of time (less than 12 months)
- (5) Linked to corporate goals of “stimulating the economic growth” and “supporting a thriving river system”
- (6) Applied to one or more of TVA’s Critical Success Factors, such as “balance and optimize competing demands on the river system”

The TFBCS had two additional purposes as well:

- (1) To examine methodological approaches for determining boating density and water-based carrying capacity for lakes/reservoirs
- (2) To analyze current boat storage, boat access, and boating use data as surrogate measures for determining the on-water boating densities and recreational boat carrying capacity for Tims Ford Reservoir

The TFLP, reviewed by staff from TVA, Tennessee Department of Environment and Conservation, and TWRA, determined that boating densities on TFR would range from 6.1 to 7.8 surface acres per boat **at build-out**. Recent reports on the following reservoirs provided boating density data for comparison with TFR: Lucky Peak Reservoir near Boise, Idaho (U.S. Army Corps of Engineers [USACE] 1988); Deep Creek Reservoir in western Maryland (Environmental Resources Management [ERM] 2004); and Jocassee and Keowee reservoirs in the northwest area of South Carolina, Keowee-Toxaway Project (Duke Energy 2008). The results of these studies provide representative thresholds for surface acres per boat and are shown in Table 3.

Table 3. Optimum Recreation Carrying Capacity Thresholds: Boat

Reservoir Name	Usable Surface Acres	Optimum Boat Capacity	Acres per Boat
Lucky Peak	2,787	463	6.0
Jocassee	6,555	1,026	6.4
Tims Ford	10,560	1,641	6.4
Deep Creek	2,939	452	6.5
Keowee	13,641	1,804	7.6

The thresholds shown in Table 3 reflect boating densities from 6.0 to 7.6 surface acres per boat. This density is characterized as “at capacity” (Duke Energy 2008, page 109) and “actual carrying capacity” (ERM 2004, pages 56-58). Recreation professionals recognize that recreation areas have a theoretical capacity; however, the correct way to characterize that capacity is defined by BOR 1977, pages I-3 and 4, and Warren and Rea 1989, pages 116-118. When assessing the recreational boating capacity of waterways, additional characteristics such as location and movement of boats (i.e., density, clustering, and staging) should be analyzed. This typically occurs from boating use associated with public recreation areas (Duke Energy 2008, page 104). The *Lucky Peak Master Plan* was completed by the USACE in 1988. Phil Benge, USACE lead natural resource specialist on the Lucky Peak plan, discussed the plan’s success as a management tool and indicated that managing to a boating capacity of 6.0 surface acres per boat appeared to be appropriate. By comparing boating capacity estimates for TFR to the estimates of other reservoirs of similar size, or to other reservoirs in the southeastern United States, or to both, the surface acres per boat on TFR, or on any other reservoir, can be verified as an acceptable threshold to the general boating public.

Based on the pilot TFBCS and the other referenced studies, TVA recreation planners developed a rapid assessment planning tool to assist in developing baseline numbers for “in-use” recreational boats. The tool is called the Boating Density Worksheet and is shown in Table 4. The worksheet then was refined after examining current literature and technical reports on the Lucky Peak, Jocassee, Deep Creek, and Keowee reservoirs.

Conclusion

The Boating Density Worksheet uses information already available in existing databases to estimate boat usage on reservoirs. Because worksheet estimates compare favorably to estimates of other agencies’ boat carrying capacity studies, the worksheet can be used to estimate the following:

- Carrying capacity for any TVA reservoir
- Cumulative impacts of a proposed action on TVA reservoirs

For confirmation or rejection of the worksheet’s validity, carrying capacity data from other reservoirs of similar size and dimensions can be used to place the reservoir in context, in the manner of Table 3.

Table 4. TVA Boating Density Worksheet

				Estimated Private Access Boating Units		
Total Permits From 26a Records *						Private Only
Multiple Slips (+)						
Community Slips (+)						
Commercial Marinas (-)						
Adjusted Private Access Total						

				Estimated Boating Units - Total		
Adjusted Private Access Boating Units						
Commercial Wet Slips						
Commercial Dry Slips						
Subtotal Boating Units						

				Estimated Parking Spaces for Boating Units		
Public Ramp Parking						
Private Community Ramp Parking						
Subtotal Parking Spaces						

				Estimated % Boating Units In Use		
				Ave. Summer Weekday %	Ave. Summer Weekend Day %	Peak Holiday Summer %
Commercial Wet & Dry Slips				15%	25%	35%
Public/Private Ramp Parking				20%	60%	75%
Full Pool Surface Acres						
Full Pool Surface Acres minus barge tow w/safety zone (2x104.5) **						0

				Ave. Summer Weekday	Ave. Summer Weekend Day	Peak Holiday Summer
Est Boating Units in Use				0	0	0
Surface Acres Per Boating Unit						

* NOTE: Use stored boat counts to calculate average for 26-a; private docks, piers and boathouses

** NOTE: Where appropriate apply recommended Coast Guard Safety Zone for Commercial Boat Traffic

Summary

The Boating Density Worksheet captures a rapid, objective, and inexpensive means of assessing the density of recreational boats on TVA reservoirs. The Appendix A worksheet estimated boating density for TFR, using boat storage numbers from the preferred alternative B1 in the TFLP. Available literature provides standards that can be used to judge the acceptability of boating capacity levels on reservoirs. These standards are based on the assumption that the measure of surface acre per boat provides a suitable metric for measuring acceptability. Further assumptions are that the mix of recreational boating types and activities are similar and range from human-powered and wind-powered craft to motorized boats of various horsepower and size. If boating capacity estimates exceed a relevant standard, a more detailed analysis may be necessary.

References

- Duke Energy. 2008. *Recreation Use and Needs Study, Final Report, Keowee-Toxaway Project*. Needham, Mass.: The Louis Berger Group Inc., Federal Energy Regulatory Commission No. 2503.
- Environmental Resources Management Inc. 2004. *Final Report: Deep Creek Lake Boating and Commercial Use Carrying Capacity Study*. Prepared for Maryland Department of Natural Resources.
- National Recreation and Parks Association. 1981. *Parks, Recreation, and Open Space Guidelines*.
- Tennessee Valley Authority Act of 1933*, as amended, 16 USC 831 et seq. (2006).
- Tennessee Valley Authority. 2000. *Tims Ford Reservoir Land Management and Disposition Plan*. Prepared by TVA, River System Operations and Environment, Resource Stewardship, in partnership with Tennessee Department of Environment and Conservation.
- . 2002. *Recreational Boating Capacity Study – Tims Ford Reservoir (Supporting a Thriving River System)*. Norris, Tenn.: TVA, Resource Stewardship. Prepared in cooperation with the Tennessee Wildlife Resources Agency.
- U.S. Army Corps of Engineers. 1988. *Lucky Peak Master Plan, Technical Report - Volume 2, Supporting Data - Item 11, Carrying Capacity*. Lucky Peak Reservoir, Boise, Idaho. Vicksburg, Miss.: U.S. Army Corps of Engineers, Waterways Experiment Station.
- U.S. Department of the Interior, Bureau of Outdoor Recreation. 1977. *Guidelines for Understanding and Determining Optimum Recreation Carrying Capacity*. Bethlehem, Pa.: Urban Research and Development Corporation.
- U.S. Department of the Interior, Bureau of Reclamation. 2004. *Water Recreation Opportunity Spectrum Users' Guidebook*. Prepared by Dr. Robert Aukerman and Dr. Glenn Haas, Aukerman, Haas, and Associates LLC, in cooperation with Vernon Lovejoy and Darrell Welch, U.S. Department of the Interior, Bureau of Reclamation.
- Warren, R., and P. Rea. 1989. *Management of Aquatic Recreation Resources*. Columbus, Ohio: Publishing Horizons Inc.

Appendix A. Tims Ford Boating Density Worksheet at Build-Out

Estimated Private Access Boating Units			
Total Permits Possible From 26a Records *		1895	Private Only
Multiple Slips (+)		995	
Community Slips (+)		337	
Commercial Marinas (-)		-520	
Adjusted Private Access Total		2707	

Estimated Boating Units - Total			
Adjusted Private Access Boating Units		2707	
Commercial Wet Slips		520	
Commercial Dry Slips		0	none
Subtotal Boating Units		3227	

Estimated Parking Spaces			
Public Ramp Parking		600	
Private Community Ramp Parking		790	
Subtotal Parking Spaces		1390	

Estimated % Boating Units In Use			
		Ave. Summer Weekday %	Ave. Summer Weekend Day %
			Peak Holiday Summer %
Commercial Wet & Dry Slips	15%	25%	35%
Public/Private Ramp Parking	20%	60%	75%
Full Pool Surface Acres	10,560		
Full Pool Surface Acres minus barge tow w/safety zone (2x104.5) **			0

		Ave. Summer Weekday	Ave. Summer Weekend Day	Peak Holiday Summer
Est Boating Units in Use		762	1641	2172
Surface Acres Per Boating Unit		13.9	6.4	4.9

* NOTE: Use stored boat counts to calculate average for 26-a; private docks, piers and boathouses

** NOTE: Where appropriate apply recommended Coast Guard Safety Zone for Commercial Boat Traffic