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## State Financing Alternatives for Water Projects Required to Support Energy Development in the Western Energy Development Area

Daniel H. Hoggan

Kirk R. Kimball

Edward H. Allen

Jay M. Bagley

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A Research Proposal Entitled

STATE FINANCING ALTERNATIVES FOR WATER PROJECTS  
REQUIRED TO SUPPORT ENERGY DEVELOPMENT IN  
THE WESTERN ENERGY DEVELOPMENT AREA

Submitted to the Director,  
Office of Water Research and Technology  
Department of the Interior  
Washington, D.C. 20240

By

Daniel H. Hoggan  
Kirk R. Kimball  
Edward H. Allen  
Jay M. Bagley  
Richard L. Dewsnup  
Herbert H. Fullerton

Through the  
Utah Center for Water Resources Research  
Utah State University  
Logan, Utah 84322

November, 1977

FINANCIAL PLAN - TIME-COST ESTIMATE - TITLE I PROJECTS - FY 19

STATE: INDIA PROPOSED: ANNUAL ALLOTMENT  MATCHING GRANT  PROJECT

NEW  CONTINUING  PROJECT 1/  
 PROPOSED OR ACTUAL STARTING DATE: 10/1/78  
 PROPOSED COMPLETION DATE: 9/30/80  
 FCCSET CATEGORY 6-0

PROJECT TITLE: State Financing Alternatives  
 for Water Projects Required to Support  
 Energy Development in the Western Energy  
 Development Area

PRINCIPAL INVESTIGATOR(S): Daniel H. Hoggan Richard L. Dewsnup  
 Kirk R. Kimball Herbert H. Fullerton  
 J. L. Allen  
 G. A. Bagley  
 PROJECT NUMBER  
 (ASSIGNED BY OWRT)

COST CATEGORIES	MAN-MONTHS	ESTIMATED COSTS		
		FEDERAL \$	NON-FEDERAL \$	TOTAL \$
<b>1. DIRECT COSTS</b>				
A. SALARIES AND WAGES	TOTAL:	32,400	19,200	51,600
PRINCIPAL INVESTIGATOR(S)				
NO: 1	MAN-MONTHS: 7	( 21,000 )	( )	( 21,000 )
OTHER PROFESSIONAL STAFF				
NO: 2	MAN-MONTHS: 24	( )	( 19,200 )	( 19,200 )
GRADUATE STUDENT ASSTS & TECH.				
NO: 2	MAN-MONTHS: 24	( 7,200 )	( )	( 7,200 )
UNDERGRADUATE STUDENT ASSTS & TECH.				
NO: 1	MAN-MONTHS: 4	( )	( )	( )
ON-STUDENT TECHNICIANS & OTHERS				
NO: 1	MAN-MONTHS: 4	( 4,200 )	( )	( 4,200 )
B. EMPLOYEE BENEFITS	TOTAL:	6,876	4,608	11,484
C. NON-EXPENDABLE PROPERTY <u>2/</u>	TOTAL:			
D. EXPENDABLE PROPERTY	TOTAL:	1,000		1,000
E. OTHER DIRECT COSTS <u>3/</u>	TOTAL:	21,796	7,304	29,100
Consultants		( 9,550 )	( 5,950 )	( 15,500 )
Travel		( 8,500 )	( )	( 8,500 )
Telephone		( 2,100 )	( )	( 2,100 )
Final report review copies and publication costs		( 1,646 )	( 1,354 )	( 3,000 )
<b>TOTAL DIRECT COSTS</b>		<b>62,072</b>	<b>31,112</b>	<b>93,184</b>
<b>2. INDIRECT COSTS <u>4/</u> BASED ON 60% OF I.A.</b>		<b>--</b>	<b>30,960</b>	<b>30,960</b>
<b>TOTAL PROJECT COSTS</b>		<b>62,072</b>	<b>62,072</b>	<b>124,144</b>

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2/ NON-EXPENDABLE PROPERTY IS PROPERTY HAVING A CONTINUING USE AS A SELF-CONTAINED UNIT; IS NOT CONSUMED IN USE; DOES NOT ORDINARILY BECOME A FIXTURE OR LOSE ITS IDENTITY OR FORM A COMPONENT OF EQUIPMENT, MACHINERY, ETC. LIST INDIVIDUAL ITEMS ON ATTACHED SHEET PROVIDING A NARRATIVE JUSTIFICATION FOR INDIVIDUAL ITEMS COSTING \$1,000 OR MORE.

3/ SPECIFY OTHER COSTS SUCH AS TRAVEL, REPRODUCTION, ETC.

4/ INDIRECT COSTS ARE TO BE BASED ON AUDITED RATES.

Research Proposal

to the

Office of Water Research and Technology  
U.S. Department of the Interior

Submitting Agency

Utah Water Research Laboratory through the Utah Center for Water  
Resources Research, Utah State University, Logan, Utah 84322

Title of Proposed Research

State Financing Alternatives for Water Projects Required to Support  
Energy Development in the Western Energy Development Area

Desired Starting Date

October 1, 1978

Time Period for Which Support is Requested

24 months--October 1, 1978 to September 30, 1980

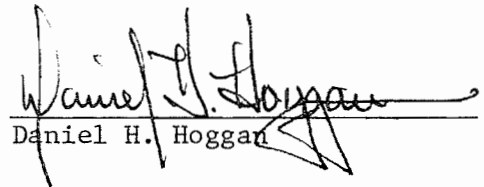
Funds Requested

Federal - \$62,072

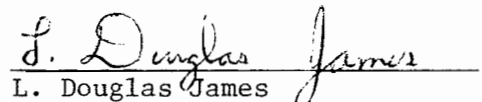
Non-federal \$62,072

Approved

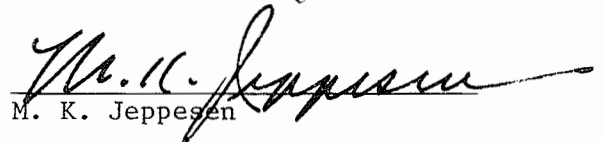
Principal Investigator

  
Daniel H. Hoggan

Director, Utah Water Research  
Laboratory and Utah Center for  
Water Resources Research

  
L. Douglas James

Contracts/Grants Officer  
Utah State University

  
M. K. Jeppesen

## Executive Summary

Title: State Financing Alternatives for Water Projects Required to Support Energy Development in the Western Energy Development Area

### Principal Investigators:

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(801) 322-2713

Duration: 24 months

Amount Requested: \$62,072

### The Problem and Approach:

As competing demands for federal funds, environmental pressures, and resistance to underwriting uneconomic projects have become more intense during recent years, federal spending for water resources development projects has diminished. As a result of this and other factors, states are feeling the pressure to assume more responsibility for financing water projects. Many states see a justification for investing in water resources development due to the multi-objective, multi-purpose orientation of public projects, the potential for generating water development capital, and the retention of control of the water resources to prevent misallocations in the long term, which would be detrimental to the public interest. In the Western States of Montana, Wyoming, Utah, Colorado, and New Mexico where extensive energy resources, including coal, oil shale, and uranium exist, the financing of water projects to support energy development is emerging as a significant problem. These states are faced with the prospect of expanding the use of traditional sources of capital financing-- long term debt and tax revenues -- as well as exploring new sources of finance to meet this demand.

### Research Contribution:

Several major studies already completed have dealt with energy resources assessment and development technologies, and several investigations

have been completed on the impacts of energy development on water resources. This proposed study will build upon this body of knowledge and explore financing alternatives for the water projects required to support energy development.

#### Research Objective:

The manner in which water resources are allocated and developed to meet energy development requirements has serious implications with respect to a state's responsibility and ability to manage these resources in the best interest of the public. The financing of water projects to support energy development in the Western Energy Development Area, as described above, is emerging as a significant problem. The overall objective of this research is to develop information on capital financing alternatives that state governments might consider for water projects to support energy development.

#### Research Approach:

The approach utilized in this project consists of seven major tasks represented by the seven objectives listed in the proposal. These tasks are as follows: (1) preparation of an inventory of potential water projects required for supporting energy development in the Western Energy Development Area (Montana, Wyoming, Utah, Colorado, and New Mexico), (2) assessment of state capital financing requirements for these projects, (3) analysis of the financial characteristics of these projects, (4) evaluation of alternative sources of capital finance, such as expansion of long term debt, special appropriations, revolving development funds, earmarked revenues, user fees, and other forms of taxes, (5) synthesis of the information developed in the aforementioned tasks in the formulation of typical future water project financing scenarios, (6) utilization of the scenarios and identified evaluation criteria to analyze the effects of changes in economic, financial, legal, and institutional conditions on the feasibility of capital financing alternatives, and (7) preparation of conclusions and recommendations.

#### Users of Research Results:

The principal users of the research results will be the water management agencies in the five states of the study region. These agencies will be able, because of the sensitivity analysis performed in Task 6, to directly apply the findings on the feasibility of financing alternatives to projects and conditions in each of their respective states. Much of the basic information developed in the study will have broad application to water project financing in all states and for all types of projects. The project will add significantly to the body of knowledge in public finance and will be useful to other researchers and scholars concerned with this subject.

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## Project Objectives

The manner in which water resources are allocated and developed to meet energy development requirements has serious implications with respect to the state's responsibility and ability to manage these resources in the best interest of the public. In the Western States of Montana, Wyoming, Utah, Colorado, and New Mexico where extensive energy resources, including coal, oil shale, and uranium exist, the financing of water projects to support energy development is emerging as a significant problem. The overall objective of this research is to develop information on capital financing alternatives that state governments might consider for water projects to support energy development. To achieve the main objective, seven sub-objectives or tasks will be accomplished as follows:

1. Prepare an inventory of potential water projects required to support energy development in the Western Energy Development Area.
2. Assess state capital financing requirements for these water projects.
3. Identify and analyze the financial characteristics of these potential water projects.
4. Evaluate alternative sources of state capital finance, such as expansion of long-term debt, special appropriations, revolving development funds, earmarked revenues, user fees, and other forms of taxes.
5. Synthesize the information developed under Objectives 2,3, and 4 in the formulation of typical future water project financing scenarios.
6. Utilizing the scenarios of Objective 5, analyze the effects of changes in economic, financial, legal, and institutional conditions on the feasibility of capital financing alternatives.
7. Prepare recommendations on capital financing alternatives of state governments for water projects to support energy development.



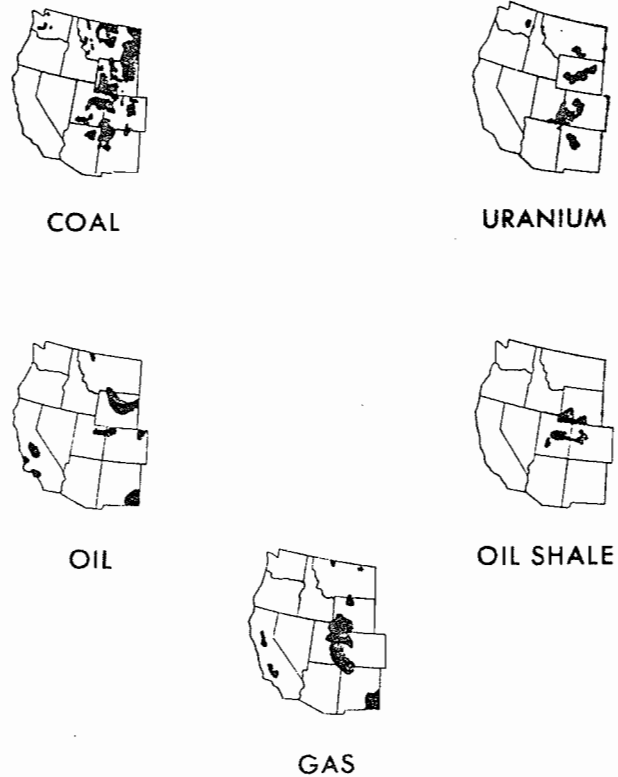
## Research Procedure

Objective 1: Prepare an inventory of potential water projects required to support energy development in the Western Energy Development Area.

This area, encompassing several western states as described in Figure 1, contains vast amounts of energy resources, including oil shale, coal, uranium, and tar sands. Estimates of water requirements to support development of known energy resources in this region have been made and a number of potential water supply projects have been identified. Preliminary design work has been completed on some of these such as the White River Project in Utah, which would supply water primarily for oil shale development.

As a basis for this study on water project financing alternatives, an inventory will be made at the outset of potential water projects required to support energy development in the region. Study reports and planning documents will be reviewed, and officials at state energy offices and state water development agencies will be interviewed in order to identify potential projects. The projects will be compiled and categorized according to type (single or multi-purpose, groundwater and/or surface water, large or small scale, low or high intensity of capital investment, and so forth). Indications of project viability, such as benefit-cost ratios, water rights availability, and environmental impacts also will be compiled to assess the importance or priority of the identified projects in meeting water development requirements. It is assumed that the data for completing this task is available from water agencies in each of the states, having been accumulated in state

water planning studies. Thus, the major effort envisioned for this task will be in compiling and analyzing available data.



Note: The Western Development Area encompasses the states of Montana, Wyoming, Utah, Colorado and New Mexico which as this figure indicates contain vast amounts of coal, oil shale, and uranium.

Figure 1. Distribution of mineral energy reserves in the West, (from Bureau of Reclamation. 1975. The Westwide Study: A Study of Critical Western Water Problems. Government Printing Office, Washington, D.C.)

Objective 2: Assess state capital financing requirements for water projects required to support energy development.

The nature of the water requirements and conditions at the geographical location of an energy site will largely dictate the appropriate type of water development. In some cases, for example, where sufficient supplies might be pumped from groundwater reservoirs without interfering with other beneficial uses, private development would probably be indicated. In other cases in which water could be developed for multiple uses, it may be appropriate for the state or some other government entity to do the development. Otherwise, valuable purposes not related to the limited interests of the private developer may not be included.

In the administration of water rights and water allocations, states have the responsibility to manage water resources in an efficient and productive manner to serve the public interest. Since the value to society of various water uses change over time, it may be appropriate for states to retain some control so that adjustments in allocations can be made in the long run. Such control can be assured if states develop and manage some of the available resources rather than turning them entirely over to private development. Furthermore, some states see the development of energy-related water projects as an investment opportunity that will generate funds for other worthwhile projects.

Under this second project objective, the water development projects compiled under Objective 1 will be reviewed to identify those which have been or are being considered for state financing. A list of potential state projects or projects having an element of state financial participation will be prepared, and the potential requirement for state capital

financing will be assessed. The source of this information, again, largely will be the energy and water studies already completed by state agencies and others. Descriptive information on economic and financial characteristics of the identified projects will be compiled for use under Objective 3.

Objective 3: Identify and analyze the financial characteristics of these potential water projects.

Utilizing the data obtained in the preceding objectives with respect to identification of major energy development projects in the study area and their associated water requirements, the financial characteristics of the various water projects will be identified and described.

Various financial characteristics associated with the different energy-related water projects will be examined, including mix of multiple purposes, allocation of costs, front end capital requirements, patterns of operation and maintenance costs, market conditions and demand projections, duration and pattern of benefit streams, repayment periods and capacities, and risk factors. The generation of the desired financial data will require liaison with state water and energy development agencies.

Objective 4: Evaluate alternative sources of state capital financing, such as expansion of long-term debt, special appropriations, revolving development funds, earmarked revenues, user fees, and other forms of taxes.

Although some features of the financing alternatives examined may require only routine financial analysis, the impetus of western energy development is likely to require new financing alternatives and the creation of intermediary financial institutions. Private financial analysis

has traditionally examined the more limited aspects of specific financial problems. The proposed research is necessary to provide the broader framework within which the new problems associated with energy-related water development financing may be analyzed.

Since long-term debt, consisting of revenue bonds or non-guaranteed debt and general obligation bonds, which have "full faith and credit" backing of the issuing government, traditionally has been the major source of capital financing for states, expanded use of this source for new water development capital will be examined. The status of legal debt limitations in each of the states will be reviewed, including changes in constitutional restrictions, interest rate ceilings, maturity limitations, and so forth. Practices related to circumventing long-term debt limitations also will be examined such as the utilization of lease purchase arrangements, the shifting of financing responsibility from state governments to less restricted special districts and authorities, and the issuance of non-guaranteed debt (revenue bonds) in lieu of guaranteed debt (general obligation bonds). The information for this part of the study will be obtained through correspondence and interviews with treasury and water development agency officials in each of the states involved.

Further, in connection with long-term borrowing possibilities, the availability of credit resources and credit conditions related to the prospective borrowing entities will be considered. Inquiries will be made to investment banking specialists and municipal bond dealers to ascertain current and potential bond market conditions. The record of borrowing experience and the organizational mechanisms available to issue

long term debt in the states will be examined as well as current credit ratings. The establishment of intermediary financial institutions and other innovative arrangements to facilitate capital financing of water projects will be explored.

With respect to the question of increasing appropriations as a source of additional water project funds, the record of the various states in making appropriations for water projects will be reviewed. Some, if not all, of the states have established revolving loan funds for providing water project capital to local entities. The nature and size of these funds will be examined and the possibilities for expanding them to meet new energy-related water project capital requirements will be explored.

State water user fees are a possible new source of revenue that might be utilized to service bonds or be earmarked for water development funds. In a broad sense, a user fee might be considered as any form of a charge imposed upon a user for the use of a resource. Sales taxes, severance taxes, excise taxes, tolls, entrance fees, water rates, and so forth all could be considered as user fees under this broad definition. In the case of water users, fees could be employed in a number of ways. They might be charged on amounts of water actually used or on rights to use water irrespective of amounts used. They might be designed to cover the costs of development or to charge the users merely for the privilege of utilizing the resource itself, unrelated to development costs. For some uses, the charge might be made directly on the quantity consumed or diverted; for others, the charges might have to be made indirectly

on projects or services related to the water resource. Under the concept of state or public ownership of water resources, states might employ user fees similar to excise or severance taxes. Imposing a charge, or surcharge, as the case may be for the use of the resource per se. User fees and other forms of taxes will be analyzed along with other possible sources of capital.

State governments vary considerably both in their capacity to raise revenue through taxation and in the extent to which they have utilized fiscal capacity (taxable resources) available to them. It is impractical to assess in an absolute way what a state's fiscal capacity is or what its tax effort should be, but interstate comparisons based upon census data and studies by the Advisory Commission on Intergovernmental Relations, will be used to indicate where untapped fiscal resources exist.

Objective 5: Synthesize the information developed under Objective 2, 3, and 4 in the formulation of typical future water project scenarios.

At a given energy development location, physical, economic, and legal conditions would dictate the type of water project that would be appropriate. As between different energy sites, the water projects would probably vary according to scale, number and variety of purposes served, legal and institutional constraints, risk, and other factors that would affect the feasibility of financing options. Rather than analyze all of the conditions at all of the sites in the region independently, the technique used in this research to analyze the range of conditions that exist will be to synthesize one or more typical scenarios.

The scenarios will define a given set of physical, economic, legal, and institutional conditions and financing arrangements. For example one scenario may describe a water project for developing a coal field, the project also having hydro power, irrigation, municipal supply and recreation features. The legal and institutional conditions at the project site would be specified. State and local government organizations, programs and regulations as they would effect the financing problem would be defined. Markets and other economic conditions related to the products of the project would be specified and so forth. The scenario would be developed from an analysis of planned projects and actual conditions to arrive at a probable set of conditions at an energy development site.

Water projects may have significant effects on income distribution and other aspects of a region's economy. Although such effects need to be studied and understood in the process of deciding which water projects should be built and by whom, extensive economic feasibility analyses are beyond the scope of this project. Economic, political, and social feasibility as well as financial feasibility are all pertinent to the political decision process, but this study deals primarily with the latter. Assumptions concerning economic effects of water project investments, based on regional economic studies which have already been done will be used. The tests of financial feasibility incorporated in this approach will be conservative in that estimates of economic expansion in the private sector resulting from the water projects analyzed will be held to conservative levels.



Once the scenario or scenarios are constructed, the given set of conditions may be varied in a form of sensitivity analysis to simulate different sets of conditions anticipated at actual energy sites and to analyze the effects of changed conditions on financing options (objective 6).

Objective 6: Utilizing the scenarios of Objective 5, analyze the effects of changes in economic, financial, and legal conditions on the feasibility of capital financing alternatives.

The scenarios developed in Objective 5 will be utilized as a base line or control for studying changes in water project variables and isolating the impacts of these changes on the financial feasibility of state funding alternatives. To accomplish this objective, three tasks will be completed.

First, criteria for evaluating financial feasibility will be identified from a review of pertinent economic and public finance literature. Examples of possible criteria are funding availability, repayment potential, and administrative efficiency.

Following the completion of the first task, the financing arrangements associated with the scenarios, which constitute the initial conditions, will be evaluated with the criteria to determine financial feasibility. From this evaluation, a base line or set of initial performance conditions, will be identified.

The final step of this procedure involves changing certain financial, economic, and legal constraining parameters of the scenarios to assess the impacts on the feasibility of the selected funding methods. By controlling

for project type, funding source, and institutional characteristics, it is possible to assess the specific effect of parameter changes on state financing alternative feasibilities. This will provide valuable information about the desirability of the funding alternatives to those states whose constraining parameters are variations of the scenarios.

Objective 7: Prepare recommendations on financing alternatives for energy related water projects.

Based upon the information and findings of the work performed under all of the foregoing objectives, particularly the sensitivity analysis under Objective 6, recommendations concerning the most feasible financing alternatives will be deduced. The pros and cons of utilizing various sources and combinations of sources of financing in connection with different types of projects will be listed and discussed. The recommendations will be organized so that state organizations, with widely varying energy and water resources conditions may utilize the findings and recommendations to work out suitable financing arrangements.

#### Relevance of the Research

As competing demands for federal funds have become more intense during recent years, federal spending for water resources development projects has been diminishing. As a result of this and other factors such as inflation, which decreases the amount of water development a dollar will buy, states are feeling the pressure to assume more responsibility for financing water projects. Although the reduction in Federal spending probably has resulted also from efforts to curtail the underwriting of uneconomic projects, some economically feasible projects may

be jeopardized in the process. In at least one area of water development with which this research project is concerned--that required to support energy development--no specific federal program has been established. Some states see a justification for investing in water resources development to provide for multiple objectives and multi-purposes, to generate water development capital, and to retain control of the water resources to prevent misallocations in the long term which would be detrimental to the public interest.

The major sources of capital financing available to state governments include bond proceeds, tax revenues, and federal financial aid. Long-term debt (bonds) has financed the largest share of state capital outlays, but many states have not taken advantage of this source for water development. Legal debt limitations and interest rate ceilings loom ominous in several states; furthermore, voters in some states hold to a "pay as you go" attitude and are reluctant to incur long-term debt to pay for water projects. Although tax burdens are by no means uniform in all the states, and some states could do a better job of tapping this source, the unprecedented high level of taxation in some areas makes this avenue to capital funds unattractive. Spending policies of the federal government, of course, have considerable effect on state governments, and special incentive provisions of federal financial aid programs have been successful in encouraging state financial participation in some capital projects. With costs of education and other urgent state programs spiraling, funds for even the most attractive water projects will be difficult to obtain. All of the current sources

of funds probably will have to be used more effectively, and states may have to consider new and innovative approaches to obtain the water project capital required.

In the states of the Western Energy Development Area where extensive energy resources--coal, oil shale, uranium, etc.--are located, the problem of financing water projects to support energy development is particularly significant. Conditions of international energy supply instability and increasing national energy demand have accentuated the problem during the past four years.

The development of western energy resources involves many complex factors. In the process of converting the raw resource to its final energy product, a large number of engineering, economic, legal, political, and financial problems must be overcome. Although many of the physical problems associated with extraction and conversion have been resolved through recent research efforts, some of the other problems remain.

As energy development technologies have become perfected, attention has shifted to the factors which will determine final viability. Environmental impacts of energy development have been assessed, the economic factors derived from national energy demand have been analyzed, and the problems of legal systems and political institutions also have received attention.

One result of this extensive energy related research has been the recognition of the role of water in energy development. According to Gardner (1976):

Oil shale is one of the most abundant but undeveloped forms of energy in the United States. High grade deposits, located within the Green River formation of Utah, Colorado, and Wyoming (Upper Colorado River Basin), contain the equivalent of 600 million barrels of oil. Exploitation of this resource would offer a significant supplement to U.S. supplies of liquid petroleum. Studies of the feasibility of oil shale indicate that the availability of large amounts of water will play a key role in determining to what extent an oil shale industry can become a reality.

Oil shale is only a part of the western energy storehouse that will require water for development. Coal also will play an important role as a future energy supplier. The Westwide Study completed by the Bureau of Reclamation (1975) recognized that the western states contained over 70 percent of the country's strippable coal reserves. Reserves of oil, natural gas, uranium, and geothermal energy also exist in the study area. The extracting and processing of all of these energy resources will require large supplies of water, and the associated satellite towns and industries which provide energy related services also will require new water supplies (Bureau of Reclamation, 1975).

The states in the Western Energy Development Area have a vital stake in the development of these energy resources from an economic, social, and environmental standpoint. They also have a key role in regulating and allocating the use of available water resources. The manner in which water resources are allocated and developed to meet energy development requirements have serious implications with respect to the states responsibility and ability to manage these resources in the best interest of the public. For example, valuable multiple use opportunities of water supply development may be lost if the water resources are developed by private interests to meet solely the requirements of energy

development. By becoming involved in the financing of water projects required for energy development, the state may help to expedite the development of critically needed energy supplies and at the same time assure that the water resources are utilized fully and effectively for the benefit of the public.

This proposed research project will provide valuable information to states, particularly in the Western Energy Development Area, about the magnitude of the financing requirement for energy-related water development and about the potentials and problems associated with various alternative sources of funds that might be pursued to meet these demands. The financing conditions and peculiarities of water projects which include water supplies for energy together with supplies for other uses will be investigated. The feasibility of long term debt instruments, water development funds, user fees and other forms of financing will be evaluated.

Although the main thrust of the research is to investigate state financing for water projects related to energy development, most of the results of the studies and analyses on alternative sources of funds would be applicable to all forms of water development. The information developed on pros and cons of various long term debt instruments (general obligation bonds vs. revenue bonds), legal debt limitations, bond market conditions, bond servicing methods, loan guarantees, and so forth would be extremely valuable to any state considering the financing of water projects.

This proposed project deals with two high priority research topics-- "water for energy development" and "water resources financing." The

topic of water for energy development is included in the list of seven priority research topics identified by the Office of Water Research and Technology. A conference on water resources financing and cost sharing co-sponsored by OWRT, the Universities Council on Water Resources, the U.S. Water Resources Council, and the Interstate Conference on Water Problems was held at Jekyll Island, Georgia in September, 1977. State and local capability and methods to finance water projects were high priority research issues identified at the conference.

Relationship of Project to the Center's Overall Program

Program priorities and research needs are carefully considered each year by the Utah Center for Water Resources Research. Recommendations are obtained from state and federal action agencies, OWRT, the regional consortium of Water Institutes and Centers, the Center's Citizen Advisory Council, and others. One of the critical water problems identified this year by this process was the impact of different levels and kinds of energy development on water resources. The need was identified to carefully assess the opportunities for meeting the water requirements for energy development with a minimum impact on existing economic sectors.

In the program area of water problems related to energy, the Center has underway and/or completed a number of water research projects. Two recent projects have examined the problems of energy development and water resources allocation. Project B-131, "The Impact of Energy Resources Development on Utah Water Allocations", formulated two linear programming models to assess the impacts of allocation shifts that will result from development of the coal and oil shale resources of Eastern Utah. Project B-141, "Alternative Energy Development Options and the Impact on Water Resource Management," developed a model to quantify the marginal tradeoffs between energy production, water, and salinity. Information pertaining to the value of water in energy production and the efficient allocation of water resources can be obtained from the model solution. The information gained from these projects can be used to assess energy related water demands, economic impacts of energy development, and other characteristics of energy-related water projects which will be used in the proposed research.



Water resources planning and management is another area of emphasis in the Center's program. Water project financing has been identified by the Utah Division of Water Resources, the Utah Legislature and others as a high priority problem. A recently completed matching grant project, B-122, examined the feasibility of state water user fees for financing water development, and there is great interest in the state in exploring other financing alternatives.

The project described in this matching grant proposal will bear directly upon both of these high priority program areas--water for energy development and water resources development financing, and will complement ongoing and completed studies.

The fact that the proposed study has regional dimensions does not conflict with the Center's overall program. The Center has conducted several regional research projects, some in cooperation with other water centers and some, because of the nature of the projects, more independently. Although it will be necessary for the research team to obtain data from all of the states in the region, the data-collection portion of the project is a relatively small part. The major effort in the project will be in compiling the data, developing the financing scenarios, and in analyzing and evaluating various financing alternatives. This effort can be effectively accomplished in one location; however, arrangements have been made with consultants in each of the other states to advise and assist with the work pertaining to their respective states.

### Literature Review and Related Research

Various water problems related to energy development are treated in the literature; however, state financing of water projects required for energy development in the Western U.S. has not been given attention. Some significant research has dealt with the technical feasibility of western energy development and impacts on water resources. Research directed to energy location has been completed by Doelling (1972), Theobald, et al, (1972), and Wagstaff (1972,1974). Further attention has been directed to the technological development of resource extraction and processing by the research of Hendrickson (1974), Jones, et al. (1971), Office of Coal Research (1973), Stefankø, et al, (1973), and Ridley (1974). Several studies (Bishop, et al, 1975; Gardner, et al, 1976; Water Resources Council, 1974; Flug, et al, 1977; Western States Water Council, 1977; and the Utah Section of American Water Resources Association, 1975) have assessed the potential water demand for energy development.

This general research has been supplemented by case studies which are limited to specific energy related problems of small geographical areas. Examples of such research are found in Thomas and Andersen (1976), Viesman and Stock (1974), and Diemer and Wenger (1977). Some of this research has examined the institutional problems associated with energy development (Van Zandt, 1975; Trelease, 1976).

The capital financing of state governments has received considerable attention in recent years and a number of reports and books, wholly or in

part related to the subject, have been published. In the area of fiscal capacity and tax effort, reports by the Advisory Commission on Intergovernmental Relations (1961, 1962, 1970, 1971) have made important contributions. Writings by Fabricant (1952), Fisher (1964), Sachs and Harris (1964), Sharkansky (1968), and others have reported on social science research that has pursued the relationships of variables such as per capita income to interstate variation in expenditures of state and local governments. Reports of other social scientists, such as Dye (1966), have compared the influence of economic and political phenomena upon outputs of state political systems, expenditures being one of the outputs. Wildavsky (1964), Lindblom (1966), and Anton (1966) are representative of the research that has been done on the decision-making process in government itself, expenditures again being an important part.

Other significant writings published recently on the subject of state and local finance include: Maxwell (1969), Rabinowitz (1969), Council of State Governments (1969), Hirsch (1970), and Hoggan (1971).

Under provisions of the Water Resources Development Act of 1974 (PL. 93-251), Section 80, various options for federal versus non-federal cost sharing on federal and federally assisted water programs have been studied. The results of these Section 80 studies will be of value to this study in providing data for arriving at projected state funding requirements for water development cost sharing.

The research that has already been accomplished provides an excellent basis for the research proposed herein. The engineering problems associated with western energy development have, received a great deal of attention, and the findings on state financing in general provide insights into the more specific problems of state financing of energy related water development.

An investigation of current research projects has revealed that there are none that would duplicate the project proposed herein. Of the research projects listed in Volume 11 of the Water Resources Research Catalog, three that appear to be somewhat related to the proposed project are as follows:

- 6.0143 Meeting Demands for Public Services Created by Water and Energy Resources Development Financing Problems in Impacted Wyoming Communities.
- 6.0078 Research and Analysis on the Economic Impact of Fiscal Constraints on Water Project Construction.
- 6.0191 Institutional Arrangements for Effective Water Management in Colorado.

Two of these, No. 6.0143 and No. 6.0191 probably would provide useful information to the project on energy development and institutional conditions in two of the states of the Western Energy Development Area--Wyoming and Colorado. Project No. 6.0078 would provide information on the fiscal characteristics of water projects pertinent to Objective 3 of the proposed project.

Principal Investigator

Dr. Daniel H. Hoggan, the principal investigator, has ten years of experience in water research project management and consulting with government agencies on water planning and management problems. In the subject area of this proposed project, he has directed research on state water organizations, state and local government capability to finance water development, repayment interest rates for water projects, water user fees and excise taxes, and other water project financing alternatives. He has had consulting assignments with the U.S. Water Resources Council and the Pacific Northwest River Basins Commission in the area of water development financing. Reflecting this experience, eight of his publications are in the area of state water organization and finance.

Dr. Hoggan also has experience and knowledge in the area of energy development, having recently completed a one-year sabbatical leave assignment with the U.S. Energy Research and Development Administration (now the Department of Energy). Assigned as an Advanced Technology Specialist in the Idaho Operations Office, Geothermal and Hydro-electric Energy Branch, he had an opportunity to become familiar with the federal energy organization and programs.

Other Personnel

Mr. Kirk R. Kimball, research assistant, Utah Water Research Laboratory, will be serving as a professional staff member on the proposed study. He will spend 100 percent of his time on this research. Mr. Kimball brings a background of water resources planning, economics, business administration, and public administration to the project. This background will be valuable in the work pertaining to all of the objectives of the study. He has been an active participant in three previous OWRT water resources research projects, in which his principle tasks were centered around social impact assessment of water development projects, quantitative analysis of social-political issues, and data acquisition for development of a coordinated water policy formulation model.

The project organization includes a technical advisory group and a state government contact in each of the states of the region. Both of these elements of the organization serve the purpose of providing coordination with key regional and state organizations and guidance in water and energy matters related to the project.

In the Advisory Group, Dr. Berry Crawford and Mr. Jack Barnett are affiliated with Western State regional organizations (see table of organization in following section) that are vitally concerned with the water for energy problem. Dr. Herbert Fullerton is affiliated with the Utah Consortium for Energy Research and Education, which has a study funded by the Department of Energy for assessing the economic, social and environmental impacts of energy development in the Intermountain West. Although the consortium is comprised of Utah universities only, it has a status similar to a Department of Energy field office or laboratory and its current study in the area of socio-economic impacts of energy

development is related closely to the study proposed herein.

The state government contacts will be identified by each of the respective states (probably an official of its water development agency) after the project is initiated.

The four general consultants who have been selected to supplement and assist the research staff each have outstanding credentials and expertise for dealing with the difficult and complex problems that are likely to be encountered in the project. Dr. Edward H. Allen has a strong background of experience in public finance and energy policy. He has worked with several federal, state, and regional organizations on energy development and public finance problems of the Western Intermountain States. Dr. Jay M. Bagley has broad experience in the area of water management and institutions. His outstanding knowledge of water conditions and problems in the region, and his acquaintance with many key government water officials and the university research community will be valuable assets to the project. Mr. Richard Dewsnup, a lawyer with considerable experience in natural resources and water law will assist in dealing with legal questions concerning water development financing alternatives in the various states of the study region and he is familiar with the water law and legal systems in each one. Dr. Herbert H. Fullerton, an economist who has worked on numerous water resources research projects including several regional economic studies related to water project impacts, will be the project's general consultant on economics. He will be serving in a dual capacity in this position coupled with his role in the technical advisory group. These four consultants will meet with the project staff regularly to provide counsel, and will do research and writing on special problem areas as required.

A consultant from each of the states in the study region will assist with data collection and analysis of projects and problems in each of their respective states. The men selected for these assignments are familiar with the water-for-energy problems in their states and their considerable experience and expertise in dealing with these problems will provide strength to the project staff, particularly in the relevant subject areas of economics, public administration, and energy policy. The five men who will serve in this capacity are as follows:

Henry P. Caulfield, Jr.  
Colorado State University

Edward H. Allen\*  
Utah State University

Clynn Phillips  
University of Wyoming

Richard Stroup  
Montana State University

Bruce Kimzey  
New Mexico State University

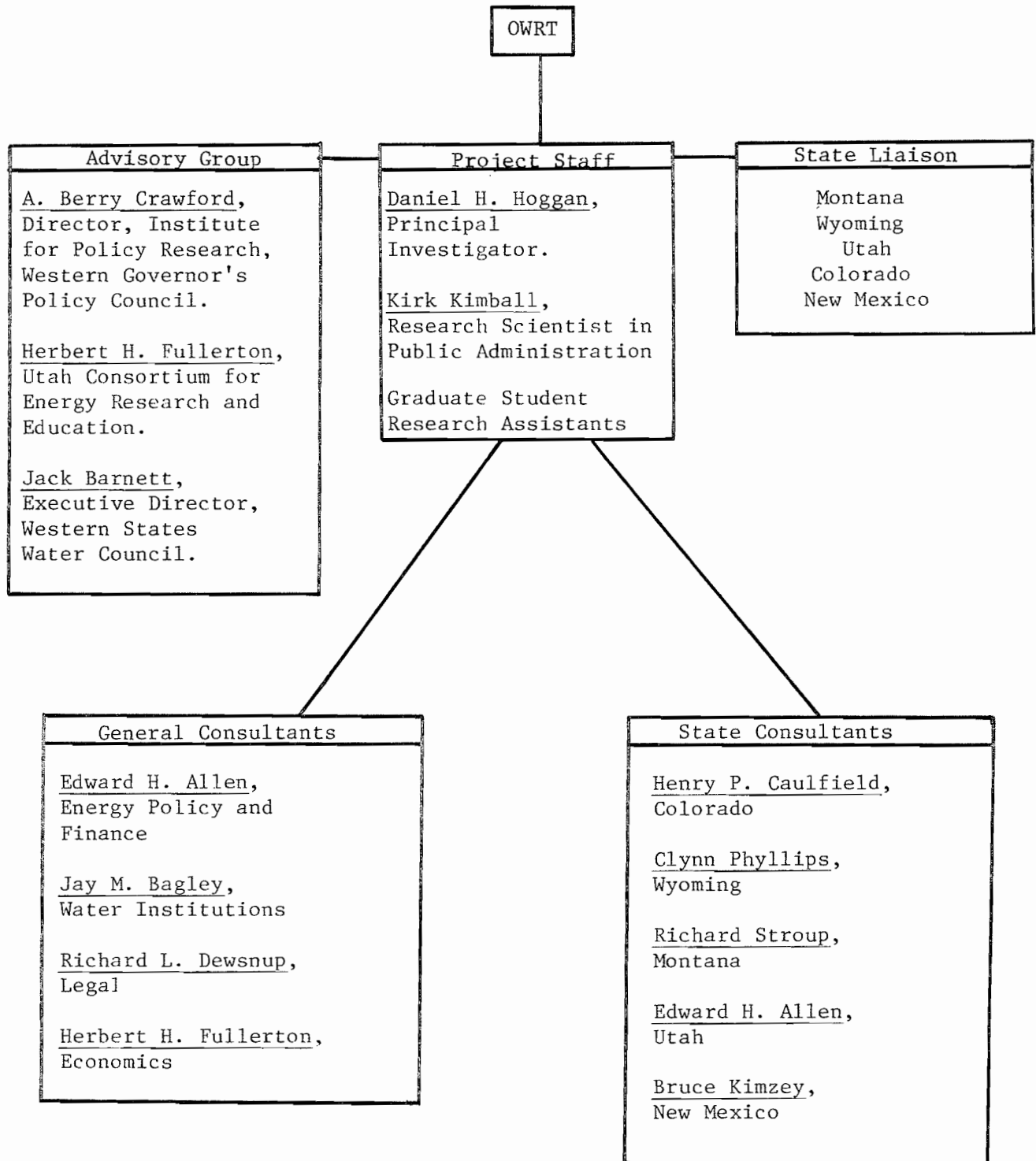
A small amount of money has been allocated in the budget for unspecified consulting services. As the study delves into the complexities of the bond market and taxing policies, it is likely that the assistance of specialists in these areas will be required for advice and counsel on a very limited basis.

#### Project Management

The principal investigator, Dr. Hoggan, and his staff will manage and coordinate the work of the various consultants on the project. Upon award

\*Dr. Allen will serve in a dual capacity as a general consultant and a state consultant.



Project Organization:

of the project, the Technical Advisory Group and the panel of general consultants will meet with the project staff to formulate in detail the research project plan of work and schedule. This group will meet again every six months during the duration of the project to review progress and discuss any major problems that have arisen. Appropriate adjustments in the work plan and schedule will be considered at these meetings to keep the work on target for accomplishing the research objectives. In the interim periods between meetings, the project staff will coordinate with members of both of these groups individually and/or jointly as the need arises.

At the outset of the project, an initial planning meeting will be held by the principal investigator and his assistant, Mr. Kimball, with each of the state consultants and state government contacts. The purpose of these meetings will be to discuss data sources in each of the states and formulate plans for collecting the required data. It is anticipated that two additional meetings will be held with these individuals in each of the states in the process of collecting and analyzing the required data.

For the purpose of keeping all participants in the project continually abreast of progress and problems that develop, a brief quarterly technical progress report will be prepared and distributed to all participants and any other interested parties, such as the OWRT monitor, water center directors in each of the states and so forth.

Project costs and effort will be monitored monthly by the principle investigator with the aid of a computerized system of monthly financial report which will track and compare actual expenditures with the budget and time schedules.

#### TRAINING OPPORTUNITIES

Two graduate students with an interest in public finance will be employed as research assistants on the Project. The "tutorial" relationship these students will have with the other research staff in analyzing an important real world problem should provide a valuable dimension to their academic training. They will assist in the review of literature, interviews with public officials, compilation and analysis of data, and writing of the final report.

#### PUBLICATION OF RESULTS

The results of this research will be published in a Utah Water Research Laboratory report and submitted for publication to appropriate professional journals.

#### LOCATION

Project headquarters will be at the Utah Water Research Laboratory, Utah State University. Office space and other essential supporting services will be provided through the laboratory and operated according to University and State regulations.

#### OTHER PARTICIPATING COLLEGES OR UNIVERSITIES

Since the research will include collaboration with other states in the region, contacts have been established with the Water Research Centers in these states and special consultants have been identified by each of the center directors to participate in the project. These

individuals will assist with the collection and analysis of data and coordination of this project with related projects at the other centers.

#### FACILITIES

The Utah Water Research Laboratory, a state authorized research institution located on the campus of Utah State University will provide the necessary facilities and supporting services to operate the project. Essentially all the facilities and services necessary for the project are available, i.e. secretarial, business management, motor pool, computer, office space, recorders, transcribers, etc. No special equipment or facilities will need be acquired.

#### NEED FOR SUPPORT

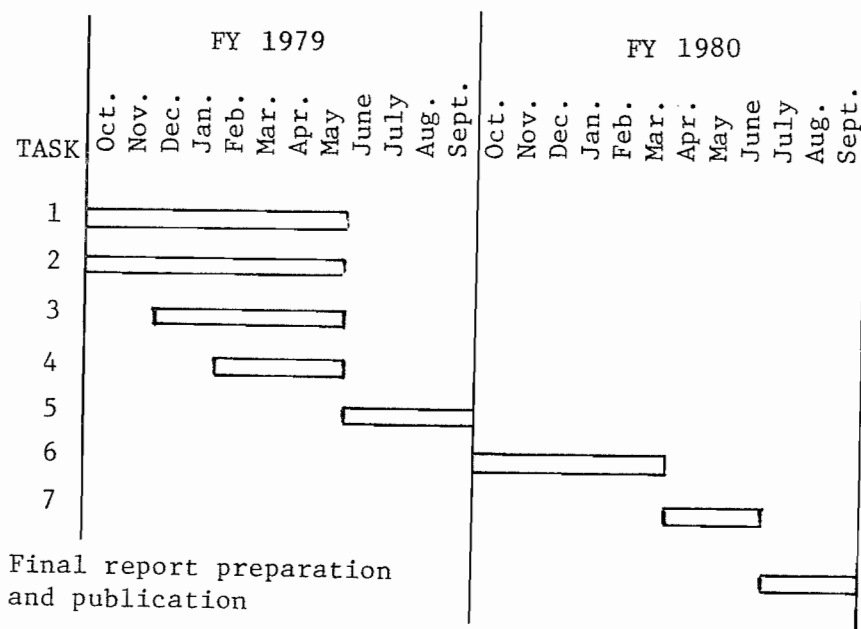
Laboratory budgets are so limited with respect to the many high priority research topics proposed, that a general policy is to curtail full funding of research projects but use available funding for joint (matching) sponsorship. Federal funding will be needed to initiate the project.

#### FINANCIAL PLAN

The proposed budget and estimated schedule of expenditures are shown on the attached budget forms. (See form A-1 and B-2.)

### SCHEDULE OF ACTIVITY

The project consists of seven major tasks specified in the project objective section of the proposal. These will be performed in accordance with the following schedule:



### ASSURANCE OF REQUIRED MATCHING FUNDS

Signatures shown on the endorsement sheet are assurance that required matching funds will be made available.

### REPORTS DUE

All reports due, as required by Part 506 of the Rules and Regulations have been submitted by the Director of the Utah Center for Water Resources Research.

## SUBMITTAL OF PROPOSAL TO OTHERS

No plans have been made to submit this proposal to any other agency.

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DANIEL H. HOGGAN

Professor of Civil and Environmental Engineering  
Utah State University

Date and Place of Birth

September 25, 1929                      Lorenzo, Idaho

Degrees

B.S.                      Utah State University, Logan, Utah, Civil Engineering,  
1952  
M.S.                      Stanford University, Stanford, California, Civil  
Engineering, 1953  
Ph.D.                      Utah State University, Logan, Utah, Civil Engineering,  
1969

Professional Experience

1953-54                      Assistant Civil Engineer with Fluor Corp. Ltd. of  
Los Angeles, California. Petroleum refinery engineer-  
ing and construction.  
1954-55                      Civil Engineering Officer with U.S. Air Force in the  
Far East. Design and construction of air base facilities.  
1956-60                      Structural detailer and designer with U.S. Steel Corp.  
Provo, Utah. Design of steel mill buildings and  
facilities.  
1960-61                      Assistant Project Engineer with U.S. Atomic Energy  
Commission, Idaho Falls, Idaho. Administration of a  
design contract for a nuclear aircraft reactor assembly  
and test facility.  
1961-65                      Engineer with The Ralph M. Parsons Co. of Los Angeles,  
California on the following assignments related to the  
design and construction of missile and space vehicle  
facilities:  
  
Resident Project Engineer. Minuteman Engr. Test Facility.  
Hill Air Force Base, Utah.  
  
Resident Engineer and Consultant to Corps of Engineers.  
Titan III Space Vehicle Assembly and Launch Facilities,  
Cape Kennedy, Florida.  
  
Resident Engineer. Titan II Missile Launch Facilities.  
Vandenberg Air Force Base, California.  
1967                      Summer research appointment with Lawrence Radiation  
Laboratory. University of California at Livermore,  
California. Development of conceptual design for a  
nuclear explosive aggregate production experiment  
related to earth-fill dam construction.

1967-68	Staff Specialist with U.S. Water Resources Council, Washington, D.C. Dissertation research project-- Organizational Patterns in State Governments for Comprehensive Planning of Water and Related Land Resources Development.
1968-1976	Professor of Civil and Environmental Engineering, Utah State University, Logan, Utah. Teaching and Research primarily related to water resources engineering.
1971-1976	Assistant Director of the Utah Water Research Laboratory, Utah State University, Logan, Utah.
1976-1977	Sabbatical leave assignment with the U.S. Energy Research and Development Administration, Idaho Operations Office, in geothermal and hydroelectric energy programs.
1977-present	Professor of Civil and Environmental Engineering, Utah State University, Logan, Utah. Teaching and Research primarily related to water resources engineering.

#### Consulting Experience

1969	Pacific Northwest River Basins Commission at Vancouver, Washington. Studies and consultation on regional and river basin planning.
1970	U.S. Water Resources Council, Washington, D.C. Studies and consultation on financing and cost-sharing policies for water development.
1974	Colorado State University, Fort Collins, Colorado. Development of training package for U.S. Water Resources Council on multiple-objective planning

#### Scientific and Professional Societies

American Water Resources Association  
 American Society of Civil Engineers  
 Registered Civil Engineer in Utah and California

#### Patents

Optical Lettering Guide Patent No. 3,291,552 - December 1966  
 No. 3,819,251 - June 1974

#### Honors and Recognitions

NSF Traineeships--1965, 1966  
 Listed:  
     Who's Who in the West  
     The National Register of Prominent Americans and International Notables  
     Personalities of the West and Mid West  
     American Men of Science

#### Security Clearances

“Q” and DOD

## Major Research Projects

A Flood Plain Management Program for Utah.

Integrated Water Quality/Water Resources Planning for Utah.

A Preliminary Study on Expanding and Financing a State Water Development Program.

Feasibility of State Water-User Fees for Financing Water Development and Cost Sharing.

A Regional Approach to Multi-Objective Planning for Water Related Resources.

Integrating Water Resources and Land Use Planning.

Management of Large Scale Interdisciplinary Research Projects.

A Study of Interactions Among Different Levels of Analysis in Comprehensive River Basin Planning.

Study of Conceptual Design for Earth Fill Dam Excavation Experiment Using Nuclear Explosives.

Study of State Water Planning Organization.

Study of Planning Approach for Eastern Washington and Upper Snake River Water Development Plans.

Optimal Allocation of Colorado River Water in Utah: A Systems Approach.

Great Salt Lake Desert Hydrologic Inventory.

Study of State and Local Financing Capability for Water Development.

Study of Effectiveness of Water Planning Groups.

Virgin River Project: A Regional Approach to Multi-Objective Planning for Water Resources Development.

## Publications

State Organizational Patterns for Comprehensive Planning of Water Resources Development (published dissertation). Logan, Utah: Utah Water Research Laboratory, 1969.

State Organizations for Water Resources Planning. Journal of American Water Works Association. LXI No. 12 (December 1969) 667-674.

Repayment Interest Rates for Water Projects. Journal of Water Resources Research. VI, No. 3. June 1970. 683-689.

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Can States Pay More..., Water and Wastes Engineering. IX, No. 5 (May 1972) 63-78.

Can State and Local Governments Assume more of the Costs of Water Development? Water Resources Bulletin, AWRA. VIII, No. 3 (June 1972) 625-630.

Hydrologic Inventory of the Great Salt Lake Desert Area. Utah Water Research Laboratory, Logan, Utah. 1971. (with Gary L. Foote and Robert W. Hill).

Development of Regional Supply Functions and a Least-Cost Model for Allocating Water Resources in Utah: A Parametric Linear Programming Approach. Utah Water Research Laboratory, Logan, Utah. 1972. (with Alton B. King, Jay C. Andersen, and Calvin G. Clyde).

Interregional Planning of Water Resources Allocations by Systems Analysis Approach: A Summary Report. Utah Water Research Laboratory, Logan, Utah. 1973. (with John E. Keith, Jay C. Andersen, Alton B. King, Mark H. Anderson, Thomas C. Anderson, and Calvin G. Clyde)

A Study of the Effectiveness of Water Resources Planning Groups: A Final Report. Utah Water Research Laboratory, Logan, Utah. 1974. (with Jim Mulder, Sarah Jane Taylor, Dennis E. Oaks, Brent Somers, and Raymond L. Richardson)

River Basin Water Planning Organizations in the 1960's. Water Resources Bulletin, AWRA. X, No. 6 (December 1974) 1173-1187.

Tradeoff Analysis in Urban Water Resources Planning. Proceedings of World Conference on the Environment of Human Settlements: Vol. II, World Environment and Resources Council, Brussels, Belgium. 1976. (with J. P. Riley and Yacov Haimmes)

A Study of the Feasibility of State Water User Fees for Financing Water Development: A Final Report. Utah Water Research Laboratory, Logan, Utah. 1977. (with Jay C. Anderson and O. William Asplund)

The Virgin River Basin Study: A Regional Approach to Multi-Objective Planning for Water and Related Resources. Utah Water Research Laboratory, Logan, Utah. 1977. (with John E. Keith, Jim Mulder, Trevor C. Hughes, V. A. Narasimham, Lance R. Rovig, Karl Eriksen, Don D. Fowler, Lucinda Borchard, Kirk Kimball, Spence Ballard, and K. S. Turna)

KIRK R. KIMBALL

PERSONAL INFORMATION

Born April 19, 1953 Kanosh, Utah

Address: 729 East 900 North  
Logan, Utah 84321

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RESEARCH EXPERIENCE

Participated as a Research Assistant in an Office of Water Research and Technology grant (Project Number B-084-Nevada) to study Surrogate Worth Trade-Off Methodology in assessing economic and political feasibility of alternative plans for the Virgin River Basin (1975-1976)

Participated as a Research Assistant in an Office of Water Research and Technology Title II grant (Project Number C-6279-Utah) to study water planning and land use planning in order to identify the relationships and develop a framework for integrated planning (1976-1977)

Participated as a Research Assistant in an Office of Water Research and Technology Title II grant (Project Number C-7161-Utah) to study the inter-relationships between human values, environmental quality, courses of action, and political decision making in water resources planning in order to identify the interactions among the different levels of analysis in comprehensive river basin planning (1976-1977)

Recipient of a grant from the Utah Water Research Laboratory to evaluate and develop an information management system for use at the Laboratory (1977-1978)

EDUCATIONAL EXPERIENCE

B.A., Political Science, Utah State University, 1975; M.S., Political Science (Public Administration) with academic emphasis in economics and civil engineering, Utah State University, 1978.

RESEARCH INTERESTS

Water Resources Policy and Planning, resource economics, public finance, natural resource development and administration, simulation/modeling

FELLOWSHIPS AND HONORS

Graduate Research Assistantship, Utah Water Research Laboratory, 1975-1976

Pi Sigma Alpha, Political Science Honorary Fraternity, Utah State University Chapter

PUBLICATIONS

Co-Authored:

Virgin River Project: A Regional Approach to Multi-Objective Planning for Water and Related Resources, Utah Water Research Laboratory report to the Department of the Interior, Office of Water Research and Technology, June 1977.

Integrating Water Resources and Land Use Planning, Utah Water Research Laboratory report to the Department of the Interior, Office of Water Research and Technology, to be published January, 1978.

A Study of Interactions Among Different Levels of Analysis in Comprehensive River Basin Planning, Utah Water Research Laboratory report to the Department of the Interior, Office of Water Research and Technology, to be published January 1978.

REFERENCES

Available upon request

## BIOGRAPHICAL SKETCH

### JACK A. BARNETT

Jack A. Barnett was raised in Utah and educated in the Davis County School District before pursuing advanced education at Utah State University and the University of Utah where he received B.S. and M.S. degrees in groundwater geology.

Mr. Barnett has had work experience with the State of Utah in the administration of water rights and the investigation of water resources, and has had similar experience in the State of Idaho where he served as the Deputy Director of the Department of Water Administration. While in Boise, Mr. Barnett founded a consulting engineering firm and consulted in water rights, water resources, and geothermal development.

Mr. Barnett was employed in 1974 as the Executive Director of the Western States Water Council and is presently serving in this capacity. The Western States Water Council is an organization of the 11 western governors, created to address multi-state water issues.

Jack Barnett is a registered professional engineer and a registered professional geologist. He is married to the former Ilene Ricks. They have six children.



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Department of Political Science  
Utah State University  
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Professional Career

Current Position:

Associate Professor of Political Science, Utah State University, Logan, Utah,  
1975 - Present.

Public Finance Advisor, Drexel, Burnham, Lambert, Inc., New York, New York,  
1976 - Present.

Previous Employment:

Visiting Scholar, Hoover Institution on War, Peace and Revolution, Stanford  
University, Stanford, CA, 1976-77 (while on leave from Utah State University);  
Participating Guest, Lawrence Berkeley Laboratory, University of California,  
Berkeley, CA, 1976-77 (while on leave from Utah State University); Director,  
Civic Project Division, Wyoming Community Development Authority, Casper,  
Wyoming, 1975-76 (while on leave from Utah State University); Assistant  
Professor of Political Science, Utah State University, Logan, Utah, 1971-75;  
Research Associate, Foreign Policy Research Institute, Philadelphia, PA,  
1970-71; Assistant Production Manager, W.B. Saunders Company, Philadelphia,  
PA, 1964-66.

Fellowships and Awards

Rockefeller Foundation Fellowship in Environmental Affairs, 1975-77; Utah  
State University Summer Research Grant, 1973; Visiting Scholar, U.S.  
Department of State, 1971; Post-Doctoral Research Fellow, Foreign Policy  
Research Institute, 1970-71; Rena and Angelus Anspach Institute Grant for  
study and research in Mexico, 1969; University of Pennsylvania Doctoral  
Fellow, 1969-70; National Science Foundation Traineeship, 1967-69.

Education

Post-Doctoral Year, Moore School of Electrical Engineering, University of  
Pennsylvania, Philadelphia, PA, 1970-71; Major area of study: Statistics  
and Communications Theory. Ph.D. (1970), Wharton School, University of  
Pennsylvania, Philadelphia, PA, 1966-70; Major area of study: Political  
and Economic Development; dissertation: Complexity and Politicodynamics.  
A.B. (1974), Swarthmore College, Swarthmore, PA, 1961-64; Major area of  
study: American Literature. Undergraduate Year, Stanford University,  
Stanford, CA, 1960-61. Major area of study: mathematics.

Areas of Specialization

Public Finance  
Business and Government  
Energy and Environmental Policy

Other Professional Experience

Consulting:

For U.S. Department of the Interior, Office of Minerals Policy Research; Washington, D.C.

For Energy Resources Board, State of New Mexico; Santa Fe, New Mexico.

For Federation of Rocky Mountain States, Inc.; Denver, Colorado.

For Region VIII Office, Federal Energy Administration; Denver, Colorado.

For Resource Communities, Inc.; Santa Fe, New Mexico.

For Office of Finance and Environment, Federal Energy Administration, Washington, D.C.

For Rocky Mountain Institute for Policy Research; Denver, Colorado.

Recent Presentations:

To American Society of Public Administration, Annual Meeting. Subject: energy conservation policy in local government, 1975.

To the Denver Federal Executive Board. Subject: energy conservation policy, 1976.

To the Rocky Mountain Center on Environment. Subject: energy conservation policy, 1976.

To the Utah Five County Association of Governments. Subject: managing the impacts of energy development, 1976.

To the Grants-Millan, New Mexico Association of Governments. Subject: financial problems of energy boomtowns, 1976.

To the Lawrence Berkeley Laboratory Summer Workshop. Subject: energy conservation extension services, 1976.

To the Farm Foundation. Subject: energy extension services, 1976.

To the Federal Energy Administration's Workshop on Energy Facilities Siting. Subject: Socioeconomic impact of energy development, 1976.

To the Department of Fiscal Policy and Analysis, State of Wisconsin. Subject: State controls on socioeconomic impact, 1977.

Publications

Books:

Public Management of Socio-Economic Change (in preparation).

Federal Energy Impact Assistance: An Analysis and Evaluation of Techniques (USGPO, forthcoming), 1978.

Ed., Socio-Economic Impact of Western Energy Development with A.B. Crawford (Ann Arbor Science Press, in press, 1978).

Implementing Energy Conservation Programs: A Guidebook for State and Local Government. (The Committee on Energy and Environment of the Denver Federal Executive Board and the Interstate Energy Conservation Leadership Conference, 1976).

Handbook of Energy Policy for Local Government (Lexington Book Division, D.C. Health Co., 1975).

Papers, Articles, and Book Chapters:

"Economic Planning Makes a Debut in America" in State Planning Issues (National Governor's Association, Washington, D.C.) forthcoming.

"Wyoming Struggles with Growth" in RF Illustrated (Rockefeller Foundation, New York) forthcoming.

"Some Economic and Institutional Constraints to Expanded Coal Development and Utilization" with Erik Stenehjem (Argonne National Laboratory, Chicago) forthcoming.

"Some Impacts of Energy Development on our Economic Institutions" Proceedings of the LWV Workshop on Energy Impacts (League of Women Voters, Washington D.C.) forthcoming.

"Siting Costs, Socioeconomic Impact and Productivity in the Energy Industry: A Quantitative Analysis" with Erik Stenehjem (Argonne National Laboratory, Chicago) in preparation.

"Socioeconomic Issues in Energy Facility Siting" (for the Federal Energy Administration, 1976).

"Community Developmental Costs of Energy Development: Who is Responsible for Financing?" in Financing Energy Development (Western Governors Energy Policy Office, 1976).

"Making an Energy Conservation Extension Service Work" (forthcoming in Increasing Understanding of Public Problems and Policies - 1976, The Farm Foundation, 1976).

"Growth Management in Western Energy Development Areas: The Uses of State and Local Taxation Tools" (for the Technology Assessment of Western Energy Resources Development Project of the Environmental Protection Agency, 1976).

"The Business of Saving Energy" in Proceedings of 1976 Summer Workshop on An Energy Extension Service, National Technical Information Service, (LBL-5236), May 1977.

"Financing Infrastructure in Western Energy Development Areas," co-author, (Rocky Mountain Institute for Policy Research, 1975).

"Negative Probabilities and the Uses of Signed Probability Theory" (Philosophy of Science, March 1976).

"State and Local Responsibilities" (in Energy Development in the Rocky Mountain Region: Goals and Concerns, Federation of Rocky Mountain States, July 1975).

"A Formal Cybernetic Approach to the Theory of Steady State Societies" (in Proceedings of the First European Meeting on Cybernetics and Systems Research, Transcripta Books, London, 1972).

"Revolution and Economic Growth: A Review of Clark Reynold's. The Mexican Economy" (in Orbis, Fall, 1972).

"The Proposed New Treaties for the Panama Canal" with M.D. Tate (Europa Archiv, No. 16, 1969; reprinted in International Affairs, 42:2, April, 1969; reprinted in Latin America and the United States in the 1970's, edited by Richard B. Gray, F.E. Peacock Publishers, Inc., Ithaca, IL, 1971).



## Consulting Experience (Continued)

Ralph M. Parsons Company, Consulting Engineers, Los Angeles, California  
The Anaconda Company, Salt Lake City, Utah  
Water Resources Division, Dept. of Natural Resources, Salt Lake City, Utah  
Agency for International Development  
National Oceanic & Atmospheric Agency  
Experience, Incorporated, Minneapolis, Minnesota

## Major Research Projects

Evaluation of Sprinkler Systems in Northern Utah  
Water Supplies and their Utilization in Iron, Washington, and Kane  
Counties in Utah  
Consumptive Use of Water by Native Vegetation and Irrigation  
Requirements of Crops in the Virgin River Area in Utah  
Developing Methods for Estimating Runoff from Watersheds with  
Limited Hydrologic Data  
Application of the Theory of Stochastic Processes to Hydrologic  
Phenomena  
State Water Plan Investigations  
Use of Electronic Analogs in River Basin Investigations  
Effect of Highly Mineralized Springs on Manageable Water Supplies  
Hydrology of the Great Salt Lake  
Watershed Model Studies of Rainfall-Runoff Process  
Remote Sensing Applied to Hydrology of Natural Watersheds  
Optimization of Sequential Water Uses in a Hydrologic-Quality Complex  
Hydro-Climatic Atlas of Utah  
Extending Utility of Non-Urban Water Supplies  
Institutional Impacts of Federal Water Pollution Control Programs  
on State Water Planning, Management, and Regulatory Agencies  
Evaluation of Legal Constraints in Making Water Use Changes

## Scientific and Professional Societies

American Geophysical Union  
American Society of Civil Engineers  
International Association of Scientific Hydrology  
National Planning Association  
National Society of Professional Engineers  
Sigma Xi  
Society of Sigma Tau  
Phi Kappa Phi  
Registered Professional Engineer

## Publications

### Individual Authorship

A Study of Factors Influencing Intake Rates Under Surface Irrigation. M. S. thesis, Utah State University, Logan, Utah. June 1953.

Irrigation Pumps: Their Selection, Care, and Maintenance. Better Farming Methods. 28(6):50-53, 1956.

Cooperative Sprinkler Irrigation Projects. Irrigation Engineering and Maintenance. March 1958.

An Application of Stochastic Process Theory to the Rainfall-Runoff Process. Tech. Report No. 35, Department of Civil Engineering, Stanford University. May 1964.

Effects of Competition on Efficiency of Water Use. Proc. ASCE, J. Irrig. & Dr. Div., Vol. 91, Part 1, IR-1. March 1965.

A Perspective of Contemporary Water Planning and Management Problems in Utah. Proc. of the Brigham Young University Engineering Symposium. April 16, 1966.

Weber Basin Water Resource Inventory. Proc. of a Symposium on Status of Water Planning in Utah. Utah Water & Power Board. June 1966.

The Salinity Problem in Reuse of Water. Proc. of Symposium on Water Supplies for Arid Regions, 43rd annual meeting of the South-western and Rocky Mountain Div., AAAS. April 29-May 3, 1967. Tucson, Arizona.

Some Considerations in the Adaptation of Markov Process Theory to Rainfall-Runoff Phenomenon. Proc. of the International Hydrology Symposium, Fort Collins, Colorado, September 6-8, 1967, Vol. 1.

Annual Report of the Utah Center for Water Resources Research, CWRR, Utah State University (FY 1973, FY 1974, FY 1975, FY 1976).

### Joint Authorship

Evaluation of Sprinkler Irrigation Systems in Northern Utah. Ut. Agr. Exp. Sta., Bul. 387, 30 pp. June 1956. (with Wayne D. Criddle)

What About Sprinkler Irrigation in Utah? Farm & Home Science, Vol. 17, No. 2, Ut. Agr. Exp. Sta. 1956. (with Wayne D. Criddle)

More Water for Southwestern Utah. Farm and Home Science, Vol. 19, No. 2, Ut. Agr. Exp. Sta. June 1958. (with Wayne D. Criddle and R. Keith Higginson)

Water Supplies and their Uses in Iron, Washington, and Kane Counties of Utah. Ut. Agr. Exp. Sta. Special Report No. 13, 56 pp. June 1959. (with Wayne D. Criddle and R. Keith Higginson)

Graphical Determination of the Most Economical Pipe Size. Agri. Engr. Vol. 42, No. 10. October 1961 (with R. K. Linsley)

Utah's Water Resources--Problems and Needs--A Challenge. Utah State University and Utah Water and Power Board. PR.EC48-2. March 1963. (et al.)

Report on Feasibility of an Electronic Analog Approach to Sevier River Basin Investigations for Water Resource Development and Conservation Planning. Engr. Exp. Sta., Utah State University and Agr. Res. Ser., USDA, PR.EC51-1. August 1963. (with Duane G. Chadwick, Robert B. Hickok, and Marvin Rosa)

Summary of Surface Water Records in Utah. Utah State University and Utah Water and Power Board. PR.EC48-3. Sept. 1963. (et al.)

Water Yields in Utah. Utah State University and Utah Water and Power Board. Agr. Exp. Sta. Special Report No. 18. Sept. 1964. (with Roland W. Jeppson and Cleve H. Milligan)

Consumptive Use of Water by Native Vegetation and Irrigated Crops in the Virgin River Area of Utah. Information Bulletin No. 14. Utah State Engineer, Salt Lake City, Utah. Sept. 1964. (with Wayne D. Criddle and R. Keith Higginson)

Proceedings of Summer Institute in Water Resources, (Editor) Four volumes. Civil Engr. Dept. and UWRL, Utah State University. April 1966.

Mineralized Springs in Utah and their Effect on Manageable Water Supplies. Utah State University and Utah Water and Power Board. Report WG23-6. Sept. 1966. (with James H. Milligan and Ray Marsell)

Application of Electronic Analog Computer to Solution of Hydrologic and River Basin Planning Problems: Utah Simulation Model II. Utah Water Research Laboratory, Utah State University. Oct. 1966. (with J. Paul Riley and Duane G. Chadwick)

The Great Salt Lake: Hub of Utah's Water Development. Utah Science, Vol. 28, No. 1, Ut. Agr. Exp. Sta. March 1967. (with Gaylord V. Skogerboe and Donna Higgins)

Methods of Estimating Mean Annual Water Yield in Areas of Limited Hydrologic Data. Proc. International Conference on Water for Peace. Washington, D. C. May 23-31, 1967. (with A. Leon Huber and Roland W. Jeppson)

Mathematical Simulation of Small Watershed Hydrologic Phenomena, Utah Water Research Laboratory, PRWG46-2, Utah State University, December 1967. (with V. V. Dhruva Narayana)

Hydrologic Atlas of Utah, Utah Water Research Laboratory, PRWG35-1, Utah State University, 1969. (with R. W. Jeppson, Gaylen Ashcroft, A. L. Huber, and G. V. Skogerboe)



Water Importation into Arid Lands (Editor) A symposium included in "Arid Lands in Perspective," AAAS, The University of Arizona Press, Tucson, Arizona, 1969

Water Supply Augmentation by Reuse. Proc. Am Water Resources Assn. symposium on Water Balance in North America, Banff, Alberta, June 1969 (with David W. Hendricks)

Developing a Hydro-Quality Simulation Model, Utah Water Research Laboratory, Utah State University, PRWG67-1, June 1970. (with Neal P. Dixon, David W. Hendricks, and A. Leon Huber)

Extending Utility of Non Urban Water Supplies. Prepared for the National Water Commission. Utah State University Foundation, Logan, Utah. (One of 15 contributing authors) July 1971.

Research Implementation, a Coordinated Approach. Proceedings of the First International Conference on Transfer of Water Resources Knowledge, September 14, 1972. Colorado State University, Fort Collins, Colorado. (with J. Paul Riley and Daniel F. Lawrence)

National Water Research Opportunities. A Report to the Office of Water Resources Research, U.S. Dept. of the Interior, June 1972. (with 10 co-authors)

Water Resources and Uses. A contribution to the Rocky Mountain Environmental Research Project. Institute of Ecology. (with 11 contributing authors) July 1974.

Water Resources Problems and Research Budget Projections, FY 1978. Colorado River-Great Basin Consortium of Water Research Centers, December 1975. (with 5 co-authors)

A Review of Utah Water Conservancy Districts--Their Role and Operation. Utah Water Research Laboratory, Utah State University, PRWG190-1, August 1976. (with Frank W. Haws and Carl H. Carpenter)

BIOGRAPHICAL DATA ON RICHARD L. DEWSNUP

1. Personal Data: Born September 4, 1930, in Delta, Utah; married, four children; home address is 5071 Woodmont Street, Salt Lake City, Utah 84117 (Telephone: (801) 272-0491).

2. Present Positions: Legal Consultant on natural resources and environmental litigation; active in conducting studies related to natural resources (including water and wildlife); Director of the Western Natural Resources Foundation; present office address is Suite 9, 445 East 200 South, Salt Lake City, Utah 84111 (Telephone: (801) 322-2713).

3. Educational Background: Attended Brigham Young University, University of Utah, and University of Chicago; graduated from University of Utah Law School with LL.B (J.D.) in 1956; ranked No. 1 in scholastic standing in law school; served as Editor-in-Chief of Utah Law Review; elected to Order of the Coif and Phi Kappa Phi; named outstanding graduate of 1956 by Johnson Inn of Phi Delta Phi International Legal Fraternity; received various scholarship awards, including Bancroft Whitney Award for scholarship in natural resources and Award by Lawyers' Title Company of Richmond, Virginia, for scholarship in real estate; awarded Harry Bigelow Teaching Fellowship by University of Chicago School of Law.

4. Professional Experience: Served as Teaching Fellow at University of Chicago School of Law under Bigelow Fellowship, and conducted advanced legal research simultaneously (1956-57); practiced law with firm of Clyde & Mecham in Salt Lake City (1957-58); partner in Clyde & Mecham law firm (1958-63); Assistant Utah Attorney General (1963-65); Chief Deputy Utah Attorney General (1965-66); professor of clinical law at University of Utah Law School (1966-67); special work in mining law, oil & gas and riparian rights litigation (1967-70); staff counsel for National Water Commission (1970-72); present position and activity since 1972.

Served as the member of the National Water Commission Staff having primary responsibility for studying the legal, institutional and practical aspects of instream flows for fish and wildlife uses; served as the lawyer for the Utah Division of Wildlife Resources for several years and later was a member of the policy Board for the Division; conducted litigation to preserve and protect the water rights of the Division for fish and wildlife uses; participated in negotiating agreements with Arizona and Wyoming, respectively, on Lake Powell and Flaming Gorge Reservoir; and assisted in formulating positions with respect to the minimum flows needed to sustain fishery needs on the streams originating on the South Slope of the Uinta Mountains (limitations on transbasin diversions and stream depletions by the Central Utah Project).

Represented towns, cities, counties, water improvement districts and water conservancy districts in water project development

and water rights litigation while in private practice. While Assistant Attorney General, represented the Division of Wildlife Resources on legal matters related to water project development for fish and wildlife resources and in water rights litigation to protect water uses for wildlife, as well as proceedings to improve water quality for fishery resources. As a member of the Board of Wildlife Resources, participated in the formulation of policies and positions with respect to water project development for wildlife needs, acquisition of water rights for wildlife purposes, and protection of instream flows for wildlife needs. While serving as Assistant Attorney General and Chief Deputy Attorney General, worked closely with legislators from all parts of the political spectrum, and drafted numerous bills that were enacted into law; and testified on natural resource matters before both the House and Senate Committees on Interior and Insular Affairs of the United States Congress. Experience on the Staff of the National Water Commission required participation in developing recommendations for a wide range of national water policies and required close collaboration with all professional disciplines involved with water resources.

In recent years, served as consultant on major natural resource litigation for major oil and coal companies, for major water districts, and for natural resource agencies of the State of Utah; served as consultant for universities and national organizations; and litigated natural resource cases at all levels of the state and federal judicial systems, including the United States Supreme Court.

5. Publications and Reports Dealing with Natural Resources and Environmental Law

Proposed Procedures for Planning, Allocating and Regulating Use of Water Resources in Utah (Utah Division of Water Resources, 1975; Dallin W. Jensen was co-author).

Industrial Development and the Environment: Legal Reforms to Improve the Decision-Making Process in Industrial Site Selection (Special Committee on Environmental Law of the American Bar Association, review draft published in 1973 and final draft in 1974; Dallin W. Jensen was co-director of project).

Summary-Digest of State Water Laws (National Water Commission, 1973; Dallin W. Jensen was co-editor).

Public Access Rights in Waters and Shorelands (National Water Commission, PB-205-247, 1971).

Legal Protection of Instream Water Values (National Water Commission, PB-205-003, 1971).

Legal Aspects of Water Salvage (National Water Commission, PB-205-005, 1971).

Improvement of State Water Records (National Water Commission, PB-202-618, 1971; Charles J. Meyers was co-author).

6. Papers and Speeches Dealing with Natural Resources and Environmental Law

1968: Legal Aspects of Federal versus State Management of Wildlife Resources, Annual Conference of the Western Association of State Game and Fish Commissioners, Reno, Nevada, July, 1968.

1971: Assembling Water Rights for a New Use: Needed Reforms in the Law, Seventeenth Annual Rocky Mountain Mineral Law Institute, Vail, Colorado, July, 1971 (published in 17 Rocky Mountain Mineral Law Institute 613-565).

1971: Instream Water Use for Wildlife Resources, Annual Conference of the International Association of State Game and Fish Commissioners, Salt Lake City, Utah, September, 1971.

1972: Instream Water Values and Current Legal Developments, National Water Policy Conference, sponsored by the American Bar Association in cooperation with the National Water Commission, Denver, Colorado, April, 1972.

1973: Instream Water Use Under State Water Laws, Annual Conference of American Society of Civil Engineers, Washington, D.C., January, 1973.

1973: Prospects for Improving Industrial Site Selection, Annual Conference of the Special Committee on Environmental Law of the American Bar Association, Airlie House (Near Warrenton), Virginia, April, 1973.

1973: Proposed Recommendations on Industrial Site Selection, Association of the Bar of the City of New York, New York City, October, 1973.

1974: Regulation of Land Use at the State Level, Course of Instruction for Environmental Law-IV, Sponsored by the American Law Institute and the American Bar Association, San Francisco, California, February, 1974.

1975: Problems Under State Water Laws: Initiation of New Rights, Water Law Conference of the American Bar Association, Denver, Colorado, February, 1975 (published in Natural Resources Lawyer, Volume VIII, No. 2, 347-358 (1975)).

HERBERT H. FULLERTON  
547 South 400 East  
Logan, Utah 84321

Education:

B.S. Utah State University (Ag. Economics), 1961  
M.S. Utah State University (Ag. Economics), 1966  
Ph.D. Iowa State University (Economics), 1971  
Dissertation: An Economic Simulation Model for Development  
and Resource Planning

Areas of Specialization:

Regional Economics  
Resource Economics and Public Policy  
Economic Theory

Major Research Interests:

Regional and National Economic Development  
Analysis of Economic Impacts of Public Resource Policies  
(water, land, people)

Professional Career:

Research: July 1967 - October 1969. Research Associate in  
Economics at Iowa State University. Dissertation and  
related research was conducted in regional economics,  
area development, and resources planning. Major work  
was devoted to computer simulation of regional economies.

November 1969 - present. Assistant (1969) and Associate  
(1974) Professor of Economics at Utah State University.  
Work has focused on the developmental impacts of public  
resource management and policy (water, land, people).

Teaching: November 1969 - present. Assistant (1969) and Associate  
(1974) Professor of Economics at Utah State University.  
Senior-graduate courses in land economics, land and water  
economic problems, agricultural policy, regional economics  
and income theory. Graduate courses in agricultural  
policy.

Honors and Awards:

Gamma Sigma Delta (Iowa)  
Alpha Zeta (Utah)  
Omicron Delta Epsilon (Iowa)

Recent Consulting and Advisory Assignments:

- 1971-72 National Water Commission - USU Foundation, Analysis of Regional Growth and Water Resource Investment.
- 1973,74,75 Utah State Highway Department, Leader-Economic Task Force for preparation of EIS, member of several other Task forces.
- 1973-74 National Academy of Science, Transportation Research Board, Review panel.
- 1974-75 National Science Foundation - University of Utah, Measurement of Agricultural Technology.
- 1974-75 Environment and Man Program - USU Foundation, Energy Policy Research conferences and writing.
- 1975-76 Resource Policy Program - USU Foundation, Proposal for Technology Assessment.
- 1975-76 National Park Service - Denver Center, Regional Socio-Economic Implications of Park Service Actions and Management.
- 1974-75 US/AID, USU International Programs Office, Food Crops Research Evaluation Team - East Africa.
- 1975-76 White River Shale Oil Project, Regional Socio-Economic Implications of Oil Shale Development in Eastern Utah.
- 1975-76 U.S. Forest Service, Valuation of Nonmarketed Recreation Services.
- 1974-75 Montana State University - OWRT, Opportunity Value of Water Based Recreation.
- 1975-76 National Commission on Water Quality, Task force on Regional Socio-Economic Implications of 92-500 Legislation in the Colorado River Basin.
- 1976-77 Institute for Policy Research, Western Governors Policy Office, Measurement of Drought Impacts, Leader Technical Committee.
- 1976-77 Policy Research Program - USU Foundation, Review of Project on Water Resources and Ute Self Determination.

Publications:

"Transfer Mobility and Value of Water", American Journal of Agricultural Economics 50 (3):556-571, August 1968 (with B. D. Gardner).

"Rising Water Values That Result from Increased Mobility", Utah Ag. Exp. Sta. Bul. 476, August 1968 (with B. D. Gardner).

"Ecology, Politics, Economics: WAEA Proceedings Report No. 21, 1971.

"An Economic Simulation Model for Development and Resource Planning", unpublished Ph.D. dissertation, Iowa State University Library, Ames, Iowa (1971).

"Transfer Restrictions and Misallocation of Irrigation Water", unpublished M.S. thesis, Utah State University Library, Logan, Utah, (1966).

"Capital Resources in the Four-Corners Economic Development Region", Special Report No. 3, New Mexico State University Agricultural Experiment Station, 1971 (with A. J. Randall, S. W. Fuller, and J. H. Lewis).

"The Role of Water in Regional Economic Development", report to the National Water Commission, NTIS PB 206 372, 1972 (with Jay C. Andersen, B. D. Gardner, and W. C. Lewis).

"The Environmental Movement and Rural Development", WAEA Proceedings Report No. 22, 1972 (with W. C. Lewis).

"Estimating Quality and Location Values for Recreation Resources", Journal of Leisure Research, summer 1973 (with E. B. Wennergren, J. C. Wrigley).

Regional Growth and Water Resource Investment, Book. D. C. Heath and Company, 1973 (with Jay C. Andersen, B. D. Gardner, and W. C. Lewis).

"Estimation of Quality and Location Values for Resident Deer Hunting in Utah", Experiment Station Research Bulletin, 1973 (with E. B. Wennergren and James C. Wrigley).

"Environmental Management in the Colorado River Basin - Resource Allocation and Management in the Colorado River Basin", USU Press, Logan, Utah, 1974 (with J. Baden and J. Neuhold).

"Empirical Estimation of Quality Values for Pheasant Hunting in Utah", Intermountain Economic Review, Spring 1974 (with E. B. Wennergren and James C. Wrigley).

"The Concept of Carrying Capacity in Regional Planning: A Feasibility Study", a research report submitted to the Environmental Studies Division of the Environmental Protection Agency, December 1973 (with A. B. Bishop, et al.).

An Economic Model for Resource Planning, book, Ann Arbor Science, April 1975, (with J. C. Prescott).

"Developing Pressures for Migration Toward Rural Areas", in Proceedings of the American Sociological Association, Montreal, Canada, Fall 1974 (with Stan Albrecht and John Baden).

"Economic Value of Water-Oriented Recreation Quality", PRRAE 805-1, Utah Water Research Laboratory, January 1975 (with John Keith, Boyd Wennergren, and Robin Meale).

"Supply Response Equations for Maize, Kenof, and Cassava in the Northeast Region", Technical Paper, Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok, Thailand, May 1977 (with Kitipong Surainrungsikul).

"Input-Output Analysis and Multipliers", Staff Working Paper, Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok, Thailand, January 1977.

"Regional Multipliers", Staff Working Paper, Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok, Thailand, April 1976.

"Applications of the Regional Crop Model of Thailand", DAE Technical Report, Ministry of Agriculture and Cooperatives, Bangkok, Thailand, May 1977, (with Prapai Vongmonta).

"Applications of the Regional Crop Model of Thailand", presented at the ADC Conference on Agricultural Sector Analysis, Singapore, Republic of Singapore, November 8-11, 1976.

"Agricultural Development Planning in Thailand: A Sector Analysis Approach", forthcoming in CARD series, Iowa State University, Ames, Iowa.

"Future Plans for Agricultural Sector Analysis in Thailand", Technical Paper presented at the ADC Seminar on Agricultural Sector Planning, Singapore, Republic of Singapore, November 8-11, 1976.

"Future Plans for Agricultural Sector Analysis in Thailand", DAE Technical Report, Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok, Thailand, May 1977.



## Curriculum Vita

Henry P. Caulfield, Jr.  
June 1, 1977

### Born

New York City, November 25, 1915

### Education

Los Angeles City Schools; graduate of Hollywood High School, June 1935

California Institute of Technology, Pasadena, California -- 1935-36  
Institute Scholarship  
Fields of concentration: Physics, Chemistry, and Mathematics

Lingnan University, Canton, China -- 1936-37  
Foreign Exchange Scholarship  
Fields of concentration: Science, Social Anthropology, and  
Chinese History

Harvard College -- 1938-40

S.B. degree cum laude, June 1940

Fields of concentration: Economics and Government

Harvard University, Graduate School of Public Administration --  
February 1948-March 1950

Worked toward joint degree in Political Economy and Government

Fields of concentration: Political Theory, Economic Theory,  
Constitutional Law and Industrial Organization and Control

MPA degree, June 1949

Passed General Examination for Ph.D., May 1950; thesis not completed.

Oxford University, Oxford, England; Summer School -- 1948

### Experience

Economist, Work Projects Administration, Research Division, Washington,  
D.C. -- July 1940-December 1941

Naval Officer (Ensign to Lieutenant Commander)

United States Navy, assigned to Office of the Secretary

Navy Department, Washington, D.C. -- January 1942-December 1945

Received Secretary's Commendation Award

Executive Assistant to Director, Office of War Mobilization and  
Reconversion, Washington, D.C. -- January-February, 1946

Instructor in Economics, Williams College, Williamstown, Massachusetts --  
March-September 1946

Assistant for International Affairs to the Assistant Director for  
Statistical Standards, Bureau of the Budget, Washington, D.C. --  
October 1946-January 1948

Director, International Economic and Statistical Education Program,  
International Statistical Institute, London, England -- July 1950-  
June 1951

Economist, Office of the Secretary, Department of the Interior,  
Washington, D.C. -- June 1951-September 1955

Research Associate on Energy Policy, Resources for the Future,  
Washington, D.C. -- September 1955-February 1961

Assistant Director and then Director, Resources Program Staff, Office  
of the Secretary, Department of the Interior, Washington, D.C. --  
February 1961-April 1966

Executive Director, Water Resources Council, Washington, D.C. --  
April 1966 to September 1969

Visiting Lecturer, University of Sarajevo, Yugoslavia, October 1972  
and February 1975

Lecturer, Institute of Water Resources, Army Corps of Engineers, Fort  
Belvoir, Virginia, October 1973 and October 1974

Visiting Lecturer, University of Massachusetts, March 1975

Member, Water Board, City of Fort Collins, 1974-Present

Professor of Political Science, Colorado State University, Fort  
Collins, Colorado, September 1969 to present.

#### Honor Awards

Citation for Distinguished Service, U.S. Department of the Interior, 1968  
Pi Sigma Alpha (see attachment)  
Sigma Xi  
Iban Award, American Water Resources Association, 1975

#### Publications

"The Living Past in Federal Electric Power Policy," Annual Report  
for 1959, Resources for the Future, Inc., Washington, D.C.

"Getting the Most Out of Water Resources," jointly with Professor  
Irving Fox, a paper presented at the Interstate Conference on  
Water Problems, Chicago, Illinois, December 5-6, 1960; published  
as Reprint No. 28, Resources for the Future, Inc., 1960

"Welfare, Economics, and Resources Development" in Land, Water Planning  
for Economic Growth, University of Colorado Press, 1961

"Municipal Water in Federal Programs" in Water: Development, Utiliza-  
tion Conservation, University of Colorado Press, 1963

"Urban Waterfront Redevelopment," in Beauty for America (Proceedings of  
the White House Conference on Natural Beauty, Washington, D.C.,  
May 1965)

- "The Water Resources Planning Act of 1965 and Federal-State Collaboration in Resource Planning" in Strategies for Western Regional Water Development (Proceedings of the Western Interstate Water Conference, Corvallis, Oregon: 1965) pp. 143-153.
- "The New Conservation: Pure Water, Clean Air, a More Beautiful America," a paper presented at the 33rd Annual Meeting, New York State Conservation Council, Jamestown, New York, September 1966 and published in the proceedings of that meeting.
- "Techniques of Water Resources Planning, Water Law and Institutions," a paper presented at the Second Annual Water Resources Research Conference, Washington, D.C., January 24, 1967 and published in the proceeding of that conference.
- "Flood Plain Management Policies" in Proceedings of National Conference of State and Federal Water Officials, Denver, Colorado, September 6-8, 1967 (Published by the Interstate Conference on Water Problems and Federal Water Resources Council, Washington, D.C.)
- "Partnership in Comprehensive River Basin Planning," Journal of the American Water Works Association (Vol. 59, No. 10, Part I, October 1967)
- "Environmental Management: Water and Related Land," paper included in a Symposium on Environmental Policy: New Directions in Federal Actions (Public Administration Review, Vol. XXVIII, July-August 1968, No. 4)
- "National Water Resources Planning," Bulletin 621, June-July 1969, American Railway Engineering Association
- "A New Look in Planning, Coordination and Policy-Making in Water Resources Use," a paper presented at the Western Interstate Water Conference, Fort Collins, Colorado, August, 1969 (published in conference proceedings)
- "Deciding About Water," a review of "Strategies of American Water Management," Gilbert White (University of Michigan Press, Ann Arbor, 1969), published in Science, Vol. 169, No. 3920, February 1970
- "The Allocation of Water and Related Land Resources," Proceedings of the the Western Resources Conference, Denver, Colorado, July 1970
- "Planning the Earth's surface," in No Deposit-No Return edited by Huey D. Johnson (Addison-Wesley, Reading, Mass.; 1970)
- "Political Considerations," a chapter included in A Manual of Wildlife Conservation, published by the Wildlife Society, Washington, D.C. 1971
- "Politics of Ecosystem Management," in Ecosystem Management Shortcourse (Range Science Department of Colorado State University under sponsorship of the United States Forest Service; 1971) pp. 32-33.
- "Interdisciplinary Research: Some Reactions of a Participants," Proceedings of the Committee on the Economics of Natural Resources Development (Western Agricultural Research Council: 1971) pp. 41-64

- "Water Resources and Social Goals: Conceptualization Toward a New Methodology," co-author with six others (First-year Report for Office of Water Resources Research on Project C-2194, Department of the Interior: 1971)
- "A National-Regional Impact Evaluation System-Discussion," in the 1971 Proceedings of the Business and Economics Section (American Statistical Association) pp. 211-214
- "Federal Guidelines for Water Resource Project Evaluation," in Environment Impact on Rivers, H. W. Shen, Editor (H. W. Shen, P.O. Box 606, Fort Collins, Colorado, U.S.A., 80521:1973), pp. 20-1 to 20-16
- "Transfer of Water Resource Knowledge," remarks at the First International Conference on Transfer of Water Resource Knowledge, September 1972, Fort Collins, Colorado, (Water Resources Publications, P.O. Box 303, Fort Collins, Colorado: 1973) pp. 531-534
- "The Conciliar Approach to Organization for Water Resources Planning and Action Within a Federal System of Government." Proceedings of the Interregional Seminar on Water Resources Administration, New Dehli, India, 22 January to 2 February, 1973 (United Nations, New York: 1975), pp. 113-119
- "The Concept and Function of Action Variables," with John T. Davenport (Program in Environmental Economics, University of California; report No. PRWG 112-2; 1972)
- "Water Resources Planning, Social Goals, and Indicators: Methodological Development and Empirical Test," co-author with six others, (Completion Report for Office of Water Research and Technology on Project C-2194 Department of Interior, December 31, 1974; published by Utah Water Research Laboratory, Utah State University, Logan, Utah, PRWG 131-1)
- "Manual for Training in the Application of the Principles and Standards of the Water Resources Council, co-editor and author of a chapter on "Public Decisionmaking Processes," (Environmental Resources Center, Colorado State University, Fort Collins, Colorado, 80521; December 1974).
- "The Politics of Multiple Objective Planning" in the Proceedings of the Multiple Objective Planning and Decisionmaking Conference, Boise, Idaho, January 1975, (Published by the Idaho Research Foundation, Inc., Moscow, Idaho: 1975)
- "Let's Dismantle (Largely but not fully) the Federal Water Development Establishment, or the Apostasy of a Longstanding Water Development Federalist" in the proceedings of the National Conference on Water, Washington, D.C., April 1975, Sponsored by the U.S. Water Resources Council, (U.S. Government Printing Office, Washington, 1976; Stock Number 024-001-02798-4) pp. 180-184
- "Legal and Institutional Constraints in the Use of Models--Introductory Remarks of the Moderator," Proceedings of a seminar held at Utah State University, July 16-18, 1975 on "Colorado River Basin Modelling Studies" (Utah Water Research Laboratory, Logan, Utah: March 1976) pp. 105-112

"Politics and Food Production in the West," in Proceedings of the 16th Annual Western Resources Conference, Fort Collins, Colorado, July 1976 (Colorado State University: 1977) pp. 57-59.

"Perspectives on Instream Flow Needs," in Proceedings of Instream Flow Needs Conference, Boise, Idaho, May 1976 (published by American Fisheries Society, Bethesda, Md.: September, 1976) pp. 4-16.

"Energy and the Environment: State and Local Concerns," in Energy, Water and the West (American Association for the Advancement of Science, Washington, DC: May 1976) p. 23.

Other papers, addresses, testimony before Congressional Committees variously published and unpublished; and anonymous authorship, alone and with others, of Federal Government publications, messages, speeches and statements.

#### Consultant Services

Soil and Water Conservation Commission, State of Nebraska, 1970

Presidential Advisory Council on Executive Organization, Spring 1970

Chairman, Environmental Advisory Panel to the Texas Water Development Board, 1970-1972

United Nations Panel of Experts on Water Resources Development Policies, 1970-1975

International Bank for Reconstruction and Development, 1973

U.S. General Accounting Office, 1973

Water Resources Research Institute, Rutgers University and the Philadelphia Academy of Natural Science on NSF-RANN research project on "The Petroleum Industry in the Delaware Estuary," 1974 to present

Natural Resources Department, State of Colorado, 1976 to present

#### Membership -- Professional Societies

American Political Science Association

American Society for Public Administration

American Water Resources Association

American Association for the Advancement of Science

Western Political Science Association

Policy Studies Organization

#### Professional Committees

Member, Committee on Desert and Arid Zone Research, Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science, 1970-1975.

Chairman, Water Resources Committee, Environmental Resources Center, Colorado State University, 1969-present

Member, Steering Committee on the J.F.K. Airport Expansion Study,  
Environmental Studies Board, National Academy of Sciences,  
Summer, 1970

Panel Leader, Research Conference on the Evaluation Process in Water  
Resources Planning, American Water Resources Association, at  
University of Wisconsin, Milwaukee, June 1970

Member, Working Group on Energy and Economic Growth, Committee on  
Power Plant Siting, National Academy of Engineering, 1971

CSU Delegate, Universities Council on Water Resources, 1971-present

Chairman, Task Force on Finance in Public Water Resource Use and  
Development, Committee on Education and Research in Social Sciences,  
Universities Council on Water Resources, 1972-1973

Ph.D. Fellowship Selection Committee, Resources for the Future, Inc.,  
Washington DC, 1973-1975

Awards Committee, American Water Resources Association, 1974-1976

Governor's Scientific Advisory Committee (Colorado), 1975-present

Member, Board of Directors, Fort Collins Foundation, 1976-present

Member, Environmental Studies Board, National Academy of Sciences/  
National Research Council, 1976-1979

Member, Governor's Drought Council, 1977

Other Affiliations

National Parks Association

Sierra Club

Wilderness Society

National Wildlife Federation

Harvard Club of the Rocky Mountains

Colorado Open Space Council

Poudre Valley Greenbelt Association



THE SECRETARY OF THE INTERIOR  
WASHINGTON

CITATION  
FOR DISTINGUISHED SERVICE

HENRY P. CAULFIELD, JR.

in recognition of an outstanding public service career as a staff advisor to the Secretary of the Interior.

Since the start of his Government service in 1940, Mr. Caulfield has steadily demonstrated qualities of the exceptionally able public servant. He is a person of unfailing high standards of integrity, loyalty and devotion to public service. His quiet but persistent powers of persuasion and his ability to resolve complex resources problems have characterized his career as an effective advisor. From early 1961 to 1966, first as Assistant Director and later as Director of the Resources Program Staff, Mr. Caulfield had a very active part in developing numerous Administration proposals in the natural resources field which have been enacted into law. These include: the Land and Water Conservation Fund Act, the Water Resources Research Act, the Federal Water Project Recreation Act, the Delaware Watergap National Recreation Act, the Wild and Scenic Rivers Act, the Clean Rivers Restoration Act of 1966, and the Water Resources Planning Act of 1965. Mr. Caulfield served as Chairman of the Interdepartmental Staff Committee of the Ad Hoc Water Resources Council established in 1961 at the request of President Kennedy, to develop unified Federal policies and to coordinate Federal planning for water and related land resources development. Following enactment of the Water Resources Planning Act of 1965, which provided the statutory basis for the Water Resources Council, Mr. Caulfield left the Department of the Interior to become the Executive Director of the Council, where he continues to provide leadership on complex water and related land resources policy and planning problems. In recognition of his significant contributions in the development of natural resources policies and programs, the Department of the Interior presents to Mr. Caulfield its highest honor, the Distinguished Service Award.

Secretary of the Interior

## VITA

### PERSONAL DATA:

Name: Bruce W. Kimzey  
Address: 1800 Fairway Circle, Las Cruces, New Mexico 88001  
Department of Economics, Box 3CQ, New Mexico State University,  
Las Cruces, New Mexico 88003  
Telephone: (Home) 505-522-2279  
(Office) 505-646-1003  
Date of Birth: March 10, 1942  
Marital Status: Married, 6 Children

### EDUCATION:

BS, Brigham Young University, 1964, Major in Economics  
PhD, Washington State University, 1970, Major in Economics

### SPECIALIZED AREAS:

Public Finance, Monetary Theory and Policy, International Trade and  
Finance, Macro and Micro Theory  
Dissertation Title: "Local Government Finance and the Future for the  
Seattle Area"

### EXPERIENCE:

#### Teaching

8-72 to Present  
Associate Professor of Economics  
New Mexico State University  
9-68 to 8-72  
Assistant Professor of Economics  
New Mexico State University  
9-67 to 6-68  
Instructor in Economics  
Washington State University

#### Research and Grants

Principal Investigator for five funded grants in the last four years.  
Largest were:  
\$32,000, "Solar Business" New Mexico Energy Resources Board  
\$14,178, "Quarai Amphitheater" Four Corners Regional Commission  
\$ 9,913, "Industrial Revenue Bonds" Department of Development  
Publications in last five years; two books, 3 articles, 3 research  
reports from funded grants.

#### Consulting

Commercial Banks, Public Utilities, state government agencies.



Major Committee Assignments

Masters Committees - 44 in the last 6 years  
NMSU Faculty Senate - 6 years  
NMSU Faculty Affairs Committee - 6 years  
BA&E College Curriculum Committees - 6 years  
Econ-Ag Econ Joint Graduate Committee - 4 years

Lectures and Seminars

Twenty-four in the last 4 years to such groups as:  
El Paso Chamber of Commerce  
New Mexico Municipal League  
Las Cruces Rotary Club  
WSMR Accountants and Managers  
Las Cruces and Albuquerque Industrial Development Boards  
New Mexico State Department of Development  
KRWG-TV panel member  
Numerous church groups

Book Reviews

Worth Publishers, Harper and Row Publishers, Dickenson Publishers,  
and Wadsworth Publishers

COURSE EXPERIENCE:

Macroeconomic Theory (Graduate)  
Macroeconomic Policy (Graduate)  
State and Local Government Finance (Graduate)  
Macroeconomics (MBA students)  
Principles of Taxation  
Public Finance  
Money and Banking  
International Economics  
Intermediate Price Theory  
Introduction to Economics

MEMBERSHIPS IN PROFESSIONAL ASSOCIATIONS:

National Tax Association-Tax Institute of America  
Western Economic Association

HONORS:

Member of BYU Honors Program and graduated with Honors  
Outstanding Educators of America, 1975

REFERENCES:

Personal references are available on request

PUBLICATIONS:

- "Fiscal Problems of Urban-suburban Development in New Mexico" (with Robert W. Beckstead), Department of Economics, New Mexico State University, June 1970 (Research Report)
- "The Wage-Price Freeze" Proceedings, Wage-Price Symposium, Center for Business Services, New Mexico State University, September 1971
- "Meeting Financial Needs" and "Speculators, Land, and Economics," Proceedings, Third Annual New Mexico State Land-Use Symposium, New Mexico State University, December 1971
- "An Analysis of Markets for Sulfuric Acid Produced in New Mexico" (with Jerry Hunt and John Loveland), Center for Business Services, New Mexico State University, December 1971 (Research Report)
- "Revenue Sharing: Solution or New Problem?" Business Studies, North Texas State University, Spring 1972
- The Vested Interest Economy: The American Road to Socialism, New Mexico State University, November 1972
- "Cost-Push Inflation and Recent U.S. Experience" Business Studies, North Texas State University, Fall 1973
- "An Analysis of New Mexico Firms Operating Under an Industrial Revenue Bond Act Project" Center for Business Services, New Mexico State University, September 1974 (Research Report)
- "An Economic Feasibility Analysis of the Quarai Outdoor Amphitheater" Center for Business Services, New Mexico State University, November 1975 (Research Report)
- The Property Tax in New Mexico, University Press of America, Washington, D.C., January 1977
- "The Property<sup>TAX</sup> in New Mexico: Is it Worth the Trouble?" New Mexico Business, Bureau of Business and Economic Research, University of New Mexico, April 1977
- "An Analysis of the Potential for Commercialization of Solar Energy in New Mexico" (with Tom GoHo, David Smith, and Ed Thode), New Mexico Energy Institute, New Mexico State University, August 1977 (Research Report)

CLYNN PHILLIPS

EDUCATION:

Ph.D. (Agricultural Economics), Montana State University, 1964  
M.S. (Agricultural Economics), Utah State University, 1962  
B.S. (Agricultural Economics), Utah State University, 1960

EMPLOYMENT:

Associate Director, Wyoming Water Resources Research Institute	1973-present
Director, Division of Business and Economic Research, University of Wyoming	1970-1973
Acting Director, Division of Business and Economic Research, University of Wyoming	1969-1970
Professor of Water Resources (Economics), University of Wyoming	1975-present
Associate Professor of Economics, University of Wyoming	1969-1975
Assistant Professor of Economics, University of Wyoming	1966-1969
Agricultural Economist, U.S. Department of Agriculture	1964-1966
Instructor, Department of Agricultural Economics, Montana State University	1963-1964

CONSULTANT:

Wyoming Recreation Commission, Cheyenne, Wyoming  
Wyoming Travel Commission, Cheyenne, Wyoming

PROFESSIONAL ASSOCIATIONS:

American Agricultural Economics Association  
Western Farm Economics Association  
Wyoming Recreation and Parks Association

CLYNN PHILLIPS

PUBLICATIONS:

- "Cost of Operating Machines for Seedbed Preparations and Planting on Irrigated Farms in Utah, 1960," Utah Resources Series 13, Agricultural Experiment Station, Utah State University, Logan, Utah, 1962.
- "Marketing Montana Hay," Bulletin 595, Montana Agricultural Experiment Station, Montana State University, Bozeman, Montana, 1965.
- "Potential Impact of Hay Processing on the Montana Hay Market," Montana Agricultural Experiment Station, Montana State University, Bozeman, Montana, 1965.
- "Economic Opportunities for On-the-Farm Feed Processing in Montana," Montana Agricultural Experiment Station, Montana State University, Bozeman, Montana, 1965.
- "Wyoming Data Book, 1967," Division of Business and Economic Research, College of Commerce and Industry, University of Wyoming, Laramie, Wyoming, April, 1968 (with Barbara J. Newman and Dwight M. Blood).
- "Outdoor Recreation in Wyoming," Vol. I: "Participation in Outdoor Recreation by Wyoming Residents," Division of Business and Economic Research, College of Commerce and Industry, University of Wyoming, Laramie, Wyoming, June, 1968 (with Dwight M. Blood).
- "Outdoor Recreation in Wyoming," Vol. II: "Outdoor Recreation Participation by Out-of-State Visitors in Wyoming," Division of Business and Economic Research, College of Commerce and Industry, University of Wyoming, Laramie, Wyoming, June, 1968 (with Dwight M. Blood).
- "Outdoor Recreation in Wyoming," Vol. III: "Recreational Boating on Wyoming's Lakes and Reservoirs," Division of Business and Economic Research, College of Commerce and Industry, University of Wyoming, Laramie, Wyoming, October, 1968 (with David S. Moewes and Dwight M. Blood).
- "Outdoor Recreation in Wyoming," Vol. IV: "Outdoor Recreation in Wyoming, 1985," Division of Business and Economic Research, College of Commerce and Industry, University of Wyoming, Laramie, Wyoming, February, 1970 (with G. Fred Doll and D. Allen Rogers).
- "An Outdoor Recreation Plan for Wyoming," Wyoming Recreation Commission, Cheyenne, Wyoming, June, 1970 (with Dwight M. Blood).
- "Recreation Potential on the Wind River Indian Reservation," Division of Business and Economic Research, College of Commerce and Industry, University of Wyoming, Laramie, Wyoming, November, 1971 (with David S. Moewes).

CLYNN PHILLIPS

CURRENT RESEARCH PROJECTS:

- The Development of an Economic Simulation Model for Wyoming's Powder River Basin - Office of Water Research and Technology, U.S. Department of the Interior.
- Campground Alternatives in the Grand Teton/Yellowstone National Parks Area - Eisenhower Consortium, Rocky Mountain Forest and Range Experiment Station, U.S. Forest Service.
- Economic Impact of Transportation Alternatives for the Greater Yellowstone National Park Area - National Park Service, USDI and Rocky Mountain Region, U.S. Forest Service.
- Fishing Use Pressure on Wyoming Waters - Wyoming Game and Fish Commission.
- Land Use Strategies for Teton County; A Study of Growth Alternatives - Teton County.

SPECIAL PROFESSIONAL ASSIGNMENTS AND DUTIES:

- 1974-1975, served as a member of a National Academy of Sciences Committee that was constituted to review and evaluate demand projection techniques and planning methodologies for outdoor recreation.
- 1972 to present, appointed by former Wyoming Governor Hathaway and reappointed by Governor Herschler to serve as Chairman of a committee that was established to coordinate the recreation development plans and activities in Wyoming of state and federal agencies. This committee includes two Regional Foresters, Superintendents of Grand Teton and Yellowstone National Parks, State Director of the Bureau of Land Management and the agency directors and chief planners for numerous other state and federal agencies that have recreation development responsibilities in the state.
- 1972-1975, member of State Multiple-Use Advisory Committee to the Bureau of Land Management.

VITA

October 1977

RICHARD L. STROUP

Associate Professor of Agricultural Economics & Economics  
Montana State University

Academic Background:

Massachusetts Institute of Technology	1961-1962
University of Washington, B.A., M.A.	1966
University of Washington, Ph.D. (Economics)	1970

Employment:

Teaching Assistant and Instructor, University of Washington, 1966-1968  
Lecturer, Seattle University, January-September, 1969  
Assistant Professor, Montana State University, September, 1969-June, 1974  
Visiting Associate Professor, Florida State University, March-June, 1974  
Associate Professor, Montana State University, July 1974-present

Publications and Papers Presented:

- "Financing Higher Education" 1966, M.S. Thesis, University of Washington.
- "The Economics of Air Pollution Control: 1970, Ph.D. Thesis, University of Washington.
- "Pollution, Information, and Choice: The Usefulness of Economic Analysis" presented April 22, 1971 at the regional meeting of the American Association for the Advancement of Science (AAAS).
- "Choice, Faith, and Politics" (with John Baden) Public Choice Vol. XII, Spring, 1972.
- "Air Pollution Control Economics: The Case of a Montana Smelter's SO<sub>2</sub> Emmissions" (with E. Barry Asmus) Montana Agricultural Experiment Station Research Report No. 24, July, 1972.
- "Measurement of Employment Discrimination According to Sex" (with James Gwartney) Southern Economic Journal, April, 1973.
- "Impacts of Induced Rainfall on the Great Plains of Montana: Economics" (with Stuart Townsend), Research Report 42, Section 5, Montana Agricultural Experiment Station, (86 pp., with Appendix of 211 pp.), 1973.
- "Externality, Property Rights and the Management of Our National Forests" (with John Baden) Journal of Law and Economics, April 1974. Reprinted in The Economics of Legal Issues, Henry Manne, ed. 1975, West Publishing Co.

- "The Demand for Water in Western Coal Development" (with Stuart Townsend) presented June 10, 1974 at the annual meeting of the Western Economics Association.
- "Water Use and Coal Development in Eastern Montana: Water Availability and Demands" (with S. B. Townsend) Montana University Joint Water Resources Research Center, Report No. 59, December 1974.
- "The Changing Economics of Energy: Electricity, Gas, and Coal" presented April 26, 1975, at the annual Pacific Northwest Regional Economics Conference, Spokane.
- "The Political Economy of Coal Gasification: Some Determinants of Demand for Western Coal" (with Verne House) presented June 26, 1975 at the Western Economics Association meetings, San Diego, (Staff Paper 75-17).
- "Forecasting Coal Gasification Activity in the Northern Plains" (with Walter Thurman), published in Montana University Coal Demand Study: Final Report (NSF Grant No. AER 75-14178) November 1975.
- "The Economics of Competing Water Use in the Northern Great Plains," presented March 24, 1976 at the national AAAS meetings, Boston, (Staff paper 76-8).
- Coursebook for Economics: Private and Public Choice (with A. Studenmand and J. Gwartney) New York: Academia Press, 1976.
- "Estimation of Amenity Values as Opportunity Costs for Energy Related Water Use in Montana" (with M. Copeland and R. Rucker) Montana University Joint Water Resources Research Center, Report No. 81, October 1976.
- "Property, Rights, Environmental Quality, and the Management of National Forests" (with John Baden) in Managing the Commons, G. Hardin, J. Baden editors, W. H. Freeman and Co., San Francisco 1977.
- "Property Rights and the Role of Resource Exploitation" presented at the 1977 Public Choice Society meetings, (Staff Paper 77-4).

Papers and Presentations for Non-Economists:

- "How Much Energy is Needed?" Proceedings: Montana and the Rest of the World Third Public Affairs Forum, Missoula MT, February 1975, published by Montana State University Cooperative Extension Service, Bozeman, MT, July 1975.
- "Projecting Pacific Northwest Demands for Electricity," Montana Business Quarterly, Vol. 13, No. 1, Winter 1975.

"Two Views of the Energy Crisis," Staff Paper 75-8, Department of Agricultural Economics and Economics, Montana State University, March 1975.

"Towards Equity and Efficiency in Pollution Control: The Emissions Charge on Polluters," Staff Paper 75-9, Department of Agricultural Economics and Economics, Montana State University, April 1975.

"Will Coal Gasification Come to the Northern Great Plains?" (with W. Thurman) Montana Business Quarterly, Vol. 14, No. 1, Winter 1976.

"Feasibility of Ethanol from Grain in Montana" (with T. Miller). Staff Paper 77-19, Department of Agricultural Economics and Economics, MSU, October 1977 (review draft of report to Montana Legislature from the Montana Agricultural Experiment Station).

#### Research Experience:

1970-74 "An Air Pollution Problem in Montana" Montana Agricultural Experiment Station Project 059; Principal Investigator.

1972-73 "Impacts of Induced Rainfall in the Great Plains of Montana" Multi-university project, funded by the Bureau of Reclamation; team leader, economics.

1973-74 "Water and Coal Development in Eastern Montana: Water Availability and Demands" Funded by the Office of Water Resources Research; Co-Principal Investigator.

1975 "Projecting Coal Gasification in the Northern Plains to the Year 2000" funded by NSF-RANN as part of a multi-university, multi-discipline study on the impacts of coal development; sub-project investigator.

1975-76 "Estimation of Amenity Values as Opportunity Costs for Energy-Related Water Use in Montana" funded by Office of Water Research and Technology; Principal Investigator.

1974-Present "Economic Analysis of the Impacts of Coal Development in Montana" Montana Agricultural Experiment Station Project 075; has included work on feasibility of ethanol from grain also; Principal Investigator.

#### Teaching Experience:

Economic Principles

Macroeconomic Theory (graduate)

Labor Economics (junior level)

Political Economy of the Environment (sophomore level)