



WYOMING WATER RESEARCH CENTER
THE UNIVERSITY OF WYOMING

Robert W. Brocksen
Director

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FIRST ANNUAL REPORT

OF THE

WYOMING WATER RESEARCH CENTER

(Activities during FY82)

The First Annual Report of the Wyoming Water Research Center discusses the organization, program and activities of the Water Center for the period October 1, 1981 through September 30, 1983.

Robert W. Brocksen
Director

TABLE OF CONTENTS

	<u>Page</u>
DIRECTOR'S STATEMENT	1
RESEARCH ACTIVITIES DURING FISCAL YEAR 1982	12
A-030-WYO: Investigations into Predictive Techniques for Estimating Hydrograph Characteristics for Ungaged Mountain Streams	14
A-034-WYO: Fault Severing of Aquifers and Other Geologically Controlled Permeability Contrasts in the Basin-Mountain Interface, and the Implications for Ground Water Recharge to and Development from the Major Artesian Basins of Wyoming . .	17
A-035-WYO: Tree Water Relations of Engelmann Spruce and Subalpine Fir in Wyoming	21
A-036-WYO: Development of In-Storm Rainfall Distribution for the State of Wyoming	24
A-037-WYO: Heavy Element Release to Groundwater at In-Situ Uranium Solution Mining Sites/Phase I	28
A-038-WYO: Design and Evaluation of a New Class of Water Flow Tracing Compounds	31
A-039-WYO: Projected Demands and Supplies of Water Under Alternative Energy and Agricultural Development Scenarios in the Green River Drainage of Wyoming: An Economic Analysis	37
APPENDIX A - FINANCIAL STATEMENTS	40

DIRECTOR'S STATEMENT

Fiscal Year 1982

KEY WATER RELATED PROBLEMS IN WYOMING

Water availability and allocation for farming, ranching, mineral extraction, and industrial development continue to be the center of water related problems in Wyoming. The development of new water resources through impoundment, while complying with existing interstate water compacts, is a challenge in planning and implementation. Once additional surface and groundwater supplies are available, the equitable distribution, conservation and maintenance of quality are important and complex issues facing the State.

In an attempt to address those problems most critical to the State, the Wyoming Water Research Center (WWRC), in consultation with its Research Review and Priorities Advisory Committee, established the following three major areas of water research: 1) evaluation of historical and current water use practices; 2) demand analysis and water resources development and 3) development of water resources. These three major areas include water quality and quantity, as well as the economic and social aspects of water research. We believe this emphasis provides a very logical, step-wise approach to addressing water research needs in the State of Wyoming. Certainly, projects dealing with the economic, technical and legal aspects of historical and current water use practices are necessary for the proper analysis of need for additional water resources development and the appropriate development of water resources can best be determined with information resulting from efforts under items 1 and 2 above. This framework should allow for a meaningful priority structure that can lead to information development germane to the needs of the State and the western United States.

RESEARCH RESULTS

The University of Wyoming, through the Institute program, has a long tradition of research in the area of trout habitat evaluation.

During FY82, Thomas A. Wesche conducted a study entitled, "Two Approaches for Estimation of Manning's n in Mountain Streams". Manning's n is a key coefficient in analyzing the suitability of mountain streams as trout habitat.

An analysis of roughness coefficients for mountain streams in the Rocky Mountain Region was conducted to devise an empirical method for determination of Manning's n . Two separate approaches were developed. One procedure utilizes a diagrammatic key approach based upon water surface slope and observable attempts to relate the time-of-travel velocity of a dye cloud through a stream reach to channel roughness. The conclusions drawn from the study indicate that:

- Good potential exists for the diagrammatic key approach to roughness coefficient estimates.
- While preliminary results using the time-of-travel approach were encouraging, verification studies failed to duplicate the original strong relationship.
- In steep, rough, tributary channels (especially at low flow), the use of tabled roughness coefficients and/or photographic comparisons can lead to erroneous estimation of Manning's n .
- Under field conditions n was generally found to increase as flow was reduced. However, several examples were found when the opposite occurred. Thus, any analysis which makes this assumption should also include a detailed inspection of the study channel to attempt to eliminate the possibility of such exceptions.
- The predictive equations developed for mountain streams can be used with a high degree of reliability to estimate parameters that would, under most circumstances, be time and equipment intensive.

The results of this research are particularly important to state and federal agencies charged with the management of fisheries resources. The cost savings using this reliable methodology are significant and results are being requested by many agencies for incorporation in their current models for instream flow evaluation.

INFORMATION DISSEMINATION

Over the past year, WWRC has developed a computerized Wyoming Water Bibliography containing nearly 15,000 citations on previous and current water research in the State. The use and availability of this database has been demonstrated to all state and federal agencies having responsibility for water resources. Seminars have been given at all of the regional community colleges for interested water users. In addition to the Water Research Bibliography, the Water Resources Data System (WRDS) has been updated and demonstrated for use to state and federal agencies, as well as the private sector.

WWRC has an impressive number of publications each year and faculty working through the Water Center have reported their results in professional journals and at conferences. The results of research are also disseminated through technology transfer efforts by organized workshops, seminars, etc.

ADVISORY STRUCTURE

The organizational structure and operational procedures of WWRC for a high degree of accountability and relevance to state and regional water research seems to be working well. In 1982, the WWRC was restructured to include a Research Advisory and Priorities Committee appointed by the Governor of the State of Wyoming with membership approved by the President of the University. The membership was designed to reflect the interests and inputs of the Executive Office, the legislative branch of government, the academic community and the University administration (Table 1). The Committee meets at least three times annually to discuss Water Center activities, research needs as they may have been perceived to change, and to approve projects presented.

Prior to presentation of projects to the Advisory Committee, a review process that includes relevant state agencies in addition to scientific peer review has been completed. This process has insured good science directed toward issues meaningful to water research needs

Table 1. WWRC - Research Review and Priorities Committee

Chairman:

Dick Hartman
State Planning Coordinator
2320 Capitol Avenue
Cheyenne, Wyoming 82002
777-7574

Executive Secretary:

Robert W. Brocksen, Director
Wyoming Water Research Center
Room 151, VA Building
766-2143

U.W. Appointees:

Donald L. Veal, President
Office of the President
Old Main, Room 206
766-4121

Dennis H. Knight
Department of Botany
Aven Nelson, Room 135
766-3291

Robert A. Jenkins
Vice President for Research
Old Main, Room 408
766-5353

Donald J. Brosz
Agricultural Engineering
Engineering Bldg., Room 260
766-4396

(All University of Wyoming, Laramie, Wyoming 82071)

Executive Appointees:

Governor Ed Herschler
State Capitol Building
Cheyenne, Wyoming 82002
777-7434

Paul Schwieger
DEPAD
Division of Water Development
Barrett Building
Cheyenne, Wyoming 82002
777-7284

Kenneth Kennedy
Water Development Commission
Circle Drive
Wheatland, Wyoming 82201
322-9789 (office)
322-3100 (home)

Warren White (alternate)
Governor's Office
State Capitol Building
Cheyenne, Wyoming 82002

Legislative Appointees:

George R. Salisbury, Jr.
Representative, Carbon County
Savory, Wyoming 82331
383-2430

Donald R. Cundall
Senator, Goshen-Platte County
Wendover Route
Guernsey, Wyoming 82214
322-3311

in the State. A citizens advisory committee is currently being formed and will input to the main Advisory Committee a broader set of perspectives on water related issues.

ADMINISTRATION

The FY82 period saw the formation of the WWRC with two interim acting directors and the installation of a full-time director. The transition period has been difficult, but successful. The State of Wyoming committed \$1.2 million to the operation of the WWRC for the period July 1, 1982 through June 30, 1984. These funds are for operational purposes, as well as for research support for University faculty participating with the Water Center. In addition to these activities, the Center has dedicated an amount of these monies for response to short-term State requests.

In general, the WWRC has demonstrated a viability to serve as a focal point in the State of Wyoming for water research and information dissemination. We believe we are meeting the objectives of the Federal Institute Program and the needs of the State of Wyoming. We are continually attempting to increase our awareness of state and regional information requirements and respond to them in a timely and meaningful manner.

For the Water Center program to achieve maximum effectiveness, it must be addressing those water problems most critical to Wyoming. The following is a summary of staff activities as well as faculty research projects funded with state allocations.

Director's Office

The majority of the Director's time has been spent in confirming organizational and operational charges of the Center. For purposes of this report, both the Director's office activities and technical staff activities will be presented in abbreviated form.

- Service to State Agencies

- Continual liaison with state agency officials.
- Basic technology transfer to state agencies and Wyoming water users and managers.
- Serve as advisor to Wyoming Water Development Commission.
- Continued attempts to integrate state and federal research programs.
- Attend Governor's Water Forum.
- Attend meetings regarding specific research projects.

- University Service

- Serve on University committees.
- Continued effort to apprise faculty members of research needs and opportunities in water-related research.
- Work with academic standards committee on Water Resources curriculum.
- Serve on appropriate graduate student committees.
- Serve on appropriate national and international technical review panels.

- Other Activities

- Continued effort to be cognizant of regional and national water issues and research opportunities.
- Participation in state water resource management symposium.
- Transfer of research results to appropriate users.

WWRC Staff

- Development of the Wyoming Water Bibliography

A major State service project undertaken by the Water Center technical staff during the past year has been the development of the Wyoming Water Bibliography (WWB). The WWB is the most comprehensive, multidisciplinary, computer-based bibliographic storage and retrieval system regarding Wyoming's water resources ever developed. Currently operational, the WWB contains approximately 11,000 citations which can be searched, free of charge, on a request basis. The User's Manual for the system is now developed and being mailed to over 1,000 people in the State involved with water issues, including legislators, agency personnel, representatives of county and municipal governments, libraries, special interest groups and interested members of the private sector. As previously mentioned, seminars will be given by Water Center staff statewide this coming spring to familiarize potential users with the system.

- Water Resources Data System

The Water Resources Data System (WRDS) has provided water related data to Wyoming researchers for over a decade. The system, through the years, has developed into the most comprehensive single source of surface and ground water quantity and quality, snow quantity and climatological data available for Wyoming. The broad applicability of the system is attested to by the variety of its users. Over the past 18 months, staff members of eight Wyoming state agencies have used WRDS in support of their functions. In addition, the system has provided information to many federal, county and municipal agencies and private firms.

Since quality answers to research questions depend upon accurate and comprehensive information, it is important that WRDS be kept current in its data and analytical capabilities. The

system has been supported in total by the State Engineer's Office during the 1983-1984 biennium. Resource constraints over the past several years have limited activities on the system's data and program correction and documentation, and data updating through major sources providing magnetic tape data. During the 1985-86 biennium, the Center will cost share with the State Engineer's Office to enhance the WRDS capabilities. This enhancement project will assure that WRDS be maintained at a progressive level through the sustained reinstatement of limited manual data entry and development activities.

● Other Service to the State

- Preparation of report for Precipitation Enhancement in Northeast Wyoming
(Wyoming Water Development Commission)
- Evaluation of Impacts to Hog Park Area from Cheyenne's Stage II Water Development
(Wyoming Game and Fish Department,
U.S. Forest Service)
- Critique of Water Resources Section of Peacekeeper EIS
(Wyoming Governor's Office)
- Critique of Hydrologic Report for Federal Flood Insurance Program
(Wyoming Office of Disaster Preparedness)
- Evaluation of U.S. Fish and Wildlife Service's "Water for Energy" Program
(Wyoming Governor's Office)
- Preparation of manuscript entitled "Stream Channel Modifications and Reclamation Structures to Enhance Fish Habitat"
(Wyoming Highway Department)
- Provided hydrologic data reduction services for the Laramie River Basin Water Commissioner
(State Engineer's Office)

While the above activities are not all inclusive, they are indicative of the varied activities in which the technical staff have been involved in behalf of service to the State.

● Participation in Funded Research

Center technical staff have assigned responsibilities in the following research projects:

- Channel Conveyance Loss Study
- Upper Green River Evapotranspiration Study
- Development of the Bighorn Basin Natural Resources Bibliography
- Overthrust Industrial Association Project
- Development and testing of two methods for determining channel roughness coefficient in steep, rough channels
- Winter trout stream conditions and habitat utilization by brook trout in the Snowy Range
- Evaluating the use of ocular stream habitat assessment methods to predict trout biomass
- Maintenance of the Snowy Range Observatory

- University Service

Technical staff of the Center have been involved in numerous service activities during the past 18 months for the University in general and in particular for those departments involved with water research, extension and education. These activities are as diverse as assisting with the maintenance of the Water Center Library to organizing seminars by industrial manufacturing representatives on water resources instrumentation.

Faculty Research Activities - State Funds

The 1982 Legislature appropriated \$1,247,875 for the 1983-1984 biennial funding of the Wyoming Water Research Center. Of this amount, \$650,000 was allocated to grants-in-aid for research pertinent to Wyoming's water research needs. Projects funded are relevant to these needs, and 10 of the 20 projects funded were in direct response to state agency requests to address specific issues. A listing of approved and funded projects follows.

- Funded Research Projects

- Flaming Gorge Watershed Project: Analyses with existing data. (Zoology Dept., Parker and Hubert)
- Evaluation of factors and models pertinent to estimating natural losses of water in Wyoming streams. (Civil Engineering Dept., Hasfurther)
- Evaluation of evaporation/transpiration losses in the Green River. (Agricultural Engineering Dept., Burman, Pochop, Borrelli)
- Development of a Wyoming Water Bibliography. (Wyoming Water Research Center, Wesche)

- Underground water resources: Thermopolis Hot Springs. (Geology Dept., Huntoon)
- Operation of the Snowy Range Observatory. (Wyoming Water Research Center, Wesche)
- Use of furrow compaction to improve irrigation efficiency and irrigation return flow quality. (Agricultural Engineering Dept., Smith)
- Use of satellite imagery to determine regional relationships between snowcover and annual runoff in Wyoming. (Geology Dept., Marrs)
- Alternative management and policy strategies for center pivot irrigation. (Agricultural Economics Dept., Jacobs)
- Winter stream habitat conditions in the Snowy Range of the Medicine Bow Mountains. (Wyoming Cooperative Fish & Wildlife Unit, Hubert and Wesche)
- Geothermal potential in Wyoming. (Geology Dept., Heasler)
- Available information on hazardous waste production, transport, and disposal in Wyoming. (Zoology Dept., Bergman)
- Acid deposition in Wyoming. (Wyoming Water Research Center, Brocksen)

RESEARCH ACTIVITIES DURING FISCAL YEAR 1982

1982 Annual Cooperative Program
14-34-0001-2154

A. OWP Annual Allotment Program

Reports of individual investigators for the Wyoming Water Research Center's Annual Cooperative Program are given on the following pages.

Projects included are:

Information Dissemination:

Land and Water Law Review: Volume XVII

A-030-WYO:

Investigations into Predictive Techniques for Estimating Hydrograph Characteristics for Ungaged Mountain Streams

A-034-WYO:

Fault Severing of Aquifers and Other Geologically Controlled Permeability Contrasts in the Basin-Mountain Interface, and the Implications for Ground Water Recharge to and Development from the Major Artesian Basins of Wyoming

A-035-WYO:

Tree Water Relations of Engelmann Spruce and Subalpine Fir in Wyoming

A-036-WYO:

Development of In-Storm Rainfall Distribution for the State of Wyoming

A-037-WYO:

Heavy Element Release to Groundwater at In-Situ Uranium Solution Mining Sites/Phase I

A-038-WYO:

Design and Evaluation of a New Class of Water Flow Tracing Compounds

A-039-WYO:

Projected Demands and Supplies of Water Under Alternative Energy
and Agricultural Development Scenarios in the Green River Drainage
of Wyoming: An Economic Analysis

ANNUAL REPORT -- ANNUAL COOPERATIVE PROGRAM OR MATCHING FUND PROGRAM PROJECT

OWRT PROJECT NO. <u>A-030-WYO</u> AGREEMENT NO. 14-34-0001- <u>2154</u> FCCSET RESEARCH CATEGORY: <u>II-E</u>	<u>PROJECT TITLE:</u> INVESTIGATIONS INTO PREDICTIVE TECHNIQUES FOR ESTIMATING HYDROGRAPH CHARACTERISTICS FOR UNGAGED MOUNTAIN STREAMS
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NAME AND LOCATION OF UNIVERSITY WHERE PROJECT IS BEING CARRIED OUT:

University of Wyoming
Laramie, Wyoming 82071

PROJECT BEGAN -- MONTH: <u>October</u> ; YEAR: <u>1981</u>	TO BE COMPLETED -- MONTH: <u>September</u> ; YEAR: <u>1983</u>
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<u>PRINCIPAL INVESTIGATORS</u>	<u>DEGREE</u>	<u>DISCIPLINE</u>
Wesche, Thomas A.	M.S.	Water Resources
<u>Other Professional Investigators</u>		
Hasfurther, Victor R.	Ph.D.	Civil Engineering
Hill, William	M.S.	Civil Engineering
<u>STUDENT ASSISTANTS</u> ^{1/}	<u>DEGREE HELD (IF ANY)</u>	<u>DISCIPLINE OR ACADEMIC BACKGROUND</u>

^{1/} LIST ONLY THOSE STUDENTS SERVING AS RESEARCH ASSISTANTS IN A PROFESSIONAL SENSE. DO NOT INCLUDE HOURLY WAGE EARNERS SUCH AS LAB DISWASHERS HERE BUT INCLUDE THEM IN FORMS OW-2, 3, AND 5. INCLUDE POST-DOCTORAL STUDENTS IF NOT SERVING AS PROFESSIONAL INVESTIGATORS.

NARRATIVE STATEMENTS

(REFER TO THE ATTACHMENT TO THIS FORM OW-1)

NARRATIVE STATEMENT

A-030-WYO

Investigations into Predictive Techniques for Estimating Hydrograph Characteristics for Ungaged Mountain Streams

A. Research Project Accomplishments

An analysis of roughness coefficients for mountain streams in the Rocky Mountain Region was conducted to devise an empirical method for determination of Manning's n . Two approaches were developed. One procedure utilizes a diagrammatic key approach based upon water surface slope and observable channel characteristics, while the other attempts to relate the time-of-travel velocity of a dye cloud through a stream reach to channel roughness. The conclusions drawn indicate that good potential exists for the use of the diagrammatic key approach. A second significant conclusion of the study is that the estimation of n for steep, rough, tributaries at low flow by means of published tables and/or photographic comparisons can lead to erroneous results.

B. Application of Research Results

The determination of roughness coefficients for particular stream reaches can be an extremely difficult task, especially in steep, rough channels. The methodology developed during this project will be applied in the selection of proper coefficients by river engineers/hydrologists in the determination of streamflows and the development of proper channel designs. Also, habitat biologists working in the areas of instream flow analysis and habitat improvement/modification will find the approach useful. Thus, the results of this project will be of benefit to stream scientists from state, federal and local agencies dealing with water as well as engineering and environmental consulting firms from the private sector.

A-030-WYO

C. Publications

Wesche, T.A., W.T. Hill, Jr., and V.R. Hasfurther. 1983. Two Approaches for Estimation of Manning's n in Mountain Streams. Research Project Technical Completion Report (A-030-WYO, Agreement No. 14-34-0001-2154), prepared for U.S. Dept. of Interior, September. 42 p.

It is also anticipated that in the near future this report will be disseminated as a WWRC Series Publication for statewide and regional distribution and as a contribution to a major water research journal for national exposure.

D. Project Status

Completed and completion report submitted.

ANNUAL REPORT -- ANNUAL COOPERATIVE PROGRAM OR MATCHING FUND PROGRAM PROJECT

OWRT PROJECT NO. <u>A-034-WYO</u>	<u>PROJECT TITLE:</u> FAULT SEVERING OF AQUIFERS AND OTHER GEOLOGICALLY CONTROLLED PERMEABILITY CONTRASTS IN THE BASIN-MOUNTAIN INTERFACE, AND THE IMPLICATIONS FOR GROUND WATER RECHARGE TO AND DEVELOPMENT FROM THE MAJOR ARTESIAN BASINS OF WYOMING
AGREEMENT NO. 14-34-0001- <u>2154</u>	
FCCSET RESEARCH CATEGORY: <u>II-A</u>	

NAME AND LOCATION OF UNIVERSITY WHERE PROJECT IS BEING CARRIED OUT:

Department of Geology and Geophysics
University of Wyoming
Laramie, Wyoming 82071

PROJECT BEGAN -- MONTH: <u>March</u> ; YEAR: <u>1982</u>	TO BE COMPLETED -- MONTH: <u>June</u> ; YEAR: <u>1983</u>
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<u>PRINCIPAL INVESTIGATORS</u>	<u>DEGREE</u>	<u>DISCIPLINE</u>
Peter W. Huntton	Ph.D.	Hydrology

<u>STUDENT ASSISTANTS^{1/}</u>	<u>DEGREE HELD (IF ANY)</u>	<u>DISCIPLINE OR ACADEMIC BACKGROUND</u>
Dale Doremus	B.S. (Working on M.S.)	Geology
John R. Copeland	B.S. (Working on M.S.)	Geology
Julia Dudley	B.S. (Working on M.S.)	Geology

^{1/} LIST ONLY THOSE STUDENTS SERVING AS RESEARCH ASSISTANTS IN A PROFESSIONAL SENSE. DO NOT INCLUDE HOURLY WAGE EARNERS SUCH AS LAB DISWASHERS HERE BUT INCLUDE THEM IN FORMS OW-2, 3, AND 5. INCLUDE POST-DOCTORAL STUDENTS IF NOT SERVING AS PROFESSIONAL INVESTIGATORS.

NARRATIVE STATEMENTS
(REFER TO THE ATTACHMENT TO THIS FORM OW-1)

NARRATIVE STATEMENT

A-034-WYO

Fault Severing of Aquifers and Other Geologically Controlled Permeability Contrasts in the Basin-Mountain Interface, and the Implications for Ground Water Recharge to and Development from the Major Artesian Basins of Wyoming

A. Research Project Accomplishments

The recharge areas for the major Paleozoic aquifers in the Wyoming foreland basins fall into three broad classes ranked from least to most efficient in hydraulic interconnection with the aquifers in the basins: (1) fault severed, (2) continuous homoclines, and (3) obliquely faulted. The fault severed and continuous homoclines classes each encompass slightly less than half the basin perimeters thus making these types very common. Recharge to the deep basins is precluded the fault severed boundaries. Consequently independent circulation develop in the hanging wall blocks mountainward from the basin perimeter. Most of the recharge water which enters the recharge areas along the homoclinal margins is rejected from the aquifer before entering the deep parts of the basin. This results because the diagenetic processes of recrystallization, cementation, and compaction have operated to reduce or destroy permeability basinward from the recharge areas since the recharge areas became differentiated from the basin proper. In both the fault severed and homoclinal margin cases, recharge along the basin perimeters is precluded or diminished over permeabilities determined for the aquifers from the recharge areas. The consequences of this finding are twofold: (1) development of ground water from the Paleozoic rocks in the interior parts of the extensive Wyoming artesian basins is largely unfavorable, and (2) developers are forced to limit their search for the best prospects to the recharge zones along the perimeters of the basins. The immediate result is: (1) the target drilling areas are dramatically reduced to a small percentage of the basin surfaces, and (2) development in the recharge areas interferes with existing surface water rights.

B. Application of Research Results

The results of this research are usable directly in basin development and management strategies by every Wyoming state agency involved in water including:

1. Wyoming State Engineer's Office,
2. Wyoming Water Development Commission,
3. Wyoming Department of Environmental Quality
4. Wyoming Department of Economic Planning and Development, and
5. Wyoming Governor's Office.

Ground water consultants concerned with development of water from the Paleozoic aquifers in the Wyoming foreland province are anxiously awaiting the results of this study.

Wyoming municipalities are in urgent need of this type of information in order to get the jump on industrial competitors for the limited ground water prospects available.

C. Publications

Huntoon, P. 1983. Fault severed aquifers along the perimeters of Wyoming artesian basins: Ground Water, in review.

Huntoon, P. 1983. Rejection of recharge water from the Madison aquifer along the eastern perimeter of the Bighorn artesian basin, Wyoming: Ground Water, in review.

Huntoon, P. 1983. Gradient controlled caves, Trapper-Medicine Lodge area, Bighorn Basin, Wyoming: Ground Water, in review.

Huntoon, P. 1983. Fault Severing of Aquifers and Other Geologically Controlled Permeability Contrasts in the Basin-Mountain Interface, and the Implications for Ground Water Recharge to and Development from the Major Artesian Basins of Wyoming. Research Project Technical Completion Report (A-034-WYO, Agreement No. 14-34-0001-2154), prepared for U.S. Dept. of Interior, June. 64 p.

A-034-WYO

D. Project Status

The project has been completed.

E. Work Remaining

None.

ANNUAL REPORT -- ANNUAL COOPERATIVE PROGRAM OR MATCHING FUND PROGRAM PROJECT

OWRT PROJECT NO. <u>A-035-WYO</u> AGREEMENT NO. <u>14-34-0001-</u> <u>2154</u> FCCSET RESEARCH CATEGORY: <u>II-D</u>	<u>PROJECT TITLE:</u> TREE WATER RELATIONS OF ENGELMANN SPRUCE AND SUBALPINE FIR IN WYOMING
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NAME AND LOCATION OF UNIVERSITY WHERE PROJECT IS BEING CARRIED OUT:

Department of Botany
University of Wyoming
Laramie, WY

PROJECT BEGAN -- MONTH: <u>October</u> ; YEAR: <u>1981</u>	TO BE COMPLETED -- MONTH: <u>September</u> ; YEAR: <u>1983</u>
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<u>PRINCIPAL INVESTIGATORS</u>	<u>DEGREE</u>	<u>DISCIPLINE</u>
Dennis H. Knight	Ph.D.	Botany
William K. Smith	Ph.D.	Botany

<u>STUDENT ASSISTANTS^{1/}</u>	<u>DEGREE HELD (IF ANY)</u>	<u>DISCIPLINE OR ACADEMIC BACKGROUND</u>
Greg Carter	M.S.	Botany
Julian Hadley	M.S.	Botany

^{1/} LIST ONLY THOSE STUDENTS SERVING AS RESEARCH ASSISTANTS IN A PROFESSIONAL SENSE. DO NOT INCLUDE HOURLY WAGE EARNERS SUCH AS LAB DISWASHERS HERE BUT INCLUDE THEM IN FORMS OW-2, 3, AND 5. INCLUDE POST-DOCTORAL STUDENTS IF NOT SERVING AS PROFESSIONAL INVESTIGATORS.

NARRATIVE STATEMENTS
(REFER TO THE ATTACHMENT TO THIS FORM OW-1)

NARRATIVE STATEMENT

A-035-WYO

Tree Water Relations of Englemann Spruce And Subalpine Fir in Wyoming

A. Research Project Accomplishments

Leaf conductances (g_{wv}) to water vapor loss were determined from late May through mid-August for Picea engelmannii, Abies lasiocarpa, and Pinus contorta at 2,860 m, and for Picea engelmanni and Abies lasiocarpa at 3,200 m in the Medicine Bow Mountains of Wyoming. Moist soil conditions persisted throughout the summer. Near- or below-freezing air temperatures in late spring and early summer limited maximum g_{wv} in spruce and fir at 3,200 m to 0.4 and 0.1 mm s⁻¹, respectively. Following onset of consistently non-freezing nights, maximum daily g_{wv} in all species at both elevations generally increased over the summer, but low soil temperatures at the higher elevation site appear to be a primary factor limiting maximum g_{wv} . Diurnally, spruce g_{wv} was generally greater than fir g_{wv} , and pine g_{wv} was higher than in either spruce or fir from mid-to-late summer. These results will be useful in developing a computer simulation model for water flow through the subalpine spruce-fir forests of Wyoming.

B. Application of Research Results

This research is of interest to watershed managers with the U.S. Forest Service in the Rocky Mountain region. Though considerable information is now available for lodgepole pine, these latest results pertain to the spruce-fir forest, which covers an extensive area in the region and which is less well known hydrologically. The results contribute toward a database which will be used in developing computer simulation models for water yield from subalpine forests.

C. Publications

The final report was written in a form that could be submitted directly to the journal Ecology. This has been done, and the manuscript is now being reviewed.

Carter, G.A., J.L. Hadley, W.K. Smith and D.H. Knight. 1983.
Summer Water Relations of Abies lasiocarpa, Picea engelmanni,
and Pinus contorta at Higher and Lower Elevation Sites in
Southeastern Wyoming. Research Project Technical Completion
Report (A-035-WYO, Agreement No. 14-34-0001-2154), prepared
for U.S. Dept. of Interior, December. 24 p.

D. Project Status

This one-year project has been completed, and the Final Report has been submitted.

E. Work Remaining

None

ANNUAL REPORT -- ANNUAL COOPERATIVE PROGRAM OR MATCHING FUND PROGRAM PROJECT

OWRT PROJECT NO. <u>A-036-WYO</u> AGREEMENT NO. <u>14-34-0001- 2154</u> FCCSET RESEARCH CATEGORY: <u>II-B</u>	<u>PROJECT TITLE:</u> Development of In-Storm Rainfall Distributions for the State of Wyoming
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NAME AND LOCATION OF UNIVERSITY WHERE PROJECT IS BEING CARRIED OUT:

University of Wyoming
Laramie, Wyoming

PROJECT BEGAN -- MONTH: <u>October</u> ; YEAR: <u>1981</u>	TO BE COMPLETED -- MONTH: <u>September</u> ; YEAR: <u>1983</u>
---	---

PRINCIPAL INVESTIGATORS

Hasfurther, Victor R.

DEGREE

Ph.D.

DISCIPLINE

Civil Engineering

STUDENT ASSISTANTS^{1/}

Patrick Tyrrell

DEGREE HELD (IF ANY)

B.S.
M.S.

DISCIPLINE OR
ACADEMIC BACKGROUND

Mechanical Engineering
Civil Engineering

^{1/} LIST ONLY THOSE STUDENTS SERVING AS RESEARCH ASSISTANTS IN A PROFESSIONAL SENSE. DO NOT INCLUDE HOURLY WAGE EARNERS SUCH AS LAB DISWASHERS HERE BUT INCLUDE THEM IN FORMS OW-2, 3, AND 5. INCLUDE POST-DOCTORAL STUDENTS IF NOT SERVING AS PROFESSIONAL INVESTIGATORS.

NARRATIVE STATEMENTS

(REFER TO THE ATTACHMENT TO THIS FORM OW-1)

NARRATIVE STATEMENT

A-036-WYO

Development of In-Storm Rainfall Distribution for the State of Wyoming

A. Research Project Accomplishments

Parametric flood prediction on ungaged basins in Wyoming requires the use of temporal storm patterns that realistically represent anticipated local rainfall events. Because methods of hyetograph construction currently in use are very general in application, this requirement is not met. Therefore, a design storm methodology based on analysis of time distribution characteristics of 603 observed storms in Wyoming was developed. The "WYO" method of storm design that was developed uses not one, but several mass rainfall curves, allowing flexibility of use and maximization of runoff from a given storm volume.

Comparisons were made between the "WYO" method and design storms recommended by the U.S. Soil Conservation Service and U.S. Bureau of Reclamation using HEC-1, HYMO, HYDRO (Triangular Hydrograph), and USGS Distributed Routing rainfall-runoff models.

Conclusions

1. The time distribution of both thunderstorms and general storms is not dependent upon the drainage basin in which the storms occur.
2. The most outstanding characteristic of the storms analyzed is their individual diversity. No relationship exists between time distribution characteristics and duration of general storms or thunderstorms. However, a difference in the time distribution of thunderstorm rainfall, compared to general storm rainfall, exists.
3. One set of thunderstorm design curves and one set of general storm design curves can be used to create design hyetographs for the entire State of Wyoming.

4. The "WYO" design storm methodology should not be used to design for "probable maximum" type events because the most intense rainfall values have been neglected by the definition of ten percent and 90 percent limit curves.
5. Simulation of runoff peak and volume using WYO design curves is sensitive to storm duration and choice of model.
6. WYO curves typically predict greater runoff peaks than Soil Conservation Service or Bureau of Reclamation synthetic hyetographs for short duration events, and less runoff for long duration events, according to HEC-1, HYMO, and HYDRO model results.
7. WYO Curves consistently produce less runoff than Soil Conservation Service or Bureau of Reclamation synthetic hyetographs when the USGS Distributed Routing model is used.

B. Application of Research Results

The Wyoming Highway Department has adopted the methodology developed in this research and has incorporated it into some of their rainfall-runoff models. The savings will result in better design storm runoff estimates for sizing culverts, etc.

C. Publications

Tyrrell, Patrick, T. 1983. Design Rainfall Patterns for the State of Wyoming. Proceedings of the ASCE Irrigation and Drainage Division Specialty Conference on Advances in Irrigation and Drainage: Surviving External Pressures, Jackson, Wyoming, July 20-22. pp. 494-502.

Hasfurther, Victor R. and Patrick T. Tyrrell. 1984. Wyoming Storm Hyetograph Properties. Accepted for publication in: Transportation Research Board Journal, 1984. Paper presented at 63rd Annual Meeting of TRB, January 16-20, 1984, Washington, D.C.

A-036-WYO

Hasfurther, Victor R. and Patrick T. Tyrell. 1983. Design Rainfall
Distributions for the State of Wyoming. Research Project
Technical Completion Report (A-036-WYO, Agreement No.
14-34-0001-2154), prepared for U.S. Dept. of Interior, August.
41 p.

D. Project Status
Project is completed.

ANNUAL REPORT -- ANNUAL COOPERATIVE PROGRAM OR MATCHING FUND PROGRAM PROJECT

OWRT PROJECT NO. <u>A-037-WYO</u> AGREEMENT NO. <u>14-34-0001-</u> <u>2154</u> FCCSET RESEARCH CATEGORY: <u>V-B</u>	<u>PROJECT TITLE:</u> HEAVY ELEMENT RELEASE TO GROUNDWATER AT IN-SITU URANIUM SOLUTION MINING SITES, PHASE I
---	---

NAME AND LOCATION OF UNIVERSITY WHERE PROJECT IS BEING CARRIED OUT:

University of Wyoming
Laramie, Wyoming 82071

PROJECT BEGAN -- MONTH: <u>April</u> ; YEAR: <u>1982</u>	TO BE COMPLETED -- MONTH: <u>August</u> YEAR: <u>1983</u>
---	--

<u>PRINCIPAL INVESTIGATORS</u>	<u>DEGREE</u>	<u>DISCIPLINE</u>
Michael J. Humenick	Ph.D.	Environmental Engineering
<u>CO-INVESTIGATORS</u>		
James I. Drever	Ph.D.	Geology

<u>STUDENT ASSISTANTS^{1/}</u>	<u>DEGREE HELD (IF ANY)</u>	<u>DISCIPLINE OR ACADEMIC BACKGROUND</u>
William Dam	B.S.	Geology

^{1/} LIST ONLY THOSE STUDENTS SERVING AS RESEARCH ASSISTANTS IN A PROFESSIONAL SENSE. DO NOT INCLUDE HOURLY WAGE EARNERS SUCH AS LAB DISWASHERS HERE BUT INCLUDE THEM IN FORMS OW-2, 3, AND 5. INCLUDE POST-DOCTORAL STUDENTS IF NOT SERVING AS PROFESSIONAL INVESTIGATORS.

NARRATIVE STATEMENTS
(REFER TO THE ATTACHMENT TO THIS FORM OW-1)

NARRATIVE STATEMENT

A-037-WYO

Heavy Element Release to Groundwater at In-situ Uranium Solution Mining Sites/Phase I

A. Research Project Accomplishments

This laboratory experimental research project evaluated the mechanism and kinetics of release of heavy elements to groundwater from sandstone ores which have been mined by an in-situ leach process and subsequently subjected to groundwater flow through mined area. Ores from Wyoming and Texas were examined during the work, and heavy elements of interest were uranium, molybdenum, vanadium, arsenic and selenium.

The mechanism of release was found to be controlled by diffusion. The kinetics of release were modeled by an overall mass transfer relationship. Under conditions of the experiments, the heavy elements were calculated to be anionic in nature. Data were obtained and processed to provide required information to simulate field conditions when evaluating heavy element migration at uranium solution mining sites.

The experimental procedures utilized a recirculating batch system for the leach and groundwater flow steps. The experimental equipment is thought to be innovative and most useful in achieving the desired results.

B. Application of Research Results

The results of this research will be used to develop simulation models of groundwater transport of heavy elements. This work is just starting as part of Phase II of the work. The modeling effort will be very useful in setting criteria for the restoration and eventual closing of the solution mining sites.

A-037-WYO

C. Publications

We are in the process of developing a paper for publication in the refereed literature.

Humenick, M.J., W.L. Dam, J.I. Drever. 1983. Heavy Element Release to Groundwater at In-Situ Uranium Mining Sites: Phase I. Research Project Technical Completion Report (A-037-WYO, Agreement No. 14-34-0001-2154), prepared for Dept. of Interior, August. 71 p.

D. Project Status

This work is continuing as Phase II in which we are developing a simulation model as indicated in (B), above. A final report is submitted for Phase I.

E. Work Remaining

Work on Phase I is completed.

ANNUAL REPORT -- ANNUAL COOPERATIVE PROGRAM OR MATCHING FUND PROGRAM PROJECT

OWRT PROJECT NO. <u>A-038-WYO</u> AGREEMENT NO. <u>14-34-0001- 2154</u> FCCSET RESEARCH CATEGORY: <u>IV-B</u>	<u>PROJECT TITLE:</u> DESIGN AND EVALUATION OF A NEW CLASS OF WATER FLOW TRACING COMPOUNDS
---	--

NAME AND LOCATION OF UNIVERSITY WHERE PROJECT IS BEING CARRIED OUT:

Department of Chemistry
University of Wyoming
Laramie, Wyoming 82071

PROJECT BEGAN -- MONTH: <u>October</u> ; YEAR: <u>1981</u>	TO BE COMPLETED -- MONTH: <u>September</u> ; YEAR: <u>1983</u>
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PRINCIPAL INVESTIGATORS

DEGREE

DISCIPLINE

David A. Nelson

Ph.D.

Organic Chemistry

STUDENT ASSISTANTS^{1/}

DEGREE HELD (IF ANY)

DISCIPLINE OR
ACADEMIC BACKGROUND

Douglas M. Lenz

B.S.

Chemistry

^{1/} LIST ONLY THOSE STUDENTS SERVING AS RESEARCH ASSISTANTS IN A PROFESSIONAL SENSE. DO NOT INCLUDE HOURLY WAGE EARNERS SUCH AS LAB DISWASHERS HERE BUT INCLUDE THEM IN FORMS OW-2, 3, AND 5. INCLUDE POST-DOCTORAL STUDENTS IF NOT SERVING AS PROFESSIONAL INVESTIGATORS.

NARRATIVE STATEMENTS

(REFER TO THE ATTACHMENT TO THIS FORM OW-1)

NARRATIVE STATEMENT

A-038-WYO

Design and Evaluation of a New Class of Water Flow Tracing Compounds

A. Research Project Accomplishments

Six new compounds for use as water tracers were synthesized by alkylation of the sodium salts of 3-phenyl-2-pyridone and 3-carbomoyl-2-pyridone with $\text{Br}(\text{CH}_2)_x\text{SO}_3^-\text{Na}^+$, where $x = 2, 3,$ and 4 . These $-(3\text{-substituted-2-oxo-1-pyridyl})\text{-alkylsulfonates}$ are chemically stable and resist adsorption in the environment. The compounds are designed to be separated by ion-impairing reversed phase high performance liquid chromatographic (HPLC) techniques, with fluorescence detection. These properties make the compounds uniquely suited for site-specific water tracers.

B. Application of Research Results

Some of the compounds developed from this research have been used by Dr. Glenn Thompson at the Department of Hydrology, University of Arizona. Dr. Thompson is a consulting hydrologist, and a recognized expert in the use of water tracers. Although preliminary tests were inconclusive, they indicated the problems that needed to be solved, and led to the design of the pyridone sulfonates. He feels that these compounds do have unique potential as tracers, and has agreed to test others as they become available in quantity.

Interest in these compounds has also been expressed by a group at the Water Systems Development Branch, TVA, Norris, Tennessee, and by a research group at MIT.

The benefits or savings that would result from the effective application of these compounds as water tracers relate to a) their sensitivity of detection, b) the lower cost of the detection system, and c) the simplicity of the detection method.

Even though the compounds are more expensive per unit than some currently used tracers, the levels of detection are so low that the cost is more than compensated for. Technology is currently available to detect these compounds at levels 100 to 1000 times lower than those reported. These methods would involve microbore HPLC and laser-induced fluorescence.

The levels of detection report here can be achieved with commercially available equipment costing less than \$10,000. The only competitive technology would be a gas chromatograph coupled with a mass spectrometer (GC-MS). These systems cost from \$100,000 to over \$250,000.

The HPLC instrumentation used in the methods developed in this research is relatively simple to operate. Dedicated HPLC systems can be operated by individuals with expertise in other areas, and by general technicians. Their maintenance costs are low, particularly if modern microbore systems are used. GC-MS requires expert operators and maintenance is expensive.

These compounds are uniquely suited for remote monitoring, and for multiple-site labeling. In this latter regard, they offer benefits in that no other group of structurally related compounds exists that can be determined by the same method in the same sample in one run. This fact would result in significant savings in analysis time for anyone using water tracers.

C. Publications

A paper reporting these results has been submitted for presentation at the 1984 Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy. A copy of the abstract is attached.

A-038-WYO

Nelson, D.A. and D.M. Lenz. 1983. Synthesis and High Performance Liquid Chromatography of ω -(3-Substituted-2-Oxo-1-Pyridyl)-Alkylsulfonates for Use as Water Tracing Compounds. Research Project Technical Completion Report (A-038-WYO, Agreement No. 14-34-0001-2154) prepared for U.S. Dept. of Interior, September. 21 p.

D. Project Status

OWRT funding for this project ended September 30, 1983, and a completion report has been submitted.

E. Work Remaining

Research related to this project will be continued as part of a Ph.D. program. Additional compounds will be synthesized, and laboratory tests related to properties as water tracers will be conducted. Continued funding for this research will be sought.

**New, Highly Fluorescent Water Tracing Compounds Designed for
HPLC Analysis**

Douglas M. Lenz and David A. Nelson, Dept. of Chemistry,
University of Wyoming, Laramie, WY 82071.
(307)766-3134

Categories 46, 24a, 20

Please consider this contributed paper for oral presentation.

We declare that this paper, and all material therein, has not been
and shall not be published or presented before the 1984 Pittsburgh
Conference week.

Douglas M. Lenz
Douglas M. Lenz

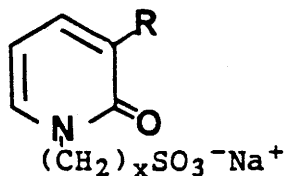
David A. Nelson
David A. Nelson

Date 11 Aug 1983

The objective of this research was to design a series of
compounds suitable for water tracing that could be separated and
detected using modern HPLC methods. In this way a set of tracers
could be differentiated in the same sample, and thus serve as
site-specific markers.

To this end we have synthesized the two series of compounds
shown below, which are 1,3-disubstituted-2-pyridones. Synthesis
involved the alkylation of the pyridone sodium salts with the
corresponding bromoalkyl sulfonates. These compounds are highly
fluorescent, with quantum yields of fluorescence ranging from 0.3
to over 0.9. Absorption maxima are at 325 nm ($\epsilon=9000$) for series
I, and 315 nm ($\epsilon=6000$) for series II. Emission maxima are near 390
nm for both series.

Series I $R = \text{CONH}_2$, $X = 2, 3, 4$



Series II $R = \text{C}_6\text{H}_5$, $X = 2, 3, 4$

Both series of compounds have desirable properties as water tracers. They are photochemically stable and resistant to adsorption. Their fluorescence intensity is essentially constant over the pH range 2-12. The fluorescence is not quenched by chloride, or a variety of heavy metal ions. Series II is chemically very stable, and can withstand a variety of aggressive conditions, both oxidative and reductive. Series I compounds can undergo hydrolysis to the acid ($R=\text{COOH}$), but this form can be detected with equal sensitivity. The series $R=\text{COOH}$ is extremely stable, chemically.

Separation of series I compounds was achieved using a C-18 column and a mobile phase of 85% 0.05 M tetrabutyl ammonium phosphate (Waters Associates PIC-A ion pairing reagent) and 15% acetonitrile. Series II compounds were separated with 90% PIC A and 10% acetonitrile. Detection of the compounds was accomplished using a Schoeffel FS 970 L.C. Fluorometer modified to use a zinc resonance lamp as light source. With this system we can detect a 10 μl sample of a 5×10^{-10} M solution of series I compounds. This is equivalent to 5×10^{-15} moles, or about 10^{-12} grams (1 picogram) of compound Ia. Various preconcentration techniques could be used to increase the sensitivity to significantly lower levels.

Limited field tests have been carried out with derivatives of Series I which indicate that the compounds are resistant to biodegradation. The compounds have shown persistence of several months in a test well.

Our initial research with these compounds leads to the conclusion that they could be very useful to measure pollution transport. Various locations at pollution sites or burial dumps could be marked with a series of the test compounds. Since the synthesis is a general one, additional members of any series could be obtained. The compounds are new, and thus would be exotic in any particular environment. Any potential interferences should be minimized by the HPLC separation.

ANNUAL REPORT -- ANNUAL COOPERATIVE PROGRAM OR MATCHING FUND PROGRAM PROJECT

OWRT PROJECT NO. <u>A-039-WYO</u> AGREEMENT NO. <u>14-34-0001-</u> <u>2154</u> FCCSET RESEARCH CATEGORY: <u>VI-B</u>	<u>PROJECT TITLE:</u> PROJECTED DEMANDS AND SUPPLIES OF WATER UNDER ALTERNATIVE ENERGY AND AGRICULTURAL DEVELOPMENT SCENARIOS IN THE GREEN RIVER DRAINAGE OF WYOMING
--	--

NAME AND LOCATION OF UNIVERSITY WHERE PROJECT IS BEING CARRIED OUT:

Department of Agricultural Economics
University of Wyoming
Laramie, Wyoming 82071

PROJECT BEGAN -- MONTH: <u>June</u> ; YEAR: <u>1982</u>	TO BE COMPLETED -- MONTH: <u>August</u> ; YEAR: <u>1983</u>
--	--

<u>PRINCIPAL INVESTIGATORS</u>	<u>DEGREE</u>	<u>DISCIPLINE</u>
Douglas R. Franklin	Ph.D.	Agricultural Economics
James J. Jacobs	Ph.D.	Agricultural Economics

<u>STUDENT ASSISTANTS^{1/}</u>	<u>DEGREE HELD (IF ANY)</u>	<u>DISCIPLINE OR ACADEMIC BACKGROUND</u>
Paul J. Farris	M.S.	Agricultural Economics

^{1/} LIST ONLY THOSE STUDENTS SERVING AS RESEARCH ASSISTANTS IN A PROFESSIONAL SENSE. DO NOT INCLUDE HOURLY WAGE EARNERS SUCH AS LAB DISWASHERS HERE BUT INCLUDE THEM IN FORMS OW-2, 3, AND 5. INCLUDE POST-DOCTORAL STUDENTS IF NOT SERVING AS PROFESSIONAL INVESTIGATORS.

NARRATIVE STATEMENTS
(REFER TO THE ATTACHMENT TO THIS FORM OW-1)

NARRATIVE STATEMENT

A-039-WYO

Projected Demands and Supplies of Water Under Alternative Energy and Agricultural Development Scenarios in the Green River Drainage of Wyoming

A. Research Project Accomplishments

The results of a linear program model suggest that if water is easily transferable, development of energy resources along with their municipal impacts could be accomplished with limited public investment, loss in net farm income, or increases in salinity in the Green River Basin of Wyoming. Wyoming will not "use" up its entitlement to Colorado River water. If, however, water is not freely transferable and agricultural returns increase by 25 percent, the net cost to the state is estimated to be a minimum of \$1.5 million in salinity damages. Salinity concentration is a major constraint to development in the Upper Colorado River Basin. If agricultural growth is to take place, given the EPA ruling in 1974 salinity levels, public investment must take place and some trade-off of water between energy and agriculture must be incorporated. Without public investment and water transfer to energy, the implications could be of a larger magnitude because of reduced development of energy resources. As increases in the salt concentration occur downstream, the imposition of an additional cost borne by Wyoming decreases the opportunity to increase profits.

B. Application of Research Results

The Wyoming Water Development Commission has indicated (summer 1982) having a copy of the final report to use in its study of the Green River Basin. The consulting firm of ARIX has also indicated an interest.

A-039-WYO

C. Publications

Franklin, D.R., J.J. Jacobs and P.J. Farris. 1983. Projected Demands and Supplies of Water Under Alternative Energy and Agricultural Development Scenarios in the Green River Drainage of Wyoming. Research Project Technical Completion Report (A-039-WYO, Agreement No. 14-34-0001-2154) prepared for U.S. Dept. of Interior, August. 50 p.

D. Project Status

Project is completed during the fiscal year ending September 30, 1983.

APPENDIX A
FINANCIAL STATEMENTS

OWP Annual Allotment Program (14-34-0001-2154)

Financial Statements for the Wyoming Water Research Center's Annual Allotment Projects for FY82 are submitted herein.

Information Dissemination:

Information Dissemination/Technology Transfer Program

Land and Water Law Review: Volume XVII

Publication costs for Volume XVII were included in the budget for Information Dissemination/Technology Transfer Program

- A-030-WY0: Investigations into Predictive Techniques for Estimating Hydrograph Characteristics for Ungaged Mountain Streams
- A-034-WY0: Fault Severing of Aquifers and Other Geologically Controlled Permeability Contrasts in the Basin-Mountain Interface, and the Implications for Ground Water Recharge to and Development from the Major Artesian Basins of Wyoming
- A-035-WY0: Tree Water Relations of Engelmann Spruce and Subalpine Fir in Wyoming
- A-036-WY0: Development of In-Storm Rainfall Distribution for the State of Wyoming
- A-037-WY0: Heavy Element Release to Groundwater at In-Situ Uranium Solution Mining Sites/Phase I
- A-038-WY0: Design and Evaluation of a New Class of Water Flow Tracing Compounds
- A-039-WY0: Projected Demands and Supplies of Water Under Alternative Energy and Agricultural Development Scenarios in the Green River Drainage of Wyoming: An Economic Analysis

Director's Office Administration Statements

Form OW-3 - Institute Director's Office

OW-4 - Estimated Functional Distribution of Fiscal Annual
Cooperative Program Funds Expended for Operation of
the Office of Institute Director

OW-5 - Summary Sheet - Annual Cooperative Program

OW-10 - Source and Application of Institute Financial
Resources for Fiscal Year 1982

ACP and MFP FY 1982 Annual Report

Form OW-2
(Rev. 10/80)

Prepare a separate form for each Sec. 101 and Sec. 105(a) Project in Progress During FY

State where Institute is located: <u>WYOMING</u>	Report as of September 30, 19 <u>83</u>
OWRT Project No: <u>NA</u> Agreement No: <u>14-34-0001- 2154</u> Federal Amount of Agreement: \$ <u>13,982</u> Type of Project: Annual Cooperative <input checked="" type="checkbox"/> Matching Fund <input type="checkbox"/> Tech. Transfer <input type="checkbox"/>	Project Title: <u>Information Dissemination</u>

Principal Investigator(s):
Smith, James L. and Jenkins, Robert A. (Interim Directors)

Project Starting Date October, 1981; Actual/Scheduled Completion Date September 1983

Cost Categories and Work Months	Budgeted 1/		Expenditures FY 1982 2/	
	Total	Federal	Non-Federal	Total
A. Salaries and Wages				
Principal Investigator(s)				
No: Work-Months:	()	(\$ 881.15)	()	(\$ 881.15)
Other Professional Staff				
No: Work-Months:	(\$ 4,052.00)	()	(\$ 4,261.83)	(4,261.83)
Grad. Stu. Assts. & Tech.				
No: Work-Months:	()	()	()	()
Undergrad. Stu. Assts. & Tech.				
No: Work-Months:	()	(1,352.15)	()	(1,352.15)
Non-Stu. Techs. & Others				
No: Work-Months:	(3,080.00)	(4,323.80)	(2,289.00)	(6,612.80)
Total:	7,132.00	6,557.10	6,550.83	13,107.93
B. Employee Benefits Total:			2,017.46	2,017.46
Non-Expendable				
C. Property Total:				
D. Expendable Property Total:	350.00	567.24		567.24
E. Other Cost (specify) Communication/Contractual	1,000.00	3,857.66	()	(3,857.66)
Land & Water Law Review	(5,500.00)	(3,000.00)	()	(3,000.00)
Indirect Costs	()	()	(7,628.91)	(7,628.91)
Total:	\$ 6,500.00	\$ 6,857.66	\$ 7,628.91	\$ 14,486.57
Total Expenditures FY 1982	\$ 13,982.00	\$ 13,982.00	\$ 16,197.20	\$ 30,179.20
Cumulative Expenditures since Start of Project (if Multivear)				

- 1) Total Federal/Non-Federal amount budgeted as set forth in project budgets (and revisions) submitted and accepted by OWRT.
- 2) Actual Expenditures including outstanding commitments (or obligations); for example, unliquidated orders for equipment.

ACP and MFP FY 1982 Annual Report

Form OW-2
(Rev. 10/80)

Prepare a separate form for each Sec. 101 and Sec. 105(a) Project in Progress During FY

State where Institute is located:

WYOMING

Report as of September 30, 1983

OWRT Project No: A-030-WYO
Agreement No: 14-34-0001- 2154
Federal Amount of Agreement: \$ 12,600
Type of Project: Annual Cooperative ☒
Matching Fund ☐
Tech. Transfer ☐

Project Title:
Investigations into Predictive Techniques
for Estimating Hydrograph Characteristics
for Ungaged Mountain Streams

Principal Investigator(s):

Wesche, Thomas A.

Project Starting Date October, 1981; Actual/Scheduled Completion Date September 1983

Cost Categories and Work Months	Budgeted 1/		Expenditures FY 1982 2/	
	Total	Federal	Non-Federal	Total
A. Salaries and Wages				
Principal Investigator(s) No: Work-Months:	(\$ 2,500.00)	(\$ 101.76)	(\$ 4,220.46)	(\$ 4,322.22)
Other Professional Staff No: Work-Months:	(2,500.00)	()	(7,041.54)	(7,041.54)
Grad. Stu. Assts. & Tech. No: Work-Months:	()	()	()	()
Undergrad. Stu. Assts. & Tech. No: Work-Months:	(5,000.00)	(5,751.21)	()	(5,751.21)
Non-Stu. Techs. & Others No: Work-Months:	()	(3,345.30)	()	(3,345.30)
Total:	10,000.00	9,198.27	11,262.00	20,460.27
B. Employee Benefits Total:	900.00	1,455.71	2,252.39	3,708.10
C. Non-Expendable Property Total:				
D. Expendable Property Total:	500.00	1,507.20		1,507.20
E. Other Cost (specify)	()	()	()	()
Travel	(1,200.00)	(438.82)	()	(438.82)
Indirect Costs	()	()	(8,687.51)	(8,687.51)
Total:	1,200.00	438.82	8,687.51	9,126.33
Total Expenditures FY 1982	\$ 12,600.00	\$ 12,600.00	\$ 22,201.90	\$ 34,801.90
Cumulative Expenditures since Start of Project (if Multivyear)				

- 1) Total Federal/Non-Federal amount budgeted as set forth in project budgets (and revisions) submitted and accepted by OWRT.
- 2) Actual Expenditures including outstanding commitments (or obligations); for example, unliquidated orders for equipment.

ACP and MFP FY 1982 Annual Report

Form OW-2
(Rev. 10/80)

Prepare a separate form for each Sec. 101 and Sec. 105(a) Project in Progress During FY

State where Institute is located:

Report as of September 30, 1983

WYOMING

OWRT Project No: A-034-WYO
 Agreement No: 14-34-0001- 2154
 Federal Amount of Agreement: \$ 13,148
 Type of Project: Annual Cooperative ☒
 Matching Fund ☐
 Tech. Transfer ☐

Project Title:
 Fault Severing of Aquifers and Other
 Geologically Controlled Contrasts in the Basin-
 Mountain Interface, and the Implications for
 Ground Water Recharge to and Development from
 the Major Artesian Basins of Wyoming

Principal Investigator(s):

Huntoon, Peter W.

Project Starting Date October, 1981; Actual/Scheduled Completion Date September 1983

Cost Categories and Work Months	Budgeted 1/		Expenditures FY 1982 2/	
	Total	Federal	Non-Federal	Total
A. Salaries and Wages				
Principal Investigator(s) No: Work-Months:	(\$ 2,000.00)	(\$ 6,659.05)	(\$ 5,800.00)	(\$ 12,459.05)
Other Professional Staff No: Work-Months:	()	()	()	()
Grad. Stu. Assts. & Tech. No: Work-Months:	(3,450.00)	()	()	()
Undergrad. Stu. Assts. & Tech. No: Work-Months:	()	(200.00)	()	(200.00)
Non-Stu. Techs. & Others No: Work-Months:	(1,350.00)	()	()	()
Total:	6,800.00	6,859.05	5,800.00	12,659.05
B. Employee Benefits Total:	603.00	976.72	1,160.00	2,136.72
Non-Expendable				
C. Property Total:		300.00		300.00
D. Expendable Property Total:	1,275.00	3,640.67		3,640.67
E. Other Cost (specify) Communication/ Contractual	(1,000.00)	(317.06)	()	(317.06)
Travel	(3,470.00)	(1,054.50)	()	(1,054.50)
Indirect Costs	()	()	(6,656.90)	(6,656.90)
Total:	4,470.00	1,371.56	6,656.90	8,028.46
Total Expenditures FY 1982	\$ 13,148.00	\$ 13,148.00	\$ 13,616.90	\$ 26,764.90
Cumulative Expenditures since Start of Project (if Multiyear)				

- 1) Total Federal/Non-Federal amount budgeted as set forth in project budgets (and revisions) submitted and accepted by OWRT.
- 2) Actual Expenditures including outstanding commitments (or obligations); for example, unliquidated orders for equipment.

ACP and MFP FY 1982 Annual Report

Form OW-2
(Rev. 10/80)

Prepare a separate form for each Sec. 101 and Sec. 105(a) Project in Progress During FY

State where Institute is located:

WYOMING

Report as of September 30, 1983

OWRT Project No: A-035-WYO

Agreement No: 14-34-0001- 2154

Federal Amount of Agreement: \$ 13,500

Type of Project: Annual Cooperative ☒Matching Fund ☐Tech. Transfer ☐

Project Title:

Tree Water Relations of Engelmann Spruce
and Subalpine Fir in Wyoming

Principal Investigator(s):

Knight, Dennis H.

Project Starting Date October, 1981; Actual/Scheduled Completion Date September 1983

Cost Categories and Work Months	Budgeted 1/		Expenditures FY 1982 2/	
	Total	Federal	Non-Federal	Total
A. Salaries and Wages				
Principal Investigator(s)				
No: Work-Months:	()	()	(\$ 2,517.30)	(\$ 2,517.30)
Other Professional Staff				
No: Work-Months:	(650.00)	(650.00)	()	(650.00)
Grad. Stu. Assts. & Tech.				
No: Work-Months:	(5,775.00)	(5,772.00)	()	(5,772.00)
Undergrad. Stu. Assts. & Tech.				
No: Work-Months:	()	()	()	()
Non-Stu. Techs. & Others				
No: Work-Months:	(1,800.00)	(1,747.35)	(105.92)	(1,853.27)
Total:	8,225.00	8,169.35	2,623.22	10,792.57
B. Employee Benefits Total:	441.00	540.75	522.32	1,063.07
Non-Expendable				
C. Property Total:	2,188.00	2,182.49		2,182.49
D. Expendable Property Total:	1,700.00	1,195.61		1,195.61
E. Other Cost (specify) Communication/				
Contractual	()	(466.34)	()	(466.34)
Travel	(946.00)	(945.46)	()	(945.46)
Indirect Costs	()	()	(5,592.64)	(5,592.64)
Total:	946.00	1,411.80	5,592.64	7,004.44
Total Expenditures FY 1982	\$ 13,500	\$ 13,500.00	\$ 8,738.18	\$ 22,238.18
Cumulative Expenditures since Start of Project (if Multiyear)				

- 1) Total Federal/Non-Federal amount budgeted as set forth in project budgets (and revisions) submitted and accepted by OWRT.
- 2) Actual Expenditures including outstanding commitments (or obligations); for example, unliquidated orders for equipment.

ACP and MFP FY 1982 Annual Report

Form OW-2
(Rev. 10/80)

Prepare a separate form for each Sec. 101 and Sec. 105(a) Project in Progress During FY

State where Institute is located:

WYOMING

Report as of September 30, 1983

OWRT Project No: A-036-WYO
Agreement No: 14-34-0001- 2154
Federal Amount of Agreement: \$ 10,586
Type of Project: Annual Cooperative ☒
Matching Fund ☐
Tech. Transfer ☐

Project Title:
Development of In-Storm Rainfall
Distributions for the State of Wyoming

Principal Investigator(s):

Hasfurther, Victor R.

Project Starting Date October, 1981; Actual/Scheduled Completion Date September 1983

Cost Categories and Work Months		Expenditures FY 1982 2/			
		Budgeted 1/ Total	Federal	Non-Federal	Total
A. Salaries and Wages					
Principal Investigator(s)					
No: Work-Months:		(\$ 2,510.00)	(\$ 2,832.21)	(\$ 5,559.41)	(\$ 8,391.62)
Other Professional Staff					
No: Work-Months:		()	(5,095.50)	()	(5,095.50)
Grad. Stu. Assts. & Techn.					
No: Work-Months:		(5,900.00)	(47.55)	()	(47.55)
Undergrad. Stu. Assts. & Techn.					
No: Work-Months:		(500.00)	()	()	()
Non-Stu. Techns. & Others					
No: Work-Months:		(910.00)	(1,460.87)	()	(1,460.87)
Total:		9,820.00	9,436.13	5,559.41	14,995.54
B. Employee Benefits	Total:	616.00	791.69	1,111.87	1,903.56
C. Property					
Non-Expendable	Total:				
D. Expendable Property	Total:	150.00	358.18		358.18
E. Other Cost (specify)					
Indirect Costs		()	()	(5,738.78)	(5,738.78)
Total:				5,738.78	5,738.78
Total Expenditures FY 1982		\$ 10,586	\$ 10,586.00	\$ 12,410.06	\$ 22,996.06
Cumulative Expenditures since Start of Project (if Multivyear)					

- 1) Total Federal/Non-Federal amount budgeted as set forth in project budgets (and revisions) submitted and accepted by OWRT.
- 2) Actual Expenditures including outstanding commitments (or obligations); for example, unliquidated orders for equipment.

ACP and MFP FY 1982 Annual Report

Form OW-2
(Rev. 10/80)

Prepare a separate form for each Sec. 101 and Sec. 105(a) Project in Progress During FY

State where Institute is located:

Report as of September 30, 1983

WYOMING

OWRT Project No: A-037-WYO
 Agreement No: 14-34-0001- 2154
 Federal Amount of Agreement: \$ 10,800
 Type of Project: Annual Cooperative ☒
 Matching Fund ☐
 Tech. Transfer ☐

Project Title:

Heavy Element Release to Groundwater
 at In-Situ Uranium Solution Mining
 Sites: Phase I

Principal Investigator(s):

Humenick, Michael J.

Project Starting Date October, 1981; Actual/Scheduled Completion Date September 19 83

Cost Categories and Work Months	Budgeted 1/		Expenditures FY 1982 2/	
	Total	Federal	Non-Federal	Total
A. Salaries and Wages				
Principal Investigator(s)				
No: Work-Months:	()	()	(\$ 6,811.07)	(\$ 6,811.07)
Other Professional Staff				
No: Work-Months:	()	()	()	()
Stu. Assts. & Tech.				
No: Work-Months:	(\$ 7,700.00)	(\$ 8,413.84)	()	(8,413.84)
Undergrad. Stu. Assts. & Tech.				
No: Work-Months:	()	()	()	()
Non-Stu. Techs. & Others				
No: Work-Months:	()	()	()	()
Total:	7,700.00	8,413.84	6,811.07	15,224.91
B. Employee Benefits Total:		506.74	1,362.21	1,868.95
C. Non-Expendable Property Total:	1,500.00			
D. Expendable Property Total:	650.00	1,812.28		1,812.28
E. Other Cost (specify) Communication/Contractual	350.00	67.14	()	(67.14)
Travel	600.00	()	()	()
Indirect Costs	()	()	6,352.71	(6,352.71)
Total:	950.00	67.14	6,352.71	6,419.85
Total Expenditures FY 1982	\$ 10,800	\$ 10,800.00	\$ 14,525.99	\$ 25,325.99
Cumulative Expenditures since Start of Project (if Multiyear)				

- 1) Total Federal/Non-Federal amount budgeted as set forth in project budgets (and revisions) submitted and accepted by OWRT.
- 2) Actual Expenditures including outstanding commitments (or obligations); for example, unliquidated orders for equipment.

ACP and MFP FY 1982 Annual Report

Form OW-2
(Rev. 10/80)

Prepare a separate form for each Sec. 101 and Sec. 105(a) Project in Progress During FY

State where Institute is located:

WYOMING

Report as of September 30, 1983

OWRT Project No: A-038-WYO

Agreement No: 14-34-0001- 2154

Federal Amount of Agreement: \$ 9,840

Type of Project: Annual Cooperative

Matching Fund

Tech. Transfer

Project Title:

Design and Evaluation of a New
Class of Water Flow Tracing Compounds

Principal Investigator(s):

Nelson, David A.

Project Starting Date October, 1981; Actual/Scheduled Completion Date September 1983

Cost Categories and Work Months	Budgeted 1/		Expenditures FY 1982 2/	
	Total	Federal	Non-Federal	Total
A. Salaries and Wages				
Principal Investigator(s)				
No: Work-Months:	()	()	(\$ 1,333.61)	(\$ 1,333.61)
Other Professional Staff				
No: Work-Months:	()	()	()	()
Grad. Stu. Assts. & Tech.				
No: Work-Months:	(\$ 4,590.00)	()	()	()
Undergrad. Stu. Assts. & Tech.				
No: Work-Months:	(750.00)	(\$ 3,547.45)	()	(3,547.45)
Non-Stu. Techs. & Others				
No: Work-Months:	()	()	()	()
Total:	5,340.00	3,547.45	1,333.61	4,881.06
B. Employee Benefits	Total:		266.71	266.71
Non-Expendable				
C. Property	Total:	495.00		495.00
D. Expendable Property	Total:	3,500.00	4,942.81	4,942.81
E. Other Cost (specify)	Communication/			
Contractual	300.00	(574.85)	()	(574.85)
Travel	700.00	(279.89)	()	(279.89)
Indirect Costs	()	()	(3,837.62)	(3,837.62)
Total:	1,000.00	854.74	3,837.62	4,692.36
Total Expenditures FY 1982	\$ 9,840.00	\$ 9,840.00	\$ 5,437.94	\$ 15,277.94
Cumulative Expenditures since Start of Project (if Multivyear)				

- 1) Total Federal/Non-Federal amount budgeted as set forth in project budgets (and revisions) submitted and accepted by OWRT.
- 2) Actual Expenditures including outstanding commitments (or obligations); for example, unliquidated orders for equipment.

ACP and MFP FY 1982 Annual Report

Form CW-2
(Rev. 10/80)

Prepare a separate form for each Sec. 101 and Sec. 105(a) Project in Progress During FY

State where Institute is located:

Report as of September 30, 1983

WYOMING

OWRT Project No: A-039-WYO
Agreement No: 14-34-0001- 2154
Federal Amount of Agreement: \$ 7,658
Type of Project: Annual Cooperative ☒
Matching Fund ☒
Tech. Transfer ☒

Project Title:
Projected Demands and Supplies of Water
Under Alternative Energy and Agricultural
Development Scenarios in the Green River
Drainage of Wyoming: An Economic Analysis

Principal Investigator(s):

Franklin, Douglas R.

Project Starting Date October, 1981; Actual/Scheduled Completion Date September 1983

Cost Categories and Work Months	Budgeted 1/		Expenditures FY 1982 2/	
	Total	Federal	Non-Federal	Total
A. Salaries and Wages				
Principal Investigator(s)				
No: Work-Months:	(\$ 1,050.00)	(\$ 1,052.94)	()	(\$ 1,052.94)
Other Professional Staff				
No: Work-Months:	()	()	()	()
Grad. Stu. Assts. & Tech.				
No: Work-Months:	()	()	()	()
Undergrad. Stu. Assts. & Tech.				
No: Work-Months:	()	()	()	()
Non-Stu. Techs. & Others				
No: Work-Months:	(4,858.00)	(4,500.00)	()	(4,500.00)
Total:	5,908.00	5,552.94		5,552.94
B. Employee Benefits Total:			\$ 1,085.59	1,085.59
Non-Expendable				
C. Property Total:				
D. Expendable Property Total:	500.00	491.21		491.21
E. Other Cost (specify) Communication/Contractual	500.00	420.42	()	420.42
Travel	750.00	1,193.43	()	1,193.43
Indirect Costs	()	()	3,059.01	3,059.01
Total:	1,250.00	1,613.85	3,059.01	4,672.86
Total Expenditures FY 1982	\$ 7,658.00	\$ 7,658.00	\$ 4,144.60	\$ 11,802.60
Cumulative Expenditures since Start of Project (if Multiyear)				

- 1) Total Federal/Non-Federal amount budgeted as set forth in project budgets (and revisions) submitted and accepted by OWRT.
- 2) Actual Expenditures including outstanding commitments (or obligations); for example, unliquidated orders for equipment.

**FY 1982 ANNUAL REPORT
FOR INSTITUTE DIRECTOR'S OFFICE**

State where Institute is located: <u>WYOMING</u>		Report as of September 30, 19 <u>83</u>		
Director's Name: <u>Smith, James L.</u> <u>Jenkins, Robert A.</u> (Interim Directors)		Annual Coop. Agreement: No.: <u>14-34-0001- 2154</u>		
Cost Categories and Work-Months	Budgeted 1/	Expenditures FY 19 <u>82</u> 2/		
	Total	Federal	Non-Federal	Total
A. Salaries and Wages				
Principal Investigator(s) No: Work-Months:	(\$ 4,527.00)	()	()	()
Other Professional Staff No: Work-Months:	(6,087.00)	(\$ 5,321.43)	(\$ 1,195.72)	(\$ 6,517.15)
Grad. Stu. Assts. & Tech. No: Work-Months:	()	()	()	()
Undergrad. Stu. Assts. & Tech. No: Work-Months:	()	()	()	()
Non-Stu. Techs. & Others No: Work-Months:	(6,160.00)	(8,112.12)	(1,678.60)	(9,790.72)
Total:	16,774	13,433.55	2,874.32	16,307.87
B. Employee Benefits Total:			2,766.55	2,766.55
C. Non-Expendable Property Total:				
D. Expendable Property Total:		2,160.24		2,160.24
E. Other Cost (specify) <u>Communication/Contractual</u>	()	(1,450.38)	()	(1,450.38)
Travel	(1,500.00)	(1,229.83)	()	(1,229.83)
Indirect Costs	()	()	(7,644.83)	(7,644.83)
Total:	1,500.00	2,680.21	7,644.83	10,325.04
Total Expenditures FY 19 <u>82</u>	\$ 18,274.00	\$ 18,274.00	\$ 13,285.70	\$ 31,559.70 ^{3/}

- 1) Amount budgeted is as set forth in budget (and revisions) submitted to and accepted by OWRT.
- 2) Actual expenditures including firm outstanding commitments (or obligations); for example, unliquidated orders for supplies or equipment.
- 3) If total of actual expenditures vary more than 10% from amount budgeted an explanation of such variance should be provided on an attachment to this sheet.

FY 19 82 ANNUAL REPORT -- FOR THE INSTITUTE DIRECTOR'S OFFICEEstimated Functional Distribution of FY 19 82 Annual Cooperative Program Funds
Expended for Operation of the Office of the Institute Director

	<u>Federal</u>	<u>Non-Federal</u>	
1. Research program (P.L. 95-467) planning and development, including establishment of 5 year goals and objectives, and review and analysis of research project proposals - - - - -	\$ <u>2,500.00</u>	\$ <u>5,455.34</u>	
2. Coordinating the approved Institute P.L. 95-467 research and development and related training activities, including evaluation of progress, coordination with State agencies, etc. - - - - -	\$ <u>1,500.00</u>	\$ <u>3,249.98</u>	
3. Water research and training program symposia relating to current or projected P.L. 95-467 activity but not directly associated with (or included in) the budgets of specific projects- -	\$ <u>1,321.43</u>	\$ <u>2,901.78</u>	
4.			
5.			
6.			
7. Administrative expenses, including such house-keeping activities as the preparation of Institute time and attendance reports, requisitioning miscellaneous office supplies and equipment, operating Institute mails and files systems, general Institute record keeping, etc. - - - - -	\$ <u>12,952.57</u>	\$ <u>1,678.60</u>	<u>1/</u>
TOTAL Expenses for the Institute			
Director's Office - - - - -	\$ <u>18,274.00</u>	\$ <u>13,285.70</u>	<u>2/</u>

1/ If a cost of the Institute Director's Office can be attributed to a research program activity, such as described in items 1, 2, and 3 above, then that cost should be included in that program activity and not as "administrative expenses."

2/ This dollar figure should be equal to the total "actual expenditures FY 19__" as shown on the bottom line of Form CW-3, FY 19__ Annual Report--For the Institute Director's Office.

FY 1982 ANNUAL REPORT

SUMMARY SHEET

ANNUAL COOPERATIVE PROGRAM ☒ /X/

or

MATCHING FUND PROGRAM ☐ /

(Prepare a Separate Summary Report for each Program and Indicate By ☒ Above)

State Where Institute is Located: <u>WYOMING</u>	Total Number of Projects Underway, FY 19 <u>82</u> : <u>9</u> Of these, number completed during FY: <u>9</u>
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Cost Categories and Work Months	Budgeted 1/	Expenditures FY 1982 2/		
	Total	Federal	Non-Federal	Total
A. Salaries and Wages				
Principal Investigator(s) No.: Work-Months:	(\$ 12,587.00	)( \$ 11,527.11	)( \$ 26,241.85	)( \$ 37,768.96
Other Professional Staff No.: Work-Months:	(13,289.00	)( 11,066.93	)( 12,499.09	)( 23,566.02
Grad. Stu. Assts. & Tech. No.: Work-Months:	(27,415.00	)( 14,233.39	)(	)( 14,233.39
Undergrad. Stu. Assts. & Tech. No.: Work-Months:	(6,250.00	)( 10,850.81	)(	)( 10,850.81
Non-Stu. Techs. & Others No.: Work-Months:	(18,158.00	)( 23,489.44	)( 4,073.52	)( 27,562.96
Total:	77,699.00	71,167.68	42,814.46	113,982.14
B. Employee Benefits Total:	2,560.00	4,271.61	12,545.10	16,816.71
C. Non-Expendable Property Total:	3,688.00	2,977.49		2,977.49
D. Expendable Property Total:	8,625.00	16,675.44		16,675.44
E. Other Cost (specify) Communication/Contractual	3,150.00	7,153.85	7,153.85	7,153.85
Travel	9,166.00	5,141.93	5,141.93	5,141.93
Land & Water Law Review	5,500.00	3,000.00	3,000.00	3,000.00
Indirect Costs	(	)(	)( 55,198.91	)( 55,198.91
Total:	17,816.00	15,295.78	55,198.91	70,494.69
Total Expenditures FY 1982:	\$110,388.00	\$110,388.00	\$110,558.47	\$220,946.47

This summary report includes, but is not limited to, the following projects completed during the reported fiscal year (show OWRT project numbers):

Institute Director's Office

A-030-WYO

A-036-WYO

A-039-WYO

A-034-WYO

A-037-WYO

A-035-WYO

A-038-WYO

1/ Total Federal and Non-Federal amount budgeted as set forth in project budgets (and revisions) submitted and accepted by OWRT.

2/ Actual expenditures, including firm outstanding commitments (or obligations); for example, unliquidated orders for equipment.

SOURCE AND APPLICATION OF INSTITUTE FINANCIAL RESOURCES
(Expenditure of Funds During the Fiscal Year) d/

Form OW-10
(Rev. 10/80)

Fiscal Year: 82

State Where Institute is Located: Wyoming

	ACTIVITY	OWRT Funds		Non-OWRT Funds <u>c/</u>			TOTAL
		Allotment <u>a/</u>	Other OWRT <u>b/</u>	Other Federal	State	Private	
1	Research & Development Program:						
1A	Annual Federal/State Cooperative Projects (ACP)	78,132			170,899		249,031
1B	OWRT Matching Fund Projects (MFP)						
1C	OWRT Focused Research Projects						
1D	Non-OWRT Sponsored Research and Development Projects						
2	Subtotal - Research & Development Program (Shown Above)	78,132			170,899		249,031
3	Five-Year Water Research Priorities Development						
4	State Research Program Development & Coordination				200,000		200,000
5	Technology and Information Transfer Activities	13,982					13,982
6	Administration	18,274			30,000		48,274
7	Column Totals (2 thru 6): Allocation by Source of Support	110,388			400,899		511,287

a/ Allotment - Expenditures supported by Federal funds provided by OWRT through the Annual Cooperative Program.

b/ Other OWRT - Expenditures supported by Federal funds provided by OWRT through the Matching Fund Program, Focused R&D Program, Technology and Information Transfer Program, and other OWRT programs.

c/ Non-OWRT - Expenditures supported by funds made available from sources other than OWRT.

d/ Expenditures include firm commitments, such as undelivered orders. Indirect costs or in-kind contributions applied to the Institute program during the fiscal year, even though not appearing in Institute-related accounting records, should be considered to be expenditures for purposes of this report.