Social-economic Benefits from Potential Changes in Water Releases from John H. Kerr Reservoir (Cooperative Agreement: W912HZ-14-2-0011)

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February 20, 2015

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Cooperative Agreement: W912HZ-14-2-0011

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Acknowledgements

The authors would like to thank Mr. Frank Yelverton of the U.S. Army Corps of Engineers, Wilmington District, whose inspiration and leadership launched this project. We also thank Mr. Chuck Peoples, Northeast North Carolina Program Director for The Nature Conservancy, for supplying encouragement, hydrologic modeling data, and plenty of patience as our university department underwent coincidental downsizing. Thanks also to the Cameron School of Business for $1,000 to help support an additional student field surveyor. As always, Mr. Marc Maus of UNC-Wilmington provided firm resolve and a steady hand as we navigated the university sponsored projects process. Ms. Jennifer Mackethan of the UNC-Wilmington Swain Center provided excellent contracting and human resources assistance. We would be remiss if we forgot to thank Chase bank, whose credit card division financed this study until the university finally figured out how to pay us back for project expenses. Finally, we must thank our intrepid undergraduate field surveyors, Mr. Mansfield Fisher, Mr. Ben Driscoll, Ms. Kathryn "Kat" Tregaskis, and Ms. Alexia "Lexi" O'Brien for hard work, excellent attention to detail, and the ability to "adapt and overcome" during the summer of 2014 while braving the elements to collect the recreational survey data for this study.

Executive Summary

- This study examines the effects of a potential change in water management policy on recreational activities at J.H. Kerr Reservoir and associated economic recreation value and economic impacts in the surrounding region.
- John H. Kerr Reservoir is managed by the United States Army Corps of Engineers and is located along the NC/VA border, with the dam being located about 68 miles north of Raleigh, NC.
- Public recreation facilities and activities at J.H. Kerr include beaches, picnic areas, campsites, boat ramps and marinas.
- An "Existing/Baseline" (ca. 2014) water management policy is compared to an alternative "QRR" policy that should remove water from the system quickly, better maintain flood storage in the reservoir, more closely mimic the natural river hydrograph, reduce downstream flood duration, and reduce stress on the bottomland hardwood ecosystem during wet years.
- The study uses data from three sources: (1) USACE data on the numbers of visitor trips from 2010 to 2012, (2) TNC data on modeled water elevation levels, and (3) a field survey conducted in the summer of 2014 to collect new data on recreation activities.
- Analysis of the water elevation data reveals that the QRR scenario has more days per year at reservoir elevations of 295-297 feet and 301-302 feet compared to the baseline "Existing" scenario. The QRR scenario has fewer days per year at other water elevations, but especially fewer days at elevations 298-300 feet and 303+ feet.
- During the peak recreation summer season, water levels of 301'-303' occur more frequently under QRR, and water levels at other elevations (both higher and lower) occur less frequently, relative to the Existing scenario. At 302'-303', some amenities are available fewer days (flooded more days) per summer season under the QRR scenario. At 304'+, some amenities are flooded less frequently under the QRR scenario. The net effect is a small <u>increase</u> in the availability of recreational amenities over the summer season.
- For the Existing/Baseline water management scenario, 1,038,862 adult person-trips/yr. result in $26.9 million/year (M/yr) (year 2014 dollars) of direct impacts to output/sales in the J.H. Kerr region (within 10 miles of J.H. Kerr). These output/sales directly support an estimated 227 jobs, $4.73 M/yr in labor income (wages, salaries, and small business profits), $2.61 M/yr in capital income (interest, rent and dividend income for corporations), $954 thousand/yr. in state and local tax receipts, and $1.03 M/yr in federal tax receipts. With multiplier effects, the total impacts are $36.75 M/yr in output/sales in the local region, 326 jobs supported, $8.25 M/yr in labor income, $5.60 M/yr in capital income, $1.47 M/yr in state and local taxes, and $1.83 M/yr in federal taxes.
- The economic impacts of the QRR scenario are <u>positive</u> but small. The trip frequency model results indicate that roughly one in every 100 overnight recreationists will take an additional trip/yr.under the QRR scenario, while one in every 10 day trip recreationists will take an additional trip/yr.with a net result of an additional 21,518 adult person-trips/yr. under the QRR scenario (these additional trips are assumed to occur in the summer season). The additional trips under QRR support an additional $525 thousand/yr. in output/sales in the local region, 5 additional jobs, $116 thousand/yr. in additional labor income, $80 thousand/yr. in additional capital income, $22 thousand/yr. in additional state and local taxes, and $27 thousand/yr. in additional federal taxes.
- Economic recreation value model (RUM) results indicate that overnight visitors enjoy an additional $1.16 per adult person-trip in recreation value under the QRR scenario, and day use visitors enjoy an additional $3.75 under QRR. Aggregating by the number of summer season adult person-trips under the QRR scenario yields a gain of approximately $2.37 M/yr. in aggregate recreation value (compensating variation) at J.H. Kerr due to increased amenity availability under QRR.

Introduction and Study Area

John H. Kerr Dam and Reservoir (J.H. Kerr) was constructed in the 1950s by the United States Army Corps of Engineers (USACE) primarily for flood control and hydropower generation. The 50,000-acre reservoir is located along the NC/VA border (Figure 1), with the dam being located about 68 miles north of Raleigh, NC. The reservoir and the additional 55,000 acres of surrounding land now support substantial recreational activity. The timing and magnitude of water releases from the dam affect the quantity and quality of recreational opportunities in and around the reservoir as well as environmental quality in the Roanoke river downstream.

There are many public recreation facilities and activities within the J.H. Kerr management area that could be affected by changes in water levels due changes in water management policy. Including adjacent state-managed lands, over 100,000 acres with over900 miles of wooded shoreline surround the reservoir, bordering three counties in Virginia and three in North Carolina (USACE 2015b, USACE 2015c). An economic analysis conducted in 2012 found that recreation activity at J.H. Kerr was substantial and supported an estimated 1.6 million person-visits per year (USACE 2015c). However, of the 1.6 million person-visits, only 1.04 million were actual, recorded visits, and the remaining 0.56 million were computer model-estimated "Dispersed Use" visits, where visitors walk or drive onto the recreation area but do not use a designated recreation site. The computer model used to estimate the Dispersed Use visits is a national recreation visitation model used by the USACE and is not site-specific for J.H. Kerr reservoir. This study will take a conservative approach by focusing on the recorded visits and by omitting the computer model-estimated Dispersed Use visits.

Marinas, boat ramps, piers, swim beaches, picnic areas and camp grounds located along the shoreline supported an average of 1.09 million adult person-visits (not including Dispersed Use visits) per year from 2010 to 2012 (Tables 1-3, Figures 2a, 2b, 2c, Appendix I). Four campgrounds are operated

by the Corps of Engineers, seven by the North Carolina State Parks and two by the Virginia State Parks (Table 4). These campgrounds provide tent and trailer camping at both primitive and water/electric sites with boat ramps, bath facilities, beaches, playgrounds and hiking trails. In addition to campgrounds, the Corps of Engineers also operates several other day-use facilities for boat launching, swimming and picnicking. Furthermore, the recreational facilities at J.H. Kerr support many special events (Table 5) and educational/outreach activities (Table 6). The reservoir provides habitat for many game fish species. Kerr Reservoir is widely known for large-mouth bass and striped bass fishing. Resident and non-resident fishing licenses from Virginia or North Carolina are recognized on all reservoir waters, and over 100 fishing tournaments were held on the reservoir annually from 2010 and 2013.

Existing water releases from J.H. Kerr are generally limited to a maximum of 20,000 cubic feet per second (cfs) during flood operations, unless lake levels in the reservoir reach 312 ft., when flood releases can be increased to 25,000 cfs, or 35,000 cfs, when the reservoir level reaches 315 ft. Because of this flood release plan, during wet years 20,000 cfs can be released for a long period (several months) during the summer season, which stresses bottomland hardwood trees and the associated ecosystem. It has been proposed that more frequent releases of 35,000 cfs would remove water from the system quickly, better maintain flood storage in J.H. Kerr reservoir, more closely mimic the natural river hydrograph, reduce downstream flood duration, and thus reduce stress on the bottomland hardwood ecosystem during wet years. However, changes in water management policy may affect recreational activities at J.H. Kerr.

Project Scope and Methodology

The purpose of this study is to examine the effects of a potential change in reservoir water management policy on recreational activities at J.H. Kerr Reservoir and associated economic recreation value and economic impacts in the region[1]. John H. Kerr Reservoir is managed by the United States Army Corps of Engineers and is located along the NC/VA border, with the dam being located about 68 miles north of Raleigh, NC. The study region includes Halifax, Charlotte, and Mecklenburg counties in Virginia, and Granville, Vance and Warren Counties in North Carolina. There are two reservoirs downstream of J.H. Kerr (Lake Gaston and Roanoke Rapids) that are operated by Dominion Power. The evaluation includes J.H. Kerr but does not include Lake Gaston or Roanoke Rapids.

The study considers two reservoir water level management scenarios: a baseline "Existing" (circa 2014) reservoir water management policy, and an alternative "QRR" reservoir water management policy. These water management scenarios are based on modeled ("back-cast") reservoir water levels from 1930 to 2009 as defined more fully below in the "Reservoir Water Level Management Scenarios" section of this report. Data on recreational activities and expenditures are drawn from USACE visitation data from year 2012 and a field survey of recreationists conducted at the reservoir in the summer of 2014.

This project consists of four principal tasks: survey design, data collection, data analysis and report preparation. The project was conducted by principal investigators (PI's) Dr. Chris Dumas and Dr. Pete Schuhmann, who supervised field survey data collection efforts by UNCW student research assistants.

[1] Although the original project scope included an analysis of changes in recreational activities downstream of the reservoir dam, initial survey efforts indicated that very little activity was occurring on the river at the time of the survey (the primary fishing season is in the spring), and so the decision was made to focus project resources on the analysis of effects occurring at the reservoir itself.

Task 1—Survey Design. (May 2014)

Dr. Dumas and Dr. Schuhmann will design surveys to collect on-site information from J.H. Kerr recreationists. The survey data will be used in conjunction with USACE, NC State Parks, and VA State Parks site visitation data to estimate economic valuation models, including economic impact and travel cost models. Dr. Dumas and Dr. Schuhmann will also design a sampling plan to ensure that the survey sample is representative and appropriate for statistical analysis.

Task 2—Data Collection. (June—Aug. 2014)

On-Site Survey--UNCW students will collect survey data for 8 weeks (approximately June 15th to August 15th) at recreation sites along the shore of J.H. Kerr Reservoir. The students will live in a hotel in Henderson, NC, to minimize travel time to the project site. The survey sampling plan will ensure that all 7 days of the week and all hours of the day are sampled. The students will be paid, and the students' gas expenses will be reimbursed.

Additional Data—The PI's will contact USACE Wilmington District and The Nature Conservancy to obtain additional information on reservoir water elevations, aggregate recreational visits to the reservoir, recreation site elevations, and recreation sites flooded by water elevation.

Task 3—Data Analysis. (Sept.--Oct. 2014)

Dr. Dumas and Dr. Schuhmann will analyze the on-site survey data in conjunction with data provided by TNC and the USACE Wilmington District on the recreation facilities and activities at

the J.H. Kerr Reservoir site. Existing water management operations will be evaluated in comparison to an alternative scenario (the "QRR" scenario).

Economic travel cost models will be used to estimate the value of the recreation experience ("consumer surplus") for each scenario. The Travel Cost Method, one of the most widely-used revealed preference valuation techniques, uses information on actual travel behavior to estimate a trip demand curve from which the value of a resource can be derived. The demand curve is estimated using visitation data, including travel costs and the number of trips taken by individuals to a particular site. Using distance traveled as a proxy for the price of a trip, and the number of trips taken as quantity, individual or group demand curves can be estimated for a site or destination. The net economic benefits of a particular site or the value of the resources within each site can then be estimated. If a policy change results in the elimination of a recreation site (i.e., due to flooding) or a change in the quality of the site, the economic value of the change can be estimated.

The economic impacts of any changes in the numbers of recreation trips and/or trip expenditures will be calculated using the IMPLAN (Version 3) modeling software. This software is commonly used by business, government, and academic institutions to develop economic impact analyses. UNCW has the IMPLAN software and the 2012 IMPLAN datasets (the most recent available at the time of project proposal) necessary to conduct the analysis. Economic impacts will be estimated using input-output analysis (via IMPLAN) to track the flow of dollars between and among businesses, consumers, workers, and government agencies in the study region. Economic impacts include the direct effects of economic activity (spending) and the "indirect and induced" (or "multiplier") effects that follow from the direct effects.

Task 4—Report Preparation. (Nov.-Dec. 2014)

Dr. Dumas and Dr. Schuhmann will complete a report describing the study findings and provide both hardcopy and electronic versions to the project sponsors.

Data Collection

The results of this study are based on data from three sources: (1) the USACE provided data on the numbers of visitor trips to the recreation sites around J.H. Kerr Reservoir, (2) TNC provided data on water elevation levels in J.H. Kerr Reservoir, and (3) the study authors collected new data on recreation visitor origins, activities and monetary expenditures via field surveys.

The USACE (2015) provided data on the numbers of visitor trips (adult person visits) by recreation site (Table 1) and by month (Table 2) for J.H. Kerr reservoir for federal Fiscal Years (FY) 2010, 2011 and 2012. Additional detail was provided for FY 2012. For FY 2012, the distribution of visits across recreation activities (boating, camping, swimming, picnicking, etc.) was also provided (Table 3). These data were aggregate, not trip-level, for each recreation site and activity. The USACE also provided data on recreation site locations (Figures 2a, 2b, 2c), recreation site amenities (Figure 2a and Appendix 1), boat ramp elevations (Table 22) (USACE 2012), the number of individual campsites at each recreation site (Table 4) (USACE 2015), and the impacts of high water levels on the number of usable campsites, beaches, boat ramps and marinas on the shore of the reservoir (Table 23) (USACE 2015),

The Nature Conservancy (Chuck Peoples, personal communication) supplied data from the Roanoke River Basin Operations Model (RRBROM), as prepared by Hydrologics, Inc., on water elevation levels in J.H. Kerr Reservoir for two water management policies. The data consisted of the modeled reservoir elevation level in feet for each day from January 11, 1930, to December 25, 2009, for two

water management scenarios (Tables 20 and 21): the baseline “Existing” (circa 2014) reservoir water management policy, and an alternative “QRR” reservoir water management policy.

The authors of this study collected new data on recreation visitor origins, recreation activities and monetary expenditures using two field surveys conducted simultaneously (Tables 7-19). Originally, the project proposal called for data collection during the peak recreation season, from mid-May through mid- August 2014. However, due to delays in project funding, surveyors were in the field from June 24, 2014, through August 15, 2014. Two surveys were conducted simultaneously, an in-person intercept survey of recreationists in the field at recreation sites around the reservoir and a mail-back survey of boaters placed on the windshields (under the wiper) of vehicles with boat trailers parked in parking lots at marinas and boat ramps around the reservoir. The mail-back survey was conducted to ensure that boaters who were on the lake when the surveyors were in the field would be included in the survey sample (surveyors worked on shore and did not work in vessels on the reservoir). Two teams of two persons each (one male and one female on each team) conducted the in-person surveys. A survey sampling plan was developed with care to ensure that all recreation sites on both the Virginia and the North Carolina shores of the reservoir were surveyed at random with respect to day of the week and time of day (9am to 6pm). Surveyor effort was distributed across sites in proportion to the historical distribution of visitation across sites and the distribution of visitation across sites as observed in the field at the time of the survey. The goal of the survey sampling plan was to ensure that each recreational visitor to the reservoir had roughly the same probability of being selected for inclusion in the survey (the basic characteristic of a random sample survey).

Survey Results

Two field, intercept surveys were conducted simultaneously from June through August 2014: an in-person intercept survey of recreationists at recreation sites around the reservoir and a mail-back survey of boaters placed on the windshields (under the wiper) of vehicles with boat trailers parked in parking lots at marinas and boat ramps around the reservoir. The results from the field surveys are used to estimate the monetary expenditures of recreationists, the value of the recreation experience to the recreationists (i.e., consumer surplus), and the impacts of changes in reservoir water management policy on the numbers of recreational trips, consumer surplus, expenditures, and associated economic impacts.

An issue that arises in field intercept surveys is "avidity bias." Avidity bias can occur when all individuals (e.g., recreationists) surveyed do not make the same number of trips to the survey site per time period (e.g., per year). Individuals who make a larger number of trips per time period to the survey site have a higher chance of being surveyed than individuals who make a smaller number of trips. Statistics based on such data (such as the average age of an individual) can be biased towards the values of the individuals who make a larger number of trips. However, statistics calculated from such data can be corrected for avidity bias. The statistics provided in this report have been corrected for avidity bias using methods described in Thompson (1991). To conduct the avidity bias correction, we assume that the total number of adult visits to J.H. Kerr in 2014 is equal to the total number in 2012, or 1,038,862 adult person-trips, the most recent year for which USACE were able to provide visitation data. Assuming 1,038,862 adult person-trips per year based on the 2012 USACE visitor data, after adjusting for avidity bias an estimated 373,488 unique adults visited the reservoir at least once in 2014 (Some adults made more than one visit per year; see below.).

Of the 1,038,862 annual adult person-trips, an estimated 648,170 (or 62.39%) occurred in the summer season (May-Sept) based on the average percentage of annual trips occurring in the summer season from 2010 to 2012 (Table 2).

The summer 2014 in-person survey had a sample size of 600 completed surveys, and the windshield survey had a sample size of 376 returned and completed surveys, for a total sample size of 976. The response rate was over 90 percent (600 completed surveys / 656 attempted) for the in-person survey (the field surveyors reported that recreationists were very eager to take the survey) and about 36 percent (376 returned /1050 handed out) for the windshield survey. These are considered good response rates for these types of surveys.

The summer 2014 survey collected data on the annual number of trips to J.H. Kerr by each surveyed visitor. However, because the study focuses on changes in recreational activity in the summer peak recreation season (May-Sept), the survey focuses on trip characteristics (travel distance, expenditures, etc.) of summer season trips.

Based on the summer 2014 survey results, 49.17% of visitors were residents of NC, 45.87% were residents of VA, and 1.55% were residents of MD (Table 9). Residents of the following states were also represented in the sample at low frequency (less than 1%): WV, NY, NJ, PA, SC, AL, CA, DC, DE, FL, LA, MA, MO, NV, OH, TN. North Carolina-resident visitors came from 53 of the 100 North Carolina counties, with the highest visitation from Wake County (14.5% of NC visitors),Granville County (13.66%), Vance County (12.82%), Franklin County (8.61%), Durham County (4.83%) and Alamance County (4.2%) (Table 10). The Commonwealth of Virginia is divided into 95 counties, along with 39 independent cities that are considered county-equivalents for census purposes (Table 11). Virginia-resident visitors came from 74 of the counties and/or cities in Virginia, with the highest visitation from Mecklenburg County (13.48% of VA visitors), Halifax County (13.03%), Chesapeake City (6.07%), Chesterfield County (4.72%), Danville City (4.27%), and Charlotte County (4.04%).

Table 7 presents avidity bias-corrected descriptive statistics for all recreationists surveyed (both in-person survey and windshield survey) at J.H. Kerr Reservoir in summer 2014. (The variable names from Table 7 are provided in ALL CAPS in the narrative below.) The average adult visitor made an average (mean) of 2.77 visits per year (TRIPS12MO) to J.H. Kerr, but the number of visits per year ranged from 1 to 275 visits per year (some visitors live very close to the reservoir, are retired, and make frequent visits). Each trip lasted an average of 5.01 days (DAYS), with the number of days per trip ranging from 1 to 300. On average, survey respondents have been visiting J.H. Kerr for 17.68 years (YEARSRES), with some visiting for up to 66 years, and some visiting for the first time in 2014. The one-way distance between the respondents' location of trip origin and J.H. Kerr (TRAVMILE) ranged from 0 miles (for respondents with homes on the shore of the reservoir) to 547 miles, with an average one-way distance of 87.4 miles.

The number of adults (ADULTS) travelling together in a party (group) to the reservoir ranged from 1 to 30, with an average (mean) of 2.96. The number of kids (KIDS) travelling with each party of adults ranged from 0 to 20, with a mean of 1.54.

An estimated 53.3% of the survey respondents were male (MALE), and their ages (AGE) ranged from 19 to 70, with an average age of 49.4. An estimated 80.7% of respondents were married (MARRIED), and 72.8% were employed (EMPLOYED). Annual household income (INCOME) before taxes ranged from $20,000 to $300,000 per year, with an average of $75,779 per year. In terms of educational attainment (Table 8), about 53% of survey respondents had completed high school, with 38% of respondents completing college and almost 8% of respondents completing a graduate degree.

The distribution of survey respondents across recreation sites visited is presented in Table 12. Comparing the distribution of survey respondent sites visited with historical USACE data on the distribution of aggregate visits across sites from 2010-2012 (Table 1), the summer 2014 survey did well in terms of representing the distribution of visits by state: 42.84 percent of surveys were obtained from

NC sites, and 57.16 percent of all surveys were obtained from VA sites. These values compare well with 39.81 percent of all visits occurring at NC sites and 60.19 percent of all visits occurring at VA sites in the USACE data. However, the summer 2014 survey did over-sample or under-sample at some particular sites, relative to the USACE historical averages. The survey over-sampled somewhat at County Line, Henderson Point, Kimball Point, Nutbush Bridge, North Bend and Staunton. The survey under-sampled at Flemington, Grassy Creek, Satterwhite, Steele Creek, Clarksville and Tailrace. Over- and under-sampling could be due to a number of factors, including differences in visitation patterns across years, and variable weather affecting visitation and survey collection at particular sites on particular days of the summer 2014 sampling plan. In cases where the survey over-sampled, the characteristics of those sites and visitors will be somewhat over-represented in the analysis.

Over 13 percent of survey respondents reported visiting more than one recreation/fishing/boating site during their visit to J.H. Kerr (Table 7, variable OTHERSITES).

Information on participation by summer 2014 survey respondents in various recreational activities at J.H. Kerr is presented in Table 13. The data are presented for day users, overnight users and all users together. Respondents were allowed to select any or all of the activities. Over 71 percent of survey respondents report participating in beach recreation, 49 percent in power boating, 2 percent in sail boating, 18 percent in canoeing/kayaking, 19 percent in water skiing, 12 percent in jet skiing, 78 percent in swimming, 53 percent in fishing, 79 percent in camping, 29 percent in hiking, 31 percent in picnicking, 1 percent in golfing, and 20 percent in other activities. For comparison, information on recreational activity participation from USACE visitation data for year 2012 are presented in Table 3. Relative to the USACE data, the survey results reflect higher participation rates in all activities except "other." The results may not be directly comparable in that (1) the survey reflects activities in the summer months only, whereas the USACE data reflect activities over a full calendar year, (2) the survey reflects a larger percentage of overnight users and a smaller percentage of day users relative to the

USACE data (recreational activity use by day user / overnight user was not available for the USACE data), and (3) the methods / survey questions used by USACE to collect recreation participation data may be different from the methods / questions used in the 2014 summer survey. The present study will rely on the participation data from the 2014 summer survey, as the proposed water management policy changes will largely affect summer, "in water" recreational activities, and the 2014 summer survey uses a known, representative sampling data collection methodology.

The importance and relative uniqueness of the recreational opportunities at J.H. Kerr is underscored by respondents answer to the question: "If John H. Kerr Reservoir were not accessible, would you have made a trip somewhere else instead, or would you have stayed home?" Although 76.3 percent of respondents would have made a trip somewhere else instead, a full 23.7 percent would have stayed home and taken no trip if J.H. Kerr were not accessible (Table 7, variable NOACCESS). Those who stay home do not spend their dollars in the regional economy around J.H. Kerr (and, of course, some of those who make trips elsewhere would spend their dollars far from J.H. Kerr).

Survey respondents report spending an average of $462.40 per trip for all persons together participating in the trip (Table 7, variable TOTSPEND). Dividing by the average number of adults per trip, 2.96, results in an average expenditure of $156.22 per adult per trip.

Average expenditures per adult per trip by expenditure category (hotel, camping fees, food/bev, gasoline, etc.) for 2014 summer survey respondents are shown in Table 14 for all visit categories combined, Table 15 for day use visits to sites located in NC, Table 16 for day use visits to sites located in VA, Table 17 for overnight visits to sites located in NC, and Table 18 for overnight visits to sites located in VA. The results in these tables reflect expenditure patterns under the existing, baseline reservoir water management scenario. Expenditure values do not include expenditures made by "dispersed use" visits or "wildlife area use" visitors. The mean value for each category includes expenditures of visitors

spending zero dollars in the category, such that the mean applies to all visitors, rather than to only those visitors who spent money in the category.

Reservoir Water Level Management Scenarios

The study considers two reservoir water level management scenarios: a baseline "Existing" (circa 2014) reservoir water management policy, and an alternative "QRR" reservoir water management policy (Figure 3). An annual frequency distribution of reservoir water elevations was developed for each scenario using output from the Roanoke River Basin Operations Model (RRBROM), as prepared by Hydrologics, Inc. (Table 20) The model output consisted of the reservoir water elevation levels in feet for each day from January 11, 1930, to December 25, 2009, for each scenario. On average across all months of the year, the QRR scenario has more days per year at reservoir elevations of 295-297 feet and 301-302 feet compared to the baseline "Existing" scenario. The QRR scenario has fewer days per year at other elevations, but especially fewer days at elevations 298-300 feet and 303+ feet.

Because this study considers the impacts of water management policy on recreation, the analysis focuses on the peak recreation season, the 153 day period from the beginning of May through the end of September. Table 21 presents the annual frequency distribution of reservoir water levels during the peak recreation season period for each scenario. Under both scenarios, the reservoir water elevation is between 297 feet and 304 feet (inclusive) more than 93 % of the time during the peak recreation season. For the purposes of this study, the *differences* between the two frequency distributions are important. The differences are presented in the right-most two columns of Table 21. A positive difference means that the reservoir water level at the indicated elevation occurs more often under the QRR scenario relative to the Existing scenario. Although there are very minor differences between the two distributions at high and low water levels, the significant difference is that under the

QRR scenario the reservoir water level occurs at 301 to 303 feet more frequently, and at other elevations (both higher and lower) less frequently, relative to the water levels that occur under the Existing scenario. (Although the QRR scenario also increases the number of days that the reservoir water level occurs at 295-297 feet over the course of the year, these days occur outside the May-September summer season.) That is, during the summer season, there are more days during which the water level in the reservoir is at a moderate level of 301 to 303 feet, and fewer days during which the water level is at a more extreme (either higher or lower) elevation, under the QRR scenario relative to the Existing scenario.

Economic Impact Methodology and Results

An economic impact analysis considers both the direct economic effects of a change in a regional economy and the "indirect and induced" (or "multiplier") economic effects that follow from the direct effects.

The "regional economy" considered in this study is defined by a collection of counties: Halifax, Charlotte, and Mecklenburg counties in Virginia, and Granville, Vance and Warren Counties in North Carolina.

The "change in the regional economy" considered in this study is a change in recreation activity at J.H. Kerr Reservoir resulting from a change in water management policy from the "Existing" polity to the "QRR" policy.

The “direct economic effects” are changes in economic activity due to changes in the following recreational activities around the reservoir:

- Overnight Activities
    - Camping at improved sites near the water
- Day Use Activities
    - Boating, with access to the reservoir via boat ramps or marinas
    - Swimming and Beach recreation
    - Picnicking at improved sites near the water

Although other recreational activities occur around the reservoir, such as hiking, biking and sightseeing, these activities would most likely be unaffected by the changes in the reservoir water level considered in this study.

The “indirect and induced (or “multiplier”) economic effects” are any changes in the economic activity of businesses that support or supply the directly-affected recreational sectors of the economy. For example, regional gas stations, restaurants, hotels, sporting goods stores, etc., support the recreational activities at the reservoir. When recreational activity increases at the reservoir, these businesses enjoy higher sales, hire more employees, pay more in wages, pay more in rents, interest and dividends, and pay more taxes that support increased government revenues. These are the “indirect” effects of the change in recreational activity. In addition, when the owners and employees of these businesses spend the additional wages and profits made possible by the increase in recreational activity, additional economic effects occur; these are the “induced” economic effects of the change in recreational activity.

Input-output analysis is used by economists to track the flow of dollars between and among businesses, consumers, workers, and government agencies in a study region. Input-output analysis is commonly used by economists to estimate the "indirect and induced effects" (or "multiplier effects" or "ripple effects") of a change in a regional economy. IMPLAN Professional® Input-Output Analysis computer software (IMPLAN Group LLC. 2014) will be used in this study to conduct input-output analysis. IMPLAN is a leading input-output modeling software package used by university researchers, government agencies, and consultants nationwide. The IMPLAN software tracks over four hundred industry sectors, and local, state and Federal government sectors, on a county-by-county basis. The developers of the IMPLAN software also market a county-level database that tracks the flow of dollars between and among businesses, consumers, workers, and government agencies at the county level. The database is developed from government surveys of businesses and consumers, employment data, etc. The IMPLAN software and database will be used together with data supplied by USACE to estimate economic multiplier effects associated with changes in recreational activity at J.H. Kerr Reservoir.

Input-output analysis provides measures of five categories of economic effects: changes in (1) economic output (sales), (2) employment, (3) "labor income" (wages and small business profits), (4) "capital income" (rental, interest and corporate dividend income), and (5) government tax and fee revenues.

Economic Impacts of the Existing/Baseline Reservoir Management Scenario

The direct economic impacts of recreationist expenditures within the local region (within 10 miles) of J.H. Kerr reservoir under the Existing/Baseline water management scenario are based on the year 2012 trip numbers from USACE and the expenditure per trip data from the summer 2014 survey.

To calculate the direct economic impacts, the numbers of adult person-trips[2] per year for four recreationist subcategories (Table 26, "Existing/Baseline Scenario" column) are multiplied by the average expenditure per adult per trip for the various expenditure categories (Tables 15-18) and then multiplied by the percentage of expenditures occurring within 10 miles of J.H. Kerr reservoir by recreationist subcategory and expenditure category (Table 19). These values are then summed over recreationist subcategories to obtain aggregate expenditures in each expenditure category. The aggregate expenditures in each expenditure category are the direct economic impacts to output (sales) that are entered into the IMPLAN model. The IMPLAN model then calculates the other categories of direct economic impacts (employment, labor income, taxes, etc.) and the regional "multiplier effects" (i.e., the indirect and induced effects) based on the direct economic impacts.

The economic impact results for the Existing/Baseline reservoir water management scenario are presented in Table 27, Panel A. All dollar impacts are presented in year 2014 dollars. Under the Existing/Baseline scenario, an annual average of 1,038,862 adult person-trips are made to J.H. Kerr[1]. These trips result in $26.9 million/year (M/yr) of direct impacts to output/sales in the J.H. Kerr region (within 10 miles of J.H. Kerr reservoir) (Table 27, Panel A, first row, first column). These output/sales directly support an estimated 227 jobs, $4.73 M/yr in labor income (wages, salaries, and small business profits), $2.61 M/yr in capital income (interest, rent and dividend income for corporations), $954 thousand in state and local tax receipts, and $1.03 M/yr in federal tax receipts.[3] In addition to these direct impacts, the economic "multiplier effects" within the region generate additional indirect and induced impacts. The total impacts are an estimated $36.75 M/yr in output/sales in the local region, 326 jobs supported, $8.25 M/yr in labor income, $5.60 M/yr in capital income, $1.47 M/yr in state and local tax receipt, and $1.83 M/yr in federal tax receipts (Table 27, panel A, bottom row).

[2] Note that the numbers of trips do not include "Dispersed Use" or "Wildlife Management Area" trips.
[3] Note that the labor income, capital income, and tax impacts are included in the output/sales impacts; they are not in addition to the output/sales impacts.

For comparison purposes, the Corps conducted an economic impact study of recreation activity at J.H. Kerr in 2012 (USACE. 2015c) that calculated economic impacts for 1,609,097 adult person-trips (a number of trips that included "Dispersed Use" trips and "Wildlife Management Area" trips, which are not included in the present, 2014 study) and multiplier effects within a 30-mile radius of J.H. Kerr (a larger area than the 10-mile radius used in the present, 2014 study). The 2012 USACE study found total impacts of $41.1 M/yr in output/sales in the local region, 677 jobs supported, $13.9 M/yr in labor income, and $10.8 M/yr in capital income (impacts on tax receipts not reported). The total impacts calculated in the present, 2014 study are comparable to the results of the 2012 USACE study when allowance is made for the fact that the 2014 study does not include "Dispersed Use" or "Wildlife Management Area" trips, and the 2014 study considers a smaller "local region" for the calculation of multiplier effects (a 10-mile radius for the 2014 study vs. a 30-mile radius for the 2012 study).

Economic Impacts of the QRR Reservoir Management Scenario

Calculating the changes in economic impacts due to a change in reservoir management scenario from the Existing/Baseline scenario to the QRR scenario is a several step process. First, the "Difference in Days per Summer Season" between the Existing/Baseline reservoir management scenario and the QQR scenario for each reservoir water elevation was determined. (Table 21, rightmost column).

Second, information from USACE on the reservoir water elevations at which various recreational amenities become flooded (Tables 22 and 23) was compared with the "Difference in Days per Summer Season" (Table 21) to determine the effects of the QRR scenario on the annual average availability of recreational amenities during the 153-day summer season (May-Sept) in terms of both the fraction of the amenity affected (e.g., 2 of 14 beaches) and the fraction of days during which the amenity is affected (e.g., 21.24 days of the 153-day summer season). These effects (Table 24) were determined

for the three primary recreational amenities affected by reservoir water elevations: beaches, campsites and boat ramps. Because water elevations are more frequently at 302'-303' under the QRR scenario relative to the Existing/Baseline scenario, some amenities are available for fewer days per summer season under the QRR scenario at these water elevations. However, water elevation are at 304'+ are less frequent under the QRR scenario compared to the Existing/Baseline scenario, so amenities are available for more days per summer season under QRR for these water elevations.

Third, the information on the fraction of each amenity affected and the fraction of days affected were combined to determine the change in the "percentage availability" of each amenity at each water elevation (Table 25). For example, 2 out of 14 beaches available for 21.24 fewer days per 153-day summer season (compared to the days of availability under the Existing/Baseline scenario) is defined as a 1.983% loss in availability of beaches during the summer season (1.983% = 0.01983 = (2/14)*(21.24/153)). The inverse example would also be true: 2 out of 14 beaches available for 21.24 more days per 153-day summer season (again, compared to days of availability under the Existing/Baseline scenario) would be defined as a 1.983% gain in availability of beaches during the summer season (1.983% = 0.01983 = (2/14)*(21.24/153)).

Fourth, changes in percentage availability of each amenity were included as a variable in the trip prediction model (see report section Modeling Changes in the Numbers of Trips below) to determine the effects of changes in recreational amenity availability on the numbers of trips taken by recreationists to J.H. Kerr reservoir. Changes in trips were calculated for all recreationists together, as well as four sub-categories of recreationists: day users visiting NC sites, day users visiting VA sites, overnight users visiting NC sites and overnight users visiting VA sites (Table 26, "Difference" column).

Fifth, the numbers of trips taken to J.H. Kerr by the various categories of recreationists were adjusted by the values in the "Difference" column of Table 26. For example, the total number of trips taken by all categories of recreationists together increases from 1,038,862 under the Existing/Baseline

scenario to 1,060,380 under the QRR scenario. Although some recreational amenities are flooded more often at 302'-303' under QRR, decreasing trips, other amenities are flooded less often at 304'+ under QRR, increasing trips, and the net effect is an increase in trips.

Sixth, under the assumption that expenditures per adult per trip remain the same, aggregate direct expenditures under the QRR scenario are calculated by multiplying the number of adult person-trips for each category of recreationist under the QRR scenario (Table 26, "QRR Scenario" column) by the expenditures per adult person-trip by recreationist category and expenditure category (Tables 15-18) and then by the percentages of each expenditure category occurring in the local region (Table 19). These aggregate direct expenditures are the direct impacts to output/sales reported in Table 27, panel B, first row, first column.

The economic impacts of recreation activity at J.H. Kerr reservoir under the QRR scenario are presented in Table 27, panel B. As for the economic impacts reported for the Existing/Baseline scenario, all dollar impacts for the QRR scenario are presented in year 2014 dollars. Under the QRR scenario, an annual average of 1,060,380 adult person-trips are made to J.H. Kerr[1], an increase of 21,518 adult person-trips per year relative to the Existing/Baseline scenario. These trips result in $27.3 M/yr of direct impacts to output/sales in the J.H. Kerr region (within 10 miles of J.H. Kerr reservoir) (Table 27, Panel B, first row, first column), an increase of $387 thousand/year relative to the Existing/Baseline scenario. These $27.3 M/yr of direct output/sales support an estimated 230 jobs, $4.80 M/yr in labor income (wages, salaries, and small business profits), $2.65 M/yr in capital income (interest, rent and dividend income for corporations), $969 thousand/year in state and local tax receipts, and $1.05 M/yr in federal tax receipts.[4] In addition to these direct impacts, the economic "multiplier effects" within the region generate additional indirect and induced impacts. The total impacts are an estimated $37.28 M/yr in output/sales in the local region, 331 jobs supported, $8.37 M/yr in labor income, $5.68 M/yr in capital

[4] Note that the labor income, capital income, and tax impacts are included in the output/sales impacts; they are not in addition to the output/sales impacts.

income, $1.49 M/yr in state and local tax receipt, and $1.86 M/yr in federal tax receipts (Table 27, panel B, bottom row).

The differences in economic impacts between the Existing/Baseline reservoir water management scenario and the QRR scenario are presented in Table 27, panel C. Including multiplier effects, the difference in total impacts are positive but small, with the QRR scenario supporting 21,518 additional adult person-trips per year, supporting an additional $525 thousand/year in total output/sales in the local region, 5 additional jobs, $116 thousand/year in additional labor income, $80 thousand/year in additional capital income, $22 thousand/year in additional state and local tax receipt, and $27 thousand/year in additional federal tax receipts (Table 27, panel C, bottom row).

Travel Cost Model Methodology and Results

Economic Values from Changes in Recreational Amenities

Economists define the economic value of a particular good or service as what it is *worth*, in terms of the contribution of the good or service to human well-being (Bockstael et al., 2000). This notion of value is most often measured by estimating what people are *willing and able to pay* for a good or service. Value is often confused with cost. However, cost is what people *actually pay* for a good or service, and is considered *expenditure*. The cost of acquiring a good or service may differ greatly from the economic value of that good or service. For example, a riparian engineering project may involve $x million in physical and engineering costs, but may generate considerably more (or less) than $x in economic value. Understanding the true economic value of changes in natural resources such as recreational amenities must therefore include estimation of actual expenditures as well as what people are willing and able to pay.

It should also be recognized that economic value extends beyond goods and services traded in formal markets to "*nonmarket*" goods and services such as clean air and water and healthy ecosystems. Further, economic value may include benefits to people derived without any direct use or interaction with the goods and services in question. These "non-use values" include benefits derived from simply knowing that a particular resource exists and benefits from the knowledge that resources may be available for potential future use or for future generations.

The estimation of non-market values is facilitated by a suite of well-established valuation techniques, including revealed preference methods and stated preference methods. For an in depth discussion on the full range of methods and the history of non-market valuation, see Bockstael, McConnell, and Strand (1989), and Bockstael, Hanemann, and Kling (1987).

Revealed preference methods use data on observable human behaviors where market goods are used together with non-market goods (Kahn, 1998), and include the travel cost method (TCM) and the hedonic pricing method (HP). By empirically connecting changes in natural resources and changes in the observed behavior of people, the value of the resource change can be derived. For example, changes in reservoir water levels may result in recreationists moving to another location and/or taking fewer trips.

The Travel Cost Method (TCM) is one of the most widely used revealed preference valuation techniques for the valuation of natural resources associated with recreation. TCM requires data on travel behavior by individuals who visit sites to interact with the natural environment. Using distance traveled as a proxy for trip price and the number of trips taken as quantity, the demand for a site or destination can be estimated. The value of (changes in) the resource can subsequently be derived.

Modeling Changes in Economic Value per Trip

The random utility model (RUM) is a variation of the travel cost method of valuation. The RUM is commonly employed for non-market valuation associated with recreation-based resources when

multiple destinations or sites are available for use. The choice of site by recreationists is modeled as a function of the satisfaction or "utility" derived from alternative sites. A utility function (mathematical equation) is specified as a function of site attributes (such as amenities, catch rates or water levels), and can be estimated using data on individual trips and site characteristics. The estimated utility function can then be used to estimate a measure of economic value known as the *compensating variation*. The compensating variation measures the economic value of a change in one or more of the site attributes or the economic value of a change in the availability of one or more sites, such as when a campsite is lost due to flooding.

The RUM framework assumes that, for each recreation trip occasion, an individual compares the utility that could be derived from each of the recreation site alternatives and then chooses the site with the highest expected level of utility. The utility functions[5] for each site, U, illustrated in equation (1), are specified to be a function of the price of recreating at site j, and a vector of site attributes, Z_{ijt}, and are comprised of both a systematic component, V, and a random and unobservable component ε_{ij}.

We will assume that the ith recreationist's indirect utility from a visit to site *j*, U_{ij}, is given by:

(1) $U_{ij} = V(TC_{ij}, Z_{ij}) + \varepsilon_{ij}$,

where:

TC_{ij} is the travel cost associated with a visit to site j by individual i,

Z_{ij} is a vector of observable variables that affect the utility derived from a visit to site *j* by recreationist *i,* such as site amenities, catch rates or water levels, and

ε_{ij} is the random (unobservable) component of utility known only to individual *i*.

Recreationist *i* visits site *j* if:

(2) $V(TC_{ij}, Z_{ij}) + \varepsilon_{ij} > V(Z_{ik}) + \varepsilon_{ik}$ for all $k \neq j$.

[5] Technically, these are conditional indirect utility functions.

That is, a recreationist chooses to visit site *j* if the utility from site *j* is higher than the utility from each of the other alternative sites.

Invoking the common modeling assumption that the error terms are independent and identically distributed as type 1 extreme value random variables, the probability, π_{ij} , that an individual will visit site *j* on a given trip can be estimated as:

(3) $$\pi_{ij} = \frac{exp(U_{ij})}{\sum_{j=1}^{J} exp(U_{ij})}$$

By specifying a functional form and using data on trips taken by many individuals across multiple sites, the indirect utility function in (1) can be estimated via the statistical method of maximum likelihood. Hanemann (1982) shows that for individual *i*, the expected value of the maximum of these site utilities can be represented by:

(4) $$I_{ij} = \ln \sum \exp (U_{ij}) + .577$$

This expected value, known as the "inclusive value", is a preference weighted measure of site costs and attributes. The more favorable are sites, the larger the measure in (4). This model can be used to estimate the economic value from an improvement in the quality of one of the site characteristics as the per trip compensating variation for the logit model:

(5) $$CV_{it} = \frac{1}{\beta_{TC}} \left\{ \ln\left[\sum_{j=1}^{J} \exp U_{ij}^{1}\right] - \ln\left[\sum_{j=1}^{J} \exp U_{ij}^{0}\right] \right\}$$

$$= (I_{ij}^{1} - I_{ij}^{0}) / \beta_{TC} \ ,$$

where:

β_{TC} is the coefficient on travel cost in the indirect utility function,

U^0 and U^1 represent utility before and after the quality change, and

I_{ij}^0 And I_{ij}^1 represent the pre- and post-quality change inclusive values as given in (4).

Further, as shown in Parsons et al. (2000), the loss in value associated with the elimination of a site from the choice set is given by the change in expected utility divided by the coefficient on travel cost:

(6) CV from the loss of site 1 = $\frac{1}{\beta_{TC}}\left\{\ln\left[\sum_{j=1}^{J}\exp U_{ij}\right]-\ln\left[\sum_{j=2}^{J}\exp U_{ij}\right]\right\}$

In the context of recreational use of the John H. Kerr Reservoir, recreational campers and boaters can be assumed to make trip decisions based on expected net benefits from a day visit (beach recreation, boating, hiking, etc.) or an overnight trip (camping and other activities). These benefits are a function of the costs and quality of the experience. Using data collected at beaches, picnic areas, camp sites and boat launch sites on the Reservoir, we employ the RUM framework above to estimate trip utility functions for recreational campers and boaters. These functions will be used to estimate the compensating variation or willingness-to-pay for changes in quality associated with QRR scenarios that affect reservoir water levels and (potentially) the availability of sites. These values will then be aggregated to derive estimates of the overall benefits of the policy changes to the entire user population.

In order to estimate the model outlined above, we specify a form for the indirect utility function by identifying observable variables which are likely to influence site choice. It is common to assume that the utility is linear in access costs and site quality. Access costs are measured as the sum of direct travel costs and the opportunity cost of travel time. The quality of each site is composed of observable site-specific attributes as well as estimates of expected fish catch rate.[6]

To estimate a RUM for site choice for recreational boaters and campers at the John H. Kerr Reservoir, we use site visitation data collected via in-person and mail-in surveys in the summer of 2014.

[6] As there are many of different species which could potentially be caught on a given fishing trip, having the catch rate of each species as a site characteristic is not a realistic option.

In order to maintain statistical power, sites with less than three observations were removed from the sample or were combined with proximate sites, creating a subsample of 578 observations and 16 sites from the in-person (beaches/picnic/camping) sample and a subsample of 369 observations and 23 sites from the mail-in (boating) sample. Sites used in each RUM are shown in Tables 28 and 29 below. Descriptive statistics for each of the samples are shown in Tables 30 and 31.

Tables 28 and 29 also list site-specific attributes for each site that are used to estimate the observable components of utility (equation 1) derived from the sites. Site-specific proxies for expected fish catch include average number of fish caught (all species) at the site reported by respondents in our data ("Average Catch") as well as the proportion of people who fished at that site and caught at least one fish ("Prob Catch"). Other quantitative variables expected to influence site choice include the number of campsites, the number of boat launches (ramp lanes) and the number of docks at each site. In order to control for the management agency at each site, indicator variables are created for North Carolina State and Virginia State parks, with USACE sites serving as the omitted category (base case). Indicator variables are also created for the availability of site amenities such as bathrooms, showers, swimming beaches, marinas, trails, and picnic areas.[7] We also create an indicator variable for fee-based sites. Finally, following Ben-Akiva and Lerman (1985), we control for the size of sites using the log of the number of parking places as an additional quality variable.

Explicit travel costs were estimated at $0.56 per mile, which was the standard mileage rate used to calculate the deductible costs of operating an automobile in 2014 by the Internal Revenue Service (IRS, 2013). Driving time was calculated assuming 45 miles per hour average speed. Respondent incomes were used to estimate the hourly wage assuming a 40-hour work week. Following Parsons and Needelman (1992), one-third of the wage is used as an approximation of the opportunity cost of time.

[7] Amenities available at each site were determined using personal counts by field surveyors, information available on websites, site maps and through the USACE Reservoir map.

An explicit form for equation (1), the indirect utility from a recreational trip to site *i* for recreationist *k,* is therefore given as:

(7) $V_{ik} = \alpha_1(\textit{travel cost}_{ik}) + \alpha_2(\textit{expected catch}_i) + \alpha_3(\textit{No. launches}_i) + \alpha_3(\textit{No. docks}_i)$

$+ \alpha_5(\textit{No. campsites}_i) + \alpha_6(\textit{NC agency}_i) + \alpha_7(\textit{VA agency}_i) + \alpha_8(\textit{bathroom}_i)$

$+ \alpha_9(\textit{shower}_i) + \alpha_{10}(\textit{swimming beach}_i) + \alpha_{11}(\textit{trails}_i) + \alpha_{12}(\textit{marina}_i) + \alpha_{13}(\textit{picnic area}_i)$

$+ \alpha_{14}[\log(\text{parking spaces}_i)]$

where:

$\textit{travel cost}_{ik} = (.56)^* (\text{round-trip distance}_{ik}) + [(.33)^*(\text{income}_k/2080)]^*(\text{round-trip distance}_{ik}/45)$, and $\textit{expected catch}_k$ = average catch at site k by all fishers surveyed at site k or percentage of fishers surveyed at site k that caught at least one fish.

To refine model fit, additional covariates can be created by interacting characteristics of recreationists (demographics, purpose of visit, etc.) with site-specific variables.[8] Hence, alternative specifications of (7) can be estimated. We estimate (7) separately for data collected from individuals interviewed in-person (at beaches, picnic areas, campsites) (n = 578) and individuals that responded to the mail-in survey distributed at boat ramps (n = 369).

Modeling Changes in the Numbers of Trips

Equations (5) and (6) above provide measures of per-trip economic value, or willingness to pay, for changes in site quality, such as changes in the number of unflooded campsites at a recreation area. For the purposes of estimating aggregate economic welfare effects, it is necessary to have a measure of the seasonal or annual economic value. The random utility model literature contains several

[8] Individual characteristics cannot be included in the site-choice model alone because such values to not vary over site alternatives.

alternatives for arriving at seasonal welfare measures for an change in the quality of recreational experiences.[9] Perhaps the most favorable alternative is to use information on the total number of trips taken by each recreationist and the site visited on each trip to model both participation and site choice in a repeated discrete choice framework.[10] Unfortunately, the problems associated with acquiring such detailed data usually prevent it from being obtained.[11] An alternative seasonal measure can be estimated using information on the number of trips taken over an extended period of time, without requiring recall regarding the location or dates of the trips. Given this information, an estimate of the annual value of an change in trip quality can be obtained by multiplying each individual's per trip economic value for the change by the number of trips reported for the year. However, such a measure may be an inaccurate measure of seasonal benefits because changes in site quality may result in recreationists changing their trip frequency.

To account for changes in trip frequency, a participation function must be estimated which allows us to predict the number of trips which will be taken by each individual given the changes in recreation site quality. A measure of seasonal benefits can then be obtained by adjusting the seasonal measure in (5) for the willingness to pay for the new trips taken following the improvement:

(8) *Annual* CV_{ik} *of site quality change*

$$= (\text{per trip } CV_{ik}) \cdot (\text{ predicted number of trips with quality change})$$

To estimate (8), we first model trip frequency by regressing individuals' annual number of trips to the JHK Reservoir on demographic characteristics and a measure of pre-change site quality such as the inclusive value (IV) shown in equation (4). We then predict trip frequency after the quality change by fitting the trip function to the new quality levels using the post-change inclusive value.

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[9] See for example, Morey, Shaw and Rowe (1991), Needelman and Kealy (1995), Parsons and Kealy (1995), and Smith and Kaoru (1986).

[10] See Carson, Hanemann, and Wegge (1987), or Bockstael, Hanemann, and Strand (1984).

[11] Collecting data on every trip taken by each individual surveyed requires a large additional time cost and poses difficulty for respondents in terms of accurate recollection of trip details.

To estimate changes in the numbers of trips due to changes in site characteristics, we model trip frequency as:

(9) $T^0_i = \beta_0 + \beta_1 (IV^0_i]) + \beta_2 [\ln(income_i)] + \beta_3 (age_i) + \beta_4 (male_i) + \beta_5 (VA\ Resident_i) + \beta_6 (Years\ JHK_i) + \beta_7 (employed_i) + \varepsilon_i$

where:

T^0_k is the reported number of trips to JHKR in the past 12 months by individual i,

IV^0_i is the pre-change inclusive value (expected utility) for individual i,

$\ln(income_i)$ is the log of income for individual i, [12]

age_i is the age of individual i,

$male_k$ = 1 if individual i is male, and = 0 if female,

Years JHK_i is the number of years the individual has been coming to JHKR,

$employed_i$ = 1 if individual i is employed, and = 0 otherwise, and

ε_i is an error term.

Because our data were collected on-site, trip frequency values are necessarily greater than or equal to 1. We are interested in understanding trip frequency decisions for the population of potential users of JHKR (not just those who happened to be intercepted by the field survey on site), hence we model (9) using a truncated negative binomial specification.[13]

[12] We use a simple OLS predictor of income for missing values, where dependent variables include age, age-squared, education level and indicator variables for marital status and gender.

[13] The truncated negative binomial specification is appropriate for count data where the value of zero cannot occur.

Economic Value per Trip (RUM) Results

Results for the site choice (RUM) model are shown in Tables 32 and 33 for in-person (beaches, picnic areas, camp sites) and mail-in (boat ramp) surveys respectively. Each table contains alternative model specifications. Goodness of fit measures indicate better model fit for the camp site sample, likely due to fewer sites over which choice is modeled. Fit is also improved with the inclusion of interaction terms, suggesting that recreationists have some degree of heterogeneity in their preferences. As expected, the coefficient on travel cost is consistently negative and highly significant for both samples, indicating that, all else equal, recreationists prefer travelling shorter rather than longer distances to reach recreation sites.

With regard to site characteristics, the coefficient on the number of boat launches (ramp lanes) is consistently positive and significant for both samples, indicating that both campers and boaters prefer sites with more boat-launch capacity. Perhaps counterintuitively, the number of docks at each site appears to detract from utility. However, this result could be an artifact of correlation with launch capacity. The presence of a swimming beach appears to add to the utility of recreationists in the camp site sample, and is either negative or insignificant in the boat launch sample. It may be the case that more human activity near the shoreline detracts from the utility of fishers, who comprise approximately 72 percent of the boat launch sample. The number of camp sites at each site is positive and significant for both samples, indicating that both groups of recreationists favor sites with more camping capacity.

While recreationists in the boat launch sample appear to favor sites managed by the USACE, those in the camp site sample appear to favor sites managed by a North Carolina agency. Sites with private marinas appear to detract from trip utility, perhaps due to additional noise and/or crowding associated with commercial boating activities. As might be expected, fee sites are viewed less favorably than non-fee sites, other factors held constant. Our proxy measures for expected catch (average catch

at the site and the percentage of fishers at the site that caught at least one fish) appear to capture a contribution to utility, but it seems that the former measure serves as a better measure for the boat launch sample, while the latter (less granular) measure is appropriate for the camp site sample. Finally, the presence of hiking trails at sites does not appear to contribute to the utility of recreationists in either sample.

The inclusion of interaction terms (shown in Models 3-5) improves model fit and leads to intuitive results. First, it appears that campers are willing to pay a premium for additional camp site capacity. The coefficient on the interaction term between the number of camp sites and a camping indicator variable is positive and significant. A similar result is found for recreationists engaged in day trips and the presence of a swimming beach as well as fishers and expected catch. Individuals on day trips appear to place a premium on beaches and fishers place a premium on catch.

Trip Frequency Model Results

Results of the trip frequency model (equation 9) are shown in Table 34. We note that the signs of the coefficients in this model are generally as expected, with older individuals and employed individuals visiting JHKR less frequently, and individuals with a longer history of visiting JHKR taking more frequent trips. Males in our mail-in sample appear to take more frequent trips. Trip utility (as measured by the inclusive value) is positively associated with trip frequency. These results are used to generate the expected number of trips under the QRR scenario.

Change in Economic Value Due to QRR Scenario

The QRR scenario is expected to change water levels in the Reservoir such that water levels of 302'-303' will occur more often and water levels above 304' will occur less often as shown in Tables 24 and 25. The increased frequency of water levels between 302' and 303' are expected to result in

beaches and campsites being available for 21.24 fewer days each summer, while the decreased frequency of water levels at 304' and above will result in beaches, campsites and boat ramps being available for 6.55 (2.2 + 2.6 + 1.75 = 6.56) additional days each summer. Because we do not know the specific sites that will be impacted, we assume that the effects are distributed evenly across the sites in each choice set. For example, with regard to more frequent water levels between 302'and 303', the QRR scenario suggests that 2 of 14 beaches (14.28 percent) and 47 of 1213 campsites (3.87 percent) will be unavailable for 21.24 days per summer (13.88 percent of the 153 summer days). The share-weighted losses in beach and campsite availability are therefore 1.98 percent and 0.54 percent over the 153 summer days impacted by more frequent water levels between 302'and 303'. We approximate the losses to recreationists associated with this aspect of the QRR change by assuming that the availability of beaches across the choice set declines by 1.98 percent per summer season and the availability of campsites declines by 0.54 percent per summer season. We use the similar methods for the other expected changes in water levels shown in Tables 24 and 25. We also estimate changes in economic value for the entire share-weighted QRR scenario (Table 25, rightmost column).

Using these quality changes, the per trip compensating variation measure shown in equation (5) is estimated using the coefficient estimates from Model 5 (Tables 32 and 33) assuming that beaches, campsites and boat launches across each choice set are impacted simultaneously by the QRR changes in water levels. These results are shown in Table 35 for each of the four water level changes (first four columns) independently, as well as for the aggregate changes induced by the QRR scenario (rightmost column). Because the increased frequency of water levels between 302' and 303' will result in diminished availability of beaches and campsites, compensating variation measures are negative for this aspect of the QRR for the in-person sample, which is largely comprised of overnight campers. However, values for these same water level changes are positive for the mail-in sample, which is largely comprised of fishers and boaters who have disutility from sites with campsites and beaches. The decreased

frequency of water levels above 303' results in positive welfare changes for both samples to such an extent that the overall change in benefits to recreationists from the QRR scenario is positive (values in rightmost column). Mean values of per-trip compensating variation range from $1.16 (in-person sample, overnight visitor) to $3.94 (mail-in, overnight visitor). In conclusion, while some trips will be negatively impacted by the increased frequency of water levels between 302' and 303', when taken together, the expected water level changes associated with the QRR scenario are expected to result in net gains in economic value per trip to recreationists at the JHKR.

We predict the expected change in trip frequency from the QRR scenario using the inclusive value from the QRR quality changes and the truncated negative binomial regression results for trips per 12 months (Table 34). As might be expected, the average increase in the number of trips per 12 months per person is relatively small. Individuals making overnight trips are expected to increase visitation by an average of approximately 0.01 adult person-trips per summer season (based on the in-person sample model in Table 34), while individuals making day trips are expected to increase visitation by an average of approximately 0.11 adult person-trips per summer season (based on the mail-in sample model in Table 34). We can interpret these results to suggest that roughly one in every 100 overnight recreationists will take an additional trip per year under the QRR scenario, while one in every 10 day trip recreationists will take an additional trip per year.

Based on these changes in trip frequency, we estimate that total visitation to the JHKR is likely to increase under the QRR scenario by the numbers of trips shown in Table 26 (last column), a total of approximately 21.5 thousand additional adult person-trips per year (Table 26, first row, last column), with all of these additional trips occurring in the summer season.

An approximation of net economic gains from the QRR scenario can be constructed by multiplying these per-trip compensating variation measures by the total numbers of trips to JHKR in the summer season (equation 7). The total numbers of adult person-trips to J.H. Kerr in the summer season

by category of recreationist under the QRR scenario are presented in Table 26 (NC day user trips = 241,149, VA day user trips = 372,131, NC overnight user trips = 30,346, VA overnight user trips = 26,037). Using the mean per-trip CV from the in-person sample for overnight trips ($1.16/trip) and the mean per-trip CV from the mail-in sample for day trips ($3.75/trip) yields a total gain of approximately $2.37 million per year in aggregate economic recreation value (gain in compensating variation) at J.H. Kerr due to QRR.

Discussion and Conclusions

The purpose of this study is to examine the effects of a potential change in reservoir water management policy on recreational activities at J.H. Kerr Reservoir and associated economic recreation value and economic impacts in the region. John H. Kerr Reservoir is managed by the United States Army Corps of Engineers and is located along the NC/VA border, with the dam being located about 68 miles north of Raleigh, NC. There are many public recreation facilities and activities within the J.H. Kerr management area that could be affected by changes in water levels due changes in water management policy, including beaches, picnic areas, campsites, boat ramps and marinas.

The study considers two reservoir water level management scenarios: a baseline "Existing" (circa 2014) reservoir water management policy, and an alternative "QRR" reservoir water management policy. It has been proposed that the QRR policy would remove water from the system quickly, better maintain flood storage in J.H. Kerr reservoir, more closely mimic the natural river hydrograph, reduce downstream flood duration, and thus reduce stress on the bottomland hardwood ecosystem during wet years. However, changes in water management policy may affect recreational activities at J.H. Kerr.

The study is based on data from three sources: (1) USACE data on the numbers of visitor trips to the recreation sites around J.H. Kerr Reservoir from 2010 to 2012, (2) TNC-provided data on modeled water elevation levels in J.H. Kerr Reservoir for the two policy scenarios, and (3) a field survey conducted in the summer of 2014 to collect new data on recreation visitor origins, activities and monetary expenditures.

Analysis of the water elevation data for the two policy scenarios revealed that, on average across all months of the year, the QRR scenario has more days per year at reservoir elevations of 295-297 feet and 301-302 feet compared to the baseline "Existing" scenario. The QRR scenario has fewer days per year at other elevations, but especially fewer days at elevations 298-300 feet and 303+ feet.

Because this study considers the impacts of water management policy on recreation, the analysis focuses on the peak recreation season, the 153 day period from the beginning of May through the end of September. During the summer season, under the QRR scenario the reservoir water level occurs at 301 to 303 feet more frequently, and at other elevations (both higher and lower) less frequently, relative to the water levels that occur under the Existing scenario. These changes in water level affect three primary recreational amenities: beaches, campsites and boat ramps. Because water elevations are more frequently at 302 to 303 feet under the QRR scenario relative to the Existing/Baseline scenario, some amenities are available fewer days (flooded more days) per summer season under the QRR scenario. However, water elevations of 304+ feet are less frequent under the QRR scenario compared to the Existing/Baseline scenario, so amenities are available more days (flooded fewer days) per summer season under QRR at these elevations . The net impact is a small increase in the availability of recreational amenities over the summer season under QRR.

The economic impact analysis for year 2014 assumes aggregate visitation of 1,038,862 adult person-trips per year (the actual value in 2012, not including "Dispersed Use" trips), with an estimated 648,170 trips (or 62.39%) occurring in the summer season (May-Sept) based on the average percentage of annual trips occurring in the summer season from 2010 to 2012. For the Existing/Baseline water management scenario, the 1,038,862 adult person-trips result in $26.9 million/year (year 2014 dollars) of direct impacts to output/sales in the J.H. Kerr region (within 10 miles of J.H. Kerr reservoir). These output/sales directly support an estimated 227 jobs, $4.73 million/year in labor income (wages, salaries, and small business profits), $2.61 million/year in capital income (interest, rent and dividend income for corporations), $954 thousand/year in state and local tax receipts, and $1.03 million/year in federal tax receipts. In addition to these direct impacts, the economic "multiplier effects" within the region generate additional indirect and induced impacts. The total impacts are an estimated $36.75 million/year in output/sales in the local region, 326 jobs supported, $8.25 million/year in labor income,

$5.60 million/year in capital income, $1.47 million/year in state and local tax receipt, and $1.83 million/year in federal tax receipts.

The economic impacts of the QRR scenario are positive but small. The trip frequency model results indicate that roughly one in every 100 overnight recreationists will take an additional trip per year under the QRR scenario, while one in every 10 day trip recreationists will take an additional trip per year, with a net result of an additional 21,518 adult person-trips per year under the QRR scenario (these additional trips are assumed to occur in the summer season). These trips support an additional $525 thousand/year in output/sales in the local region, 5 additional jobs, $116 thousand/year in additional labor income, $80 thousand/year in additional capital income, $22 thousand/year in additional state and local tax receipt, and $27 thousand/year in additional federal tax receipts.

Results from the model of economic recreation value per trip (the RUM) indicate that overnight visitors enjoy an additional $1.16 per adult person-trip in recreation value under the QRR scenario, and day use visitors enjoy an additional $3.75 per adult person-trip in recreation value under QRR. This additional value arises from more recreational amenities being available (not flooded) a larger percentage of the time (on net) during the summer season under QRR. Aggregating by the number of summer season adult person-trips under the QRR scenario yields a gain of approximately $2.37 million per year in aggregate recreation value (compensating variation) at J.H. Kerr due to QRR.

References

Ben-Akiva, M., and S.R. Lerman, Discrete Choice Analysis: Theory and Application to Travel Demand. MIT Press, 1985.

Bockstael, N. E., M. W. Hanemann, and C. L. Kling, 1987. "Estimating the Value of Water QualityImprovements in a Recreation Demand Framework." *Water Resources Research.*23:951-60.

Bockstael, N. E., A.M. Freeman, R. J. Kopp, P.R. Portney, and V. K. Smith, 2000. "On measuring economic values for nature." *Environmental Science and Technology* **34**: 1384-1389.

Bockstael, N.E., K.E. McConnell, and I.E. Strand, 1989. "A Random Utility Model for Sportfishing: Some Preliminary Results for Florida." Marine Resource Economics, 6: 245-60.

Carson, R.T., Hanemann, M.W., and Wegge, T. 1987. South-central Alaska Sport Fishing Economic Study. Report prepared by Jones and Stokes Associates, Sacramento, CA, for Alaska Department of Fish and Game, Anchorage, AK.

Hanemann, W. M. 1982. "Applied welfare analysis with qualitative response models". *Department of Agricultural & Resource Economics, UCB*.

IMPLAN Group LLC. 2014. IMPLAN version 3.0 software and 2012 dataset. Huntersville, NC. Available: http://implan.com/

Internal Revenue service, 2013. "2014 Standard Mileage Rates". IR-2013-95, Dec. 6, 2013.

Kahn, J.R., 1998. "The economic approach to environmental and natural resources", Dryden Press Fort Worth, TX.

Morey, E.R., Shaw, W.D., and Rowe, R.D. 1991. A Discrete-Choice Model of Recreation Participation, Site Choice, and Activity Valuation When Complete Trip Data Are Not Available. Journal of Environmental Economics and Management, 20:181-201.

Needelman, M.S., and Kealy, M.J. 1995. Recreational Swimming Benefits of New Hampshire Lake Water Quality Policies: An Application of a Repeated Discrete-Choice Model. Agricultural and Resource Economics Review, 24:78-87.

Parsons, G.R. and Kealy, M.J. 1995. A Demand Theory for the Number of Trips in a Random Utility Model of Recreation. Journal of Environmental Economics and Management, 29:357-367.

Parsons, G. R., D. M. Massey, and T. Tomasi, 1999. "Familiar and favorite sites in a random utility model of beach recreation". *Marine Resource Economics*, *14*, 299-315.

Parsons, G.R. and M.S. Needelman, 1992. "Site Aggregation in a Random Utility Model of Recreation", *Land Economics*, Vol. 68 (4): 418-433.

Miller, R. E., and P. D. Blair. 1985. *Input-Output Analysis: Foundations and Extensions*. Prentice Hall. 464 pp.

Smith, V.K. and Kaoru, Y. 1986. Modeling Recreation Demand Within a Random Utility Framework. Economics Letters, 22:395-399.

Thomson, Cynthia J. 1991. Effects of the Avidity Bias on Survey Estimates of Fishing Effort and Economic Value. *American Fisheries Society Symposium*. 12:356-366.

USACE. 2015. Personal communication. Mr. Michael Womack, Operations Project Manager, John H. Kerr Reservoir. United States Army Corps of Engineers. March 2015.

USACE. 2015b. *John H. Kerr Dam and Reservoir*. United State Army Corps of Engineers, Wilmington District. Available: http://www.saw.usace.army.mil/Locations/DistrictLakesandDams/JohnHKerr.aspx

USACE. 2015c. *Value to the Nation--Fast Facts, Lake Level Report: John H. Kerr Dam and Reservoir, VA and NC, Recreation 2012*. United States Army Corps of Engineers. Available: http://www.corpsresults.us/recreation/fastfacts/lake.cfml?lakeID=202

USACE. 2012. *John H. Kerr Dam and Reservoir—Final Master Plan.* United States Army Corps of Engineers. November.

Tables

Table 1. Average Annual Recreation Visitation (Adult Person-Trips) by Recreation Site, J.H. Kerr Reservoir, 2010-2012. (Source: USACE 2015.)

Recreation Site	USACE Map Site Number	Average Annual Visitation (Adult Person-Trips) 2010-2012	Percentage of Average Annual Total Visitation 2010-2012
Bluestone	31	29,249	2.67%
Buffalo Park	23	48,037	4.39%
Buffalo Spring	24	34,818	3.18%
Clarksville M.	22	37,810	3.45%
Clover	27	17,788	1.62%
Eagle Pt	36	7,134	0.65%
Eastland Creek	37	36,184	3.30%
Island Creek	19	20,540	1.88%
Ivy Hill	18	21,601	1.97%
Longwood	21	63,320	5.78%
North Bend	2	84,007	7.67%
Occoneechee	32	66,992	6.12%
Palmer Point	6	38,324	3.50%
Rudds	33,34	69,512	6.35%
Staunton View	30	15,404	1.41%
Tailrace	3	61,276	5.60%
Tanner Center	4	3,099	0.28%
Visitor Center	1	3,936	0.36%
VA Visitation	**Subtotal**	**698,530**	**60.19%**
Bullocksville	9	21,510	1.96%
CountyLine	8	23,712	2.17%
Flemingtown Rd	10	46,962	4.29%
Grassy Creek	20	39,500	3.61%
Henderson Pt	17	26,816	2.45%
Hibernia	16	35,143	3.21%
Kimball Pt	7	53,344	4.87%
Nutbush Bridge	13	58,209	5.32%
Satterwhite Pt P & M.	11,12	73,196	6.69%
Steele Creek M.	15	57,414	5.24%
NC Visitation	**Subtotal**	**396,306**	**39.81%**
	Total	**1,094,836**	**100.00%**

Note: Does not include estimated “Dispersed Use” visits.

Table 2. Average Annual Visitation by Month (Adult Person-Trips), J.H. Kerr Reservoir, 2010-2012
Source: USACE 2015.

Month	Average Annual Visitation 2010-2012	Percentage of Annual Visitation
OCT	72,994	6.69%
NOV	49,813	4.57%
DEC	29,541	2.71%
JAN	31,073	2.85%
FEB	31,574	2.89%
MAR	81,730	7.49%
APR	113,539	10.41%
MAY	140,589	12.89%
JUN	156,640	14.36%
JUL	167,417	15.35%
AUG	120,599	11.05%
SEP	95,393	8.74%
TOTAL	1,090,900	100.00%

Note: Does not include estimated “Dispersed Use” visits.

Note: An average of 62.39% of all annual trips occur in the summer (May-Sept) season. This study focuses on changes in recreational activity in the summer season.

Table 3. USACE Recreation Activity Participation Data for 2012 (person-trips)[1,3] (Source: USACE. 2015.)

Site Name	USACE Map Site Number	Camp	Picnic	Boat	Fish	Hunt	Waterski	Swim	Sightsee	Other
BLUESTONE BOAT RAMP	31	0	0	21013	16342	0	1623	1360	1358	21020
BUFFALO PARK	23	4260	2845	20295	14010	0	1705	4682	15899	25229
BUFFALO SPRINGS	24	0	7073	4629	3222	0	726	11725	9590	2986
BULLOCKSVILLE PARK	9	3472	1219	4992	4201	0	635	1561	5599	10810
CLARKSVILLE MARINA	22	0	0	2325	1527	0	0	230	14700	20707
CLOVER BOAT RAMP	27	0	537	7249	7596	0	0	1431	7346	8809
COUNTY LINE PARK	8	4405	1557	6327	5308	0	812	1996	7130	13618
EAGLE POINT BOAT RAMP	36	0	297	3116	3236	0	0	791	3492	3904
EASTLAND CREEK BOAT RAMP	37	0	1181	13535	14106	0	0	3146	14618	16771
FLEMINGTOWN ROAD LANDING	10	0	1531	25581	22624	0	1257	2145	8933	28681
GRASSY CREEK PARK	20	0	7560	5023	3333	0	836	13578	9946	2947
HENDERSON POINT PARK	17	4696	1680	5731	5619	0	877	2154	7652	14240
HIBERNIA PARK	16	7734	2656	11128	9449	0	1386	3399	12329	24437
ISLAND CREEK PARK	19	0	644	11188	10118	0	466	797	3612	13655
IVY HILL PARK	18	334	1437	9506	8933	0	1263	2261	7843	11786
KIMBALL POINT PARK	7	4831	3179	20368	13620	0	1932	5310	15776	24546
LONGWOOD PARK	21	2644	1726	29925	26745	37	2049	3389	13779	37915
NORTH BEND PARK	2	9544	1758	29234	25984	170	3797	6069	22963	51237
NUTBUSH CREEK PARK	13	6662	900	15467	12800	0	2391	3728	13704	43831
OCCONEECHEE STATE PARK & MARINA	32	5569	1416	34115	32895	709	2216	3609	16380	48055
PALMER POINT	6	0	6946	4797	2755	0	931	15208	8314	2047
RUDDS CREEK DAY USE AND CAMPGROUND	33,34	19107	12558	13415	14096	0	3081	19242	12881	25448
SATTERWHITE POINT PARK & MARINA	11,12	8503	1587	27255	24382	170	3337	5319	20361	49012
STAUNTON VIEW PARK & RIVER STATE PARK	29,30	0	3227	2094	1449	0	333	5372	4324	1326
STEELE CREEK MARINA	15	8072	2797	11787	9974	0	1442	3535	12846	27485
TAILRACE PARK	3	47	5179	8798	9938	43	0	0	26618	7700
	Totals[3]	89880	71490	348893	304262	1129	33095	122037	297993	538202
	Percentages[2]	8.65%	6.88%	33.58%	29.29%	0.11%	3.19%	11.75%	28.68%	51.81%

[1] Visitors could participate in more than one activity per trip. [2] Percentages of total 1,038,864 person-visits for J.H. Kerr in 2012. [3]Does not include estimated "Dispersed Use" visits.

Table 4. Number of Individual Campsites by Recreation Area, J.H. Kerr Reservoir.
(Source: USACE 2015.)

Site Name	USACE Map Site Number	Managing Agency	Individual Campsites	Site Class
BUFFALO	23,24	USACE	21	A
BULLOCKSVILLE	9	STATE NC	58	A
COUNTY LINE	8	STATE NC	66	A
HENDERSON POINT	17	STATE NC	74	A
HIBERNIA REC AREA	16	STATE NC	134	A
KIMBALL POINT REC AREA	7	STATE NC	67	A
LONGWOOD	21	USACE	66	A
NORTH BEND	2	USACE	244	A/B
NUTBUSH CREEK REC AREA	13	STATE NC	79	A
OCCONEECHEE STATE PARK	32	STATE VA	48	A
RUDDS CREEK	34	USACE	99	A
SATTERWHITE POINT (JC COOPER) REC AREA	11,12	STATE NC	109	A
STAUNTON RIVER STATE PARK	29	STATE VA	47	A
STEELE CREEK MARINA	15	STATE NC	40	A
TOTAL			1152	

Table 5. Special Recreational Events, 2010 and 2011.
(Source: USACE. 2015)

Special Events

2010

EVENT TYPE	NUMBER	PARTICIPANTS
Fishing Tournaments	124	13,516
Boat Regattas	2	150
Festivals	5	8,100
Sporting Events	3	2,155
Other Special Recreation Programs	1	700
Total	**135**	**24,621**

2011

EVENT TYPE	NUMBER	PARTICIPANTS
Fishing Tournaments	268	19,214
Boat Regattas	6	400
Festivals	2	6,000
Sporting Events	6	1,100
Other Special Recreation Programs	8	3,600
Total	**290**	**30,314**

Table 6. J.H. Kerr Reservoir Outreach Programs--2010, 2011.
(Source: USACE 2015)

Outreach Programs

Water Safety, Environmental, Corps Mission, Cultural, etc.

2010

CORPS RUN	NUMBER	PARTICIPANTS
On-site	38	2,866
Off-site	33	8,249
Indirect	119	119
Total	**190**	**11,234**

2011

CORPS RUN	NUMBER	PARTICIPANTS
On-site	30	2,368
Off-site	91	12,134
Indirect	156	156
Total	**277**	**14,658**

Table 7. Descriptive Statistics for All Survey Respondents (n = 976, avidity-bias adjusted).[1]

Variable	Sample Size[2]	Minimum	Maximum	Sum	Mean	Variance
Male	973	0	1	200581.107	0.533181	0.00051
Age	972	19	70	18617603.2	49.43766	0.323699
EdLevel	963	1	5	1324983.72	3.489197	0.001091
Married	963	0	1	306279.555	0.806553	0.000321
Employed	960	0	1	277276.955	0.727887	0.000392
Income	855	20,000	300,000	3.2441E+10	75779.37	6160782
YearsRes	926	0	66	6983345.67	17.67812	0.596988
Trips12Mo	972	0	275	1038862	2.770067	0.007519
TripsYr	970	1	200	739658.979	1.966147	0.004069
Moretrips	960	0	150	745859.403	1.962083	0.010475
ExpTrips12Mo	959	1	225	1472494.32	3.869538	0.01917
MainPurp	967	1	6	958058.015	2.533495	0.002246
Days	950	1	300	1928442.61	5.014594	0.023473
OtherSites	967	0	1	50958.3454	0.134755	0.000213
NoAccess	960	0	1	290402.22	0.763142	0.000345
TotSpend	940	0	15,000	179728965	462.4045	459.4601
Adults	927	1	30	1166619.44	2.956474	0.019891
Kids	927	0	20	609450.651	1.544484	0.011993
TravMile	967	0	546.82	33052693.1	87.40478	14.21346

[1]Includes data from all survey respondents, both in-person survey and windshield survey. This includes both day users and overnight users, and both North Carolina site visitors and Virginia site visitors.
[2]Sample size is sometimes less than the number of survey respondents because all respondents did not answer every survey question.

Table 8. Educational Attainment of Summer 2014 Survey Respondents.
(Source: Field survey by authors.)

Education Level Completed (EDLEVEL)	Number of Survey Respondents	Percent
Primary School (1)	3	0.36%
Secondary School (2)	18	2.16%
High School (3)	428	51.38%
College/University (4)	318	38.18%
Masters or other Graduate Degree (5)	66	7.92%
Total	833[1]	100.00%

[1] Not all survey respondents answered this question.

Table 9. Numbers and Percentages of Summer 2014 Survey Respondents by State of Residence. (Source: Field survey by authors.)

State	Number	Percentage
NC	476	49.17
VA	444	45.87
MD	15	1.55
WV	7	0.72
NY	5	0.52
NJ	4	0.41
PA	4	0.41
SC	2	0.21
AL	1	0.1
CA	1	0.1
DC	1	0.1
DE	1	0.1
FL	1	0.1
LA	1	0.1
MA	1	0.1
MO	1	0.1
NV	1	0.1
OH	1	0.1
TN	1	0.1
All	968	100

Table 10. Numbers and Percentages of Summer 2014 Survey Respondents, North Carolina Residents, by County of Residence. (Source: Field survey by authors.)

North Carolina County	Number	Percentage
Wake	69	14.50
Granville	65	13.66
Vance	61	12.82
Franklin	41	8.61
Durham	23	4.83
Alamance	20	4.20
Guilford	19	3.99
Nash	19	3.99
Rockingham	16	3.36
Johnston	15	3.15
Person	15	3.15
Warren	15	3.15
Wilson	13	2.73
Orange	9	1.89
Wayne	9	1.89
Forsyth	6	1.26
Caswell	5	1.05
Cumberland	4	0.84
Hertford	3	0.63
Surry	3	0.63
Beaufort	2	0.42
Bertie	2	0.42
Dare	2	0.42
Davidson	2	0.42
Duplin	2	0.42
Edgecombe	2	0.42
Gates	2	0.42
Greene	2	0.42
Lenoir	2	0.42
Mecklenburg	2	0.42
Onslow	2	0.42
Pasquotank	2	0.42
Stokes	2	0.42

North Carolina County	Number	Percentage
Alleghany	1	0.21
Brunswick	1	0.21
Cabarrus	1	0.21
Caldwell	1	0.21
Camden	1	0.21
Charlotte	1	0.21
Craven	1	0.21
Currituck	1	0.21
Halifax	1	0.21
Harnett	1	0.21
Moore	1	0.21
New Hanover	1	0.21
Pender	1	0.21
Perquimans	1	0.21
Randolph	1	0.21
Roanoke	1	0.21
Roanoke City	1	0.21
Sampson	1	0.21
Tyrrell	1	0.21
Washington	1	0.21
All	476	100

(53 of North Carolina's 100 counties represented)

Table 11. Numbers and Percentages of Summer 2014 Survey Respondents, Virginia Residents, by County of Residence. (Source: Field survey by authors.)

Virginia County	Number	Percentage
Mecklenburg	60	13.48
Halifax	58	13.03
Chesapeake City	27	6.07
Chesterfield	21	4.72
Danville City	19	4.27
Charlotte	18	4.04
Virginia Beach Cit	16	3.6
Pittsylvania	14	3.15
Appomattox	12	2.7
Campbell	11	2.47
Lunenburg	11	2.47
Brunswick	9	2.02
Henrico	9	2.02
Prince Edward	8	1.8
Amelia	6	1.35
Buckingham	6	1.35
Dinwiddie	6	1.35
Henry	6	1.35
Martinsville City	6	1.35
Nottoway	6	1.35
Albemarle	5	1.12
Amherst	5	1.12
Bedford	5	1.12
Lynchburg City	5	1.12
Colonial Heights C	4	0.9
Franklin	4	0.9
Hanover	4	0.9
Isle of Wight	4	0.9
Norfolk City	4	0.9
Petersburg City	4	0.9
Prince George	4	0.9
Carroll	3	0.67
Patrick	3	0.67
Portsmouth City	3	0.67
Powhatan	3	0.67
Richmond City	3	0.67

Virginia County	Number	Percentage
Culpeper	2	0.45
Fairfax	2	0.45
Fluvanna	2	0.45
Franklin City	2	0.45
Giles	2	0.45
Hampton City	2	0.45
Montgomery	2	0.45
New Kent	2	0.45
Newport News City	2	0.45
Person	2	0.45
Spotsylvania	2	0.45
Sussex	2	0.45
Waynesboro City	2	0.45
Wythe	2	0.45
York	2	0.45
Botetourt	1	0.22
Buncombe	1	0.22
Caroline	1	0.22
Craig	1	0.22
Frederick	1	0.22
Galax City	1	0.22
Gloucester	1	0.22
Goochland	1	0.22
Grayson	1	0.22
Hopewell City	1	0.22
James City	1	0.22
King George	1	0.22
Nelson	1	0.22
Orange	1	0.22
Prince William	1	0.22
Roanoke	1	0.22
Salem City	1	0.22
Smyth	1	0.22
Southampton	1	0.22
Suffolk City	1	0.22
Warren	1	0.22
Washington	1	0.22
Winchester City	1	0.22
All	445	100

(74 of Virginia's 133 counties and independent cities represented)

Table 12. Distribution of Summer 2014 Survey Respondents by J.H. Kerr Recreation Site Visited. (Source: Field survey by authors.)

Recreation Site Name	State	USACE Map Site Number	Survey Type				All Respondents	
			In-Person		Windshield			
			n	Percent	n	Percent	n	Percent
BLUESTONE BOAT RAMP	VA	31	2	0.33	25	6.72	27	2.78
BUFFALO PARK	VA	23	6	1	23	6.18	29	2.99
BUFFALO SPRINGS	VA	24	13	2.17	---	---	13	1.34
CLARKSVILLE MARINA	VA	22	1	0.17	3	0.81	4	0.41
EAGLE POINT BOAT RAMP	VA	36	3	0.5	---	---	3	0.31
EASTLAND CREEK BOAT RAMP	VA	37	2	0.33	8	2.15	10	1.03
HYCO BOAT RAMP, STAUNTON RIVER BATTLEFIELD, CLOVER BOAT RAMP, DIFFICULT CREEK NATURE PRESERVE	VA	25,26,27 & 28	5	0.83	4	1.08	9	0.93
ISLAND CREEK PARK	VA	19	---	---	10	2.69	10	1.03
IVY HILL PARK	VA	18	1	0.17	9	2.42	10	1.03
LONGWOOD PARK	VA	21	32	5.34	21	5.65	53	5.46
NORTH BEND PARK	VA	2	95	15.86	51	13.71	146	15.04
OCCONEECHEE STATE PARK & MARINA	VA	32	32	5.34	24	6.45	56	5.77
PALMER POINT	VA	6	16	2.67	12	3.23	28	2.88
RUDDS CREEK DAY USE, RUDDS CREEK CAMPGROUND, WILLOW GROVE MARINA	VA	33, 34 & 35	82	13.69	15	4.03	97	9.99
STAUNTON RIVER STATE PARK, STAUNTON VIEW PARK	VA	29 & 30	32	5.34	23	6.18	55	5.66
USACE VISITORS CENTER , TAILRACE PARK, TANNER ENVIRO EDUC CENTER, LIBERTY HILL FISHING ACCESS & TRAIL,	VA	1,3,4 & 5	4	0.67	1	0.27	5	0.51

ALL VA SITES								**57.16**
BULLOCKSVILLE PARK	NC	9	11	1.84	4	1.08	15	1.54
COUNTY LINE PARK	NC	8	64	10.68	10	2.69	74	7.62
FLEMINGTOWN ROAD LANDING	NC	10	---	---	14	3.76	14	1.44
GRASSY CREEK PARK	NC	20	3	0.5	10	2.69	13	1.34
HENDERSON POINT PARK	NC	17	31	5.18	25	6.72	56	5.77
HIBERNIA PARK	NC	16	23	3.84	16	4.3	39	4.02
KIMBALL POINT PARK	NC	7	59	9.85	10	2.69	69	7.11
NUTBUSH CREEK PARK, WILLIAMSBORO WAYSIDE BOAT ACCESS	NC	13 & 14	52	8.68	32	8.6	84	8.65
SATTERWHITE POINT PARK & MARINA	NC	11 & 12	30	5.01	7	1.88	37	3.81
STEELE CREEK MARINA	NC	15	---	---	15	4.03	15	1.54
ALL NC SITES								**42.84**
ALL SITES		**All Sites**	**599**	**100**	**372**	**100**	**971**	**100**

n = sample size.

Table 13. Percentage of Summer 2014 Survey Respondents Participating in Recreational Activities (Avidity-adjusted) (Source: Field survey by authors.)

	Percentage Participating in Activity		
Recreational Activity	Day Use Visitors (n = 298)	Overnight Use Visitors (n = 646)	All Visitors (n = 964)
Beach	62.8%	74.4%	71.7%
Power Boating	33.1%	52.7%	49.0%
Sail Boating	1.6%	2.0%	2.2%
Hiking	5.2%	33.7%	28.5%
Swimming	66.0%	81.8%	78.4%
Fishing	35.1%	56.7%	53.0%
Picnicking	47.8%	28.3%	31.4%
Camping	5.8%	94.8%	78.9%
Jet Skiing	5.0%	13.0%	11.6%
Waterskiing	8.6%	21.0%	18.7%
Canoeing / Kayaking	1.2%	21.4%	17.8%
Golfing	0.0%	1.3%	1.1%
Other	4.7%	23.2%	19.9%

Table 14. Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Water Management Scenario: Existing Baseline
Visitors Category: All Users, All Sites
Sample Size Applicable to this Scenario/Visitor Category Combination: n = 972 surveys

Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Expenditure Category	Expenditure Occurred in	n	Mean ($'s, Year 2014)	Variance
Hotel/Motel	NC	903	0.37381404	0.051529948
Hotel/Motel	VA	903	1.79681092	0.407654793
Camping	NC	903	21.8550836	3.248689672
Camping	VA	902	22.9726065	8.041620803
Boat Ramp	NC	901	0.88852097	0.129577389
Boat Ramp	VA	902	0.74238575	0.07350979
Food/Bev-Groceries	NC	901	33.4339895	8.463933187
Food/Bev-Groceries	VA	902	27.6213842	5.486756452
Food/Bev-Restaurants	NC	902	3.13517402	0.414523731
Food/Bev-Restaurants	VA	902	3.65456549	0.224175237
Gas for Car	NC	901	18.3147842	1.821480639
Gas for Car	VA	900	17.1907131	2.554679098
Gas for Boat	NC	901	9.10543905	1.791305013
Gas for Boat	VA	902	8.79558603	2.613636846
Bait	NC	901	1.73110845	0.086363112
Bait	VA	901	2.00804446	0.097367959
Other Misc. Retail	NC	903	3.41283589	1.499903464
Other Misc. Retail	VA	903	6.30498255	4.623856988

Notes:
Does not include "dispersed use" visits or "wildlife area use" visits.
Mean value for each category includes expenditures of visitors spending zero dollars in the category.

Table 15. Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Water Management Scenario: Existing Baseline
Visitors Category: Day Users, Sites Located in North Carolina
Sample Size Applicable to this Scenario/Visitor Category Combination: n = 92 surveys

Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Expenditure Category	Expenditure Occurred in	n	Mean ($'s, Year 2014)	Variance
Hotel/Motel	NC	82	0.378497791	0.119125349
Hotel/Motel	VA	82	0	0
Camping	NC	82	2.987481591	1.781690905
Camping	VA	82	0.073637703	0.004480902
Boat Ramp	NC	82	0.527982327	0.034914662
Boat Ramp	VA	82	0.334315169	0.019747885
Food/Bev-Groceries	NC	82	11.45213549	6.051071551
Food/Bev-Groceries	VA	82	0.701767305	0.066102446
Food/Bev-Restaurants	NC	82	0.489690722	0.054908781
Food/Bev-Restaurants	VA	82	0.140648012	0.006949342
Gas for Car	NC	82	14.6988218	9.608141977
Gas for Car	VA	82	1.11634757	0.247485422
Gas for Boat	NC	82	13.42709867	10.83318434
Gas for Boat	VA	82	1.478645066	0.373290086
Bait	NC	82	0.532400589	0.046071394
Bait	VA	82	0.404270987	0.069719134
Other Misc. Retail	NC	82	0.208394698	0.01296702
Other Misc. Retail	VA	82	0.015463918	0.000192215

Notes:
Does not include "dispersed use" visits or "wildlife area use" visits.
Mean value for each category includes expenditures of visitors spending zero dollars in the category.

Table 16. Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Water Management Scenario: Existing Baseline
Visitors Category: Day Users, Sites Located in Virginia
Sample Size Applicable to this Scenario/Visitor Category Combination: n = 207 surveys

Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Expenditure Category	Expenditure Occurred in	n	Mean ($'s, Year 2014)	Variance
Hotel/Motel	NC	195	0.030932937	0.000987829
Hotel/Motel	VA	195	1.404850285	1.587584676
Camping	NC	195	0.189062113	0.006654843
Camping	VA	194	5.500618965	16.45516065
Boat Ramp	NC	195	0.488987874	0.065145152
Boat Ramp	VA	194	0.360009911	0.006522853
Food/Bev-Groceries	NC	195	2.264785944	0.359744515
Food/Bev-Groceries	VA	194	6.799058474	1.81895445
Food/Bev-Restaurants	NC	194	0.657086224	0.118180182
Food/Bev-Restaurants	VA	194	2.206392468	1.149048303
Gas for Car	NC	195	5.255629795	3.137833746
Gas for Car	VA	193	5.780094316	1.362432525
Gas for Boat	NC	195	2.512496907	0.359492738
Gas for Boat	VA	194	3.949454906	2.522638785
Bait	NC	195	0.520910666	0.037057286
Bait	VA	194	1.094400396	0.191595999
Other Misc. Retail	NC	195	0.518436031	0.147900129
Other Misc. Retail	VA	195	0.696362287	0.393954597

Notes:
Does not include "dispersed use" visits or "wildlife area use" visits.
Mean value for each category includes expenditures of visitors spending zero dollars in the category.

Table 17. Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Water Management Scenario: Existing Baseline
Visitors Category: Overnight Users, Sites Located in North Carolina
Sample Size Applicable to this Scenario/Visitor Category Combination: n = 314 surveys

Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Expenditure Category	Expenditure Occurred in	n	Mean ($'s, Year 2014)	Variance
Hotel/Motel	NC	295	0	0
Hotel/Motel	VA	295	1.600752445	0.928566979
Camping	NC	295	49.73852521	9.906789433
Camping	VA	295	3.627238525	1.566856186
Boat Ramp	NC	294	1.259108396	0.509796575
Boat Ramp	VA	295	0.057712566	0.001328747
Food/Bev-Groceries	NC	294	74.6837897	32.60510839
Food/Bev-Groceries	VA	295	3.574492099	1.487036284
Food/Bev-Restaurants	NC	295	6.396388262	2.320448901
Food/Bev-Restaurants	VA	295	0.598118886	0.04520314
Gas for Car	NC	294	37.05853511	4.886817864
Gas for Car	VA	294	2.219029568	0.373527706
Gas for Boat	NC	294	16.05710191	4.969861141
Gas for Boat	VA	295	1.674642588	0.950989647
Bait	NC	293	3.411415976	0.352901776
Bait	VA	294	0.238059136	0.010799027
Other Misc. Retail	NC	295	7.528893905	8.933606453
Other Misc. Retail	VA	295	0.613769752	0.181603857

Notes:
Does not include "dispersed use" visits or "wildlife area use" visits.
Mean value for each category includes expenditures of visitors spending zero dollars in the category.

Table 18. Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Water Management Scenario: Existing Baseline
Visitors Category: Overnight Users, Sites Located in Virginia
Sample Size Applicable to this Scenario/Visitor Category Combination: n = 333 surveys

Average (mean) Expenditures per Adult per Trip, Summer Season (May-Sept) 2014

Expenditure Category	Expenditure Occurred in	n	Mean ($'s, Year 2014)	Variance
Hotel/Motel	NC	314	0.792866037	0.278355812
Hotel/Motel	VA	314	2.270197026	1.278503733
Camping	NC	314	3.533802095	2.559463454
Camping	VA	314	49.76466711	33.82206572
Boat Ramp	NC	313	0.676841796	0.251728305
Boat Ramp	VA	314	1.542078664	0.40134288
Food/Bev-Groceries	NC	313	5.513428236	2.487803747
Food/Bev-Groceries	VA	314	60.29986084	18.18810989
Food/Bev-Restaurants	NC	314	0.973339193	0.112602056
Food/Bev-Restaurants	VA	314	7.34856808	0.959883506
Gas for Car	NC	313	4.578588201	2.101699863
Gas for Car	VA	314	36.78466271	9.918770806
Gas for Boat	NC	313	4.023040798	4.905553616
Gas for Boat	VA	314	18.02600161	12.36005029
Bait	NC	314	0.586171537	0.138685491
Bait	VA	314	4.149857174	0.462026851
Other Misc. Retail	NC	314	0.660880393	0.119349913
Other Misc. Retail	VA	314	14.20859884	24.41651355

Notes:
Does not include "dispersed use" visits or "wildlife area use" visits.
Mean value for each category includes expenditures of visitors spending zero dollars in the category.

Table 19. Percentages of Direct Expenditures Occurring Locally (within 10 miles of J.H. Kerr)

Expenditure Category	Expenditures Occurring in North Carolina		Expenditures Occurring in Virginia	
	Day Users	Overnight Users	Day Users	Overnight Users
Hotel/Motel	1.00000[1]	0.76526	0.72340[1]	0.62217
Camping	0.86066[1]	0.97439	0.97000[1]	0.94793
Boat Ramp	0.57418	0.76512	0.98345	0.58163
Food/Bev-Groceries	0.18901	0.36887	0.31366	0.40250
Food/Bev-Restaurants	0.50649	0.81895	0.72182	0.82255
Gas for Car	0.11671	0.38198	0.21074	0.29997
Gas for Boat	0.37307	0.74115	0.49918	0.73924
Bait	0.25592	0.86544	0.37670	0.79212
Other Misc. Retail	0.24713	0.64011	0.67619	0.67596

[1] A "day user" may have hotel/motel or camping expenditures when the user stays at a hotel/motel/campsite that is not located at J.H. Kerr and makes day visits to J.H. Kerr.
[2] An "overnight user" may make a portion of overnight expenditures away from J.H. Kerr when some hotel/motel/camping expenditures occurred on the trip to/from the overnight site at J.H. Kerr.

Table 20. J.H. Kerr Reservoir Water Elevations for Two Water Management Scenarios (Based on model runs for years 1930 to 2009.) (Source: Roanoke River Basin Operations Model (RRBROM), Hydrologics, Inc.)

Reservoir Elevation (feet)	Existing Scenario (Status Quo 2014) Percent	Days per Year	QRR Scenario Percent	Days per Year	Percent Difference (QRR Percent – Existing Percent)	Difference in Days per Year (QRR Days – Existing Days)
290 (-)	0.36%	1.314	0.32%	1.168	-0.04%	-0.146
291	0.04%	0.146	0.02%	0.073	-0.02%	-0.073
292	0.13%	0.4745	0.05%	0.1825	-0.08%	-0.292
293	0.24%	0.876	0.05%	0.1825	-0.19%	-0.6935
294	0.21%	0.7665	0.16%	0.584	-0.05%	-0.1825
295	3.49%	12.7385	9.42%	34.383	5.93%	21.6445
296	10.53%	38.4345	13.01%	47.4865	2.48%	9.052
297	8.24%	30.076	12.87%	46.9755	4.63%	16.8995
298	9.79%	35.7335	7.60%	27.74	-2.19%	-7.9935
299	19.21%	70.1165	14.14%	51.611	-5.07%	-18.5055
300	17.90%	65.335	12.95%	47.2675	-4.95%	-18.0675
301	7.53%	27.4845	8.47%	30.9155	0.94%	3.431
302	11.21%	40.9165	18.14%	66.211	6.93%	25.2945
303	2.81%	10.2565	1.75%	6.3875	-1.06%	-3.869
304	1.59%	5.8035	0.23%	0.8395	-1.36%	-4.964
305	1.29%	4.7085	0.15%	0.5475	-1.14%	-4.161
306	0.88%	3.212	0.10%	0.365	-0.78%	-2.847
307	0.66%	2.409	0.10%	0.365	-0.56%	-2.044
308	0.72%	2.628	0.08%	0.292	-0.64%	-2.336
309	0.55%	2.0075	0.07%	0.2555	-0.48%	-1.752
310	0.47%	1.7155	0.07%	0.2555	-0.40%	-1.46
311	0.45%	1.6425	0.04%	0.146	-0.41%	-1.4965
312	0.30%	1.095	0.04%	0.146	-0.26%	-0.949
313	0.36%	1.314	0.04%	0.146	-0.32%	-1.168
314	0.32%	1.168	0.03%	0.1095	-0.29%	-1.0585
315	0.22%	0.803	0.03%	0.1095	-0.19%	-0.6935
316	0.16%	0.584	0.02%	0.073	-0.14%	-0.511
317	0.12%	0.438	0.02%	0.073	-0.10%	-0.365
318	0.06%	0.219	0.01%	0.0365	-0.05%	-0.1825
319	0.05%	0.1825	0.01%	0.0365	-0.04%	-0.146
320 (max)	0.10%	0.365	0.01%	0.0365	-0.09%	-0.3285
Totals	100%	365	100%	365	0.01%	0

Table 21. J.H. Kerr Reservoir Water Elevations During Peak Recreation Season (May-September, or 153 days) for Two Water Management Scenarios (Based on model runs for years 1930 to 2009.) (Source: Roanoke River Basin Operations Model (RRBROM), Hydrologics, Inc.)

Reservoir Elevation (feet)	Existing Scenario (Status Quo 2014)		QRR Scenario		Percent Difference (QRR Percent – Existing Percent)	Difference in Days per Year (QRR Days – Existing Days)
	Percent	Days per Year	Percent	Days per Year		
290 (-)	0.51%	0.7803	0.45%	0.6885	-0.06%	-0.0918
291	0.07%	0.1071	0.02%	0.0306	-0.05%	-0.0765
292	0.06%	0.0918	0.10%	0.153	0.04%	0.0612
293	0.06%	0.0918	0.06%	0.0918	0.00%	0.0000
294	0.06%	0.0918	0.06%	0.0918	0.00%	0.0000
295	0.23%	0.3519	0.06%	0.0918	-0.17%	-0.2601
296	1.00%	1.53	0.10%	0.153	-0.90%	-1.3770
297	2.84%	4.3452	1.33%	2.0349	-1.51%	-2.3103
298	5.65%	8.6445	4.31%	6.5943	-1.34%	-2.0502
299	27.62%	42.2586	20.65%	31.5945	-6.97%	-10.6641
300	30.42%	46.5426	24.04%	36.7812	-6.38%	-9.7614
301	7.67%	11.7351	15.43%	23.6079	7.76%	11.8728
302	15.10%	23.103	28.91%	44.2323	13.81%	21.1293
303	3.03%	4.6359	3.10%	4.743	0.07%	0.1071
304	1.18%	1.8054	0.30%	0.459	-0.88%	-1.3464
305	0.72%	1.1016	0.17%	0.2601	-0.55%	-0.8415
306	0.62%	0.9486	0.10%	0.153	-0.52%	-0.7956
307	0.54%	0.8262	0.14%	0.2142	-0.40%	-0.6120
308	0.60%	0.918	0.08%	0.1224	-0.52%	-0.7956
309	0.33%	0.5049	0.07%	0.1071	-0.26%	-0.3978
310	0.22%	0.3366	0.06%	0.0918	-0.16%	-0.2448
311	0.24%	0.3672	0.05%	0.0765	-0.19%	-0.2907
312	0.20%	0.306	0.07%	0.1071	-0.13%	-0.1989
313	0.19%	0.2907	0.08%	0.1224	-0.11%	-0.1683
314	0.23%	0.3519	0.07%	0.1071	-0.16%	-0.2448
315	0.04%	0.0612	0.05%	0.0765	0.01%	0.0153
316	0.07%	0.1071	0.04%	0.0612	-0.03%	-0.0459
317	0.08%	0.1224	0.03%	0.0459	-0.05%	-0.0765
318	0.10%	0.153	0.02%	0.0306	-0.08%	-0.1224
319	0.11%	0.1683	0.02%	0.0306	-0.09%	-0.1377
320 (max)	0.19%	0.2907	0.03%	0.0459	-0.16%	-0.2448
Totals	100%	153	100%	153	0%	0

Table 22. J.H. Kerr Reservoir Boat Ramp Elevations (as of 10/22/2010)
(Source: USACE 2012)

RAMP	OPERATED BY	TOP ELEVATION	BOTTOM ELEVATION
Bluestone	USACE	305.52'	289.0'
Buffalo	USACE	303.72'	R-285'/L-290'
Eagle Point	USACE	306.72'	L-292.0' R-291.7'
Eastland Creek	USACE	309.15'	L-290.2' R-286.2'
Grassy Creek	USACE	306.56'	L-291.6' R-289.3'
Island Creek	USACE	315.74'	288.4'
Ivy Hill	USACE	307.69'	284.8'-
Longwood	USACE	308.60'	L-290.1' R-286.2'
North Bend Park (Area C)	USACE	309.51'	L-291.7' R-285.8'
North Bend Park (Old Marina-A)	USACE	314.69'	290.9'
North Bend Park (Main)	USACE	311.73'	285.0'
Palmer Point	USACE	304.94'	293.3'
Rudd's Creek (Campground)	USACE	307.13'	293.0' - single
Rudd's Creek Day Use	USACE	306.34'	285.0' - double
Staunton View	USACE	306.7	291.2'
Henderson Point (Campground)	KLSRA	304.79'	289.5' - double
Henderson Point (Shelter 1)	NCWRC	306.47'	290.0'
Henderson Point (Shelter 2)	KLSRA	306.8'	291.79'
Henderson Point (Shelter 3)	KLSRA	306.67'	292.87'

RAMP	OPERATED BY	TOP ELEVATION	BOTTOM ELEVATION
Kimball Point Park	KLSRA	304.28'	285.77'
Nutbush #1 (at picnic shelter)	KLSRA	302.83'	292.41'
Nutbush #2 (NEW RAMP- 4 LANES)	KLSRA	310.0'	L-291.0' R-288.0'
Nutbush #3 (South side of Bridge	KLSRA	302.7'	UNKNOWN/Old Road Bed
Satterwhite Point (J.C. Cooper)	KLSRA	303.38'	292.35'
Clarksville Marina	Subleased by Town of Clarksville, VA	305.38'	289.9'
Satterwhite Point Marina	Subleased by NCDNR	307.03'	294.0'
Steele Creek (Townsville New)	Subleased by NCDNR	310.0	?
Steele Creek (Townsville Old)	Subleased by NCDNR	305.31'	290.5'
Bullocksville	KLSRA	305.92'	291.75'
County Line	NCWRC	306.71'	L-294.5' R-285.0'
Flemingtown Road	NCWRC	305.21'	292.9'
Hibernia	KLSRA	305.82'	L-290.48' R-293.2'
Hibernia	NCWRC	305.43'	290.6'
Occoneechee (Old #1)	VDCR	304.88'	291.6'
Occoneechee #1 (New-HWY 58)	VDCR	308.25'	289.0'
Occoneechee #2 (Park Office)	VDCR	308.30'	289.0'
Staunton River State Park	VDCR	310.0'	291.0'
Clover	VDGIF	313.0'	292.0'
Hyco River	VDGIF	313.0'	291.0'

Table 23. USACE-Estimated Recreation Site Loss by Reservoir Water Elevation. (Source: USACE 2015.)

U.S. Army Corps of Engineers Wilmington District

Unusable Public Campsites

	Corps (426)	NC (650)	VA (137)	Total (1,213)
300 feet	0	0	0	0
302	3	44	0	47
304	5	100	0	169
306	58	252*	0	310
310	112	427	0	539

U.S. Army Corps of Engineers Wilmington District

Unusable Public Boat Ramps

	Corps (15)	NC (15)	VA (4)	Total (34)
300 feet	0	0	0	0
302	0	0	0	0
304	2	3	0	5
306+	5	12	0	17

U.S. Army Corps of Engineers Wilmington District

Unusable Public Beaches

MSL	Corps (13)	NC (1)	VA N/A	Total (14)
300	0	0	N/A	0
302	2	0	N/A	2
304	10	1	N/A	11
306+	13	1	N/A	14

U.S. Army Corps of Engineers Wilmington District

Marinas

	Clarksville (VA)	Steele Creek (NC)	Satterwhite Point (NC)
300 feet	**198 slips + ramp**	**350 slips + ramp**	**130 slips + ramp**
302	**Full ops**	**Full ops**	**Full ops**
304	**Highest level that allows full ops; no room for rise**	**Full ops**	**Moving docks in and out becomes difficult**
306+	**Ramp closed; 3 of 4 walkways to slip docks closed; critical at 308+**	**No data available**	**Main Parking Lot inundated; ramp closed (307)**

Table 24. Effects of QRR Scenario on Availability of Recreation Amenities During 153-Day Summer Season (May-Sept.)

Recreation Amenity	Reservoir Water Elevation			
	302'-303' (see note 1)	304' - 305' (see note 2)	306' - 309' (see note 2)	310' + (see note 2)
Beaches	2 (of 14) beaches available for 21.24 fewer days each summer	11 (of 14) beaches available for 2.2 more days each summer	14 (of 14) beaches available for 2.6 more days each summer	14 (of 14) beaches available for 1.75 more days each summer
Campsites	47 sites (of 1213) available for 21.24 fewer days each summer	169 sites (of 1213) available for 2.2 more days each summer	310 sites (of 1213) available for 2.6 more days each summer	539 sites (of 1213) available for 1.75 more days each summer
Ramps	no effect	5 ramps (of 34) available for 2.2 more days each summer	17 ramps (of 34) available for 2.6 more days each summer	17 ramps (of 34) available for 1.75 more days each summer

[1] **Reservoir water level is more frequently at this elevation under QRR, causing flooding that would otherwise not occur under Existing/Baseline conditions.**

[2] **Reservoir water level is less frequently at this elevation under QRR, avoiding flooding that would otherwise occur under Existing/Baseline conditions.**

Table 25. Effects of QRR Scenario on Availability of Recreation Amenities During 153-Day Summer Season (May-Sept.)

Recreation Amenity	Reservoir Water Elevation				Net Effect of QRR
	302'-303' (see note 1)	304' - 305' (see note 2)	306' + (see note 2)	310' + (see note 2)	
Beaches	1.983%[3] loss in availability, May-Sept.	1.130% gain in availability, May-Sept.	1.699% gain in availability, May-Sept.	1.144% gain in availability, May-Sept.	1.990% gain in availability, May-Sept.
Campsites	0.538% loss in availability, May-Sept.	0.200% gain in availability, May-Sept.	0.434% gain in availability, May-Sept.	0.508% gain in availability, May-Sept.	0.605% gain in availability, May-Sept.
Ramps	no change	0.211% gain in availability, May-Sept.	0.850% gain in availability, May-Sept.	0.572% gain in availability, May-Sept.	1.633% gain in availability, May-Sept.

[1] **Reservoir water level is more frequently at this elevation under QRR, causing flooding that would otherwise not occur under Existing/Baseline conditions.**

[2] **Reservoir water level is less frequently at this elevation under QRR, avoiding flooding that would otherwise occur under Existing/Baseline conditions.**

[3] **Based on numbers in top panel of table, for example, 1.983% = 0.01983 = (2/14)*(21.24/153).**

Table 26. Changes in Numbers of Recreational Trips Due to Changes in Reservoir Water Elevation from Existing Baseline Water Management Scenario to QRR Scenario

	Existing Baseline Scenario	QRR Scenario	Difference (QRR – Baseline)
All Users, All Sites (n = 972 surveys)			
Adult Person-Trips Per Year (USACE data)[1]:	1,038,862	1,060,380	21,518
Estimated Average Number of Unique Adults Visiting J.H. Kerr Over Year:	373,488	373,488	0
Estimated Average Number of Person Trips Per Adult Per Year :	2.782	2.839	0
Estimated Average Number of Adult Person-Trips Per Summer (May-Sept) Season[1,2,3]:	648,146	669,664	21,518
Day Users, Sites Located in NC (n = 92 surveys)			
Adult Person-Trips Per Year (USACE data)[1]:	374,116	381,854	7,738
Estimated Average Number of Unique Adults Visiting J.H. Kerr Over Year:	67,382	67,382	0
Estimated Average Number of Person Trips Per Adult Per Year :	5.552	5.667	0
Estimated Average Number of Adult Person-Trips Per Summer (May-Sept) Season[1,2,3]:	233,411	241,149	7,738
Day Users, Sites Located in VA (n = 207 surveys)			
Adult Person-Trips Per Year (USACE data)[1]:	574,868	588,339	13,471
Estimated Average Number of Unique Adults Visiting J.H. Kerr Over Year:	117,306	117,306	0
Estimated Average Number of Person Trips Per Adult Per Year :	4.901	5.015	0
Estimated Average Number of Adult Person-Trips Per Summer (May-Sept) Season[1,2,3]:	358,660	372,131	13,471
Overnight Users, Sites Located in NC (n = 314 surveys)			
Adult Person-Trips Per Year (USACE data)[1]:	48,375	48,540	165
Estimated Average Number of Unique Adults Visiting J.H. Kerr Over Year:	21,410	21,410	0
Estimated Average Number of Person Trips Per Adult Per Year :	2.259	2.267	0
Estimated Average Number of Adult Person-Trips Per Summer (May-Sept) Season[1,2,3]:	30,181	30,346	165
Overnight Users, Sites Located in VA (n = 333 surveys)			
Adult Person-Trips Per Year (USACE data)[1]:	41,505	41,647	142
Estimated Average Number of Unique Adults Visiting J.H. Kerr Over Year:	18,389	18,389	0
Estimated Average Number of Person Trips Per Adult Per Year :	2.257	2.265	0
Estimated Average Number of Adult Person-Trips Per Summer (May-Sept) Season[1,2,3]:	25,895	26,037	142

Notes:[1]Does not include "dispersed use" visits or "wildlife area use" visits. [2]Assumes 62.39% of annual trips occur in summer (May-Sept) season based on USACE monthly trip data for J.H. Kerr for years 2010-2012. Mean value for each category includes expenditures of visitors spending zero dollars in the category. [3] Assumes any change in annual trips occurs in the summer season.

Table 27. Economic Impact Results

PANEL A -- BASELINE SCENARIO Total Trips (Adult person-trips per year): 1,038,862

Impact Type	Output/Sales	Employment	Labor Income	Interest, Rent & Dividend Income	State & Local Tax	Federal Tax
Direct Impacts	$26,934,900	227	$4,733,764	$2,611,951	$954,881	$1,032,650
Indirect Impacts	$3,216,819	34	$1,043,273	$873,629	$164,287	$256,538
Induced Impacts	$6,601,254	66	$2,476,715	$2,112,880	$347,137	$543,663
Total Impacts	$36,752,973	326	$8,253,751	$5,598,472	$1,466,305	$1,832,851

PANEL B -- QRR SCENARIO Total Trips (Adult person-trips per year): 1,060,380

Impact Type	Output/Sales	Employment	Labor Income	Interest, Rent & Dividend Income	State & Local Tax	Federal Tax
Direct Impacts	$27,322,124	230	$4,800,608	$2,649,624	$969,369	$1,047,919
Indirect Impacts	$3,261,112	34	$1,057,582	$885,665	$166,590	$260,137
Induced Impacts	$6,694,568	67	$2,511,767	$2,142,720	$352,273	$551,710
Total Impacts	$37,277,804	330	$8,369,956	$5,678,021	$1,488,232	$1,859,765

PANEL C -- DIFFERENCE Additional Total Trips (Adult person-trips per year): 21,518

Impact Type	Output/Sales	Employment	Labor Income	Interest, Rent & Dividend Income	State & Local Tax	Federal Tax
Direct Impacts	$387,224	3	$66,844	$37,673	$14,487	$15,269
Indirect Impacts	$44,294	0	$14,308	$12,036	$2,304	$3,599
Induced Impacts	$93,313	1	$35,053	$29,840	$5,136	$8,047
Total Impacts	$524,831	5	$116,205	$79,549	$21,927	$26,915

Notes: Tables above present economic impact results for expenditures occurring within 10 mi of JH Kerr (impacts of expenditures occurring beyond 10 miles are not included). Indirect and Induced Effects measure economic multiplier effects occurring within counties adjacent to JH Kerr (any multiplier effects occurring outside these counties are not included). Does not include any economic impacts of “Dispersed Use” or “Wildlife Management Area” visits.

Table 28. Attributes for Camping Random Utility Model Estimation

USACE Site Code	SITE NAME	n	Agency	Marina	Fee	Parking Spaces	No. boat ramps	No. Docks	Bath-rooms	Picnic area	Swim Beach	Average catch	Prob catch	Trails	Showers	Camp-sites	Cabins
2	NORTH BEND PARK	95	USACE	0	1	63	4	2	3	1	1	4.1	0.41	1	1	244	0
6	PALMER POINT	16	USACE	0	1	25	1	0	1	1	1	6.09	0.45	0	0	0	0
7	KIMBALL POINT PARK	59	NC	0	1	0	1	0	1	1	1	4	0.6	0	1	67	0
8	COUNTY LINE PARK	64	NC	0	1	42	2	1	0	1	0	9.6	0.7	0	1	66	0
9	BULLOCKSVILLE PARK	11	NC	0	1	0	1	2	1	1	0	1.25	0.25	1	1	58	0
11	SATTERWHITE POINT PARK & MARINA	29	NC	1	1	4	3	2	1	1	1	3.28	0.43	1	1	123	2
13	NUTBUSH CREEK PARK	53	NC	0	1	143	5	3	1	1	0	7.66	0.41	1	1	79	0
16	HIBERNIA PARK	23	NC	0	1	38	3	3	1	1	0	2.31	0.44	1	1	134	0
17	HENDERSON POINT PARK	31	NC	0	1	172	7	7	1	1	0	3.6	0.44	0	1	74	0
21	LONGWOOD PARK	32	USACE	0	1	65	2	1	1	1	1	33.52	0.71	0	1	66	0
23	BUFFALO PARK	6	USACE	0	1	39	2	1	1	1	1	20.61	0.57	0	1	21	0
24	BUFFALO SPRINGS	13	USACE	0	0	0	0	0	1	1	0	0	0	0	0	0	0
29	STAUNTON RIVER STATE PARK	25	VA	0	1	59	2	1	1	1	0	11	0.71	1	1	47	7
30	STAUNTON VIEW PARK	9	USACE	0	1	32	1	1	1	1	0	6.23	0.88	0	0	0	0
32	OCCONEECHEE STATE PARK & MARINA	32	VA	1	1	171	6	3	1	1	0	15.56	0.63	1	1	48	13
33	RUDDS CREEK DAY USE	82	USACE	0	1	71	2	1	1	1	1	12.33	0.81	0	1	99	0

Table 29. Attributes for Boating Random Utility Model Estimation

USACE Site Code	SITE NAME	n	Agency	Marina	Fee	Parking Spaces	No. boat ramps	No. Docks	Bath-rooms	Picnic area	Swim Beach	Average catch	Prob catch	Trails	Showers	Camp-sites	Cabins
2	NORTH BEND PARK	51	USACE	0	1	63	4	2	3	1	1	4.1	0.41	1	1	244	0
6	PALMER POINT	11	USACE	0	1	25	1	0	1	1	1	6.09	0.45	0	0	0	0
7	KIMBALL POINT PARK	10	NC	0	1	0	1	0	1	1	1	4	0.6	0	1	67	0
8	COUNTY LINE PARK	10	NC	0	1	42	2	1	0	1	0	9.6	0.7	0	1	66	0
9	BULLOCKSVILLE PARK	4	NC	0	1	0	1	2	1	1	0	1.25	0.25	1	1	58	0
10	FLEMINGTOWN ROAD LANDING	14	NC	1	0	62	4	3	0	0	0	4.21	0.36	0	0	0	0
11	SATTERWHITE POINT PARK & MARINA	7	NC	1	1	4	3	2	1	1	1	3.28	0.43	1	1	123	2
13	NUTBUSH CREEK PARK	32	NC	0	1	143	5	3	1	1	0	7.66	0.41	1	1	79	0
15	STEELE CREEK MARINA	16	PRIV.	1	0	?	3	1	1	1	0	5.125	0.44	0	1	20?	0
16	HIBERNIA PARK	16	NC	0	1	38	3	3	1	1	0	2.31	0.44	1	1	134	0
17	HENDERSON POINT PARK	25	NC	0	1	172	7	7	1	1	0	3.6	0.44	0	1	74	0
18	IVY HILL PARK	9	USACE	0	1	47	2	1	1	1	1	2.44	0.33	0	0	0	0
19	ISLAND CREEK PARK	10	USACE	0	1	16	1	1	1	0	0	3.70	0.36	0	0	0	0
20	GRASSY CREEK PARK	10	USACE	0	1	13	2	1	1	1	1	5.30	0.50	0	0	0	0
21	LONGWOOD PARK	21	USACE	0	1	65	2	1	1	1	1	33.52	0.71	0	1	66	0
22	CLARKSVILLE MARINA	3	PRIV	1	0	?	1	0	1	0	0	1.33	0.33	0	0	0	0
23	BUFFALO PARK	23	USACE	0	1	39	2	1	1	1	1	20.61	0.57	0	1	21	0
29	STAUNTON RIVER STATE PARK	7	VA	0	1	59	2	1	1	1	0	11	0.71	1	1	47	7

30	STAUNTON VIEW PARK	17	USACE	0	1	32	1	1	1	1	0	6.23	0.88	0	0	0	0
31	BLUESTONE BOAT RAMP	25	USACE	0	1	73	2	1	1	0	0	23.16	0.76	0	0	0	0
32	OCCONEECHEE STATE PARK & MARINA	25	VA	1	1	171	6	3	1	1	0	15.56	0.63	1	1	48	13
33	RUDDS CREEK DAY USE	44	USACE	0	1	71	2	1	1	1	1	12.33	0.81	0	1	99	0
37	EASTLAND CREEK BOAT RAMP	8	USACE	0	1	37	2	1	1	0	0	2.00	0.50	0	0	0	0

Table 30. Descriptive statistics for Camp Site Interview Sample

Variable	n	Mean	Std Dev	Min	Max
Travel miles to destination	575	71.88	71.27	0.00	546.82
Hours travelled to destination	560	2.15	8.56	0.05	200.00
Trips to JHKR in last 12 months	578	5.75	11.52	0.00	150.00
Years coming to JHKR	575	20.62	16.90	0.00	66.00
Trips to JHKR per year	578	3.06	4.68	1.00	50.00
Additional trips planned this year	574	3.43	7.44	0.00	80.00
Age	576	49.68	12.98	19.00	70.00
Male	576	0.51	0.50	0.00	1.00
Education Level	567	3.46	0.67	1.00	5.00
Married	572	0.80	0.40	0.00	1.00
Employed	574	0.70	0.46	0.00	1.00
Income	498	80903.61	42295.63	20000.00	300000.00
Used beach this trip	578	0.76	0.42	0.00	1.00
Went power boating this trip	578	0.46	0.50	0.00	2.00
Went sail boating this trip	578	0.01	0.12	0.00	1.00
Went hiking this trip	578	0.31	0.46	0.00	1.00
Went swimming this trip	578	0.81	0.39	0.00	1.00
Went fishing this trip	578	0.51	0.50	0.00	1.00
Had picnic this trip	578	0.40	0.60	0.00	9.00
Went camping this trip	578	0.85	0.50	0.00	9.00
Days spent on JHKR this trip	577	5.47	3.75	1.00	30.00
Total amount spent this trip	560	464.05	415.06	0.00	2948.00
Number of adults in party	560	3.13	2.75	1.00	30.00
Number of children in party	560	1.68	2.20	0.00	20.00
Hours spent fishing today	264	4.08	3.16	0.00	24.00
Targeting a particular species	267	0.48	0.50	0.00	1.00
Caught fish this trip	264	0.44	0.50	0.00	1.00

Table 31. Descriptive statistics for Boat Ramp Survey Sample

Variable	n	Mean	Std Dev	Min	Max
Travel miles to destination	366	51.89	42.02	0.00	406.17
Hours travelled to destination	358	1.50	1.42	0.00	14.00
Trips to JHKR in last 12 months	365	20.47	28.22	0.00	275.00
Years coming to JHKR	324	26.06	16.60	0.00	60.00
Trips to JHKR per year	363	11.64	16.89	1.00	200.00
Additional trips planned this year	358	10.04	11.87	0.00	100.00
Age	367	54.07	11.86	19.00	70.00
Male	368	0.80	0.40	0.00	1.00
Education Level	367	3.59	0.70	1.00	5.00
Married	363	0.85	0.36	0.00	1.00
Employed	359	0.67	0.47	0.00	1.00
Income	338	87144.97	44634.02	20000.00	180000.00
Used beach this trip	365	0.26	0.44	0.00	1.00
Went power boating this trip	365	0.65	0.48	0.00	2.00
Went sail boating this trip	364	0.04	0.19	0.00	1.00
Went hiking this trip	363	0.04	0.20	0.00	1.00
Went swimming this trip	365	0.41	0.49	0.00	1.00
Went fishing this trip	365	0.72	0.45	0.00	1.00
Had picnic this trip	365	0.14	0.35	0.00	1.00
Went camping this trip	365	0.20	0.40	0.00	1.00
Days spent on JHKR this trip	345	3.09	9.89	0.00	180.00
Total amount spent this trip	353	260.73	854.79	0.00	15000.00
Number of adults in party	341	2.19	1.76	0.00	25.00
Number of children in party	263	0.82	1.23	0.00	7.00
Hours spent fishing today	261	5.22	3.24	0.00	15.00
Targeting a particular species	256	0.77	0.42	0.00	1.00
Caught fish this trip	369	0.54	0.50	0.00	1.00
Number of fish caught and released	369	5.15	12.49	0.00	100.00
Number of fish caught and kept	369	4.62	22.99	0.00	390.00
Total number of fish caught	369	9.76	29.92	0.00	440.00

Table 32. Site choice (Random utility) model results for in-person interviews at camp sites

	Coefficient (std error)				
Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Travel Cost	-0.063*** (0.004)	-0.063*** (0.004)	-0.062*** (0.004)	-0.062*** (0.004)	-0.062*** (0.004)
Log(parking spaces)	0.031 (0.057)	-0.192*** (0.062)	-0.219*** (0.062)	-0.218*** (0.062)	-0.217*** (0.062)
No. Launches	0.640*** (0.100)	0.656*** (0.101)	0.668*** (0.102)	0.657*** (0.103)	0.663*** (0.103)
No. Docks	-0.726*** (0.092)	-0.448*** (0.095)	-0.419*** (0.096)	-0.419*** (0.096)	-0.426*** (0.096)
Swimming Beach	0.273 (0.379)	1.208*** (0.389)	1.182*** (0.402)	1.179*** (0.402)	1.213*** (0.403)
Fee Site	-0.201 (0.460)	-3.804*** (0.701)	-4.394*** (0.722)	-4.396*** (0.722)	-4.377*** (0.723)
No. Campsites	0.007*** (0.001)	0.007*** (0.001)	-0.004* (0.002)	-0.004* (0.002)	-0.004* (0.002)
NC Agency	0.633* (0.368)	1.529*** (0.384)	1.719*** (0.395)	1.719*** (0.394)	1.753*** (0.396)
VA Agency	0.199 (0.402)	0.297 (0.393)	0.412 (0.396)	0.410 (0.396)	0.453 (0.397)
Trails	-0.900*** (0.167)	0.080 (0.217)	0.188 (0.221)	0.190 (0.221)	0.171 (0.221)
Marina	-0.117 (0.199)	-0.544*** (0.198)	-0.607*** (0.199)	-0.607*** (0.199)	-0.602*** (0.199)
Average Catch	-0.006 (0.009)				
Prob Catch		4.602*** (0.682)	5.308*** (0.711)	5.309*** (0.711)	5.061*** (0.718)
Campsites*Camper			0.014*** (0.002)	0.014*** (0.002)	0.014*** (0.002)
Beach*Day Trip			0.854*** (0.260)	0.862*** (0.261)	0.849*** (0.261)
No. Launches*Boater				0.050 (0.062)	0.043 (0.062)
Prob Catch*Fisher					2.589** (1.043)
Adjusted R-squared	0.0771	0.0953	0.1111	0.1112	0.1135

*** , ** and * denote statistical significance at the 1%, 5% and 10% levels respectively

Table 33. Site choice (Random utility) model results for mail-in surveys from boat ramps

	Coefficient (std error)				
Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Travel Cost	-0.016*** (0.003)	-0.016*** (0.003)	-0.015*** (0.0030	-0.015*** (0.003)	-0.015*** (0.003)
Log(parking spaces)	-0.005 (0.089)	0.008 (0.088)	-0.004 (0.089)	-0.004 (0.089)	-0.070 (0.088)
No. Launches	0.460*** (0.121)	0.561*** (0.128)	0.458*** (0.122)	0.458*** (0.122)	0.627*** (0.127)
No. Docks	-0.234** (0.105)	-0.314*** (0.103)	-0.233** (0.105)	-0.233** (0.105)	-0.295*** (0.105)
Swimming Beach	-0.405** (0.193)	-0.160 (0.204)	-0.401** (0.193)	-0.507** (0.222)	-0.306 (0.230)
Fee Site	-0.136 (0.258)	-0.195 (0.260)	-0.130 (0.257)	-0.132 (0.257)	-0.229 (0.259)
No. Campsites	0.004*** (0.001)	0.003** (0.001)	0.003** (0.001)	0.003** (0.001)	0.003** (0.001)
NC Agency	-0.679*** (0.192)	-0.537*** (0.194)	-0.664*** (0.192)	-0.665*** (0.192)	-0.539*** (0.195)
VA Agency	-0.865*** (0.290)	-0.930*** (0.295)	-0.857*** (0.291)	-0.858*** (0.290)	-0.921*** (0.292)
Trails	0.155 (0.181)	0.114 (0.174)	0.152 (0.181)	0.152 (0.181)	0.165 (0.175)
Marina	-0.712** (0.319)	-0.650** (0.317)	-0.703** (0.319)	-0.703** (0.319)	-0.835*** (0.321)
Average Catch	0.026*** (0.008)		0.027*** (0.008)	0.027*** (0.008)	0.016* (0.008)
Prob Catch		1.356*** (0.507)			
Campsites*Camper			0.004* (0.002)	0.005** (0.002)	0.004* (0.002)
Beach*Day Trip				0.219 (0.221)	0.193 (0.221)
No. Launches*Boater					-0.117* (0.070)
Prob Catch*Fisher					2.723*** (0.601)
Adjusted R-squared	0.0069	0.0052	0.009	0.0093	0.0182

*** , ** and * denote statistical significance at the 1%, 5% and 10% levels respectively

Table 34. Truncated Negative Binomial Regression of Trips per 12 Months

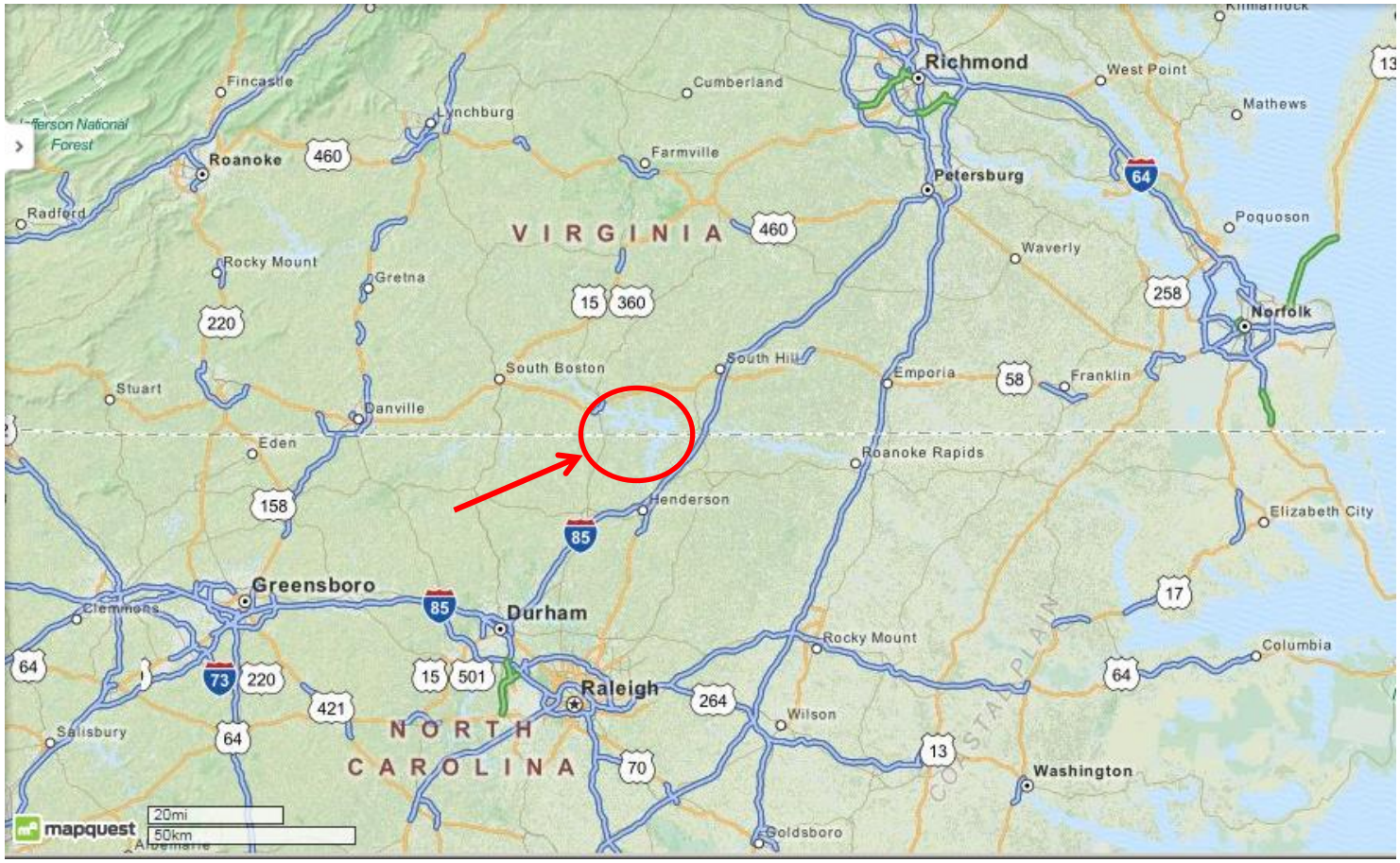
	Mail-in sample	**In-person sample**
Variable	**Coefficient (standard error)**	
Intercept	2.055*** (0.727)	2.1893 (2.914)
Age	-0.014** (0.006)	-0.00824 (0.009)
Male	0.588*** (0.153)	-0.1105 (0.195)
VA resident	-0.050 (0.122)	0.3326* (0.184)
Employed	-0.266* (0.153)	0.1153 (0.249)
Log(income)	0.048 (0.112)	-1.1825*** (0.402)
Years coming to JHKR	0.020*** (0.004)	0.033*** (0.006)
Inclusive Value	0.1024 (0.075)	0.289** (0.148)
N	289	554
-2 Log Likelihood	2211.8	2677.9

Table 35. Per trip compensating variation for QRR changes in water levels

QRR water level changes					
	302'-303'	304' - 305'	306' +	310' +	Total QRR
Mean Per Trip Compensating Variation ($) In-Person Sample (standard deviation)					
Full sample (n = 578)	-0.33 (0.10)	0.29 (0.05)	0.73 (0.09)	0.47 (0.07)	1.16 (0.12)
Daytrips (n = 91)	-0.49 (0.02)	0.38 (0.01)	0.79 (0.04)	0.49 (0.03)	1.17 (0.06)
Overnight (n = 487)	-0.30 (0.07)	0.28 (0.04)	0.72 (0.09)	0.46 (0.07)	1.16 (0.13)
Mean Per Trip Compensating Variation ($) Mail-in Sample (standard deviation)					
Full sample (n = 369)	0.03 (0.05)	0.48 (0.07)	2.02 (0.26)	1.30 (0.18)	3.85 (0.49)
Daytrips (n = 173)	-0.01 (0.02)	0.48 (0.06)	1.98 (0.22)	1.27 (0.14)	3.75 (0.42)
Overnight (n = 196)	0.06 (0.05)	0.47 (0.08)	2.06 (0.29)	1.33 (0.20)	3.94 (0.53)

Figures

Figure 1. John H. Kerr Reservoir, Location Map



(Source: MapQuest.com)

Figure 2a. John H. Ker Reservoir, Recreation Sites Map
(Source: USACE. 2015. Available: http://www.saw.usace.army.mil/Portals/59/docs/recreation/johnhkerrlake/Lake%20Map.pdf)

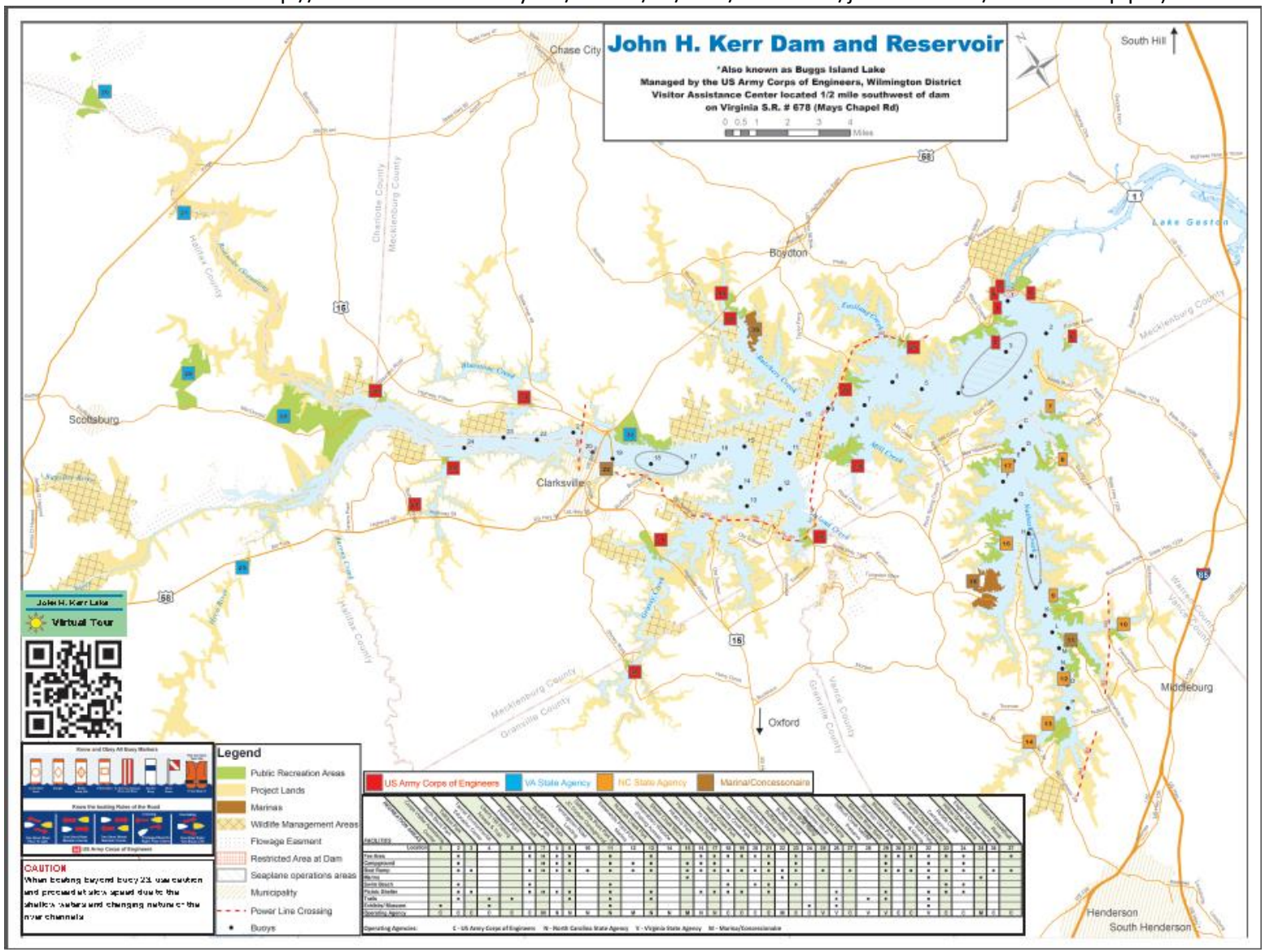


Figure 2b. John H. Ker Reservoir, Recreation Sites Map, West Detail

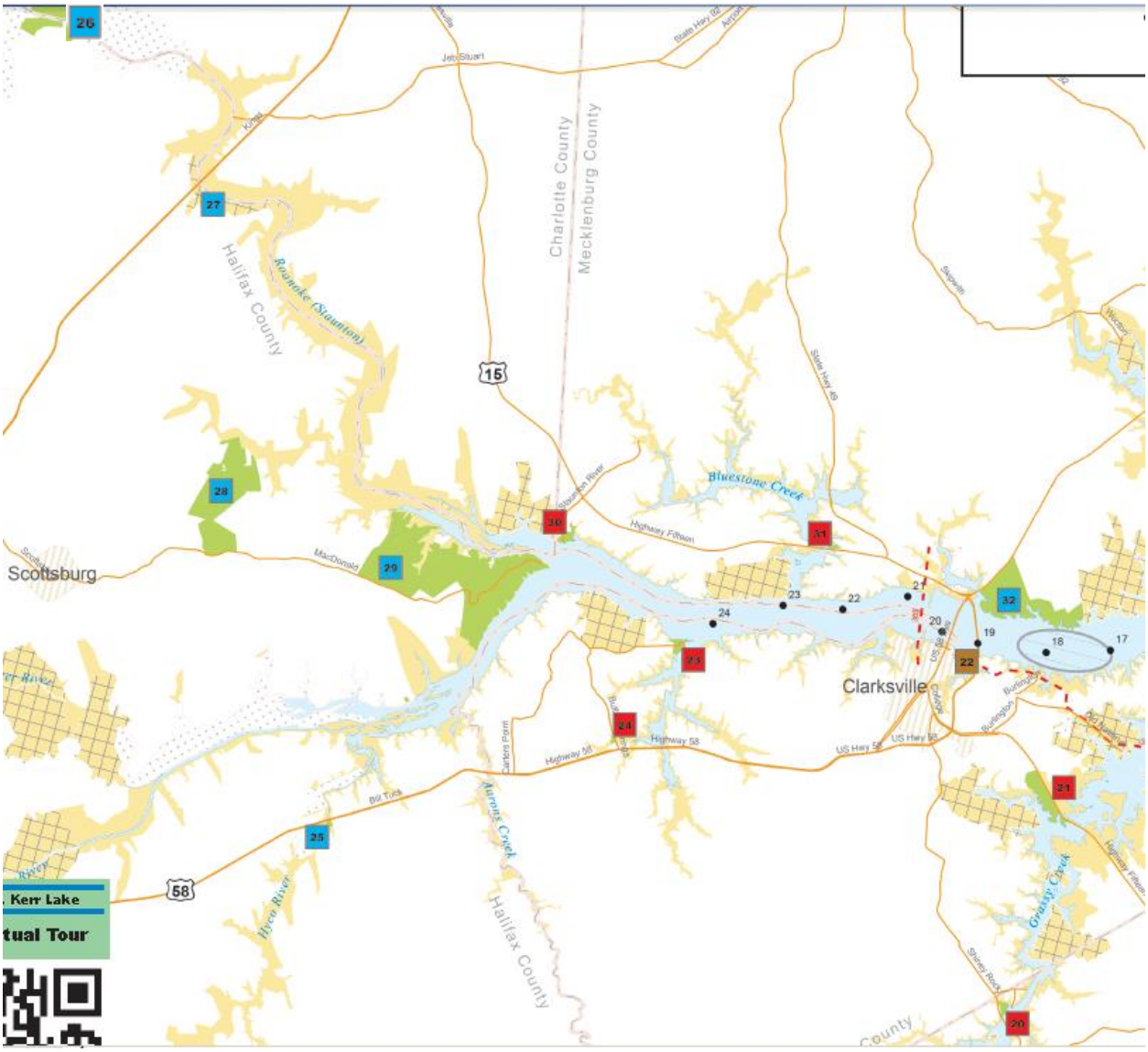


Figure 2c. John H. Ker Reservoir, Recreation Sites Map, East Detail

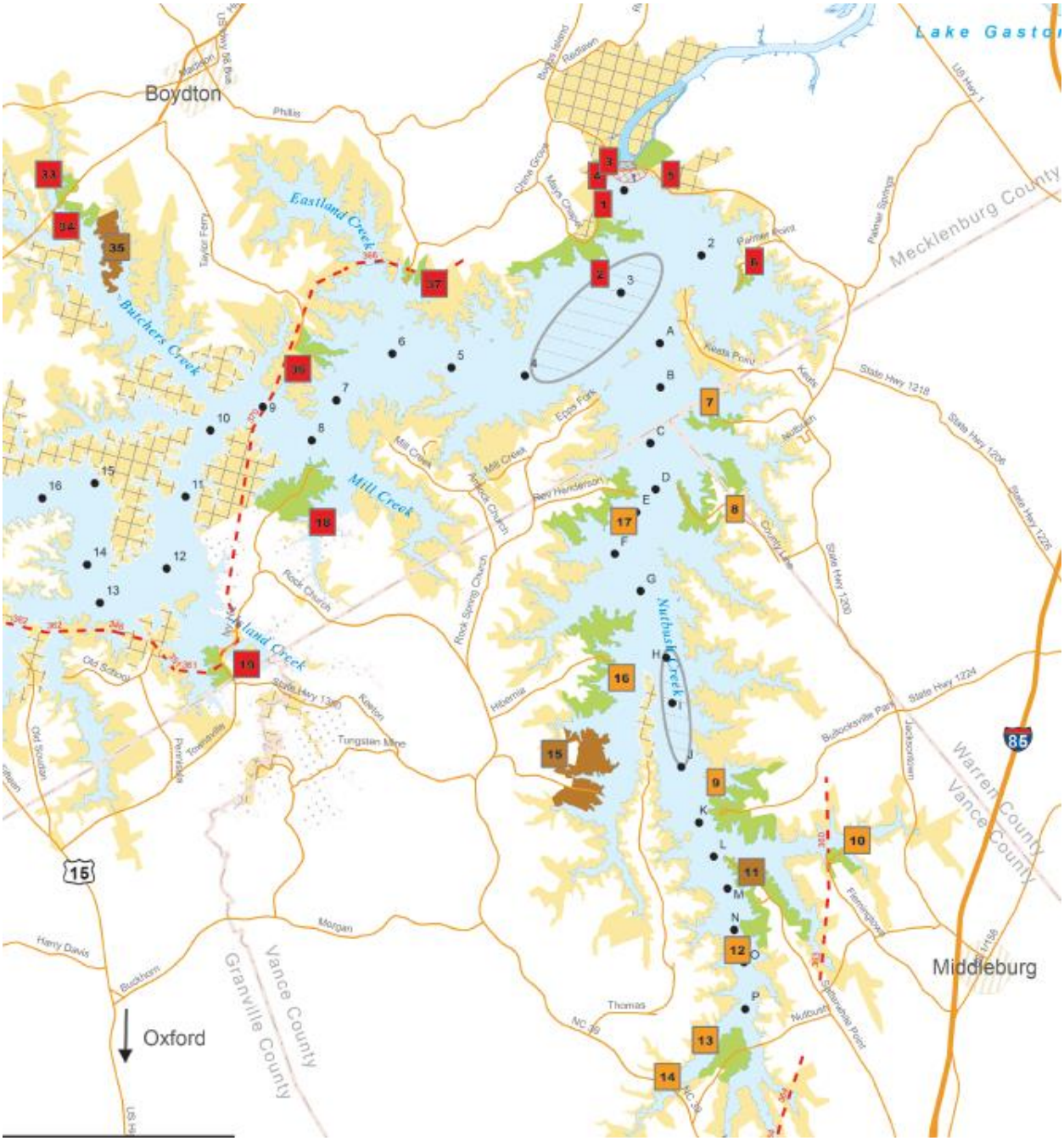
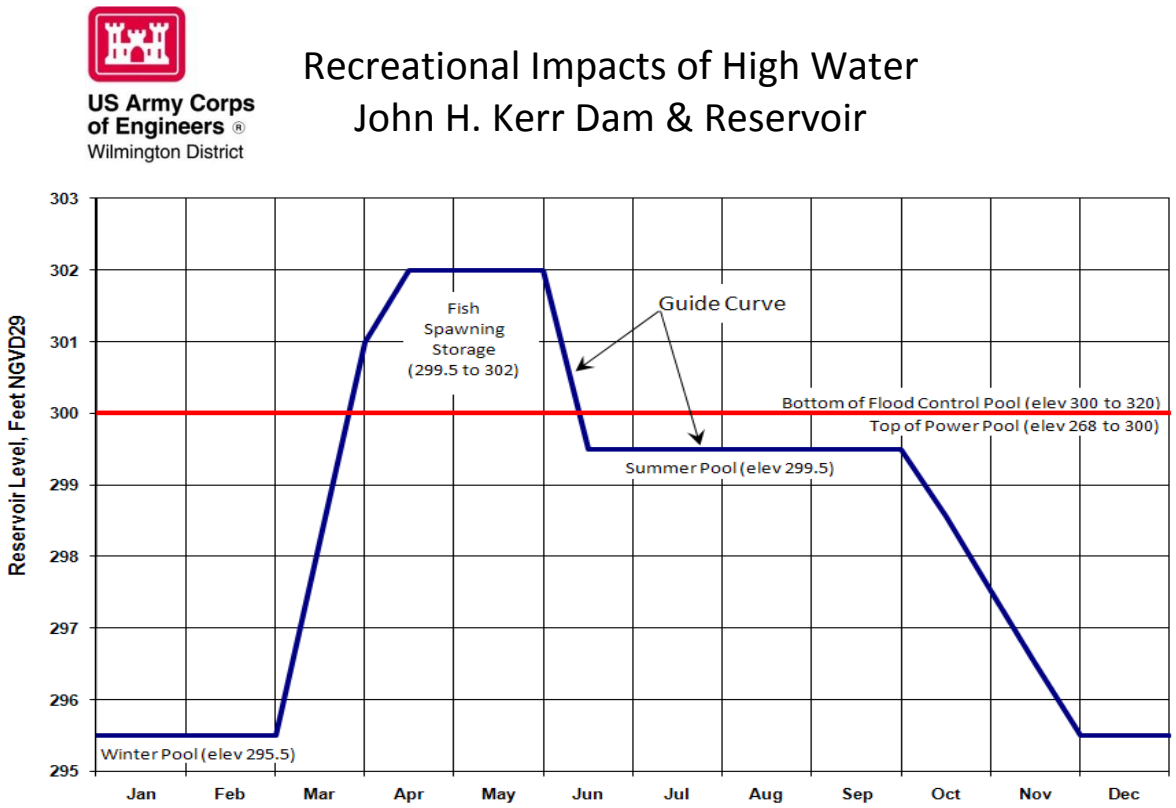


Figure 3. Reservoir Water Elevation Management Scenarios



Existing Operations (ca 2014) Scenario		QRR Scenario
Kerr Lake Level (ft-msl)	Roanoke Rapids Releases (cfs), year-round	Roanoke Rapids Releases (cfs), year-round
Below 300	Up to 8,000	**Above Guide QRR Curve (GC)**: Outflow ~=Inflow up to 35,000 cfs based on a weekly average inflow. **Below GC:** Minimum energy (equal or exceeds FERC minimum releases at Roanoke Rapids Dam). Above 320: Existing Operations.
300-312	Up to 20,000	
312-315	Up to 25,000	
315-320	Up to 35,000	
320-321	85% of inflow or up to 35,000, whichever is higher	
Above 321	Inflow	

Appendix I—Recreation Areas and Marinas

(Source: http://www.saw.usace.army.mil/Locations/DistrictLakesandDams/JohnHKerr/Recreation/RecreationAreas.aspx)

Key: * Operated by U.S. Army Corps of Engineers
** Operated by State of North Carolina
*** Operated by Commonwealth of Virginia

Recreation Areas

1. USACE Visitor Assistance Center* Facilities available: visitor center, interpretive exhibits on hydropower and area cultural history, flush toilets, brochures and information on area and Corps of Engineers, picnic area, and scenic lake overlook. This is a free area. Center is operated year round, hours: 8:00am to 4:30pm, Monday through Friday, closed Federal Holidays. Park Address: 1930 Mays Chapel Rd, Boydton VA 23917

2. North Bend Park* Facilities available: public boat launching, tent and trailer camping, public picnic areas, accessible fishing pier, group camping areas, hot water showers, flushing toilets, public swimming beach, sanitary dump station, and trail. Camping fees from April to October are $20.00 to $26.00 per night. Piney Woods group camping area can be reserved for $100 per night and Mays Chapel group camping area can be reserved for $75 per night. A $4.00 visitor fee is charged for non-camping visitors to the campground and a $4.00 day use fee for access to use the day use areas. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the visitor or day use fee. Picnic Shelters can be reserved for $35.00 per day. Picnic Shelter can be reserved for $35.00 per day by calling 434-738-6143; the $4.00 day use fee still applies to those visitors using a reserved shelter. Fishing tournaments may be held at the park by obtaining a special events permit, a fee may apply. Park Address: 64 North Bend Drive, Boydton VA 23917

3. Tailrace Park* Facilities available: public boat launching, picnic area and shelter, fishing access, trails, wildlife viewing platform, accessible canoe/kayak launch, vault toilet, and flushing toilets April to October. This is a fee free area.

4. Joseph S.J. Tanner II Environmental Education Center and Forest Study Area* Facilities available: Interpretive exhibits on local flora and fauna, butterfly garden flush toilets, trails, interpretive signs on forest management, family fun programming, amphitheatre, and Tugboat Dan. The center is operated-Hours: 9:00am to 4:00pm and closed 12:00pm to 1:00pm for lunch, April 1st to October 31st Saturday, Sunday and Federal Holidays; in addition Memorial Day Weekend through Labor Day Weekend, the center will also be open Thursday and Friday. Schools and groups may request free programs at the center throughout the year by calling 434-738-6143. This is a free area. Park Address: 5164 Buggs Island Rd, Boydton VA 23917

5. Liberty Hill Fishing Access and Trail* Facilities available: picnic area, bank fishing access, scenic lake overlook, and 2 mile interpretive hiking trail. The Corps of Engineers discourages visitors to use the area for swimming, and there is NO SWIMMING in the Restricted Area near the Dam. This is a free area.

6. Palmer Point* Facilities available: public boat launching, public picnic area and shelter, vault toilet, and a public swimming beach. There is a day use fee of $4.00 to use the area. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. The picnic shelter

can be reserved for $35.00 per day by calling 434-738-6143; the $4.00 day use fee still applies to visitors using a reserved picnic shelter. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply. Park Address: 899 Palmer Point Rd, Boydton VA 23917

7. Kimball Point Park** Facilities available: public boat launching, tent and trailer camping, public picnic areas, group camping areas, hot water showers, flushing toilets, a sanitary dump station and campsite hook-ups.

8. County Line Park** Facilities available: public boat launching, tent and trailer camping, public picnic areas, group camping areas, hot water showers, flushing toilets, a sanitary dump station and campsite hook-ups.

9. Bullocksville Park** Facilities available: public boat launching, tent and trailer camping, public picnic areas, group camping areas, flushing toilets, and a sanitary dump station.

10. Flemingtown Road Landing** Facilities available: public boat launching.

11. Satterwhite Point Park & JC Cooper Campground** Facilities available: public boat launching, tent and trailer camping, public picnic areas, hot water showers, flushing toilets, group camping areas, a sanitary dump station, and campsite hookups.

12. Satterwhite Marina Facilities available include boat docking and mooring, boat and motor repairs, motor fuel and oil, sporting equipment and bait, food and drinks, overnight cabins, flushing toilets, marina dump station, dry stack storage. (252) 430-1300

13. Nutbush Creek Park** Facilities available: public boat launching, tent and trailer camping, public picnic areas, hot water showers, flushing toilets, a sanitary dump station and campsite hook-ups. South Side Park is open year round.

14. Williamsboro Wayside** Facilities: Public fishing access only, no boat ramp.

15. Steele Creek Marina Facilities available include boat docking and mooring, motor fuel and oil, sporting equipment and bait, food and drinks, public picnic areas, hot water showers, flushing toilets, group camping areas, a marina, dump station, and campsite hookups. (252) 492-1426

16. Hibernia Park** Facilities available: public boat launching, tent and trailer camping, public picnic areas, group camping areas, hot water showers, flushing toilets, a sanitary dump station and campsite hook-ups.

17. Henderson Point Park** Facilities available: public boat launching, tent and trailer camping, public picnic areas, group camping areas, hot water showers, flushing toilets, a sanitary dump station and campsite hook-ups.

18. Ivy Hill Park* Facilities available: public boat launching, public picnic areas, public swimming beach, and vault toilet. There is a $4.00 day use fee to use the area. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. The picnic shelter can be reserved for $35.00 per day by calling 434-738-6143; the $4.00 day use fee still applies to those visitors using a reserved shelter. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply. Park Address: 3197 Ivy Hill Rd, Clarksville VA 23927

19. Island Creek Park* Facilities available: public boat launching and vault toilet. A $4.00 day use fee is charged to use the boat ramp only. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply.

20. Grassy Creek Park* Facilities available: public boat launching, public picnic areas, vault toilet, and a public swimming beach. A $4.00 day use fee is charged to use this area. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply.

21. Longwood Park and Boat Ramp* Facilities available: tent and trailer camping, hot water showers and flushing toilets are available to campers, sanitary dump station, public picnic area and shelter, public swimming beach, and vault toilets. Camping fees from April to October are $20.00 to $40.00 per night. A $4.00 visitor fee is charged for non-camping visitors to the campground and a $4.00 day use fee for access to use the day use areas. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the visitor or day use fee. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. The picnic shelter can be reserved for $35.00 per day by calling 434-738-6143; the $4.00 day use fee still applies to those visitors using a reserved shelter. Park Address: 13500 Hwy 15, Clarksville VA 23927
Longwood Boat Ramp* Facilities available: public boat launching with courtesy dock and vault toilet. A $4.00 day use fee is charged to use this area. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply.

22. Clarksville Marina Facilities available include boat docking and mooring, boat and motor rentals, boat and motor repairs, motor fuel and oil, sporting equipment and bait, and food and drinks. (434) 374-8501

23. Buffalo Park* Facilities available: public boat launching with courtesy dock, vault toilet, sanitary dump station, public picnic area and shelter, public swimming beach, tent and trailer camping and one double site, hot water showers and flushing toilets are available to campers only. Camping is available from May to September and camping fees are $20.00--$52.00 per night, and advanced site reservation is not available. A $4.00 visitor fee is charged for non-camping visitors to the campground and a $4.00 day use fee for access to use the day use area. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the visitor or day use fee. The picnic shelter can be reserved for $35.00 per day by calling 434-738-6143; the $4.00 day use fee still applies to visitors using a reserved picnic shelter. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply. Park Address: 5199 Carters Point Rd, Buffalo Junction VA 24529

24. Buffalo Springs National Historic Site* Facilities available: public picnic area and shelter, historical interpretive signs, vault toilet, and drinking water. This area is free.

25. Hyco Boat Landing*** Facilities available: public boat launching.

26. Staunton River Battlefield Park*** Facilities available: visitor center and trails.

27. Clover Landing Boat Ramp*** Facilities available: public boat launching.

28. Difficult Creek Nature Preserve*** This 818-acre nature preserve is managed to restore the historic savanna ecosystem and its constituent rare species. Vehicular access restricted to State Secondary Route 719. Facilities available: over two miles of hiking on the fire access lanes within the preserve.

29. Staunton River State Park*** Facilities available: public boat launching, overnight cabins, tent and trailer camping, public picnic areas, swimming pool, hot water showers, flushing toilets, group camping areas, and a sanitary dump station.

30. Staunton View Park* Facilities available: public boat launching, vault toilet, trail, and public picnic area. There is a day use fee of $4.00 to use the boat ramp only. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply.

31. Bluestone Boat Ramp* Facilities available: public boat launching with courtesy dock and vault toilet. A $4.00 day use fee is charged to use this area. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply.

32. Occoneechee State Park and Marina*** Facilities available: public boat launching, tent and trailer camping, equestrian camping area, public picnic areas, hot water showers, flushing toilets, sanitary dump station, trails, marina, gas dock, and interpretive visitor center.

33. Rudds Creek Recreation Area (Day Use)* Facilities available: public boat launching with courtesy dock, public picnic area and shelter, vault toilet, flushing toilets from April to October, and a public swimming beach. There is a day use fee of $4.00 to use the area. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. The picnic shelter can be reserved for $35.00 per day by calling 434-738-6143; the $4.00 day use fee still applies to visitors using a reserved picnic shelter. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply. Park Address: 16065 Hwy 58, Boydton VA 23917

34. Rudds Creek Campground* Facilities available: boat launching with courtesy dock, tent and trailer camping including double sites, picnic shelter at the swimming beach, hot water showers, flushing toilets, swimming beach, and sanitary dump station. As of 2015 camping fees from April to October are $20.00 to $52.00 per night. There is also a $4.00 visitor fee for non-camping visitors in the campground. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the visitor fee. Park Address: 16064 Hwy 58, Boydton VA 23917

35. Rudds Creek (Willow Grove) Marina Facilities include boat docking and mooring, motor fuel and oil, marine and convenience store. (434) 738-7655

36. Eagle Point Boat Ramp* Facilities available: public boat launching and vault toilet. Parking for the Mumford Trailhead is located just before the entrance. This area is free.

37. Eastland Creek Boat Ramp* Facilities available: public boat launching with courtesy dock and vault toilet. A $4.00 day use is charged to use this area. Visitors may choose to purchase and display a valid Corps of Engineers Annual Pass in lieu of the day use fee. Fishing tournaments may be held at the area by obtaining a special events permit, a fee may apply.

Appendix II--In-Person Survey Instrument

JR1 Initials _____ Date___/___/___ Time _____ Site _____

John H. Kerr Reservoir Recreation Survey

INTRODUCTION

Hello, my name is _____. I am a student at the University of North Carolina Wilmington and I am working on a research study regarding the economic value of the Roanoke River and John H. Kerr Reservoir.

Do you have a few minutes to answer some questions about yourself and your current trip?

If yes, *OK great. Thank you*.

If no, *Thanks anyway. I hope you have a great day.*

First I have to ask if you are 18 years old or older…. If no, stop*… Thank you anyway!*

The study that we're working on is being funded through a partnership with the Nature Conservancy, the US Army Corps of Engineers and the University of North Carolina Wilmington.

This survey is completely ***anonymous and confidential****. We will not ask for your name, address or phone number. Your participation is* ***voluntary****, you can stop at any time or refuse to answer any question and your responses will not be treated any differently by the researchers. Your answers are important for future decisions about natural resource management, so please be as truthful and complete as possible in answering the questions.*

PLEASE TELL US ABOUT YOURSELF

1. Note respondent gender ☐ Male ☐ Female

2. Do you live in the US? ☐ Yes ☐ No write in _____

3. What state (Province if Canada) do you live in?
State _____
Province_____

4. From what US zip code did your trip begin? _____

If refused, ask what county in (state) _____

5. How many trips to the JH Kerr Reservoir did you take in the last 12 months? _____ trips

6. How many years have you coming to the JH Kerr Reservoir? _____ years

7a. How many trips to the JH Kerr Reservoir have you taken so far this year, including this trip?____ trips

8b. How many additional trips to the JH Kerr Reservoir do you anticipate taking this year?____ trips

9. (Hand respondent **age** card) This card has letters for different age groups. Which letter matches your current age group?

☐ E. Under 20 years ☐ G. 30-39 years ☐ F. 50-59 years ☐ D. over 69 years
☐ A. 20-29 years ☐ C. 40-49 years ☐ B. 60-69 years

10. What is the highest grade you completed in school?
☐ Primary school ☐ Secondary school ☐ High school
☐ College/University ☐ Masters or other graduate degree

11. Are you married? ☐ Yes ☐ No

12a. Are you currently employed? ☐ Yes ☐ No

12b. If currently employed, what is your job/occupation? (if retired, list your last job)
_____

13. (Hand respondent **income** card) This card has letters for different income groups. Which letter matches your current **annual household income before taxes**? (Again, this survey is completely anonymous)

☐ F. UNDER $20,000 ☐ B. $100,000 - $119,999
☐ C. $20,000 - $39,999 ☐ G. $120,000 - $139,999
☐ I. $40,000 - $59,999 ☐ D. $140,000 - $159,999
☐ A. $60,000 - $79,999 ☐ H. $160,000 - $179,999
☐ J. $80,000 - $99,999 ☐ E. $180,000 and ABOVE

NEXT I'M GOING TO ASK YOU SOME QUESTIONS ABOUT YOUR CURRENT TRIP

14. What was your primary recreation destination (which boat ramp, campsite, beach, river reach, etc.) in the John H. Kerr Reservoir region? _____

15. For each recreation activity that I list, please answer yes if you participated in that activity on this trip. For each activity, please also tell me how many times you did that activity on this trip.

☐ Use beaches / Sun bathe ____ times ☐ Swimming ____ times ☐ Jet skiing ____ times
☐ Boating on a power boat ____ times ☐ Fishing ____ times ☐ Water skiing ____ times
☐ Sail boat /catamaran ____ times ☐ Picnicking ____ times ☐ Canoeing/kayaking ____ times
☐ Hiking ____ times ☐ Camping ____ times ☐ Golf ____ times
☐ Other recreation _____ ____ times

16. Of those activities, which would you say was the **MAIN PURPOSE** of this visit to John H. Kerr Reservoir?
☐ Fishing ☐ General boating/swimming/watersports
☐ Camping ☐ Picnicking / sunbathing on shore / relaxing on shore
☐ Other (please specify) _____

17. Approximately how many hours did you spend travelling from your home or point of origin to the reservoir?_____ hours

18. How many days in length is your trip to the reservoir?_____ days

19. Approximately how many hours did you spend at the reservoir today? _____ hours

20. Approximately how many more hours will you spend at the reservoir today? _____ hours

21. Does this trip include visits to other recreation/fishing/boating sites? ☐ No ☐ Yes,

22. If yes, what other sites have been, or will be, visited during this trip? _____

23a. If John H. Kerr Reservoir was not accessible, would you have made a trip somewhere else instead, or would you have stayed home? ☐ made a trip somewhere else ☐stayed home

23b. If you would have made a trip somewhere else, where? _____ to do what? _____

24. How much was your total expenditure for this trip to the reservoir? $_____

25a. How many adults (18 years or over) does this expenditure cover? _____

25b. How many kids (17 years or younger) does this expenditure cover? _____

25c. How much of this money did you spend on each of the following items:

	SPENT IN N.C.	SPENT IN V.A.	SPENT WITHIN 10 MILES OF Reservoir?
Hotel/motel/inn/bed & breakfast fees	$_____	$_____	☐ Yes ☐ No
Camping fees	$_____	$_____	☐ Yes ☐ No
Boat ramp / boat dock fees	$_____	$_____	☐ Yes ☐ No
Food, drinks, ice bought in grocery/convenience stores	$_____	$_____	☐ Yes ☐ No
Food and drinks bought in restaurants/bars	$_____	$_____	☐ Yes ☐ No
Gasoline for automobile	$_____	$_____	☐ Yes ☐ No
Gasoline for boat	$_____	$_____	☐ Yes ☐ No
Bait, tackle, and other fishing related expenses	$_____	$_____	☐ Yes ☐ No
All other spending	$_____	$_____	☐ Yes ☐ No

IF THE RESPONDENT FISHED ON THIS TRIP . . .

26. Of the hours spent at the reservoir each day, how many hours were spent fishing? _____ hours

27. Did you target a particular species of fish? ☐ No ☐ Yes

28. If yes, what was your primary fishing target on this trip?

☐ Striped bass ☐ Hickory Shad ☐ American Shad ☐ Blueback herring
☐ Large Mouth Bass ☐ Alewife ☐ Catfish ☐ Other (specify) _____

29a. Did you catch fish on this trip? ☐ No ☐ Yes

29b. If yes, how many fish did you *catch and **release***? (please indicated number and species)

____ Striped bass ____ Hickory Shad ____ American Shad ____ Blueback herring
____ Largemouth bass ____ Alewife ____ Catfish ____ Other (specify)_____

29c. How many fish did you *catch and **keep***? (please indicated number and species)
____ Striped bass ____ Hickory Shad ____ American Shad ____ Blueback herring
____ Largemouth bass ____ Alewife ____ Catfish ____ Other (specify)_____

30. Prior to your trip, how many fish did you expect to catch today? _____ fish

31. What was the primary type of bait that you used fishing today?
☐ live bait ☐ cut bait ☐ artificial bait ☐ a combination of different types of bait

PLEASE TELL US ABOUT THE BOAT YOU USED ON THIS TRIP

32. If you went boating, do you own the boat? ☐ yes ☐ no

33. What is the length of the boat?
☐ UNDER 10 feet ☐ 13 feet – 15 feet ☐19 feet – 21 feet ☐ 25 feet – 27 feet
☐ 10 feet – 12 feet ☐ 16 feet – 18 feet ☐ 22 feet – 24 feet ☐ 28 feet or ABOVE

34. What is the horse power of the motor?
☐ N/A the boat did not have a motor
☐ UNDER 15 HP ☐ 30 HP – 40 HP ☐ 90 HP – 100 HP ☐ 175 HP – 200 HP
☐ 15 HP – 25 HP ☐ 50 HP – 75 HP ☐ 125 HP – 150 HP ☐ 225 HP or ABOVE

PLEASE TELL US ABOUT THE QUALITY OF YOUR TRIP

35. On a scale of 1-5, with 1 meaning “lowest quality” and 5 meaning “highest quality”, please rate the following attributes based on this trip to the John H. Kerr Reservoir. If an item does not apply, indicate by circling n/a (not applicable). If you don’t know, circle dk (don’t know).:

	Low quality			High Quality			
The cleanliness & visibility of the water	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
The water level in the reservoir	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
The overall quality of camping	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
The overall quality of beach areas	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
The overall quality of fishing	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
Crowding at the boat ramp	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
Crowding on the water	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
Crowding at the campsite	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
Crowding at the beach	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
Availability of parking	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk

PLEASE TELL US ABOUT WHETHER YOU WILL RETURN IN THE FUTURE

36. If the cleanliness & visibility of the water remain as they were during this visit, will you return to the JH Kerr Reservoir in the future? ☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

37. If the cleanliness & visibility of the water were to decrease by 10%, and all other conditions remained the same, would you return to JH Kerr Reservoir in the future?
☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

38. If fishing quality remains as it was during this visit, will you return to the JH Kerr Reservoir in the future?

☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

39. If fishing quality was to decrease by 10%, and all other conditions remained the same, would you return to JH Kerr Reservoir in the future?

☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

40. If crowding conditions on the water remain as they were during this visit, and all other conditions remained the same, will you return to the JH Kerr Reservoir in the future?

☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

41. If crowding conditions on the water were to increase by 10% (the water would be 10% more crowded), and all other conditions remained the same, would you return to JH Kerr Reservoir in the future?

☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

42. If crowding conditions at the boat ramp/launch remain as they were during this visit, and all other conditions remained the same, will you return to the JH Kerr Reservoir in the future?

☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

43. If crowding conditions at the boat ramp/launch were to increase by 10% (the ramp would be 10% more crowded), and all other conditions remained the same, would you return to JH Kerr Reservoir in the future?

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Appendix III—Windshield/Boating Survey Instrument

JB1 Initials _____ Date___/___/___ Time _____ Site _____

John H. Kerr Reservoir Boating Survey

INTRODUCTION

This survey is part of a study of the economic value of the Roanoke River and John H. Kerr Reservoir. The study is being funded through a partnership with the Nature Conservancy, the US Army Corps of Engineers and the University of North Carolina Wilmington.

The survey is completely **anonymous and confidential**. We do not require your name, address or phone number. Your participation is **voluntary**, you can stop at any time or refuse to answer any question and your responses will not be treated any differently by the researchers. Your answers are important for future decisions about natural resource management, so please be as truthful and complete as possible in answering the questions.

We have included a self-addressed envelope with current postage paid. Please complete this survey, enclose it in the self-addressed envelope and mail it back to us at your earliest convenience.

Thank you for agreeing to take this survey.

PLEASE TELL US ABOUT YOURSELF

1. Where do you live? ☐ United States … State _____ County _____
☐ Canada … Province_____
☐ Other … Country _____

2. If you live in the United States, from what US zip code did your trip begin? _____

3. How many trips to the JH Kerr Reservoir did you take in the last 12 months? _____ trips

4. How many years have you coming to the JH Kerr Reservoir? _____ years

5a. How many trips to the JH Kerr Reservoir have you taken so far this year, including this trip?____ trips

5b. How many additional trips to the JH Kerr Reservoir do you anticipate taking this year?____ trips

6. In which age group are you?
☐ Under 20 years ☐ 30-39 years ☐ 50-59 years ☐ over 69 years
☐ 20-29 years ☐ 40-49 years ☐ 60-69 years

7. Are you male or female? ☐ Male ☐ Female

8. What is the highest grade you completed in school?
☐ Primary school ☐ Secondary school ☐ High school
☐College/University ☐ Masters or other graduate degree

9. Are you married? ☐ Yes ☐ No

10a. Are you currently employed? ☐ Yes ☐ No

10b. If currently employed, what is your job/occupation? (if retired, list your last job)
_____

11. What is your approximate **annual household income before taxes** (for you and your spouse combined, if you have a spouse)? (Please recall that this survey is completely anonymous)

☐ UNDER $20,000	☐ $100,000 - $119,999
☐ $20,000 - $39,999	☐ $120,000 - $139,999
☐ $40,000 - $59,999	☐ $140,000 - $159,999
☐ $60,000 - $79,999	☐ $160,000 - $179,999
☐ $80,000 - $99,999	☐ $180,000 and ABOVE

PLEASE TELL US ABOUT YOUR CURRENT TRIP

12. What was your primary recreation destination (which boat ramp, campsite, beach, river reach, etc.) in the John H. Kerr Reservoir region? _____

13. What recreation activities did you participate in on this trip to John H. Kerr Reservoir? (Tick all that apply and indicate number of times you did this activity during your trip):

☐ Use beaches / Sun bathe ____ times ☐ Swimming ____ times ☐ Jet skiing ____ times
☐ Boating power boat ____ times ☐ Fishing ____ times ☐ Water skiing ____ times
☐ Sail boat /catamaran ____ times ☐ Picnicking ____ times ☐ Canoeing/kayaking ____ times
☐ Hiking ____ times ☐ Camping ____ times ☐ Golf ____ times
☐ Other recreation _____ ____ times

14. What was the **MAIN PURPOSE** of this visit to John H. Kerr Reservoir?
☐ Fishing ☐ General boating/swimming/watersports
☐ Camping ☐ Picnicking / sunbathing on shore / relaxing on shore
☐ Other (please specify) _____

15. Approximately how many hours did you spend travelling from your home or point of origin to the reservoir?_____ hours

16. How many days in length is your trip to the reservoir?_____ days

17. Approximately how many hours did you spend at the reservoir today? _____ hours

18. Approximately how many more hours will you spend at the reservoir today? _____ hours

19. Does this trip include visits to other recreation/fishing/boating sites? ☐ No ☐ Yes,

20. If yes, what other sites have been, or will be, visited during this trip? _____

21a. If John H. Kerr Reservoir was not accessible, would you have made a trip somewhere else instead, or would you have stayed home? ☐ made a trip somewhere else ☐ stayed home

21b. If you would have made a trip somewhere else, where? _____ to do what? _____

22. How much was your total expenditure for this trip to the reservoir? $_____

23a. How many adults (18 years or over) does this expenditure cover? _____

23b. How many kids (17 years or younger) does this expenditure cover? _____

23c. How much of this money did you spend on each of the following items:

	SPENT IN N.C.	SPENT IN V.A.	SPENT WITHIN 10 MILES OF Reservoir?
Hotel/motel/inn/bed & breakfast fees	$_____	$_____	☐ Yes ☐ No
Camping fees	$_____	$_____	☐ Yes ☐ No
Boat ramp / boat dock fees	$_____	$_____	☐ Yes ☐ No
Food, drinks, ice bought in grocery/convenience stores	$_____	$_____	☐ Yes ☐ No
Food and drinks bought in restaurants/bars	$_____	$_____	☐ Yes ☐ No
Gasoline for automobile	$_____	$_____	☐ Yes ☐ No
Gasoline for boat	$_____	$_____	☐ Yes ☐ No
Bait, tackle, and other fishing related expenses	$_____	$_____	☐ Yes ☐ No
All other spending	$_____	$_____	☐ Yes ☐ No

IF YOU FISHED ON THIS TRIP . . .

24. Of the hours spent at the reservoir today, how many hours were spent fishing? _____ hours

25. Did you target a particular species of fish? ☐ No ☐ Yes

26. If yes, what was your primary fishing target on this trip?
☐ Striped bass ☐ Hickory Shad ☐ American Shad ☐ Blueback herring
☐ Large Mouth Bass ☐ Alewife ☐ Catfish ☐ Other (specify) _____

27a. Did you catch fish on this trip? ☐ No ☐ Yes

27b. If yes, how many fish did you ***catch and release***? (please indicated number and species)
____ Striped bass ____ Hickory Shad ____ American Shad ____ Blueback herring
____ Largemouth bass ____ Alewife ____ Catfish ____ Other (specify)_____

27c. How many fish did you ***catch and keep***? (please indicated number and species)
____ Striped bass ____ Hickory Shad ____ American Shad ____ Blueback herring
____ Largemouth bass ____ Alewife ____ Catfish ____ Other (specify)_____

28. Prior to your trip, how many fish did you expect to catch today? _____ fish

29. What was the primary type of bait that you used fishing today?
☐ live bait ☐ cut bait ☐ artificial bait ☐ a combination of different types of bait

PLEASE TELL US ABOUT THE BOAT YOU USED ON THIS TRIP

30. If you went boating, do you own the boat? ☐ yes ☐ no

31. What is the length of the boat?
☐ UNDER 10 feet ☐ 13 feet – 15 feet ☐19 feet – 21 feet ☐ 25 feet – 27 feet
☐ 10 feet – 12 feet ☐ 16 feet – 18 feet ☐ 22 feet – 24 feet ☐ 28 feet or ABOVE

32. What is the horse power of the motor?
☐ N/A the boat did not have a motor
☐ UNDER 15 HP ☐ 30 HP – 40 HP ☐ 90 HP – 100 HP ☐ 175 HP – 200 HP
☐ 15 HP – 25 HP ☐ 50 HP – 75 HP ☐ 125 HP – 150 HP ☐ 225 HP or ABOVE

PLEASE TELL US ABOUT THE QUALITY OF YOUR TRIP

35. On a scale of 1-5, with 1 meaning "lowest quality" and 5 meaning "highest quality", please rate the following attributes based on this trip to the John H. Kerr Reservoir. If an item does not apply, indicate by circling n/a (not applicable). If you don't know, circle dk (don't know).:

	Low quality					High Quality	
The cleanliness & visibility of the water	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
The water level in the reservoir	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
The overall quality of camping	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
The overall quality of beach areas	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
The overall quality of fishing	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
Crowding at the boat ramp	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
Crowding on the water	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
Crowding at the campsite	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk
Crowding at the beach	☐ 1	☐2	☐ 3	☐ 4	☐ 5	☐ n/a	☐ dk

Availability of parking ☐ 1 ☐2 ☐ 3 ☐ 4 ☐ 5 ☐ n/a ☐ dk

PLEASE TELL US ABOUT WHETHER YOU WILL RETURN IN THE FUTURE

36. If the cleanliness & visibility of the water remain as they were during this visit, will you return to the JH Kerr Reservoir in the future?
☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

37. If the cleanliness & visibility of the water were to decrease by 10%, and all other conditions remained the same, would you return to JH Kerr Reservoir in the future?
☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

38. If fishing quality remains as it was during this visit, will you return to the JH Kerr Reservoir in the future?
☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

39. If fishing quality was to decrease by 10%, and all other conditions remained the same, would you return to JH Kerr Reservoir in the future?
☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

40. If crowding conditions on the water remain as they were during this visit, and all other conditions remained the same, will you return to the JH Kerr Reservoir in the future?
☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

41. If crowding conditions on the water were to increase by 10% (the water would be 10% more crowded), and all other conditions remained the same, would you return to JH Kerr Reservoir in the future?
☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

42. If crowding conditions at the boat ramp/launch remain as they were during this visit, and all other conditions remained the same, will you return to the JH Kerr Reservoir in the future?
☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

43. If crowding conditions at the boat ramp/launch were to increase by 10% (the ramp would be 10% more crowded), and all other conditions remained the same, would you return to JH Kerr Reservoir in the future?
☐ Definitely ☐ Probably ☐ Probably not ☐ Definitely not ☐ Unsure

Appendix IV--The Study Authors

Dr. Chris Dumas received B.S. degrees in Economics and Natural Resource Management from North Carolina State University in 1990, and M.S. and Ph.D. degrees in Natural Resource Economics from the University of California, Berkeley, in 1991 and 1997. Dr. Chris Dumas has been a member of the Department of Economics and Finance at UNC Wilmington since 1997. Dr. Dumas' research focuses on the economics of recreational and commercial fisheries, beach and coastal management, the economic impacts of hurricanes, and economic impact analysis. Dr. Dumas teaches microeconomics, environmental economics, economic impact assessment, quantitative methods, and econometrics. Dr. Dumas is a member of the Socio-economics Advisory Panel of the South Atlantic Fisheries Management Commission. Dr. Dumas has conducted research for USACE-Wilmington District, the National Commission on Energy Policy, N.C. Sea Grant, N.C. Dept. Environment and Natural Resources, N.C. Coastal Resources Commission, South Atlantic Marine Fisheries Management Council, Pew Charitable Trusts, Oceana, Dare County, N.C., and the Cities of Wrightsville Beach and Carolina Beach, N.C.

Dr. Peter Schuhmann received his Masters and PhD in Economics from North Carolina State University with field concentrations in Environmental Economics and Statistics. Dr. Schuhmann has been a member of the Department of Economics and Finance at UNC Wilmington since 1999. Dr. Schuhmann focuses his research on the economic value of recreational fisheries and coastal resources in North Carolina and the Caribbean. Dr. Schuhmann teaches microeconomics, natural resource economics, development economics, and econometrics. Dr. Schuhmann is a member of the North Carolina Division of Marine Fisheries, Habitat & Water Quality Advisory Committee, and the Striped Bass Technical Committee, Atlantic States Marine Fisheries Commission. Dr. Schuhmann has conducted research for the U.S. Fish and Wildlife Service, U.S. Dept. of the Interior, Minerals Management Service, U.S. Department of Agriculture, Animal and Plant Health Inspection Service, N.C. Sea Grant, Barbados Ministry of Tourism, and Pew Charitable Trusts, and World Resources Institute.