

# **Landowners' Perceptions of Hydropower and Flood Control Operations**

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*Abstract:* A survey was conducted of landowners on upper Lake of the Ozarks, from the Harry S Truman Dam at Warsaw, Missouri, to 16 miles below the dam. The study was initiated to determine citizen opinion toward the current 4-turbine operation at Harry S Truman Dam in light of managing authorities' proposals to increase power generation through routine use of 2 additional turbines that could diminish recreation and tourism values of upper Lake of the Ozarks. Results revealed that landowners residing at the lake had little tolerance for any changes in hydropower operations that would increase water fluctuations, bank erosion, and siltation at the lake. Generally, property owners indicated that fishing, swimming, and boating on the lake had worsened since the dam began generating power in 1981, but the quality of these recreational activities still was acceptable under prevailing management. Landowners did not support managing authorities' desires to operate the project at its technological potential.

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Use of public opinion surveys to guide natural resource policy can be invaluable in averting or mitigating management conflicts. Particularly helpful are public perceptions of impacts from major development of natural resources. Both positive and negative consequences stem from large-scale modifications of the natural environment. Monitoring public sentiment toward these changes assists project managers in formulating the best-informed management strategies.

One structure with a controversial history is Harry S Truman Dam in west-central Missouri at Warsaw. The U.S. Army Corps of Engineers (USACE) closed the spillway gates of the dam in 1979 and began filling the 22,460-ha conservation pool that today forms Harry S Truman Reservoir (Richards et al. 1986). Immediately below the dam on what once was the Osage River is Lake of the Ozarks, created in

1931 by Bagnell Dam (150 km downstream from Harry S Truman Dam) and covering 22,220 ha at normal pool. Land adjacent to Lake of the Ozarks is privately owned, with extensive residential and recreational development, representing 1 of Missouri's most important tourist areas.

Controversy over Harry S Truman Dam stems from both its purpose and design. Originally authorized in 1954 as a flood control structure, efforts in 1962 to enhance reservoir benefits resulted in a proposal to produce electricity using 3 generators. By 1966, however, the proposal had been dramatically modified, and a hydropower plant was constructed with 6 reversible pump-turbines with water releases in excess of downstream channel capacity. Reversible turbines would allow water to be pumped from the "reregulation reservoir"—upper Lake of the Ozarks—up and into Harry S Truman Reservoir to increase the lake level and enhance hydropower production.

Indications of potential problems downstream from the dam on upper Lake of the Ozarks were revealed in the draft Environmental Impact Statement (U.S. Army Corps Eng. 1978), and more thoroughly defined in the final statement (U.S. Army Corps Eng. 1980). Possible effects included erosion of banks and sediment bars subjected to increased water flows and inundation, changes in aquatic and terrestrial vegetation, impacts on the downstream fishery linked to increased flows and pump-back, and potential safety hazards to recreationists from high water velocities.

A serious problem was confirmed when pump-back was tested in 1982. One turbine was reversed for 2 hours on 13 April and a second unit for 1 hour on 14 April, destroying 579 identifiable fish, weighing a total of approximately 900 kg, and mutilating uncountable others (Richards 1982). Following this and several subsequent tests, USACE announced no pump-back would be conducted until a means was found to prevent high levels of fish loss.

Downstream residents and recreationists experienced the change in upper Lake of the Ozarks from placid water to an intermittent high-flow river with the initiation of power generation in 1981. In 1983, residents along Lake of the Ozarks asked the Missouri Congressional Delegation to ensure that the dam be operated in a responsible manner. The Delegation responded by directing USACE to have an independent study of the dam conducted. The resulting report (Morris et al. 1985) recommended: (1) pump-back should not be used until effective fish protection was provided; and (2) only 4 of the 6 generators should be operated, except during power emergencies or flood control releases when 6 could be operated.

In November 1987, USACE announced intentions to generate power with 5 instead of 4 turbines, justifying the increase on the basis that effects on bank erosion, water velocity, water fluctuations, fishing, boating, boat dock maintenance, and swimming would be acceptable to the citizenry using Lake of the Ozarks. In response, Missouri Governor John Ashcroft instructed the Missouri Department of Conservation to determine public perceptions of the acceptability of the dam's effects on the lake. The Department observed that landowners on upper Lake of the Ozarks (presumably the group most knowledgeable about the dam's effects) should be questioned first.

## **Methods**

A mail survey was made of 2,599 landowners randomly selected from the population of 7,800 property holders in Benton County, Missouri, owning land within approximately 1.6 km of upper Lake of the Ozarks from Harry S Truman Dam at Warsaw to 26 km downlake. Objectives of the survey were to: (1) permit property owners to express opinions on the severity of water velocity, bank erosion, water fluctuations, siltation, and flooding at upper Lake of the Ozarks since power generation began at Harry S Truman Dam, and to indicate if these conditions were acceptable or unacceptable; and (2) provide property owners an opportunity to express their opinions on the effects of dam operations on fishing, boating, swimming, real estate values, and boat dock maintenance at upper Lake of the Ozarks and to indicate if these effects were acceptable or unacceptable.

All respondents willing to voice an opinion were included in the analysis, even those using upper Lake of the Ozarks for <8 years (that is, those lacking a comparative baseline of knowledge prior to hydropower generation in 1981). Respondents with <8 years experience at the area could have acquired an opinion of the dam by talking to other property owners and through local media accounts. Respondents were given the opportunity to respond "no opinion" to all attitudinal questions. Respondents failing to answer a question and those who wrote on their questionnaires that they had no thoughts on power generation, were coded as having "no opinion," resulting in the most conservative opinion profile possible for property holders.

## **Results**

After 3 mailings, 1,731 out of 2,457 deliverable questionnaires were returned (70.5%). A follow-up survey of 49 non-respondents living in Missouri confirmed that they were more likely than respondents to have no opinions about the dam, but no attempt was made to correct for possible non-response bias.

### **Resource Conditions**

Considering all respondents, pluralities or majorities had no opinion on the effect of Harry S Truman Dam on water velocity (45%), bank erosion (48%), siltation (56%), and flooding (53%) (Table 1). Forty-nine percent agreed that water fluctuations were greater since generation of power began, but over one-third had no opinion on this issue. General lack of awareness was shown by property holders regarding whether resource conditions were acceptable or unacceptable (Table 1). A notable exception was plurality agreement (42%) that water fluctuations were unacceptable since commencement of power generation at the dam.

Lack of opinion about hydropower issues among landowners at large was explained by a survey finding that fully 41% of this group did not use upper Lake of the Ozarks or they visited it infrequently. Though all landowners presumably held some stake in the manner in which the dam was managed, not all of these absentees were interested or informed enough to offer opinions on operation of the dam. Sub-

**Table 1.** Landowners' perceptions of status and acceptability of selected resource conditions on upper Lake of the Ozarks since inception of power generation at Harry S Truman Dam. Data are percentages of respondents in each group.

Condition and Group <sup>a</sup>	Status				Acceptability		
	Less	No Change	More	No Opin.	Accept.	Unaccept.	No Opin.
Water velocity							
All	5	8	42	45	27	29	44
Non-residents	5	9	33	53	23	25	52
Residents	4	7	71	18	33	50	17
Bank erosion							
All	5	14	33	48	23	29	48
Non-residents	5	14	25	56	22	22	56
Residents	5	15	57	23	24	52	24
Water fluctuations							
All	8	5	49	38	21	42	37
Non-residents	8	5	41	46	34	20	46
Residents	8	5	76	11	24	65	11
Siltation							
All	10	10	24	56	21	23	56
Non-residents	9	9	19	63	18	19	63
Residents	12	11	41	36	26	39	35
Flooding							
All	19	13	15	53	31	16	53
Non-residents	17	11	12	60	13	28	59
Residents	28	16	26	30	41	27	32

<sup>a</sup>All = All landowners ( $N = 1,731$ ); Non-residents = Landowners not in year-round residence at upper Lake of the Ozarks ( $N = 1,321$ ); Residents = Landowners in residence year-round at upper Lake of the Ozarks ( $N = 410$ ).

groups of property holders thus were formed on the basis of year-round residency at the lake.

Landowners not in year-round residence at the lake comprised about three-quarters of the sample. This high percentage was not unexpected because of the large number of vacation-homes in the area. These respondents showed general uncertainty about resource conditions on upper Lake of the Ozarks; the majority or plurality response across all resource conditions was "no opinion" (Table 1). Similarly large percentages of landowners were unsure of the acceptability of resource conditions.

The opinion profile of respondents who were year-round residents was a dramatic contrast to non-residents. Most perceived that more water velocity (71%), more water fluctuation (76%), and more bank erosion (57%) had occurred since Harry S Truman Dam began generating power (Table 1). Even siltation, a resource process that generally is an uncommon issue, was evaluated by a plurality (41%) as greater since power generation, though over a third of respondents had no opinion on this condition. Year-round residents showed ambivalence about the severity of flooding since the dam was in operation, with nearly equal percentages responding

**Table 2.** Landowners' perceptions of status and acceptability of recreation and real estate values on upper Lake of the Ozarks since inception of power generation at Harry S Truman Dam. Data are percentages of respondents in each subgroup.

	Fishing (N = 1,125) <sup>a</sup>	Boating (N = 974) <sup>a</sup>	Swimming (N = 668) <sup>a</sup>	Real Estate Values (N = 410) <sup>b</sup>	Boat Dock Maintenance (N = 410) <sup>b</sup>
Status:					
Worsened	52	47	44	40	65
No Change	18	27	26	20	12
Improved	17	12	15	17	6
No opinion	13	14	15	23	17
Acceptability:					
Acceptable	44	47	45	32	20
Unacceptable	41	36	38	38	58
No opinion	15	17	17	30	22

<sup>a</sup>N = Number of respondents with past involvement. Subgroups are not mutually exclusive.

<sup>b</sup>Landowners in residence year-round at upper Lake of the Ozarks.

“less,” “more,” and “no opinion” (Table 1). Mixed opinions about flooding were surprising, given that flooding was the very condition the dam was intended to alleviate. Perhaps respondents equated flooding with water discharges for power generation.

Year-round residents felt unacceptable conditions included water fluctuations (65%), bank erosion (52%), and water velocity (50%). Respondents were indecisive about the acceptability of siltation, with a plurality indicating that siltation was unacceptable (39%). Flooding since Harry S Truman Dam began generating power was acceptable to a plurality (41%), perhaps in recognition of the extreme flooding that occasionally occurred on upper Lake of the Ozarks prior to dam construction.

### Recreation and Real Estate Values

Respondents were grouped by past involvement in selected recreational activities on upper Lake of the Ozarks regardless of their residence status at the area (Table 2). Majority agreement existed among anglers that fishing had worsened (52%) since the dam began generating power. Pluralities of boaters (47%) and swimmers (44%) indicated that their activities had worsened as well. The quality of these 3 activities might be characterized as borderline, based on pluralities of participants that indicated that fishing (44%), boating (47%), and swimming (45%) were acceptable.

Year-round residents were deemed best able to evaluate possible impacts of hydropower operations on boat dock maintenance and real estate values (Table 2). Particularly troublesome to year-round residents was boat dock maintenance, with nearly two-thirds indicating that maintenance had worsened. In fact, a majority (58%) of year-round residents indicated that problems with boat dock maintenance since the dam began generating power were unacceptable (Table 2).

A plurality (40%) said real estate values had worsened. Residents expressed mixed feelings about the acceptability of effects of the dam on real estate values, with the plural attitude being "unacceptable" (38%).

Relatively small percentages of recreational participants and year-round residents were unwilling to offer opinions on the status and acceptability of recreation and real estate values. Exemplary of this were 1,125 respondents with angling experience on upper Lake of the Ozarks (65% of the total sample), only 13% of whom held no opinion on the status of fishing since Harry S Truman Dam began generating power and only 15% of whom had no opinion on the acceptability of angling on the lake (Table 2). Respondents seemed better able to offer opinions on direct impacts of power generation to recreation and property than on underlying resource conditions.

## Discussion

Landowners familiar enough with the issues at upper Lake of the Ozarks appeared willing to concede that Harry S Truman Dam offers some flood control benefits. However, year-round residents at the lake and landowners having recreational experience at the area generally had little tolerance for additional effects from power generation, such as water fluctuations, and impacts on fishing, boating, boat dock maintenance, swimming, and real estate values. This borderline tolerance was evidenced by a response pattern in which activities at the lake were said to have worsened since the dam began generating power, yet were acceptable. This opinion profile might be summarized, "We recognize what the dam has done for us, but don't let the dam do more to us."

Landowners' perceptions of responsible hydropower management contrasted with the desires of project authorities, who felt that fuller utilization of the dam's technological potential would receive public support, or at least not promote public opposition. The current controversy arose over increasing power production using 5 versus 4 turbines. Project managers ultimately want this multi-million dollar project to achieve full operation—6 turbines and pump-back. But this seems impossible in view of the current impasse over 5 turbines (Mo. Electric Coop. 1988). How is it that hydropower managers and citizens found themselves at such odds over issues that should have been discussed, understood, and resolved long before the current controversy arose?

Stucky et al. (1987) offered several explanations of controversy in major resource development that can be applied to Harry S Truman Dam. First is the simple matter of time. Projects impacting natural resources often are lengthy undertakings extending over decades from inception to completion. Over time, the base of public support narrows. Constituencies that may have been strong advocates early in a project can pass from the scene, or citizens may grow complacent or simply uninterested as the original need for the project grows less pressing. In the meantime, project managers, for whom the effort may represent a career commitment of

formidable significance and duration, move ahead with the project, developing a certain passion for its completion.

Second, public indifference may change to opposition as information about project impacts becomes more complete. Reversible turbines at Harry S Truman Dam were hailed as a means to enhance power production. The reality of fish mutilations and associated long-term impacts on the fishery of upper Lake of the Ozarks quickly dampened the thrill of technological achievement, and raised the question of whether pump-back could ever be regularly used at the dam. This problem, plus negative impacts on resource conditions and recreation, crystallized public skepticism of the promises held for Harry S Truman Dam.

Project managers must now be responsive to public concerns over Harry S Truman Dam. Being responsive to public opinion does not imply that opinion information should dictate resource management policy (Witter and Sheriff 1983). Professional resource managers are best able to determine strategies for accomplishing specific goals, but management of major water projects involves more than engineering techniques and construction. The essence of project management is the assignment of priorities which sometimes entails balancing maximum project performance with public perceptions of what constitutes responsible management.

As a result of this study, managing officials were made aware that the public did not accept changes in project management resulting in increased water flow below Harry S Truman Dam. Operation of turbines 5 and 6 was placed in abeyance indefinitely.

Survey results also served as a reminder that problems surrounding management of Harry S Truman Dam involve complex social and economic issues and demand reasoned decision-making. Following release of survey results, the USACE, Missouri resource agencies, and power companies agreed to appoint representatives to a small arbitration team, allowing future operation of the project to be balanced.

Finally, the study demonstrated the need to monitor public perceptions of dam operations, particularly in view of the lingering desire of power companies to run the project at full capacity on a routine basis. The public will be most cooperative if consulted prior to any future changes in project management.

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