Platte River Programmatic Environmental Impact Statement
Technical Appendix

Recreation Appendix

Table of Contents

Wyoming

Wyoming Travel Cost Model

The objective of this modeling effort is to be able to estimate the changes in recreation visitor use that can be attributed to the various action alternatives. These alternatives represent different water management regimes. The premise is that long-term changes in water management (and corresponding changes in surface area of the reservoirs) at the selected recreation areas in Wyoming would affect the amount of recreation use a reservoir receives (Piper 1996).

Changes in the management and operation of dams and reservoirs can and do result in fluctuations in reservoir elevations and surface water area. This relationship is observable throughout the year. These changes can have an effect on water related recreation visitation.

Source of Data

In October 1993, the State of Wyoming Division of State Parks and Historic sites conducted a survey of visitors to 18 different parks and historic sites throughout the state. The purpose of the survey includes documentation of visitation patterns and activity levels in Wyoming to determine factors that are important in Wyoming recreation decisions, estimate recreation expenditures, and evaluate other factors that would help the Division of State Parks and Historic Sites meet recreation demands. The survey also provided data about where the visitor came from, number of visits over the year, and other socio-economic questions. This information was used to estimate a recreation visitation model for Wyoming reservoirs.

Recreation at nine of the 18 sites is not water based, so these sites were removed from the data set. The data for another three sites were dropped because the water feature consisted of river segments, which were unlike the large reservoirs and lacked comparable surface area data. The six remaining sites used for this analysis include: Boysen, Buffalo Bill, Glendo, Guernsey, Keyhole, and Seminoe. All of these sites support reservoir-based recreation and there is a great deal of variation in the size of the reservoir and the facilities available, which helps in the estimation of a statistically significant model. The final data set included 121 observations. The size of each reservoir and the types of facilities available are presented in table 1.

Table 1- Facilities at the Wyoming Recreational Areas Included in the Analysis

Recreation site	Camp Grounds	Fishing	Picnic Shelters	Reservoir Surface Area

Boysen	12	Yes	22	19,560
Buffalo Bill	3	Yes	7	8,150
Glendo	7	Yes	6	12,365
Guernsey	7	Yes	4	2,375
Keyhole	11	Yes	6	13,686
Seminoe	3	Yes	18	20,291

Source: Wyoming Division of State Parks and Historic Sites

The Wyoming Recreation Visitation Model

This section presents a regional recreation visitation model developed by Steve Piper, U.S. Bureau of Reclamation, which includes the surface area of a reservoir as a variable explaining annual per capita visitation for six Wyoming reservoirs. The modeling results are then used to estimate the changes in recreation use for Seminoe, Glendo, and Guernsey Reservoirs. These reservoirs were selected for analysis because both visitor use data and hydrologic data are available for study, and these reservoirs are within the North Platte River watershed and thus could be affected by a long-term change in water management. Pathfinder Reservoir was not included in the Wyoming survey because it is a USBR reservoir and because reliable visitor use data is not available for this recreation site. Therefore, changes in recreational use were not able to be estimated for Pathfinder Reservoir.

The recreation visitation model included seven variables to explain per capita visitation: household size, age, the cost of traveling to the site, the cost of traveling to substitute sites, income, whether or not the visitor camped overnight, and surface water acres of the reservoir. The model is essentially a travel cost model except that the estimated visitation model is not translated into a demand curve showing the change in site visitation as a function of the change in travel cost.

Travel cost to the recreation site and to substitute sites are important variables in explaining per capita recreation visitation because they represent the price of recreation for a specific site and the price of recreation at the nearest substitute site. The visitor-origin survey data were used to determine the distance and cost of traveling to a recreation site and back home again. Zip code information from the Wyoming survey data are used to locate the origination point of each individual visitor, from which travel distance and cost can be estimated. The distance traveled from the trip origination point to the recreation site was doubled (to account for the return trip) and multiplied by the cost of driving a vehicle. The cost of driving in 1993 was estimated at 9.3 cents per mile (American Automobile Manufacturers Association, 1996).

The cost of time per visitor was estimated assuming an average speed of 50 miles per hour and an opportunity cost of time at one-third the average wage indicated in the survey data. The survey data were also used to estimate the number of persons per vehicle and the resulting costs per visitor. Taking average per capita income and dividing by 2,080 hours estimated the hourly wage. Substitute recreation sites were accounted for by using the round-trip cost of traveling to

the substitute site as a measure of substitute availability. All observations with a travel distance of more than 350 miles were dropped to avoid multiple site trips, which would contribute to overestimating recreation benefits. The average distance traveled by a visitor to each site and the nearest substitute site is shown in table 2.

Table 2- Average Distance to a Site and to a Substitute Site

Recreation Area	Average one-way Distance to Site	Average one-way Distance to Substitute
Boysen	96	22
Buffalo Bill	49	76
Glendo	104	23
Guernsey	112	26
Keyhole	36	110
Seminoe	153	26

Source: Wyoming Division of State Parks and Historic Sites, and U. S. Bureau of Reclamation

A pooled regional visitation model was estimated using individual data from a 1993 Wyoming state park survey. The 121 observations were separated by site, and then combined into zones of origin for each site. The proportion of visitation from each zone for the visitor survey data was then applied to total visitation at each site in 1993 to derive the total number of visits to each site from each distance zone.

Per Capita Visitation Model Estimation

The visitation model was estimated using ordinary least squares. The model was estimated using a semi-log functional form, where visits per capita and surface water area were transformed into natural logarithms. The estimated Wyoming model is:

ln Vis/Cap = f(HH Size, Age, Cost, Subcost, Income, Camp, ln Sur Acre,),

where:
ln Vis/Cap = natural logarithm of visits per capita,
HHsize= size of the household,
Age = age of the respondent,
Cost = estimated travel cost per visitor,
Subcost = cost of driving to a comparable substitute site,
Income = per capita income in 1993,
Camp = does the respondent participate in camping at the site (1=no, 2=yes),
ln Sur Acre = natural logarithm of average 1993 surface water acreage at the site.

ln Visits/Capita =	-7.936347	+ 0.258617(HH Size)	+ 0.028677(Age)
	(-4.6438)	(3.2300)	(2.6816)
	– 0.053189(Cost)	+ 0.030716(Subcost)	+ 0.000022(Income)
	(-8.7161)	(2.4541)	(1.1333)
	+0.998527(Camp)	+ 0.386267(ln Sur Acre)	
	(2.3400)	(2.4715)	

t-values are shown in parenthesis ( )
F-Value = 26.38
Adjusted R^2 = 0.59687

Household size was expected to have a positive sign because it is included as a proxy for children and having children is assumed to encourage participation in outdoor activities at state parks. It was expected that age would have a positive effect on visitor use. Travel cost (which represents the price of recreation) was expected to have a negative effect on visitation: it did. The cost of traveling to and from the substitute site was expected to have a positive influence because this cost represents the price of a substitute good. Economic theory suggests that income would have a positive impact on visitation; the affect is positive but not significant. Whether or not the visitor camped at the site was expected to positively influence the number of visits a visitor would make to the site. The availability and use of camping facilities and average surface water acreage were expected to have positive impacts on visitation because they represent recreational opportunities that may not be available elsewhere and essentially represent site quality variables.

The modeling results were generally good. All of the variables have the expected sign and the overall fit of the model is reasonably good based on the adjusted R-squared statistic and F ratio. The R-squared statistic indicates that approximately 60 percent of the variation in visits per capita is explained by the model. The estimated coefficients for all of the explanatory variables, except income, were significantly different from zero at the 5 percent level of significance or better.

Impact of Changes in Surface Water Acreage on Visitation

The estimated regional visitation model was used to approximate the effect various water management options could have on recreational use. The present condition surface area for Glendo, Guernsey, and Seminoe, reservoirs were modeled to be 8,750 acres, 1,386 acres, and 13,180 acres. The variable value for surface water acreage was changed from the baseline value for a specific site to evaluate the impacts of different management options (action alternatives) on visitation.

To determine the estimated number of recreation visits for the Present Condition Alternative; the model was used to predict the natural logarithm of visits per capita for each observation in the data set. This number was converted to the predicted number of visits per capita. The 2002 population of each zone of origin (city or town) was multiplied by the visits per capita to estimate the number of visits each respondent would have made based on the Present Condition water surface areas for Glendo, Guernsey, and Seminoe Reservoirs. These visits were added together to arrive at the predicted number of visits for the year 1947. This process was repeated for each year from 1947 through 1994 using the simulated water conditions for each alternative, and the annual sums were added together and the average was recorded. The annual average figure for the Present Condition would serve as the baseline for comparison with the results obtained for the action alternatives.

Results

The Governance Committee alternative would result in the following average annual surface areas for the three reservoirs in question: Glendo 8,384 acres, Guernsey 1,384 acres, and Seminoe 12,870 acres. These figures were used in the same manner as above to identify the annual average number of visits for the three recreation areas. These surface area reductions for Glendo (4.2%), Guernsey (0.1%) and Seminoe (2.4%) translate into recreation visitation losses of 2.3%, 0.06%, and 0.9%, respectively for the Governance Committee alternative.

Methodology and modeling results for Lake McConaughy, Nebraska

Recreation activity at Lake McConaughy is likely to be affected by the alternatives under consideration because of the impact of these alternatives on reservoir elevation and surface acreage and the timing of these changes. It seems intuitive that a reduction in surface water acreage will result in a decrease in reservoir visitation because there is less reservoir area available. However, the change in visitation may not be the same proportion as the change in surface area and there may not be any impact on visitation at all if crowding is not a problem

In order to evaluate the influence of reservoir elevation levels and the resulting surface water acreage on Lake McConaughy visitation, a regression analysis was completed which estimates the relationship between visitation, surface water area, and other variables that are expected to influence visitation. While surface water area is expected to be an important variable in explaining visitation at Lake McConaughy, it is recognized that many other climatic and demographic factors have a large impact on visitation. These additional factors must be accounted for when evaluating the impact of various alternatives on recreation. Using a regression model, the impact of changes in surface water acreage on visitation can be separated from other effects that are not related to the alternatives under consideration.

Variables included in the Lake McConaughy recreation visitation model
Twelve months are included in the model in order to better evaluate all the variables that influence use, particularly the climate variables. The majority of visitation occurs during the late spring-summer-early fall months. Therefore, a seasonal dummy variable is included in the model. If the month is during the ”summer“ (defined as April through September for this analysis) the dummy variable has a value of 1. If the month is a ”winter“ month (October through March), then the dummy variable has a value of 0. The seasonal dummy variable is expected to have a positive coefficient, indicating greater visitation during the ”summer“ months.

The explanatory variable of primary interest in this analysis is surface water area. The surface acres used to estimate the Lake McConaughy recreation model are based on a conversion of lake elevation to surface area provided by the Denver Technical Service Center Water Supply, Use, and Conservation Group. For this analysis, surface water acreage and surface water acreage squared terms are both included in the estimated equation, which means the estimated equation is a quadratic function in terms of surface acreage. It is expected that the surface area coefficient will have a positive sign and the squared term will have a negative sign. These signs would mean that a change in surface area would have a relatively small impact on visitation at very low and high surface acreages, but larger impacts at moderate surface acres.

Temperature and precipitation are included in the model as climate variables which would affect the desirability of recreating at the Lake. Months that are generally warm and dry would be expected to have higher levels of recreational activity than cold and wet months. Therefore, the temperature variable would be expected to have a positive impact on visitation while precipitation would be expected to have a negative impact.

A population variable is included as a measure of the base number of people from which visitors to the Lake originate. The coefficient of the population variable is expected to be positive, indicating that a larger population base will result in more visits to the Lake, assuming all other factors are held constant.

The data year is included as a trend variable, which should account for changes in preferences and habits which would affect the desire to recreate at Lake McConaughy. The year 1983 is considered year1, 1984 is year 2, and so on. There was no expected sign for the time trend variable.

Sources of data

Monthly visitor use data were obtained from the Lake McConaughy State Recreation Area. Historic lake elevation data were obtained from the Central Nebraska Public Power and Irrigation District. Lake elevations were converted to surface area using conversion factors provided by the Denver Technical Service Center Water Supply, Use, and Conservation Group.

Historical monthly average temperature and monthly total precipitation data for 2002 were obtained for Kingsley Dam from the High Plains Regional Climate Center website (http://www.hprcc.unl.edu).

Annual population estimates for each county included in the base population data were obtained from the U.S. Bureau of the Census, Population Division. The counties included as part of the population base from which Lake McConaughy visitors originate are shown in table x.

Table X - Counties included in population base

Colorado Counties		Nebraska Counties	
Larimer	Morgan	Sioux	Chase
Boulder	Washington	Scotts Bluff	Dundy
Jefferson	Yuma	Banner	Hayes
Douglas	Logan	Kimball	Hitchcock
Elbert	Sedgwick	Cheyenne	Frontier
Arapaho	Phillips	Morrill	Red Willow
e	Kit Carson	Garden	Dawson
Denver	Cheyenne	Deuel	Gosper
Adams	Lincoln	Keith	Furnas
Weld		Arthur	Lincoln
		McPherson	Logan
		Perkins	Custer

For the purposes of this analysis it was assumed that 75 percent of the visitors at Lake McConaughy come from Colorado and 25 percent come from Nebraska. These percentages are based on two sources of information. The report ARecreational Resources and Facilities, The Central Nebraska Public Power and Irrigation District, Federal Energy Regulatory Commission Project No. 1417" indicated that 74 percent of the visits at Lake McConaughy and Lake Ogallala in 1990 were from states other than Nebraska, with the majority coming from Colorado. The publication AA Journey Through the Central District: A Summary of the Origin, Development and Facilities of the Central Nebraska Public Power and Irrigation District, 1995" indicated about 70 percent of the visitors to Lake McConaughy come from Colorado. As a result, the population base from which Lake McConaughy visitors originate is estimated to be 75 percent of the population total from the Colorado counties listed in table X and 25 percent of the total from the Nebraska counties.

Impacts of the proposed plan on recreation at Lake McConaughy

The estimated Lake McConaughy model presented above can be used to predict changes in visitation at various surface water acreages during different months. Changes in visitation can be estimated based on changes in surface water acreage associated with various alternatives. For this explanation only the present condition and the Governance Committee alternatives are evaluated. The impacts of the Governance Committee alternative on visitation are based on a comparison of the Governance Committee alternative to the present condition.

The surface areas used to estimate changes in visitation are based on the 1947 to 1994 end of month data for the present condition and Governance Committee. The temperature data are the monthly mean temperature from 2004 at Kingsley Dam and the precipitation data are the average monthly total precipitation from 2004 at Kingsley Dam. The 2002 population base was estimated to be about 3.2 million people. The base year is considered to be 2002, so the trend variable Ayear@ was set at 20. The seasonal dummy variable was set at 0 for the months October through March and 1 for April through September.

The impact of the Governance Committee alternative on recreation visitation is estimated by applying the model to each year of surface area data (1947 to 1994) for each month. This is done for both the present condition and the Governance Committee alternative. Visitation for each month is then added up for an annual recreation visitation estimate. The estimated annual visitation is then the average of the 1947 to 1994 annual estimates. Visitation for some of the winter months, mostly in December and January, were negative. Visitation in these cases was estimated to be zero. The negative visitation is a result of error in the modeling estimates. However, since the important comparison is between alternatives and the same model is used for both alternatives and the negative visitation estimates occurred only during the low visitation months, the negative predictions do not appear to be a major problem. The percent changes between the estimated visitation using the model are applied to actual 2004 Lake McConaughy visitation. The models' average annual visitation for the present condition scenario was

588,709 visits and visitation for the Governance Committee alternative was 577,452 visits, a reduction of about 2.0 percent compared to the present condition. Applying a 2 percent change from the actual present condition (711,644)1 to the Governance Committee alternative yields 698,036 recreation visits at Lake McConaughy.

During the 1947 to 1994 period, the average annual reduction in surface water acreage for the Governance Committee alternative was 5.6 percent which indicates that the reduction in recreation visitation is somewhat less than the percentage change in surface water acreage.

Note: In the DEIS, visitation impacts were also estimated by using average surface water acreages over the period 1947 to 1994 for each month. These representative surface water area estimates were then input into the model. Using this procedure, the annual average visitation under the present condition was 620,900 visits and under GC1 620,800 visits (essentially no change). It seems the procedure using the model for each year and then averaging the annual estimates (the first procedure in the section above) is the most correct because it captures the variation that would be expected from year to year. The second method shows little impact because the yearly variation is averaged out with the average monthly surface area.

[1] Present Condition visitation based on the 2000-2004 average visitation to Lake McConaughy.

Bibliography

American Automobile Manufacturers Association, Inc. 1996. Motor vehicle facts and figures, 1996. Washington, D.C.

Cesario, F.J. 1976. “A Value of Time in Benefit Recreation Studies.” Land Economics, 52(1): 32-41.

Loomis, J.B., C.F. Sorg, and D.M. Donnelly, 1986. "Evaluating Regional Demand Models for Estimating Recreation Use and Economic Benefits: A Case Study." Water Resources Research, 22(4): 431-438.

Piper, Steven L. 1996. "Travel Cost Model for Wyoming 1996", unpublished paper, Bureau of Reclamation, Technical Service Center, Economics Group. Denver, Colorado.

U.S. Bureau of the Census. 1997. 1990 Census of Population and Housing. Summary tape file 3A; from internet site http://venus.census.gov/cdrom/lookup.

_____, 2000. Population Estimates for Places, Population Estimates for the Years 1994-1999. Internet release date: October 20, 2000.
http://www.census.gov/population/estimates/metro-city/placebyst/SC99T7_CO.txt
http://www.census.gov/population/estimates/metro-city/placebyst/SC99T7_MT.txt
http://www.census.gov/population/estimates/metro-city/placebyst/SC99T7_NE.txt
http://www.census.gov/population/estimates/metro-city/placebyst/SC99T7_SD.txt
http://www.census.gov/population/estimates/metro-city/placebyst/SC99T7_UT.txt
http://www.census.gov/population/estimates/metro-city/placebyst/SC99T7_WY.txt

U.S. Water Resources Council. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. March 10, 1983.

Walsh, R.G. 1986. Recreation Economic Decisions: Comparing Benefits and Costs. State College, PA: Ventura Publishing, Inc.