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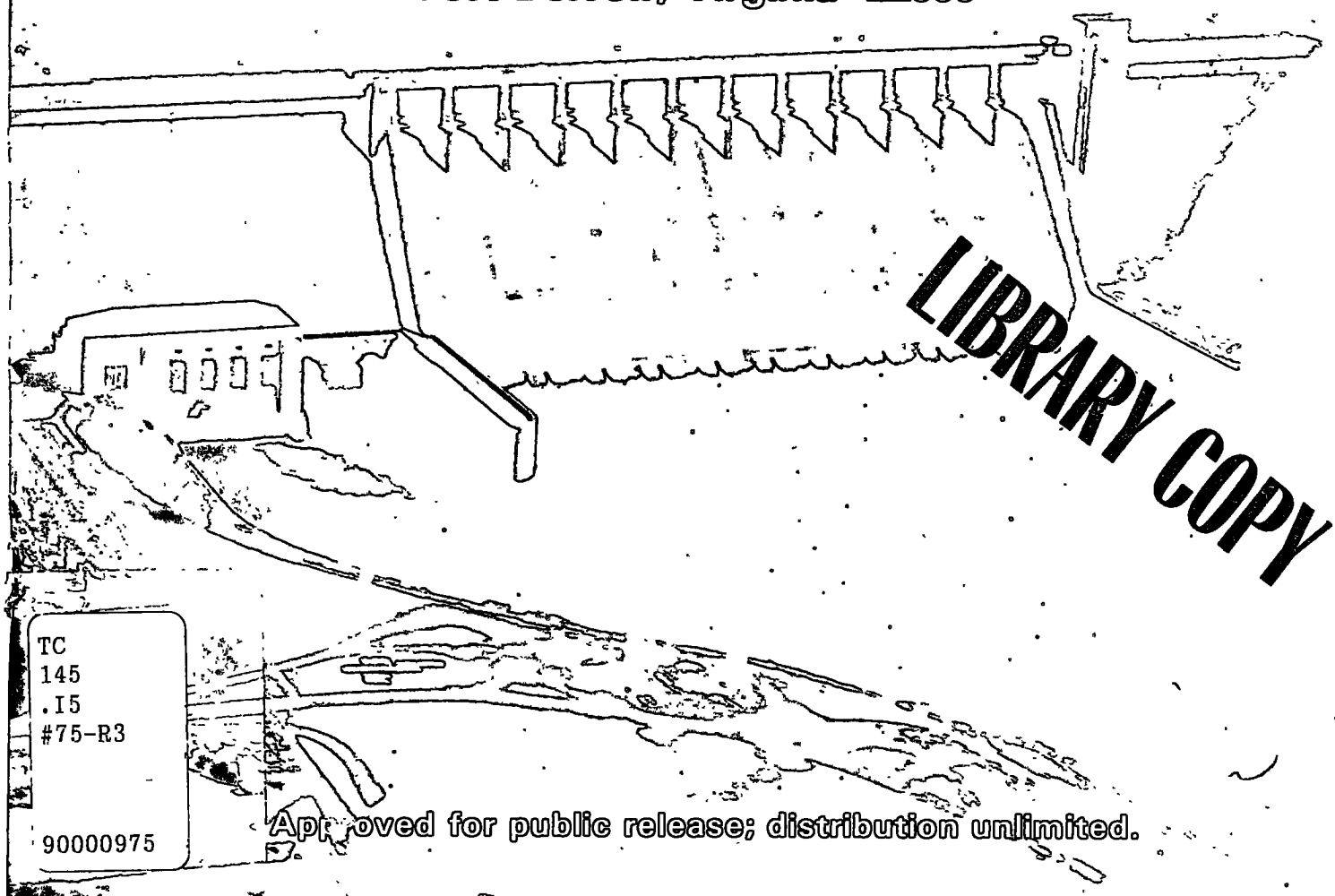
# AN OVERVIEW OF THE IMPACT STUDY OF THE McCLELLAN-KERR MULTIPLE PURPOSE ARKANSAS RIVER SYSTEM

A Report Prepared for:

U. S. Army Engineer Institute for Water Resources
Kingman Building
Fort Belvoir, Virginia 22060



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by

Lloyd G. Antle

Institute for Water Resources

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This report summarizes the results of the first stage of assessment of impacts of the completed McClellan-Kerr Arkansas River System, located in Arkansas and Oklahoma. The system is designed to produce benefits to multiple purpose including transportation, hydroelectric production, flood damage abatement, water supply, sediment control and stabilization, recreation of fish and wildlife enhancement. Results of the first round of research and the first year's output of the project are discussed in the perspective of

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the decision process leading to approval, authorization and appropriation and from the perspective of public awareness of actual and potential impacts.

# AN OVERVIEW OF THE IMPACT STUDY OF THE McCLELLAN-KERR MULTIPLE PURPOSE ARKANSAS RIVER SYSTEM

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# AN OVERVIEW OF THE IMPACT STUDY OF THE McCLELLAN-KERR MULTIPLE PURPOSE ARKANSAS RIVER SYSTEM

This report reflects the completion of the first round of research on determining the impacts of the completed McClellan-Kerr Arkansas River Project. Since the project was formally dedicated in 1971, and much of the data reflects the first full year's operation, this report should be construed to reflect the approach to the study. The report, prepared by IWR, presents some tentative conclusions reached during the research but should not be considered to be final or conclusively documented.

Four reports have been completed and are described below. The reports reflect the basic research strategy and the organization of the Corps of Engineers support of the research. The research work plan and completed research reflect joint leadership from the Southwestern Division (SWD) and the Institute for Water Resources (IWR). This organization permits flexibility in organizing resources and encourages a broader based perspective to be assigned to the task of impact assessment. The basic approach to impact analysis is to begin with physical changes in the river regimen introduced by the project, determine the direct uses made by people of these changes, trace these changes through second and higher order impacts and then weigh these impacts by the values placed on them from a number of perspectives. For example, the Report on Project Use during 1971 (Draft) by SWD, reflects an effort to collect information on direct uses of the improved river system while the Report on Socio Economic Profiles (draft by SWD) develops base line profiles for the region receiving the majority of direct impacts. The report on Discriminant Analysis Applied to Commodity Shipments in the Arkansas River Area

by SWD describes the commodity flows into and out of the region and the truck, rail and water modes selected by transportation users in the first year of project operation. The commodity flows described are basically water transport sensitive commodities. The Port Development: A Case Study of Regional Response to Waterway Development by the University of Arkansas describes the port development strategy undertaken by various localities as the waterway was opened and reflects a good deal about the perspective of that region. The report on Evaluation of Interregional Input Output Models for Potential Use in the McClellan-Kerr Arkansas River Multiple Purpose Impact Study, by Catholic University, describes a methodology for adapting the existing Harvard University multi-regional input output model to the case of estimating second and higher order economic impacts of the water project.

## Interim Conclusions

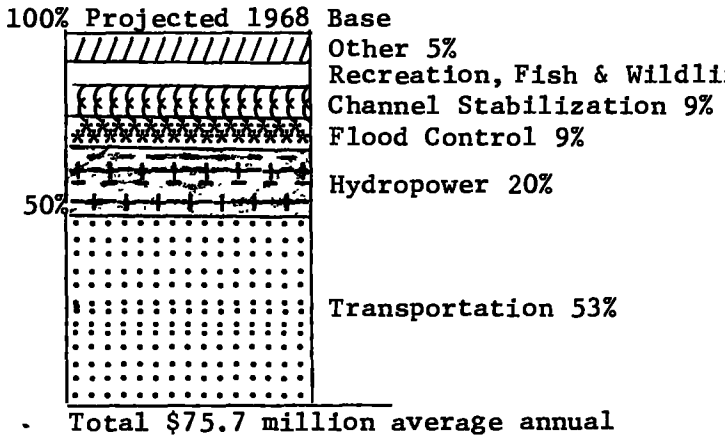
The impacts which can be discerned today are in many cases unanticipated -- at least from review of the formal documentation, and the more significant impacts are likely to become obvious only after years of careful observation. What is important, is an assessment of the kinds of impacts which are discernable and which can be directly related to the project. It should be noted that the study of a completed project makes available data -- that can never be discovered in the planning case -- which is the basic rationale for the study of completed projects. These impacts are not the product of measuring some time series and then trying to net out nonproject related impacts, but they are obtained by going through the process of relating people's use of the modified river system, through second and higher order impacts, and then placing values from

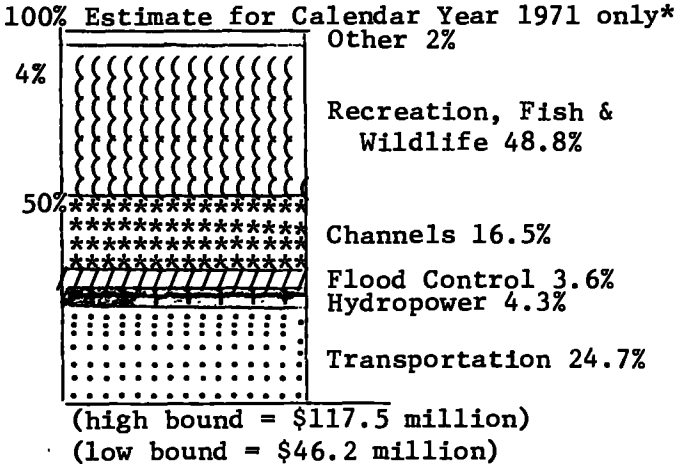
various perspectives.

User benefits approach costs during the first year of operation. Direct user benefits for the first year of operation have been estimated from the information contained in the Project Use During 1971, from the report on Discriminant Analysis Applied to Commodity Shipment in the Arkansas River Area and from other Corps reports. Sources and assumptions are documented in the Appendix. Since legitimate criticisms can be directed to some of the assumptions, low and high bounds that were estimated and the rate of return to invested capital computed. A rate of return between 2.5 and 7.4 percent was attained during 1971. By comparison, the project benefits and costs computed for the 1970 budgetary presentation show a 4.7 percent return to capital. The benefit to cost ratio has not been revised since then.

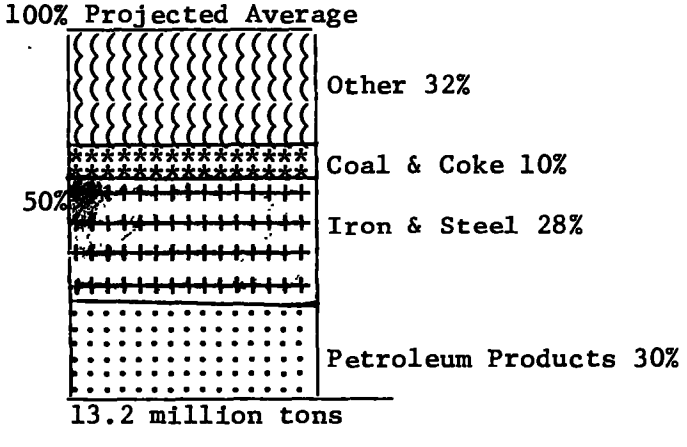
The mix of user benefits is quite different from that anticipated. Navigation benefits are substantial, the quantity moving on the waterway is developing at a rate which will exceed forecast levels probably within ten years, but the mix of commodities moving on the waterway is quite different from the forecast. The difference in the commodity mix is, in part, attributable to the change in economic conditions which have occurred since the project was originally conceived in the early 1940's. Power benefits are somewhat lower than forecast because of a deficiency in flows during 1971 and the total capacity has not yet been installed. Flood control benefits were lower, simply because of the absence of serious floods during 1971. Recreation benefits, however, are significantly higher than those utilized in project benefit cost estimates.

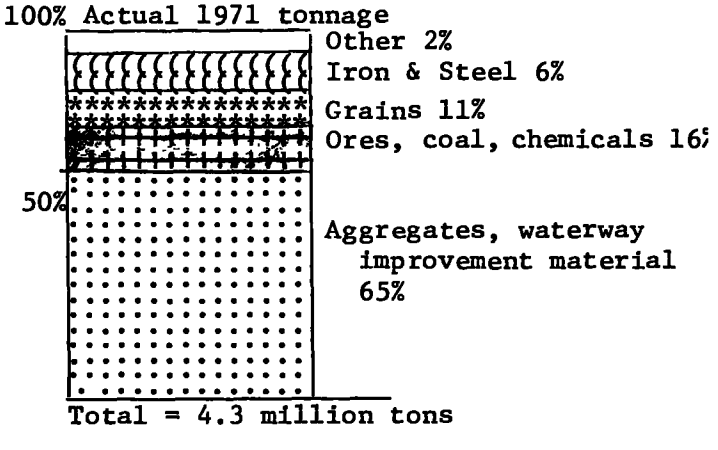
Estimated User Benefits for Calendar Year 1971*
Compared to the Estimated Annual User Benefits (1968 Base)




Comparison of 1971 Traffic Composition to Estimated Traffic




*The 1971 estimate reflects the first year of operation of the waterway to Catoosa, whereas the project estimate was based on an average value to be achieved over the life of the project.

Recreation benefits were not credited to the project during preauthorization planning studies in the 40's or in the update in the 50's as the state of recreation benefit analysis at that time was in its infancy; however, in recognition of the recreational use that was being experienced at Corps of Engineer projects all over the nation in the early 60's, parts of the overall system have been credited with recreation benefits. The high rate of recreation use at this project, as at many other water resource projects, results from increasing levels of economic well being, leisure time and mobility as well as recreational attractiveness of water resource projects.

Petroleum movements of the magnitude projected have not materialized due in part to the pipeline network through the project area. However traffic during calendar year 1973 show petroleum to be 10 percent of the total tonnage. This is due in part to the fact that in the Little Rock area where the electrical utility is developing waterside petroleum handling facilities to receive fuel oil for their power stations and the rail company is developing fuel oil facilities. Grain movements are lower than the estimates, mainly because of a lack of waterside grain handling facilities, which are a result of rate changes introduced by competing modes. Waterside grain handling facilities in place are characterized by fast handling design, limited storage and low capital intensity -- a trend which appears to be a reasoned response until competitive rate structures stabilize. One significant point in the benefit estimate -- about one-third of the tonnage in 1971 accounted for up to 99 percent of the benefits.

The McClellan-Kerr Project was constructed during a period in which the trend in outmigration reversed. Historical trends in employment and

per capita income demonstrate relatively stable growth, approaching national rates of increase and comparable absolute values in the Tulsa Metropolitan area and, to a somewhat lesser degree, in the Little Rock Metropolitan area. The area which historically exhibited net outmigration limited growth in employment and low per capita income is the rural area of the region and to a lesser extent, the Fort Smith Metropolitan area. With the exception of the Delta counties of Arkansas, the downward trend in employment growth and the increasing trend in outmigration were reversed in the 1960's, resulting in a population increase from 1960 to 1970.

Major response to the project in rural areas is to the recreation industry developing in response to about 13 million visitor days of recreation use, to the substantial developing seasonal and permanent home industry and to the expenditures of these users, which is on the order of $100 million per year. Retired persons account for many permanent home residents, a trend which is significant in inmigration.

Regional response to the project is uneven. The University of Arkansas port study illustrates the wide range in regional response to essentially similar stimuli of potential reductions in transport rates. The wide range reflects basic differences in the perception of the potential gains (and losses), differences in port development strategy and differences in the organizational, managerial and financial resources available to confront the port development issue. Tulsa port of Catoosa reflects a heavily capitalized and massive attempt to focus the metropolitan economic development strategy on the port and its industrial park. Other port cities opted for a much less dramatic role for port development, ranging to a view that

the port should simply play a transfer function to move shipments from one mode to another or to storage.

The ongoing Industrial Revolution in Arkansas and Eastern Oklahoma has resulted in limited waterfront industrial location. The Tulsa Tribune of July 19, 1972 commented that "...one of the striking features of the... navigation project is the lack of industrial development along the 440 mile long waterway...." The Tribune article reflects that some developers "...feel that the fact that the Army Engineers own back from the waterfront from 300 to 500 feet on each side is a deterrent...." while others feel that ownership "...is wise and express the fear that the Verdigris will in time become a sewer for industry unless the government keeps control...." and that "...recreation interests would like to see the entire government holding along the 50 miles of the Verdigris channel preserved as a public recreation area." Government ownership in fee is limited to that part of the project above lock and dam in Oklahoma and around Ozark and Dardanelle Lakes in Arkansas.

Concurrently, industrial development in Arkansas has reflected a conscious, vigorous and visibly successful state policy of attracting some industry to every county seat, instead of following a developmental pole or growth center strategy. Another important coincidence is that the development of Interstate 40 in Arkansas and the Muskogee Turnpike in Oklahoma parallels both the river and the time of development of the McClellan-Kerr project. Therefore, impact analysis in this case is doubly complicated by these and other significant causes.

Over $1.1 billion investment is reported in announced new industrial plants and expansion in the waterway area through early 1973. These plants

claim that the waterway bears on their investment decision. Over one-half of the $1.1 billion investment is in power generation stations, and better than one-half of the power investment is in the Arkansas Nuclear Stations #1 and #2 at Russelville, Arkansas. Cooling water is withdrawn from the Dardanelle Reservoir for one station but a cooling tower is utilized for the other. About the only waterway traffic to be gained was the shipment of some of the large fabricated parts for the steam generator, and paradoxically, loaded coal barges destined for TVA Power Stations at Memphis. The latest power generation units announced in the project area are coal burners, although announcements by Oklahoma Gas and Electric Company indicate plans to bring coal from Wyoming coalfields to the new Muskogee plant, evidently a response to air pollution regulations.

A note on distribution of benefits. These early studies reflect only a glimpse of the nature of the distribution of benefits, yet there are several illuminating examples which might provide some focus for future analysis. A general argument could be advanced that reduction in factor prices (transport costs) would be absorbed by producers in quasi-monopoly cases and output would be increased. Savings thereby gained could be directed to payment to capital and to the labor force for increased output, or they could be passed directly to consumers in a perfectly competitive market. Thus, savings on newsprint utilized by Tulsa newspapers could be translated into increased profits, lower prices or higher wage payments. In another case, shipments of earth moving equipment by Unit Rig of Tulsa to worldwide markets are expedited by the all water route at lower costs. Since freight charges are paid directly by the customer, savings are retained, but Unit Rigs competitive position is enhanced and potential

improvement in U. S. balance of payments is possible. The Eastern Oklahoma Export elevators at Dunkin, Oklahoma, operate a fast handling grain shipping facility which exploited a 30 to 50 cent per bushel arbitrage differential in soy bean prices between county elevators tied into major grain dealer distribution networks and the New Orleans export market. In this case, farmers netted the gain, but county elevators lost grain volume and perhaps incurred increased unit costs because of the lower volumes.

The decision-making process reflected in the McClellan-Kerr project influences impacts of the project. The McClellan-Kerr project reflected a highly personal style of decision-making between a limited number of participants. Controversy at the regional level was restrained to concern for outmigration versus concern for loss of land but controversy between regional advocates and the Washington decision-making community was significant and persistent.[1] One of the interesting attributes of the controversy was and is the legitimate objectives of the project. Regional political advocates generally describe the project rationale as economic development within a region characterized by relatively low income, low growth in employment and high outmigration rates, especially of young people. Given this dominating rationale, the question addressed to the Corps of Engineers was, "Can you justify the project?" But paradoxically, Corps justification criteria are formally limited to a narrowly defined efficiency criteria which results in Corps reports which never

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[1]Roland McKean, Public Spending (1968) p. 27 "The Costs and Gains from the Arkansas River Project (a notoriously inefficient undertaking) as viewed by its supporters must have diverged greatly from the total costs and gains as seen from the nation's viewpoint..."

directly relate the Arkansas River project to economic development strategies for the nation or for the region. Rather, the reports which are clearly addressed to the Washington level review community, discuss technical engineering issues and benefit/cost calculations which are limited to project (budget) costs and direct user benefits (which is typical for all Corps reports). Thus, there is a gap between the articulated concerns and issues of the region and the water resources plan.

The conflict is characterized by the Board of Engineers for Rivers and Harbors issuing a not convinced declaration to the navigation features of the project in 1945; a 1955 letter from General Sturgis informing Congress that "...While the ultimate economic feasibility appears to be established, the margin of future net benefits over costs and the reliability of the estimates are insufficient to justify a commitment to construction of the plan as a whole in the immediate future..."; the impoundment of funds allocated to the Arkansas project by President Eisenhower in 1956[2] and omission of construction funds in the 1957 budget message, which ultimately resulted in Congressional addition of funds for construction starts on Eufaula and Dardanelle Reservoirs.

It may be that the conflict itself transformed the issues into highly abstract images on all sides. The "project" appears to be highly abstract when discussed with people who were involved in the controversy. The abstractions range from the image that the project would, by itself, transform the region into a modern industrial economy to the image that the project justification was insufficient, from a national efficiency accounting

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[2]Work on some portions of the project began in 1950.

stance, to warrant federal investment. The unconvinced also do not wish to advocate the use of federal water resources programs for any other objective than efficiency. An effort to draw out some of the active proponents on their view of the mechanics of the transformation resulted in responses which borders on a "faith" that it would happen, apparently without further action aside from completion of the project.

This problem of images and myths and that of conflicting interest groups within the region converge to stifle aggressive nonfederal action to achieve the condition of a modern industrial economy, with planned avoidance of environmental blunders. Thus, state and local action is fragmented and hesitant. The federal agencies having direct responsibility for economic development make grants for cooperating investment (for example, ports) without a long range plan or even a vision of a desirable one. Local communities are left to their own devices to develop proposals for grants. Consistent and continued planning and decision processes to achieve the politically persuasive objectives for the Arkansas River project have not been available.

Even if the objectives for water resources development cannot be agreed upon, shifting attention to the post construction implementation phase might be feasible and desirable, rather than concentrating all decision-making resources on authorization and appropriation for construction.

The decision process is inexorably intertwined with the public involvement strategy. Some attitude research was conducted in the Washington University report, A River, A Region and A Research Problem, published as

IWR Report 71-6[3]. Subsequent interviews which confirm the general impressions contained in that report follow:

> "...The most important difference in attitudes between Oklahoma and Arkansas was the greater awareness and excitement over economic development possibilities among government officials and businessmen in Oklahoma. The responses of the 'average citizen' (people not directly affected by the ARDP)[4] did not seem to differ in the two states. The responses for the Oklahoma section of people with more direct involvement indicate that the highly concentrated nature of the impact area, and the dominance of that area by the business community of one city, Tulsa, has resulted in greater awareness and inducement to participate in development activities. In Arkansas, the picture is much more diffuse, despite the fact that the Little Rock area is a zone of concentration, like Tulsa. Nevertheless, the economic involvements of the river in Arkansas are so diffused, and cover such a large section of the state, that the possible effects of the ARDP may not be visualizable as crucial."

The 'average citizen's' responses can be characterized as follows:

a) Vague -- little concrete knowledge of the ARDP and what it comprises.

b) Where pro-con feelings were visible, no strong bias was noticeable either way. Negative perspectives, when present, centered around fears that development would destroy the old ways of the community. Positive attitudes were generally pro-business, but sometimes took the form of vague approval of anything to further 'progress'.

c) A fairly common attitude, considered neither pro nor con, took the form of 'well...it won't do us much good, but you can't stop progress, I guess'. That is, a sense of possible deprivations or disbenefits, but a feeling of inevitability.

d) Generalized differences in responses depending on the nature of contact of the ARDP on the respondent's interests. Thus: people with land potentially saleable were more interested in the program, but not necessarily more 'pro'. People with hopes that better jobs or wages or business opportunities might result, were generally 'pro'. People who complained about the intermittent character of their jobs often felt that

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[3]The interviews were not conducted with a statistical sample design and therefore may be biased.

[4]ARDP - The Arkansas River Development Project.

the development resulting from the ARDP might cure this ill.

In conclusion, the response to the ARDP varies by involvement. Farmers who lose bottomland may resent it; people who want to sell land may welcome it; businessmen who stand to gain, approve; those who may lose are anxious if not opposed. Laborers who get high wages are for it; union labor is mixed. Local officials and media people mix booster optimism with caution and skepticism. Some communities have moved to attract new business; some have hung back. Those who have done the former are usually in an area of direct impact: port towns, places near tributary reservoirs or near large cities.

The 'average citizen,' not involved with the project directly, not standing to gain immediately, was indifferent. These people were not quoted; their remarks were largely dismissals of the topic: 'Don't ask me, I don't know anything about it.' A few felt that since most of the work on the project, and most of the new industries, were affairs of outsiders, not even Oklahomans or Arkansans, the whole thing is something done by God and its effects locally were something to wait and see.

The attitudes therefore hang on the balance: Failure of gains to materialize, or the accumulation of felt disbenefits, could easily move feelings in strong negative directions. But positive feelings are general, though not strong, and there is something of a reservoir of good feeling about the whole project and its results....

A Public Involvement Strategy. The basis for strong feelings about the project relate to two factors: (1) a sense of a stake in the outcome; (2) a sense of ability to influence that outcome. It would seem logical to orient public involvement to these two factors. First, acquaint individuals and communities with their potential stake in the outcome of the study. We noted above the dichotomy between articulated regional objectives for the Arkansas River project and the project reports. Public involvement must be based on information which relates to local, regional and national perception of issues and problems. Thus the reports should openly discuss the issues. Second, demonstrate (1) those affected can influence the outcome of a study; (2) that decision-makers are sensitive and willing to accommodate diverse interests and help avoid extreme costs and windfall benefits; and (3) that this is an open decision process which

reacts to openly articulated issues rather than to subtle, guarded and low visibility pressure.

Finally, public involvement can work on an implementation plan. The Corps can deliver part of the plan, but other federal agencies, states, local communities, private businesses and individuals must do even more. Coordinated action is likely to produce better results and avoid counter-productive action if the agenda is developed properly. Then, the potential Corps action could be placed in perspective, with respect to longer range action.

The Failure to Follow Through. In common with the problems discussed above of relating public goals to planning objectives for public works projects, a consistent dialogue with widespread public involvement and a broad based decision process should follow. In no other federal program is there such a preponderance of federal presence and funding in the planning, design and construction phases as in water resources. The Corps of Engineers' is capable and responsible to bring a project like the McClellan-Kerr on line, subject to the consensus of the local, state and federal political structure. But, what of the economic goals which played such a significant role in motivating regional proponents? Obviously, economic development, in an area characterized by long-run outmigration, low income, and limited industrialization, requires a more deliberate sequence of steps than would a region which possesses an active economic base, huge capital and managerial resources, and a diversified labor force. In the latter case, perhaps the alteration of factors that affect prices (lowering transportation costs, electrical costs, improving supply of industrial sites, etc.) would result in an instantaneous reaction by the

economy. This is not the case in underdeveloped regions -- which could not exist if factors and prices were freely mobile and if the production possibility frontiers were common.[5] The presence of long-run underdevelopment equilibrium with accompanying low incomes and productivity is generally accompanied by risk adverse behavior and social controls which reflect social risk aversion. Confronted by significant uncertainties about new production arrangements, markets, distribution of factor payments and the possibility of dramatic shifts in the distribution of social and political power, underdeveloped regions require a special set of stimuli -- outside of alteration of factor prices, introduced in an unbalanced growth strategy.[6] The development of public entrepreneurship is strategic to successful economic development. Entrepreneurship requires the acceptance of risk to achieve projects or social payoff, as well as the skill to organize factors of production into the desired configuration for production. Development of entrepreneurship in the public sector to organize the activities of the public sector in such a way as to reduce the information costs and uncertainty about the possibilities of private production appear to offer substantial benefits.

If local or regionally defined design objectives were first accepted and then evaluated from a local, regional and national accounting perspective, formulating a plan might be expedited. Public involvement should focus on implementation steps rather than be limited to a 'yes' or 'no' decision to authorize and construct, since in many cases the level and

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[5]K. J. Arrow, "Limited Knowledge and Economic Analysis," American Economic Review, March 1974.

[6]A. O. Hirschman, The Strategy of Economic Development, 1964.

distribution of impacts can be managed by operation rules. The Appalachian Water Resources Survey[7] demonstrated a practical planning style which emphasized cooperating enterprise between federal, state and local governments and the private investment required to achieve the target levels of regional economic activity and employment. Yet, the most frequent reaction of reviewers was to discard the secondary benefits and costs as extraneous to the choice of or scale of a project. Paradoxically, secondary benefits were of the dominant influence upon design objectives and were evaluated from a national perspective to reduce the bias toward emphasis of transfer benefits. The follow-through strategy is dominated by secondary costs and benefits, and can be served by an informational and public involvement emphasis.

The lack of follow-through -- in the Arkansas River project case -- which has resulted in limited river front development, could result in environmentally costly location decisions, and may result in an otherwise avoidable level of conflict between competing user groups with respect to operating rules for the project.[8]

Institutions that help transfer initiative from dominantly federal to dominantly local levels may facilitate the completion of projects. Several institutional forms have been recommended, some tentatively adopted, but little progress is visible. Institutional alternatives run from the creation

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[7] Appalachian Water Resources Survey, Office of Appalachian Studies, Corps of Engineers, 1969.

[8] The deficiency is a problem in implementing the notion of Federalism. Federal agencies with the exception of TVA have little responsibilities for programs after water resource projects are constructed.

of a Federal Valley Authority similar to TVA to Federal-State compacts, to Bi-State compacts, to joint State committees and commissions, to State agencies, to joint state-local-private organizations. An Arkansas Valley Authority was proposed and available during the Roosevelt and Truman Administrations. This form of organization was not adopted, partly from public utility opposition. Various forms of federal, state and state compacts have been proposed and evaluated. An interagency -- multi-state -- committee is continuing this dialogue. The MECA organization proposed a joint university-state-private interest consortium to provide environmental management of the valley. This effort has attracted very limited support in Arkansas and little more in Oklahoma. Efforts to organize around the Ozarks Regional Commission introduced three more states and additional bargaining issues to the pressing problem of bringing Arkansas and Oklahoma interests together.

What options are open to facilitate the environmentally successful economic development of this region, which in President Nixon's dedication address was held to be capable of supporting 25 million additional people fully employed within 30 years? Industrial parks developed as adjuncts to port development have sufficient space and support facilities to accommodate foreseeable expansion and location of those manufacturing and marketing industries which are normally located in industrial parks for about 20 years. Sites for free standing, often environmentally threatening activities, have not been developed or designated. A move by the states independently or bilaterally to designate and acquire such sites would be warranted. Since ample space to locate power plants, chemical plants, paper and pulp mills in sites where environmental disruption is

minimized is now available, timing is critical. Corps management of shorelines owned by the Federal Government in Oklahoma could be of strategic assistance to state implementation of socially, environmentally and economically desirable land use patterns. The Corps role could be a strategy of keeping options open, developing a continuing public dialogue through hearings and impact statements on proposed private and public changes of land use requiring access to the river, and by continued pressure for development of strong cooperative federal-state implementation mechanisms.

## Current Research

During Fiscal Year 1974 a number of activities have been initiated to complement the initial round of research discussed above. The Southwestern Division is:

(1) Conducting a survey of rate adjustments by competing transport modes. The record is available and this information could go far in addressing this important policy issue.[9]

(2) Conducting a survey of the impact of high water restrictions on navigation users during 1973. Navigation was restricted on the upper portion of the waterway for up to 90 days during the long flood season of spring 1973. The purpose of this survey is to find how users of the waterway adjust to the problem.

(3) Preparing a brief summary of project output during 1972. This requires some modification of the annual report of the Arkansas River Basin Coordinating Committee to exclude projects upstream from Keystone Reservoir.

(4) Developing socio-economic profile data by census tracts and graphic techniques for display of this information, then testing the efficacy of the regional economic boundaries utilized in impact assessment for social impact studies.

The Institute for Water Resources is:

(1) Completing the implementation of the Harvard University Multi-Region Input Output Model on Corps computer equipment for use in tracing

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[9]Robert Haveman, The Economic Performance of Public Investment, Johns Hopkins Press, 1974, p. 65.

second and higher order impacts over a number of regions of the nation. The model would be available for use in impact analysis for other Corps projects at very low start-up costs. This work was done by contract with Catholic University and was completed in December 1974.

(2) Beginning a study of the emerging recreation industry which has developed in response to the 17 million annual visitors to the Arkansas River project (including upstream reservoirs). The study is to develop estimates of expenditures by major classes of recreational users across the 83 industry sectors of the I-O model described above. This allows impacts to be traced across industries and regions of the nation. The research is to be undertaken by the Oklahoma State University and is due for completion in October 1975.

APPENDIX A

Estimates of Realized Benefits During 1971 for
McClellan-Kerr Multiple Purpose Arkansas River System

General. Estimates of realized benefits during calendar year 1971 are based upon (1) Report on 1971 Activities, Arkansas River Basin Coordinating Committee, prepared by U. S. Army Engineer Southwestern Division Reservoir Control Center, March 1972, (2) The Economic Impact of Tenkiller Ferry Lake, prepared by U. S. Army Engineer District, Tulsa, by the Oklahoma State University, (3) Project Use During 1971, McClellan-Kerr Arkansas River Project Socio-Economic Impact Study and (4) Discriminant Analysis Applied to Commodity Shipments in the Arkansas River Area, prepared for the Institute for Water Resources by the U. S. Army Engineer Southwestern Division.

All benefits and costs discussed below are related to the components of the McClellan-Kerr Arkansas River Navigation system, representing an investment of $1.232 billion. This project includes the navigation locks and dams from the Mississippi River to Catoosa, main stem reservoirs-Webbers Falls, Robert S. Kerr, Ozark and Dardanelle and three upstream reservoirs -- Eufala, Keystone and Oolagah (see project map). The McClellan-Kerr Arkansas River Navigation system was redefined in 1971 (PL 91-6 & 9) to include all projects authorized in 1938 as amended and supplemented. Impacts are measured at the work most practical level of aggregation, then partitioned for certain comparisons. Explanation of the basis for estimates and assumptions utilized follow:

Flood Damages Prevented. The "1971 Activities...." reports benefits of $125,000 during the Oct 20 - Nov 2, 1971 storm and $1,300,000 benefits

during the Dec 8 - 17 storm from reduction in damages from upstream storage, for a total of $1,455,000 during 1971. These estimates are based upon flood reports.

Navigation. The "1971 Activities...." indicates 1971 tonnage of 4.3 million tons. A survey of waterway and competing rail and truck movement were conducted during 1971 and reported in "Discriminant Analysis Applied to Commodity Shipments during 1971". That report is the basis of estimated benefits per ton of shipment.

Total Shipments and Sample Shipments
By Commodity Groups, Arkansas River, 1971

| Commodity | Total Shipments (tons) | Sample Shipments (tons) |
|---|---|---|
| Sand, Gravel and Rock | 2,014,890 | - |
| Waterway Improvement Materials | 778,402 | - |
| Ores, Coal, Chemicals | 668,621 | 601,125 |
| Grains | 476,124 | - |
| Iron, Steel and Metals | 277,443 | 229,798 |
| Paper and Allied Products | 36,563 | - |
| Petroleum Products | 24,579 | - |
| Other | 17,501 | - |
| TOTAL | 4,300,000 | 831,000 |

Estimated benefits based on the willingness to pay for barge shipment in the 1971 survey was $24.33 per ton of commodities included in that survey. Since no sand and gravel observations were taken in the survey, and since the maximum haul is approximately ten miles, a separate estimate was made for benefits to this category. In addition we have made an estimate for the waterway improvement materials. Assuming the survey estimates were applicable to items other than aggregates and waterway improvement material, benefits per ton for the 1,500,756 tons would be $36,502,883 (1,500,756 x $24.33).

Assuming that the maximum haul for aggregate is ten miles, it may be conjectured that this transportation cost indicates an upper bound to willingness to pay. Since the shipments are made in small quantities (1 - 2 barge loads), it is assumed that average costs are on the order of 1¢ per ton mile. To simplify the calculation, it is assumed that the average haul is 7.3 miles which provides another point on the demand curve. (The basis for the 7.3 miles is 14,700,318 tons miles divided by the 2,014,890 tons).

The area under the demand curve is equal to $174,281 for an average of $.087 per ton. Extending this estimate to include materials utilized for waterway improvement would add 778,402 tons x $.087 or $67,720. Correcting for the difference in average haul (accounted for by the ton mileage) would add a factor or a multiplier of 2.24 which gives a total of $151,831. (This factor is derived by dividing 12,740,000 ton miles by 778,462 tons which is equal to 16.3, and then dividing by 7.3 which is equal to 2.24).

Summary of Estimated Transportation Benefits 1971 (high bound)

| | tons | | | Percent |
|---|---|---|---|---|
| Aggregates | 2,014,890 | $ .087 | $ 174,231 | .5 |
| Waterway Improvement Material | 778,402 | .195 | 151.831 | .5 |
| Iron, Steel, Ore, Minerals, Chemicals & Chemical Fertilizers, Grains, Coal & Coke & others | 1,500,756 | 24.33 | 36,502,883 | 99.0 |
| | 4,294,048 | $8.58 | $36,828,995 | 100.0 |

Another basis for estimating transportation benefits is to assume that the only factor affecting choice of mode is transport costs. If this assumption is made, a somewhat lower estimate would result, as follows:

Sample data indicated average transportation rates for barge shipments to be $4.66 and handling costs $2.75 per ton. Average rail rates were $12.13 and handling costs were $1.61. Average savings for using the waterway would be (12.13 + 1.61) - (4.66 + 2.75) = $6.33. Using this value to represent shipments other than aggregates and waterway improvement material results in the following estimated benefits:

Summary of Estimated Transportation Benefits 1971 (low bound)

| | tons | | Benefits |
|---|---|---|---|
| Aggregates | 2,014,890 | $.087 | $ 174,284 |
| Waterway Improvement Materials | 778,402 | .195 | 151,831 |
| Iron, Steel, Chemicals & Chemical Fertilizers, Ores & Minerals, Grains, Coal & Coke & others | 1,500,756 | 6.33 | 9,499,785 |
| | 4,294,048 | $2.29 | $9,825,897 |

One could argue that the high bound estimate is biased upward by the statistical assumption utilized in simulating willingness to pay. These assumptions include:

(1) Observations represent equilibrium conditions in the transportation industry and full information by transport users.

(2) The data are multivariate normal and each group possess equal covariance matrices.

IWR Report 74-R2 discusses these assumptions along with several other empirical problems encountered during the study. Equilibrium assumptions are possibly the strongest and most difficult to defend. There is however another side to that assumption. In all likelihood, many shippers were choosing the water mode to accelerate downward competitive rate adjustments by competing modes (primarily rail). To the extent that this behavior affected choice of transport mode, the resulting estimates are higher than if other forms of behavior are assumed. Current research is aimed at documenting the competitive rate adjustments by competing modes.

One could argue the extent to which waterway improvement material and aggregate movements should be included in benefit estimates. Waterway improvement material implies a self-generating need which could conceivably

be defined as a cost, yet transportation by water is at a savings which in fact could be introduced as a benefit. Aggregates, however, have traditionally been dredged from the river, although the project affords improved access to sand and gravel deposits, thus decreasing production costs and encouraging utilization of alluvial deposits on the river. As a matter of perspective, elimination of aggregates and waterway improvement materials would result in a decrease of only 1% in the high bound case and about 7% in the low bound case.

Hydroelectric Benefits. Hydroelectric power output of 1,142.2 hundred million kilowatt hours were reported in 1971. Benefits are more difficult to estimate because the power is marketed, along with output from other projects through the Southwestern Power Administration (SPA). SPA in turn disposes of power under three basic supply arrangements -- firm power, peak power and dump power (see The Economic Impact of Tenkiller Ferry Lake, prepared for the U. S. Army Engineer District, Tulsa, by the Research Foundation, Oklahoma State University (1973)). Firm power rates include a firm capacity charge of $14.40 per kilowatt per year, 2 mills per KWH for the first 1150 KWH per month, 3 mills for the next 290 KWH and 5 mills for all energy in excess of 1440 KWH per month. Peaking power rates include similar charge for fixed capacity plus an energy charge of 2 mills per kilowatt. Dump power is sold at 1.5 mills per KWH. Since FY 68, the average returned to the treasury has been about 5 mills per KWH from SPA. Since definite information of power revenues is not available for the Arkansas Project, a high and low estimate was made utilizing the 6.9 mills per KWH average SPA revenue for firm power and 1.5 mills per KWH average SPA revenue for dump power as

shown below:

| | |
|---|---|
| High Estimate | 1,142,200,000 KWH X 6.9 mills = $7,881,180 |
| Low Estimate | 1,142,200,000 KWH X 1.5 mills = 1,713,300 |

Sediment Control and Channel Stabilization. Annual benefits to lands and improvements on the flood plan from sediment control and channel stabilization was estimated to be $6,575,000 in the last updated estimate prepared in 1968. Benefits are attributed to reduced dredging, reduction in loss of land, and reduction in damage to improvements. No empirical studies have been made to reevaluate these impacts, so the project estimate was assumed to be valid.

Recreation. Recreation use and benefits have substantially exceeded those envisioned in previous project benefits estimates. Average recreation and fish and wildlife benefits were estimated in 1968 to be $2,609,000 annually reporting benefits credible to Kerr, Ozark and Webbers Falls projects, plus fish and wildlife benefits for Keystone and Oologah. Actual attendance in 1971 was 4,871,380 for Locks & Dam 1 thru 15 (visitor data was not available for Lock and Dam 16, 17, and 18) and 8,146,500 for Keystone, Oologah, and Eufala lakes for a total visitation of 12,917,880. If the benefit value suggested in Supplement #1 to Senate Document 97 and utilized in most current Corps of Engineers Survey Studies is adopted, benefits would be 12,917,880 x $1.50 = $19,376,820. However, if willingness to pay criteria are substituted for the largely judgmental values contained in Supplement #1, significantly higher unit values are obtained. Two sources of empirical estimates are available. The Tenkiller Ferry Lake Impact Study, previously cited, estimates consumer surplus values of $21,482,450 to $10,186,862 for the 3,095,700 visitors utilizing

Lake Tenkiller Ferry in 1972 for an average benefit of $6.94 to $3.29 per visitor day. Volume V of IWR Research Report 74-R1, A Generalized Recreation Day Use Planning Model provides estimates of consumer surplus based on 1964-1968 visitor data for five reservoirs in the Arkansas System -- Eufala, Fort Gibson, Keystone, Oologah and Tenkiller Ferry. Under two sets of assumptions regarding the relation between travel cost and time average benefits for the reservoirs would be $3.60 to $2.92 per visitor day (Table 5, page 29). Using the $3.60 estimate, benefits would be 12,917,880 x $3.60 = $46,504,368.

Water Supply. The projected $828,900 annual benefits for water supply were utilized in the estimate for 1971. Potential water supply benefits are in many ways restricted because of the high background level concentration of chlorides flowing in the Keystone Reservoir and into the Eufala Reservoir. However, the Verdigris, Neosha, Illinois and Poteau River Tributaries contain relatively high quality water and impoundments on these streams provide additional water supply. An example is provision of water to the Kerr-McGee Nuclear Fuel Processing Facility near Gore, Oklahoma from Tenkiller Ferry Lake.

SUMMARY OF BENEFITS ($) FOR 1971
McCLELLAN-KERR NAVIGATION SYSTEM

| ITEM | HIGH BOUND | (%) | LOW BOUND | (%) |
|---|---|---|---|---|
| Transportation | 36,828,995 | 36.8 | 9,825,897 | 24.7 |
| Flood Control | 1,425,000 | 1.4 | 1,425,000 | 3.6 |
| Hydroelectric | 7,881,180 | 7.9 | 1,713,300 | 4.3 |
| Sediment Control & Channel Stabilization | 6,575,000 | 6.6 | 6,575,000 | 16.5 |
| Recreation | 46,504,368 | 46.5 | 19,376,820 | 48.8 |
| Water Supply | 828,900 | .8 | 828,900 | 2.1 |
| TOTAL | 100,043,443 | 100.0 | 39,744,917 | 100.0 |

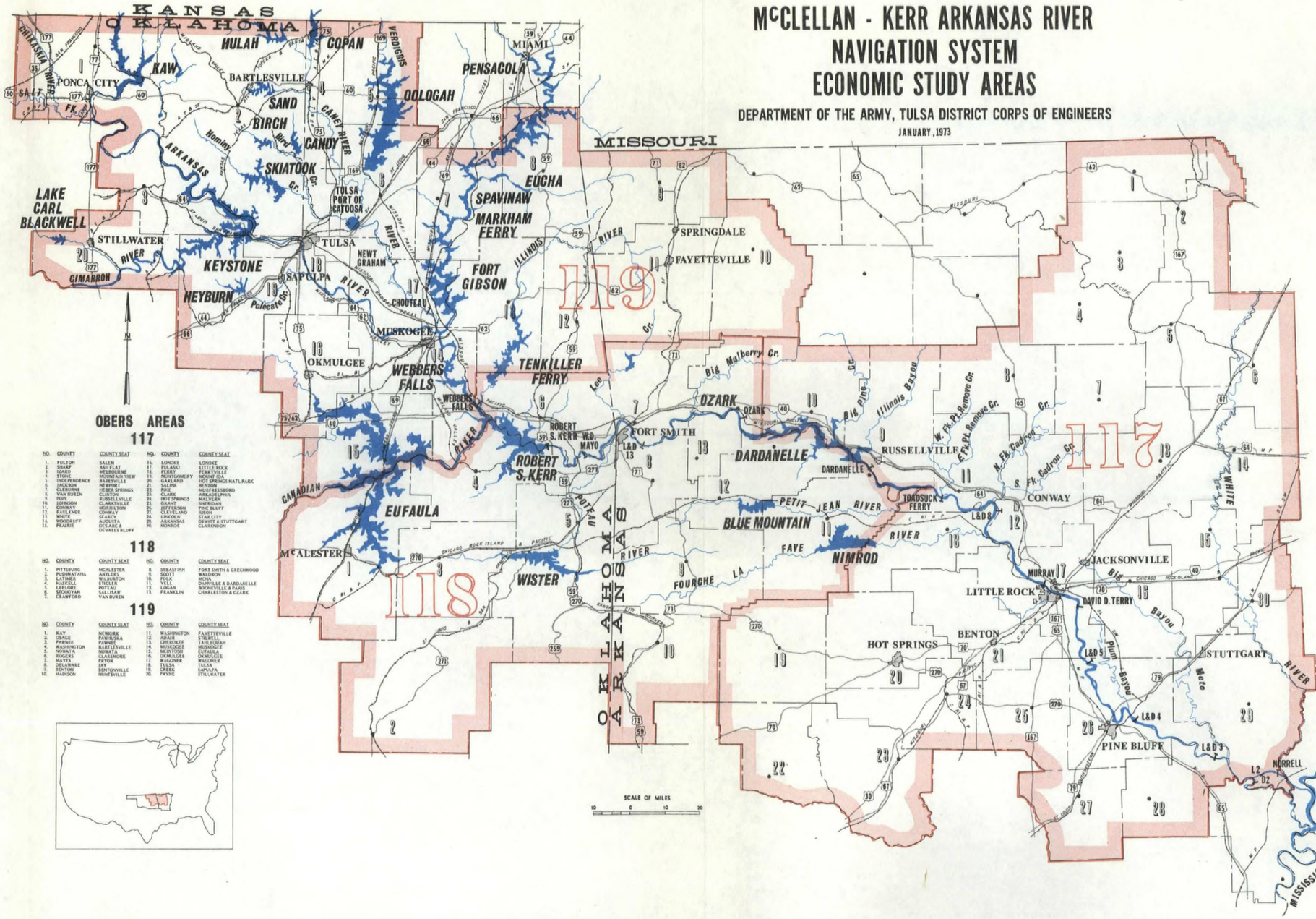
RETURN TO INVESTMENT - 1971

| | HIGH BOUND | LOW BOUND |
|---|---|---|
| Total Benefits | 100,043,443 | 39,744,917 |
| Less O&M Expenditures | 8,800,000 | 8,800,000 |
| Net Benefits | 91,243,443 | 30,944,917 |
| Investment | 1,232,968,000 | 1,232,968,000 |
| Return on Investment (1971) | 7.4 percent | 2.5 percent |

# McCLELLAN - KERR ARKANSAS RIVER NAVIGATION SYSTEM ECONOMIC STUDY AREAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS

JANUARY, 1973




## OBERS AREAS 117

| NO. | COUNTY | COUNTY SEAT | NO. | COUNTY | COUNTY SEAT |
|---|---|---|---|---|---|
| 1. | FULTON | SALEM | 16. | LONOKE | LONOKE |
| 2. | SHARP | ASH FLAT | 17. | PULASKI | LITTLE ROCK |
| 3. | IZARD | MELBOURNE | 18. | PERRY | PERRYVILLE |
| 4. | STONE | MOUNTAIN VIEW | 19. | MONTGOMERY | MOUNT IDA |
| 5. | INDEPENDENCE | BATESVILLE | 20. | GARLAND | HOT SPRINGS NATL PARK |
| 6. | JACKSON | NEWPORT | 21. | SALINE | BENTON |
| 7. | CLEBURNE | HEBER SPRINGS | 22. | POLK | MENA |
| 8. | VAN BUREN | CLINTON | 23. | CLARK | ARKADELPHIA |
| 9. | POPE | RUSSELLVILLE | 24. | HOT SPRINGS | MALVERN |
| 10. | JOHNSON | CLARKSVILLE | 25. | GRANT | SHERIDAN |
| 11. | CONWAY | MORRILTON | 26. | JEFFERSON | PINE BLUFF |
| 12. | FAULKNER | CONWAY | 27. | CLEVELAND | RISON |
| 13. | WHITE | SEARCY | 28. | LINCOLN | STAR CITY |
| 14. | WOODRUFF | AUGUSTA | 29. | ARKANSAS | DEWITT & STUTTGART |
| 15. | PEARCE | DE'S ARC & DEVALLS BLUFF | 30. | MONROE | CLARENDON |

## 118

| NO. | COUNTY | COUNTY SEAT | NO. | COUNTY | COUNTY SEAT |
|---|---|---|---|---|---|
| 1. | PITTSBURG | McALESTER | 8. | SEBASTIAN | FORT SMITH & GREENWOOD |
| 2. | PUSHMATAHA | ANTLERS | 9. | SCOTT | WALDRON |
| 3. | LATIMER | WILBURTON | 10. | POLK | MENA |
| 4. | HASKELL | STIGLER | 11. | YELL | DANVILLE & DARDANELLE |
| 5. | LEFLORE | POTEAU | 12. | LOGAN | BOONEVILLE & PARIS |
| 6. | SEQUOYAH | SALLISAW | 13. | FRANKLIN | CHARLESTON & OZARK |
| 7. | CRAWFORD | VAN BUREN | | | |

## 119

| NO. | COUNTY | COUNTY SEAT | NO. | COUNTY | COUNTY SEAT |
|---|---|---|---|---|---|
| 1. | KAY | NEWKIRK | 11. | WASHINGTON | FAYETTEVILLE |
| 2. | OSAGE | PAWHUSKA | 12. | ADAIR | STILWELL |
| 3. | PAWNEE | PAWNEE | 13. | CHEROKEE | TAHLEQUAH |
| 4. | WASHINGTON | BARTLESVILLE | 14. | MUSKOGEE | MUSKOGEE |
| 5. | NOWATA | NOWATA | 15. | McINTOSH | EUFAULA |
| 6. | ROGERS | CLAREMORE | 16. | MAYES | OKMULGEE |
| 7. | MAYES | PRYOR | 17. | WAGONER | WAGONER |
| 8. | DELAWARE | JAY | 18. | TULSA | TULSA |
| 9. | BENTON | BENTONVILLE | 19. | CREEK | SAPULPA |
| 10. | MADISON | HUNTSVILLE | 20. | PAYNE | STILLWATER |

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