THE CORPS OF ENGINEERS AND A NEW APPROACH

TO PROJECT EVALUATIONS

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Historically, our society has sought economic growth, and toward that end the U. S. Army Corps of Engineers has planned and built many water resources projects. As our population and affluence has grown, however, it has become increasingly clear that there are limits to the burden our natural environment can bear. In recent times, we have come to realize that growing demands for resource consumption pose serious threats to social well-being.

The production of paper, for example, provides an excellent illustration of external social costs resulting from unplanned resource use. To produce the vast quantities of paper needed in today's society, forest products and chemicals are used extensively in converting wood to paper. If not managed properly, this process can set up a devastating chain reaction. Improper planning in the cutting of forests can destroy wildlife habitats and alter rainfall runoff patterns, thus contributing to serious social problems. The manufacture of chemicals used during the process of papermaking also produces wastes that are often dumped into streams, thereby rendering them of little value for alternative uses. And finally, after paper has been used, it may be improperly discarded, adding to the burden of solid waste in the social environment.

Planners in the Corps of Engineers today appear to be faced with a dilemma. While being charged with the responsibilities for meeting increasing demands for water resources to support higher levels of economic activity, the Corps is also directed to conserve the quality of the natural environment. This report will attempt to show that these apparently conflicting demands need not be mutually exclusive if viewed from a humanistic social perspective.

Water resources planning must give weight to the consequences of man's uses of water upon the institutional framework of society itself. An environmental policy which pretends man does not exist is inappropriate for today's planning. Since man does exist, and can be expected to increase in numbers and activities, he inevitably produces change. The central problem in planning water resources development is to manage this change so that it contributes to social well-being rather than to social disorder.

This research report attempts to provide an understanding of the origin and nature of the Corps of Engineers' civil works program and outlines a theory for evaluating water resources development projects. Chapters I and II trace the history of the Corps as well as its organization and functions in water resources development. In

Chapter III, the Willamette River Basin (Oregon) Comprehensive Study and the Arkansas River Multiple Purpose Project (Arkansas-Oklahoma) are examined in order to gain insight into the scope of such studies and projects. Chapter IV expands work begun in Chapter II to include a detailed look at some of the current problems associated with the evaluation of water development projects. Chapter V discusses relationships between regional and national planning goals, while Chapter VI outlines a theory for evaluating proposed water resources projects through socio-economic profile analyses.

Procedures recommended by this report for comprehensive evaluations of projects involve three major steps: first, the identification of major national socio-economic goals; second, identification and subsequent analysis of major socio-economic characteristics of the project's study region; and third, implementation of a systematic procedure by which professional analyses and judgements can assess significant socio-economic impacts of the proposed project.

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THESIS

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PREFACE

Historically, our society has sought economic growth, and toward that end the U. S. Army Corps of Engineers has planned and built many water resources projects. As our material life has grown, however, it has become increasingly clear that there are limits to the burden our natural environment can bear. In recent times, we have come to realize that growing demands for resource consumption pose serious threats to social well-being; that man's environment is composed of interdependent systems, both natural and man-made; and that abusive changes in one system jeopardize the quality of others.

Many problems inherent in resource use and conservation are best understood in a historical context. Ancient man, feeling a need to communicate, devised written languages. Requiring something on which to record his thoughts and deeds, he invented papyrus. With the subsequent invention of the printing press, man immensely increased his ability to disseminate knowledge and information. The spiraling growth of knowledge led to further increases in the demand for paper. As technological improvements in the production of paper were made, man found that the material was useful in a host of other ways.

To produce the vast quantities of paper needed in today's society, forest products and chemicals are used extensively in converting wood into paper. If not managed properly by man, this process can set up a devastating chain reaction. Improper planning in the cutting of forests can destroy wildlife habitats, alter rainfall runoff patterns, and contribute to serious social problems. Without resource planning and regulation, the manufacture of chemicals often produces wastes which are dumped into streams, rendering them of little value in alternative uses. And finally, after paper has been produced and used in a variety of ways, it may be improperly discarded, adding to the burden of solid waste in the social environment.

Today, planners in the Corps are faced with a dilemma. On the one hand, they are called upon to meet increasing demands for water resources to support higher levels of economic activity, while at the same time they are directed to conserve those same resources in order to preserve the quality of the natural environment. This report will attempt to show that these apparently conflicting demands need not be mutually exclusive if viewed from a humanistic social perspective.

Water resources planning must give weight to the consequences of man's uses of water upon the institutional framework of society itself. An environmental policy which pretends man does not exist is invalid. Since man does exist and can be expected to increase in numbers and activities, he inevitably produces change. The central problem in planning water resource use is to manage this change so that it contributes to social well-being rather than to social disorder.

This research report attempts to provide an understanding of the origin and nature of the Corps of Engineers civil works program. Chapters I and II trace the history of the Corps as well as its organization and functions in water resources development. In Chapter III, two actual multiple-purpose projects--the Arkansas River Multiple Purpose Project and the Willamette River Basin Comprehensive Study--are examined through the history of their formulation and use in the initial year of operation. Chapter IV expands work begun in Chapter II to include a detailed look at current problems associated with the evaluation of water development projects. Chapter V discusses the relationship between regional and national goals, while Chapter VI outlines a theory for evaluating water resources development from a socio-economic profile analysis.

TABLE OF CONTENTS

TABLE OF CONTENTS--Continued

LIST OF TABLES

LIST OF TABLES--Continued

LIST OF ILLUSTRATIONS

CHAPTER I

EARLY HISTORY OF THE CORPS OF ENGINEERS

Origin of the Corps

The history of how the U. S. Army became involved in providing non-military public services to the nation is an interesting one. It is made all the more so in view of two accepted facts: first, our internal political system does not rest upon military power, and second, the nature of the services rendered involves water and its uses.

Historically, the U. S. Army Corps of Engineers, also referred to as "Army Engineers" or simply "Corps," dates from June 16, 1775, when the Continental Congress resolved that

> . . . there be one Chief Engineer at the Grand Army and that his pay be $60 per month./ That two assistants be employed under him, and that the pay of each of them be $20 per month. [Also] . . . in December of 1776, General Washington was authorized to "raise and collect a Corps of Engineers" (3, II, p. 1).

In 1802, Congress reorganized the Corps of Engineers and directed "that the principal engineer . . . shall have the superintendence of the [West Point] academy" (3, II, p. 2). In 1817, with the appointment of Sylvanus Thayer as Chief Engineer, training at West Point was extensively diversified.

> [Thayer] . . . had become convinced after visiting French [Polytechnical] School in 1815-1816 that the technical education at West Point must include such courses as would produce officers capable not only of building seacoast fortifications, but capable of conducting the explorations, surveys, and civil works so much needed in developing the Western country [of the United States]. He realized that one engineering school at West Point could not produce the vast army of technical engineers the country would need during the coming years. For twenty-two years West Point had been the only engineering school in America. He preached that additional technical schools must be established (2, p. 7).

Undoubtedly, Thayer's influence played a great part in inaugurating the Corps' civil programs. In the early development of the nation, the Corps applied technical knowledge, often unavailable elsewhere, to civilian use.

> The United States Military Academy at West Point was the first institution in the United States to offer "civil" engineering . . . and the term was first defined officially in 1818 . . . (1, p. 342).

Early Accomplishments of the Corps of Engineers

The following are some of the Corps' notable accomplishments prior to the twentieth century:

(1) conducted nearly all preliminary explorations and prepared maps;

(2) constructed roads and built bridges and canals in the developing territories;

(3) initiated work in geodetic, topographic, and hydrographic surveys;

(4) located routes, built, and often managed railroads;

(5) located U. S. and state boundary lines;

(6) completed work on the Washington Monument and Capitol as well as other public buildings in Washington, D. C.; and

(7) acted as consultants to foreign governments in civil engineering (1, p. 342; 3, II, pp. 3-4).

A turning point in the functions of the Corps took place after the Civil War. Although Congress had actually authorized the Corps to engage in waterway and harbor development by the "Rivers and Harbors Act of 1824" (2, p. 9), only limited work was undertaken in the early years of that authority. The significance of post-Civil War interest in waterway development is of considerable importance in the work of today's Corps.

> With railroads linking the country and developing engineers of their own, and with the cavalry remaining to protect the fast-fading frontier, the Army Engineers were turned by Congress to other important peace-time assignments. They were directed to develop the Nation's waterways, improve harbors, and construct Federal buildings (3, II, p. 5).

Work authorized in waterway improvement following the Civil War included "a detailed survey of the Lower Mississippi Valley [which] . . . was the forerunner of [a] modern, nation-wide program of flood control" (3, II, p. 6).

The Corps in the Early Twentieth Century

Following the turn of the century, the Corps planned and constructed many civil projects which helped to develop newly acquired territories.

> Alaska, Hawaii, Cuba, Puerto Rico, the Philippines, Guam and the Canal Zone--each brought to the Corps of Engineers problems that required all the experience, skills and knowledge it had acquired during the . . . Nineteenth Century (3, II, p. 6).

The civil works program of the Corps was directly affected by the "Rivers and Harbors Act of 1922." This act changed authorization for funding civil works. Subsequently, a project could be found "feasible" and authorized, but Congress could postpone funding to a more opportune time.

> . . . the Act of September 22, 1922, . . . and later Flood Control Acts, have only authorized specific projects. The funds for their accomplishment have been provided in separate and distinct Civil Functions, Department of the Army bills (3, III, p. 9).

In 1925, Congress directed the Secretary of War, through the Corps of Engineers and Federal Power Commission, to prepare estimates of costs related to a survey of the rivers over the United States

> . . . with a view to formulation of general plans for the most effective improvement of such streams for the purposes of navigation and the prosecution of such improvement in combination with the most efficient development of the potential water power, the control of floods, and the needs of irrigation (3, III, p. 20).

The surveys completed under this directive constitute the most complete and comprehensive "river basin studies . . . made, and formed the basis of subsequent legislation by the Congress for flood control and for the TVA" (3, III, p. 20). In 1927, President Calvin Coolidge directed the Corps of Engineers to prepare a comprehensive plan for flood control on the Mississippi River (3, III).

> In 1927, the attention of the country was focused on the alluvial valley of the Mississippi, when the great flood of that year broke all previous high water records and caused the loss of some 200 lives, rendered 600,000 people homeless and caused property damage of approximately 400 million dollars (3, III, p. 20).

Continued flooding and the need for work relief programs during the 1930's brought about the Flood Control Act of 1936, which authorized the Corps to implement numerous flood control projects.

> Congress took its most comprehensive step in the history of flood control legislation and established for the first time a national flood control policy. [The Works Progress Administration and other depression influenced programs were created about this same time.] Under the new policy, the Act authorized 300 flood control projects that had been investigated previously by the Corps. . . . It also authorized the appropriation of 310 million dollars to initiate the work, and assigned to the Corps of Engineers the task of carrying out the national flood control program. . . . Since the original Flood Control Act of 1936, Congress has broadened the scope of the national flood control program, and has clarified and increased the authority of the Corps of Engineers in carrying out this work (3, III, p. 24).

The Corps of Engineers made many accomplishments during its pre-World War II years. Many cannot be designated either "civilian" or "military" achievements, for what effects one sector often proves valuable in the final analysis to the other. For example, some of the most widely-known military deeds have led to scientific advances and peaceful uses. Research by the Manhattan District during World War II helped to develop the atomic bomb, a fearsome weapon indeed, and yet its development has opened up a potential energy source for mankind's peaceful use. The Alcan Highway, constructed for military transport during World War II, has led to the present-day Alaska Highway. Civil projects, too, may ultimately prove to have military value. The Panama Canal project, intended as a civil project of the Corps of Engineers and the Army Medical Corps, has proven its value during two World Wars (1, p. 342).

A summary of the significant events in the Corps' history is presented in Table I.

TABLE I

SIGNIFICANT EVENTS IN THE EVOLUTION OF THE CORPS' CIVIL WORKS PROGRAM UP TO WORLD WAR II

Date	Event
1775	Corps of Engineers formed by Continental Congress.
1802	Act of Congress assigns both military and civil duties to the Corps.

TABLE I--Continued

Date	Event
1817	As Chief Engineer and Superintendent of West Point, Sylvanus Thayer promoted wider study of technical subjects and Corps of Engineers' role in westward expansion.
1824	Congress passed the first "Rivers and Harbors Act" giving the Corps responsibility for improving the nation's waterways.
1865-1878	Emphasis of Corps functions shifted from exploration and land surveying to waterway improvement.
1899	Rivers and Harbors Act (National Refuse Act) of 1899 passed by Congress. This Act provided for the protection of navigation by prohibiting the discharge or dumping of refuse matter of any kind or description other than that flowing from streets and sewers, into any navigable water or its tributary.
1902	Board of Engineers for Rivers and Harbors was created by Congress with review authority over field surveys and recommendations.
1927	Corps was directed to make comprehensive surveys of rivers of the U. S. for purposes of improvement of navigation, flood control, irrigation and power generation. Surveys of 191 rivers resulted in the so-called "308 Reports" which led to comprehensive planning of water resource projects such as the Arkansas River system.
1936	Corps civil works program was given a major boost by passage of the "Flood Control Act of 1936."

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CHAPTER II

CIVIL WORKS AND PROJECT PLANNING SINCE WORLD WAR II

Only limited civil works were undertaken during the years of World War II, although some studies, such as the "1943 Navigation Study of the Arkansas River," were made for post-war construction of various projects. However, in 1944, Congress did broaden the Corps' civil works to include recreation, irrigation, and water supply (9, A, p. 13). With the end of fighting, Congress again increased the scope of the Corps' civil works program by adding responsibility for planning and building facilities for shore and beach erosion (1946), hurricane protection (1955), and water quality (1948, 1961, and 1972) (9, A, p. 13). These additional responsibilities have "expanded the legislative basis for Corps participation in the functional areas of water management to a comprehensive basis" (9, A, p. 13).

With respect to its civil works program, the Corps of Engineers has evolved into a unique military organization. In this report, as in common usage, it has been said that the Corps "plans" and "builds" water resource development projects. Actually, the Corps is only responsible for project planning and design. Construction work is customarily done by contract, and at times planning and design is "contracted' by private firms. The Corps does, in most cases, continue to operate and maintain various types of projects after construction (4).

Despite usually being considered a part of the "military" sector of the economy, almost all employees of the Corps' civil works program are civilians. Current (1973) statistics show that of approximately 32,000 full-time employees in the program, only about 200 are military personnel. The military personnel represent the executive branch of the organization (3).

The national headquarters for the civil works program is the Office of the Chief of Engineers, Department of the Army, Washington, D. C. Supervision of the program is decentralized among eleven divisions over the United States (3). Most of the actual planning, construction, and operational work is carried out by a still lower echelon of field offices which form "engineering districts," of which thirty-eight were engaged in civil works in 1971 (5). The boundaries of the engineer divisions and districts generally follow natural watershed divides rather than state boundaries. See Appendix A, Table XI for the location and mailing address of each of the eleven divisions and thirty-eight district offices.

Procedures for Implementing and Completing Public Works Projects

In the conception, planning, authorization, and construction of civil works projects, there is an elaborate process involving years and often decades of effort. For example, navigation studies were undertaken on the Arkansas River Project in 1943, yet the project was not completed until 1971. The following is an outline of the procedure for implementing and completing a multiple-purpose project (12, pp. 31-36).

Step one: initiation of action by local interests.--Local citizens desiring Federal aid for water resource projects, such as beach erosion control and flood control, should contact their Senators and Representatives requesting the Federal government to consider funding the project. Advice on procedures may also be obtained from representatives of the Corps of Engineers.

Step two: consultation by Senator or Representative with Public Works Committee.--If previous reports on navigation or flood control have been made in the area in question, the Senator or Representative may request the Senate or House Committee on Public Works to adopt a resolution authorizing a review of the report of the Corps. If advisable, alterations to the previous report may be made. If no previous study has been made, the Senator or Representative may request that the House or Senate

Committee on Public Works include authorization for a survey in a flood control or other bill. Regarding beach erosion control and hurricane protection, the Senator or Representative may sponsor an act authorizing a study or may request the Committee on Public Works of either House of Congress to adopt a resolution authorizing a survey in accordance with the River and Harbor Act of 1962.

Step three: action by Public Works Committee.--If the Public Works Committee feels a review report is necessary, it will adopt a resolution calling upon the Board of Engineers for Rivers and Harbors to make the review. In the case of beach erosion control, the resolution requests that the Secretary of the Army conduct the survey. Any report involving the project for the alluvial valley of the Mississippi River and its tributaries will be reviewed by the Chief of Engineers rather than by the Board. Where there is no previous study, the Public Works Committee may request Congress to authorize a survey in a flood control or other bill. The Committee may also consult the Chief of Engineers for advice on the desirability of a proposed survey.

Step four: assignment of investigation by Chief of Engineers.--If Congress authorizes a study, the Chief of Engineers assigns the survey, usually to the Division Engineer in the affected area. If he so desires, the Division Engineer may assign the study to the appropriate

District Engineer. However, no investigation may be conducted until Congress has appropriated funds to pay for such studies.

Step five: public hearings by Division or District Engineer.--In order to determine the wishes and opinions of local residents regarding the proposed public works project, the Division or District Engineer holds public hearings at times and places convenient to those involved. Notices of such hearings are distributed to those known to be concerned about and interested in the proposed improvements. At the hearings,

> local interests will be afforded full opportunity to express their views on the character and extent of the improvement desired, on the need and advisability of its execution, and on their general willingness and ability to cooperate with the Federal Government in the costs of projects in accordance with established policies and laws (12, p. 33).

Step six: investigation by Division or District Engineer.--After careful analysis of field studies as well as engineering and economic data, the Division or District Engineer will arrive at an estimate of the probable benefits and costs of the proposed project. The Engineer also determines the advisability of related programs such as area redevelopment.

> In selecting the plan of improvement best suited for the problems and the area in question, consideration will be given to optimum use of all water resources of the

> area by providing related improvements. . . . A favorable recommendation will depend on whether the benefits to be derived through the plan of improvement exceed the costs to be incurred (12, p. 33).

If the project is felt to be economically justified, additional local hearings may be held to inform local citizens and to obtain agreement from responsible officials regarding requirements for local cooperation.

Step seven: review by Division Engineer and issuance of public notices.--When the survey is completed by the District Engineer, the appropriate Division Engineer will review the report and transmit it to the Board of Engineers for Rivers and Harbors. He will also issue a public notice to those known to be interested in the proposed project explaining the findings and recommendations of the investigation. Those interested parties are then invited to present their views to the Board.

Step eight: review and hearings by Board of Engineers for Rivers and Harbors or Mississippi River Commission.--The Board of Engineers for Rivers and Harbors in Washington, D. C. is required by law to review all investigations and studies made by the Corps of Engineers except those dealing with the alluvial valley of the Mississippi River. The latter are reviewed by the Mississippi River Commission. Both the Board and the Commission are required to submit their findings to the Chief of Engineers. However, either body may hold public hearings before submitting recommendations.

Step nine: preparation of proposed report of Chief of Engineers and review thereof by affected states and Federal agencies.--When he receives the completed report and recommendations of the Board or Commission, the Chief of Engineers will prepare a report and forward it, together with the Board's or Commission's report, to the governors of the affected states and to other interested Federal agencies. These affected parties may then make recommendations on the improvements discussed in the report. The Federal agencies involved include the Federal Power Commission and the Departments of Commerce, Interior, Labor, and Health, Education, and Welfare. Recommendations of affected parties should be forwarded to the Chief of Engineers within ninety days.

Step ten: transmittal of report to the Office of Management and Budget.--Upon receipt and consideration of recommendations from governors and Federal agencies, the Chief of Engineers will complete his report and submit it to the Secretary of the Army. The Secretary of the Army then submits the report of the Chief of Engineers and all pertinent documents to the Director of the Office of Management and Budget "for a determination of the relationship of the report to the program of the President."

Step eleven: transmittal of report to the Congress.--After he receives and considers the comments of the Office of Management and Budget, the Chief of Engineers will forward his report with all pertinent data to the Secretary of the Army, who sends it to Congress.

Step twelve: project authorization by the Congress.--After receipt of the report of the Chief of Engineers, the Congressional Committees on Public Works may hold hearings on the report. Authorization for construction of public works projects is usually included in omnibus river and harbor and flood control bills.

Step thirteen: assurances of local cooperation.--Before construction of the project may begin, the District Engineer must receive formal assurances from local officials that they will fulfill their commitments to the project. If such assurances are not forthcoming, projects are usually placed on the inactive list.

Step fourteen: request for planning and construction funds.--Before construction of the proposed project can begin, funds must be requested from Congress. Such requests are reviewed by the Office of Management and Budget, and, "if found to conform with the President's budgetary policies, will be transmitted to the Congress as part of the President's Budget" (12, p. 35). They are then evaluated by the Appropriations Committees.

Step fifteen: appropriation of planning and construction funds.--Upon completion of hearings, the Appropriations Committees refer a bill to the full Congress for passage. The bill then goes to the president for his signature. If the president signs the bill into law, the Chief of Engineers is authorized to begin planning and construction of the proposed projects.

Step sixteen: preparation of detailed plans.--Before construction is actually begun, "detailed plans, specifications, and cost estimates" will be prepared by the District Engineer, with assistance from the Division Engineer and the Chief of Engineers.

Step seventeen: invitation to bid.--After detailed specifications have been approved, reputable and qualified contractors are asked to bid on constructing the proposed improvements. The contract is awarded to the eligible low bidder.

Step eighteen: construction of project.--Once the contract is awarded, construction of the proposed project begins. Upon its completion, "a final sharing of costs is determined, and the Federal government or local interests assume operation and maintenance of the project in accordance with authorized requirements" (12, p. 36).

The Development of Project Evaluation Criteria Since World War II

The system for determining which projects are to be constructed evolved rapidly after 1936. Since this report is concerned primarily with the technical evaluation of project feasibility through an estimate of probable benefits and costs, the research has been limited to functions described in step six of the procedures for implementing and completing a multiple-purpose project:

> The Division or District Engineer after careful analysis of engineering and economic data obtained through field and office studies, will formulate alternative plans of improvement and determine their costs and probable benefits . . . (12, p. 33).

As previously mentioned, passage of the Flood Control Act of 1936 greatly expanded the Corps' responsibility in water resource development through flood control. Passage of this Act (Public Law 738) also established criteria for evaluating water development projects.

> Section 1 declared flood control to be a proper Federal activity; that improvements for flood control purposes are in interest of the general welfare; that the Federal Government should improve or participate in the improvement of navigable water or their tributaries for flood control " . . . if the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are not otherwise adversely affected" (9, B, p. 7).

Stephen C. Smith and Emery N. Castle (7, p. 1), in discussing benefit-cost analysis, report that early work of this type was dominated by agricultural economists and governmental agency economists, but "in the latter part of the 1950's and the 1960's a wider professional concern with public investment grew, and articles and books have continued to appear." Essentially, benefit-cost analysis is a "budget type of procedure that permits the systematic organization of benefits and costs . . . " (7, p. 173). N. A. Back has emphasized that these studies have evolved into "a considerable body of concepts and techniques . . . " (11, I, p. 10). R. J. McDonald has also borne out the thrust of the Corps' planning toward comprehensive evaluations:

> The evolutionary [and some might say revolutionary] changes in planning scope and emphasis seems to be causing a shift for the technologic specialist toward some sort of philosophic man, but note that the skills listed are not independent, they are additive (11, I, p. 18).

The increasing complexity of and evolutionary changes in project evaluations can be illustrated through an examination of major policy directives for the evaluation of water resources development projects. Since 1936, four major directives increasing the complexity of project evaluations have been handed down to district and division offices. McDonald (11, I, p. 18) has listed these directives and has shown a graphical presentation prepared by G. Patrick Johnson which indicates that "eras" of planning procedures are being compressed into shorter time periods. Johnson's curve is reproduced as Fig. 1.

The first directive, the so-called "Green Book," was a report, issued May, 1950, to the Inter-Agency Committee on Water Resources (made up of the Federal Power Commission and the Departments of Agriculture, Army, Commerce, Health, Education, and Welfare, Interior, and Labor) by the Subcommittee on Evaluation Standards, Washington, D. C. (2, I). This directive developed new techniques and standards of measurement of benefits and costs.

> Measurement standards discussed include price levels, interest rates and risk allowances, period of analysis, amortization and salvage. The measurement problems considered include the treatment of tangible and intangible effects, adjustments for levels of economic activity, treatment of costs of affected public facilities, acquisition of land and improvements, treatment of taxes, extension of useful life, displaced facilities, and consequential damages (2, pp. 4-5).

The second directive, Senate Document 97, 87th Congress, was approved for use in guiding the Corps' evaluation of water projects by President John Kennedy in May, 1962 (9, A, p. 18). This document adopted the report of a panel of consultants to the Bureau of the Budget (Office of Management and Budget) on "Standards and Criteria for Formulating and Evaluating Federal Water Resources Development" (1). The report expanded

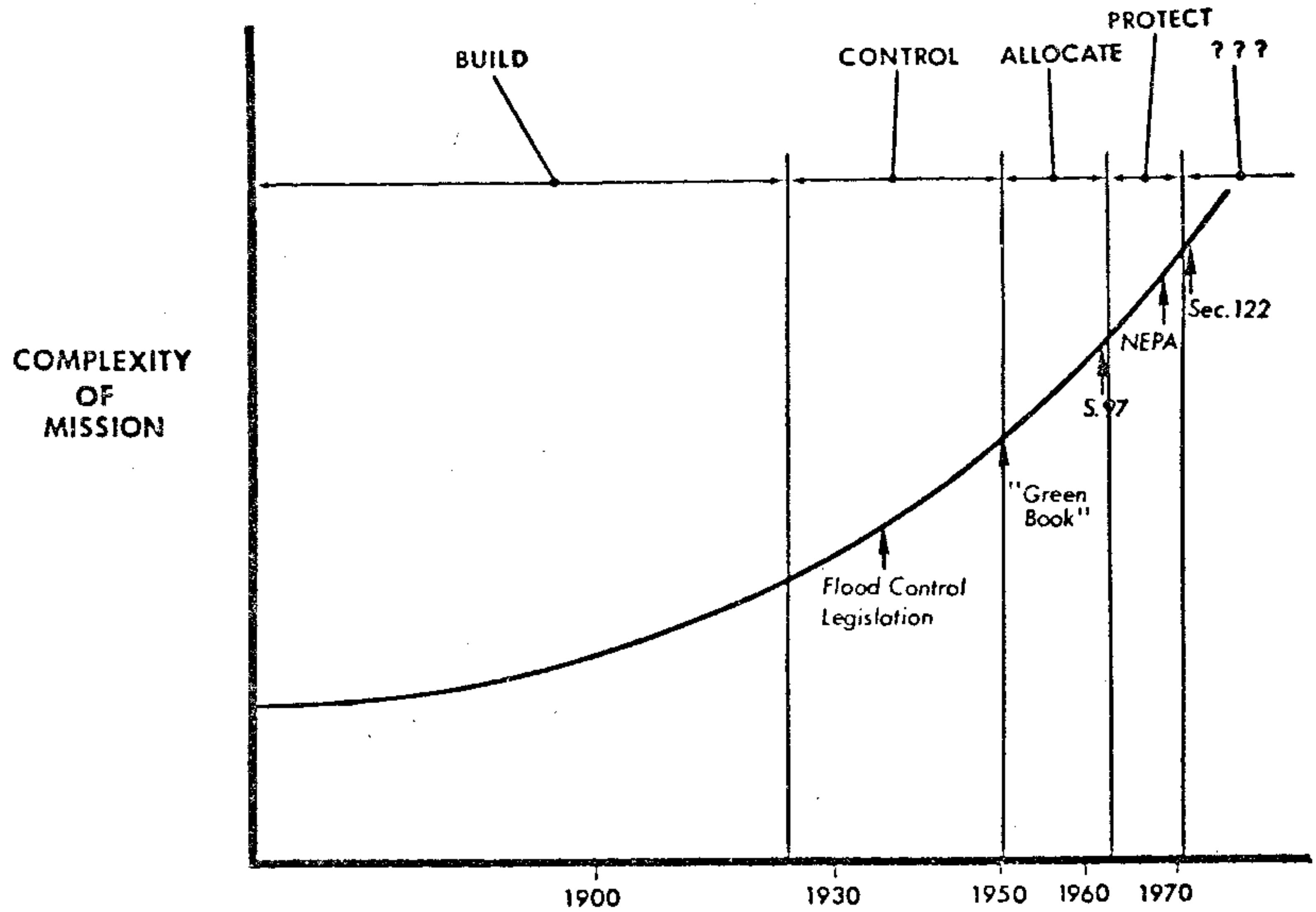

Fig. 1--"Eras" curve of planning procedures

water resource project evaluations to include secondary benefits: (1) national income gains; (2) regional and group income distribution; (3) other social goals; (4) cyclical employment stabilization; and (5) the rescue of depressed areas (1, p. 25).

Corps evaluation of projects was tremendously effected by the third directive, Public Law 91-190, the 1970 "National Environmental Protection Act." Section 101 of this act "established a broad Federal Policy of Environmental Quality" (9, B, p. 17), while Section 102 "required a five-point environmental impact statement (EIS) on proposed Federal actions affecting the environment" (9, B, p. 18).

On December 31, 1970, Congress passed the fourth directive effecting Corps evaluation of projects, Public Law 91-611, the "River and Harbor and Flood Control Act." This Act provided more stringent criteria for evaluating proposed projects.

> Section 122 provided for submission of guidelines not later than 1 July 1972, for considering possible adverse economic, social, and environmental effects of proposed projects.
>
> Section 209 expressed the intent of Congress that the objectives of enhancing regional economic development, the quality of the total environment, including its protection and improvement, the well-being of the people, and the national economic development are the objectives to be included in Federally financed water resource projects (9, B, p. 18).

Senate Document 97 and Public Laws 91-190 and 91-611 have had a pronounced effect on water resource development projects. Efforts to evaluate multiple objectives and effects have led to at least three special reports on the subject: (1) "Procedures for Evaluation of Water and Related Land Resource Projects" (13) by a special task force to the Water Resources Council (June, 1969); (2) "A Test of Proposed Procedures for Evaluation of Water and Related Land Resources Projects" (8)--a special study (March, 1970) in accordance with Report one listed above; and, (3) "A River, a Region, and a Research Problem" (6), Institute for Water Resources Report 71-6 (July, 1971).

On December 15, 1972, the Office of the Chief of Engineers, Department of the Army, formally issued directive "ER 1105-2-105" entitled "Guidelines for Assessment of Economic, Social, and Environmental Effects of Civil Works Projects." This directive attempted to synthesize studies on the problem of comprehensive project evaluations (10). The character and results of these reports and directives will be explored and assessed for applicability in Chapter IV of this report.

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CHAPTER III

COMPREHENSIVE PLANNING AND MULTIPLE-PURPOSE PROJECTS

To many people, the tremendous complexities involved in comprehensively planning and developing a river basin project are difficult to visualize. This chapter attempts to develop a proper perspective of project planning through the analysis of a recently completed "comprehensive study" and a recently completed "multiple-purpose" project.

The "Willamette River Basin Comprehensive Study" of 1969 was chosen for examination largely because of the general belief that Oregonians strongly advocate preservation of the natural environment. For the *ex post* review of a completed project, the "Arkansas River Multiple-Purpose Project" was chosen not only because of its recent completion but also because it represents "the largest civil works program ever undertaken by the U. S. Army Corps of Engineers [from the standpoint of costs]" (5, J, p. 5).

The River and Harbor Act of 1917 "authorized surveys of rivers to be made for flood control and required the Corps of Engineers to give consideration to all related water uses" (12, III, p. 19). Following this legislation, Congress directed the Secretary of War in 1925 to prepare, through the Corps of Engineers and Federal Power Commission, estimate-of-cost surveys of the rivers of the United States so that comprehensive plans for their effective improvement could be made (12, III, p. 20).

> The River and Harbor Acts of 1927 and 1928 authorized the recommended river surveys by the Corps of Engineers. During the following decade, the Corps of Engineers completed the "308" surveys and reports on more than 200 rivers, including essentially all of the major streams of the United States. . . . Congress has authorized the Chief of Engineers to keep those studies up-to-date, and from time to time has authorized reviews of specific "308" studies. Congress has thus specifically directed the Corps of Engineers to prepare comprehensive plans for the improvement of river basins throughout the country.

The Willamette River Basin Comprehensive Study

Through directives and inter-agency agreements, the comprehensive study of certain river basins, such as the Willamette River in Oregon, has been assigned to specifically formed basin commissions. The Willamette Basin Comprehensive Study was performed by such a special task force made up of the Oregon State Water Resources Board, the U. S. Army Engineer District (Portland), the Bureau of Reclamation, the Soil Conservation Service of the Department of Agriculture, the Weather Bureau Forecast Center of the Department of Commerce, the Federal Power Commission, the Bureau of Employment Security of the Department of Labor, and the Public Health Service of the Department of Health, Education, and Welfare (10, p. iii).

The Willamette Basin Comprehensive Study is only one of a group of surveys entitled "Regional or River Basin Studies (Level B)."

> These studies are directed by the Water Resources Council generally with study participation by the Corps. They are reconnaissance-level evaluations of water and land resources . . . and they identify and recommend action, plans and programs to be pursued by individual Federal, State and local entities. Regional or river basin planning studies are concerned with a broad array of component needs of multi-objectives. The identification of the more urgent elements of the plan that require early action are used to guide subsequent implementation studies (2, A, p. 32).

In the "Implementation Studies (Level C)," project feasibility is determined and specific projects are planned (2, A, p. 33). Because this report is primarily concerned with the evaluation of projects through the benefit-cost mechanism, the various requirements of "Level C" investigations are significant and will be explored in Chapter IV. This allows our current interest to focus on the Comprehensive (Level B) Study and Report.

The "Willamette Basin Comprehensive Study Report" (10, p. ii) contains a "Main Report" and thirteen "Appendices," representing about 3,000 pages of information related to study area, hydrology, economic base, fish and wildlife, flood control, irrigation, land measures and watershed protection, municipal and industrial water supply, navigation, power, recreation, water pollution control, and plan formulation.

The Willamette River Basin consists of about 12,000 square miles of land area, or approximately one-eighth the area of Oregon itself (16, p. 39). As shown in Fig. 2, the Willamette Basin lies in the northwestern part of the state between the Cascade and Coast Ranges.

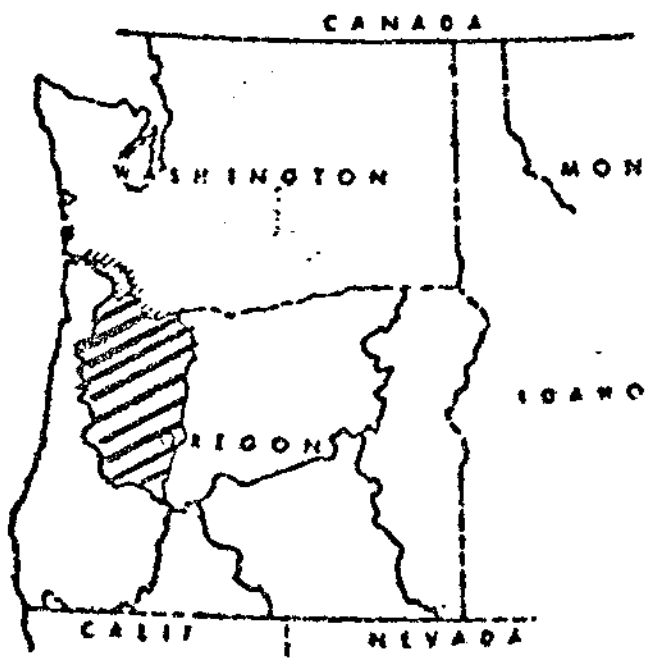

Fig. 2--The Willamette Basin and two-state area

The Willamette River Basin contains about two-thirds of Oregon's population and includes its three largest cities--Portland, Eugene, and Salem. It is one of the few major rivers in America to flow in a northerly direction (16, p. 20). Forming at the confluence of its Coast and Middle Forks, near Springfield at the southern end of the Willamette Basin, it has a total length of approximately 187 miles (8, p. iv).

The basin typically experiences warm, dry summers and comparatively mild, wet winters. Measurable precipitation falls between 150 and 180 days of the year, depending on location. Normal annual precipitation is about sixty inches with a range of thirty-five inches in the valley to more than 180 inches in the Coast Range. Average snowfall at Portland is about nine inches (8, p. 21).

Population density figures for the three sub-areas of the basin indicates significant variation. In 1965, the upper sub-area around Eugene-Springfield contained about fifty persons per square mile, while the middle sub-area around Salem contained approximately sixty persons per square mile. In the lower sub-area of the basin, Portland and surrounding vicinity, population density was about 300 persons per square mile (8, p. 57; 14). For the Willamette Basin as a whole, population density in 1965 was 111, twice that for the United States as a whole (fifty-five in 1965) (8, p. 61; 18, pp. 5-6).

Of the approximately one million people who live in urban areas of the basin, 900,000 live within ten miles of the Willamette River, and it is along this narrow strip that industry and commerce has developed (9, I, p. 9).

> [The] Willamette Basin is noted for products associated with its natural resource base. Principal commodity-producing industries are forest products and food processing which combined account for over half the 104,000 employed in manufacturing. Of the 530,400 persons employed in the basin in 1965, one out of every five was employed in the resource-based industries--forest products, agriculture, food processing, and mining and related products (9, I, p. 7).

Undoubtedly, the concentration of population in the Willamette River Basin has contributed to the so-called "Oregon attitude" toward unplanned and uncontrolled growth. The following excerpt from an article appearing in the Wall Street Journal on November 3, 1971, summarizes this attitude.

> . . . Oregon already boasts what environmentalists consider to be some fundamental accomplishments. The Willamette River, which runs through the state's most heavily populated and industrialized section, now is swimmable for the first time in 40 years, and salmon have returned to its water. Pollution laws are vigorously enforced, and the state once held up all building permits in one county for nine months until new sewage treatment plants were built. There are no private beaches; every foot of beach along Oregon's entire coast is open to the public. . . . Gov. Tom McCall recently made national headlines when he urged out-of-staters [whom he sometimes calls "foreigners"] to "come and visit us again and again. But for heaven's sake, don't come here to live. . . ." The hue and cry to restrict growth in Oregon is echoed in an increasing number of other

> states and communities . . . Delaware [has] enacted into law a measure that will ban new industry along the state's entire 100-mile coast (3, p. 1).

The Willamette Basin Comprehensive Study Plan does not prohibit development; however, it stresses that development be planned in a symbiotic framework as exemplified by the report's theme:

> We as Willamette residents are entering an era of unprecedented growth and development, which threatens, and if allowed to proceed without plan will destroy, much of our environmental heritage.
>
> Neither the armor of total preservation of what we now have nor the faith of resignation to progress is adequate response to this threat. Changes will come; changes that will alter the face of the land. If we are to step into the future without leaving behind the type of life we value so highly, we must plan each phase of our development, keeping in mind that beyond the economic necessities livability is the number-one priority.
>
> To the extent that our various planning efforts are directed toward maintaining and enhancing our total livability, we will be responsive to one of the major tasks history has assigned our generation.
>
> We must seek, at every level, the courses of action which will insure for future generations a quality life in an environment in which each individual can find opportunity, dignity, and a sense of purpose (10, p. ix).

The Arkansas River Multiple-Purpose Project

In groundbreaking ceremonies for the Dardanelle Dam site on the Arkansas River, the principal speaker quoted Henry Van Dyke: "It is with rivers as it is with people--the greatest are not always the most agreeable nor the best to live with" (4, p. 66).

The Arkansas River rises in the Rocky Mountains of Colorado. From there, it descends the eastern slopes of the Continental Divide and flows through Royal Gorge as a clear mountain stream (13). Fig. 3 shows the location of the Arkansas River.

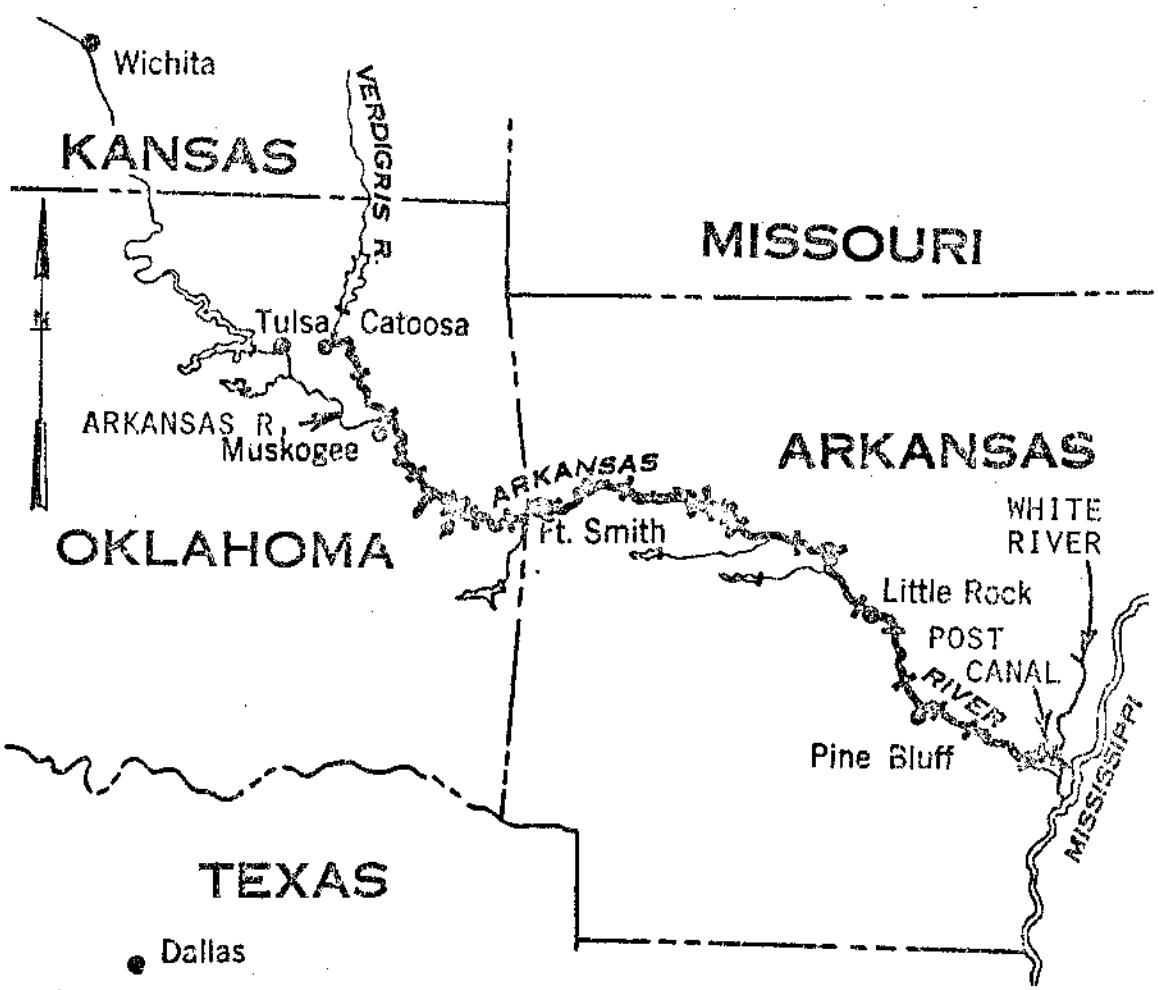

Fig. 3--Arkansas River and vicinity

In Oklahoma, the Arkansas River becomes polluted from natural deposits of salt and heavy sedimentation.

> The Canadian River and the Arkansas River upstream from Tulsa are known to have contributed more than 70 percent of the sediment deposited down stream into the lower reaches of the Arkansas. On the average, 105 million tons of sediment passed the Little Rock gaging station annually. Through the operation of upstream lakes this [rate] is . . . [currently] 25 million tons (13).

In order to trap sedimentation and thereby help to sustain navigation depths on the project, the Corps built Eufaula Dam on the Canadian River. This dam, with a total storage capacity of almost four million acre feet, is located north of McAlester, Oklahoma. Columnist Joseph Kraft, who had been one of the project's detractors and disbelievers (17), recently wrote in the Washington Post:

> I remember flying over the project about 10 years ago. . . . The stream below us was a muddy trickle. [But today] . . . the river has been totally transformed.
>
> The dams have stopped the silting, and with the sediment gone, the tiny organisms known as plankton have reappeared, reopening the river to the life-giving force of the sun. The river has become greenish-blue in color, instead of brown. Bass and other freshwater fish rare 10 years ago are now abundant. A freshwater shrimp, unknown before, has turned up (7, A, p. 9).

The improved environment of the Arkansas River has also been attested to by A. W. Busch, Southwest Regional Director of the Environmental Protection Agency (6, A,

p. 2). Floyd Clay, in "The Renaissance of a River," has portrayed the project as a battle between nature and mankind:

> From the prehistoric period to the near-present the river has acknowledged no master. It has cunningly allowed man years to install some restraining devices, to shore up weak banks, to build levees, to span its breadth with bridges, and even to divert its channel, only to wipe out his labor in hours with one surging rampage. The Corps of Engineers, on the other hand, was not seeking to destroy the river, but only to harness its awesome energies and develop its channels for the benefit of man (4, pp. 66-67).

The Arkansas River Multiple-Purpose Project was authorized in 1946, and construction began in 1957 (13). The project was not officially completed to Catoosa, Oklahoma, until January, 1971. Costing 1.2 billion dollars--four times as much as the Panama Canal and almost twice as much as the St. Lawrence Seaway (1, p. 124)--the Arkansas River Project is a multiple-purpose project. A multiple-purpose project derives its name from the fact that several benefits to society result from its completion. However, benefits from a multiple-purpose plan for one river project may totally differ from plans for a second river. Each plan takes into consideration the individual characteristics of the river, the surrounding region, and planning objectives established by Congress. Purposes for which the Arkansas River Project was built, along with the estimated benefits, are shown in Table II (11, J, p. 16).

TABLE II

PURPOSES AND ESTIMATED ANNUAL VALUE OF BENEFITS FROM THE ARKANSAS RIVER MULTIPLE-PURPOSE PROJECT*

Benefit	Total Savings
Savings in transportation	$40,470,000
Power value	14,838,900
Flood control benefits	6,602,600
Channel stabilization	6,575,000
Water supply	828,900
Fish and wildlife	612,000
Recreation	2,297,000
Redevelopment	3,355,800

*As submitted for approval and subsequently authorized by the "River and Harbor Act" of July, 1946.

The total benefit estimated to accrue annually to the project is valued at $75,580,200, over a 100-year life or about 1.5 times the estimated average annual costs (11, J, p. 16). With savings in waterborne commerce valued at 54 percent of the total benefits, navigation plays a dominant role in the project's estimated value. As shown by Table III, annual commerce on the waterway is estimated to eventually reach about 13,200,000 tons (11, J, p. 16).

Although the Arkansas River Navigation Channel, subsequently named the McClellan-Kerr Arkansas Navigation System, was not officially completed to Catoosa (Tulsa), Oklahoma, until January, 1971, commerce on the lower reaches became significant in 1969.

The tonnage chart provided in Table IV shows waterborne traffic on the Arkansas River for 1971. It is

TABLE III

ESTIMATED ANNUAL WATERBORNE COMMERCE
ON THE ARKANSAS RIVER

Item	Million Tons
Petroleum products	3.9
Iron and steel products	3.7
Coal	1.3
Wheat	0.6
Flour and food	0.2
Less than barge lots	2.6
Miscellaneous	0.9
Total	13.2

interesting to compare the actual commodities moving on the waterway with those projected to move in the feasibility study (Table III). The largest movement expected to occur was petroleum products (3.9 million tons annually). As illustrated in the tonnage chart, no such large scale movement of petroleum products has occurred. On the other hand, the largest actual movement--sand, gravel, and crushed rock at 2.0 million tons in 1971--was not specifically included in the feasibility study projections of traffic.

TABLE IV

MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION
SYSTEM: TONNAGE CHART, 1971*

Commodities	Tonnage	Ton Mileage
Coal and coke		
Coal and lignite	41,944	. . . . .

TABLE IV--Continued

Commodities	Tonnage	Ton Mileage
Coke, including petroleum coke	684	. . . . .
Total	42,628	12,470,232
Aggregates		
Sand, gravel, crushed rock	2,014,890	. . . . .
Total	2,014,890	14,700,318
Grains		
Corn	28,916	. . . . .
Wheat	18,307	. . . . .
Soybeans	428,901	. . . . .
Total	476,124	17,419,852
Chemicals and chemical fertilizers		
Sodium hydroxide (caustic soda)	91,800	. . . . .
Alcohols	21,796	. . . . .
Benzene and toluene, crude and commercially pure	2,800	. . . . .
Sulphuric acid	8,756	. . . . .
Basic chemicals and products not elsewhere classified	3,825	. . . . .
Synthetic rubber	1,602	. . . . .
Nitrogenous chemical fertilizers except mixtures	54,087	. . . . .
Phosphatic chemical fertilizers, except mixtures	18,474	. . . . .
Fertilizer and fertilizer materials, not elsewhere classified	95,697	. . . . .
Total	298,837	31,709,893
Ores and minerals		
Bauxite and other aluminum ores and concentrates	325,448	. . . . .

TABLE IV--Continued

Commodities	Tonnage	Ton Mileage
Nonferrous metal ores and concentrates, not elsewhere classified	3,235	. . . . .
Gypsum, crude, and plasters	1,085	. . . . .
Nonmetallic minerals, except fuels, not elsewhere classified	2,042	. . . . .
Total	331,810	36,724,607
Iron and steel		
Iron and steel ingots, and other primary forms, including blands for tube and pipe and sponge iron	2,589	. . . . .
Iron and steel bars, rods, angles, shapes, and sections including sheet piling	42,679	. . . . .
Iron and steel plates and sheets	99,293	. . . . .
Iron and steel pipe and tube	77,655	. . . . .
Primary iron and steel products, not elsewhere classified, including castings in the rough	3,876	. . . . .
Total	226,092	70,147,139
All other		
Molasses	12,165	. . . . .
Basic textile products, except textile fibers	496	. . . . .
Logs	11,275	. . . . .
Pulpwood, log	5,907	. . . . .
Lumber	450	. . . . .
Veneer, plywood, and other worked wood	100	. . . . .
Wood manufactures, not elsewhere classified	530	. . . . .
Pulp	4,446	. . . . .
Standard newsprint paper	10,709	. . . . .

TABLE IV--Continued

Commodities	Tonnage	Ton Mileage
Paper and paper board	3,146	. . . . . .
Lubricating oils and greases	23,149	. . . . . .
Asphalt, tar, and pitches	1,430	. . . . . .
Rubber and miscellaneous plastic products	111	. . . . . .
Fabricated metal products, except ordnance, machinery, and transportation equipment	11,451	. . . . . .
Machinery except electrical	8,192	. . . . . .
Iron and steel scrap	5,761	. . . . . .
Nonferrous metal scrap	25,085	. . . . . .
Waste and scrap, not elsewhere classified	862	. . . . . .
Materials used in waterway improvement, government materials	778,402	. . . . . .
Total	903,667	73,467,369
Grand Total	4,294,048	256,105,254

*Source: McClellan-Kerr Arkansas River Navigation System, tonnage graph, distributed by the U. S. Army Corps of Engineers, Little Rock and Tulsa districts, November, 1971.

As shown by the navigation channel profile, Fig. 4 (13), the main stem of the McClellan-Kerr Arkansas River Multiple-Purpose Project does not follow the route of the Arkansas River entirely. Starting at the Mississippi River, the navigation channel initially goes up the White River for a short distance, through a man-made canal (Arkansas Post) to the Arkansas River. The navigation

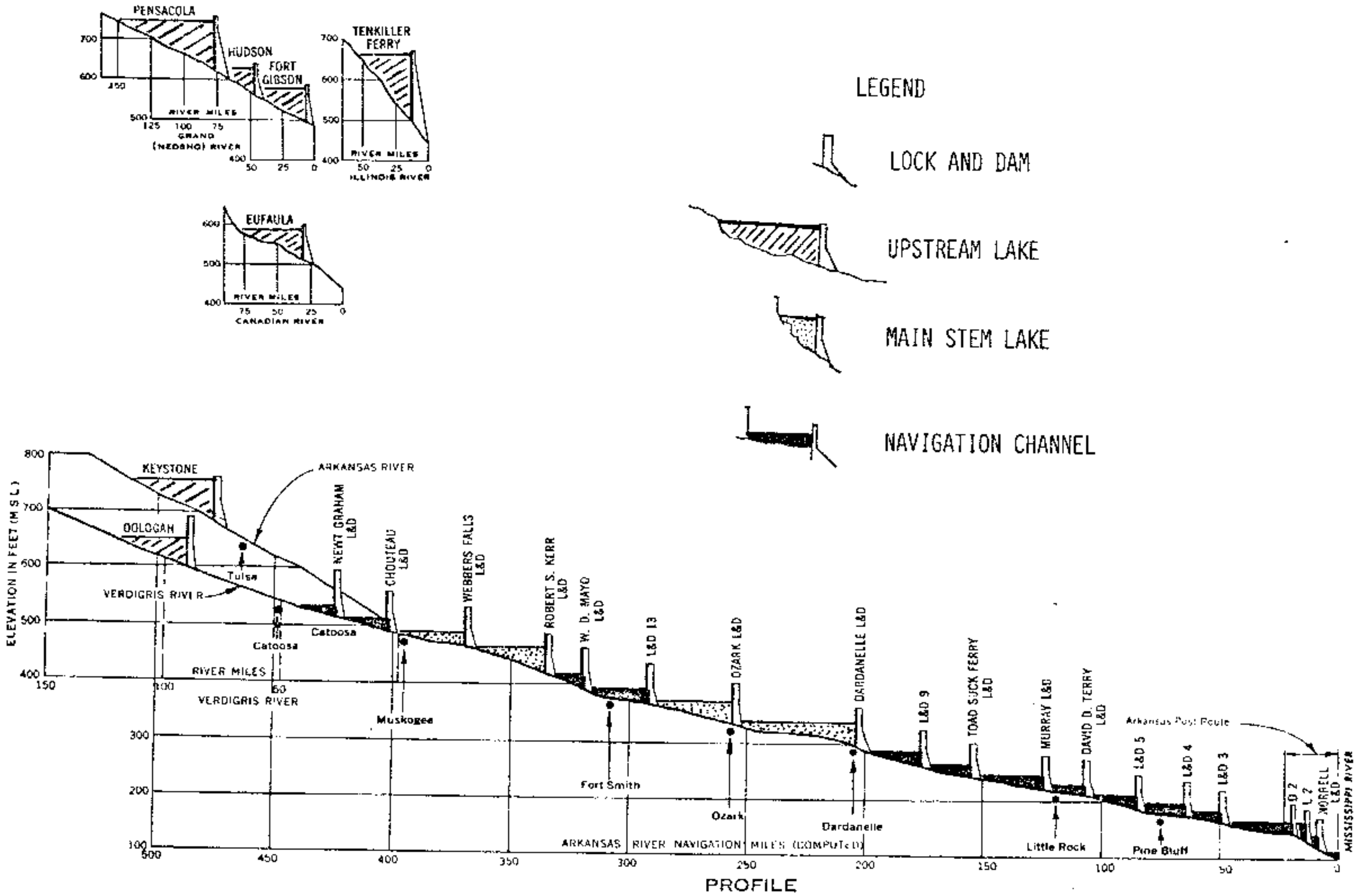

Fig. 4--Navigation channel profile

channel straightens the ox-bowed Arkansas River to a point near Muskogee, Oklahoma, where it turns up the Verdigris River and continues to Catoosa, Oklahoma.

The main stem of the channel consists of seventeen locks and dams, as illustrated in Table V (13).

TABLE V

MAIN STEM FEATURES OF THE ARKANSAS RIVER MULTIPLE-PURPOSE PROJECT: LOCKS AND DAMS

Structure	Navigation Miles Upstream from Mouth of White River	Elevations (feet above m.s.l.)		Lift (feet)
		Upper Pool	Lower Pool	
Verdigris River				
Newt Graham L & D (No. 18)	6.5	532	511	21
Chouteau Dam (No. 17)	8.2	511	490	21
Chouteau Lock	26.7	. .	. .	. .
Arkansas River				
Webbers Falls L & D (No. 16)	368.9	490	460	30
Robert S. Kerr L & D (No. 15)	336.2	460	412	48
W. D. Mayo L & D (No. 14)	319.6	412	392	20
Lock & Dam No. 13	292.8	392	372	20
Ozark L & D (No. 12)	256.8	372	338	34
Lock & Dam No. 11*	. .	. .	. .	. .

TABLE V--Continued

Structure	Navigation Miles Upstream from Mouth of White River	Elevations (feet above m.s.l.)		Lift (feet)
		Upper Pool	Lower Pool	
Dardanelle L & D (No. 10)	205.5	338	284-287	54
Toad Suck Ferry L & D (No. 8)	155.9	265	249	16
Murray L & D (No. 7)	125.4	249	231	18
Lock & Dam (No. 9)	176.9	284-287	265	19
David D. Terry L & D (No. 6)	108.1	231	213	18
Lock & Dam No. 5	86.3	213	196	17
Lock & Dam No. 4	66.0	196	182	14
Lock & Dam No. 3	50.2	182	162	20
Dam No. 2	40.5**	162	Ark. River	. .
<u>Arkansas Post Canal</u>				
Lock No. 2	13.3	162	142	20
Norrell L & D (No. 1)	10.3	142	White River	30

*Deleted.

**Mileage above mouth of Arkansas River.

Fig. 5 illustrates the operation of a typical lock on the Arkansas River. Traffic on the river passes from one level to another by means of the lock. When going upstream, a tow, barge, or other vessel enters the lower pool. At this time, the upper gate and valves are closed, and water is at the lower pool level. After the vessel has entered the lower pool, the lower pool gate is closed, and upper pool filling valves are opened. Water then enters the lock

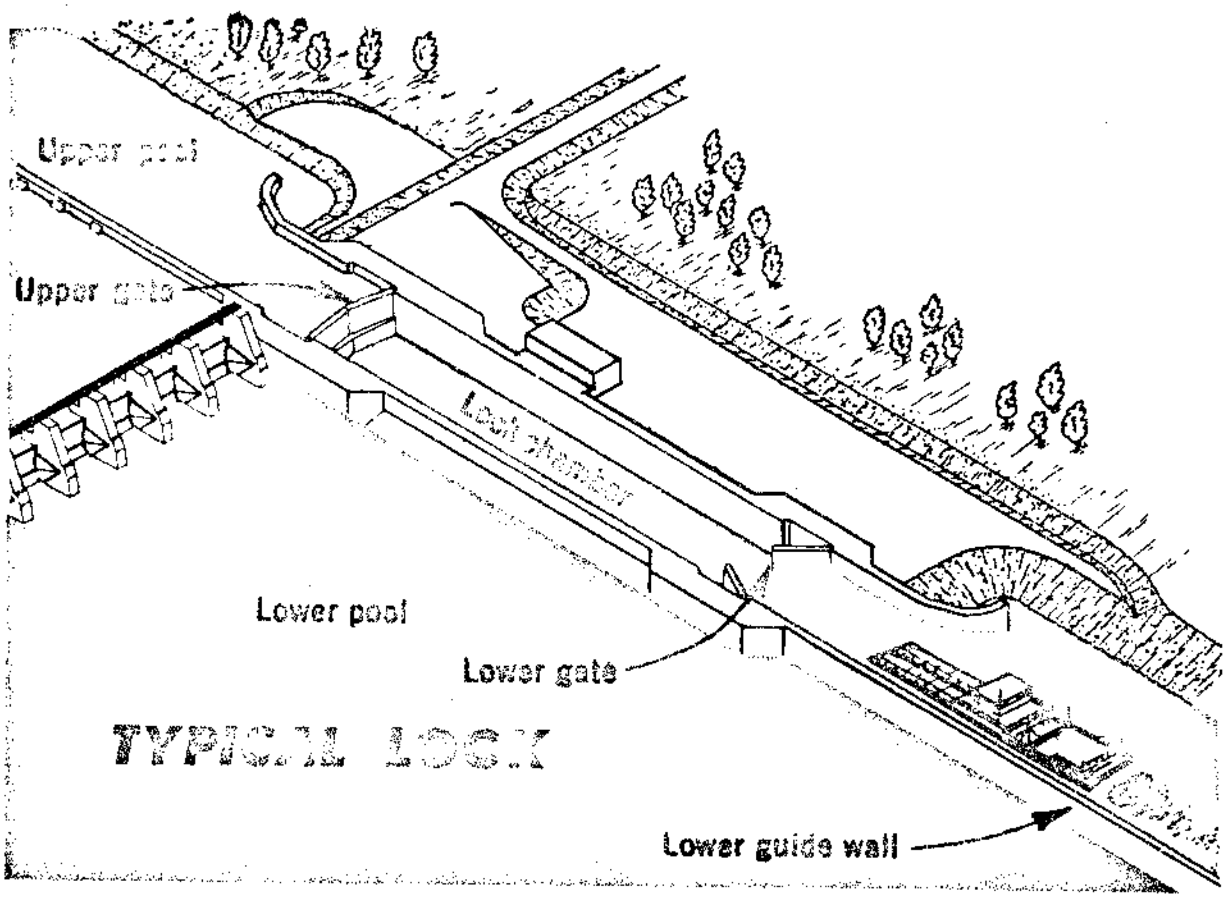

Fig. 5--Typical lock in a multiple-purpose project

chamber, which is allowed to reach upper pool level. Once the water reaches upper pool level, the upper gate is opened, allowing the vessel to proceed upstream. For a vessel going downstream, the procedure is reversed (15, p. 24).

Table VI shows the main stem lakes on the Arkansas River system.

TABLE VI

MAIN STEM FEATURES OF THE ARKANSAS RIVER MULTIPLE-PURPOSE PROJECT: LAKES*

Project Data	Webbers Falls	Robert S. Kerr	Ozark	Dardanelle
Location				
Navigation miles	359	314	251	201
Construction	UC	IO	UC	IO
Purpose	N, P & R	N, P & R	N, P, R, & FW	N, P, & FW
Drainage Area				
Upstream from dam (in square miles)	97,033	147,756	151,820	153,703
Elevations (feet above m.s.l.)				
Top of dam	520	483	399	355
Top of power pool	490	460	372	338
Top of navigation pool	487	458	370	336

TABLE VI--Continued

Project Data	Webbers Falls	Robert S. Kerr	Ozark	Dardanelle
Lake area (acres)	10,900	42,000	10,600	36,600
Storage Capacity, acre feet				
Power	30,000	79,500	19,400	65,000
Navigation	135,200	414,100	129,000	421,000
Lock				
Size, feet	110 x 600	110 x 600	110 x 600	110 x 600
Lift, feet	30	48	34	54
Power Capacity (kw.)				
Initial installation	66,000	110,000	100,000	124,000
Ultimate installation	66,000	110,000	100,000	124,000

*"UC"--under construction, "kw."--kilowatt, "m.s.l."--mean sea level, "R"--recreation, "F"--flood control, "P"--hydro-electric power, "IO"--in operation, "N"--navigation, "FW"--fish and wildlife.

As shown in Table VII (13), there are seven upstream multiple-purpose lakes in the project, with three--Keystone, Oologah, and Eufaula--playing a significant role in the operation of navigation on the main stem.

TABLE VII

UPSTREAM LAKES IN THE ARKANSAS RIVER
MULTIPLE-PURPOSE PROJECT*

Project data	Keystone	Oologah	Pensacola
Location			
River	Arkansas	Verdigris	Grand (Neosho)
Miles upstream from mouth	538.8	90.2	77
Construction status	IO	IO	IO
Purposes (uses)	F, P, N, W, FW	F, FP, N, W, & FW	F, P & W
Drainage			
Upstream from dam, in sq. mi.	74,506.0	4,339.0	10,298
Elevation (feet above m.s.l.)			
Top of dam	771.0	687.0	757
Nominal top of flood-control pool	754.0	651.0	755
Top of power pool	723.0	. . . .	745
Top of conservation pool	. . . .	683.0	. . . .
Reservoir area (acres)			
Top of flood-control pool	55,400.0	57,000.0	59,200
Top of power pool	26,300.0	. . . .	46,500
Top of conservation pool	. . . .	29,500.0	. . . .
Storage capacity (acre feet)			
Flood control	1,216,000.0	965,000.0	525,000
Power	331,000.0	Deferred	1,192,000
Navigation	. . . .	. . . .	. . . .
Water supply	20,000.0	342,600.0	. . . .
Sediment and other	312,000.0	9,300.0	480,000

TABLE VII--Continued

Hudson	Fort Gibson	Tenkiller Ferry	Eufaula
Grand (Neosho)	Grand (Neosho)	Illinois	Canadian
47.4	7.7	12.8	27
IO	IO	IO	IO
F, P, & W	F, P, & W	F, W, & P	F, P, N, & W
11,533.0	12,429.0	1,610.0	47,522
645.0	593.0	677.0	612
636.0	582.0	667.0	597
619.0	554.0	632.0	585
. . . .	. . . .	. . . .	. . . .
18,800.0	51,000.0	20,800.0	143,000
10,900.0	19,900.0	12,850.0	102,500
. . . .	. . . .	. . . .	. . . .
244,200.0	919,200.0	574,600.0	1,470,000
**	53,900.0	345,000.0	1,425,000
. . . .	. . . .	. . . .	. . . .
. . . .	. . . .	25,400.0	56,000
200,300.0	311,300.0	285,000.0	897,000

TABLE VII--Continued

Project data	Keystone	Oologah	Pensacola
Powerplant capacity (kw.)			
Initial installation	70,000.0	Deferred	. . . .
Ultimate installation	70,000.0	12,000.0	86,400***

*"UC"--under construction, "kw."--kilowatt, "m.s.l."--mean sea level, "IO"--in operation, "F"--flood control, "P"--hydro-electric power, "FP"--future power, "N"--navigation, "W"--water supply, "FW"--fish and wildlife.

**Run of the river.

***Present installation.

TABLE VII--Continued

Hudson	Fort Gibson	Tenkiller Ferry	Eufaula
100,000.0	45,000.0	34,000.0	90,000
100,000.0	67,500.0	34,000.0	90,000

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CHAPTER IV

GENERAL PROBLEMS IN EVALUATING CORPS' PROJECTS

Comprehensive studies of river basins, such as that outlined for the Willamette Basin, may provide a starting point for individual investigations into the feasibility of related water development projects. "These are detailed studies for decision-making purposes concerning the need for and desirability of undertaking specific projects and programs" (2, A, p. 33).

Water Resources Development and the Hydrologic Cycle

Flood control, navigation, hydroelectric power, fish and wildlife enhancement, development of water-based recreational areas and facilities, storage of water for irrigation and for industrial and municipal uses, and water quality control through stream impoundment and flow augmentation represent only some of the purposes for water resources development projects (16, p. 1). The planning of comprehensive water resources development also includes consideration for environmental consequences pursuant to the National Environmental Policy Act of 1969 which requires a statement of

> (1) the environmental impact of the proposed action; (2) the adverse environmental effects which cannot be avoided if the project is carried out; (3) alternatives to the proposed action; (4) the relationship between the short-term use of the environment and the maintenance of long-term productivity; and (5) the irreversible and irretrievable commitments of resources which would be made if the proposed project were adopted (16, p. 3).

The comprehensive planning of water use, such as that discussed for the Willamette River Basin, and the building of multiple-purpose projects, such as the Arkansas River project, require that man once again demonstrate a need and will to exercise dominance over what many consider a "natural" cycle. The hydrologic cycle is illustrated in Fig. 6 (7). As shown, the endless circulation of the earth's water begins with precipitation of rain from a cloud. The rain sinks into the earth, some of the water eventually seeping into the ocean, some of it running into channels and lakes. Simultaneously, it starts on the reverse stage of the cycle, evaporation. Some water actually evaporates during the rainfall; most of it, however, rises from wet ground, from lakes and streams, and from the ocean. The evaporated water collects into clouds; as these cool, precipitation occurs, and the cycle repeats itself.

Erich Zimmermann, in his Introduction to World Resources, expresses the opinion that water in the hydrological cycle utilizes the sun's power during

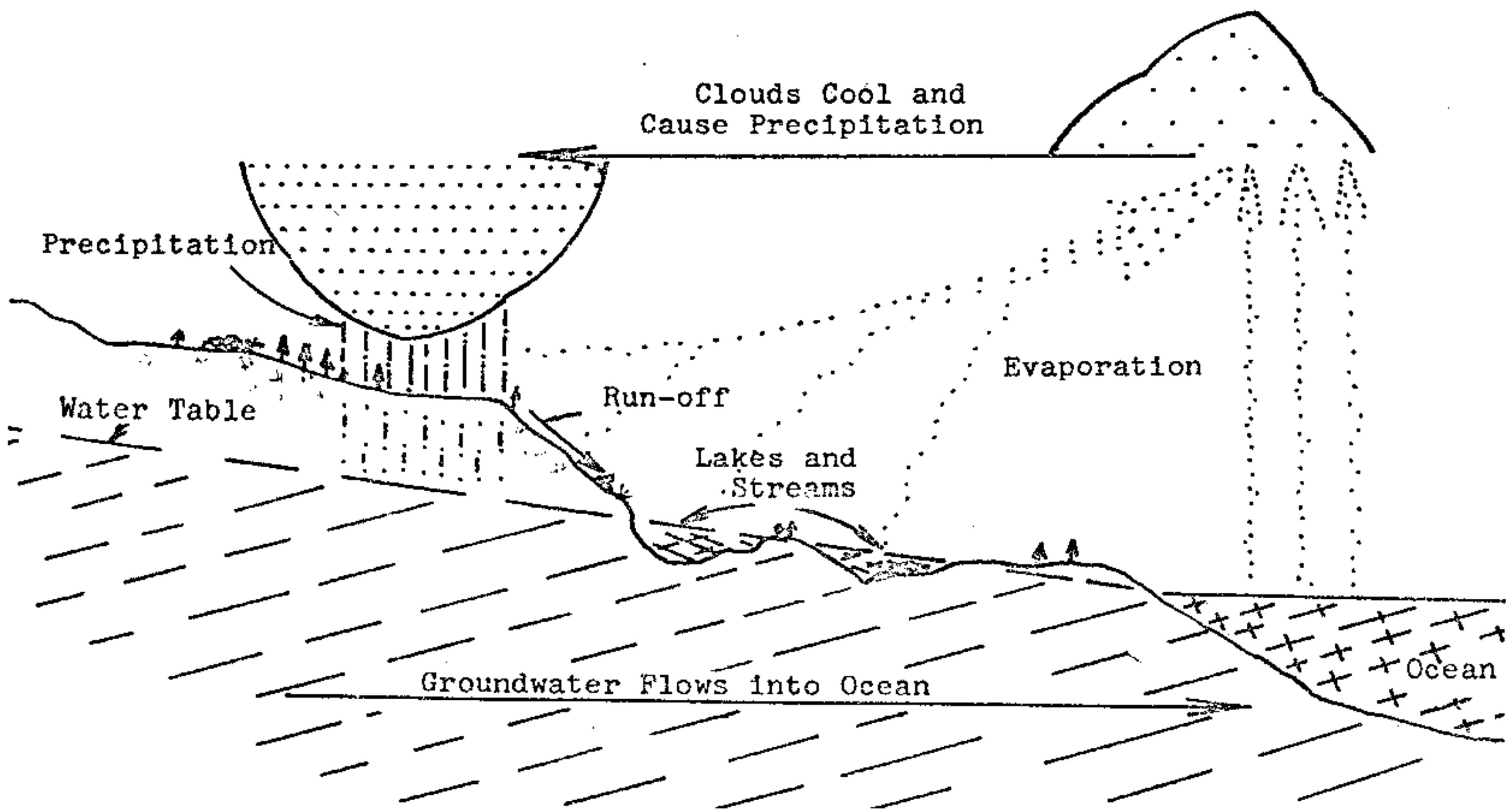

Fig. 6--The hydrologic cycle

evaporation, cloud formation, and condensation. Through this cycle, water becomes a renewable resource (6, p. 69). In discussing water as a flow resource, Zimmermann also points out that

> the sun, together with gravity, causes movement of the air as well as of water, which man can utilize in many ways. Of the water which reaches the land in the form of rainfall, chiefly "surface run-off," the rivers can be used for purposes of generating mechanical energy. . . . The energy of moving, especially falling, water is utilized directly by objects floating downstream and indirectly with the aid of water wheels and water turbines. The relation of winds and rainfall to climate and, through it, to all organic life, is fundamental (6, p. 76).

Luna B. Leopold and others have also stressed that water is a renewable resource since the earth's original water supply is still in use:

> . . . little has been added or lost in the hundreds of millions of years since the first clouds formed and the first rains fell. The same water has been pumped time and again from the oceans into the air, dropped upon the land and transferred back to the sea. . . . At any instant, only about 0.005 per cent of the total water supply is moving through the cycle; most of the water is stored in the oceans, frozen in glaciers, held in lakes or detained underground. In the U. S. a drop of water spends an average of only 12 days passing through the air, then may remain in a glacier for 40 years, in a lake for 100 years, or in the ground from 200 to 10,000 years, depending on how deep it goes. Eventually, however, every drop is moved on through the cycle. The hydro-olgic cycle uses more energy in a day

> than man has generated throughout history. But the cycle's machinery, powered by a constant input from the sun, has more energy than it can ever use (7, p. 42).

Water may also have been the medium for the origin of life itself. The first races of primitive life have definitely been traced to the Pre-Cambrian date, and biologists say that life itself may have begun "somewhere in the warm, marginal water of a primeval sea . . . rich in nucleic acids, carbon dioxide, potassium, calcium, sulphur and phosphorus . . . " (17, p. 23).

Considering the role of water in the creation and maintenance of life, many people might question the advisability of man "tampering" with the "natural" hydrological cycle. However, the role of man throughout history must also be considered. Man has always dominated life, in beneficial as well as harmful ways, but, nevertheless, for his benefit. Man seeks, whether successful or not, to improve his well-being through planning and manipulation of natural conditions. True, some men conspire to destroy water resources through individual, municipal, or industrial waste discharge into streams; however, comprehensive planning which leads to the cleaning up of this pollution still does not yield the "natural" environment espoused by some. The so-called "natural" environment does not exist except in myth, for how far back in time should one go to find a "natural" river--one hundred years, 1,000 years, or perhaps 1,000 billion years?

Man's planning of water resources development, of the type related to the Arkansas River, involves altering the run-off and stream-flow patterns in order that the hydrological cycle work for, rather than against, mankind's betterment. Benefits derived from properly administered water resources development are numerous--flood control, channelization of navigation, bank stabilization, hydroelectric power, recreation, and environmental enhancement (14, J, p. 16).

The Benefit-Cost Ratio

Customarily, the economic feasibility of a proposed project is determined by a comparison of its expected benefits and costs in monetary terms. Benefit-cost analyses, along with environmental impact assessments, form the major part of project evaluations at the technical level of decision-making. Benefit measurement has been described as "increases, net of associated or induced cost, in the value of goods and services which result from conditions with the project as compared with conditions without the project" (2, A, p. 37). This vague and generalized statement means a great deal more than meets the casual eye. A Corps' economist specializing in benefit-cost analysis made the following statement regarding benefit measurement:

> Benefits are represented by the expected use of project outputs over a period of time with each output measured in terms of market value, or imputed value in some cases. The use of project outputs [such as recreation use, flood damages prevented, etc.] depends upon the extent of demand for each output under initial and future conditions in the nation and particularly in the project's region (18).

Project costs include those "necessary to establish and operate the project. [Also] . . . taken into account are the period the costs are to be incurred, interest charges, amortization of investments . . . and similar factors" (2, A, p. 36).

In some respects, the analysis of benefit-cost ratios in the estimation of project feasibility is characteristic of the "marginal efficiency of capital" concept in private decision-making. In both cases, the decision entails an expectation of output at a certain pre-determined unit value over a period of time as well as definite expectations regarding capital outlay, interest costs, and operating expenses.

To the general public, one of the most startling and least known facts about benefit-cost analysis in the evaluation of proposed projects is the extended time frame over which projected benefits and costs are computed.

> The period of analysis [computation of benefits and costs] is the shorter of either the physical life or the economic life of the structure, facility or improvement. A period of 100 years is normally regarded as the upper limit. The following working guides apply: (1) 100 years for large reservoirs, major long-term urban flood protection and for mainline levee protection; and (2) 50 years for all other types of projects (2, A, p. 39).

Benefit-cost computations are thus based on projected economic gains for an area (such as "value added by manufacture" in petrochemical processing in Oklahoma (18) or projection of housing value increases through per capita personal income along Clear Creek, Texas) for fifty or perhaps 100 years into the future.

Because of the extended time periods involved in benefit-cost computations in the realm of public finance, the validity of such computations has been questioned by many authorities. In a discussion of value premises and social science research, Gunnar Myrdal made this point:

> . . . valuations to be used as value premises should most often refer to a future situation. Particularly in broader issues, this situation may be far off. It might represent the results of great changes on all sorts of levels and even in the institutional structure of society. To draw inferences about people's valuations in radically changed circumstances . . . is hazardous . . . (8, pp. 66-67).

Sar A. Levitan of George Washington University expressed an even stronger objection to the use of benefit-cost analysis as a tool for decision-making.

> Don't fall for academic claptrap of measuring costs and benefits. . . . We conned the public for years. . . . Attempts for objective evaluation just don't work because I can make any program look good and any program look bad. It depends on what you include in the costs and what you include in the benefits (10, A, p. 9).

Otto Eckstein, in _Water Resource Development: The Economics of Project Evaluation_, pointed out that, on the costs side of benefit-cost computations, "joint costs" are often difficult to assess.

> A typical multipurpose project will include a dam which is used to form a reservoir, the storage capacity of which will be used to provide flood control, stream-flow regulation for navigation, seasonal or annual carry-over of water for irrigation, as well as long- and short-term storage for hydro-electric power. Some of the costs, such as expenditures for electric generating equipment or for irrigation pumping facilities, can be assigned to one of the purposes, but much of the investment, especially the dam and reservoir, is necessary for each purpose. Even when specific portions of the storage behind a dam are assigned to the different purposes . . . the storage cost cannot be assigned unambiguously because the cost of any one layer of storage space depends on the existence of the layers above and below it (3, p. 259).

There are, of course, those who advocate the continued use and improvement of benefit-cost analysis in project evaluations. In discussing the problem of quantifying, both in physical and monetary terms, Stephen Smith and Emery Castle suggest that development of quantitative criteria can prove valuable.

> Economics and the social sciences in general do not stand alone in dealing with important problem areas in which quantifying is difficult or irrelevant. On the other hand, an attempt to overcome these difficulties and to determine the relevance of quantification is an important stimulus of scientific progress (12, p. 11).

Steve H. Hanke (4), Robert H. Haveman (5), and others have advocated a strict, judgement-free application of benefit-cost criteria in view of "wide professional agreement within the national efficiency framework on definitions and measurement techniques for . . . benefits and costs" (4, p. 1). And even Otto Eckstein, who realized some of the problems inherent in benefit-cost analyses, nevertheless recognized possible values in utilizing the benefit-cost system.

> . . . benefit-cost analysis is an extremely promising evaluation method for public expenditures, which in the limited cases where it can be applied, could put policy judgments on a much firmer economic basis than is usually possible (3, p. 273).

The intent of this report is not to castigate the views of either opposing group regarding the virtues of benefit-cost analysis as a proper tool for measuring the economic feasibility of projects. The purpose in raising this issue is to illustrate the fact that benefit-cost analyses are, in fact, abstract models involving countless assumptions based on the value judgements of those making the analyses. Establishing this understanding should preclude charges that the alternative methods, to be outlined in Chapters V and VI are based on value judgements and are hence unacceptable in rigorous project evaluations.

From the standpoint of this report, Paul Samuelson's discussion of the applicability of models perhaps best illustrates the process of abstract modeling:

> The art of . . . modeling has, I think, made steady progress. But I suspect that it is still the case that the best judgmental forecasts are still about as good or bad as the best computer forecasts; indeed, something like this must be at the heart of the fact . . . [that] almost all model builders adjust their constants by various quasi-judgmental procedures . . . (11, p. 5).

Changes in any one major aspect of a proposed project evaluation may drastically effect the validity of benefit-cost ratios. The "discount rate," or interest charges related to capital costs, for example, is extremely important in determining benefit-cost ratios. A change in the discount rate of only a point or two can have a significant effect on the average annual value of a project over a fifty or 100 year period. Marginal projects, such as those with a benefit-cost ratio of 1.2 to 1.0, may become unfeasible (say 0.9 to 1.0) as a result of only a small increase in the discount rate (18).

Executive-Legislative Conflicts in Establishing Project Evaluation Criteria

Efforts by the executive and legislative branches of the Federal government to establish clear-cut criteria for project evaluations have resulted in controversy. The two branches do not always agree on order of priorities. William Donovan, Chief of the Economics and Evaluation Branch of the Office of the Chief of Engineers in Washington, has described the controversy that developed over project evaluation priorities.

> S[enate] D[ocument] 97 itself essentially resulted from the generally adverse Congressional reaction to the economic efficiency emphasis of BOB's [the Bureau of the Budget, a division of the executive branch of the Federal government] Circular A-47. SD 97 established regional development, environmental quality and social well-being as appropriate objectives for water resource development, in conjunction with the earlier-stated goal of economic efficiency. However, these broad statements of objectives were not immediately followed by the establishment of procedures whereby they might be employed. This is probably not independent of the fact that OMB [Office of Management and Budget] has consistently maintained an efficiency-oriented posture with regard to the interpretation of SD 97 (15, I-5, pp. 2-3).

Donovan also discussed subsequent legislative and executive conflicts over evaluation criteria.

> In 1968 the Water Resources Council, after considerable debate both within and outside the executive branch, announced a change in the criteria on which the discount rate would be selected for use in evaluating federal water projects. The discount rate would be based on the yield rate rather than the coupon rate on outstanding long-term government bonds as provided by SD 97. Congressional reaction to this was quick and direct; it demanded that the executive branch implement without delay that part

> of the Water Resources Planning Act of 1965 which called for the development of detailed evaluation procedures which would provide expression for the broadened planning objectives set forth in SD 97. This led to creation of the Special Task Force on Evaluation Procedures of the Water Resources Council in November 1968 (15, I-5, p. 3).

The Special Task Force on Evaluation Procedures initiated studies which led to two water resources planning guidelines, the so-called "Blue Book" of June, 1969 and the "Principles and Standards of August, 1970."

> These preliminary procedures were almost entirely lacking in detail with regard to the environmental quality and social well-being objectives. These procedures were field-tested by the agencies and a number of independent university field teams. Generally, the results were favorable and many improvements were suggested. Nine public hearings throughout the country also resulted in numerous suggestions toward improvement. . . . After issuing its final report and recommendations in August 1970 the Special Task Force disbanded (15, I-5, p. 4).

A Southwestern Division (Tulsa) District team of engineers, economists, and environmental planners participated in the field testing of the Special Task Force's "Principles and Standards" (13). A summary statement attached to the team's study report enumerated objectives of the field testing.

> (1) Measurement of the effects of the [upper Poteau River] SCS [Soil Conservation Service] Program. (2) Formulation of the "best" plan incorporating the multi-objective format suggested by the WRC [Water Resources Council]

> standards and (3) Adequately displaying formulated alternates in a form which will lead to a rational selection of the "best" plan (13, Attachment, p. 1).

Essentially, the test procedures devised centered upon a comparison matrix with alternate plans "arbitrarily assumed to have resulted from formulation procedures which produced the 'optimized' plan in each case" (13, Attachment, p. 3). The study report concluded that:

> . . . the plans which may ultimately be displayed in matrix analysis must of necessity be formulated substantially on the basis of professional judgement and technical expertise of experienced planners . . . (13, Attachment, p. 3).

Donovan summarized the Water Resources Council Special Task Force's "Principles and Standards" for evaluating projects as follows:

> The proposed Principles and Standards, viewed as a further extension of applied welfare economics in the area of water resource planning, are frequently discussed or identified under another rubric, namely that of "multi-objective" planning, an approach, which, as originally conceived and recommended by the Special Task Force encompassed the four objectives of national economic development, environmental quality, social well-being and regional development. It was not a coincidence that these same objectives received the endorsement of Congress in Section 209 of the Rivers and Harbors Act of 1970 (15, I-5, p. 4).

However, the idea of multi-objective planning has been, to some extent, watered down by the OMB's revision of Section 209 of the Rivers and Harbors Act of 1970. The OMB reduced the original four objectives of the Special Task Force's "Principles and Standards" to two, national economic development and environmental quality. Regional development may also be an accepted objective, but prior approval must be obtained. The criteria for approval has not been discussed by the OMB (15, I-5, p. 4).

The OBERS Report

In 1964, the Water Resources Council initiated a program with the then Office of Business Economics (OBE) and the Economic Research Service (ERS) designed to assist in evaluating water resources projects (9). The OBERS program, as the combined study has been designated, produced a five volume report of significant interest to regional planners.

> Volume 1 includes an introduction, a discussion of concepts and methodology in three parts, the national summary tables, and four appendices relating to the measures and terms used.
>
> Volume 2 includes the historical and projected economic measures for the United States and the BEA [Bureau of Economic Analysis] economic areas. [The term "BEA economic areas" will be defined and discussed in subsequent portions of this report.]
>
> Volume 3 includes the historical and projected economic measures for the United States and the 12 water resources regions and their subareas located in the East.
>
> Volume 4 includes the historical and projected economic measures for the United States and the 12 water resources regions and their subareas located in the West.
>
> Volume 5 includes the historical and

> projected economic measures for the United States and the individual States (9, p. 2).

The objectives of the OBERS report include the development and maintenance of

> (1) a regional economic information system with provisions for rapid and flexible data retrieval; (2) near term (1980-1990), mid-term (2000) and far term (2020) projections of population, economic activity and land use for the Nation and its geographic subdivisions; and (3) special analytical systems designed for use in water resources and other public investment planning (9, p. 1).

The OBERS study undoubtedly grew out of the generally recognized need for a framework of projected growth for small areas which, when aggregated, would essentially agree with a reasonable national growth projection. Such a framework became necessary when the Army Engineers discovered that the atomistic character of individual project evaluations frequently led to claims of higher growth potential in individual districts than could be justified. To what extent Corps' economists have knowingly falsified their claim of growth cannot be known. However, the decentralized nature of the Corps and its innumerable reports containing growth parameters such as population, personal income, value added by manufacture, and value of mineral production make it difficult to determine the actual extent of excessive claims. Thus, the OBERS information, with its allocation of growth to small areas and its summary growth projection for the nation as a whole, is of value in limiting excessive claims in individual area studies.

> In its simplest form, the shift-share technique distinguishes a proportional growth element and a differential growth element between a region and the Nation in each industry or income component (9, p. 26).

The OBERS projections are subject to adjustment during the economic base study phase of project evaluations if just cause can be shown (1).

The OBERS study also delineated economic areas related to a specific central city, usually a Standard Metropolitan Statistical Area (SMSA). These are the so-called "BEA" or "OBERS" economic areas. Although they vary in size, OBERS areas typically contain ten to twenty counties including the SMSA counties, which represent the nodal-functional center, and the surrounding counties, which are related to the SMSA primarily through economic interaction (9, Appendix E, p. 2). There are 173 OBERS areas in the United States (9, p. 24).

Since the OBERS areas represent essentially economic trading areas (9, Appendix E, p. 2), they offer regional planners helpful evaluation criteria in determining economic and marketing policies. Because OBERS economic reports will be maintained over a long period of time (9, p. 1), they may aid in analysis of county growth patterns by showing shifts of individual counties from one OBERS area to another, or from non-metropolitan to SMSA classification. The OBERS reports also include projections of population change, personal income, employment, earnings, and output. Employment, earnings, and output are divided into major classes of industry (9, p. 1).

Despite their use to regional planners, the OBERS data does little to solve the major problems of non-monetary evaluations called for by Section 209 of the Rivers and Harbors Act of 1970 (15, I-5, p. 4). Although the original multiple-objectives for evaluating projects were reduced by the Office of Management and Budget to national economic development and environmental quality, Congress continues to display interest in multi-objective evaluations:

> The proposed new Principles and Standards have been the subject of extensive questioning of Corps officers and officials at recent House Appropriations hearings. The line of questioning evidenced much concern with all major areas of the new proposals, including the [WRC] recommended [higher] discount rates, effect on the complexity and timeliness of preparing survey reports, and the plan formulation itself, among others. The continuing concern of the Congress in this area appears likely (15, I-5, p. 6).

If the views of Congress are to prevail regarding multi-objective evaluations, broader and more concise guidelines and proposals must be produced.

> . . . neither the original Task Force recommendations of August 1970 nor the revised proposals of 21 December 1971

has provided a concise, unambiguous, practical, interim operating rule by which projects can be rejected (or approved). . . . Thus, in their present form the new proposals suggest a major problem and dilemma for decision-makers (15, I-5, p. 7).

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CHAPTER V

A NEW APPROACH TO PROJECT EVALUATIONS

Approximately thirty years ago, C. E. Ayres wrote:

> If all values are relative, including intellectual values, then it would seem to follow that modern scientific thinking also is relative to the culture which accredits it, including social thinking, including the principle that all values are relative.
>
> For economics in particular this impasse is disastrous. Economics is nothing if it is not a science of value. The founders of the classical tradition of political economy held the belief of the eighteenth and earlier centuries that genuine and stable, if not eternal, values do exist and are somehow knowable; that such values are registered in demand and therefore measured by price; and hence that the economic affairs of commercial society are meaningful, since they are organized by price which is the measure of value (3, p. 208).

The use of professional judgement is both a necessary and desirable feature of determining values and goals.

> Historically, the process of evolutionary experimentation has been made more hazardous because of the prevalence of nonfunctional attitudes about the role of values and goals. . . . there is a tendency of the science community to deny a role to valuation. Even where science is engaged, as it often is, in the development and testing of instrumental values, there is a preference to speak of "criteria" and "efficiency." . . . The social science community needs to recognize that it is

> participation in an ongoing process of social system design that involves not only the testing of developmental hypotheses against the standard of established goals, but also the testing of social system goals in the light of their adequacy as planning metaphors (7, p. 170).

However, judgements in specifying a complex abstract model, as advocated in matrix analysis, often tends to hide the important assumptions under a mass of complexities inherent in such abstractions.

Comprehensive planning of all types, whether public or private decision-making, requires that information inputs reflect the likely consequence of a specific act. But since time is often limited in the review of studies, reviewers--including Congress--often find themselves relying entirely on end results rather than inputs. In the field test of the Water Resources Council's "Proposed Evaluation Procedures," the study team attempted to develop a ranking system for assessing the probable effects of alternative water development plans. The study team also established a trade-off matrix for determining both monetary and non-monetary benefits (21). The "ranking system" and trade-off matrix are, as pointed out by Paul A. Samuelson in his discussion of models (19), products of value judgements in their specifications. Furthermore, the trade-off matrix shows relationships which are assumed only for the current situation (21, Attachment, p. 3). No consideration is given directly to either national or regional socio-economic goals.

George Antle, senior-level economist employed by the Corps' Institute for Water Resources, in his report of research on economic and social indicators, stated:

> If an approach similar to that indicated for environmental impacts is utilized, a time-consuming, lengthy and arduous task will be required. The taxonomy of environmental impacts easily explodes to [an] evaluation of 600 x 600 matrices or larger dimensions (1, p. 2).

What appears to be required in the project evaluation dilemma, and that which will be recommended by this report, is a new criteria system of broad socio-economic measures related to <u>human</u> well-being in a national context.

Procedures recommended by this report for project evaluations involve three major steps: first, the identification of major national socio-economic goals; second, identification and subsequent analysis of major socio-economic characteristics of the project's study region; and third, implementation of a systematic procedure in which professional judgements can be properly made in assessing significant impacts of the proposed projects.

Regional Development and the Nation: The Socio-Economic Profile

> To confine federal planners to national efficiency forms of analysis . . . is to

> disregard the much broader role which they, and economic analysis can . . . and must assume. . . . Economists, in their preoccupation with the national efficiency criterion, have ignored other essential economic aspects of the decision-making process and have consequently been less relevant to this process than they could have been (12, p. 5).

As previously stated in this report, Senate Document 97 liberalized the planning of water development projects and included regional development and "well-being" as worthwhile and necessary objectives. Aspects of regional development cannot be measured entirely by dollars and cents but require assessments of project impacts in relation to broader national goals. "The pitfall of most concepts connected with regional economic development is the failure to harmonize the regional concept with its corresponding national . . . concept" (8, p. 13).

Numerous research and planning organizations, such as the National Advisory Commission on Rural Poverty, the National Goals Research Staff, the Commission for National Goals, the Commission on Population Growth and the American Future, and the Departments of Agriculture and Health, Education, and Welfare, have, in recent years, made studies and developed frameworks of broad generally accepted "goals." These goals usually include population dispersion; wider distribution of incomes; environmental enhancement, particularly in urban areas; advances in learning; improved health status; social stability; and the "traditional" economic targets of full employment and price stability (18, 14, 17, 28, 22, 5).

In discussing national goals and regional development, Joseph Fischer explored concepts related to "balanced" regional growth.

> . . . development in many parts of the Southeast is said to be unbalanced, or out of balance, because it is not up to the national average. This is true of per capita income payments, for example. . . . Economic studies and promotional campaigns alike frequently take as their implied objective the attainment of the national average (8, p. 9).

Of course, as Fischer recognized, different regions possess different potentials and absolute equalization of regional development is, in fact, only a planning target (8, p. 15).

> . . . the give-and-take among regions has to be taken fully into account to the end that the interrelated parts make their fullest contribution to the development of the whole organism of the nation (8, p. 16).

Concerning population distribution, a 1970 report by the National Goals Research Staff recommended "a policy of encouraging growth in alternate growth centers away from the large urban masses, coupled with . . . use of new towns" (14, p. 58). And, a 1967 report issued by the President's National Advisory Commission on Rural Poverty stated:

> The urban riots during 1967 had their roots, in considerable part, in rural poverty. A high proportion of the people crowded into

> city slums today came there from rural slums. This fact alone makes clear how large a stake the people of the nation have in an attack on rural poverty (18, p. ix).

Selection of a Hypothetical Project Study Area

OBERS area 118, Fort Smith, Arkansas-Oklahoma, has been chosen as the hypothetical project "study area" to illustrate an alternative evaluation procedure. This was done for three reasons. First, the area includes Scott County, Arkansas, and Le Flore County, Oklahoma, both previously subject to tests of the Water Resources Council's proposed guidelines (21). Second, the area includes a portion of two states, thereby testing the availability of comparable inter-state data. Third, the area is relatively low in socio-economic development.

As illustrated in Fig. 7, OBERS area 118 is composed of thirteen counties, of which seven are in Arkansas and six are in Oklahoma. The area has one Standard Metropolitan Statistical Area consisting of two Arkansas and two Oklahoma counties. In this metropolitan area, the manufacture of household furnishings is significant to the economy. For the remaining nine counties, agriculture and mining are significant economically (2, p. 34).

Socio-economic indicators have been organized as "Area Profiles" by other study groups to depict conditions and life-styles and to make comparisons between different areas

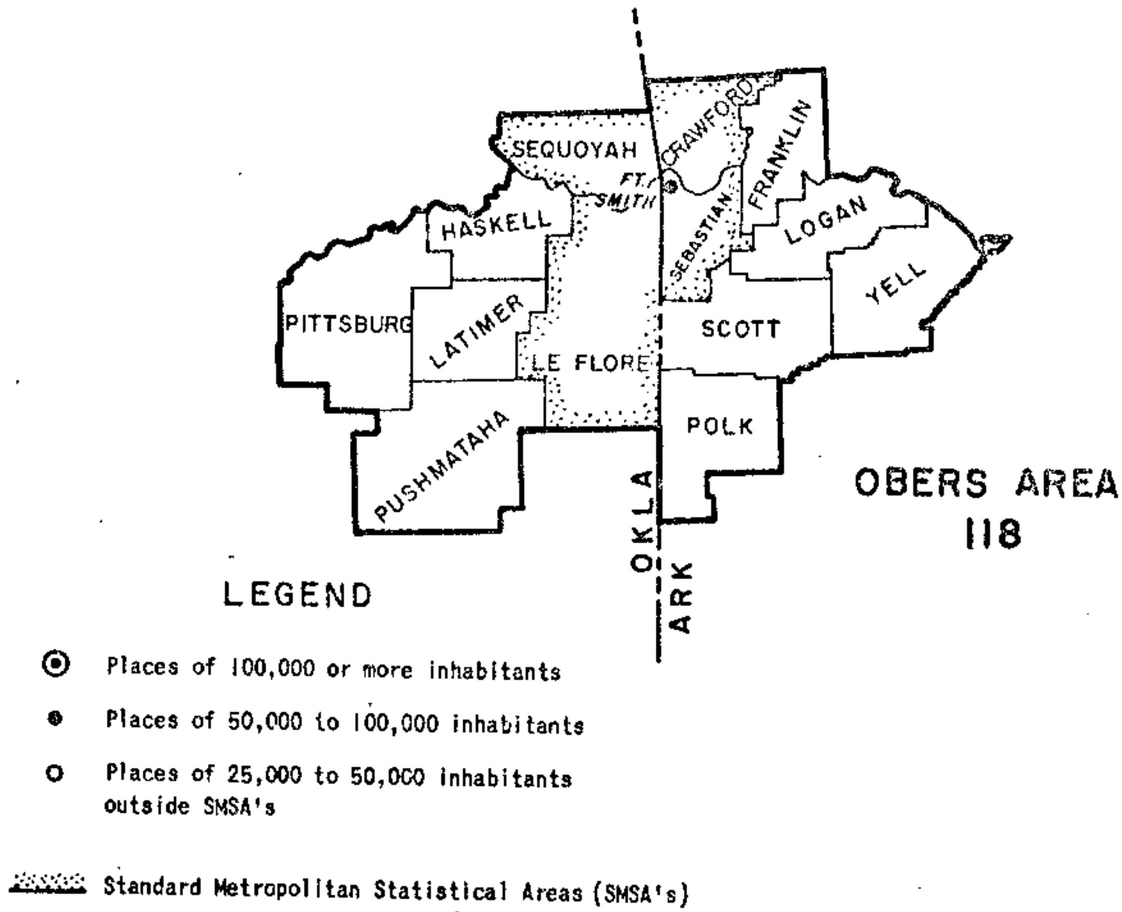


Fig. 7--OBERS area 118

(9, 30, 16). After studying such reports as well as characteristics of the hypothetical study area, OBERS area 118, the following socio-economic indicators were selected to portray an alternative approach to Corps project evaluations: population growth, 1950-1960 and 1960-1970; the ratio of workers to non-workers, 1970; the percent of total workers in non-agricultural work, 1970; percent of persons in poverty, 1969; percent of persons over twenty-five years of age with high school education, 1970; infant mortality rate, 1964; divorce rates, 1968; and percentage of population born in state, 1970. It is recognized that changes within the region from internal migration would likely influence the well-being of its population. For this reason, data collected by individual counties were divided into two groups, area SMSA counties and area Non-SMSA counties. The socio-economic indicators were compiled for each segment of the study area (SMSA and Non-SMSA groups) as shown in Table VIII. These data were then related to the United States analog for deviation from the national average.

Using the formula,

$$D = \frac{y-x}{x}$$

the data was computed on the socio-economic indicators to arrive at the socio-economic profile shown in Fig. 8. In the formula, "D" represents the percent of deviance from the national average, "y" represents regional input, and "x" represents national input. Utilizing per capita personal income as an example, the formula may be set up as follows:

$$D = \frac{2222 - 3698}{3698} = \frac{-1476}{3698} = -40\%$$

In this equation, $2222 represents the per capita personal income of the SMSA counties, while $3698 represents the national per capita income. The solution to the equation

TABLE VIII

SUMMARY OF COMPUTATIONS FOR SOCIO-ECONOMIC PROFILE: OBERS AREA 118 RELATED TO THE U. S.

Selected Indicator	County SMSA	Groupings NMSA*	United States
Population growth, 1950-1960	- 0.80	- 20.00	18.50
Population growth, 1960-1970	18.70	10.40	13.20
Ratio workers to non-workers, 1970	0.58	0.51	0.69
Percent of workers to non-agriculture, 1970	96.30	91.40	96.30
Per capita personal income, 1969	2222.00	1946.00	3698.00
Percent of persons in poverty, 1969	23.80	29.60	13.70
Percent of persons over twenty-five with high school education or more, 1970	42.00	29.00	52.00
Infant mortality rate, 1964	1557.00	1547.00	1700.00
Divorce rates, 1968	5.40	4.30	2.90
Percent of population born in state, 1970	67.00	70.00	65.00

*Non-Metropolitan Statistical Area County.

shows that the SMSA counties had a 40 percent lower per capita income than the national average.

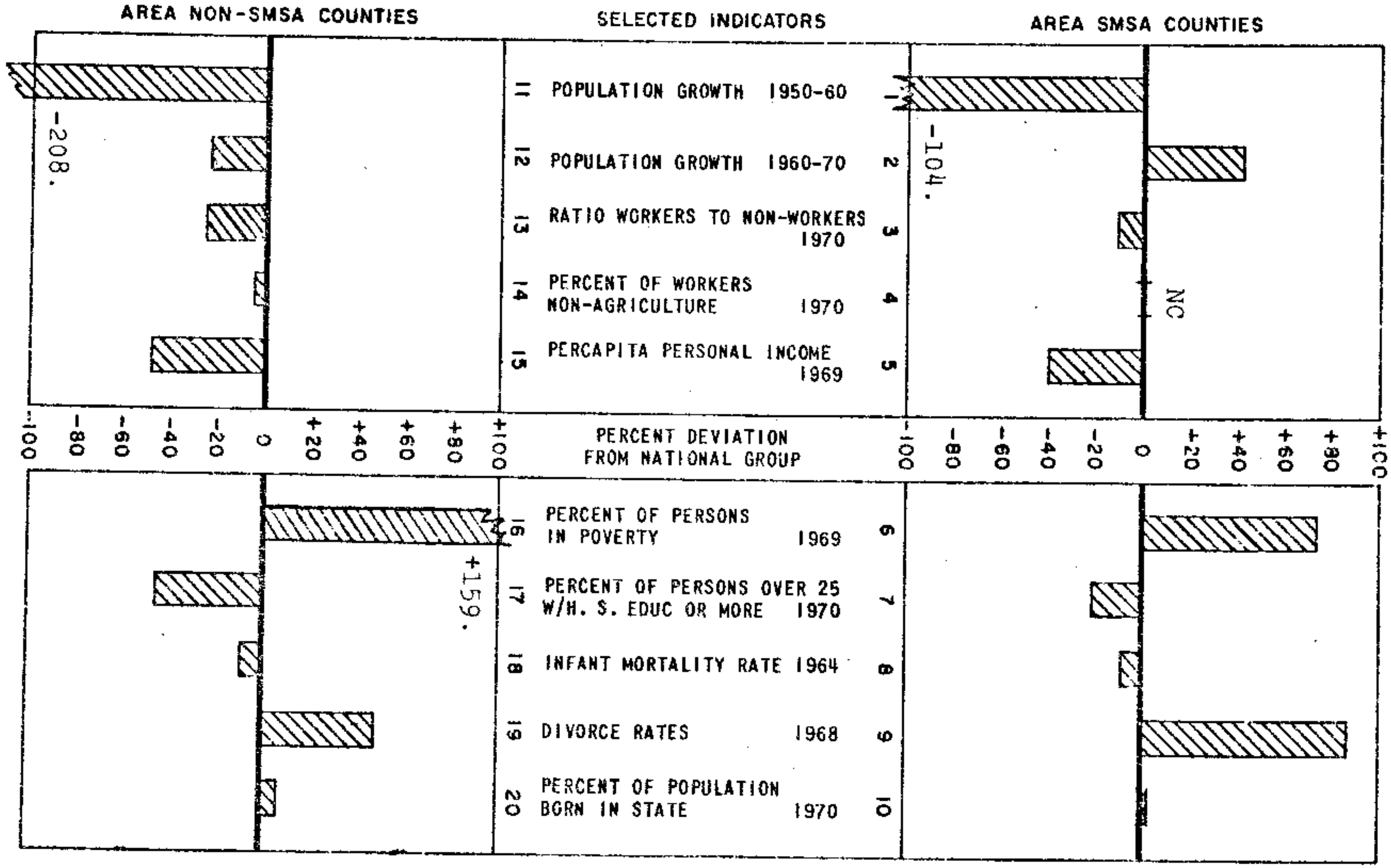


Fig. 8--Socio-economic profile chart, OBERS area 118

Socio-economic profiles have been described as a technique "to increase the scope, accessibility, accuracy and utility of information which supports the planning evaluation of programs . . . " (16, p. 1). However, as indicated by use of the words "which support," such profiles are unsuitable as an exclusive tool for planning and evaluating, since they represent a static rather than changing analysis of the area. Too, the selection of indicators to depict socio-economic conditions in various areas may differ themselves because of greater or lesser relevance in each case. For example, instead of "infant mortality rates" as a measure of health status, economists might find that "life expectancy of coal miners," "freedom from mental disease," or "number of dentists per 100,000 persons" (16, p. 44) would better describe health status. Or a combination of several indicators might best depict the human resources of an area.

Because this research report is primarily concerned with concepts rather than precise specifications, the problem of selecting appropriate indicators was given only moderate attention. In order to show how socio-economic profiles might be varied to fit alternative situations, data were assembled for the states of Arkansas and Oklahoma and related to data for the United States as a whole. The comparison of socio-economic indicators for Arkansas, Oklahoma, and the United States is shown in Table IX.

TABLE IX

UNITED STATES, ARKANSAS, AND OKLAHOMA SOCIO-ECONOMIC INDICATOR RELATIVES

Socio-Economic Indicator Relatives	U. S. Rel.	Arkansas Relative		Oklahoma Relative	
	X	Y	D_a*	Z	D_o*
Population density, 1970	57.40	37.000	-35.500	37.200	-35.200
Population growth, 1960 to 1970	13.20	7.700	-41.700	9.900	-25.000
Ratio of workers to non-workers, 1970	.69	.578	-16.200	.658	- 4.600
Percent employed in white collar jobs, 1970	48.20	39.000	- .191	47.900	- .006
(U. S. scale)	. . .	. . .	. . .	. . .	. . .
Median family income, 1969	9590.00	6273.000	- .346	7725.000	- .195
Percent completing 4 years college, 1969	10.70	3.700	- .654	10.000	- .065
Non-white infant mortality rates 1966	39.00	37.000	- .051	33.000	- .154
Violent crime rate, 1968	294.60	216.700	- .264	173.200	- .412

*D_a, $D_o = \frac{Y, Z - X}{X}$

These comparisons were made by the same technique as that used for profiles of OBERS area 118. The socio-economic profile constructed for Arkansas and Oklahoma is shown in Fig. 9.

Socio-Economic Profile Indicators

In the development of the socio-economic profiles shown in Figs. 8 and 9, data were selected solely for the purpose of illustrating concepts and techniques that might be used. Therefore, the format employed and the individual indicators selected should not be considered as specific recommendations for actual use. Although care was exercised in making the selection of indicators, some of those selected were chosen for the purpose of illustrating hazards in the selection process.

Because profiles involve comparisons of individual characteristics, they are frequently shown as bar-charts, with individual bars drawn either vertically or horizontally (16, 9). Profiles may also make comparisons by pictograms (24) or simply in tabular form with percentages given (30). Many socio-economic characteristics are intangible, or lacking a value scale; "unlike economics . . . there exists no overtly standard 0, no 100 . . . " (15, p. 214). Therefore, socio-economic characteristics must be measured, or compared with either a "norm" or some

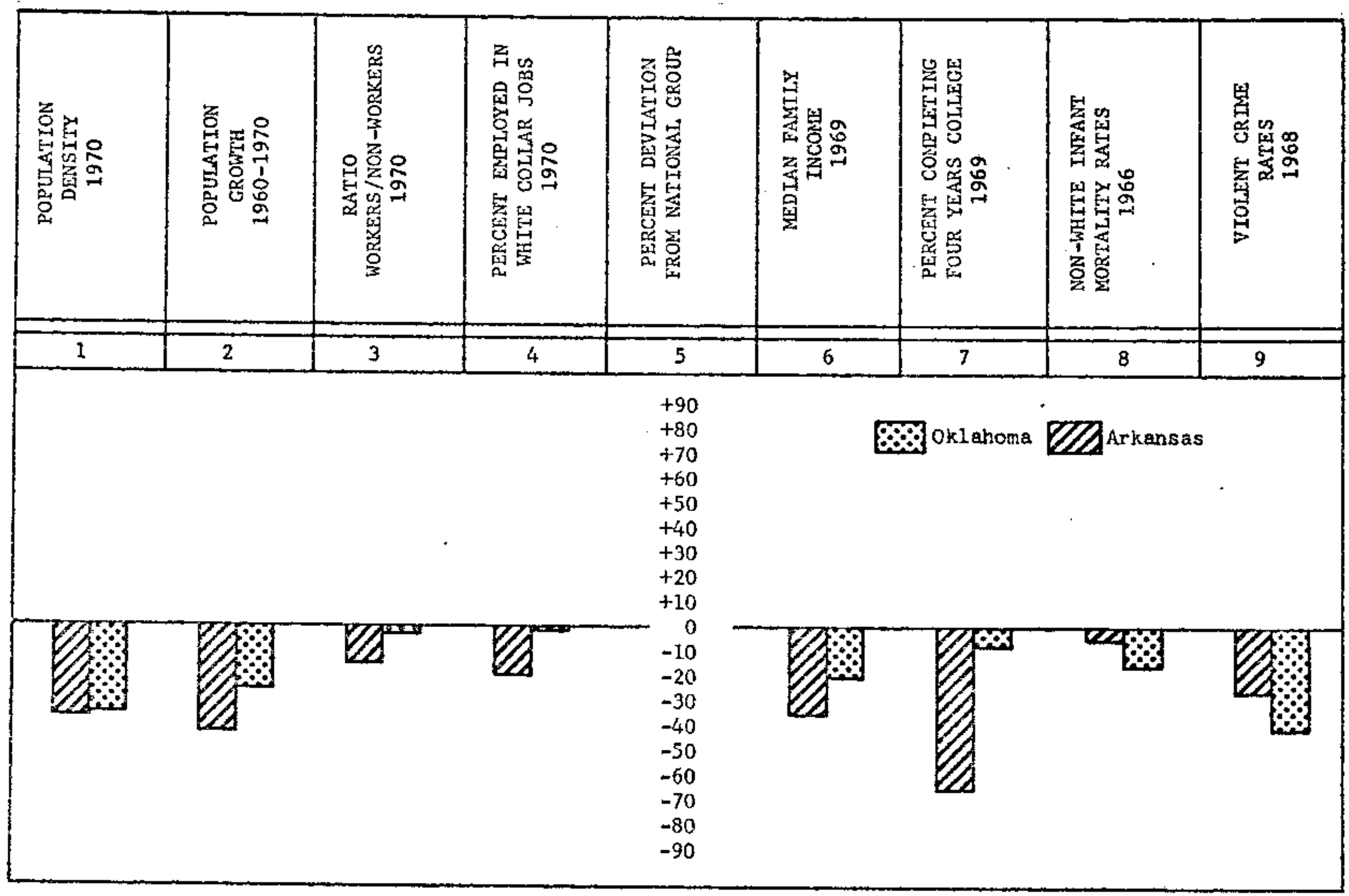


Fig. 9--Socio-economic profile of Arkansas and Oklahoma by selected indicators.

other contrived base. In so doing, an index can be developed which will depict variance from that "norm."

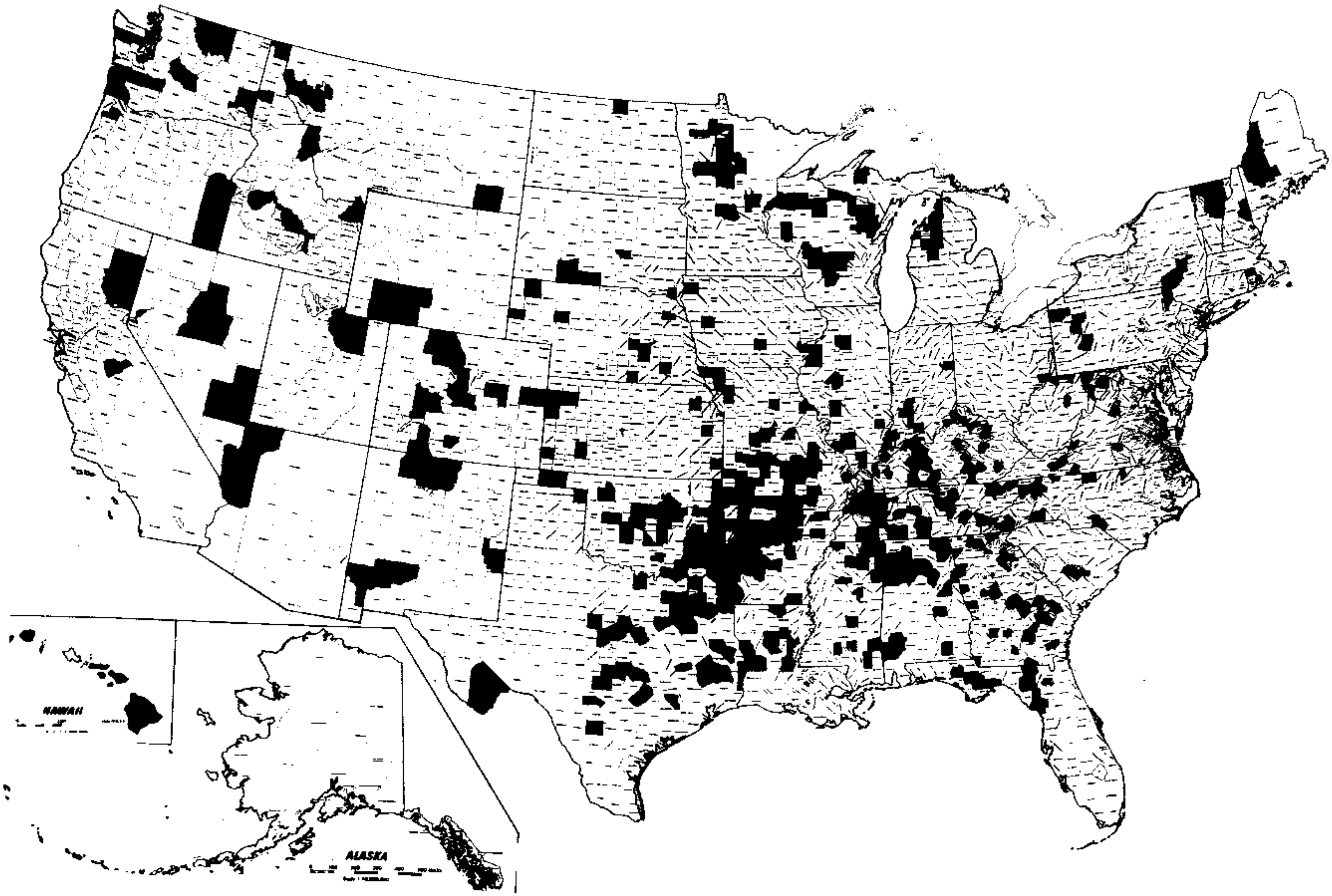
In the actual planning of socio-economic profiles, the profile design should allow an analysis of indicators relevant to the purpose of the study. For example, if general educational attainment by residents in an area is sought, "median school years completed by persons over twenty-four years of age" might be selected as a single indicator; or this indicator might be used in combination with another, "selective service mental test scores" (9). On the other hand, if functional illiteracy among non-white residents of a county is to be studied, "the percentage of non-white population over twenty-four completing less than five years of school" might be appropriate (16). If a profile is to be developed for a specific date, data such as "infant mortality rates, 1964," as a measure of health status should be sought.

Much of the data for the profile constructed for the United States, Oklahoma, and Arkansas were obtained from Bureau of the Census figures and from the Bureau's _City and County Data Book_ (23, 24, 25, 26). Data for "divorce rates in 1968" for Oklahoma counties, not found in published form, were acquired by telephone request from the State Bureau of Vital Statistics (13). Figures for land area were acquired from the _Statistical Abstract of the United States, 1971_ (27, p. 5).

Population data are based on the Bureau of the Census' definition of population as "place of residence." As an exclusive indicator, population has very limited meaning; however, when developed over a time series or when used with other indicators such as income or square miles land area (density), population data becomes highly important (30, 16). For example, as shown in Fig. 10, the Arkansas River Basin lost population during the 1950-1960 decade but gained population from 1960-1970. The 1960-1970 period coincides with the expenditure of sizable amounts for construction of the Arkansas River Multiple-Purpose Project.

Population density for the profile was derived by calculating the numbers of persons per square mile of land area. Because of topography and other geographic features, population density can be a misleading indicator if used indiscriminantly (30). However, over time, population density can provide important clues on migration patterns and geographic mobility of residents.

The ratio of "workers to non-workers" in 1970 was obtained, using census figures, by calculating an inverted relationship of the "nonworker-worker ratio" (24, 25, 26). This computation was made to illustrate how data can be reformed, if desired. The derived indicator, "workers to non-workers," shows the ratio during the census week of



Source: <u>Rural</u> <u>Development</u> <u>Chartbook</u> of the U. S. Departmennt of Agriculture.

Fig. 10--Counties with population growth in the 1960's after loss in the 1950's.

persons in the labor force to persons not in the labor force, including persons under fourteen years of age.

The percent of workers employed in "white collar" jobs included professional, technical, and kindred workers; managers and administrators, except farm managers; sales workers; and clerical and kindred workers. The term "white collar" workers is an occupational classification.

The "percent non-agricultural employment" indicator is an industry classification which relates all employment, other than agricultural, to the size of the labor force. Included in agricultural employment are those persons employed in forestry and fisheries (24, 25, 26).

The "median family income" statistic divides families into two groups, 50 percent of which are above and 50 percent of which are below the amount shown (24, 25, 26). Median family income levels take into consideration area cost of living differentials (30).

"Per capita personal income, 1969" is the total estimated personal income for an area for 1969 divided by the number of residents of that area in 1970 (24, 25, 26). The measure, though not usually stated in comparable dollar values, broadly represents the relative affluence of residents (30, p. 17).

"Percent of population with less than poverty level incomes, 1969" is a statistical measure of the extent of poverty in an area based on census definitions of poverty level income. The percentage is based on a computation, not an actual count of individuals; however, authorities consider it a reflection of the extent to which poverty exists among groups and populations of areas (24, 25, 26, 16).

The "percent completing four years or more of college, 1969" is a measure of the educational attainment of the population and is limited to persons over twenty-four years of age as reported by census figures. "Percent of population with high school education or more in 1970" is also a measure of educational attainment limited to persons over twenty-four. Educational attainment often closely correlates per capita income and the productivity of human resources in an area (6).

"Infant mortality rates," when measured over a multiple county area, are proxy measures of general health status. According to Samuel Hoover, Associate Regional Health Director of the U. S. Public Health Service, the ratio of infant deaths to 1,000 live births (mortality rate) reflects not only the health care given infants but also the health of their mothers and other health factors (11). Infant mortality rates for the counties in OBERS area 118 were obtained from Community Profile Project, a publication resulting from an Office of Equal Opportunity study (16).

"Average daily cost of hospital care" is a relative measure of costs for hospital care as published in the Statistical Abstract of the United States, 1971 (27). According to Samuel Hoover, it is not a measure of health care and should not be used in attempting to compare the quality of health care from one area to another (11).

"Divorce rates, 1968" reflects the degree of disparity between OBERS area 118 and the nation in number of divorces in 1968 per 1,000 population in 1970. Figures for two different years were used even though the resulting correlation may not be as accurate as using 1970 population figures for both areas. Under such circumstances, research should probably be undertaken to devise an alternative measure of "family fragmentation," such as "number of divorces in 1968 per 100 marriages in 1968." Despite this difficulty, the measure was included in the profile largely to advance the theory that divorce rates are negatively related to per capita income in an area. Data on the number of divorces in Arkansas counties in 1968 were obtained from the 1972 Arkansas Almanac (2) and for Oklahoma counties by telephone request from the State Bureau of Vital Statistics (13).

The Bureau of the Census defines "percent of population born in state of residence, 1970" as a computation of data from a population sample which reflects the percentage of persons born in the state in which they were residing at the time of the census. The indicator appears to measure population mobility; however, the Bureau of the Census cautions against its unlimited application.

> The statistics on State of birth are of value mainly for the information they provide on the historic movements of the native population from one State to another within the United States from the time of birth to the date of the census. The statistics afford no indication of the amount of migration within a given State; nor do they take any account of intermediate movers between the time of a person's birth and the time of the census (24, B, p. 6).

"Violent crime rates, 1968," derived from _Uniform Crime Reports, 1968_ (29), are the number of violent crimes reported by local law enforcement agencies to the Federal Bureau of Investigation per 100,000 inhabitants of an area. Violent crimes include murder, manslaughter, forcible rape, robbery, and aggravated assault.

> Crime rates provide some indication of the dimensions and severity of a social problem that concerns the total community. . . . The wide disparity among States in the incidence of crime probably reflects other variations in State characteristics--population concentrations, economic and cultural characteristics, stability of the population, and other factors . . . (29, p. 59).

The Delphi Technique

Identification of regional characteristics relevant to long-term national goals and the development of socio-economic profiles as a concept leads to the third major step for recommended improvement of project evaluations, a procedure in which professional judgements can be made for assessing significant impacts of a proposed project. The problem involved in converting the thus far static analysis to dynamic assessment is extensive. In a special interdisciplinary research study related to this problem, Charles Leven and R. B. Read of Washington University of St. Louis wrote:

> Except for a statistical comparison of demographic data available from the decennial census, the design of techniques for measuring the impact . . . on social change . . . faces such formidable difficulties that only highly improvisational and largely unquantifiable measures can be recommended (15, p. 213).

The problem of assessing impacts in terms of intangible benefits and costs is best approached from both short-term and long-term perspectives. The systematic procedure recommended by this report is suited for short-term implementation of professional judgements and for the development of decision models for application in the long-term as well.

A special article in the 1970 Annual Report of Resources for the Future, Inc., discusses socio-economic choices.

> Americans were extraordinarily successful at constructing social choice mechanisms in the seventeenth and eighteenth centuries, when the colonists used representative legislative bodies to wrest policy control

> from Crown-appointed governors and executive councils. Later, their skill in this area seemed almost to die out. Instead, they perfected managerial and executive skills in both business and government. Faced now with value conflicts that call for social choices, they grope to relearn some of the older arts. In the meantime, social scientists have developed some useful approaches. We in the United States may be farther along than is generally recognized toward a basis for constructing new mechanisms for making social choices (20, p. 25).

One of these methods is the "Delphi" technique which appears to be gaining in popularity as a predictive tool:

> While nobody has perfect knowledge of the future, two heads are better than one, and 20 or 30 heads are about as good a crystal ball as you can get. That premise is the basis of a technique of long-range fore-casting called "Delphi," which is rapidly catching on here and abroad. Norman C. Dalkey, the current Rand Corps. expert on Delphi, estimates that 50 to 100 corporations have started actual forecasting projects to gain insights into what things will be like in the company, their industry, and their world in 25 years (10, p. 130).

Stephen S. Cohen, in "From Causation to Decision: Planning as Politics," described the French planning process, which is, in some ways, similar to the Delphi technique.

> The workings of the economie concertee are most visible in the modernization commissions of the plan, where businessmen, bankers, civil servants, planners, and "experts" assemble to prepare investment and restructuring programs for the industry (4, p. 180).

The implementation of the Delphi technique is quite simple. First, a panel of experts is organized from diversified areas. Each expert is requested to make anonymous forecasts on specific problems. In a Rand experiment, for example, experts were asked to predict the date, from thirty listed, when 20 percent of the world's food would be processed from ocean farming. Half the experts chose the year 2000, while half thought the date would be later. Each expert receives information on the forecasts of the other panelists, and after study, additional forecasts are made. Predictions may be made four or more times. Forecasters remain anonymous to allow a panelist to more readily alter his opinion after reading other opinions. In a committee session, "he may care more about defending his original idea than coming up with good predictions." In summary,

> what Delphi does . . . is to refine judgements of experts. The first time around, definitive answers are not expected. Successive iterations improve individual answers, and better individual answers add up to a better group judgement (10, pp. 130-131).

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CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS: IMPLEMENTING A SYSTEM FOR IMPROVED DECISIONS

Water resources improvement programs play an essential role in regional and national development. Project evaluations must be made continuously in the most efficient manner possible at the time. Delphi techniques can be used, in conjunction with socio-economic profile analyses, to estimate the intangible effects of proposed projects. Implementation of decision-making procedures discussed in this chapter would provide near-term improved evaluations of proposed projects and assist in the development of rigorous models for evaluating intangible effects.

A two-stage system for near-term evaluation of intangible impacts initially involves broadening economic base studies by the districts to include socio-economic profiles. The information gathered should be comparable historically, thus allowing multiple profiles of significant regional characteristics. Through the use of historic socio-economic profiles in combination with traditional economic measures of production and income, the base study should be improved. These profiles reflect socio-economic conditions and qualities of human resources which are instrumental in projecting future development in a region. This extra effort should greatly improve long-term projections and, hence, project evaluations in general.

While benefit-cost analyses as they are currently utilized have many shortcomings, they are essential. Properly made, benefit-cost analyses provide a systematic and scientific approach to decision-making. The socio-economic profiles, OBERS projections of regional economic growth, and adequate review of field evaluations will undoubtedly improve benefit-cost analyses in the future.

Environmental impact statements have also become an important part of final decisions related to water resources planning. While these evaluations are limited in that they do not consider many aspects related to human environments, they can provide meaningful information when used with traditional benefit-cost analyses and intangible socio-economic benefit analyses.

The second stage of estimating socio-economic benefits, implementing the Delphi technique, can perhaps be best realized in a central and high-level organization--perhaps the Board of Engineers for Rivers and Harbors (BERH). This organization, which currently has as its chief function the review of all survey reports authorized by Congress (1, B, p. 3), could have several advantages over the field organizations in the successful operation of Delphi techniques. First, as far back as 1917, Congress directed BERH to "state its opinion as to Federal interest, share of expense to be borne by the Federal Government, and advisability of adopting projects" (1, B, p. 5). Second, BERH appears best suited to systematically evaluate intangible project impacts because of the scale of their current operation. Third, in the act of reviewing all project evaluations made over the United States, BERH has a continuous flow of evaluations which likely would allow a full-time maintenance of the Delphi system. Fourth, because BERH is centrally located, sectionalism and self-interest in specific projects would be lessened.

In implementing Delphi techniques for near-term decisions, several modifications are envisioned. In addition to well-qualified panelists (preferably social scientists from the academic community and other research organizations), the Delphi system should involve an elaborate information process. Included in this process would be an economic base study of the region and historic socio-economic profiles; descriptive history and profiles of socio-economic conditions prior to and after completion of water development projects in the United States; and access to various computer facilities and data banks.

One of the initial problems Delphi panelists would face in analyzing intangible impacts would likely involve the time-span anticipated for socio-economic benefits and costs. There simply is no reason that such analyses yield "average annual" impacts. After all, time is continuous. To those who advocate averages over a one year accounting stance, it might be asked, "Why not monthly averages if shorter time-spans are better?" For at least initial implementation, a tentatively recommended time frame for intangible impacts is "near-term" and "long-term," approximating each half of a project's economic life. The time-span problem should be one of the first explored by the panelists, with subsequent re-examinations as techniques and procedures evolve.

Specific research and analytical techniques to be employed in the Delphi process should, of course, be determined by the panelists themselves acting individually or in small teams. After second, third, fourth, and subsequent rounds of "polling," a convergence of ideas and methods should occur (4). Although findings on specific analytical tools to be used in the Delphi process are inconclusive in this report, there are a number of statistical analyses which offer varying degrees of promise in this type endeavor as well as considerable interest in cause-effect models. Most of these experimental models (5) appear based on "weighing" various characteristics in relation to an objective function (7). In this regard, a model could be made with the objective of reducing significant differences in regional socio-economic profiles over time, and descriptive regional history could play an important part in the initial work. A hypothetical "Worksheet, Page 1" of a panelist's "Summary Report" in Delphi proceedings might appear as shown in Table X. In this hypothetical and likely over-simplified example, the panelist might surmise that air pollution and crime rates would yield a weighted -3.0 in the short-term and all other indicators would yield a weighted +17.0 in that period, for a "net" weighted socio-economic impact of +14.0 out of a possible +79.0. The hypothetical panelist might further surmise that, with a weighted short-term benefit of +14/79 and a long-term weighted benefit of +40/79, a simple average of socio-economic benefits would be +27/79, or +0.34, for the initial round conclusions. Successive rounds, by displaying anonymous work and conclusions of other panelists, should create an environment conducive to progress as knowledge is gained by each panelist (or group).

It would be essential that the Delphi researchers have access to as accurate and as complete information as possible. For instance, if the study being undertaken involved a project in OBERS area 118, Fort Smith, Arkansas-Oklahoma, and the panelist was unaware of the recent Arkansas River Project being completed in that area, his conclusions would certainly be in error.

TABLE X

DECISION PROCESS AND SOCIO-ECONOMIC IMPACTS:
POTEAU RIVER WATER SUPPLY STUDY,
DELPHI WORKSHEET--1ST ROUND,
PAGE 1

Socio-Economic Indicator (Region)	Weight of Objective	Estimation of Induced Change			
		Near-Term		Long-Term	
		Dir.*	Mag.**	Dir.*	Mag.**
Population dispersion	4	+	1	+	3
Income distribution	4	+	1	+	1
Health status	3	. .	NC	+	2
Educational attainment	4	+	1	+	2
Crime rates	2	-	1	-	1
Divorce rates	1	+	1	+	1
Air pollution	1	-	1	-	2
Non-white (mobility) opportunities	4	+	1	. .	3
Community cohesion	1	. .	NC	-	1

*Direction. **Magnitude.

PANELIST'S REMARKS:

The historical experience of regions over the U. S. with

TABLE X--Continued

similar projects was examined. Those regions showing approximately the same socio-economic base prior to construction with that of the study area were analyzed by major characteristics. Regression techniques were used by . . . . . .

Of course, not all socio-economic evaluations would yield positive benefits. Where extensive development, population congestion, air pollution, and other extensive social costs already existed, projects such as navigation channels--which appear to stimulate growth--would most likely be rated negatively.

In project evaluations, some writers seem to advocate that any result of an assessment of socio-economic benefits would require a merging with traditional dollar benefit-cost ratios (5). Conclusions from this study are, however, that Congress does not want a "final" answer, but instead wants reasonably accurate assessments of project impacts in several different categories: economic efficiency, environmental enhancement, and socio-economic (or social) benefits. Whether Congress can properly make "trade-offs" in assessing values, is moot--we have a representative form of government, and it is likely that Congress will want to consider public sentiment and make the "final" weighing of alternative choices. Recommendations of this study are, therefore, that separate accounts of project feasibility reflect the character and magnitude of economic benefits, environmental enhancement, and socio-economic benefits.

The positive and negative characterization of benefits is simply another way of saying benefits versus costs. For instance, if a project is said to be economically feasible by a ratio of 1.5 to 1.0, then it can just as easily be said that the economic benefits are +0.5 based on benefit-cost analysis. This, it is felt, actually permits a better view of the "surplus" (positive or negative) accruing to the project in a particular account. In this manner, a somewhat easier comparison of separate types of benefits could be made, for example, economic efficiency benefits, -0.10, socio-economic benefits, +0.20, and environmental benefits, +0.15. Such accounting would not limit Congress to "fixed" weights between the different accounts, but it would narrow the issue to major factors unless and until more specifics were called for in hearings. Certainly this technique would offer advantages in that say, navigation transportation savings of $40 million per year would not have to be compared to environmental aesthetics or educational attainment of Indians in Oklahoma.

The procedures broadly outlined for near-term project evaluations bear a resemblance to the planning, programing, and budgeting systems advocated by President Lyndon Johnson in 1965:

> . . . this system would assist the federal government to:
> 1. Identify our national goals with precision and on a continuing basis.
> 2. Choose among those goals the ones that are most urgent.
> 3. Search for alternative means of reaching those goals most effectively at the least cost (5, p. 169).

The recommendations of this report, however, fall short of evaluating the effectiveness of alternative programs in relation to goal achievement. Just how, for example, water resources development in a region would compare with a low-income housing development program in their effects on crime rates or educational attainment remains unknown. It is concluded that procedures for these types of comparisons should be left to Congressional discretion.

In developing human resources through improved regional socio-economic environments, it is believed that changes resulting from programs are in fact national benefits. This conclusion is made on the basis that one man-year educational attainment, for example, in a particular region reflects the same change, one man-year educational attainment, in the nation. In other words, positive and negative socio-economic benefits resulting from projects are additive. It is also concluded that conflicts which appear between "social-welfare" programs and economic "efficiency" projects likely diminish in the long-term. This observation implicit in "welfare" economics is the long-term objective of developing human resources, which in turn is our major source of economic development (2).

With implementation of Delphi techniques in researching and evaluating socio-economic impacts for near-term decisions, the experiences gained from the process would undoubtedly lead to positive results in better long-term analytical tools. In discussing the nearsightedness of long-range planning, Gunnar Myrdal has stated:

> . . . this general attitude is adverse to long-range planning. Even at the universities and other research institutions studies in terms of the long-range future are neglected, except in regard to population and resources. Not only the President and Congress but also the leader in business are left without that intellectualized vision of what the future holds in store in regard to the economic development in more general terms. But such a vision is needed for rational decision, particularly when it implies investment or other actions which have consequences far ahead . . . (6, p. 88).

The procedure recommended would in part rely on value judgements and experimentation. However, value judgements are also required in traditional benefit-cost analyses. In addition, these type analyses seem powerless in the evaluation of intangible, but nevertheless economic impacts. It is concluded that what may ultimately be required is a broader, more meaningful theory of economics and its role in modern society. Through necessity, and without directly striving for it, the U. S. Army Corps of Engineers could contribute toward the development of "socio-economic" theory. As Charles S. Peirce stated in 1893:

> To say that man accomplishes nothing but that to which his endeavors are directed would be a cruel condemnation of the great bulk of mankind and their families. But, without directly striving for it they perform all that civilization requires, and bring forth another generation to advance history another step. Their fruit is, therefore, collective; it is the achievement of the whole people. What is it, then, that the whole people is about, what is this civilization that is the outcome of history, but is never completed: We cannot expect to attain a complete conception of it; but we can see that it is a gradual process, that it involves a realization of ideas in man's consciousness and in his works, and that it takes place by virtue of man's capacity for learning, and by experience continually pouring upon him ideas that he has not yet acquired.
>
> . . . we are all putting our shoulders to the wheel for an end that none of us can catch more than a glimpse at--that which the generations are working out. But we can see that the development of embodied ideas is what it will consist in (3, p. ix).

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APPENDIX A

TABLE XI

U. S. ARMY ENGINEER DIVISIONS AND DISTRICTS

Division or District	Address
U. S. Army Engineer Division, Lower Mississippi Valley	P. O. Box 80 Vicksburg, Mississippi 39180
U. S. Army Engineer District, Memphis	668 Federal Office Building Memphis, Tennessee 38103
U. S. Army Engineer District, New Orleans	P. O. Box 60267 New Orleans, Louisiana 70160
U. S. Army Engineer District, St. Louis	906 Olive Street St. Louis, Missouri 63101
U. S. Army Engineer District, Vicksburg	P. O. Box 60 Vicksburg, Mississippi 39180
U. S. Army Engineer Division, Missouri River	P. O. Box 103 Downtown Station Omaha, Nebraska 68101
U. S. Army Engineer District, Kansas City	700 Federal Office Bldg. 601 East 12th Street Kansas City, Missouri 64106
U. S. Army Engineer District, Omaha	6012 U. S. Post Office and Court House 215 North 17th Street Omaha, Nebraska 68102

TABLE XI--Continued

Division or District	Address
U. S. Army Engineer Division, New England	. . . . . . 424 Trapelo Road Waltham, Massachusetts 02154
U. S. Army Engineer Division, North Atlantic	. . . . . . 90 Church Street New York, New York 10007
U. S. Army Engineer District, Baltimore	. . . . P. O. Box 1715 Baltimore, Maryland 21203
U. S. Army Engineer District, New York	. . . . Ill East 16th Street New York, New York 10003
U. S. Army Engineer District, Norfolk	. . . . Fort Norfolk 803 Front Street Norfolk, Virginia 23510
U. S. Army Engineer District, Philadelphia	. . . . Custom House 2nd and Chestnut Streets Philadelphia, Pennsylvania 19106
U. S. Army Engineer Division, North Central	. . . 536 South Clark Street Chicago, Illinois 60605
U. S. Army Engineer District, Buffalo	. . . Foot of Bridge Street Buffalo, New York 14207
U. S. Army Engineer District, Chicago	. . . . . . 219 South Dearborn Street Chicago, Illinois 60604
U. S. Army Engineer District, Detroit	. . . . P. O. Box 1027 Detroit, Michigan 48231
U. S. Army Engineer District, Rock Island	. . . . Clock Tower Building Rock Island, Illinois 61202

TABLE XI--Continued

Division or District	Address
U. S. Army Engineer District, St. Paul . . .	1217 U. S. Post Office and Customhouse St. Paul, Minnesota 55101
U. S. Army Engineer District, Lake Survey	630 Federal Building Detroit, Michigan 48226
U. S. Army Engineer Division, North Pacific	210 Custom House Portland, Oregon 97209
U. S. Army Engineer District, Alaska	P. O. Box 7002 Anchorage, Alaska 99051
U. S. Army Engineer District, Portland	628 Pittock Block Portland, Oregon 97205
U. S. Army Engineer District, Seattle . .	1519 Alaskan Way, South Seattle, Washington 98134
U. S. Army Engineer District, Walla Walla	Building 602 City-County Airport Walla Walla, Washington 99362
U. S. Army Engineer Division, Ohio River	P. O. Box 1159 Cincinnati, Ohio 45201
U. S. Army Engineer District, Huntington	P. O. Box 2127 Huntington, West Virginia 25271
U. S. Army Engineer District, Louisville	P. O. Box 59 Louisville, Kentucky 40201
U. S. Army Engineer District, Nashville	P. O. Box 1070 Nashville, Tennessee 37202

TABLE XI--Continued

Division or District	Address
U. S. Army Engineer District, Pittsburgh . . .	2032 Federal Building 1000 Liberty Avenue Pittsburgh, Pennsylvania 15222
U. S. Army Engineer Division, Pacific Ocean	Building 96 Fort Armstrong Honolulu, Hawaii 96813
U. S. Army Engineer Division, Honolulu	Building 96 Fort Armstrong Honolulu, Hawaii 96813
U. S. Army Engineer Division, South Atlantic	510 Title Building 30 Pryor Street, S. W. Atlanta, Georgia 30303
U. S. Army Engineer District, Charleston	P. O. Box 905 Charleston, South Carolina 29402
U. S. Army Engineer District, Jacksonville	P. O. Box 4970 Jacksonville, Florida 32201
U. S. Army Engineer District, Mobile	P. O. Box 1169 Mobile, Alabama 36601
U. S. Army Engineer District, Savannah	P. O. Box 889 Savannah, Georgia 31402
U. S. Army Engineer District, Wilmington	P. O. Box 1890 Wilmington, North Carolina 28401
U. S. Army Engineer Division, South Pacific	630 Sansome Street Room 1216 San Francisco, California 94111

TABLE XI--Continued

Division or District	Address
U. S. Army Engineer District, Los Angeles	. . . . P. O. Box 2711 Los Angeles, California 90053
U. S. Army Engineer District, Sacramento	. . . . 650 Capitol Mall Sacramento, California 95814
U. S. Army Engineer District, San Francisco	. . . 100 McAllister Street San Francisco, California 94102
U. S. Army Engineer Division, Southwestern	. . . . 1114 Commerce Street Dallas, Texas 75202
U. S. Army Engineer District, Albuquerque	. . . . P. O. Box 1580 Albuquerque, New Mexico 87103
U. S. Army Engineer District, Fort Worth	. . . . P. O. Box 17300 Fort Worth, Texas 76101
U. S. Army Engineer District, Galveston	. . . . P. O. Box 1229 Galveston, Texas 77550
U. S. Army Engineer District, Little Rock	. . . . P. O. Box 867 Little Rock, Arkansas 72203
U. S. Army Engineer District, Tulsa	. . . . P. O. Box 61 Tulsa, Oklahoma 74102

APPENDIX B

WORKSHEETS FOR DATA COMPILATION OF

SOCIO-ECONOMIC PROFILES

TABLE XII

TABULATION OF DATA: POPULATION GROWTH BY COUNTY AND COMPUTATION OF GROWTH RATES FOR COUNTY GROUPINGS AND OBERS AREA 118[a]

County	Population[b, c]		
	1950	1960	1970
Crawford, Arkansas[d]	22,727	21,318	25,677
Franklin, Arkansas[e]	12,358	10,213	11,301
Haskell, Oklahoma[e]	13,313	9,121	9,578
Latimer, Oklahoma[e]	9,690	7,738	8,601
Le Flore, Oklahoma[d]	35,276	29,106	32,137
Logan, Arkansas[e]	20,260	15,957	16,789
Pittsburg, Oklahoma[e]	41,031	34,360	37,521
Polk, Arkansas[e]	14,182	11,981	13,297
Pushmataha, Oklahoma[e]	12,001	9,088	9,385
Scott, Arkansas[e]	10,057	7,297	8,207
Sebastian, Arkansas[d]	64,202	66,685	79,237

TABLE XII--Continued

County	Population[b, c]		
	1950	1960	1970
Sequoyah, Oklahoma[d]	19,773	18,001	23,370
Yell, Arkansas[e]	14,057	11,940	14,208

[a]Sources: Arkansas data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C5, Table 43; Oklahoma data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C38, Table 43; U. S. data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C1, Table 68; 1950 and 1960 population data--the Bureau of the Census' County and City Data Book, 1967.

[b]U. S. population growth: 1950 to 1960 = +.185; 1960 to 1970 = +.132.

[c]OBERS area 118 population growth: 1950 to 1960 = -283,311 + 252,805 divided by 283,311 = -.108; 1960 to 1970 = +289,308 - 252,805 divided by 252,805 = +.144.

[d]Denotes county within SMSA; SMSA county group population growth: 1950 to 1960 = -136,262 + 135,110 divided by 136,262 = -.008; 1960 to 1970 = +160,421 - 135,110 divided by 135,110 = +.187.

[e]Denotes county within NMSA; NMSA county group population growth: 1950 to 1960 = -147,049 + 117,695 divided by 147,049 = -.20; 1960 to 1970 = +129,887 - 117,695 divided by 117,695 = +.104.

TABLE XIII

RATIO OF WORKERS TO NON-WORKERS IN OBERS AREA 118 TO THE UNITED STATES IN 1970[a, b, c]

County	Ratio Non-Worker to Worker	Population 1970	Number of Workers 1970
Crawford, Arkansas[d]	1.75	25,677	9,337
Franklin, Arkansas[e]	2.00	11,301	3,767
Haskell, Oklahoma[e]	2.05	9,578	3,140
Latimer, Oklahoma[e]	2.22	8,601	2,671
Le Flore, Oklahoma[d]	2.30	32,137	9,738
Logan, Arkansas[e]	1.94	16,789	5,711
Pittsburg, Oklahoma[e]	1.95	37,521	12,719
Polk, Arkansas[e]	1.90	13,297	4,585
Pushmataha, Oklahoma[e]	2.54	9,385	2,651
Scott, Arkansas[e]	1.91	8,207	2,820
Sebastian, Arkansas[d]	1.44	79,237	32,474
Sequoyah, Oklahoma[d]	2.20	23,370	7,303
Yell, Arkansas[e]	1.63	14,208	5,402

[a]Sources: Arkansas data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C5, Table 44; Oklahoma data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C38, Table 44; U. S. data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C1, Table 112.

TABLE XIII--Continued

[b]Ratio of non-workers to workers in the U. S. in 1970 = 1.45; number of workers in 1970 = 82,942,000; number of non-workers in 1970 = 120,267,000; ratio of workers to non-workers in the U. S. in 1970 = 82.9 divided by 120.3 = .69.

[c]Number of workers in OBERS area 118 in 1970 = 102,318; number of non-workers = 186,990; ratio of workers to non-workers = 102,318 divided by 186,990 = .55.

[d]Denotes county within SMSA; number of workers in SMSA = 58,852; number of non-workers = 101,569; ratio of workers to non-workers = 58,852 divided by 101,569 = .58.

[e]Denotes county within NMSA; number of workers in NMSA = 43,466; number of non-workers = 85,421; ratio of workers to non-workers = 43,466 divided by 85,421 = .51.

TABLE XIV

PERCENT OF TOTAL EMPLOYMENT IN 1970, NON-AGRICULTURAL[a], [b], [c]

County	Number Employed Over 15 Years of Age	
	Total	Agriculture
Crawford, Arkansas[d]	8,705	604
Franklin, Arkansas[e]	3,448	364
Haskell, Oklahoma[e]	2,952	370
Latimer, Oklahoma[e]	2,475	168
Le Flore, Oklahoma[d]	9,109	500
Logan, Arkansas[e]	5,264	517
Pittsburg, Oklahoma[e]	11,868	359
Polk, Arkansas[e]	4,290	435
Pushmataha, Oklahoma[e]	2,370	210
Scott, Arkansas[e]	2,656	199
Sebastian, Arkansas[d]	30,703	595
Sequoyah, Oklahoma[d]	6,864	355
Yell, Arkansas[e]	5,115	837

[a]Sources: Arkansas data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C5, Table 123; Oklahoma data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C38, Table 123; U. S. data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C1, Table 114.

TABLE XIV--Continued

[b]U. S. agricultural employment = 2,840,488; total employment = 76,553,599; 2,840,488 divided by 76,553,599 = .037; percent non-agricultural = 1.00 - .037 = .963.

[c]OBERS area 118 agricultural employment = 5,513; total employment = 95,819; 5,513 divided by 95,819 = .058; percent non-agricultural = 1.00 - .058 = .942.

[d]Denotes county within SMSA; SMSA agricultural employment = 2,054; total employment = 55,381; 2,054 divided by 55,381 = .037; percent non-agricultural = 1.00 - .037 = .963.

[e]Denotes county within NMSA; NMSA agricultural employment = 3,459; total employment = 40,438; 3,459 divided by 40,438 = .086; percent non-agricultural = 1.00 - .086 = .914.

TABLE XV

TABULATION OF DATA: 1969 PER CAPITA PERSONAL INCOME OF 1970 POPULATION BY COUNTY DERIVED FOR SMSA/NMSA COUNTY GROUPS AND OBERS AREA 118[a], [b], [c]

County	Reported Per Capita Personal Income 1969	Population 1970	Total Personal Income, 1969
Crawford, Arkansas[d]	1,944	25,700	49,961,000
Franklin, Arkansas[e]	1,801	11,300	20,351,000
Haskell, Oklahoma[e]	1,719	9,600	16,502,000
Latimer, Oklahoma[e]	1,737	8,600	14,938,000
Le Flore, Oklahoma[d]	1,793	32,100	57,555,000
Logan, Arkansas[e]	1,801	16,800	30,257,000
Pittsburg, Oklahoma[e]	2,234	37,500	83,775,000
Polk, Arkansas[e]	2,086	13,300	27,744,000
Pushmataha, Oklahoma[e]	1,572	9,400	14,777,000
Scott, Arkansas[e]	1,733	8,200	14,211,000
Sebastian, Arkansas[d]	2,636	79,200	208,771,000
Sequoyah, Oklahoma[d]	1,710	23,300	39,843,000
Yell, Arkansas[e]	1,995	14,200	28,329,000

[a]Sources: Arkansas data--*General Social and Economic Characteristics: U. S. Census of Population, 1970*, PC (1)-C5, Tables 43 and 124; Oklahoma data--*General Social and Economic Characteristics: U. S. Census of Population, 1970*, PC (1)-C38, Tables 43 and 124; U. S. data--*Statistical Abstract of the United States, 1971*, Table 497.

TABLE XV--Continued

[b]U. S. per capita personal income = $3,698.

[c]Total personal income for OBERS area 118 = $607,014,000; total population = 289,200; per capita personal income = 607,014,000 divided by 289,200 = $2,099.

[d]Denotes county within SMSA; total personal income = $356,130,000; total population = 160,300; per capita personal income = 356,130,000 divided by 160,300 = $2,222.

[e]Denotes county within NMSA; total personal income = $250,884,000; total population = 128,900; per capita personal income = 250,884,000 divided by 128,900 = $1,946.

TABLE XVI

TABULATION OF DATA: PERCENT OF PERSONS IN 1970 WITH LESS THAN POVERTY INCOME IN 1969[a, b, c]

County	Number of Persons in 1970 With Less Than Poverty Level Incomes in 1969
Crawford, Arkansas[d]	6,458
Franklin, Arkansas[e]	3,338
Haskell, Oklahoma[e]	3,074
Latimer, Oklahoma[e]	2,806
Le Flore, Oklahoma[d]	10,972
Logan, Arkansas[e]	5,064
Pittsburg, Oklahoma[e]	7,378
Polk, Arkansas[e]	6,641
Pushmataha, Oklahoma[e]	4,209
Scott, Arkansas[e]	2,547
Sebastian, Arkansas[d]	13,287
Sequoyah, Oklahoma[d]	7,588
Yell, Arkansas[e]	3,044

[a]Sources: Arkansas data--*General Social and Economic Characteristics: U. S. Census of Population, 1970*, PC (1)-C5, Table 124; Oklahoma data--*General Social and Economic Characteristics: U. S. Census of Population, 1970* PC (1)-C38, Table 124; U. S. data--*General Social and Economic Characteristics: U. S. Census of Population, 1970*, PC (1)-C1, Table 95.

TABLE XVI--Continued

[b]U. S. percent in poverty = 13.7.

[c]OBERS area 118 number in poverty = 76,406; total population = 289,308; percent in poverty = 76,406 divided by 289,308 = 26.4.

[d]Denotes county within SMSA; number in poverty = 38,305; total population = 160,421; percent in poverty = 38,305 divided by 160,421 = 23.8.

[e]Denotes county within NMSA; number in poverty = 38,101; total population = 128,887; percent in poverty = 38,101 divided by 128,887 = 29.6.

TABLE XVII

TABULATION OF DATA: PERCENT OF PERSONS 25 YEARS OLD AND OVER WITH HIGH SCHOOL EDUCATION OR MORE AND DERIVED PERCENT FOR SMSA/NMSA COUNTY GROUPS AND OBERS AREA 118[a, b, c]

County	Male Population		Female Population	
	Percent Reported	Derived Number	Percent Reported	Derived Number
Crawford, Arkansas[d]	34.9	6,913	37.9	7,471
Franklin, Arkansas[e]	35.0	3,190	34.9	3,460
Haskell, Oklahoma[e]	28.3	2,721	25.7	2,965
Latimer, Oklahoma[e]	32.2	2,260	34.6	2,451
Le Flore, Oklahoma[d]	34.6	8,766	31.2	9,883
Logan, Arkansas[e]	27.9	4,852	32.9	5,302
Pittsburg, Oklahoma[e]	39.6	11,220	41.9	11,448
Polk, Arkansas[e]	34.4	3,915	35.6	4,258
Pushmataha, Oklahoma[e]	38.9	2,671	32.7	2,973
Scott, Arkansas[e]	27.3	2,418	27.3	2,538
Sebastian, Arkansas[d]	50.9	20,481	49.2	24,049
Sequoyah, Oklahoma[d]	32.3	5,997	33.0	6,533
Yell, Arkansas[e]	32.1	4,014	36.2	4,403

[a]Sources: Arkansas data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (I)-C5, Table 120; Oklahoma data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (I)-

TABLE XVII--Continued

C38, Table 120; U. S. data--*General Social and Economic Characteristics*: *U. S. Census of Population, 1970, PC* (1)-*C1, Table 110.*

[b]Percent of persons in the U. S. 25 years old and over with high school education or more = .52.

[c]Number of persons in OBERS area 118 25 years old and over with high school education or more = 60,017; total population (male and female) over 25 years of age = 167,172; percent of persons over 25 with high school education or more = 60,017 divided by 167,172 = .36 (36%).

[d]Denotes county within SMSA; number of persons with high school or more education = 37,721; total population (male and female) over 25 years of age = 90,113; percent of persons over 25 with high school education or more = 37,721 divided by 90,113 = .42 (42%).

[e]Denotes count within NMSA; number of persons with high school or more education = 22,296; total population (male and female) over 25 years of age = 77,059; percent of persons over 25 with high school education or more = 22,296 divided by 77,059 = .29 (29%).

TABLE XVIII

TABULATION OF DATA: INFANT DEATHS PER 100,000 LIVE BIRTHS BY COUNTY AND ESTIMATED INFANT MORTALITY RATES DERIVED FOR SMSA COUNTY/ NMSA COUNTY GROUPS AND OBERS AREA 118[a, b, c]

County	Infant Deaths Per 100,000 Live Births 1964	Weights for Averaging (1970 County Population)
Crawford, Arkansas[d]	2,057	25.7
Franklin, Arkansas[e]	1,595	11.3
Haskell, Oklahoma[e]	2,083	9.6
Latimer, Oklahoma[e]	1,818	8.6
Le Flore, Oklahoma[d]	1,736	32.1
Logan, Arkansas[e]	359	16.8
Pittsburg, Oklahoma[e]	2,037	37.5
Polk, Arkansas[e]	1,010	13.2
Pushmataha, Oklahoma[e]	1,829	9.4
Scott, Arkansas[e]	Not reported	. . .
Sebastian, Arkansas[d]	1,524	79.2
Sequoyah, Oklahoma[d]	961	23.4
Yell, Arkansas[e]	1,515	14.2

[a]Sources: Office of Economic Opportunity, Community Profile Project, A Report of the Information Center of the Office of Economic Opportunity, Springfield, Va., 1967, p. 5.

TABLE XVIII--Continued

[b]Infant deaths per 100,000 live births in the U. S. = 1700.

[c]Infant deaths per 100,000 live births in OBERS area 118 = 437,832 divided by 282.0 = 1553.

[d]Denotes county within SMSA; infant deaths per 100,000 live births = 249,721 divided by 160.4 = 1557.

[e]Denotes county within NMSA; infant deaths per 100,000 live births = 188,111 divided by 121.6 = 1547.

TABLE XIX

TABULATION OF DATA: DIVORCES IN 1968 PER 1,000 POPULATION IN 1970 BY COUNTY AND ESTIMATED DIVORCE RATES FOR SMSA COUNTY/NMSA COUNTY GROUPS AND OBERS AREA 118[a, b, c]

County	Divorces Recorded in 1968
Crawford, Arkansas[d]	93
Franklin, Arkansas[e]	30
Haskell, Oklahoma[e]	37
Latimer, Oklahoma[e]	25
Le Flore, Oklahoma[d]	256
Logan, Arkansas[e]	64
Pittsburg, Oklahoma[e]	236
Polk, Arkansas[e]	72
Pushmataha, Oklahoma[e]	51
Scott, Arkansas[e]	34
Sebastian, Arkansas[d]	401
Sequoyah, Oklahoma[d]	116
Yell, Arkansas[e]	2

[a]Sources: Arkansas data--_1972 Arkansas Almanac_, p. 253; Oklahoma data--telephone interview with Nancy Keeling, Bureau of Vital Statistics of the State of Oklahoma; U. S. data--_Statistical Abstract of the United States, 1971_, Table 79.

[b]U. S. divorce rate per 1,000 population = 2.9.

TABLE XIX--Continued

[c]OBERS area 118 divorce rate: divorces in 1968 = 1417; population in 1970 = 289,308; 1417 divided by 289,308 = 4.9.

[d]Denotes county within SMSA; SMSA divorce rate: divorces in 1968 = 866; population in 1970 = 160,421; 866 divided by 160,421 = 5.4.

[e]Denotes county within NMSA; NMSA divorce rate: divorces in 1968 = 551; population in 1970 = 128,887; 551 divided by 128,887 = 4.3.

TABLE XX

TABULATION OF DATA: PERCENT OF PERSONS RESIDING IN THE STATE OF THEIR BIRTH AND DERIVED PERCENTAGE FOR SMSA/NMSA COUNTY GROUPS AND OBERS AREA 118[a, b, c]

County	Reported Percentage	Population in 1970	Derived Number of Persons Residing in the State of Birth
Crawford, Arkansas[d]	71.8	25,700	18,452
Franklin, Arkansas[e]	77.0	11,300	8,701
Haskell, Oklahoma[e]	73.6	9,600	7,065
Latimer, Oklahoma[e]	74.6	8,600	6,416
Le Flore, Oklahoma[d]	64.1	32,100	20,576
Logan, Arkansas[e]	77.1	16,800	12,953
Pittsburg, Oklahoma[e]	70.2	37,500	26,325
Polk, Arkansas[e]	60.3	13,300	8,020
Pushmataha, Oklahoma[e]	66.8	9,400	6,279
Scott, Arkansas[e]	71.7	8,200	5,879
Sebastian, Arkansas[d]	65.9	79,200	52,193
Sequoyah, Oklahoma[d]	66.1	23,300	15,401
Yell, Arkansas[e]	78.5	14,200	11,147

[a]Sources: Arkansas data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C5, Table 43; Oklahoma data--General Social and Economic Characteristics: U. S. Census of Population, 1970, PC (1)-C38, Table 43; U. S. data--General Social and Economic

TABLE XX--*Continued*

Characteristics: *U. S. Census of Population, 1970* PC (1)-C1, Table 87 and *Statistical Abstract of the United States, 1971*, Table 2.

[b]U. S. data--number residing in state of birth = 131,609,789; population in 1970 = 201,647,000; percentage = 131,609,789 divided by 201,647,000 = .65 = 65%.

[c]OBERS area 118 data--number residing in state of birth = 199,407; population in 1970 = 289,200; percentage = 199,407 divided by 289,200 = .69 = 69%.

[d]Denotes county within SMSA; number residing in state of birth = 106,662; population in 1970 = 160,300; percentage = 106,662 divided by 160,300 = .67 = 67%.

[e]Denotes county within NMSA; number residing in state of birth = 92,785; population in 1970 = 128,900; percentage = 92,785 divided by 128,900 = .72 = 72%.

TABLE XXI

COMPUTATION OF DEVIANCE OF SELECTED INDICATOR STATISTICS FOR SMSA COUNTY GROUP FROM NATIONAL AVERAGES

Indicator	U. S. Average (x)	SMSA County Average (y)	Deviance* (D)
Population growth, 1950-1960	.185	- .008	-1.04 (-104%)
Population growth, 1960-1970	.132	.187	.42 (42%)
Ratio workers to non-workers, 1970	.690	.580	- .16 (- 16%)
Percent of workers non-agricultural, 1970	.963	.963	N.C.
Per capita personal income, 1960	3698.000	2222.000	- .40 (- 40%)
Percent of persons in poverty, 1969	.137	.238	.74 (74%)
Percent of persons over 25 with high school education or more, 1970	.520	.420	- .19 (- 19%)
Infant mortality rate, 1964	1700.000	1557.000	- .08 (- 8%)
Divorce rates, 1968	2.900	5.400	.86 (86%)
Percent of population born in state, 1970	.650	.670	.03 (3%)

*Formula for determining deviance:

$$D = \frac{y - x}{x}$$

where x = U. S. average and y = SMSA county average.

TABLE XXII

COMPUTATION OF DEVIANCE OF SELECTED INDICATOR STATISTICS FOR NMSA COUNTY GROUP FROM NATIONAL AVERAGES

Indicator	U. S. Average (x)	NMSA County Average (y)	Deviance* (D)
Population growth, 1950-1960	.185	- .200	-2.08 (-208%)
Population growth, 1960-1970	.132	.104	- .21 (- 21%)
Ratio workers to non-workers, 1970	.690	.510	- .26 (- 26%)
Percent of workers non-agricultural, 1970	.963	.914	- .05 (- 5%)
Per capita personal income, 1960	3698.000	1946.000	- .47 (- 47%)
Percent of persons in poverty, 1969	.137	.296	1.59 (159%)
Percent of persons over 25 with high school education or more, 1970	.520	.290	- .44 (- 44%)
Infant mortality rate, 1964	1700.000	1547.000	- .09 (- 9%)
Divorce rates, 1968	2.900	4.300	.48 (48%)
Percent of population born in state, 1970	.650	.720	.11 (11%)

*Formula for determining deviance:

$$D = \frac{y - x}{x}$$

where x = U. S. average and y = NMSA county average.

TABLE XXIII

COMPUTATION OF DEVIANCE OF SELECTED INDICATOR STATISTICS FOR OBERS AREA 118 FROM NATIONAL AVERAGES

Indicator	U. S. Average (x)	OBERS Area 118 Average (y)	Deviance* (D)
Population growth, 1950-1960	.185	- .108	-1.58 (-158%)
Population growth, 1960-1970	.132	.144	.09 (9%)
Ratio workers to non-workers, 1970	.690	.550	- .20 (- 20%)
Percent of workers non-agricultural, 1970	.963	.942	- .02 (- 2%)
Per capita personal income, 1960	3698.000	2099.000	- .43 (- 43%)
Percent of persons in poverty, 1969	.137	.264	.93 (93%)
Percent of persons over 25 with high school education or more, 1970	.520	.360	- .31 (- 31%)
Infant mortality rate, 1964	1700.000	1553.000	- .09 (- 9%)
Divorce rates, 1968	2.900	4.900	- .69 (- 69%)
Percent of population born in state, 1970	.650	.690	.06 (6%)

*Formula for determining deviance:

$$D = \frac{y - x}{x}$$

where x = U. S. average and y = OBERS area 118 average.

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