SOUTH CAROLINA ELECTRIC & GAS COMPANY

COLUMBIA, SOUTH CAROLINA

SALUDA HYDROELECTRIC PROJECT

(FERC NO. 516)

BOATING DENSITY REPORT

FINAL

JUNE 2007

Prepared by:

Kleinschmidt

Energy & Water Resource Consultants

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SOUTH CAROLINA ELECTRIC & GAS COMPANY
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BOATING DENSITY REPORT

1.0 PURPOSE OF THE STUDY

The Saluda Project is an existing, licensed hydroelectric facility owned and operated by South Carolina Electric & Gas Company (SCE&G). The Project is located on the Saluda River in Richland, Lexington, Saluda, and Newberry Counties, SC. The Project impounds the 48,000 acre Lake Murray, a popular recreation area for boating and fishing, having numerous public access sites and supporting several popular recreational sport fisheries.

In comments received on the Initial Consultation Document (ICD), the South Carolina Department of Parks, Recreation & Tourism (SCPRT) requested a boating study of Lake Murray to examine boat densities and safety on the Lake now and into the future. The goals of this study are to:

1. Identify the area available for recreational boating on Lake Murray by lake segment.
2. Assess boat densities occurring under normal (weekend) and peak (holiday) use conditions on Lake Murray by lake segment.
3. Examine whether recreational boat use of Lake Murray is currently above, below, or at a desirable, or optimal, level.[1]

The results of this study will provide the Recreation Resource Conservation Group (RRCG) information for use in future recreation planning.

[1] As applied to this study, "desirable level" or "optimal level" refers to the amount and type of boating the lake can accommodate without unacceptable social impacts.

2.0 METHODS

The data used for this study included an examination of existing aerial photographs (from 2001) of recreational boating at the Project and information collected from the survey research portion of the Recreation Assessment Study (Kleinschmidt, 2007). Combined, the information provided the inputs necessary to assess recreational boating densities on Lake Murray.

2.1 Usable Boating Acreage

For this study, the lake was divided into 12 segments, corresponding with the segmentation used in the Recreation Assessment Study (Figure 2-1). The segments were entered into a Geographic Information System (GIS) and, using data provided by South Carolina Electric & Gas (SCE&G), the acreage of each segment at full pond (360' PD) was calculated. The usable boating surface area of each lake segment was determined by using the total surface area at full pond, excluding islands, and subtracting:

1. isolated lake areas that are separated from the larger reservoir and not accessible by boat from the lake; and
2. A 75-foot perimeter around the lake.[2]

[2] Private docks whether permanent, floating or a combination of both, may generally be up to 750 square feet in overall size (surface area) and 75 feet in length provided they do not interfere with navigation, ingress or egress to adjoining property or are in any manner hazardous. In some locations, such as narrow coves, the maximum size may not be permitted or docks may not be permitted at all. Floating docks attached to permanent docks may be moved out as the water level recedes, provided they do not interfere with adjacent property owner's access.

A variance in the dimensions related to the length of docks may be granted in instances where conformity with existing structures would be practical and in cases where exceptions would be desirable due to curvature and/or slope of the shoreline. However, the effects on navigation and the aesthetic values of the surrounding area will control issuance of any variance.

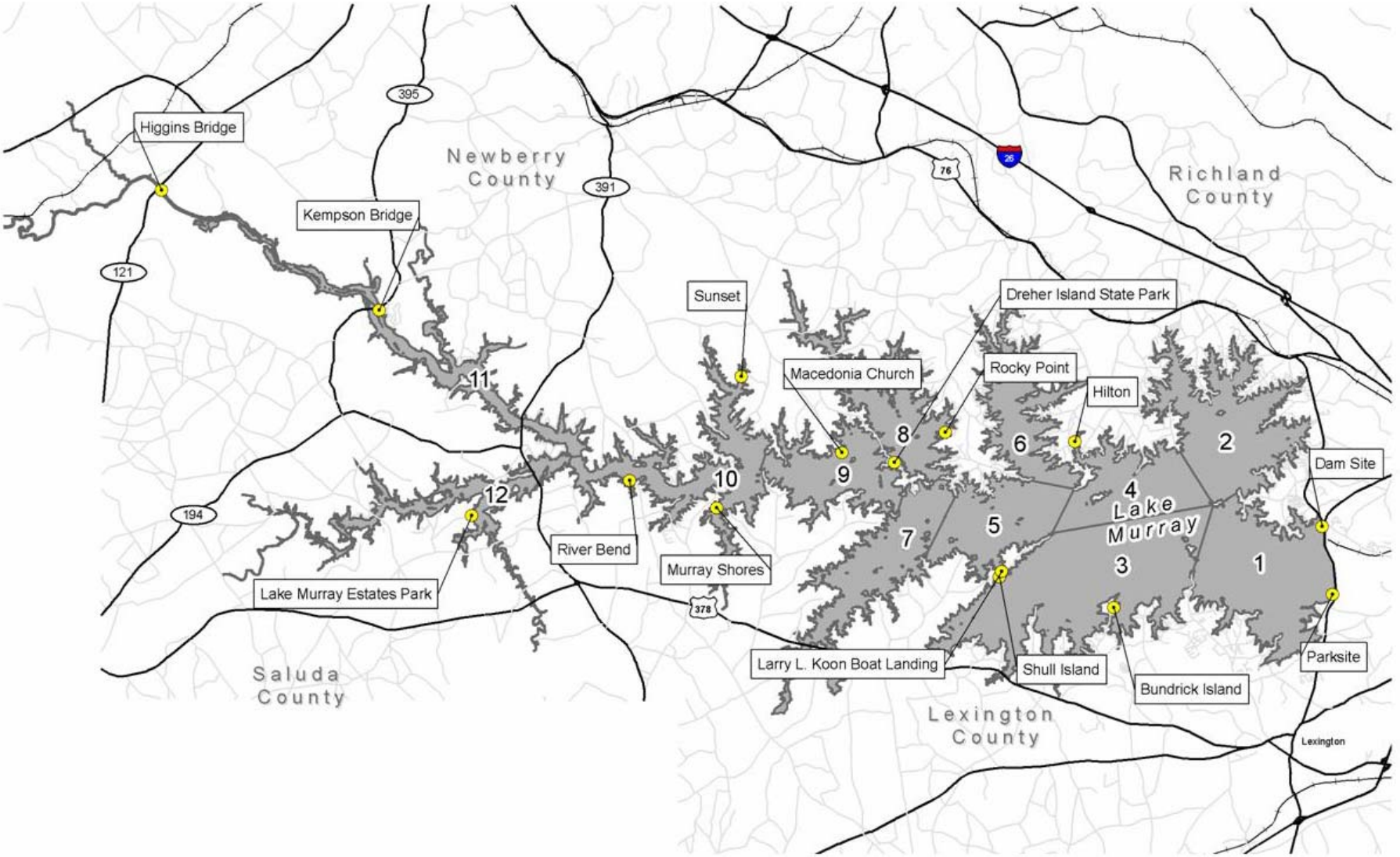


Figure 2-1: Segments of Lake Murray Used for Analysis (includes location of SCE&G-owned public recreation sites)

2.2 Boat Count Estimates

Existing photographs taken in 2001 (The Louis Berger Group, 2002) were used for this study. The photographs were taken on three holiday weekend days and seven non-holiday weekend days (Table 2-1) within the peak recreation season (April 1 to September 30; SCE&G, 2002). Photographs were taken from an elevation of approximately 3,500 ft.

Table 2-1: Dates of Photographs Taken in 2001 Used for Estimating Boat Numbers and Locations

WEEKEND DATES	HOLIDAY DATES
May 5	May 26
May 19	June 30 [a]
June 17	July 4
June 24	
July 15	
August 11	
September 22	

[a] June 30, 2001 was actually on the July 4th weekend since July 4 fell on a Wednesday in 2001.

The number of boats appearing on each photograph was tallied for each lake segment. However, in completing this process, it was revealed the lake was only partially covered by aerial photography on some dates. In an effort to complete the picture, it was necessary to estimate the percentage of each lake segment that was not covered on a particular date, and adjust the tally based on the existing coverage. For example, there were 82 boats counted in Segment 1 on the May 5 photographs. After examining all of the photographs for May 5, it was estimated that 2 percent of Segment 1 was not photographed. Therefore, for this study, we estimated 84 boats would have been in Segment 1, if the entire segment was photographed (82+(82*.02)). This provided an estimate of the number of boats for the entire segments. In total, boat tallies were adjusted in some manner for all dates.

The final boat tally for 2001 was adjusted to represent boating in 2006 using the average population increase in the four counties surrounding the Project (Lexington, Newberry, Richland, and Saluda). Combined, the four counties have experienced an

average growth rate of 4.48 percent from 2001 to 2006 (U.S. Census Bureau, 2006). Therefore, final tallies from 2001 were multiplied by 1.0448; this provided the final boat count estimates used for this study.

2.3 Recreational Boating Capacity

Optimal Boating Acreage

The "optimal" number of surface acres needed per boat for various types of boating activity is flexible and dependent upon the unique characteristics and circumstances at a particular reservoir (BOR, 1977). For this study, the optimal boating acreages necessary for each activity were derived from acknowledged standards (BOR, 1977; Warren and Rea, 1989), as well as from more recent studies in the Project vicinity (Duke Power Company, 2006).

Optimal acreages were then adjusted, based on each lake segment's characteristics, to determine if these characteristics influence the overall recreational boating capacity for each lake segment in a positive (+1), neutral (0), or negative (-1) way. The following characteristics, referred to as factors, were adapted from Warren and Rea (1989):

Multiple use of water area. Reservoirs where a mix of different activities occur generally have a lower capacity level for each activity. This is because there is a higher potential of user conflicts between activity types than there would be at a reservoir that supports few activity types. Reservoirs that support few activities typically have higher capacity levels for each activity. As Lake Murray supports multiple recreation uses, the boating activity base acreages for all lake segments was adjusted by a negative (-1) rating for this factor.

Shoreline configuration. Reservoirs with an irregular shoreline tend to accommodate fewer boats than reservoirs with uniform shorelines. Lake Murray has a large, irregular shoreline and therefore had boating acreages for all lake segments adjusted by a negative (-1) rating for this factor.

Amount of open water. Large areas of open water accommodate more boats and activities such as power boating, sailing, and water skiing in a safer manner than reservoirs with little open water. Lake segments with large areas of open water were given a positive (+1) rating. Lake segments with a moderate amount of open water were given a neutral (0) rating. Lake segments with small areas of open water were given a negative (-1) rating.

Amount of facility and shoreline development. Reservoirs with a high degree of public access, facilities, and shoreline development can support a higher recreational boating capacity than less developed areas. Also, recreators at locations with higher levels of development are more tolerant of higher use densities than recreators at less developed locations. Lake segments with a high level of development were given a positive (+1) rating for this factor. Lake segments with a moderate level of development were given a neutral (0) rating. Lake segments with a few or no public facilities or development were given a negative (-1) rating.

Crowding. Crowding of lake segments can affect the recreational experience of users in a variety of ways. Crowding can contribute to user conflicts, displacement, and negatively impact user satisfaction. Perceptions of crowding can affect the behavior of recreational users, such as altering the times that they visit the lake or altering the locations they visit. Users from urban areas, or who typically visit higher use areas, are more accustomed to higher use densities than users from rural or lower use areas and are, therefore, generally more tolerant of crowding than others. Each segment was assessed using results of the 2006 recreation site survey regarding survey respondents' perceived level of weekend crowding (rated on a scale of 1 to 5 where 1 was "light", 3 was "moderate," and 5 was "heavy"; Kleinschmidt, 2007). While holiday crowdedness ratings could have been used to estimate perceived crowding, these infrequent, high use

times do not provide information that would be pertinent to management decision making. Lake segments with a mean weekend crowdedness level of 1 to 1.6 were given a negative (-1) rating for this factor. Lake segments with a mean weekend crowdedness level of 1.7 to 3.3 were given a neutral (0) crowding rating. Lake segments with a mean weekend crowdedness of 3.4 to 5 were given a positive (+1) crowding rating.

Optimal Recreational Boating Capacity

The amount of useable surface area for each lake segment was divided by the number of surface acres needed per boating activity to provide an estimate of the number of boats that each segment of the reservoir might reasonably support at any given moment in time, assessed as though each activity were the only allowable use of the reservoir. To allow for multiple activity types, the number of boats was multiplied by the distribution of boating activities that occurs at each lake segment during normal weekend use periods (Kleinschmidt, 2007).[3] Summing these provides an estimated recreational boating capacity for each lake segment, allowing multiple activities to occur.

Existing Recreational Boating Capacity

Once the optimal recreational boating capacity was calculated for each lake segment, the optimal number of boats was compared to the final boat count estimates[4] for 2006. Dividing the existing number of boats by the optimal number of boats provides an estimate of the current percent use capacity for each lake segment.

[3] The use of the normal weekend use periods provides information that is more accurate as to activities on the lake that occur during "normal" conditions. While holidays could have been used to estimate activity distributions, these high use and infrequent times do not provide information that would be pertinent to management decision making.

[4] Final boat count estimates for 2006 are derived from the 2001 aerial photos with adjustments based on population increases for the area counties.

3.0 RESULTS

3.1 Usable Boating Acreage

The total acreage of Lake Murray at full pond is estimated to be 48,292 acres within the project boundary. Exclusion of a 75-foot perimeter around the remaining shoreline resulted in approximately 5,992 acres being eliminated from consideration. With these exclusions, a conservative estimate of the total surface area available for boating and fishing activity at the lake was estimated (Table 3-1).[5] However, the usable acreage was not applied to all activities. Since canoeing and kayaking are activities that can, and often do, take place within the 75-foot perimeter, we used the total estimated acreage for this activity rather than the usable acreage. Although fishing can also take place in this near-shore environment, we used the more conservative estimate (usable acreage) for this activity.

Table 3-1: Calculated Acreage and Estimated Useable Acreage by Segment

LAKE SEGMENT	ESTIMATED ACREAGE	ESTIMATED USABLE ACREAGE
1	5,740	5,440
2	5,132	4,580
3	8,815	8,329
4	3,275	3,055
5	3,291	3,067
6	2,927	2,454
7	3,866	3,371
8	3,209	2,654
9	2,965	2,618
10	3,933	3,164
11	2,893	2,007
12	2,246	1,561
Total	**48,292**	**42,300**

[5] The state of South Carolina also restricts boat or PWC speeds in excess of idle speed within 50 feet of a moored or anchored boat, a wharf, pier or dock, and a person in the water, thereby further limiting the number of boatable acres for activities requiring more than idle speed.

3.2 Boat Count Estimates

Once the number of boats in the photographs was tallied, including adjustments for segments with incomplete coverage, final boat count estimates were calculated based on the 4.48 percent population growth in the surrounding area. Final boat count estimates used in this study are presented in Table 3-2. Segments 1, 2, 3, and 10 were the most used areas of the lake, both on weekends and holidays. Segments 11 and 12 were the least used on weekends, while Segments 9 and 12 were the least used on holidays. The majority of segments were used more on holidays; Segments 1 and 11 experienced the most increase in use from weekends to holidays (over double the use). Segments 7 and 9 were used less on holidays. Patterns of use generally show increased use of the reservoir from May through August, and then a rapid decline in use in September.

Table 3-2: Final Boat Count Estimates for 2006 by Segment by Date

WEEKEND DAYS													
	Segment #												
Day Type (Date of Photograph) [a]	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
Early May (May 5)	87	140	76	77	33	44	44	37	45	91	29	26	730
Mid-May (May 19)	154	134	83	57	51	39	42	26	33	85	18	18	740
Mid-June (June 17)	137	234	166	19	93	73	39	50	43	27	40	56	976
Late June (June 24)	124	201	165	66	40	67	50	22	16	94	16	5	865
Mid-July (July 15)	103	100	128	23	42	37	114	31	0	97	0	40	716
Mid-August (August 11)	97	103	170	29	44	66	42	88	0	86	18	24	767
Late September (September 22)	81	53	59	19	0	19	65	18	44	42	14	9	423
Total	784	965	847	291	304	344	395	271	180	523	135	178	
Average	112	138	121	42	43	49	56	39	26	75	19	25	745

HOLIDAY DAYS													
	Segment #												
Day Type (Date of Photograph) [b]	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
Memorial Day Weekend (May 26)	100	99	161	42	115	57	47	33	0	86	24	30	794
Fourth of July Weekend (June 30) [c]	386	116	167	22	59	25	66	29	20	95	23	18	1025
Fourth of July (July 4)	241	252	130	95	47	68	47	114	34	153	79	62	1321
Total	727	468	458	159	221	151	160	175	54	334	125	109	
Average	242	156	153	53	74	50	53	58	18	111	42	36	1047

[a] Final boat count estimates for weekend day types were derived from aerial photos from 2001 and adjusted by estimated population growth.

[b] Final boat count estimates for holiday day types were derived from aerial photos from 2001 and adjusted by estimated population growth.

[c] June 30, 2001 was actually on the July 4th weekend since July 4 fell on a Wednesday in 2001.

3.3 Recreational Boating Capacity

Optimal Boating Acreage

Optimal boating acreages, or "base" acreages, are presented in Table 3-3. Based on the standards used in this study, water skiing and jet skiing require the most surface area out of the activities used (12 acres of water per boat). Canoeing and kayaking require the least amount of water (1.3 acres of water per boat).

Factor ratings were determined and summed for each lake segment (Table 3-4). As stated in the methods, all segments were negatively rated (-1) for multiple use of water area (meaning all segments support multiple uses) and shoreline configuration (considering Lake Murray's irregular shoreline). Segments 1 through 5 were scored with a positive rating (+1) for amount of open water (large areas of open water); Segments 6 through 10 were given a neutral rating (0) (moderate amount of open water); and Segments 11 and 12 were given a negative rating (-1) (given their riverine like characteristics). Although Segments 7 and 10 have more usable acreage (3,371 acres and 3,164 acres, respectively) than Segments 4 and 5 (3,055 acres and 3,067 acres, respectively), the characteristics of Segments 7 and 10 (cove areas, islands, etc.) necessitated their neutral rating. Segments 2, 6, 7, 11, and 12 were given negative ratings (-1) for available recreation access (few or no public facilities); the remaining segments were given positive ratings (+1). Segment 5, which had a 3.70 crowding rating, was the only segment receiving an adjustment for weekend crowding, receiving a negative rating (-1).

The total factor rating score was applied as an acreage adjustment to the base acreages shown in Table 3-3 to estimate the optimal recreational boating capacity for each unique lake segment for the different boating activities. Adjustments to the boating activity base acreages by the factor assessments reveal Segments 11 and 12 changed the most from the base acreages, with each segment receiving a -4 factor rating. This means that these segments needed over 1.5 times the acreage per boat for power boating, jet skiing, and sailing when compared to Segments 1, 3, and 4, which received a factor score of 0 (meaning they were assessed at the base acreage level). The only segment to receive a total positive factor score was Segment 5, which is also the only segment to be adjusted based on user perceived crowding.

Table 3-3: Boating Activity Base Acreages

	ACRES OF WATER/BOAT										
ACTIVITY	**LOW**	**-4**	**-3**	**-2**	**-1**	**BASE**	**1**	**2**	**3**	**4**	**HIGH**
Power Boating (Unlimited) [a]	18.00	16.20	14.40	12.60	10.80	9.00	7.80	6.60	5.40	4.20	3.00
Canoeing and Kayaking (flat water) [a]	2.50	2.26	2.02	1.78	1.54	1.30	1.14	0.98	0.82	0.66	0.50
Angling [b]	10.00	8.86	7.72	6.58	5.44	4.30	3.84	3.38	2.92	2.46	2.00
Jet Skiing [d]	20.00	18.40	16.80	15.20	13.60	12.00	11.00	10.00	9.00	8.00	7.00
Sailing [c]	10.00	9.00	8.00	6.00	5.00	4.30	4.00	3.30	3.00	2.30	2.00
Water Skiing [c]	20.00	18.40	16.80	15.20	13.60	12.00	11.00	10.00	9.00	8.00	7.00

[a] BOR, 1977.
[b] Duke Power Company, 2006.
[c] Warren and Rea, 1989.
[d] For purposes of this assessment, it is assumed that jet skis have the same spatial requirements as water skiing.

Table 3-4: Factor Assessment by Lake Segment

LAKE SEGMENT	MULTIPLE USE	SHORELINE CONFIGURATION	AMOUNT OF OPEN WATER	AVAILABLE RECREATION ACCESS (PUBLIC OR PRIVATE)	WEEKEND CROWDING RATING	TOTAL
1	-1	-1	1	1	0	0
2	-1	-1	1	-1	0	-2
3	-1	-1	1	1	0	0
4	-1	-1	1	1	0	0
5	-1	-1	1	1	1	1
6	-1	-1	0	-1	0	-3
7	-1	-1	0	-1	0	-3
8	-1	-1	0	1	0	-1
9	-1	-1	0	1	0	-1
10	-1	-1	0	1	0	-1
11	-1	-1	-1	-1	0	-4
12	-1	-1	-1	-1	0	-4

Boating Activity Distributions

Distributions of boating use on normal weekends and holidays are presented in Figures 3-1 and 3-2 (Kleinschmidt, 2007). Boating activity distributions on normal weekends (Figure 3-1) were fairly uniform across the reservoir, with angling being the primary activity in all segments with the exception of Segment 4, where power boating was the most reported activity. Sailing was only reported in Segment 3. Canoeing and kayaking were only reported for Segments 4 and 11. Water skiing appears to be uniformly distributed across the entire reservoir, generally accounting for about 10 percent of boating activity in each segment, with higher percentages being reported toward the lower end of the reservoir.

Activity distributions shift during holiday weekends (Figure 3-2). Angling is still the primary activity in Segments 1, 2, 5, 6, 8, and 10 through 12. Segment 3 shifts from primarily angling on weekends to more power boating on holidays, as does Segment 9. Angling use generally increases on holidays on the lower end of the reservoir (Segments 1 – 6) and decreases on the upper end of the reservoir (Segments 7 – 10).

Optimal Recreational Boating Capacity

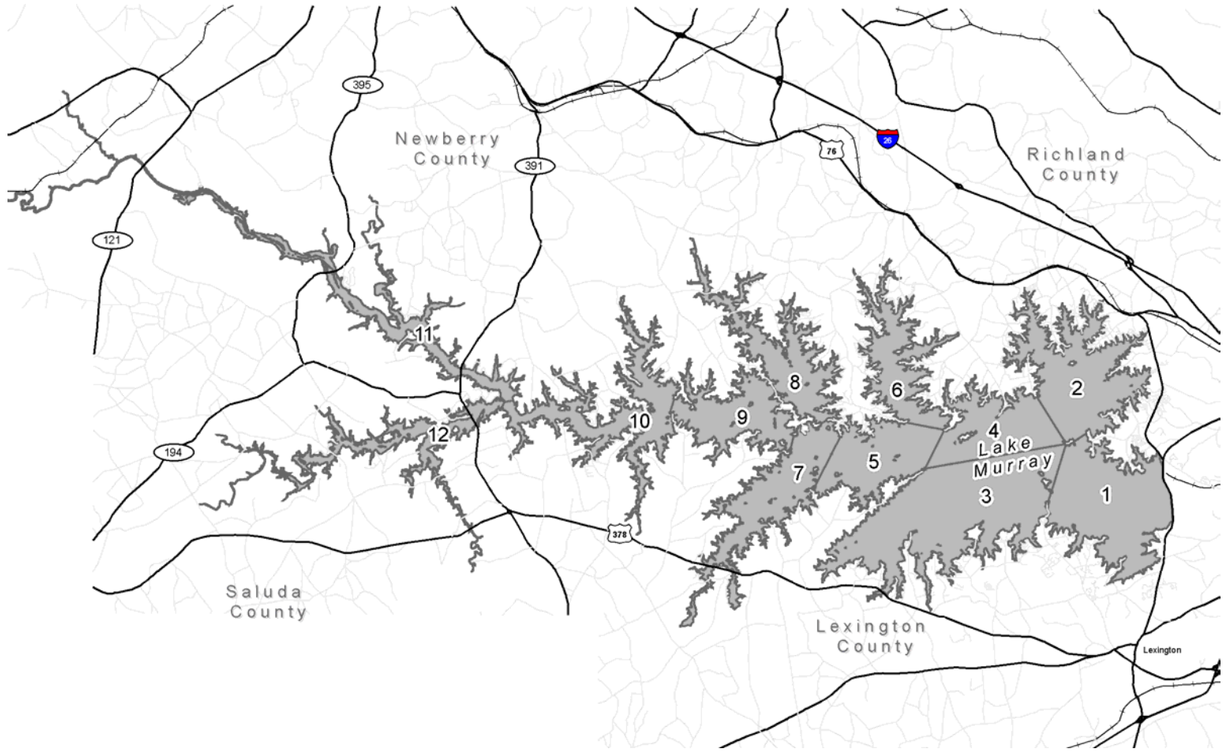
Study results show that, theoretically, Lake Murray could accommodate substantially more recreational boating than what is currently estimated to occur, if the entire lake were utilized to its greatest potential (Table 3-5). If the multiple uses of the reservoir were not considered (i.e., only one activity occurs on the lake), the surface area could theoretically accommodate about 4,000 boats engaging in power boating or 32,000 in canoeing and kayaking or 8,000 in fishing or 3,000 in jet skiing or 8,000 in sailing or 3,000 in water skiing. These numbers are presented to emphasize the relatively little amount of water needed for canoeing and kayaking as well as point out the differences in water requirements for each activity.

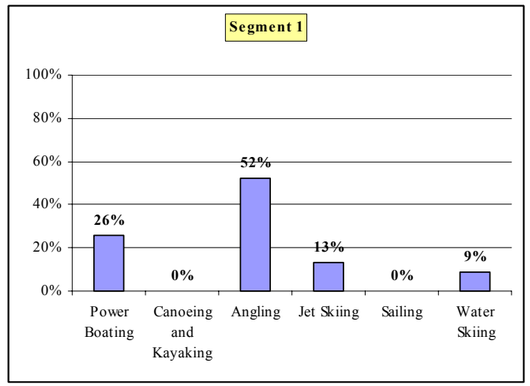
However, a reservoir of Lake Murray's size and character supports multiple activities. When multiple activities are accounted for (at least the activities used in this study), actual optimum boating use numbers are substantially less. Overall, the reservoir could theoretically support approximately 6,575 boats engaged in various activities: 1,183 in power boating, 452 in canoeing and kayaking 4,453 in angling, 181 in jet skiing, 94 in sailing, and 212 in water skiing. Segment 3 could accommodate the largest number of boats (1,379). Segment 3 is also the largest segment in this study (8,329 usable acres), almost 50% larger than the size of the next largest segment (Segment 1 – 5,440 usable acres). The segment that can accommodate the fewest number of boats was Segment 12, which is also the smallest segment used in this study.

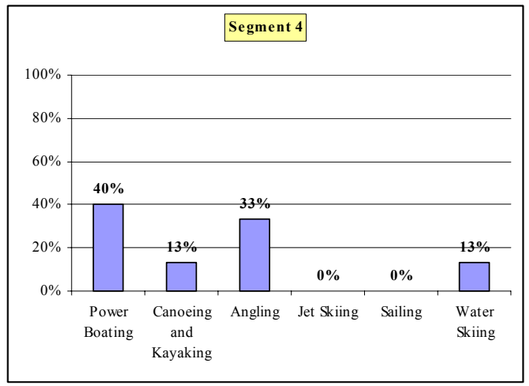
Figure 3-1: Distribution of Boating Use on Lake Murray on Weekends in 2006 by Activity and Lake Segment[6]

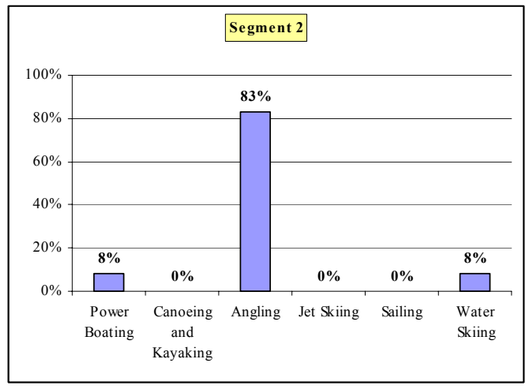
	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Power Boating	29	11	41	17	15	12
Canoeing and Kayaking	0	0	0	6	0	0
Angling	58	115	53	14	22	33
Jet Skiing	15	0	12	0	4	0
Sailing	0	0	6	0	0	0
Water Skiing	10	11	9	6	2	4
Total [a]	112	138	121	42	43	49

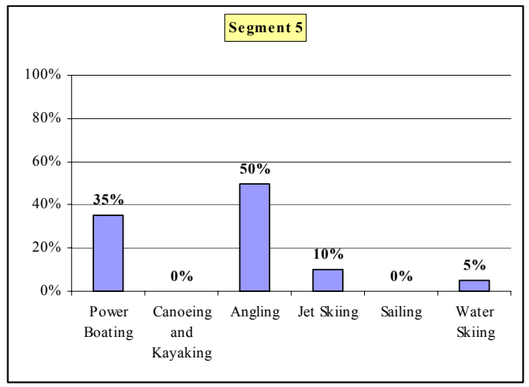
[a] The total average may not add up to the sum of individual activities due to rounding.

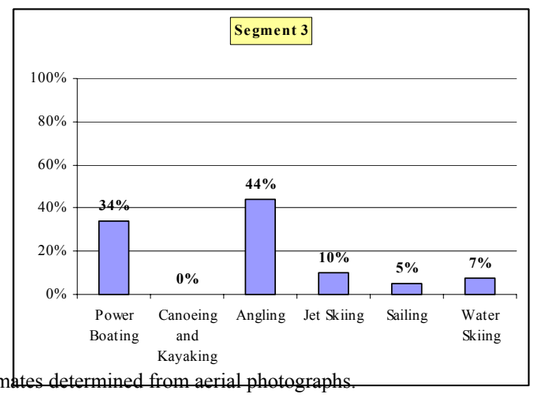


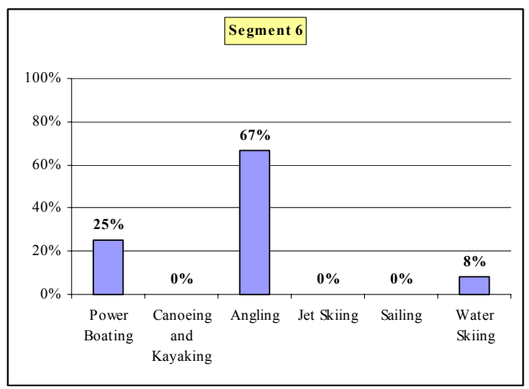










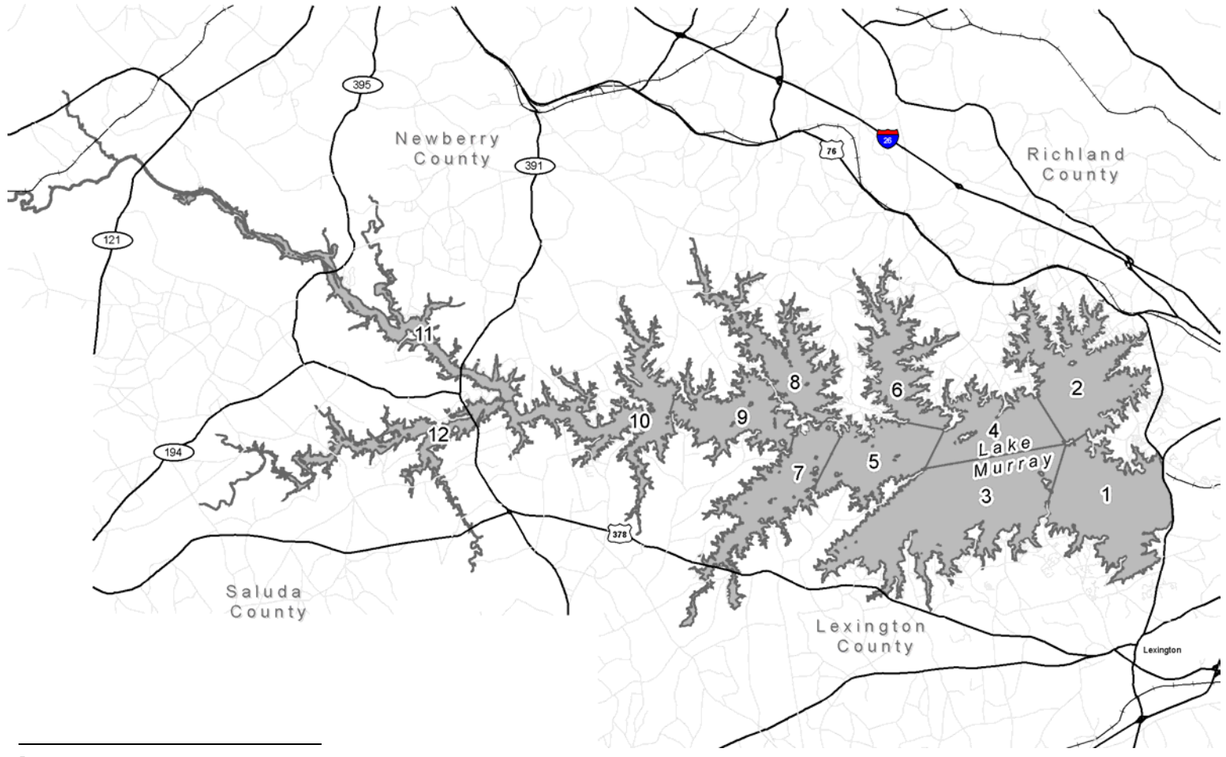


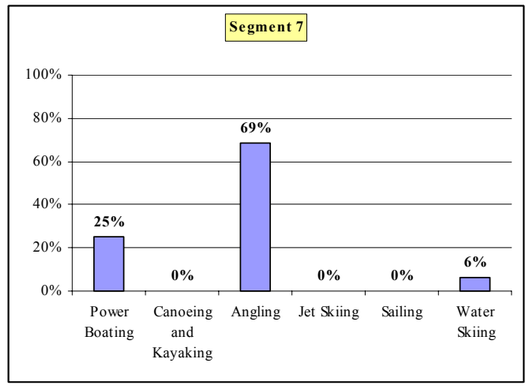
[6] Boating activity distributions are from information derived from public access areas only (Kleinschmidt, 2007) and applied to boat count estimates determined from aerial photographs.

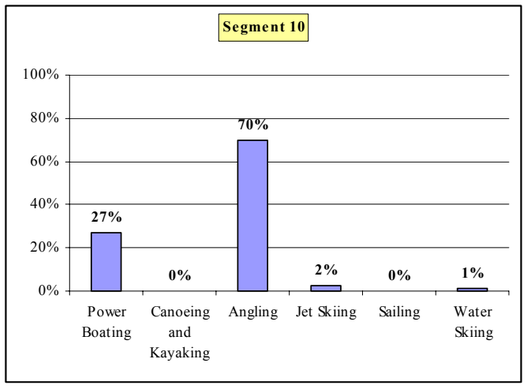
Figure 3-1: Distribution of Boating Use on Lake Murray on Weekends in 2006 by Activity and Lake Segment (cont'd)[7]

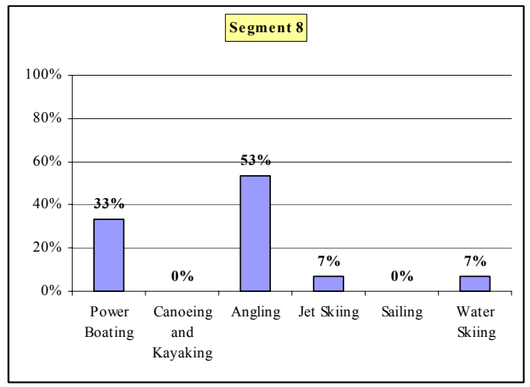
ACTIVITY	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12
Power Boating	14	13	11	20	3	6
Canoeing and Kayaking	0	0	0	0	2	0
Angling	39	21	15	52	13	17
Jet Skiing	0	3	0	2	1	1
Sailing	0	0	0	0	0	0
Water Skiing	4	3	0	1	1	1
Total [a]	56	39	26	75	19	25

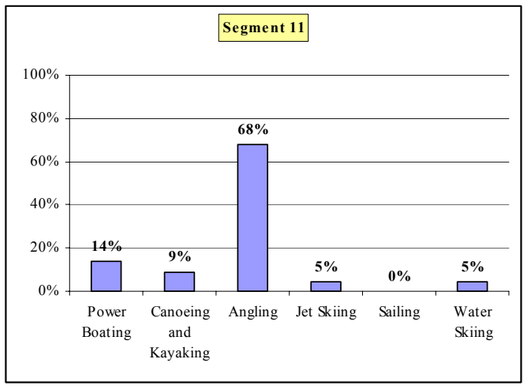
[a] The total average may not add up to the sum of individual activities due to rounding.

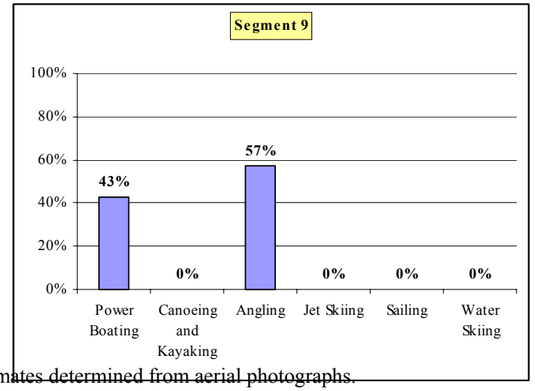


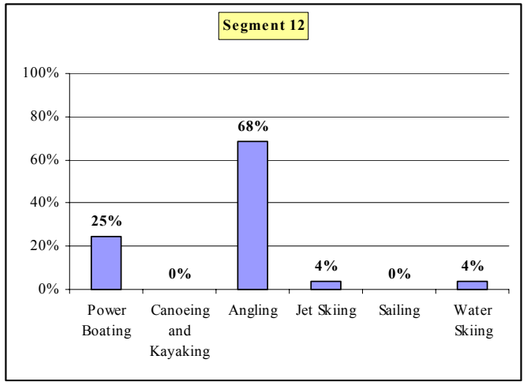










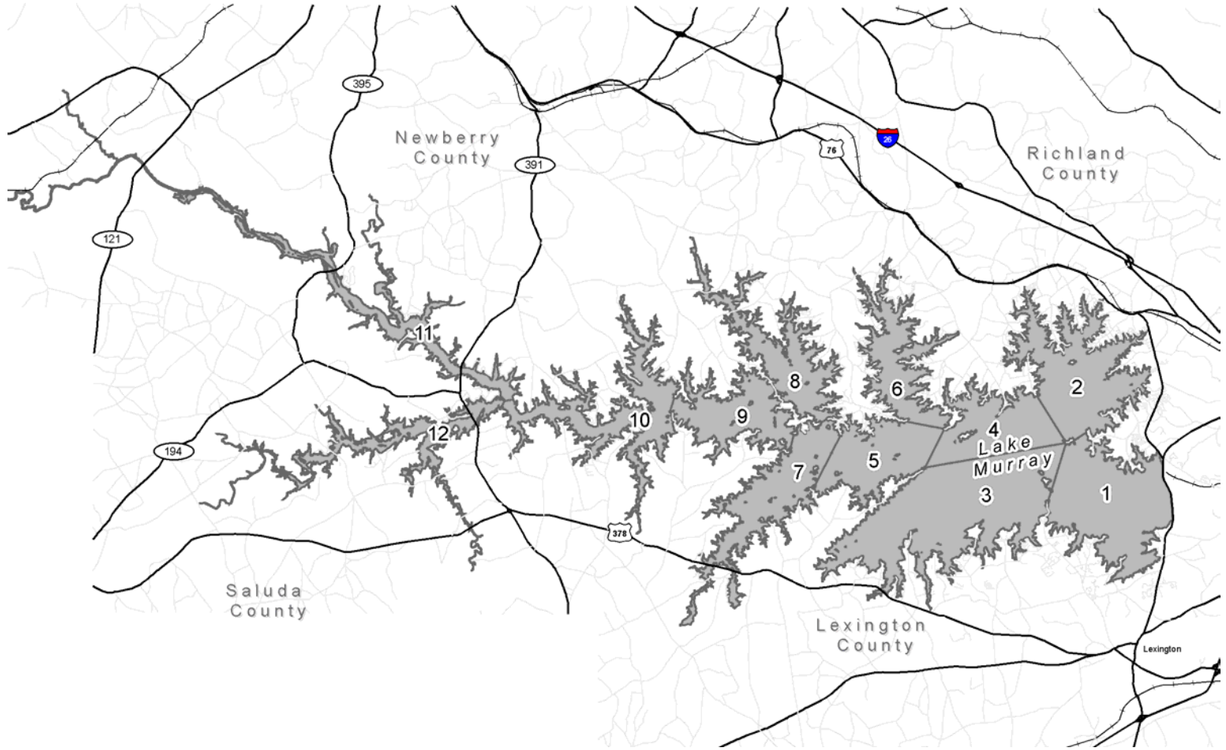


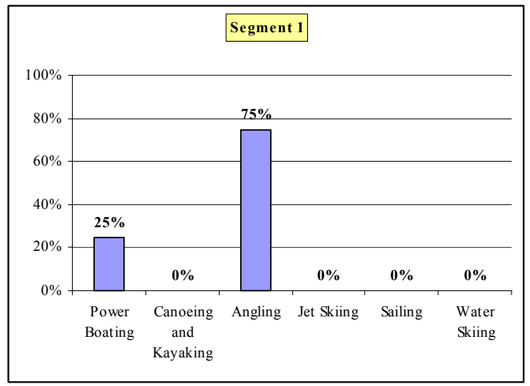
[7] Boating activity distributions are from information derived from public access areas only (Kleinschmidt, 2007) and applied to boat count estimates determined from aerial photographs.

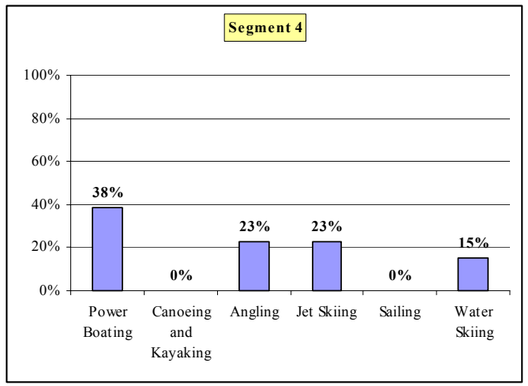
Figure 3-2: Distribution of Boating Use on Lake Murray on Holidays in 2006 by Activity and Lake Segment[8]

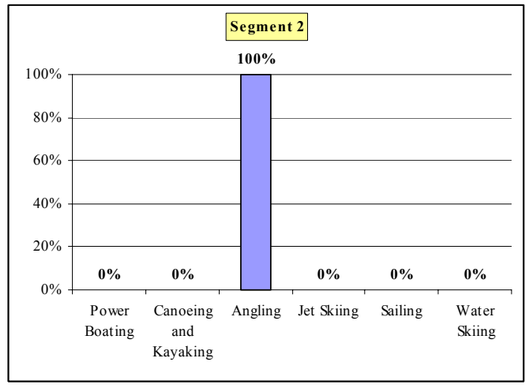
	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Power Boating	61	0	106	20	6	13
Canoeing and Kayaking	0	0	0	0	0	0
Angling	182	156	33	12	67	38
Jet Skiing	0	0	0	12	0	0
Sailing	0	0	7	0	0	0
Water Skiing	0	0	7	8	0	0
Total [a]	242	156	153	53	74	50

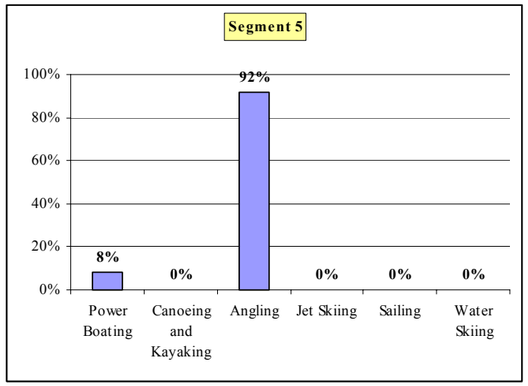
[a] The total average may not add up to the sum of individual activities due to rounding.

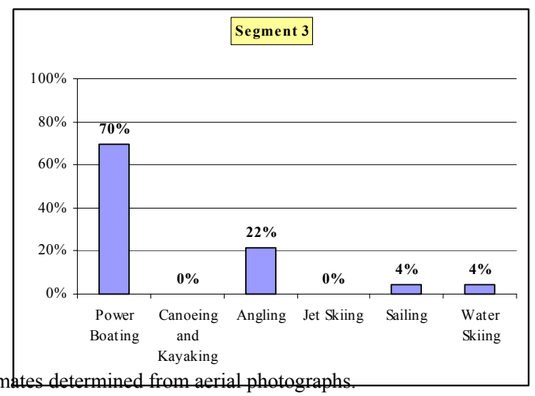


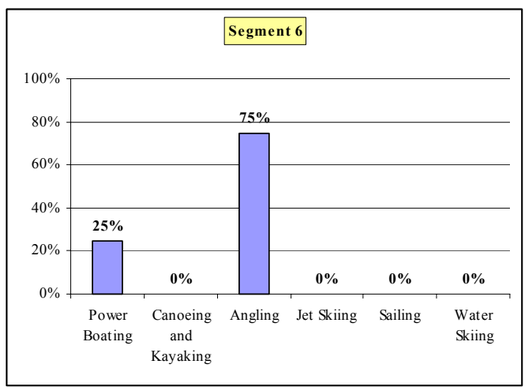










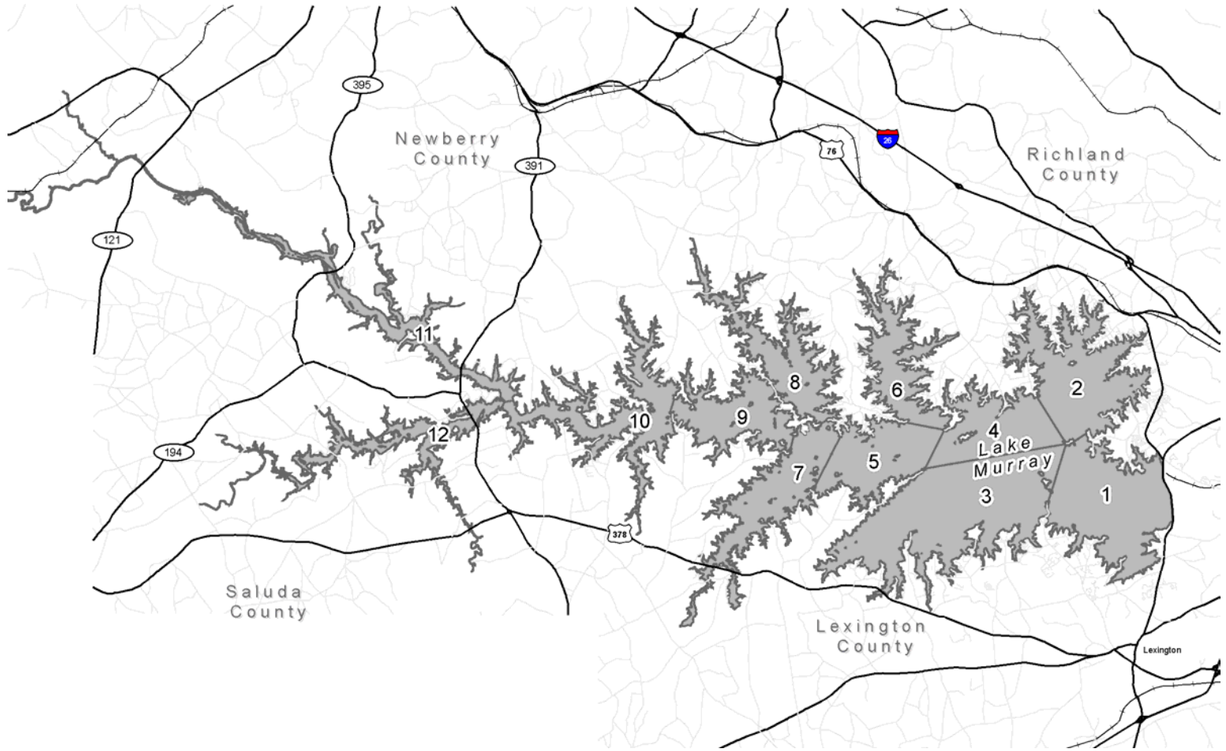


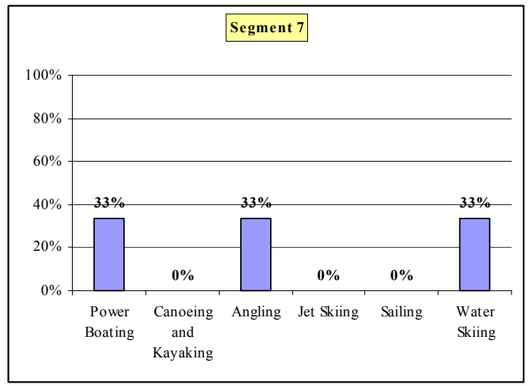
[8] Boating activity distributions are from information derived from public access areas only (Kleinschmidt, 2007) and applied to boat count estimates determined from aerial photographs.

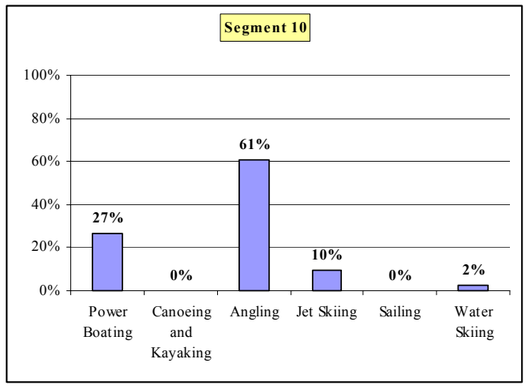
Figure 3-2: Distribution of Boating Use on Lake Murray on Holidays in 2006 by Activity and Lake Segment (cont'd)[9]

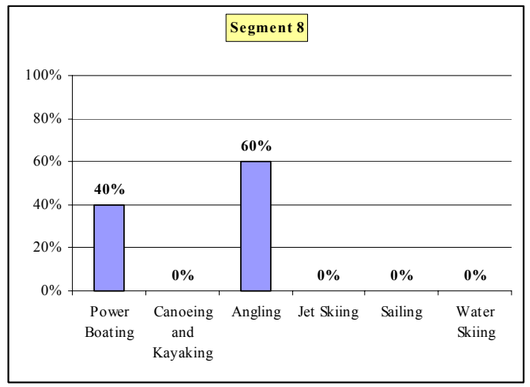
ACTIVITY	Segment 7	Segment 8	Segment 9	Segment 10	Segment 11	Segment 12
Power Boating	18	23	9	30	13	1
Canoeing and Kayaking	0	0	0	0	3	0
Angling	18	35	6	68	23	35
Jet Skiing	0	0	3	11	0	0
Sailing	0	0	0	0	0	0
Water Skiing	18	0	0	3	3	0
Total [a]	53	58	18	111	42	36

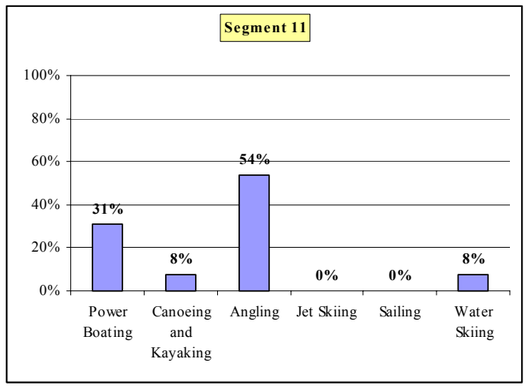
[a] The total average may not add up to the sum of individual activities due to rounding.

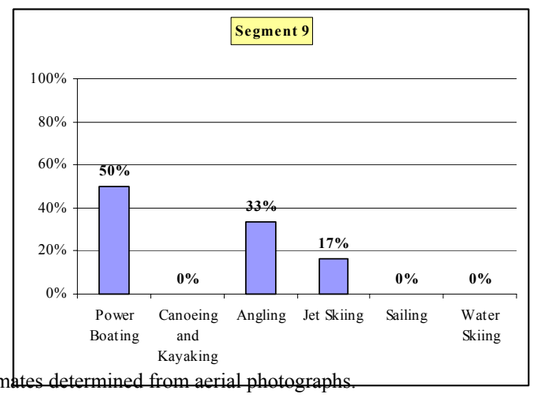


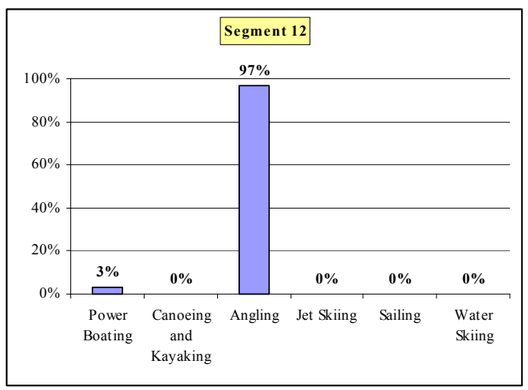












[9] Boating activity distributions are from information derived from public access areas only (Kleinschmidt, 2007) and applied to boat count estimates determined from aerial photographs.

Table 3-5: Estimated Optimum Recreational Boating Use by Segment

SEGMENT 1

Boat Activity	Usable Acreage	Use Factor	Max No. Boats [a]	Boat Activity Mix [b]
Power Boating (Unlimited)	5440.15	9.00	604	158
Canoeing and Kayaking (flat water) [c]	5740.40	1.30	4,416	0
Angling	5440.15	4.30	1,265	660
Jet Skiing	5440.15	12.00	453	59
Sailing	5440.15	4.30	1,265	0
Water Skiing	5440.15	12.00	453	39
Estimated Optimum Boating Use				916 boats

SEGMENT 2

Boat Activity	Usable Acreage	Use Factor	Max No. Boats [a]	Boat Activity Mix [b]
Power Boating (Unlimited)	4579.75	12.60	363	30
Canoeing and Kayaking (flat water) [c]	5132.48	1.78	2,883	0
Angling	4579.75	6.58	696	580
Jet Skiing	4579.75	15.20	301	0
Sailing	4579.75	6.00	763	0
Water Skiing	4579.75	15.20	301	25
Estimated Optimum Boating Use				635 boats

SEGMENT 3

Boat Activity	Usable Acreage	Use Factor	Max No. Boats [a]	Boat Activity Mix [b]
Power Boating (Unlimited)	8328.75	9.00	925	316
Canoeing and Kayaking (flat water) [c]	8814.81	1.30	6,781	0
Angling	8328.75	4.30	1,937	850
Jet Skiing	8328.75	12.00	694	68
Sailing	8328.75	4.30	1,937	94
Water Skiing	8328.75	12.00	694	51
Estimated Optimum Boating Use				1,379 boats

SEGMENT 4

Boat Activity	Usable Acreage	Use Factor	Max No. Boats [a]	Boat Activity Mix [b]
Power Boating (Unlimited)	3054.95	9.00	339	136
Canoeing and Kayaking (flat water) [c]	3275.25	1.30	2,519	336
Angling	3054.95	4.30	710	237
Jet Skiing	3054.95	12.00	255	0
Sailing	3054.95	4.30	710	0
Water Skiing	3054.95	12.00	255	34
Estimated Optimum Boating Use				742 boats

[a] usable acreage/use factor

[b] maximum number of boats * boating activity distribution

[c] As these activities can take place near shore, the total acreage for each segment is used for estimation.

SEGMENT 5				
Boat Activity	**Usable Acreage**	**Use Factor**	**Max No. Boats [a]**	**Boat Activity Mix [b]**
Power Boating (Unlimited)	3067.23	7.80	393	138
Canoeing and Kayaking (flat water) [c]	3291.23	1.14	2,887	0
Angling	3067.23	3.84	799	399
Jet Skiing	3067.23	11.00	279	28
Sailing	3067.23	4.00	767	0
Water Skiing	3067.23	11.00	279	14
Estimated Optimum Boating Use				579 boats

SEGMENT 6				
Boat Activity	**Usable Acreage**	**Use Factor**	**Max No. Boats [a]**	**Boat Activity Mix [b]**
Power Boating (Unlimited)	2453.97	14.40	170	43
Canoeing and Kayaking (flat water) [c]	2926.56	2.02	1,449	0
Angling	2453.97	7.72	318	212
Jet Skiing	2453.97	16.80	146	0
Sailing	2453.97	8.00	307	0
Water Skiing	2453.97	16.80	146	12
Estimated Optimum Boating Use				267 boats

SEGMENT 7				
Boat Activity	**Usable Acreage**	**Use Factor**	**Max No. Boats [a]**	**Boat Activity Mix [b]**
Power Boating (Unlimited)	3370.81	14.40	234	59
Canoeing and Kayaking (flat water) [c]	3865.75	2.02	1,914	0
Angling	3370.81	7.72	437	300
Jet Skiing	3370.81	16.80	201	0
Sailing	3370.81	8.00	421	0
Water Skiing	3370.81	16.80	201	13
Estimated Optimum Boating Use				371 boats

SEGMENT 8				
Boat Activity	**Usable Acreage**	**Use Factor**	**Max No. Boats [a]**	**Boat Activity Mix [b]**
Power Boating (Unlimited)	2654.33	10.80	246	82
Canoeing and Kayaking (flat water) [c]	3208.52	1.54	2,083	0
Angling	2654.33	5.44	488	260
Jet Skiing	2654.33	13.60	195	13
Sailing	2654.33	5.00	531	0
Water Skiing	2654.33	13.60	195	13
Estimated Optimum Boating Use				368 boats

[a] usable acreage/use factor

[b] maximum number of boats * boating activity distribution

[c] As these activities can take place near shore, the total acreage for each segment is used for estimation.

SEGMENT 9				
Boat Activity	**Usable Acreage**	**Use Factor**	**Max No. Boats [a]**	**Boat Activity Mix [b]**
Power Boating (Unlimited)	2618.24	10.80	242	104
Canoeing and Kayaking (flat water) [c]	2964.74	1.54	1,925	0
Angling	2618.24	5.44	481	275
Jet Skiing	2618.24	13.60	193	0
Sailing	2618.24	5.00	524	0
Water Skiing	2618.24	13.60	193	0
Estimated Optimum Boating Use				379 boats

SEGMENT 10				
Boat Activity	**Usable Acreage**	**Use Factor**	**Max No. Boats [a]**	**Boat Activity Mix [b]**
Power Boating (Unlimited)	3164.10	10.80	293	79
Canoeing and Kayaking (flat water) [c]	3932.83	1.54	2,554	0
Angling	3164.10	5.44	582	404
Jet Skiing	3164.10	13.60	233	6
Sailing	3164.10	5.00	633	0
Water Skiing	3164.10	13.60	233	3
Estimated Optimum Boating Use				491 boats

SEGMENT 11				
Boat Activity	**Usable Acreage**	**Use Factor**	**Max No. Boats [a]**	**Boat Activity Mix [b]**
Power Boating (Unlimited)	2006.95	16.20	124	17
Canoeing and Kayaking (flat water) [c]	2893.23	2.26	1,280	116
Angling	2006.95	8.86	227	154
Jet Skiing	2006.95	18.40	109	5
Sailing	2006.95	9.00	223	0
Water Skiing	2006.95	18.40	109	5
Estimated Optimum Boating Use				298 boats

SEGMENT 12				
Boat Activity	**Usable Acreage**	**Use Factor**	**Max No. Boats [a]**	**Boat Activity Mix [b]**
Power Boating (Unlimited)	1560.55	16.20	96	24
Canoeing and Kayaking (flat water) [c]	2246.45	2.26	994	0
Angling	1560.55	8.86	176	121
Jet Skiing	1560.55	18.40	85	3
Sailing	1560.55	9.00	173	0
Water Skiing	1560.55	18.40	85	3
Estimated Optimum Boating Use				150 boats

[a] usable acreage/use factor

[b] maximum number of boats * boating activity distribution

[c] As these activities can take place near shore, the total acreage for each segment is used for estimation.

Existing Recreational Boating Capacity

The recreational boating carrying capacity of each segment (Table 3-6) provides a comparison of current use levels to optimum use levels as determined from Table 3-5. Results show that Lake Murray is currently utilized well below its recreational boating capacity. Weekend percent capacity only exceeds 20 percent in Segment 2; six segments (1, 6, 7, 8, 10, and 12) had weekend percent capacities between 10 percent and 20 percent, with the remaining five segments (3, 4, 5, 9, and 11) being below 10 percent capacity on weekends. Percent capacity averaged about 12 percent on weekends across the entire reservoir. Holiday use, which is the peak use time for the reservoir, was higher in most segments, leading to higher percent capacities on holidays. Four segments (1, 2, 10, and 12) had percent capacities over 20 percent, with Segment 1 having the highest percent capacity (26 percent). Six segments (3, 5, 6, 7, 8, and 11) had percent capacities between 10 percent and 20 percent. The remaining two segments (4 and 9) were still below 10 percent capacity on holidays. Percent capacity averaged about 16 percent on holidays across the entire reservoir.

Table 3-6: Estimated Recreational Boating Carrying Capacity and Average Use Densities

		WEEKEND		HOLIDAY	
Segment	**Optimum Recreational Boating Capacity [a]**	**Average Peak Use [b]**	**Percent Capacity [c]**	**Average Peak Use [d]**	**Percent Capacity [e]**
1	916	112	12%	242	26%
2	635	138	22%	156	25%
3	1,379	121	9%	153	11%
4	742	42	6%	53	7%
5	579	43	7%	74	13%
6	267	49	18%	50	19%
7	371	56	15%	53	14%
8	368	39	11%	58	16%
9	379	26	7%	18	5%
10	491	75	15%	111	23%
11	298	19	6%	42	14%
12	150	25	17%	36	24%

[a] ((usable acreage/use factor) * boating activity distribution) summed for all activities per lake segment
[b] derived from aerial count estimates adjusted by population growth estimates
[c] (average peak weekend use/optimum recreational boating capacity) * 100
[d] derived from aerial count estimates adjusted by population growth estimates
[e] (average peak holiday use/optimum recreational boating capacity)* 100

4.0 CONCLUSIONS

Overall, according to the standards used in this analysis, Lake Murray is currently used at levels well below its estimated boating capacity. Factors that can influence boating use at the Project are discussed below. In addition, there are some limitations of this type of analysis, which will be addressed, along with recommendations regarding the use of these results.

In terms of number of boats, Segments 1, 2, and 3 are the most used segments in this study. Segment 10 is also heavily used on weekends and holidays. However, in terms of percent use capacity, while Segment 2 has the highest percent use capacity on weekends, Segments 6 and 12 have higher weekend percent use capacities than Segments 1, 3, and 10. Segment 6 is next to Dreher Island State Park, the most used public area on the lake (Kleinschmidt, 2007). Segment 12 is the smallest segment in the study, which resulted in a higher percent use capacity. Holiday percent use capacities reflect the same pattern, although the percent use capacity in Segment 3 is somewhat level. Because of its size, Segment 3 can theoretically support the greatest numbers of boats, resulting in a relatively low percent use capacity. Overall, the reservoir is at about 12 percent use capacity on the weekends and 16 percent on holidays.

Results are based on the calculated acreages of Lake Murray at full pond (360 ft PD). However, the water level at Lake Murray fluctuates, which impacts the amount of surface area available for boating activities. At elevation 358 ft PD, there are about 40,464 acres of usable surface area available; at 356 ft PD, there are about 39,614 acres of usable surface area. Nevertheless, given Lake Murray's size and the average number of boats present on the water, these differences only minimally affect percent carrying capacity. At elevation 358 ft PD, there is a one percent average increase in percent capacities across all segments on weekends and about two percent on holidays. There is also a similar rise in percent capacities at elevation 356 ft PD. In both cases, most of the rise in percent capacities is attributed to Segments 11 and 12, which experience an average rise in percent capacities at the lower elevations of about seven percent, regardless of day type.

Based on current population projections, Lake Murray should not reach the optimum level of boating identified in this report during the proposed new license term (30 - 50 years). The South Carolina Budget and Control Board, Office of Research and Statistics (SCBCB, 2006a) provides population projections for the four counties surrounding the Project in five year increments to the year 2035. According to these data, this area will experience a growth rate of 29% between 2005 and 2035. If we exclusively look at these projections and relate them to increased boating use, no segment will approach capacity during this 30-year time frame. However, this is based on the current standards used in this report; it is likely these standards will change over time.

A number of factors were used in estimating the optimal level of boating activity within each lake segment. Among these were the multiple uses of the area, shoreline configuration, amount of open water, facility and shoreline development, and crowding. It is unlikely that some of these will change over time (shoreline configuration, amount of open water). However, other factors may change over time (*e.g.*, perceptions of crowding), which would affect optimal boating levels. Also, the analysis was based on a set of standards designed in the late 1970s, when maximizing recreational use of reservoirs was encouraged. The analysis assumes, for example, that anglers would use the entire reservoir for fishing. In reality, the area typically used for fishing is generally smaller than the entire reservoir. While the process allows for some modification of these standards based on local conditions, the standards will also change over time. For example, the BOR (1977) identified 0.5 acres of water per boat for angling. This would have meant that Segment 1 could have had over 10,000 boats as an optimal level (assuming fishing is the only activity taking place). This standard was considered out of date due to the changes in fishing boat technology since the 1970s and personal and professional experience at the Project. As a result, that standard was modified to a more reasonable 4.3 acres of water per boat. It is likely that other standards will change in the future, which means the optimal levels of boating activity, as identified in this report, will likely change as well.

While the data used for obtaining the final boat count estimates was reflective of all boating use occurring at the Project, the boating activity distributions came from data obtained from public access site users. For this analysis, it was necessary to assume the distribution of boating activity is the same for shoreline residents and commercial patrons as it is for public access site users. Although the boating activity distributions were applied to the boat count estimates to determine the number of boats participating in each activity, different distributions would not have affected the total number of boats in each segment. However, different use distributions would have affected the estimated optimum use of each segment, which in turn would affect the percent use capacities of the respective segment. Since we also used boating activity distributions to estimate the number of boats participating in each activity, different distributions would also affect the numbers of boats by type of activity, but not the total number of boats in each segment. If activity distributions are different between public and private access users, the estimated optimum boating levels and percent capacities of each segment are likely different than actual conditions on the reservoir.

The area surrounding the Project is one of the fastest growing areas in South Carolina. As mentioned previously, the counties surrounding the Project have experienced a 4.5% rate of growth since 2001. However, this population growth may not lead to increased boating use of Lake Murray. In fact, three of the four counties surrounding the Project, Lexington, Newberry, and Richland, have experienced 15.4%, 4.1% and 6.3% declines in boat registrations, respectively, from 2000 to 2004. Only Saluda County had any growth in boat registrations (0.4%) over the same period (SCBCB, 2006b). The growth in Saluda is somewhat surprising considering Saluda County is estimated to have lost population over the same period (U.S. Census Bureau, 2006). Nevertheless, it is postulated that use of straight population increases over the time from when the photographs were taken to 2006 provided a conservative estimate of boating use on Lake Murray.

Caution should be used when using these results in future recreation planning. Our estimation of boat capacity and optimum levels of boating use should not be viewed as a "magic number" that dictates when the lake is over used. As mentioned previously, societal norms can and do change over time. Boating technology changes over time as well. It is difficult to forecast what levels of use will be "optimal" in the future given these unknowns. However, our results do show that Lake Murray can accommodate additional boats without detriment to the boating experience. Nevertheless, there are some segments where additional access might exacerbate perceived crowding problems. For example, Sections 1, 5, 6, and 7 had mean crowding ratings of over 3 on a 5-point scale (rated on a scale of 1 to 5 where 1 was "light", 3 was "moderate," and 5 was "heavy"). Additional access in these areas could increase perceptions of crowding to an unacceptable level. Also, some of the public access sites in these sections were identified as being at or approaching their design capacity (Kleinschmidt, 2007). Crowding at the access sites could lead to perceptions of on-water crowding and should be taken into account during any future planning. Sections 11 and 12 had the lowest crowding ratings (1.78 and 1.62, respectively) and might accommodate additional use without negatively impacting the recreation experience. This does not mean that additional access is needed in these areas, but these are concerns that should be addressed in future recreation planning.

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