WATER RESOURCES RESEARCH

HEARING

BEFORE THE

SUBCOMMITTEE ON WATER AND POWER RESOURCES

OF THE

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

UNITED STATES SENATE

NINETY-SECOND CONGRESS

FIRST SESSION

ON

S. 121, S. 219, and S. 2428

BILLS TO AMEND THE WATER RESOURCES RESEARCH ACT OF 1964 TO INCREASE THE AUTHORIZATION FOR WATER RESOURCES RESEARCH AND INSTITUTES, AND FOR OTHER PURPOSES

OCTOBER 13, 1971

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WATER RESOURCES RESEARCH

WEDNESDAY, OCTOBER 13, 1971

U.S. SENATE,
SUBCOMMITTEE ON WATER AND POWER RESOURCES
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m., in room 3110, New Senate Office Building, Senator Clinton P. Anderson (chairman of the subcommittee) presiding.

Present: Senators Anderson, Allott, Hansen, Moss, Jordan, and Burdick.

Also present: Daniel A. Dreyfus, professional staff member, and Charles Cook, minority counsel.

Senator ANDERSON. The committee will come to order.

The purpose of this hearing before the Water and Power Resources Subcommittee this morning is to take testimony on S. 219, Moss and Hatfield, and S. 121 and S. 2428, Hansen, bills to amend the Water Resources Research Act of 1964 to increase the authorization for water resources research and institutes, and for other purposes.

Each of these bills would increase annual appropriations to support a water resources research center in each State and provide for information retrieval and dissemination activities at the research centers. S. 219 would make the District of Columbia, the Virgin Islands, and Guam eligible for institute grants, and S. 2428 would also add American Samoa. A bill similar to S. 219, S. 3553—Moss—passed the Senate on September 1, 1970.

The texts of S. 121, S. 219, S. 2428, and H.R. 10203 and the reports of the Department of Interior and the Bureau of the Budget will be included in the record at this point.

(The documents referred to follow:)

92D CONGRESS
1ST SESSION

S. 121

IN THE SENATE OF THE UNITED STATES

JANUARY 25, 1971

Mr. HANSEN introduced the following bill; which was read twice and referred to the Committee on Interior and Insular Affairs

A BILL

To amend the Water Resources Research Act of 1964, to increase the authorization for water resources research and institutes, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 100 (a) of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a), is amended (A) by striking out "$100,000" and inserting in lieu thereof "$250,000" and (B) by adding a sentence at the end of the subsection to read as follows: "The amounts authorized to be appropriated by this subsection to assist each participating State shall be increased or decreased in fiscal year 1972 and each year thereafter in proportion to the average increase or decrease of the costs of such research and training as deter-

mined by the Secretary of the Interior in accordance with a suitable formula to reflect the average increase or decrease adjustment in Federal employee salaries as determined by the United States Civil Service Commission based on findings derived from Bureau of Labor Statistics' figures comparing Federal salaries with industrial salaries."

SEC. 2. The second sentence of section 100(b) of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a) is amended by inserting after the word "problems", the following: "and scientific information dissemination activities, including identifying, assembling, and interpreting the results of scientific and engineering research deemed potentially significant for solution of water resource problems, providing means for improved communication regarding such research results, including prototype operations, ascertaining the existing and potential effectiveness of such for aiding in the solution of practical problems, and for training qualified persons in the performance of such scientific information dissemination;".

92D CONGRESS
1ST SESSION

S. 219

IN THE SENATE OF THE UNITED STATES

JANUARY 26, 1971

Mr. Moss (for himself and Mr. HATFIELD) introduced the following bill; which was read twice and referred to the Committee on Interior and Insular Affairs

A BILL

To amend the Water Resources Research Act of 1964 to increase the authorization for water resources research and institutes, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 100 (a) of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a), is amended by striking out "$100,000" and inserting in lieu thereof "$200,000".

SEC. 2. The second sentence of section 100 (b) of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a) is amended by inserting after the word "problems", the following: "and scientific information dis-

semination activities, including identifying, assembling, and interpreting the results of scientific and engineering research deemed potentially significant for solution of water resource problems, providing means for improved communication regarding such research results, including prototype operations, ascertaining the existing and potential effectiveness of such for aiding in the solution of practical problems, and for training qualified persons in the performance of such scientific information dissemination;".

SEC. 3. Section 306 of the Water Resources Research Act of 1964 is amended by inserting immediately before the period at the end thereof a comma and the following: "the District of Columbia, and the territories of the Virgin Islands and Guam."

92D CONGRESS
1ST SESSION

S. 2428

IN THE SENATE OF THE UNITED STATES

AUGUST 4 (legislative day, AUGUST 3), 1971

Mr. HANSEN introduced the following bill; which was read twice and referred to the Committee on Interior and Insular Affairs

A BILL

To amend the Water Resources Research Act of 1964 to increase the authorization for water resources research and institutes, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That subsection 100(a) of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a), is amended (A) by striking out "$100,000" and inserting in lieu thereof "$250,000" and (B) by adding the following proviso at the end of said subsection: "*Provided further,* That for the fiscal year 1973 not more than $50,000 shall be appropriated for the District of Columbia, the Virgin Islands, Guam, and American Samoa, not more than $100,000 for

the fiscal year 1974, and not more than $150,000 for fiscal year 1975."

SEC. 2. Subsection 100(b) of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a) is amended (A) by inserting in the second sentence thereof, after the word "problems", the following: "and scientific information dissemination activities, including identifying, assembling, and interpreting the results of scientific and engineering research deemed potentially significant for solution of water resource problems, providing means for improved communication regarding such research results, including prototype operations, ascertaining the existing and potential effectiveness of such for aiding in the solution of practical problems, and for training qualified persons in the performance of such scientific information dissemination;" and (B) by adding to the end of said subsection the following sentence: "The annual programs submitted by State institutes to the Secretary for approval shall include assurance satisfactory to the Secretary that such programs were developed in close consultation and collaboration with leading water resources officials within the State to promote research, training, and other work meeting the needs of the State."

SEC. 3. Section 102 of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a) is amended by adding a sentence after the first sentence to read as follows:

"Funds received by a State institute pursuant to such payment may be used for any allowable costs as defined and permitted by title 41, part 1–15, of the Code of Federal Regulations: *Provided,* That the direct costs of section 100 annual allotment programs of each State institute, as distinguished from indirect costs, are not less than the amount of Federal funds made available to such State institute pursuant to said section of this Act."

SEC. 4. Subsection 200 (b) of the Water Resources Research Act of 1964 (78 Stat. 329; U.S.C. 1961a) is amended by striking the existing language of that subsection and inserting the following in lieu thereof: "(b) In addition to other requirements of this Act, the Secretary's annual report to the President and Congress as required by section 308 of this Act, shall specifically identify each contract and grant award approved under subsection (a) of this section in the preceding fiscal year, including the title of each research project, name of performing organization, and the amount of each grant or contract."

SEC. 5. Sections 303 through 307 of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a) are renumbered sections 304 through 308, respectively, and the following is inserted after section 302:

"SEC. 303. The Secretary is authorized to acquire Federal excess personal property in accordance with and as

defined by title 41, part 101–43, of the Code of Federal Regulations that will effectively contribute to the exercise of authority granted by this Act, and to dispose of such property in accordance with provisions of the aforementioned Code of Federal Regulations or in a manner similar to that authorized by section 2 of Public Law 85–934."

SEC. 6. Section 306 (renumbered 307) of the Water Resources Research Act of 1964 (78 Stat. 329; U.S.C. 1961a) is amended by inserting immediately before the period at the end thereof a comma and the following: "the District of Columbia, and the territories of the Virgin Islands, Guam, and American Samoa."

SEC. 7. Section 307 (renumbered 308) of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a) is amended by striking out the word "calendar" and inserting in lieu thereof the word "fiscal".

92D CONGRESS
1ST SESSION

H. R. 10203

IN THE SENATE OF THE UNITED STATES

OCTOBER 6, 1971

Read twice and referred to the Committee on Interior and Insular Affairs

AN ACT

To amend the Water Resources Research Act of 1964, to increase the authorization for water resources research institutes, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 100 (a) of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a), is amended (A) by striking out "$100,000" and inserting in lieu thereof "$250,000", and (B) by striking the period at the end of the subsection and adding ": *Provided further,* That for fiscal year 1973 not more than $125,000 shall be appropriated for each of the District of Columbia, the Virgin Islands, and Guam, and for fiscal year 1974 not

more than $200,000 shall be appropriated for each of such areas."

SEC. 2. The second sentence of section 100(b) of the Water Resources Research Act of 1964 (78 Stat. 329; 42 U.S.C. 1961a) is amended by inserting after the word "problems," the following: "and scientific information dissemination activities, including identifying, assembling, and interpreting the results of scientific and engineering research deemed potentially significant for solution of water resource problems, providing means for improved communication regarding such research results, including prototype operations, ascertaining the existing and potential effectiveness of such for aiding in the solution of practical problems, and for training qualified persons in the performance of such scientific information dissemination;".

SEC. 3. Subsection 100(b) of the Water Resources Research Act of 1964 is further amended by adding at the end thereof the following sentence: "The annual programs submitted by the State institutes to the Secretary for approval shall include assurance satisfactory to the Secretary that such programs were developed in close consultation and collaboration with leading water resources officials within the State to promote research, training, and other work meeting the needs of the State.".

SEC. 4. Section 102 of the Water Resources Research Act of 1964 is amended by adding after the first sentence a new sentence reading as follows: "Funds received by an institute pursuant to such payment may be used for any allowable costs within the meaning of the Federal procurement regulations that establish principles for determining costs applicable to research and development under grants and contracts with educational institutions (41 CFR 1-15.3), including future amendments thereto: *Provided,* That the direct costs of the programs of each State institute, as distinguished from indirect costs, are not less than the amount of the Federal funds made available to such State institute pursuant to section 100 of this Act.".

SEC. 5. Section 200 of the Water Resources Research Act of 1964 is amended by adding a new subsection (c) as follows:

"(c) In addition to other requirements of this Act, the Secretary's annual report to the President and Congress as required by section 307 of this Act shall specifically identify each contract and grant award approved under subsection (a) of this section in the preceding fiscal year, including the title of each research project, name of performing organization, and the amount of each grant or contract.".

SEC. 6. Section 306 of the Water Resources Research Act of 1964 is amended by changing the period to a comma and adding "the District of Columbia, and the territories of the Virgin Islands and Guam.".

SEC. 7. Section 307 of the Water Resources Research Act of 1964 is amended by striking out "March 1" and inserting in lieu thereof "October 1" and by striking out "calendar" and inserting in lieu thereof "fiscal".

SEC. 8. The Water Resources Research Act of 1964 is amended by inserting the following new section:

"SEC. 308. Excess personal property acquired by the Secretary under the Federal Property and Administrative Services Act of 1949, as amended, for use in furtherance of the purposes of this Act may be conveyed by the Secretary to a cooperating institute, educational institution, or non-profit organization, with or without consideration, under such terms and conditions as the Secretary may prescribe.".

Passed the House of Representatives October 4, 1971.

Attest: W. PAT JENNINGS,
Clerk.

69-528 O—71——2

U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., September 21, 1971.

Hon. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs,
U.S. Senate,
Washington, D.C.

DEAR MR. CHAIRMAN: In response to your request for the views of this Department concerning several bills to amend the Water Resources Research Act of 1964 to increase the authorization for water resources research and for other purposes, we furnish herewith our comments on S. 121, S. 219, and S. 2428.

We recommend that S. 2428 be enacted, if amended as set forth herein.

S. 2428 would amend section 100(a) of the Water Resources Research Act of 1964 (the Act) so as to increase to $250,000 the present $100,000 maximum authorized appropriation for support of each state university water resources research and training institute. It would authorize the use of funds for dissemination of scientific information produced by the programs, a function not now specifically covered by the Water Resources Research Act, and would require that state institute programs be developed in consultation with leading water resources officials and agencies of the respective states. Section 102 of the Act would be amended to permit funds received by an institute to be used for any allowable costs permitted by Federal Procurement Regulations, provided direct costs of the program are not less that the amount of Federal funds made available to the institute. This would eliminate the present necessity of segregating program costs to assure that Federal funds are not used for employee benefits or indirect costs. The bill would also delete the present requirement of subsection 200(b) of the Act that proposed title II contracts and grants must be submitted to Congress for 60 days prior to final execution of the contract and grant documents. It would, however, substitute a requirement that the Secretary of the Interior's annual report to the President and Congress under the Act must identify each contract and grant award approved in the preceding fiscal year. A new section 303 of the Act would also be added to permit the Secretary to acquire excess property that will effectively contribute to the authority granted by the Act and to dispose of such property in accordance with Federal Property Management Regulations. The bill would amend the Act's definition of the term "State" to include the District of Columbia and the territories of the Virgin Islands, Guam, and American Samoa, thus permitting them to participate in the state institute program. New institutes for these areas would be funded at a level of $50,000 for fiscal year 1973, $100,000 for 1974, and $150,000 for 1975. Finally, the bill would amend the Act to require that the Secretary's annual report be on a fiscal year basis rather than the present calendar year basis.

S. 121 and S. 219 are similar but not identical to S. 2428. Both bills would amend section 100(a) of the Water Resources Act of 1964 so as to increase the present $100,000 maximum authorized appropriation for support of each state university water resources and training institute. S. 219 would authorize a $200,000 maximum; S. 121 a $250,000 maximum, S. 121 would also provide for adjustment of maximum to reflect changes in the cost of research and training programs. Both bills also authorize the use of funds for dissemination of scientific information produced by the programs, as does S. 2428. In addition, S. 219 would amend the definition of the word "State" to include the District of Columbia, the Virgin Islands, and Guam, thus making them eligible to receive funds and participate in the program authorized by title I of the Act.

All bills agree on the need to increase the appropriations for annual grants to state institutes carrying out water resources research. Despite significant state contributions to this cooperative Federal-State program, the present authorized Federal contribution is not adequate to support the needed research at a time when problems of both quantity and quality of water are mounting. Inflation has seriously eroded the purchasing power of the dollar amount originally authorized, which did not anticipate today's multitude of water-related problems. Additional funds will also be needed to carry out the directive of both bills to interpret and disseminate results of water resources research to those who can apply such results to the solution of water problems. Additional funding would also increase the opportunity for highly competent research personnel of other universities to participate in state institute programs and for state insti-

tutes to expand upon their success in training water resource scientists and engineers. We believe, however, that a $200,000 maximum annual appropriation for each state institute under section 100(a) of the Act is adequate and we would therefore recommend that the figure "$200,000" be substituted in line 6, page 1 of the bill for the figure "$250,000". In addition, we believe that the provisions of section 2 of S. 2428 authorizing the use of funds for dissemination of scientific information should be deleted on the ground that the institutes now have adequate authority to disseminate such infromation. To accomplish this, we recommend striking from S. 2428 all language after the word "amended" in line 5, page 2, through the end of line 15, page 2.

As noted above, S. 2428 and S. 219 do not, in contrast to S. 121, provide the automatic cost-of-doing research adjustment of amounts authorized by section 100(a). We believe they are sound in this regard because no reliable index relevant to the changing costs of this program, due to inflation or deflation, appears to exist and if future adjustments are found to be necessary, this can be done by amendatory legislation when appropriate.

We favor generally the inclusion of the District of Columbia, the Virgin Islands, Guam, and American Samoa in the Act's title I research and training programs. We question whether the College of the Virgin Islands, the University of Guam, and the Community College of American Samoa would be able, at least initially, to utilize the full amount of grant funds efficiently and effectively for conducting the types of water resources research and training programs authorized by the Act. All three schools are relatively new and small, have a limited number of water-knowledgeable professionals in their faculties who could serve as principal research project investigators, have limited research equipment and facilities and do not have the graduate school programs that now provide so much of the high-quality research assistance at the existing institutes. We therefore agree that institutes for the Virgin Islands, Guam, and American Samoa should be funded at lower initial levels (just as the present institutes were) rising to the levels of other state institutes at no more than $50,000 per year, or less if experience shows that they cannot effectively use the grants. We would, however, recommend that an institute for the District of Columbia be fully funded and to accomplish this would recommend deletion of the words "District of Columbia" in line 9, page 1 of S. 2428.

We also concur in S. 2428's other amendments to the Act. The provision in section 2 requiring that proposed annual programs be developed in consultation with leading water resources officials and agencies of the respective states would better assure that state institute programs will contribute to the solution of important water-related problems.

Section 3 of the bill, providing that funds received by state institutes can be used for any allowable costs as permitted under Federal Procurement regulations, would retain in full the cooperative Federal-State concept and nature of the section 100 program, while simplifying the fiscal bookkeeping responsibilities of the state university institutes, since they would not need to be concerned with segregating program costs, as they are now required to do, to assure that Federal funds are not used for employee benefits or indirect costs. For the same reason, the amendment would simplify the preparation of program and project proposal budgets and improve program management generally, including some reduction in record preparation and recordkeeping costs.

Similarly, deleting the Act's present requirement that contracts and grants be submitted to the Congress for 60 days prior to final execution, and substituting a requirement that specific identification of each contract and grant be made in the Secretary's annual report, would facilitate and expedite title II research program management. The Office fo Water Resources Research believes that it can keep the Congress fully informed of the title II programs in a satisfactory manner without continuing the present procedure and the additional delay and paperwork involved. The proposed revised language would assure that congressional committees and Members of Congress were informed annually as to the specific application of title II funds.

The excess personal property acquisition and disposal authority provided by section 5 of S. 2428 would simplify recordkeeping relating to Federal excess personal property acquired in furtherance of the purposes and objectives of the Act. When adequate and satisfactory justification is provided, it will permit the transfer of title to such property to academic and nonprofit research foundations where it is shown that such property will have continuing value on water resources research and related training activities of the grantee organization.

Putting the Secretary's annual report to the President and Congress on a fiscal rather than a calendar year basis, as section 7 of the bill would do, would improve the annual report since it would be related directly to research grants and contracts and to other program activities that are funded on a fiscal year basis. The present "calendar year" report makes it necessary to provide fiscal and program accomplishment information for two fiscal years, one of which is completed and the other in progress, thus making the report more complex and less understandable and accurate.

The Office of Management and Budget has advised that there is no objection to the presentation of this report from the standpoint of the Administration's program.

Sincerely yours,

JAMES R. SMITH,
Assistant Secretary of the Interior.

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF MANAGEMENT AND BUDGET,
Washington, D.C., September 20, 1971.

Hon. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs, U.S. Senate, New Senate Office Building, Washington, D.C.

DEAR MR. CHAIRMAN: This is in response to your requests of March 2 and March 3, 1971 for the views of the Office of Management and Budget on S. 219 and S. 121, two bills "To amend the Water Resources Research Act of 1964, to increase the authorization for water resources research and institutes, and for other purposes."

In its report, the Department of the Interior recommends enactment of S. 2428 in lieu of either S. 121 or S. 219. The Office of Management and Budget concurs in the views of the Department of the Interior and accordingly would have no objection to the enactment of S. 2428 in lieu of either S. 121 or S. 219.

Sincerely,

WILFRED H. ROMMEL,
Assistant Director for Legislative Reference.

Senator ANDERSON. Senator Moss?

Senator Moss. This is a hearing held on S. 121, S. 219, and S. 2428, all of which deal with the question of the revision of the Water Resources Research Act of 1964, to increase the authorization of funding, and to extend the bill to other jurisdictions; namely, the District of Columbia and the Virgin Islands and Guam.

The bill which is now law, of course, provides for a research center on water in each of the States, and provides for $100,000 annually to each of the 50 States for this research purpose.

The bill that I introduced, S. 219, and the thrust of the other bills, is the same: to amend this legislation and to increase the amount that is available. My bill originally called for an increase to $250,000 annually for each of the jurisdictions. By amendment, that has been reduced back to $200,000.

The House has considered similar bills, and has reported that bill but, I don't know whether it has been pased. It is either reported or it is passed over there. Therefore, we are considering also the House work here today.

I have a statement, Mr. Chairman, that is more extensive indicating my position, and also it contains a number of statements that are made from reports that have been compiled by Utah State University, which is the university in my State that does the research work in Utah. These statements indicate how very helpful and useful and profitable it has been to have this research designation on funding. I think the story is similar for the other States, and I think it would

indicate that the additional authorization of money as an annual increment will pay great dividends in this field of water research.

I ask unanimous consent that this statement be placed in the record at this point.

Senator ANDERSON. Without objection, it will be done.

(The document referred to follows:)

STATEMENT OF HON. FRANK E. MOSS, A U.S. SENATOR FROM THE STATE OF UTAH

Mr. Chairman, I am pleased that the subcommittee is including consideration of my bill, S. 219 in the hearings held today on legislation to amend the Water Resources Research Act. This bill, which was introduced on January 26 is identical to the bill the Senate passed in the 91st Congress—late in August of 1970—and which died in the House of Representatives.

The bill provides an increase in the amount authorized for a water resource research center in each state from $100,000 to $200,000 annually. The bill also provides for information retrieval and dissemination activities at each research center, and treats the District of Columbia and the territories of Guam and the Virgin Islands as states for the purposes of the act, so that a water research center could be established at one of the universities in each jurisdiction and receive funds annually.

The original Water Resources Act which became law in 1964, was based on one of the recommendations made by the Senate Select Committee on National Water Resources, of which I was a member.

In the original bill, annual grants of $100,000 were authorized for each center. Since that time, however, costs have gone up considerably so that $100,000 is no longer an adequate amount to finance the level of activity contemplated in the original act.

The bill, as introduced last session, authorized an increase to $250,000 a year for each research center. The House-passed bill contains this amount, and I hope that the Senate will agree to the higher figure. Last session the Administration opposed the bill in its entirety, but this session the Administration has about-faced, and I understand now supports the bill, but at the $200,000 annual figure. I would like very much to see the amount increased to $250,000 which is realistic in view of inflation, and the wider responsibilities this bill places on the centers.

The Administration has also made some recommendations on bookkeeping and procedures in the program, which I trust the subcommittee will look at carefully.

The program carried forward under the provisions of the Water Resources Act of 1964 in my state of Utah has been most impressive, and the potential is great for enlargement under the amendments proposed here today. I would like at this time to place in the record of the hearings some excerpts from the report of the Utah Center for Water Resources Research at Utah State University at Logan. These may be helpful in consideration of the bill. The Report was prepared by Dr. Dean F. Peterson, Chairman of the Center, and was issued on May 14, 1971. I quote:

"Utah State University has been conducting research in water resources since its founding in 1888. The President of the University is Dr. Glen L. Taggart; the Provost is Dr. Gaurth A. Hansen. All research in the University is coordinated by the Vice President for Research, Dr. D. Wynne Thorne.

"Until about a decade ago, water resources research, (as was nearly all of the research program of the institution) was done under the *Agricultural Experiment Station* (AES). In 1959 the *Utah Water Research Laboratory* (UWRL) was created.

"Water resources research in Utah was given a major thrust forward in 1965 when Utah State University was named recipient institution for funding under the Water Resources Research Act of 1964. The earlier establishment of the Utah Water Research Laboratory provided excellent new facilities and some basic funding. The timely addition of the *Utah Center for Water Resources Research* (UCWRR) made possible joint efforts in Utah which are far greater than the sum of what could have been accomplished separately. The Center has assumed a coordinative and overseeing role for all of the water and water-related research of the University, especially in relation to the State generally. It has attempted to use its resources to generate new research in neglected areas, particularly where interdisciplinary efforts are desirable.

"In 1966, the Board of Trustees created the *Center for Research in Ecology* which deals basically with that subject, but does include water-related research. Water resources research may be implemented also occasionally under the general research program of the University, i.e., *University Research.* Over the past six years, the University has developed an *International Water Research and Management Program.* Over approximately the same period *Training and Education* grants have been developed under the *Water Quality Division of the Protection Agency.* . . . . . .

"The Utah Center was organized under a council composed of the Deans of the Colleges of Engineering, Agriculture, Science, and Natural Resources, the Directors of the Agricultural Experiment Station and the Water Research Laboratory, and the University Vice President for Research. The chairman is appointed by the University president and has responsibility to the Department of the Interior for the program and for the lawful expenditure of federal funds.

"The Utah Center acts through the other organizational units—colleges, departments, etc.—of the Utah State University, and of other universities as appropriate in financing and executing its program. In this way, it mobilized existing structure already widely committed to water research and devised a workable means for overseeing their efforts.

"In addition to the $100,000 allotment, the Center usually wins a matching grant totaling $75,000 to $125,000 in federal funds each year resulting in additional projects valued at $150,000 to $250,000 annually. Close liaison has been maintained with the Water Resources Division of the Natural Resources Department of the State of Utah. The Division has provided matching funds for several projects. Other sources of matching funds are the Utah Water Research Laboratory, the Agricultural Experiment Station and the general research program of the University through the colleges.

"A very important benefit of the Water Resources Research Center has been its 'catalytic' or 'entraining' effect. Since the initiation of the Utah Center's program, research in water and water-related areas throughout the University has grown by a factor of at least five. While detailed data are not available, the estimated dollar volume of such research in FY 1965 was about $400,000. In FY 1972 this will easily exceed $2.5 million. The major reason for this increase is because some firm funding was provided so that additional career opportunities could be offered by the University. A university cannot operate purely as a retail broker for research contracts. Although the impact of the basic water-related program cannot be fully measured, it doubtless provided part of the institutional capacity which permitted formation of the Ecology Center in 1968 and the Rockefeller Foundation-supported Environment and Man Program in 1971. Efforts of the Center have stimulated interest and activity in water and related resources in the social sciences which were virtually nonexistent prior to 1966." (end of quote).

Mr. Chairman, this brief summary of what has been done at the Utah Center for Water Resources Research since the 1964 Act was passed, and the impact this program has had on the work done there, indicates that the additional authorization for water resource centers for each of our states will return benefits to us worth manifold the dollar investment which we will make. I urge the subcommittee to take early action so that a bill can be passed within the next few weeks.

Senator Moss. The Senator from Nevada, and a member of our committee, has prepared a statement on the bill before us. His is directed to S. 219, in which he endorses the principle of the bill and supports the provisions of S. 219 to increase the entitlement there, and I ask that the statement of the Senator from Nevada, Senator Bible, be placed in the record at this point.

Senator ANDERSON. Without objection, it will be done.

(The document referred to follows:)

STATEMENT OF HON. ALAN BIBLE, A U.S. SENATOR FROM THE STATE OF NEVADA

Mr. Chairman and Members of the Subcommittee, I appreciate having this opportunity to address the Subcommittee in support of S. 219, to amend the Water Resources Research Act of 1964 to increase the authorization for water

resources research institutes and to authorize the establishment of such institutes in the District of Columbia and the territories of the Virgin Islands and Guam.

A primary objective of the Water Resources Research Act of 1964 was to enlist the scientific and engineering competence of university research in the critically-important matter of water resources problem-solving and to augment the number of scientists and engineers trained in sciences related to water resources.

The program launched by the Act has been increasingly effective. The 51 institutes established pursuant to the legislation are making significant contributions to the solution of water resources related problems in the many fields and disciplines involved in water resources management.

A good case in point is the Center for Water Resources Research of the Desert Research Institute, a unit of the University of Nevada System. The Nevada Center has made a very significant contribution in the field of post graduate training in the water sciences, in its conduct of specialized studies in the fields of water resources planning and management and in hydrologic research. A number of its trainees have moved on to teaching and research programs at various universities throughout the United States. Others have moved into water resources programs with the U.S. Corps of Engineers and the U.S. Geological Survey. And other graduates have continued their research with private consulting firms and under other private auspices.

Nevada's Desert Research Institute and other Water Research Institutes elsewhere in the country have done great service in augmenting the critically short supply of specially-trained scientists and engineers in this vitally important resource area.

Unfortunately, in Nevada and elsewhere throughout the country the work of our Water Research Institutes has been hampered by the general inflation that has marked the economy these past few years. Inflation is reflected in higher salary costs and in substantial increases in the cost of the supplies and equipment needed to carry on this kind of research effectively. Increased funding is essential to permit the Institutes to continue to make their invaluable contributions in this highly specialized area.

S. 219 is needed to enable the Institutes to carry out the purposes of the 1964 Act. I understand the cost of doing business in the research field has more than doubled since this program was initiated. The increased allotment provided by this legislation will help the Institutes recover the ground they may have lost as the result of inflation. It will also help spur the initiation of imaginative programs and enable additional research on water-related environmental problems.

Also, I am pleased to support the proposed establishment of Water Research Institutes here in the District of Columbia and in the Virgin Islands and Guam. I sponsored legislation recommending a District of Columbia program in the 91st Congress, and am glad to see that we are moving toward that goal. The District, the Virgin Islands and Guam are not immune from water resource related problems requiring specialized research. Effective and timely solution of their problems calls for a research capability within each of these jurisdictions with an adequate level of funding.

Again, Mr. Chairman, I am pleased to add my voice in support of this legislation, and I urge favorable action by the subcommittee.

Senator JORDAN. Mr. Chairman, I have two statements, one from Dr. Robert R. Lee, director of the Idaho Water Resources Board. I shan't read it, but I would like to have it inserted in the record at this point, if I may, and I also have a letter from President Ernest Hartung of the University of Idaho, which delineates the university's position in support of this legislation, accompanied by a statement which I should like to have included in the record at this point.

Senator ANDERSON. This will be done.

(The documents referred to follow:)

STATE OF IDAHO,
IDAHO WATER RESOURCE BOARD,
Boise, Idaho, October 4, 1971.

Senator HARRY M. JACKSON,
Chairman, Senate Interior and Insular Affairs Committee,
New Senate Office Building, Washington, D.C.

DEAR SENATOR JACKSON: It was recently announced by your office that hearings are being scheduled before the Water and Power Resources Subcommittee on three bills to increase the amounts of annual appropriations to assist water resources research institutes in each of the states. Although the Board will be unable to have a representative appear at the hearings, I would like to have included for the record the attached Statement of the Idaho Water Resource Board supporting increased appropriations for water resources research. This is the same statement submitted last year on H.R. 1400 at the hearing held on June 29, 1971 and reported in the House Report on the hearings before the Subcommittee on Irrigation Reclamation of the Committee of Interior and Insular Affairs, House of Representatives, Serial No. 92–16.

Sincerely yours,

ROBERT R. LEE,
Director.

Attachment.

STATEMENT OF DR. E. L. MICHALSON, UNIVERSITY OF IDAHO

I am Dr. E. L. Michalson, Project Leader for Wild and Scenic Rivers' Studies of the University of Idaho, representing the Water Resources Research Institute of our University. With me is Professor C. C. Warnick, Director of the Institute.

The Water Resources Research Institute of the University of Idaho has made what we feel is a very good start in stimulating a progressive and efficient program of research in water and related land resources. This is elaborated on in detail in a recent publication entitled, "A Six-Year Review—The Impact of the Water Resources Research Act at the University of Idaho as reflected in resulting research and training activities in the State of Idaho and surrounding regions."

The key accomplishments are the following:

1. A very direct impact in helping to staff and to stimulate an active State Water Resources Planning program.
2. An outstanding increase in involvement of new staff and graduate students in graduate research programs including several new doctoral degree programs.
3. A new program of research that is specifically designed to research the new concept of scenic and wild rivers, including planning for management of, and methodology for selection of such rivers.
4. Cooperative programs with such sister institutions as Washington State University and Utah State University.

The need for additional funding has come about for five principal reasons:

1. The escalation of all costs but particularly the salary of competent staff.
2. The fact that two other State Institutions, Boise State College and Idaho State University have now reached a size and graduate student capability that makes it necessary to include them in our Institute's overall State effort.
3. The passage of such acts as the Wild Rivers' Act and the implimentation of planning efforts by both State and Federal agencies operating in the State have made it very apparent there are many new problems that we need to research and the University of Idaho Water Resources Research Institute offers the most objective place for such research to be undertaken.
4. The accumulation of many of the early research findings has been concentrated in rather technical reports such as degree theses which leaves a gap in the scientific information dissemination.
5. The State of Idaho with a very limited tax base, a very large public land acreage, and many rivers and lakes that have much need for study for both potential resource development and for preservation for environmental purposes, offers an inordinate financial burden on the State and its educational institutions.

The question could be asked, why would it be a good investment in federal funds to increase funding to Idaho in particular, fully realizing all States have needs and pressures for Federal funding also? We would submit the following as justification:

1. Such federal funding is necessary to help such conservative states as Idaho to embark on the progressive programs of upgrading training, of stimulating

new ideas for both preservation and development of water and related land resources.

2. The State cannot afford to fund the research itself.

3. Many times the research is best done in the field by scientists familiar with Idaho's diverse topographic, meteorological and hydrological conditions.

4. There is need to stimulate a greater interest in water resources and the value of good scientific information to base decisions on resource development.

5. The pressures to preserve the waters in quality state make it important to know when to limit development and when not to limit development.

6. There are many more good research proposals and ideas of professional staff than we are able to sponsor and support.

We strongly recommend favorable action by the Congress to increase the funding for this important research activity that has already brought new knowledge for solving the pressing water and related land resource problems facing our entire nation.

STATEMENT OF DR. ROBERT R. LEE, DIRECTOR, IDAHO WATER RESOURCE BOARD

The Idaho Water Resource Board is hopeful that legislation to increase the authorization for water resources research will be passed since it would mean an increase in funds for the Idaho Water Resources Research Institute. We have worked closely with the Institute in conducting water needs studies and in developing the Wild Rivers Methodology Study. Water Resource Board funding has helped create an excellent capability at the University of Idaho to support water-related research. Because of our pressing need to develop our own planning and development capability, we will be unable after fiscal year 1971 to continue any major funding of University research. Increased appropriations for the Water Resources Research Institute pick up the funding slack and help maintain a water resources research capability at the University, which will be of enduring service to the State of Idaho, and, indeed, to the Nation.

UNIVERSITY OF IDAHO,
Moscow, Idaho, October 8, 1971.

Hon. SENATOR LEN B. JORDAN,
U.S. Senate Office Building,
Washington, D.C.

DEAR LEN: At this time it has come to our attention that the Senate's Subcommittee on Water and Power Resources of the Senate Interior and Insular Affairs Committee is considering amendments to the Water Resources Research Act in the form of S. 219, S. 2428 and H.R. 10203. Our institute made a presentation at the hearings of the House of Representatives on this same subject. A copy of this statement is enclosed for your reference.

We understand the Senate passed similar legislation during the past session of Congress and therefore sentiment is in favor of passage of some legislation in this regard.

Our desire now is to join with other state institutes in supporting H.R. 10203 which sets funding level at $250,000. We feel this funding level is necessary to keep a viable program at our university. The press of many problems, such as the issue of Hells Canyon—Middle Snake River, enhancement and protection of the wildlife and fishery of the state, the economic well-being of rural areas where irrigated agriculture is the sustaining support, and concern for urban water supply in the scattered communities of our state are critical problems.

At the Idaho Water Resource Board meeting of September 24–25, Professor Warnick appeared and discussed with the board eight major research topics that have urgency and need for study now. These are repeated here to indicate the extensive nature of the problems.

1. State Scenic Rivers evaluation.
2. Post audit of major project.
3. Geothermal Power.
4. Upper Snake water use.
5. Economic analysis of Jefferson County to ascertain capability to pay for rehabilitation.
6. Methodology for computing the future depletion at the Brownlee Reservoir by upstream irrigation and multiple use development.
7. Minimum flows for satisfying use downstream of Hells Canyon.

8. Recharge of Snake River Plain:
   (a) Effect quantitatively.
   (b) Effect qualitatively.
   (c) Legal considerations.

Idaho has difficulty supporting all these research areas because of its small popu ation and industrial base. Travel costs are inordinately high because the state is large and travel distances great.

We believe our past performance has demonstrated an efficient and responsive program. With regard to Section 3 subsection 100(a) of the H.R. 10203 we believe collaboration with leading water resource officials is desirable and only last week Dr. Lee of the Idaho Water Resource Board spent an afternoon on the campus discussing ways of cooperating with the institute. This week a representative of the Idaho Fish and Game Department will be on campus to discuss problems.

We solicit support for H.R. 10203 for increased funding of the Water Resources Institution by you and other members of the Senate Interior and Insular Affairs Committee. Professor Warnick is ready to answer any other questions and informs me that you do not feel it necessary for him to appear in person at the hearing on October 13.

Thanks for your continued support for our institute program.

Sincerely yours,

ERNEST W. HARTUNG,
President.

Senator HANSEN. Mr. Chairman, I have a very brief statement that I would like to ask unanimous consent for it to be included in the record.

Senator ANDERSON. Without objection, it will be done.

(The document referred to follows:)

STATEMENT OF HON. CLIFFORD P. HANSEN, A U.S. SENATOR FROM THE STATE OF WYOMING

Mr. Chairman, I am grateful to you and the members of the Subcommittee for these hearings today. I am most impressed with the work which has been done under the Water Resources Research Act since 1964. In light of the success of these programs, it is important for Congress to insure their continued productivity by providing the financial resources to conduct a meaningful program.

S. 2428, which I introduced on August 4, 1971, will increase the annual allotment available to each institute from $100,000 to $250,000. This increase will permit the research program to be conducted at a proper level, making up ground lost to inflation, and in addition providing for adequate dissemination of research findings.

Mr. Chairman, I am looking forward to the testimony we will receive today. It is my hope that the Committee will favorably report legislation amending the Water Resources Research Act at an early date.

Senator ANDERSON. All right, Secretary Smith.

STATEMENT OF HON. JAMES R. SMITH, ASSISTANT SECRETARY OF THE INTERIOR FOR WATER AND POWER RESOURCES; ACCOMPANIED BY H. GARLAND HERSHEY, DIRECTOR, OFFICE OF WATER RESOURCES RESEARCH, DEPARTMENT OF INTERIOR

Mr. SMITH. Mr Chairman, it is a privilege to be here today to support the legislation to increase the authorization and do certain other things in connection with water resources research in these United States.

Before I begin my prepared statement, I would like to say all of us who are interested in water resources research are appreciative of the fact that the Senate last year passed legislation, and we are very hopeful that the legislation which is currently before you, and goes somewhat beyond the legislation which you enacted last year, receives the support of the Senate.

Consistent with the legislative report of the Department of the Interior, my statement is in general support of S. 121, Senator Hansen's bill, S. 219, Senator Moss' bill, and S. 2428, which is the extended bill introduced by Senator Hansen. They have been introduced to amend the Water Resources Research Act of 1964 to increase the authorization for water resources research and for other purposes. S. 219 is identical to S. 3553 that passed the Senate in the 91st Congress on September 1, 1970. S. 2428 is similar but not identical to H.R. 10203 that passed the House of Representatives on October 4, 1971.

The Water Resources Research Act, Public Law 88–379, was enacted in July 1964, and is administered by the Office of Water Resources Research. The objectives of the act are: (1) To establish water resources research centers in each of the 50 States and Puerto Rico; (2) to promote a more adequate national program of water and water related research; (3) to train water resources scientists and technicians; and (4) to make generally available information and reports on projects completed, in progress, or planned in addition to publication of information by the institutes themselves.

We believe that good progress has been made toward achieving the objectives and intent of the law. For example, 51 State university water resources research institutes have been established, one in each State and in Puerto Rico; more than 1,400 research projects have been supported under the section 100 "Annual Allotment Program;" and in fiscal year 1971 alone more than 1,500 students served as research assistants on annual allotment projects, thus receiving expert training in water and related resources. The State institutes have submitted over 2,250 technical reports on research accomplished, including 780 research project completion reports and 1,470 other reports, such as theses, dissertations, scientific journal articles, interim technical reports, and miscellaneous publications.

The proposed increase in authorization applies only to the annual allotment program, section 100 of the act, and does not affect the matching grants to State institutes under section 101 or the contracts and grants for additional research under section 200 of the act.

Although S. 2428 proposes an increase from $100,000 to $250,000 in the amount authorized for annual appropriation for each State institute under section 100(a) of the act, we believe that an increase to $200,000 is adequate at this time. If a further upward adjustment is found to be necessary in future years, this can be done by additional amendatory legislation when appropriate.

I can't think of anything I should rather do than to have to come back here in a year or two and to say that these research institutes are doing such a good job in this important business of water resources research that they can use and really need additional money over what this bill would provide.

An increase to $200,000 annually per State institute is warranted for the following reasons:

Inflation has seriously eroded the water resources research and training purchasing power of the original authorization, which authorization did not anticipate the multitude of water-related problems associated with the rapidly changing environment.

The present authorized allotment of $100,000 to each institute is not adequate to support the desired scope of water resources research and

related activities that, under the act, are the responsibility of the State institutes despite significant State contributions to this cooperative Federal-State program.

Additional funding would increase the opportunity for other universities having highly competent research personnel to participate in the State institute programs.

Increased funding will make it possible for participating universities to expand upon the success they are achieving in training water resource scientists and engineers, and that is a particularly important point to me.

I can tell you gentlemen, in the two and a half years I have been in this job, I have searched and looked for people with competent water resources skills and expertise. They are very difficult to find. This is a rapidly emerging discipline, and to find competent people is difficult to achieve. I am personally convinced that the increased funding which this will provide will make it possible for us to develop more people who are qualified and skilled in this water resources business.

I believe the committee will agree that the grave facts of our water situation are evident. In major areas of the Nation, water supply deficiencies jeopardize economic growth and wholesome living conditions. Even in the humid areas, water quantity and quality problems are increasingly serious.

We recognize that research alone cannot answer all of our water problems. Proper and improved planning, development, and management also must occur. However, the amendatory legislation being considered by your committee today is one important step forward in solving these water problems and will make a significant contribution toward achieving the basic purposes of the Water Resources Research Act.

Each year the Department issues a report on the progress made in the execution of the program authorized by the Water Resources Research Act. Copies of the reports have been made available to the committee. The report discusses, in summary form, many of the research results and training accomplishments achieved to date. However, as encouraging as progress and achievements have been during the first 6 years of program operations, the program cannnot be expected to meet our water research needs on a timely basis unless augmented along the lines of the proposed amendments and the Department's recommendations relating thereto.

There are obvious and significant research gaps that need increased attention—including but not limited to those relating to urgent urban and metropolitan water problems; protection and enhancement of estuarine resources; development of effective ground water and surface water conjunctive use practices; institutional and legal problems associated with efficient water supply planning, development and management; water quality problems which may be unique to State or local areas; and other existing or rapidly developing environment-related water problems. Water research efforts should be expanded promptly if we are to match water uses with the supply available.

The Federal Government, the States, and local governments need vigorous research programs to maintain and improve the efficiency of their operations in the water resources field. How should we go about doing this?

Certainly a very significant answer to this is the greater enlistment of the research resources of the universities. They are an important reservoir of technical competence that is being only partially utilized for water resources research purposes. Experience has shown that universities can take an objective approach to water resources problems, marshal creative talents from many sciences and academic disciplines, and develop new approaches that can bring applicable new knowldege and breakthroughs.

I should like to cite several of many examples resulting from the annual allotment program under section 100:

One, New Jersey studies have determined the operating effectiveness and costs of instream aeration systems. The studies indicated that when applied to the Passaic River, an aeration system which would cost $194,000 annually would be as effective in raising dissolved oxygen levels as advanced waste treatment estimated to cost $785,000 annually.

Two, a Montana project, "Mountain Precipitation and Distribution," provided the basic support for the "spin-off" of a major multidisciplinary research effort involving substantial funding from three other sources. OWRR funded this project over a 3-year period in the amount of $30,000. This investment resulted in the discovery of one of the most unique natural laboratories in the West—the Bridger Mountain Range—for weather modification experimentation. The existence of this unique research site was recognized by other Federal agencies—NSF, Bureau of Reclamation, and U.S. Army—and these agencies have provided further funding in the amount of $1.2 million to improve weather modification technology such as seeding site location improvements. Work is continuing now to determine the effect of increased mountain precipitation through weather modification practices on the precipitation over the lower area downwind from the experimentation area.

Three, a research project at the University of California, Los Angeles, which commenced under the allotment program employs systems analysis in development of improved techniques for planning and management of water resources. State and Federal agencies are applying the research findings to achieve more efficient water management for the Central Valley project and the California Aqueduct.

Four, under an Oregon project, the influence of spray irrigation on the microclimate of an orchard in Oregon was determined. It was found that application of a mist by overhead sprays cooled fruit by 6 degrees centigrade, an amount sufficient to significantly improve fruit quality. This offers promise of being a profitable orchard practice in the Northwest.

Five, through two Michigan projects, investigators discovered a technique for monitoring water for pesticide contamination by analyzing the tissue of freshwater mussels. This technique met with widespread acclaim throughout the Great Lakes region and is now a standard procedure for pollution monitoring programs in Michigan, Wisconsin, Indiana, and Ohio.

Six, in Arizona, an innovative project has developed a watershed treatment technique for increasing runoff which otherwise would be lost. This additional high-value water is then conserved for municipal and agricultural uses by means of procedures for installing low-cost,

gravel-covered plastic catchments. The combined method of water harvesting and storage already is being used effectively in the State.

The universities' readiness to accept larger obligations and opportunities of participation in water research activities, including effective disseminaton of research results, has been stated by the National Association of State Universities and Land-Grant Colleges and by the Universities Council on Water Resources. Also, it has been demonstrated clearly by the universities participating in the program since it began in 1965. Because university representatives are scheduled to testify, I defer to them as spokesmen for the academic world. I want to say, however, that from the point of view of the Department of the Interior, we welcome and look forward to the larger involvement of universities in this critically important field of water resources research.

There are two or three elements in my prepared statement that I think I should go through in some detail.

If water resources research is to achieve its end objectives, it must be prepared in an understandable manner. This must be done in ways that make possible the transfer of research results, conclusions, techniques, and recommendations into everyday planning, management, and operations. It must bridge the communications gap between the researcher and the administrator, legislator, and water resources community participant. The State institutes now have the authority under existing law to implement the necessary dissemination of their studies. We do not believe that subsection 2(A) of S. 2428 is necessary. Through improved management and direction at the Federal and State levels, we can properly direct the transfer of technology into meaningful and practical documents that will be useful to the community of water interests.

In proceeding to develop and implement information dissemination programs under the amendatory legislation, the Department will work closely with the State institute universities to assure that full advantage is taken of ongoing and past technology transfer experience of other Federal, State and private organizations in other technical fields.

A major and highly important "bonus" that will stem from the increased support for the State water research institutes relates to the training of skilled scientists and engineers to fill essential water-related positions in the future at all levels, both public and private. This is accomplished by having students, most of them at the graduate levels, serve as research assistants to professional researchers on approved projects. The amendments being considered today will make it possible for the State university institutes to employ and train many hundreds of additional student research assistants who, upon graduation, will be qualified for water resources positions as well as for training others to fill such positions in the future.

Furthermore, the increased program will make it possible for the State institutes to bring into the national water resources research effort the multiple disciplines of many skilled and professional scientists and engineers who, up to this time, have not participated in or contributed to the solution of the Nation's water resources problems.

We are pleased that one of the amendments proposed in S. 2428 concerns a matter we feel is of significant importance—that is, the need for close consultation and collaboration between State university re-

search institutes and the leading water resources officials and agencies of the respective States. Several of the State institutes voluntarily developed effective practices and procedures within the past 2 or 3 years to accomplish this; however, we see no reason why the other State institutes should not do so and we are convinced that, by so doing, their research programs will bear increased relevance to water-related problems throughout the Nation. Therefore, we urge that the committee retain the amendatory language set forth in subsection 2(B) of S. 2428 which reads as follows:

> The annual programs submitted by the State institutes to the Secretary for approval shall include assurance satisfactory to the Secretary that such programs were developed in close consultation and collaboration with leading water resources officials within the State.

The committee will be interested in knowing, I believe, that the program authorized by section 100 of the act has developed, truly, into a cooperative Federal-State program—as contemplated when the act was passed originally. This fiscal year the States, in total, are nearly matching dollar-for-dollar the Federal funds provided. The contribution by the States was about $4.1 billion last year which is more than 80 percent of the $5.1 million which the Federal grants to institutes provides. We expect that significant amounts of non-Federal funds will continue to be provided in the future.

S. 2428 also includes a further amendment which we feel will facilitate the financial management of the program at the State institute level. Pursuant to the legislative history leading to the enactment of the Water Resources Research Act of 1964, and in the administration of the program to date, funds provided the State institutes under the section 100 annual allotment program have been available for all appropriate research costs except for the support of indirect costs and employee fringe benefit costs. Support of such costs from non-Federal fund sources has constituted, in part, the State contributions to this cooperative Federal-State program.

However, this requirement has necessitated the development and operation of cumbersome and unique bookkeeping practices at most of the State institute universities. Section 3 of S. 2428 would resolve this matter since it would permit the State institutes to utilize their Federal annual allotment program funds for any proper cost of the program, including indirect costs and employee fringe benefit costs. On the other hand, to assure that the cooperative Federal-State nature of the program is effectively retained, section 3 of S. 2428 would require that the direct costs of each State institute annual program, as such costs are defined by Federal procurement regulations, equal or exceed the amount of the annual Federal grant.

I should comment to the committee that one of the principal objectives in the Department's administration of this program will continue to be to provide research coordination so as to avoid duplication and to assure that funds are applied to achieve most effective results. Internally, within the Department, we have acted to place the Office of Water Resources Research, as well as the Office of Saline Water, under the jurisdiction of the Assistant Secretary for Water and Power Resources. This, plus legislative changes, should put us in position to do a better job. This puts virtually all of the water activities of the Department of the Interior under one boss, so we

can obtain the kind of cooperation which we think is good management and good business. We are doing that. We are all working very closely together, more closely than ever in the past.

Three other amendments are proposed by S. 2428 and we recommend their adoption. The first of these would delete from section 200(b) of the act the present requirement that proposed contracts and grants under the title II program be submitted to the President of the Senate and the Speaker of the House of Representatives for 60 days prior to the execution of contracts and grants. In lieu thereof, all title II contracts and grants would be specifically identified, by project title, performing organization, and amount of each contract or grant, in the annual program report required by the act to be submitted to the President and the Congress. We think that is a method by which on a more simple basis we can guarantee that the Congress is properly informed on what OWRR is doing. This revision would assure that congressional committees and Members of Congress are informed as to the specific application of title II funds and, at the same time, it would eliminate the paperwork and delay necessitated by the existing requirement.

The second of these amendments would provide authority to the Secretary to transfer to the grantee universities, when proper justification is provided, title to excess Federal property obtained for use by the grantees in the conduct of research authorized by the act. Right now there are several millions of dollars where the title is listed in the name of OWRR. We think it would be better if we were permitted to transfer title to these grantee universities, rather than him sitting there owning a bunch of stuff that he can't use himself.

The third amendment would place the annual program report on a fiscal year rather than calendar year basis. While we support this amendment, we would recommend against any proposal to change the March 1 date now specified in the act for submittal of the report to the President and Congress. The annual report is, in large part, based upon the annual reports of title I and title II grantees and contractors which are received in the Department on September 1. Placing the annual report on a fiscal year basis would not significantly change the period of time following September 1 needed to prepare, print and distribute the report.

These three proposed amendments are discussed in the Department's report on the bills being considered by your committee. While we believe each is significant in terms of simplifying and expediting administration of the program, and improved management, we would interpose no strong objections should the committee conclude that they should not be adopted.

As a final word, permit me to say that we are pleased with program achievements under the cooperative Federal-State water resources research act in the few years it has been in operation. The program augmented by the proposed amendments as recommended in the Department's report will continue to achieve significantly worthwhile results while at the same time operating with a relatively modest budget.

Thank you for the opportunity to present my views. If you or others of the committee have questions, I will gladly try to furnish answers.

That gives the position of the Department of the Interior on this legislation, and I would urge that the Senate take due cognizance of

our recommendations. I would now attempt to answer any questions which you gentlemen care to put.

Senator JORDAN (presiding). Mr. Secretary, do I understand that the three proposed amendments which you suggested in your statement, which are of not too great consequence in the overall, you are in full support of this legislation, is that correct?

Mr. SMITH. Yes, sir.

Senator JORDAN. Have you prepared these amendments in the exact form that you would like to see them incorporated in the bill?

Mr. SMITH. In S. 2428 they are written in the language which we think is most appropriate, sir.

Senator JORDAN. How about the other bills? Do you suggest amendments to the other bills?

Mr. SMITH. The other bills are silent on several items that 2428 has. S. 219 and 121 are both very fine bills. We would have no trouble in supporting them, but 2428 goes a little beyond and covers some items on which the other bills are silent, and which we think are important to be included in this legislative package.

Senator JORDAN. Very good. I have no more questions.

Senator ANDERSON (presiding). Mr. Hansen?

Senator HANSEN. Mr. Secretary, you stated you do not believe that the act need be amended to provide for the new dissemination function. Can I assume that your recommendation of a funding level of $200,000 does not fund the new information dissemination function provided by S. 2428, since you believe present provisions are adequate?

Mr. SMITH. That is correct, sir.

Senator HANSEN. If the new function is provided, how much is needed to fund it?

Mr. SMITH. I will defer to Dr. Hershey, the Director of OWRR.

Dr. HERSHEY. Senator, this will be variable in different States. We haven't put an exact figure on it. This is something quite new. There is no basis or no established way of doing this in the scientific field. So, we are a little unsure as to exactly how much money will be needed. In some States they might spend as much as $50,000 or even more. In other States, however, it is obvious that they couldn't spend that much money.

Senator HANSEN. One further question. There has been concern in some institutes that the statutory requirement for coordination with the States will become difficult. Could I ask you: What kind of coordination is funded?

Mr. SMITH. Senator Hansen, the subject which you brought up is one that happens to be very near and dear to my heart, because as you know I have been involved in water resources for a good many years. I don't think there is any intent on the part of our organization, the Department or OWRR, to hamper the academic freedom of these water resources research institutes.

On the other hand, I don't think it is appropriate for the Federal Government not to have any control at all and to provide merely a categorical grant which, and I know there are some instances when this has been true, provides very little more than an opportunity for a budding Ph. D. to do a thesis. They don't have any particular relevancy to the real life, real world problems that the State

water planners have, that the Governors have. And in your own State, and certainly the States in the West, they need to have the availability of the academic world to help them to solve some of their very real problems.

There is no intent to do more than to help to coordinate and see to it that these men work together, that they talk together, that they communicate with one another, so that at least part of the money from these institutes is used to help solve the real problems that we have existing in this country today.

Senator HANSEN. No further questions.

Senator ANDERSON. Mr. Allott?

Senator ALLOTT. I have no questions.

Senator ANDERSON. Well, thanks very much, Mr. Secretary.

Mr. SMITH. Thank you, Mr. Chairman.

Senator ALLOTT. Mr. Chairman, I would like to ask at this time, if I may, I don't know when you intend to close the hearings on this—I had a letter from Dr. Norman A. Evans, Director of the Environmental Resources Center at Colorado State University, who first indicated his desire to appear here. I have not heard from him subsequently and I would like to ask permission that I may insert a statement by him in the record prior to the time you close.

Senator ANDERSON. Without objection that will be done.

(The statement referred to follows:)

STATEMENT OF DR. NORMAN A. EVANS, DIRECTOR, OFFICE OF GENERAL UNIVERSITY RESEARCH, COLORADO STATE UNIVERSITY

My name is Norman A. Evans. I am Director of the Office of General University Research at Colorado State University in Fort Collins, Colorado. My responsibilities include supervision of the program of the Office of Water Resources Research, U.S. Department of Interior, in Colorado. My duties are research program development, coordination with both state and federal water agencies in Colorado, and coordination among the research institutions of the state.

When the Water Resources Research Act was implemented in 1964, Colorado was already a leader in various aspects of water resources research. Four universities have been involved. Colorado State University traces a history of national and international service in irrigation and hydraulic engineering back to the date of its founding in 1870. The University of Colorado points likewise to a long history of competence in the economic aspects of water resource development. The Colorado School of Mines, recognized as the outstanding school of its kind in the country with regard to mineral and petroleum engineering and geology, has also devoted much academic and scientific attention to water as a mineral resource. The University of Denver has focused upon the economic and social implications of water resources, particularly as they relate to water-based recreation and water pollution control. Although the history is a long one, the volume of research was small. The Act increased the volume and stimulated research in other new and important disciplines.

According to the 1964 OWRR Report for Colorado, there were 27 faculty members in 11 disciplines working in water resources research, while my 1970 Annual Report shows that there are 54 professors in 20 disciplines so engaged today. This impressive increase in scientific and professional effort is due in large measure to the stimulation of supporting funds through the Office of Water Resources Research.

During the course of the program to date, there have been 280 students supported fully or in part in their graduate work on water problems. These men and women have subsequently entered the professional world prepared to bring new knewledge, new techniques, new enthusiasms and new dedications to those problems. Without that support, many would have entered other fields leaving us even further behind in adequately trained manpower today.

The research and graduate training institutions of Colorado have, in fact, more capability for water research in terms of faculty and facilities than they

have fiscal support with which to sustain it. The increase proposed by S. 3553 would help us make fuller use of that capability.

I am tempted to review all the water problems of Colorado for you in support of legislation now being considered to increase financial support to water reknowledgeable about water problems in the various regions of the country today, search. However, I will not do so because, in the first place, this committee is fully and in the second place, I would venture to guess that the distinguished Senator from Colorado, the Honorable Gordon Allott, has already oriented you to our problems. I will, instead, show you by means of four illustrations the vitally important role which the OWRR research program is playing in the development and management of Colorado's water resources. Without this program, each of these problems would still be waiting for answers.

Case No. 1

Long range plans and priorities for state water resource development are being formulated by the Colorado Water Conservation Board with the help of the U.S. Bureau of Reclamation. At the request of these agencies a study was initiated which will measure the role of water in the total state economy. The result will be an input-output model which will become the foundation for the State Water Plan. Personnel of the two governmental agencies are getting valuable training by actively participating in every stage of the project (B–059–COLO).

Case No. 2

Colorado's water pollution control program is now moving from the standards setting and stream classification stage into one of refinement in the surveillance and enforcement program along with greater attention to forward planning and operational efficiency. Project A–010–COLO was initiated jointly with the Colorado Water Pollution Control Commission to make an analytical review of current organization, procedures, and policies. Useful recommendations have been made to the Commission concerning: (a) technical staff reorganization for better management efficiency; (b) development of a long-range planning function within the staff, and (c) greater utilization of federal funds to augment state funds in water pollution control, especially pertaining to planning. This critique from an external position gives timely guidance to the state agency as it moves ahead in its important work.

Case No. 3

Ground transportation routes in the intermountain West, because of topography, coincide with river and stream systems. Highway embankments often form one bank of a river channel, crossing and recrossing many times. Water erosion of embankments and at bridge abutments is a serious problem for which solutions have been found in Project A—002—COLO and Project B—014—COLO. Through laboratory models, erosion control design procedures were developed and provided to Highway engineers for use along the Colorado River. The Denver Water Board also uses the results in stabilizing banks of streams being used to transport water for the city of Denver.

Case No. 4

Flood runoff from watersheds in the mountain region has been difficult to estiate because of lack of historical records and the extreme complexity of precipitation events. Public agencies such as the Highway Department, the Soil Conservation Service, and the Bureau of Reclamation, along with municipalities concerned with urban drainage, having requested research to improve flood flow estimates for use in design of highway drainage, dams, canal protection floodways, and other facilities. Projects A—002—COLO. B—005—COLO, B—030—COLO, and B—054—COLO have provided new analytical techniques and procedures for making better flood flow estimates in the mountain watersheds of Colorado. The new technology applies equally well in any similar geographic region.

In conclusion: the vision of Congress in initiating the OWRR program has been confirmed. It has provided Colorado with research answers on urgent problems which otherwise would not yet be available. It has been so successful in stimulating water research and training that it should now be expanded to provide for more rapid use of results.

Public decisions are increasingly dependent upon new knowledge. Too often the decision-making stage is reached before the new knowledge is available. It is vitally important that the Congress provide for a viable, forward-looking water research program.

Senator ANDERSON. Dr. Allee?

STATEMENT OF DR. DAVID ALLEE, CHAIRMAN OF THE UNIVERSITIES COUNCIL ON WATER RESOURCES

Dr. ALLEE. Mr. Chairman, I am David J. Allee, chairman, executive board, Universities Council on Water Resources, associate director, Cornell University Water Resources and Marine Sciences Center, Ithaca, N.Y., and professor of resource economics, New York State College of Agriculture at Cornell University, Ithaca, N.Y.

Before I get into my prepared statement, I would like to put on my university hat for a minute before I wear my Universities Council on Water Resources hat, and say that a letter is coming to you from the president of Cornell University, and I would like to read just one sentence from it, because I think it makes an interesting point for our concern.

It reads:

> Cornell is placing increasing dependence on centers such as Urban Affairs, International Affairs, and Environmental Quality, as well as Water Resources and Marine Sciences as organizations which provide an essential linkage among the standard universities, colleges and departments.

I think it is this function of pulling together the resources of the university to apply them to society's needs that we are speaking about today.

I would also like to bring you greetings from Congressman Robison, who represents the district which includes Cornell. He has been very active in support of these amendments. I know he would like to be here, but pressing business prevented him from doing so.

I recently became chairman of the Universities Council on Water Resources and I must say I feel compelled, after following Assistant Secretary Smith, to make at least a few remarks on the very nice change in the environment of our working with the Department of the Interior.

Since Secretary Smith has taken over the leadership for not only the Office of Water Resources Research, but the other elements that he mentioned in the Department of the Interior, we have found that our communication has improved tremendously.

I would just like to point back to his recent statements about academic freedom. This is a concern, as you know, among the university community, yet there is an absolute need that we cooperate and work closely with our State people.

I think he shows a nice understanding of the balance here that is necessary, I would just like to say how pleased we are to be able to work with him.

Also, I would like to provide for the committee's files a copy of a report which an ad hoc committee of the Universities Council on Water Resources prepared reviewing and analyzing the whole section 100 program.

I would like now to go into my prepared statement, which I will abbreviate, but you, of course, have copies of the entire statement.

This statement is made on behalf of the Universities Council on Water Resources, an organization of some 70 of the Nation's leading universities actively engaged in education and research in fields related to water resource development and utilization.

On the occasions of its last three annual meetings, UCOWR delegates have considered the increasing need for amendments to title I of the Water Resources Research Act of 1964, and on July 2, 1969, adopted the following resolutions:

Resolutions on amendments to title I of the Water Resources Research Act:

One:

Whereas the Congress recognized the need for accelerated research in the field of water resources and the urgent need for trained personnel to meet the challenges of increased demand for the limited supply of water and passed the Water Resources Research Act of 1964, and

Whereas the research and training which can be accomplished with the fixed amount of monies authorized under Title I of the Water Resources Research Act of 1964 for research and training continues to decrease at an accelerated rate due to inflation, and

Whereas the restriction that funds provided under Title I of the Act cannot be used for fringe benefits results in the necessity for special accounting procedures at most universities to meet this requirement with unnecessarily high accounting costs, and

Whereas the problems associated with water resources have substantially increased since the passage of the Act and will increase in the future as increased pressure is placed on the quality of the environment, and

Whereas the cost of administering the research and training of the Act is substantially increased and made cumbersome by the requirement that the state centers and institutes report on a fiscal year basis and the Office of Water Resources Research report to the Congress on both a fiscal and a calendar year basis, and

Whereas the foundation for the partnership which exists between the states and the Federal Government in water resource research and training is predicated on a sound and substantial research program at each of the state centers or institutes: Now therefore be it

Resolved, That the Universities Council on Water Resources urge the U.S. Congress to amend the Water Resources Research Act of 1964 to:

(1) Increase the annual allotment program of Title I to $250,000 per year,

(2) Modify the language of the act to make all reporting on a fiscal year basis, and

(3) Provide specific language authorizing the use of allotment funds for the payment of fringe benefits.

Two:

Whereas the Universities Council on Water Resources in its 1968 Annual Meeting passed a resolution encouraging the authorization of teaching and extension-type programs in Water Resources; and

Whereas this resolution has been considered by many groups and individuals throughout the nation during the past year: Now, therefore, be it

Resolved, That the Universities Council on Water Resources reaffirms the urgent need for amendments to the Water Resources Resarch Act of 1964, to authorize the Office of Water Resources Research and the universities to develop educational programs for the interpretation and dissemination of water research findings and seek adequate appropriations to expedite these programs.

The amendment passed last year by the Senate intending to modify the Water Resources Act of 1964, unfortunately, was not matched by comparable action on the part of the House of Representatives due to a most crowded schedule. S. 219 introduced by Mr. Moss for himself and for Mr. Hatfield is the reintroduction of your committee's final bill. The House has now acted, passing a bill essentially the same as S. 2428, introduced by Mr. Hansen. Thus, our major concerns in this hearing are, hopefully, with the differences between these bills.

S. 2428 provides for the higher amount and we believe there is a persuasive case for the larger amount and that the events of the last year have made that case even stronger.

Let us examine the $100,000 provided for in the original act in 1964. In the 6-year interval, inflation has eaten into the effective purchasing power of that figure. Wages for professional personnel, faculty, technicians, graduate and undergraduate aides in the universities have risen faster than prices overall. While many feel this has only corrected unreasonable relative returns per man in the past and has partly reflected strong competition from Government agencies armed with needed pay scale increases themselves, this has nonetheless meant less research for the dollar. Equipment costs have also risen more rapidly, reflecting the high labor cost content in most scientific hardware.

It would not be unreasonable to estimate that some $50,000 per year per State is needed to correct this change in purchasing power. Note that the costs of construction of water resource development and pollution abatement projects has risen at a faster rate than this. This means that the State institutes will have firm funding that can be considered in long-range plans in balance with other more variable kinds of research funding as you envisioned this balance in 1965, and I might add, to do the job that you envisioned in 1965.

But now we are considering a broader responsibility and a more varied program than in 1964. The first phase of this expanded scope is provided for in both bills—namely technology transfer. Experience under the act has shown that greater effectiveness of the research investment can be achieved if there is an expanded investment in the dissemination function. This requires specialized personnel, not necessarily easily available to the State institutes through conventional teaching and research departments.

Senator HANSEN. May I interrupt just a moment, Dr. Allee. You used a figure "1964" a time or two in the copy of your prepared statement that I have. I see 1965. Did you mean that to be 1965 or 1964?

Dr. ALLEE. Where it says 1965, that is an error. It should be 1964.

What are called for are professionals who can work across specialized disciplines with a strong and broad problem orientation, and the skills needed to communicate the knowledge available to those who will, in fact, solve the problem.

Again, there is a need for a solid year-to-year funding base. This will and should vary from State to State, depending upon the character of the problems and the other resources available.

It is our judgment, and I have been an administrator of technology transfer types of programs, and I think it is not unreasonable to put a $50,000 figure on what would be required for a typical State as a base level for funding. This would provide for one to one-and-one-half professional man equivalents whose credentials must be comparable in almost every respect to regular research and teaching faculty. Also, this would give modest support expenses including the underwriting of seminars and workshops, printed materials, and other media costs.

But there is another aspect to the water resources research task that we only dimly perceived in the early 1960's, and indeed we may not have judged its full impact on our program even a year ago. This is, of course, the concern for the environment, its relationship to traditional water resource development, and the new challenges that it is posing for all of us with an interest in water resources.

The result in terms of demand for the output of the research community shows itself in some very obvious ways and in others that are less obvious.

First is the impact on what was considered hard and understood technology. In our old frame of reference it wasn't necessary to consider some of the alternatives that are now of interest because they may have less impact on environmental values. Before our more limited criteria—technical feasibility and economic efficiency—encouraged us to pass by some kinds of solutions. We must now go back and understand them better.

Second, we must, and have greatly increased our investigations into the environmental impact of resource development alternatives, particularly with regard to understanding the ecological systems involved. This has meant much greater involvement of biologists in particular, but also other disciplines such as environmental specialists in law and economics.

Closely related is the exploding emphasis on the water quality aspects of the various water resource development settings in the Nation, and the management of aquatic resources to enhance and protect environmental values.

Finally, the rapid escalation of concern in the environment has placed a special burden on the university community and the State institutes in particular to provide opinions and judgments in the many conflicts that have arisen. There is no lack of university faculty members willing to give off-the-cuff opinions. Some say that is what we do best. But to provide soundly developed opinions and analysis takes time and money. Hopefully as agencies find ways to regularize the solution of these problems, this demand will diminish. But right now it is very great.

In all of these respects, the Nation is asking the universities and particularly the State institutes to perform in ways that were not anticipated in the 1960's. If it takes $150,000 to provide the annual allotment program envisioned then, plus another $50,000 to respond to the need for technology transfer, an additional $50,000 to provide for an adequate response to the concerns for the environment seems modest, but we hope adequate.

I would like to turn my attention now to some of the other features of S. 2428, particularly the coordination with State water resources agencies. This has proven to be of some concern.

S. 2428 adds a sentence to subsection 100(b) of the Water Resources Research Act of 1964 to make explicit the kind of coordination with State officials which is now strongly encouraged by the rules and regulations and other policies of the Office of Water Resources Research. This language calls for "assurance * * * that such programs were developed in close consultation and collaboration with leading water resources officials . . . meeting the needs of the State.

We applaud the intent of this addition. It is a reaffirmation of the cooperative Federal-State concept upon which this program was based. State institute directors and university faculty must be in a constant dialog with leading water resources officials in order to achieve the kind of interagency, intergovernmental supportive program that is needed.

The genius of the American political system is that it divides power between many, and then builds ways to bring about their cooperation and mutual reinforcement. This is what I think this is attempting to do. The result may seem cumbersome and slow. An example is the growing length of time between the authorization of a study and the com-

pletion of a development project by one of the construction agencies. But the advantages are not to be overlooked. All points of view are considered in a more evenhanded way than would be the case if one interest could more easily hold down another. Final actions are more apt to be supported by a large majority—usually unanimity—than a bare majority. Hopefully, this means that the public interest is more fully met.

Thus, we would not change the wording of this section. The Office of Water Resources Research should continue to encourage the needed dialog. However, this may not materially help to increase OWRR's influence in encouraging the State officials to understand how the universities can help them. But it obviously should strengthen OWRR's influence in encouraging even better university involvement in solving State problems.

We must urge, however, careful development of guidelines and interpretation for this language. Under present and past administrations, the Office of Water Resources Research has understood the need for consultation and collaboration, which nonetheless recognizes the autonomy of the several agencies involved, the universities on the one hand and the State officials on the other. The universities cannot stress too hard that the essential ingredient to their contribution to society is embodied in the concept of academic freedom.

We are sure that the Congress has no intention here of in any way abridging that essential ingredient of university teaching and research. However, it would be efficient to clarify in the record of these amendments, if they are adopted, that no such thing was intended. This would prevent future misunderstandings on the part of both university and State personnel.

Many university faculty and administrators are unfamiliar with the excellent relationships between the Office of Water Resources Research and the State institutes. It is not hard to imagine them misunderstanding the intent of this section. And a more subtle point, they may also misunderstand the relationships between the institutes and the State agencies. There is a need within every university to maintain an independent image for the water program.

On the other hand, it must be recognized that State agencies have very different responsibilities. Planning, regulating and operating are very different activities than research and teaching. They cultivate different views of the world and its problems. Thus, it would not be difficult to imagine a State water official misunderstanding this section and attempting to influence the university to carry out work and come to conclusions that are not appropriate. Such misunderstandings could be prevented or more quickly resolved if the record makes clear that while this is a call for closer cooperation and a more active dialog, it is in no way intended as a means whereby the State officials can impose any particular tasks or conclusions on the university water program carried out under this act.

Senator ALLOTT. Would you yield for a question there?

Dr. ALLEE. Sure. In fact, I will leave the rest of my statement, essentially, for your perusal, and stop at this point.

Senator ALLOTT. I understand very well the points you are making. But the inclusion of the word "tasks" there, why should not the State water officials ask the universities to assume tasks? "Conclusions" I

agree with you completely, but if the State and university are to perform their function of research, for example, one that just pops into my mind would be perhaps the methods of stopping evaporation——

Dr. ALLEE. And research in that area is vitally needed.

Senator ALLOTT. Which is a basic problem for all of us in the West. Is there anything wrong with the Colorado River Conservation Board saying to the people of the State university, we would like to have you address yourselves to this task?

Dr. ALLEE. That seems like an appropriate area of research. I would not quarrel with that at all.

Senator ALLOTT. I agree with your statement with respect to conclusions, saying here is a method, we want you to do it right. Usually in the Western States, particularly the people associated with water resources are people who have a long experience personally in handling water, utilizing it, particularly industrial, but more in our area for agricultural purposes, and I really can't see anything wrong with attempting to assign tasks.

I do, like you, join wholeheartedly with the conclusions.

Dr. ALLEE. I think this is a very important point. I would like to point out, though, there is confusion occasionally on a distinction between research and what you might call normal agency staff work, and between research and planning.

In my own experience, we have had State agency people come to us with tasks which involved the routine collection of data, the routine summarization and analysis of data. They essentially asked us to perform a task which we interpreted as being no different than that which they would have had their normal planners carry out, that it involved no challenging research area at all.

I think the university has to be free to make this kind of distinction and point it out. But to cut off communications of the kind that you suggest, where they come up with a problem and say, look, from our point of view here is a research issue or a research question that needs to be tackled, we have to have more that kind of dialog.

Senator ALLOTT. I was thinking particularly I have seen so many research programs, and I put "research" there in quotation marks, financed by the Federal Government which actually were no more than tabulatory jobs that could have been done by any intelligent man with a very simple calculating machine, and maybe even just an adding machine, and then calling it a research project.

Now, you don't have, I take it from what you say, you don't have in mind that any of this sort of thing comes under research? What you are really thinking of, I think, is more on the basic research side. Perhaps some development research, too, but you are thinking more toward genuine, hard scientific research.

Dr. ALLEE. Research that uses the special skills that universities have.

Senator ALLOTT. Of the various disciplines within the university?

Dr. ALLEE. Yes.

Senator ALLOTT. I think we are talking the same language.

Dr. ALLEE. I think so, too.

Senator ALLOTT. It is very important because too often the Federal Government has financed at great expense so-called research projects which a normal, intelligent college graduate could have handled with

just an adding machine and without any particular expertise in any discipline. This is the sort of thing you would like to eliminate; would you not?

Dr. ALLEE. I would like to see the university personnel involved be free to make that distinction. The operating term, I think, in the sentence you pointed to is "imposed." The distinction here are subject to debate. I just want to be sure they can be fully debated.

Senator ALLOTT. Thank you.

Senator ANDERSON. Thank you very much, professor.

Dr. ALLEE. Thank you, sir, for this opportunity.

(The prepared statement of Dr. Allee follows:)

Prepared Statement of David J. Allee
Chairman, Executive Board
Universities Council on Water Resources
and
Associate Director
Cornell University Water Resources and Marine Sciences Center
Ithaca, New York
and
Professor of Resource Economics
New York State College of Agriculture
at Cornell University, Ithaca, N. Y.

At Hearings on S.219 and S.2428
Before the Subcommittee on Water and Power Resources
of the Senate Committee on Interior and Insular Affairs.

October 13, 1971

I am David J. Allee, Chairman, Executive Board, Universities Council on Water Resources (UCOWR), Associate Director, Cornell University Water Resources and Marine Sciences Center, Ithaca, New York and Professor of Resource Economics, New York State College of Agriculture at Cornell University, Ithaca, New York. This statement is made on behalf of the Universities Council on Water Resources, an organization of some 70 of the Nation's leading universities actively engaged in education and research in fields related to water resource development and utilization.

On the occasions of its last three annual meetings, UCOWR delegates have considered the increasing need for amendments to Title I of the Water Resources Research Act of 1964 and on July 2, 1969, adopted the following resolutions:

RESOLUTIONS ON AMENDMENTS TO TITLE I OF THE

WATER RESOURCES RESEARCH ACT

(1)

WHEREAS the Congress recognized the need for accelerated research in the field of water resources and the urgent need for trained personnel to meet the challenges of increased demand for the limited supply of water and passed the Water Resources Research Act of 1964, and

WHEREAS the research and training which can be accomplished with the fixed amount of monies authorized under Title I of the Water Resources Research Act of 1964 for research and training continues to decrease at an accelerated rate due to inflation, and

WHEREAS the restriction that funds provided under Title I of the Act cannot be used for fringe benefits results in the necessity for special accounting procedures at most universities to meet this requirement with unnecessarily high accounting costs, and

WHEREAS the problems associated with water resources have substantially increased since the passage of the Act and will increase in the future as increased pressure is placed on the quality of the environment, and

WHEREAS the cost of administering the research and training of the Act is substantially increased and made cumbersome by the requirement that the state centers and institutes report on a fiscal year basis and the Office of Water Resources Research report to the Congress on both a fiscal and a calendar year basis, and

WHEREAS the foundation for the partnership which exists between the states and the Federal government in water resource research and training is predicated on a sound and substantial research program at each of the state centers or institutes;

NOW, THEREFORE, BE IT RESOLVED that the Universities Council on Water Resources urge the U. S. Congress to amend the Water Resources Research Act of 1964 to:

(1) Increase the annual allotment program of Title I to $250,000 per year,

(2) Modify the language of the act to make all reporting on a fiscal year basis, and

(3) Provide specific language authorizing the use of allotment funds for the payment of fringe benefits.

(2)

WHEREAS the Universities Council on Water Resources in its 1968 Annual Meeting passed a resolution encouraging the authorization of teaching and extension-type programs in Water Resources; and

WHEREAS this resolution has been considered by many groups and individuals throughout the Nation during the past year;

NOW, THEREFORE, BE IT RESOLVED, that the Universities Council on Water Resources reaffirms the urgent need for amendments to the Water Resources Research Act of 1964, to authorize the Office of Water Resources Research and the Universities to develop educational programs for the interpretation and dissemination of water research findings and seek adequate appropriations to expedite these programs.

An Analysis of the Differences Between S.219 and S.2428

The amendment passed last year by the Senate intending to modify the Water Resources Research Act of 1964, unfortunately was not matched by comparable action on the part of the House of Representatives due to a most crowded schedule. S.219 introduced by Mr. Moss for himself and for Mr. Hatfield is the reintroduction of your committee's final bill. The house has now acted, passing a bill essentially the same as S.2428 introduced by Mr. Hansen. Thus our major concerns in this hearing are, hopefully, with the differences between these bills.

Should the Annual Allotment Program be Raised to $250,000 or to $200,000 per Year per State

S.2428 provides for the higher amount and we believe there is a persuasive case for the larger amount and that the events of the last year have made that case even stronger.

Inflation

Let us examine the $100,000 provided for in the original act in 1965. In the six year interval inflation has eaten into the effective purchasing power of that figure. Wages for professional personnel, faculty, technicians, graduate and undergraduate aides in the universities have risen faster than prices overall. While many feel this has only corrected unreasonable relative returns per man in the past and has partly reflected strong competition from government agencies armed with

needed pay scale increases themselves, this has nonetheless meant less research for the dollar. Equipment costs have also risen more rapidly reflecting the high labor cost content in most scientific hardware.

It would not be unreasonable to estimate that some $50,000 per year per state is needed to correct this change in purchasing power. Note that the costs of construction of water resource development and pollution abatement projects has risen at a faster rate than this. This means that the State Institutes will have firm funding that can be considered in long range plans in balance with other more variable kinds of research funding as you envisioned this balance in 1965, and I might add, to do the job that you envisioned in 1965.

Technology Transfer

But now we are considering a broader responsibility and a more varied program than in 1965. The first phase of this expanded scope is provided for in both bills -- namely technology transfer. Experience under the act has shown that greater effectiveness of the research investment can be achieved if there is an expanded investment in the dissemination function. This requires specialized personnel not necessarily easily available to the State Institutes through conventional teaching and research departments. What are called for are professionals who can work across specialized disciplines with a strong and broad problem orientation, and the skills needed to communicate the knowledge available to those who will in fact solve the problem. Again, there is a need for a solid year to year funding base. This will and should vary from state to state depending upon the character of the problems and the other resources available.

It is our judgment that on the average $50,000 per year will be required for a stable, well developed and articulated technology transfer program. This would provide for one to one and one-half professional man equivalents whose credentials must be comparable in almost every respect to regular research and teaching faculty. Also this would give modest support expenses including the underwriting of seminars and workshops, printed materials and other media costs.

The Environment

But there is another aspect to the water resources research task that we only dimly perceived in the early 1960's, and indeed we may not have judged its full impact on our program even a year ago. This is of course the concern for the environment, its relationship to traditional water resource development and the new challenges that it is posing for all of us with an interest in water resources.

The result in terms of demand for the output of the research community shows itself in some very obvious ways and in others that are less obvious. First is the impact on what was considered hard and understood technology. In our old frame of reference it wasn't necessary to consider some of the alternatives that are now of interest because they may have less impact on environmental values. Before our more limited criteria -- technical feasibility and economic efficiency -- encouraged us to pass by some kinds of solutions. We must now go back and understand them better.

Second, we must, and have greatly increased our investigations into the environmental impact of resource development alternatives particularly with regard to understanding the ecological systems involved. This has meant much greater involvement of biologists in particular, but also other disciplines such as environmental specialists in law and economics.

Closely related is the exploding emphasis on the water quality aspects of the various water resource development settings in the nation, and the management of aquatic resources to enhance and protect environmental values.

Finally, the rapid escalation of concern in the environment has placed a special burden on the university community and the State Institutes in particular to provide opinions and judgments in the many conflicts that have arisen. There is no lack of university faculty members willing to give off-the-cuff opinions. But to provide soundly developed opinions and analysis takes time and money. Hopefully as agencies find ways to regularize the solution of these problems, this demand will diminish.

In all of these respects the nation is asking the universities and particularly the State Institutes to perform in ways that were not anticipated in the 1960's. If it takes $150,000 to provide the annual allotment program envisioned then plus another $50,000 to respond to the need for technology transfer, an additional $50,000 to provide for an adequate response to the concerns for the environment seems modest, but we hope adequate.

Other Provisions of S.2428

Coordination with the State Water Resource Agencies

S.2428 adds a sentence to subsection 100(b) of the Water Resources Research Act of 1964 to make explicit the kind of coordination with state officials which is now strongly encouraged by the Rules and Regulations and other policies of the Office of Water Resources Research. This language calls for "assurance...that such programs were developed in close consultation and collaboration with leading water resources officials...meeting the needs of the State."

We applaud the intent of this addition. It is a reaffirmation of the cooperative federal-state concept upon which this program was based. State institute directors and university faculty must be in a constant dialogue with leading water resources officials in order to achieve the kind of inter-agency, inter-governmental supportive program that is needed. The genius of the American political system is that it divides power between many and then builds ways to bring about their cooperation and mutual reinforcement. The result may seem cumbersome and slow. An example is the growing length of time between the authorization of a study and the completion of a development project by one of the construction agencies. But the advantages are not to be overlooked. All points of view are considered in a more evenhanded way than would be the case if one interest could more easily hold down another. Final actions are more apt to be supported by a large majority -- usually unanimity -- than a bare majority. Hopefully, this means that the public interest is more fully met.

Thus we would not change the wording of this section. The Office of Water Resources Research should continue to encourage the needed

dialogue. However, this may not materially help to increase OWRR's influence in encouraging the state officials to understand how the universities can help them. But it obviously should strengthen OWRR's influence in encouraging even better university involvement in solving state problems.

We must urge, however, careful development of guidelines and interpretation for this language. Under present and past administrations the Office of Water Resources Research has understood the need for consultation and collaboration, which nonetheless recognizes the autonomy of the several agencies involved. The universities cannot stress too hard that the essential ingredient to their contribution to society is embodied in the concept of academic freedom. We are sure that the Congress has no intention here of in any way abridging that essential ingredient of university teaching and research. However, it would be efficient to clarify in the record of these amendments, if they are adopted, that no such thing was intended. This would prevent future misunderstandings on the part of both university and state personnel.

Many university faculty and administrators are unfamiliar with the excellent relationships between the Office of Water Resources Research and the State Institutes. It is not hard to imagine them misunderstanding the intent of this section. And a more subtle point, they may also misunderstand the relationships between the Institutes and the state agencies. There is a need within every university to maintain an independent image for the water program.

On the other hand, it must be recognized that state agencies have very different responsibilities. Planning, regulating and operating are very different activities than research and teaching. They cultivate different views of the world and its problems. Thus it would not

be difficult to imagine a state water official misunderstanding this section and attempting to influence the university to carry out work and come to conclusions that are not appropriate. Such misunderstandings could be prevented or more quickly resolved if the record makes clear that while this is a call for closer cooperation and a more active dialogue, it is in no way intended as a means whereby the state officials can impose any particular tasks or conclusions on the university.water program carried out under this act.

Indirect Costs, Review of Title II Grants, Excess Property, Reports and New Institutes

The remaining differences between the two bills are largely to streamline administrative procedures.

As long as direct costs for annual allotment programs equal the federal contribution we feel a proper intent is served. This is a partnership program and the states should make a significant contribution even beyond the amount of indirect costs for annual allotment activities. But under the rules of some states most awkward arrangements are necessary if the use of the federal funds is limited to direct costs.

Review of Title II grants by the Congress prior to award is a part of a broader debate over the prerogatives of the several branches of government. It is not clear to us that it has had a major effect one way or the other on the program.

Clarification of the acquiring of excess property and its disposal could present some needless delays and costs.

Reporting on a fiscal year rather than a calendar year would reduce some university administrative effort which now serves no purpose at the university level and apparently does not add significantly to

the information used at other levels. Instead of two overlapping time frames for reporting this program we would use one.

Finally the extension of the annual allotment program to District of Columbia, the Virgin Islands, Guam and American Samoa has not been closely studied by our organization. We do note, however, that the present program includes Puerto Rico and that the University of Puerto Rico has had the associated resources to develop a program that has gone far to meet the needs of the island. Its faculty and facilities have been more than adequate to mount an acceptable effort.

Water Resources and University Service

Research and Education Needed to Manage Our Waters

This is a good time to take stock. What is being done in research and in structuring our educational programs to meet the requirements of the nation for more regulated flows in our rivers and other related purposes. This discussion will focus on the 51 State Water Resources Research Institutes funded under the Water Resources Research Act of 1964. This is not to suggest that important work is only being done at these universities, nor that the relative emphasis should change between the universities enjoying support through these centers and others. It is simply that these 51 centers have now had a chance to get started and show us what might be done with systematic support from the federal government.

Another focus for this discussion will be the need for non-degree, non-classroom educational programs. A review of the history of these 51 centers supported under the Water Resources Research Act of 1964 shows this to be the fundamental weakness of the current approach. Experience in other programs and an understanding of the way in which universities work suggest that broadly useful problem-solving research is more likely to come about when we provide for a formal linkage between the university researcher and the audiences that need new knowledge. In the language of the ecologist and the computer programmer, we must provide a "feedback loop." This is not a one-way street. The universities must hire professionals whose job it is to take the results of research to those who have problems and, most important, to bring back to the academic researcher an intimate knowledge of the situations faced in the real world.

A casual examination of the potential for economic and population growth in the foreseeable future should suggest to anyone that there will be substantial pressure for expanding the uses that we make of our waters. This will mean more demands for stream flow regulation, more reservoirs, more channel work, more canals; in essence, moving water in time and place to serve man's needs. At the same time we must recognize that this will not be achieved easily and smoothly and with no stress and strain.

Certainly a major challenge that lies ahead of us is how to have our economically important services from water to serve one set of rising expectations and at the same time manage and preserve the environmental values to which water is so important in order to serve another set of rising expectations. Our traditional water resource development agencies are all unanimous in one aspect of their relationship to the new interest in the environment. They all agree that their present capacity to evaluate many of the questions being raised by environmentalists is inadequate. The Corps of Engineers, the Bureau of Reclamation, the Soil Conservation Service, municipal and state development agencies across the nation, find it difficult to find the trained staff or consultants who can help them avoid the time-consuming conflict that tends to arise. It is probably true that there is more misinformation on the environmental effects of water resource development than there is sound information. This doesn't make it any less effective in raising uncertainty and adding to our project backlog. The great need is that we can act because we know, rather than not act because of what we can speculate might happen.

In short, the programs of the 51 State Water Resources Research Institutes need to add a component of work that will help the developmental agencies of government respond to the environmental crisis. But past experience indicates that this will not occur unless those who do the research are assisted in the communication process by specialists at the universities, specialists in technology transfer.

The veto and supportive power of the environmental coalition must be recognized. It has been able to raise the public works budget for sewers and waste treatment plants from $214 million to $800 million. In this same period the Corps of Engineers and Bureau of Reclamation and Soil Conservation Service have faced the prospect of stable budgets which in a time of inflation really means a fall in real investment. The pressures for flood damage reduction are still there. The gains from expanded navigation works still bring many to the Congress asking for more facilities. Our cities are still looking to upstream reservoirs as a source of water supply. There are still farmers who ask the Congress to let them make the desert bloom. The environmental choices must be made and we must learn how to move ahead.

Some History

It is instructive at this point to turn to the reports of the Senate Select Committee referred to often as the Kerr Committee. This group conducted the last complete assessment of water resources policy in the United States. It is interesting to note that Ted Schad, who directed that study, is now staff director for the current review by the National Water Commission. Two extremely relevant pieces of legislation came out of that effort, the Water Resources Planning Act of 1965 and the Water Resources Research Act of 1964.

The Planning Act proposed the Water Resources Council as a formal mechanism for inter-agency coordination at the federal level. This was an outgrowth of many less formal inter-agency arrangements such as "Firebrick" and "Ice Water" and, of course, the ad hoc Water Resources Council which evolved into the present arrangement.

The Water Resources Council has pressed forward the resolution of a number of knotty policy problems. One example is the standardization of guidelines for the evaluation of hydrology between the several federal Water Resource Development

Agencies. Of course, a major task has been the coordination and development of guidelines for comprehensive water resource development planning. The Council's assessments of water resource development needs stand as a major contribution to the nation's response to its many needs. A current effort is the development of principles, standards and guidelines for project and plan evaluation. As the Water Resources Council has undertaken these several tasks, it has had opportunity to call upon the university community. The university community has been in a position to respond more effectively in recent years as it has developed capacity through the state institutes. The largest role has been in the most recent effort. The new evaluation principles which move substantially farther towards the full evaluation of all benefits of water resource development were tested by a number of university teams. Most of these teams came from universities with these institutes and the skilled manpower was available because of the experience that had been gained on supported projects.

The Water Resources Research Act of 1964, administered through the Office of the Water Resources Research in the U. S. Department of the Interior, was modeled closely on the Land Grant College and Agricultural Experiment Station system. The emphasis was to be on a mission orientation in the development tradition. A base fund of $100,000 per year has been provided to each of the institutes with opportunities to obtain competitive matching grants and open grants through the program. It is probably fair to say that this has been a more closely managed research program with careful review of each project and the development of careful guidelines that identify the nation's research needs. Nonetheless, the program fails to provide for that important Land Grant College component, namely an Extension Service responsibility.

It is perhaps instructive to note that the Water Resources Planning Act of 1965 provides substantial support for the states to develop their own water resources planning programs. It also provides for their participation in river

basin planning commissions. The passage of that act was delayed while state objections were worked out to the original formulation by the Kerr Committee. The Water Resources Research Act, on the other hand, passed somewhat more quickly, perhaps because of the active support of the National Association of State Universities and Land Grant Colleges. In its original form, it was a tried and true format for organizing the capacity of the universities to meet some of the nation's needs.

There should be no question that the Water Resources Research Act has achieved a major part of its objective. The universities provide a reservoir of skilled academic talent, much of which has a much better understanding of the problems faced by those who would develop the water resources of the nation. Government agencies have been able to choose between a group of students far better trained for the tasks which are at hand. They have been able to send employees for advanced training to the universities and yet be assured of teaching that is more relevant. The academic literature has been enriched, indeed almost flooded with the results of new research.

The annual reports of the Office of Water Resources Research detail many of the advances that have been made. The same kind of picture can be gotten from the reports of the individual Institutes. Many of the Institutes have prepared summaries of their efforts over the last five or six years. A summary of some of these is provided later in this report.

By involving members of the university faculties from a wide range of disciplines, the program has had a "ripple" effect throughout the Land Grant Universities and beyond. The problems of water have been effectively expressed at the university on an urgent and understandable level. The faculties have responded.

Some Examples of Recent Work

The planning of public projects by every level of government has been improved by the findings and analytical techniques developed in recent research. One example is the optimization of power generation, peaking power and water releases within the California water plant. Another is a new approach to integrating urban area water systems developed for the New York City area. Some of the concepts developed in this research are currently being implemented by the Northeast Water Supply Study carried out by the U. S. Army Corps of Engineers.

Preventing the degradation of the environment or taking steps to enhance it has led to the development of a number of important pollution control measures. In one state criteria were developed for stream bank stability to be used in conjunction with highway construction. Sediment in our streams has been a major source of excess nutrient loading and fish habitat destruction. Stream banks are a substantial source of such silt. In other research it has been found that stream aeration systems have greater capability than we imagined for improving aquatic environment. In particular, it is apparently possible to artificially improve the quality of lake waters by this method.

Manpower research has indicated a critical shortage of trained water resource personnel to exist currently and to grow worse by 1980. The supply of water resources manpower is expected to be 154,000 by 1980, of which 55,000 will be engaged in research. In contrast, the demand for water resources manpower is projected at 267,000 with 95,000 being needed in research. Critical shortages in 1980 are forecast for ecology, hydrology, water resources planning development and management, water quality, and watershed management.

The framers of the legislation sought to establish a federal-state partnership to mount an attack on these problems. In addition they recognized the need to interest a large number of the best minds of the country in the problem areas. The establishment of an Institute at each of the land grant universities seemed

to satisfy the criteria for implementing the research program. These Land Grant institutions had a long and successful history of cooperative research in the field of agriculture and the faculties represented a large reservoir of untapped expertise.

The performance of these Institutes over the past six years amply sustains the wisdom of the broad base of operation. Directors at the local level have been very successful in stimulating the faculty from a wide range of disciplines to focus their expertise on water problems which had heretofore gone unnoticed. The key to this stimulation was in part due to the fact that these experts became keenly aware of the water problems which surrounded them. Much of their motivation was the desire to provide input into solving local and state problems. In working on these problems they also made a large contribution to what might be considered national problems. None of the states are in isolation, the externalities are felt outside the state boundaries and Institute research has had wide applicability and usefulness throughout the nation as a whole.

The reports by the Office of Water Resources Research to the Congress each year provide tangible proof of the effective federal-state partnership which has been established. The states on an average contribute support equal to between 60 and 70 percent of the annual federal allotment. The reported contribution is probably low as the figures reflect only the most obvious and easily identifiable items. Actual contributions probably approach 50-50 funding. There are many examples where initiation of a very modest research project in the allotment program has stimulated a vigorous research program supported by other federal and non-federal funds. In some cases the expenditures for the expanded research may be 20 to 50 times the cost of the original research proposal. The statistics on training of qualified personnel are equally impressive. To supplement this training many universities design curriculum and special degree granting programs in the field of water resources.

The original program of $100,000 annually was thought by the sponsors of the legislation to be adequate to initiate the program. It has become evident that inflation has drastically eroded away the purchasing power of the amount originally authorized. In addition, the original authorization was predicated on problems recognized at time of enactment. Even the most knowledgeable scientist in 1964 did not fully anticipate the multitude of emerging problems associated with the rapidly changing environment. The present authorized appropriation is no longer adequate for this wider horizon of responsibilities.

Technology Transfer

An estimated $149,000,000 was invested in water resources research by the federal government in FY 1969. Yet, it is recognized that procedures used by funding agencies for the identification and characterization of water research needs and the transfer of research results into practice are extremely unsatisfactory. There is a demonstrated need -- a marked need -- to improve communication between research users and researchers if the research supported by this large investment is to be responsive to the needs of water planning and management agencies and the resulting new information is to flow into the hands of practitioners in a form which can be utilized by the large variety of disciplines and levels of skill involved.

The Water Resources Research Institutes are ideally situated to assume responsibility for information dissemination at the state and local level. Their programs include the relationships with the users in local and state government, planning agencies, consulting engineers and other practitioners. They are currently involved with these groups in the identification of research needs and the development of research projects responsive to those needs. What they lack is legislative authorization for the appropriations and related activities necessary to develop the second phase of their programs -- the interpretation and

dissemination of water research findings. Such programs would utilize existing state extension services such as agricultural, engineering and industrial, to the extent they are available in the same way that the Institutes currently utilize faculty and laboratory facilities for research. Where such services are not available, they would be developed along lines best fitted to the university and the unique needs of each state.

Federal funds presently authorized for Institute annual allotments and matching grants are designated for research and related training. There is no specific authorization for information interpretation and dissemination programs, nor funds for this purpose.

The result is that there is little direct communication, on a systematic basis, between the researcher and his logical counterpart -- the individual or locality with a problem. It is probably true that our agricultural research program did not begin its maximum period of effectiveness until the technology transfer function was institutionalized at the university to complement the research programs that had begun some years before. Within the university community, there is, unfortunately, considerable resistance to the development of outreach programs based upon general purpose funding. Dollars that can be used for any purpose are scarce at the university as elsewhere. Left to its own incentives, the university will use these funds for on-campus teaching and more research. Earmarked funds are needed to encourage the universities to provide this important service needed by the rest of society.

There is a demonstrated need to improve communications between research users and the researchers if the research supported by this program is to be responsive to the needs of water planning and management agencies and the resulting new information is to flow into the hands of practitioners in a form which can be utilized by the large variety of disciplines and levels of skill involved. For example consulting engineers, particularly those in small firms, would welcome the support

this program could provide. It would put at their disposal new tools, new technology, so that they in turn can do a better task of servicing their many customers.

Professionals in the transfer of technology can provide the interdisciplinary kind of information not now easily available to practitioners. Like researchers, agencies and firms today tend to be narrowly based in terms of the mix of specialties that they have represented in their staff. But the problems they face call for broader approaches.

To meet the need for more information in the hands of those who could use it and to insure that information is produced that can be used, a two-way process must be developed. Both the generator of the information and its receptor must be actively engaged in the process. Often, however, initial impedence may be so great that communication is ineffective without provision of special aides and specialized personnel.

At least four steps need to be taken in order to reduce the barriers that stand between those who produce new information and those that need it. First, specialists must be available who can define problems broadly and bring together the research from many researchers and disciplines that is potentially significant in solving those problems. Very few researchers are this sort of generalist. Second, the scientific information available must be repackaged for ready understanding by practitioners and other decision-makers. The researcher writes for his fellow members of his discipline. Translation is required for the busy practitioner. Third, educational experiences must be designed that offer ready communication between both the generator of new information and the recipient of such repackaged information. Finally, feedback must be facilitated that will alert researchers to the scientific information needs of those involved in resource decisions and actions.

In order for the Water Resources Research Institutes to become authoritative and objective sources of information, not biased in favor of particular action programs, it will be necessary to provide stable year-to-year funding for this type of activity. Other available federal sources are not sufficient or suited to this need. A project-by-project type of authorization does not provide the basis on which to employ the necessary skilled personnel and establish the lasting relationships that are needed. "Hard funds" which the university may use this year and, more importantly, for which the university may plan its activities over future years, are needed. Only in the steady, continuing program can a university recruit the kind of quality personnel necessary to insure that the program will continue to be an effective impetus for progress.

The need in order to make an effective beginning is relatively modest by current standards for public programs. But the impact of such funds may have more concrete results in work being done on localized water problems all over the nation than practically any other recent legislation currently being considered.

Senator ANDERSON. Dr. Agnew?

Senator ALLOTT. Mr. Chairman, since I made my first interruption here a few minutes ago, I have a wire addressed to me, received this morning, which is October 13, which reads as follows:

Re: S. 219 hearing; Please refer to our statement in the hearing last year, for transfer, vital step not provided in current Act. We again urge favorable action and authorization at 250K"—that is thousand—signed: Norman A. Evans, Director, Environmental Research Center, Colorado State University.

Therefore, I would like to have Dr. Evans' former statement of last year incorporated into the record simply by reference.

Senator ANDERSON. Without objection, that will be done.

Dr. Agnew?

STATEMENT OF DR. ALLEN F. AGNEW, STATE OF WASHINGTON WATER RESEARCH CENTER, WASHINGTON STATE UNIVERSITY

Dr. AGNEW. Mr. Chairman, Senators, my name is Allen F. Agnew. I am chairman of the National Association of State Universities and Land-Grant Colleges Committee on Water Resources, and I am also director of the State of Washington Water Research Center.

I have two statements here which I would like to have introduced into the record, and I would like to speak from those briefly.

Senator ANDERSON. That will be done.

Dr. AGNEW. The testimony I wish to speak from first is the statement underlined, "National Association of State Universities and Land-Grant Colleges."

I have appended a list of members of my committee, 15 men, as the last page of that statement, and you will see that President Hartung of the University of Idaho, President Heady of the University of Mexico, President Ray Chamberlain are members of this committee.

This association, as you know, is made up of 18 major State institutions of higher education, and we wish to thank the subcommittee for the opportunity to appear before it and speak in favor of the provisions of this legislation which would amend Public Law 88–379, the Water Resources Research Act of 1964.

The preceding speaker, Dr. Allee, representing the Universities Council on Water Resources has made a statement that my organization supports the National Association of State Universities, supports the UCOWR statement. These people, as you know, are members of our universities, they are the working people in the water arena. Therefore, they are closest to the problem.

My association is a policymaking organization, as you understand, and deals with all kinds of educational matters in addition to water.

Well, a year ago, Mr. Chairman, at the hearing on S. 3553 here before this subcommittee, the statement of my association showed our great interest and concern for this legislation and this concern going back to 1963 and 1964, when the act was passed, and then title II amendments in 1966. The statement that we made a year ago also showed the need that we recognized for further modification of this act in order to permit or enable the universities to do a better job of fulfilling the charge that was envisioned by the framers of this legislation back in 1963 and 1964.

I think it goes without saying that the work of the water resources research centers and the Office of Water Resources Research, the partnership during the past 6 or 7 years, has shown the effectiveness of this partnership that was established in that way.

In my statement I have cited certain projects that appeared to show the success of this program in striking at certain problems and their solutions. This is on page 2, and I have cited one from Utah and one from Idaho, and a couple from my own State of Washington.

Moving on to near the bottom of page 3, sir, in section 1 of Senate bill 2428, it would provide for an allotment of $250,000 rather than the present $100,000. As we have heard before, such an increase is needed for several reasons, one of which is to support new and enhanced information transfer functions. Another is to offset the erosive effects of inflation, and the third might be called coming closer to funding the large number of good project proposals that could search out answers to some of society's problems that we have been unable to fund at present, with the present level of funding. Senate bill 219, by providing only $200,000, therefore, in our view does not go far enough.

Now, in examining the 7-year history of the Office of Water Resources Research and the university water research program, we have noted that although it focuses mainly on regional or local problems through the allotment part of the program, many of these have national application as well, far wider reach than just the State.

I cited on page 4, four such projects, again one from New Mexico, one from Wyoming, and a couple from my own State of Washington.

If I could just look at the last one on that page, this is one I myself have been in charge of. We are examining the ground water reserves that are shared with adjacent States, because as you know ground water goes underneath State boundaries. Different States commonly have different laws; different administrative units to provide the institutional aspects of managing that resource, and I think you recognize that just as with surface water which we share across the border, our ground water resource that we share under the border is just as significant.

This particular study, or a report on that is due out very shortly.

Another major benefit of this water resources research program is that it has permitted a very substantial and coordinated State-funded program to be developed in many of the States.

I would like, then to look at section 2(b) or Senate bill 2428, which would require that annual programs submitted by these State institutes, as we have heard earlier this morning, should be developed in close collaboration with water program officials in the States and the local communities to assure the responsiveness to this local program.

My association is an agreement with the general thrust of this provision, that is that the program of the center or institute be developed in such a way as to reflect an awareness of and the interest in the State and local needs, and therefore the close communication, I think that is the keyword, with the State and local officials is highly desirable. We are nevertheless concerned that the freedom of the program, of the center or the institute, to include elements that go beyond the State's borders or beyond the agency's interest not be hampered.

Therefore, we recommend that the language be clarified along lines such as those suggested in this statement in the middle of that paragraph.

Looking at the communication transfer function, we recognize that although our water research centers have produced a wealth of professional reports dealing with all kinds of research projects funded under the act, we are only reaching one kind of public in this manner. We must communicate with many other publics, as you will require—the State agency administrator, or the local government official, who is not a water professional quite often, or the local citizen groups or individuals who need to understand the problems or their alternative solutions.

I cited in my written statement two examples of this from the State of Washington. I will move over this, just making the remark that I think a journalistic flair of a staff person in the water research center is needed to produce the kind of readable report that the potential users could use.

Looking ahead, the water research center serves as a focal point on campus for water research activity in the many subdivisions in the university. This is a positive effect of the program over the last 6 years, and we wish to enhance this focal point.

I would like to mention the matching grant program because the Office of Water Resources Research has been able to provide funds for only a small portion of the meritorious proposals submitted under this program. It is unfortunate that when our State agency people identify problems that need to be solved and come up with the matching funds, and the university comes up with its share of the matching funds, and then the university researchers are able to devise research proposals that would lead to the solution of these problems, it is unfortunate that these problems cannot be undertaken because of the inadequacy of the moneys appropriated under section 101.

Therefore, my association urges full funding of the title I matching grant, and the title II provisions of the Water Resources Research Act up to their authorized sums.

In conclusion, back to the allotment funds of the center or the institute, they have been used largely for seed grants that enable experts to put together larger and more comprehensive programs, and therefore these seed grants have had quite a substantial multiplier effect.

So, in looking back over the 7-year history of the Water Resources Research Act, we have seen a program that has been surprisingly successful and is accomplishing much of what was envisioned by the framers of the legislation in 1963 and 1964. But we also see areas, such as information transfer, wherein the program could be improved so it could be even a greater service to our Nation and the citizens. Of course, we see the many unanswered water problems that require research but for which present funding is inadequate.

Because S. 2428 and provisions of S. 219 would enable this partnership of the Federal agency and the university community to do a better job of solving society's problems with water, the National Association of Universities and Land-Grant Colleges is pleased to register its support for their provisions as we discussed here briefly this morning.

Now, I would like to abstract even more briefly the statement for the State of Washington Water Research Center, if I may.

Senator ANDERSON. Yes.

Dr. AGNEW. The statement you have in front of you is the second statement, underlined "State of Washington Water Research Center."

I appreciate, again, the opportunity to appear and represent that water research center which consists of two universities, the University of Washington and Washington State University. This dates back to the 1964 memo of agreement between the two universities, and this cooperative venture is unique between the two universities.

The relationship has been an extremely viable one with the capability of drawing on experts of all fields of water and related resources. After 7 years we can point to many accomplishments within our State that our own water research center has been able to achieve because of this program. This last spring I prepared an assessment entitled "After 6 Years" and, Mr. Chairman, I would like to leave a copy of this report for the file.

Senator ANDERSON. Without objection.

Dr. AGNEW. The research program of the State is very broad. It has been funded by the Office of Water Resources Research through two of the three programs, the allotment program and the matching grant program. The title II grants we have not participated in. But in addition, we have had State funding for State projects.

It is very important, sir, that all of these State projects have been multidisciplinary ones showing the great breadth of our water problems and the interfacing of the many subdisciplines here.

One of the projects that we prepared which represents this multidiscipline aspect is a water planning concept for the State of Washington which we prepared a year ago. This was done by 16 professionals from the two universities representing all manner of disciplines. This provided a vehicle for the State agency, a framework for it to embark upon its planning for the management of its resources in an organized way.

We feel this planning document which was entitled "A Concept Of a State Water Plan" should also go a long way in helping the State solve problems related to land-use planning with which, of course, the water resource interfaces in all manner of ways.

I have cited, sir, a few examples of research projects within the State that represent this multidiscipline aspect, and I should like to move on, then, to the fact that about three-quarters of the allotment money in the State of Washington has been used to fund these allotment projects.

These are seed grant projects, as I mentioned earlier, and there is quite a multiplier effect there. But I should like to point out one other thing, in our State the State contribution, although it is not required for the allotment program, has been equal to and slightly more than the Federal money spent on these allotment projects. This non-Federal money has come from the State department of ecology and from the two universities.

It is important to recall or to understand how we select these projects. These are subject to at least two substantial reviews. We are in the process right now of selecting the matching grant projects for next year. They are reviewed by the Joint Scientific Committee, three mem-

bers from each of the two universities representing the various disciplines, and by myself and my assistant.

After going into Washington, they are subject to another thorough review and screening there. This shows we can weed out the less efficient, or those that we deem to be less likely to result with the funding requested, in results that would be useful for that kind of money.

Many of these projects within the State have regional or national applications, as I mentioned earlier, and two or three of those are cited in my report, in my statement.

Then, on page 6, we have come to realize that the funding for the allotment programs, the funding is inadequate because we are receiving nearly twice as many good proposals in terms of dollars and numbers than we can fund. The last 2 years it has been slightly more than the amount that we have been able to fund. These are good proposals.

In addition, there are three State colleges which are now beginning to get research program gleams in their eyes, would like to be able to work in water research, and we would like to be able to fund their capable researchers.

Therefore, we support section 1 of S. 2428, which would overcome the inadequacy and move the dollar funds up to $250,000.

In brief, the State of Washington Water Research Center urges favorable action on the elements of this legislation that I just discussed here, and I should be happy to answer any further questions.

Thank you.

Senator Moss (presiding). Thank you very much, Dr. Agnew, for your very fine statement and report of the use that has been made of this program in Washington State and your recommendation that we increase the amounts in accordance with the bills before us.

I wasn't able to hear all of your statement, but I do have the written text before me, and I have been looking at that as well as listening to part of it. I don't know that I have any questions, but I will call on my colleagues to see if any of them have.

Senator Burdick?

Senator BURDICK. No questions.

Senator Moss. Mr. Hansen?

Senator HANSEN. No questions.

Senator ALLOTT. I have one brief question. I would like to ask you, and then I want to ask Dr. Allee another question.

Do you have problems in Washington relative to water administration? I had the feeling that in some instances, in my own State I know they made some advances, that we can solve at least some of our water problems by upgrading and bringing into the 20th century the river administration problems that we have. They are terribly inadequate, and I will ask you, do you have these problems in Washington?

Dr. AGNEW. Yes, we do. Senator Allott, we have examined both the legal aspects, the legal problems, and the institutional problems, or administrative problems there. We find we are afflicted with what we call districititis. All kinds of levels of overlapping jurisdictions.

In addition, at the State level we have conflicts as you know among State agencies that have specific water authorities, specific reasons for wanting to do certain things with water.

One particular project that we have right now is attempting to establish low flow guidelines for the State of Washington. We find that the

different States agencies wish a different degree of low flow, depending on whether it is a fishery or flood management agency, or recreational type agency.

We do find there are changes coming about in the last 2 or 3 years. Unfortunately, the changes don't move as rapidly as we would like to have them move, and we find again that we need to have counsel, shall we say, of State agencies' heads and the middle management people as well as working stiffs such as myself.

Senator ALLOTT. I understand your answer, but I think we have a long way to go, generally, in bringing up the administration of water. I am speaking of the West, where we are talking about the distribution of water, particularly those of us who have heard this in prior appropriations, the need for immediate and accurate measurements in sufficient numbers to provide the local commission and the State engineer with an immediate picture.

I mean, in this day and age, it is just absurd that we do not have an immediate picture. We are still doing it on the basis that we did it back in the 1890's, and continuing through most of this century. This creates a lot of abrasiveness between competing users of water.

For example, two different companies, one of which may be up the river, and one down, their appropriation priorities may overlap. The first one may have a later priority than the one below it, and it may be reversed for the second priority.

So, you get in on extremely complicated problems in the distribution of water. It seems to me that this is an area of concern. While your problems may not be identified with perhaps the water problems of the Senators at this table, I think ours are pretty generally the same, having worked in this area for a long, long time myself.

Then, when you create the shortages of water for distribution, you create animosities between the users of the river, often law suits, and you destroy the ability to work as a unit to utilize this very valuable commodity to the greatest extent.

Now, over to you, Dr. Allee. You don't live in an area where you have these problems, but with such a project of trying to work out a 20th century way of allocating water according to the laws of the State and according to the contracts of the river, would this fall within your area of research?

Dr. ALLEE. Definitely. We are engaged in some work along these lines at the present time. Our water problems are in a slightly different form than the West, but New York is not short of the kinds of problems Dr. Agnew was referring to.

For instance, the tendency to create a new agency to carry out a new function, or put new emphasis on a function, when perhaps changing the activities of an existing agency might have been more expeditious. It is sometimes viewed as more difficult to bring about, at least in the short run. The new agency comes into being and stumbles along as any new agency must, getting its feet on the ground, and perhaps doesn't grapple with the problem as well as if the problems had been given to an old one. This kind of problem we have, I don't think, it at an absolute Federal level.

The case of New York City, in its search for an expanded water supply, I think, is an interesting point. It has gone along viewing the many agencies involved, but some have viewed the traditional sources

of supplies as being the next step. These have produced substantial amounts of conflict. They have problems with the surrounding municipalities which they service, coming through equitable contracts with them and this sort of thing.

I think a new arrangement there is called for. It will involve participation on the part of Federal agencies, just as in the West. Rationalizing and improving the management of the Hudson is vitally needed. We have for too long taken water supplies as one kind of activity and water pollution as another. Putting these two together seems to be a logical approach in solving the problems of New York City.

Senator ALLOTT. The reason I ask you this is because my former questions were more directed to you along the lines of basic research and water problems.

If, for example, ditch A diverts, through poor administration, inadequate ability to properly administer 15,000 feet of water to ditch B, aside from the legal responsibility and things that result from that, you create antagonism between maybe 300 farm families here, and 500 farm families here, which is a very highly emotional one, and in which eventually you are doing many things impractical.

From the practical standpoint which would be to the advantage of all of them later——

Mr. ALLEE. Just change that to the community of northern New Jersey, and the ones surrounding New York City, and you have the same thing.

Senator ALLOTT. All right. The sort of project that I mentioned is not concerned with basic research at all. It is concerned with using available technology which we have and applying that technology to solving our own problems today. Yet as far as I have been aware, I don't know of any place that this has actually been done to bring water and river administration here. I can be corrected by my colleagues here because they may have gone further into the statement than I have seen. But it is a very important thing, and something the universities can contribute to greatly.

Dr. ALLEE. I have been working with a group of political scientists, people in university areas and public administration, trying to help them see where they can apply their talents to this problem, and I think it involves some interesting challenges in basic research in areas of political science, and I look forward to our doing more work in this area.

Senator ALLOTT. I would just as soon see the political scientists stay out of this, and get some good hard engineering, electronics as well as as hydrology and water engineers, and as far as the problems I am thinking of, I don't think the political scientists will solve any of these.

Dr. AGNEW. Could I respond to that, please?

Senator ALLOTT. Yes.

Dr. AGNEW. I think here we are putting our finger on the need for communication across disciplines. It is very important for the engineers to become versed in the political science aspects as well as the legal aspects. And it is important for the economists to do the same. Just as the political scientist, if he is going to be a true political scientist, he must know about the resources.

I am not suggesting these men go back to school and get another degree. I am urging that they sit down and communicate through these

committees and seminars which the water resources institutes through the States have been able to provide. This is one of the pieces of genius in the legislation that permitted us to do this sort of thing.

Senator ALLOTT. So do I, and I must say I have been concerned for a long time. There is too much research where perhaps the thrust of it has been into a particular discipline and we suffered too long in this country from the lack of application of interdisciplinary approaches to the solutions of our problems. We do need it.

I have taken too much time, Mr. Chairman, but I think this is a very interesting question, and these gentlemen have been very helpful.

Senator MOSS. Thank you very much, Dr. Agnew and Dr. Allee.

(Dr. Agnew's prepared statements follow:)

STATEMENT OF DR. ALLEN F. AGNEW, STATE OF WASHINGTON WATER RESEARCH CENTER, WASHINGTON STATE UNIVERSITY

Mr. Chairman and Members of the Subcommittee: My name is Allen F. Agnew. I am Director of the State of Washington Water Research Center and Professor of Geology at Washington State University, which is the land-grant institution in the State of Washington. This testimony is presented in behalf of the *National Association of State Universities and Land-Grant Colleges* through my capacity as chairman of its Committee on Water Resources. (A list of members of the NASULGC Committee is attached to this statement.) The Association is made up of 118 major State institutions of higher education, and we wish to thank the Subcommittee for this opportunity to speak in favor of the provisions of this legislation, which would amend P.L. 88-379, the Water Resources Research Act of 1964.

The testimony of the NASULGC at the hearing on S. 3553 before this Subcommittee a little more than a year ago documented the great interest and concern of the Association in the legislation that resulted in the Water Resources Research Act of 1964, and the Title II amendment of 1966. The statement of the Association a year ago also stressed the need for further modification of the Act, in order to enable the universities to fulfill better the charge envisioned by the framers of the original legislation in 1963 and 1964, most of whom continue today as members of this Subcommittee.

The past six years of experience under this unique partnership of the university community and the federal government has provided us with well-documented evidence of the success of this program in solving water-research problems in our Nation. The performance of the 51 Water Research Institutes or Centers has amply sustained the wisdom of the framers of the enabling legislation, as is shown most graphically by the annual reports of the Office of Water Resources Research to the Congress, which provide continuing tangible proof of the effectiveness of the Federal-State partnership thus established. A few examples of this success at solving water problems are given below.

A-001-Utah.—studied the problems involved in obtaining community and regional support for water-resource projects of regional interest, assessing both social behavior and institutional aspects of the matter. This project, in a virtually unexplored field, helped arouse the interest of the country in the social aspects of water problems.

A-010-Idaho.—analyzed P.L. 89-80 (the Water Resources Planning Act) for its effect on the State of Idaho; it resulted in a more definitive law passed by the 1969 Idaho legislature, concerning the beds of lakes and streams especially as related to high-watermark lands.

A-034-Washington.—examined nuisance algal growth in Moses Lake, eastern Washington, related to environmental factors; results indicated two methods that have good potential for decreasing the large biomass of blue-green algae in the lake.

A-032-Washington.—studied the hydrologic and energy balance of stocked and unstocked Douglas Fir sites, as calculated by meteorological methods. The investigation revealed that, contrary to the basic assumption of meteorological methods, all fluxes are not vertical.

The Water Resources Research Act, which provides $100,000 annually to each Water Research Institute or Center under the allotment provision of Title I, was thought by the sponsors of the original legislation to be adequate for the

initiation of the program. It has become evident that inflation has drastically eroded the purchasing power of the allotment originally authorized.

In addition, the original authorization was predicated on known problems. Even the most knowledgeable scientist in 1964 did not anticipate the multitude and complexity of the dilemmas associated with our rapidly changing environment, or understand the magnitude of the task and the cost of interpreting and disseminating the results of scientific and engineering research deemed significant for the solution of water-resource problems. Furthermore, although much attention has been directed toward some of the social sciences such as economics and the law, and to a lesser extent political science, we did not foresee the magnitude of the effort needed to be applied in other areas such as sociology—problems related to why people have certain desires, how these desires change, and the interaction of these desires with economics and with ecological or environmental effects of the use of the water resource by the different publics.

Accordingly, the Association supports the elements of S. 121, S. 219, and S. 2428 that recognize the need for an increased allotment to each of the Water Research Centers or Institutes, under Section 100(a) of Title I. These bills would also amend Section 100(b) of Title I, to reflect the responsibility of the Centers or Institutes to increase their efforts at communicating the results of water research to the user.

Section 1 of S. 2428 would provide for an allotment of $250,000 rather than the present $100,000. Such an increase in the basic allotment is needed for the new and enhanced information-transfer function, for offsetting the erosive effects of inflation, and for coming closer to funding the large number of good project proposals that could search out answers for society's problems but which must go unfunded at present. Senate Bill S. 219, by providing only $200,000, therefore does not go far enough.

In our examination of the seven-year history of this OWRR-University water research program, we have noted that, although it has focused mainly on regional or local problems, many of them have national application as well. Thus the program has provided a mix of different levels of research application, which was heretofore impossible. A few significant examples of this regional, or national, application are cited below.

B–019–New Mexico.—is a multi-university project of several disciplines, is testing the effects of transfers of water, land, and recreation on the economy of the several segments of the Rio Grande Valley region (400 miles long by 100 miles wide), from Colorado through New Mexico to Texas. It is studying the effect of irrigated land, hydrology, sediment control, desalting, and population changes on the social, legal, political, and economic conditions of the area and its people.

A–001–Wyoming.—also multi-discipline, studied criteria dealing with the desirability, practicality, and utility of water transfers between river basins within the State.

A–044–Washington.—devised a program to predict the economic losses to the State of Washington of diversion at various points in the Snake-Columbia River system. The study predicted an economic loss of $2.9 million for a diversion of 100,000 acre-feet monthly at Brownlee Dam because of reduced flow for power generation and pollution abatement. Further, the investigator believes that far more substantial losses would probably accrue because of destroyed fishing and recreational opportunities.

A–038–Washington.—studied the interstate ground-water aquifers of Washington, their physical as well as legal problems. It recommended that the common-law doctrine be eliminated from Washington's ground-water law, so that the State should follow prior appropriation only. Furthermore, it identified eleven areas of shared ground-water resources with Washington's neighbors, and noted that five of these areas merit special attention.

One of the major benefits of the water resources research program is the fact that the establishment of the Center or Institute has provided a focus on the State, and has permitted substantial and coordinated State-funded programs to be developed in many States. Section 2,B of S.2428 would require that annual programs submitted by State institutes be developed in close collaboration with water-program officials of the States and local communities, to assure responsiveness to local programs. Although we are in agreements with the general thrust of this section—that the program of the Center or Institute be developed in such a way as to reflect awareness of and interest in state and local needs, and thus that close *communication* with state and local officials is highly desirable—, we are concerned that the freedom of the program of the Center or

Institute to include elements that go beyond the state's borders not be hampered. Thus we recommend that the language be clarified along the lines suggested in the preceding sentence between the dashes.

We recognize that, although the Centers or Institutes have produced a wealth of professional reports dealing with the large number of research projects funded under the Act, we are reaching only one public in this manner. We need to communicate with many other publics—the State agency administrator or local government official who is not a water professional, and the local citizen groups and individuals who need to understand the problem and its alternative solutions. Section 2,A of S.2428 and Section 2 of S.219 would provide this authorization, so that a substantial part of the program of the Center could be devoted to such information-transfer activities.

To examples of the need for this enhanced communiction effort can be cited from the operations of my own Center in the State of Washington. (1) A massive inventory of water resources and projection of water needs for the State of Washington was produced in 1967 by a team of nearly 20 professionals from the two universities making up the State of Washington Water Research Center. Totaling approximately 1,025 pages, 135 tables, 96 figures, and 51 large maps and charts, this monumental study remains relatively unused on the shelves of most of the State-agency people, despite its 30-page summary. The problem is two-fold—it was written for the water professional, and it was not indexed.

Thus the administrator who is not a water professional cannot use it, and his professionals are often so swamped with their daily overload of brush fires to put out, that they simply cannot take the time to search out what they need. (2) The other illustration concerns the annual report of the State of Washington Water Research Center. Until Fiscal Year 1970, we had produced a series of factual, but drab, accounts of our operations during the preceeding fiscal year. In 1970, we commissioned an engineer with a journalistic flair to produce a more readable report. The result was overwhelming—we know that that annual report has been read and its contents absorbed, whereas we are equally sure that the preceding ones were opened only as a duty, if at all.

Thus at least two kinds of reports are needed to serve two kinds of users—one for the water professional and one for the nonprofessional. In addition, an expanded effort at continuing education is needed—numerous workshops, conferences, and other kinds of learning experiences whereby the potential user can become familiar with the new knowledge.

Despite the need to reach a wider set of publics, the university water research center has come to wield an influence on campus and in the State that is larger than just the projects which the Federal agency helps fund. The Center serves as a focal point for water-research activity in the many subdivisions of the university, and thus provides a communication mechanism that previously did not exist on the campus. This enables the researcher to undertake and pursue his study with an awareness of related ongoing research in governmental agencies, in universities, and in private organizations.

With regard to the Matching Grant program, the OWRR has been able to provide funds for only a small portion of the meritorious proposals submitted. It is unfortunate when State agencies identify problems that need to be solved and offer the matching funds and the university researchers are able to devise research proposals that will lead to their solution, that these problems cannot be undertaken because of the inadequacy of the moneys appropriated under Section 101. Thus the Association urges the full funding of the Title I Matching-Grant and Title II provisions of the Water Resources Research Act up to the autorized sums.

The allotment funds of the Center or Institute have been used largely as seed grants that enable experts in many disciplines to put together large and comprehensive research projects, many of which affect other natural resources such as land. Such seed grants have a substantial multiplier effect, so that the program of the Center or Institute is widespread, indeed.

In summary, then, we see in the seven-year history of the Water Resources Research Act, a program that has been surprisingly successful and is accomplishing much of what was expected of it by the framers of the legislation nearly a decade ago. We also see areas, such as information transfers, wherein the program could be improved so that it can be of even greater service to our Nation and its citizens. And we see the many unanswered water problems that require research but for which the present funding is inadequate. Because S. 2428 and S. 219 would enable this partnership of the federal government and the university community to do a better job of solving Society's water problems, the National Association of

State Universities and Land-Grant Colleges is pleased to register its support of their provisions as discussed above, and urge favorable action.

Thank you.

MEMBERS OF THE NASULGC WATER RESOURCES COMMITTEE—1971

1971: Dr. Allen F. Agnew, Director, State of Wahington Water Research Center, Washington State University, Pullman, Washington, 99163; 509/335–5531. *Chairman.*

Dr. George P. Hanna, Jr., Chairman, Department of Civil Engineering, University of Nebraska, Lincoln, Nebraska, 68508; 402 472–2371.

Dr. Alfred B. Garrett, Professor of Chemistry, The Ohio State University, Columbus, Ohio, 43210.

Dr. Charles A. Palm, Dean, College of Agriculture, Cornell University, Ithaca, New York, 14850; 607/256–2241.

Dr. E. T. York, Jr., Provost, University of Florida, Gainesville, Florida, 32601; 904/392–1971.

1972: Dr. Daniel G. Aldrich, Chancellor, University of California, Irvine, California, 92664; 714/833–5111.

Dr. A. Ray Chamberlain, President, Colorado State University, Fort Collins, Colorado, 80521; 303/491–6211.

Dr. Ferrel Heady, President, University of New Mexico, Albuquerque, New Mexico, 87106; 505/277–2626.

Dr. Richard Kassander, Director, Water Resources Research Center, University of Arizona, Tucson, Arizona, 85721; 602/884–2447.

Dr. John F. Kennedy, Director, Institute of Hydraulic Research, The University of Iowa, Iowa City, Iowa, 52240; 319/353–4679.

1973: Dr. John C. Calhoun, Vice President for Programs, Texas A & M University, College Station, Texas, 77843; 713/845–1811.

Dr. Ernest W. Hartung, President, University of Idaho, Moscow, Idaho, 83843; 208/882–3511.

Dr. Roy E. Huffman, Vice President for Research, Montana State University, Bozeman, Montana, 59715; 406/587–3121.

Prof. Robert L. Smith, Chairman, Department of Civil Engineering, The University of Kansas, Lawrence, Kansas, 66044; 913/864–3766.

Dr. George Worrilaw, Vice President for University Relations, University of Delaware, Newark, Delware, 19711; 302/738–2104.

SUPPLEMENTARY STATEMENT OF DR. ALLEN F. AGNEW, STATE OF WASHINGTON WATER RESEARCH CENTER, WASHINGTON STATE UNIVERSITY

Mr. Chairman and Members of the Subcommittee: My name is Allen F. Agnew. I am Director of the State of Washington Water Research Center and Professor of Geology at Washington State University. My appearance today is in this capacity and also as Chairman of the Committee on Water Resources of the National Association of State Universities and Land-Grant Colleges; I am presenting separately the written statement of the latter organization. The statement that follows presents the thinking and position of he State of Washington Water Research Center, which represents both Washington State University and the University of Washington.

I wish to thank the Subcommittee for the opportunity to present our views on S. 121, S. 219, and S. 2428, which would amend P.L. 88–379, the Water Resources Research Act of 1964.

THE CENTER

The State of Washington Water Research Center was formed on November 17, 1964, in response to the enactment of P.L. 88–379, through a Memorandum of Agreement signed by the Presidents of Washington State University and the University of Washington. The Director and his Assistant are members of the faculty at Washington State University.

A Joint Scientific Committee of six members, three selected by the President of each university because of their breadth of knowledge and interest in water matters as well as their competence in water research in their academic disciplines, provides guidance and advice to the Director of the Center. Appointed by their respective Presidents for overlapping three-year terms, the Joint Scientific Committee currently includes: Professor Milo C. Bell (UW—Fisheries), Dr. Walter R. Butcher (WSU—Agricultural Economics), Dr. James A. Crutchfield (UW—Economics/Public Affairs), Dr. Stanley P. Gessel (UW—Forest Resources), Dr. John F. Osborn (WSU—Civil Engineering/Hydraulics), and Professor Warren A. Starr (WSU—Agronomy/Soils). The chairmanship rotates annually between the two universities.

The Center's research projects support the graduate studies of numerous students through their specific Departments, thus contributing to their education and training—238 students have been so supported during the seven years of the Center's existence.

This cooperative venture between the two universities is unique, and this relationship has proved to be extremely viable, with the capability of drawing upon experts in all fields of water and related resources.

THE CENTER'S PROGRAM AND ACCOMPLISHMENTS

After seven years of a new program such as this, it is appropriate to consider its results and the degree to which it has accomplished what the framers of the Federal legislation intended. This re-examination is appropriate also from the State's viewpoint because a significant investment has been made by the State of Washington in the program. Accordingly, I prepared recently an assessment entitled, "After Six Years—The State of Washington Water Research Center," (Report No. 7 of the State of Washington Water Research Center, March 1, 1971, 21 pages plus 6 appendixes), a copy of which is provided for the Subcommittee file as Attachment A.

The purpose of the Center is to augment and strengthen existing programs of the two universities in all aspects of water resources—political and legal, economic and social, and scientific and engineering, and in the impact of water use on other natural resources such as the land.

The research program of the State of Washington Water Research Center is very broad. The Center has sponsored research and published results in numerous subject-matter areas—the 45 Allotment, 11 Matching-Grant, and 15 State studies through Fiscal Year 1971 are identified by more than 175 key words. It is significant that all of the State studies have been multidisciplinary, and that in several studies the different disciplines have been annealed in a truly interdisciplinary fashion, as is shown by the following example:

A Water Planning Concept for the State of Washington, by a team of 16 professionals from the two universities plus one from Central Washington State College, which was published as Water Research Center Report No. 6 in September, 1970.

Additional examples are listed in Appendix A, which is an updated version of material supplied to the Subcommittee on July 20, 1970, for the hearing on S. 3553. The interdisciplinary approach, which is characteristic of current studies for the State, and of the current Matching Grant projects and several current Allotment projects, is also going to provide the vehicle whereby the Center will engage in research on problems related to land-use planning, wherein the water resource constitutes a significant element.

A few examples of recent projects are listed below, which illustrate the foregoing statements. (See Appendixes A and B for the remainder of the projects.)

A–038–Washington.—*Interstate Ground-Water Aquifers of Washington, Physical and Legal Problems—A Preliminary Assessment*, by Dr. Allen F. Agnew (WSU/Geology) and Russell Busch (UW/Law).

B–037–Washington.—*Establishment of Low-Flow Criteria for Conservation, Recreation, and Aesthetic Purposes*, by Dr. John F. Orsborn (WSU/Hydraulics) and Dr. James A. Crutchfield (UW/Economics).

B–043–Washington.—*Model Development and Systems Analysis of the Yakima River Basin*, by a team of six faculty researchers from the two universities, under the direction of Dr. Walter R. Butcher (WSU/Agricultural Economics); disciplines represented include hydrology, economics, fisheries, forest resources, agricultural engineering, and sanitary engineering.

B–042–Washington.—*Establishing Guides for Coordinating Urban Planning and the Design, Engineering, and Construction of Urban Storm-Runoff Systems,* by Dr. David D. Wooldridge (UW/Forest Resources), Dr. Ernest L. Gayden (UW/Sanitary Engineering), and Dr. Brian W. Mar (UW/Civil Engineering).

B–044–Washington.—*The Biological Impact of Combined Metallic and Organic Pollution in Coeur d'Alene Lake-Spokane River Drainage System,* by Dr. William H. Funk (WSU/Sanitary Engineering), Dr. R. H. Filby (WSU/Nuclear Radiation Center), Dr. Fred W. Rabe (University of Idaho/Zoology).

The Center is supported financially by the Federal Office of Water Resources Research and by the State of Washington through Washington State University; in addition, funds for large multidisciplinary studies and specific projects have been provided in past years by the State Department of Ecology (formerly Water Resources).

The Center has participated in programs of research through the Office of Water Resources Research mainly under two sections of P.L. 88–379—Allotment (Sec. 100) and Matching Grant (Sec. 101); its participation in the regional Title II (Sec. 200) project through Utah State University is shown in Appendix B.

Approximately three-quarters of the Allotment money has been used to fund research projects. These seed grants, though small (averaging $4,750 Federal money per year), are sufficient to permit a problem to be examined and, in many cases, solved in one or two years. Other projects have developed sufficient information and challenges to warrant continued Allotment support for a number of years. Although non-Federal funds are not required, the amount of university and other non-Federal money applied to these Allotment projects is slightly more than the Federal money—averaging $4,800 per year for the 36 projects funded in the first six years. This non-Federal money has come from the State Department of Ecology and from the two universities. A list of Allotment projects thus supported, for Fiscal Years 1971 and 1972, is included as Appendixes A and B.

Before an Allotment project is funded by the State of Washington Water Research Center, it must pass through two thorough reviews. First, it is scrutinized by the six-man Joint Scientific Committee of the Center, by a number of other professional colleagues at the two universities, and by myself and my assistant. Then, those Allotment proposals selected for funding are forwarded to the Office of Water Resources Research where the total program is reviewed. Upon receiving a favorable statement from OWRR, the projects are funded. The reviewers pay particular attention not only to the nature of the proposed research, the plan of attack, and the competence of the investigators, but also to the relevance of the research to State problems.

Although this insistence on relevance does not preclude "far-out" ideas that were recognized as needing attention by the FCST/COWRR report, "A Ten-year Program of Federal Water Resources Research" (Feb. 1966), it does insure that most of the work will be directed toward problem solving. This relevance aspect is significant in another way—communication with State-agency personnel—for many of these project ideas were first identified by State-agency personnel as needing study. In fact, this was the subject of an early project on "Planning and Evaluation," which resulted in the publication of Report No. 1 in 1967, entitled, "Water Research Needs in the State of Washington." A reassessment of those needs is currently getting under way.

Although much of the Center's program is focused on state needs and thus might appear to have a largely parochial focus, many of the projects have regional or even national implications. Two examples are cited below.

EPA/WQO–16130 FLM.—is a multi-disciplinary analysis of engineering alternatives for environmental protection from thermal discharges. The study is developing social, economic, and ecological accounting systems in conjunction with computer-simulation models, to test the effects on the accounts of various alternative thermal power plant designs. The national application of this significant study is obvious.

B–005–Washington.—investigated techniques to provide advance warning of ground-water pollution in a glacial-outwash aquifer. The study showed that drain-field operations are not currently a serious factor contributing to ground-water pollution in the Spokane Valley, and that significant ground-water recharge does not occur from precipitation falling directly on the outwash plain. This monitoring of moisture content at depth is a basic tool to provide an understanding of drain-field operating conditions in the valley. Because glacial outwash aquifers occur throughout many of the northern States, extrapolation of these results is an added value of the study.

The Allotment program of the Center has been concentrated in four of the FCST/COWRR areas—water-resources planning, water cycle, water-quality management and protection, and water-supply augmentation and conservation. It is interesting to note that these constitute four of the five categories which have received the major part of Federal Agency research activity as well—only the category of water quantity management and control has received minimal attention through the Center's Allotment program.

One of the strengths of the Allotment (Sec. 100) program is the fact that in the selection process the high-priority Federal research categories are not applied by the OWRR as rigidly as they are in selecting the Matching Grant (Sec. 101) and Title II (Sec. 200) projects; this provides for the recognized need for breadth and flexibility in the total OWRR program, and enables each Center to be more responsive to needs and priorities in its own State and region, as enunciated by the Congress in the passage of the legislation in 1964.

We have come to realize that funds for the Allotment program are inadequate, because the State of Washington Water Research Center is receiving nearly twice the number and dollar amount of meritorious project proposals that can be funded with the existing $100,000 Allotment from OWRR. Furthermore, we should like to be able to fund some proposals of larger than seed-grant scope. In addition, the three State Colleges have expressed an interest in participating in our Allotment program and we would like to be able to fund their capable researchers. Thus, we support Section 1 of S.2428, which would overcome the inadequacy of the present allotment funding by increasing the amount to $250,000.

Though Federal money is unquestionably the backbone of the Center's operations, such funds are actually considerably less in the State of Washington on a year-to-year basis than the non-Federal funds. During the year just past, the Center was working on several studies supported by the Washington Department of Ecology; one of these, which deals with low-flow criteria, was begun in Fiscal Year 1970 with solely State money, and led into an OWRR Matching-Grant project in the Fiscal Year 1971.

The most recent major study performed for the Washington Department of Ecology (then Water Resources) consists of a set of five reports that answer questions raised by an earlier major study for the Department in 1967 entitled, "An Initial Study of the Water Resources of the State of Washington." These five later reports cover such subjects as future water requirements for agriculture, industry, and fisheries; manipulation of runoff by forest practices; water quality; flood-management criteria; and several aspects of the Columbia River as a resource.

Perhaps the most significant study performed by the Center for the State is "A Water Planning Concept for the State of Washington," referred to earlier, which provides guidance to the Washington Department of Ecology in the preparation of a State water plan. New research projects that were begun during Fiscal Years 1971 and 1972 are presented in Appendixes A and B.

The establishment of the Water Research Center has provided a focal point for water-research activity in the many divisions of the university, and thus provides a needed communication device that previously did not exist on campus. The Center has also been able to focus the multiple talents of a large number of professionals with diverse backgrounds on providing consultation to State agencies in matters such as the review of Federal agency and River Basin reports and programs.

TO ENHANCE THE PROGRAM OF THE CENTER

The need for a more substantial effort to get the research results to the user, whether a State agency, a segment of the industrial community, or a citizen group, is widely recognized and is certainly germane to the State of Washington. A greatly expanded State-wide communication program is one of the ways in which this could be achieved. Specific sections in each of the three bills under consideration would permit the addition of an editorial and journalistic staff person and support facilities, and enable much greater attention to be given to various means of information transfer. Thus, it would enable the Center to disseminate research results more adequately, thereby enhancing the total communication effort in water matters.

The legislation before the Subcommittee, S. 121, S. 219, and S. 2428, would authorize the mechanism and funding for accomplishing those aspects of the Water Resources Research program which we recognize are in need of bolstering

in the State of Washington—(1) an improved communication mechanism for transferring research results to the user, which includes other researchers as well as "practitioners," and (2) an enhanced program of research which will enable additional col eges and universities in the State to participate more fully, and will permit the funding of worthwhile seed-grant research projects and larger projects than can be supported presently.

The State of Washington Water Research Center urges favorable action on this legislation as embodied in the elements discussed above.

Thank you.

Appendix A

List of New Research Studies of the State of Washington Water Research Center, Fiscal Year 1971

OWRR ALLOTMENT

A–038–Washington.—Agnew, Dr. Allen F. (Washington State University, Geology) and Corker, Professor Charles E. (University of Washington, Law). *Interstate Ground-Water Aquifers of Washington, Physical and Legal Problems—A Preliminary Assessment,* July 1, 1970–June 30, 1971.

A–039–Washington.—Bender, Dr. Donald L. (Washington State University, Civil Engineering). *Flood Hydrograph for Ungaged Streams.* July 1, 1970–June 30, 1972.

A–040–Washington.—Carlson, Dr. Dale A. (University of Washington, Civil Engineering). *Nitrogen Removal and Identification for Water Quality Control.* July 1, 1970–June 30, 1972.

A–041–Washington.—Hunt, Dr. Bruce W. (University of Washington, Civil Engineering). *Groundwater Seepage Past Sharp and Rounded Corners.* September 1, 1970–August 31, 1971.

A–042–Washington.—Kittrick, Dr. James A. (Washington State University, Agronomy and Soils). *Water Composition Controls by Clay Minerals.* July 1, 1970–June 30, 1971.

A–043–Washington.—Leney, Dr. Lawrence (University of Washington, Forest Resources). *The Use of Pulp Mill Sludges as Extenders for Corrugating Medium.* September 1, 1970–August 31, 1972.

A–044–Washington.—Millham, Dr. Charles B. (Washington State University, Mathematics). *A Program to Determine the Economic Losses to the State of Washington of Various Diversion Patterns.* July 1, 1970–June 30, 1971.

A–045–Washington.—Welch, Dr. Eugene B. (University of Washington, Civil Engineering). *The Response of Lake Sammamish Limnoplankton to Sewage Waste Diversion.* July 1, 1970–June 30, 1972.

OWRR MATCHING-GRANT

B–036–Washington.—Agnew, Dr. Allen F. (Washington State University, Geology).

B–043–Washington.—Butcher, Dr. Walter R. (Washington State University, Agricultural Economics), Mar, Dr. Brian W. (University of Washington, Civil Engineering), and others. *Model Development and Systems Analysis of the Yakima River Basin.* July 1, 1970–June 30, 1973. Sourse of Matching Funds: Washington State Department of Ecology, WSU, UW.

B–037–Washington.—Orsborn, Dr. John F. (Washington State University, Civil Engineering) and Crutchfield, Dr. James A. (University of Washington Economics). *Establishment of Low-Flow Criteria for Conservation, Recreation and Aesthetic Purposes.* July 1, 1970–June 30, 1972. Source of Matching Funds: Washington Department of Ecology; Washington State University; University of Washington.

B–042–Washington.—Wooldridge, Dr. David D. (University of Washington, Forest Resources), Gayden, Dr. Ernst L. (University of Washington, Urban Planning), and Mar, Dr. Brian W. (University of Washington, Civil Engineering). *Establishing Guides for Coordinating Urban Planning and the Design, Engineering, and Construction of Urban Storm-Runoff Systems.* July 1, 1970–June 30, 1972. Source of Matching Funds: Washington Department of Ecology, UW, Cities of Redmond and Bellevue, and King County.

EPA/WQO

16130 FLM.—Agnew, Dr. Allen F. (Washington State University, Geology), Mar. Dr. Brian W. (University of Washington, Civil Engineering) and others. *Analysis of Engineering Alternatives for Environmental Protection from Thermal Discharges.* July 1, 1970–June 30, 1971 (Extension of project until June 30, 1972, applied for and funding expected).

OWRR TITLE II (REGIONAL, THROUGH UTAH STATE UNIVERSITY)

C–2194.—Regional Project of 11 states, through Utah State University under the direction of Dr. Dean F. Peterson. *Development of Techniques for Estimating the Potential of Water Resources Development in the Achieving of National and Regional Social Goals.* Dr. Marion E. Marts (University of Washington, Geography) a member of the seven-man Technical Committee. July 1, 1970–June 30, 1971 (Extension of project until June 30, 1972, applied for and funding is expected).

LIST OF NEW RESEARCH STUDIES OF THE STATE OF WASHINGTON WATER RESEARCH CENTER, FISCAL YEAR 1972

OWRR ALLOTMENT

A–046–Washington.—Cunnea, Dr. Patricia E. (Washington State University, Political Science). *Preliminary Analysis of the Columbia River Interstate Compact.* July 1, 1971–June 30, 1972.

A–047–Washington.—Field, Dr. Donald R. (University of Washington, Forest Resources). *Sociological Dimensions of Leisure Involvement in Water-Based Recreation.* July 1, 1971–June 30, 1973.

A–048–Washington.—Johnstone, Dr. Donald L. (Washington State University, Civil Engineering). *Survival of Intestinal Bacteria in Pristine Waters.* July 1, 1971–June 30, 1973.

A–049–Washington.—Millham, Dr. Charles B. (Washington State University, Mathematics). *A Dynamic Programming Study of Various Diversion Losses.* July 1, 1971–June 30, 1972.

A–050–Washington.—Shew, Dr. Richard J. (Washington State University, Forestry and Range Management). *Recreation Use Patterns and User Attitudes on the Snake River—Almota Canyon to Clarkston, Washington.* July 1, 1971–June 30, 1972.

A–051–Washington.—Starr, Professor Warren A. (Washington State University, Agronomy and Soils). *Organization of Land Area in Washington for Water and Land Use Planning.* July 1, 1971–June 30, 1972.

A–052–Washington.—Carlile, B. L. (Washington State University, Agronomy and Soils). *Characterization of Suspended Sediments in Water from Selected Watersheds as Related to Control Processes, Nutrient Content, and Lake Entrophication,* July 1, 1971–June 30, 1974.

OWRR MATCHING-GRANT

B–036–Washington.—Agnew, Dr. Allen F. (Washington State University, Geology).

B–043–Washington.—Butcher, Dr. Walter R. (Washington State University, Agricultural Economics), Mar, Dr. Brian W. (University of Washington, Civil Engineering), and others. *Model Development and Systems Analysis of the Yakima River Basin.* July 1, 1970–June 30, 1973. Source of Matching Funds: Washington State Department of Ecology, WSU, UW.

B–044–Washington.—Funk, Dr. William H. (Washington State University, Sanitary Engineering), Filby, Dr. R. H. (Washington State University, Nuclear Radiation Center), and Rabe, Dr. Fred W. (University of Idaho, Zoology). *The Biological Impact of Combined Metallic and Organic Pollution in Coeur d'Alene Lake-Spokane River Drainage System.* July 1, 1971–June 30, 1973. Source of Matching Funds: Washington Department of Ecology, Washington State University, University of Idaho. (Coordinated with a similar study at the University of Idaho Water Resources Research Institute, under the direction of Dr. Rabe).

Senator Moss. Our next witness is Dr. Dale Anderson of North Dakota State University.

I am going to ask my colleague from North Dakota, if he would like, to introduce Dr. Anderson to us.

Senator BURDICK. Mr. Chairman, Public Law 88–379 of 1964 established water resources and research institutes in the 50 States and I am especially proud of the efforts of my home State of North Dakota under this program.

Working under the $100,000 allotment program, both the University of North Dakota and North Dakota State University have made significant additions to the area of water research. Their joint projects over the past years include studies of livestock waste disposal systems; wildlife planning in irrigation projects; and the economic impacts of water resource development.

These, coupled with many other projects over the past years, have provided a real boon to the development of both our industrial and agricultural water resources—and this along lines consistent with sound ecological practices.

Again, North Dakota can be justly proud of the type of work done by its water resources research institute in directing studies which are of use to all segments of the water-using community. A 39-member State and Federal water agency advisory commission to the institute is a significant reason for this direction.

Today, we are faced with both a greater need for the type of information provided by the water resources research institutes and greater costs in providing these services.

This concept which has passed this body in previous Congresses and has just recently been favorably acted upon by the Houe of Representatives, will provide both the increased funds necessary for the further development of the institutes and the authorization necessary for the institutes to carry their valuable information to even a broader sector of each State.

Here with me today is Dr. Dale Anderson, the director of the North Dakota Water Resources Research Institute. Working from the campus of North Dakota State University, Dr. Anderson has coordinated the efforts of our dual program in North Dakota and has carried out the wishes of the advisory council with very beneficial results for the whole of North Dakota. I can think of no one more qualified to testify today on this bill and the related measures to amend the Water Resources Research Act of 1964.

Mr. Chairman, it is a pleasure for me to introduce to this committee Dr. Dale Anderson.

STATEMENT OF DR. DALE O. ANDERSON, DIRECTOR, NORTH DAKOTA WATER RESOURCES RESEARCH INSTITUTE, NORTH DAKOTA STATE UNIVERSITY

Dr. ANDERSON. Thank you, Senator Burdick, for your comments. It is always appreciated.

Mr. Chairman, members of the subcommittee, I am Dale O. Anderson, director of the North Dakota Water Resources Research Institute and professor of agricultural economics. My responsibilities includes (1) administration of the title I programs of Public Law 88–379, the Water Resources Research Act of 1964, in North Dakota; (2) maintaining an active research program in natural resources eco-

nomics in the agricultural experiment station; and (3) conducting on a very limited scale a statewide educational program in water resources development, management, and use.

The latter program is conducted through the university extension division. My duties as director of the water institute include identification of water research problems, coordination of water research programs with both State and Federal agencies involved in water development, management, and use in North Dakota as well as among the research institutions of the State, and to stimulate research participation in water problems by scientists of the university community.

The North Dakota Water Resources Research Institute was authorized by official action of the State board of higher education in 1964. The institute is operated on a partnership basis between North Dakota State University at Fargo and the University of North Dakota at Grand Forks. The headquarters of the institute were established at NDSU.

A six-member executive committee consisting of three staff members each from NDSU and UND provides guidance and advice to the director on research policy and related matters. In addition, this committee receives, reviews, and makes recommendations regarding projects to be supported by the water institute.

An advisory committee of 39 members representing private groups and State and Federal water agencies helps to identify and to establish priority rankings on urgent water research problems. This committee meets at least twice a year to discuss the current and long-range program of the institute and to make recommendations for changes in the priority listing. Each agency representative takes an active role in assisting the institute meet its objectives. In turn, the institute director looks to the advisory committee for guidance of a "grassroots" nature.

The primary purpose of the water resources research institute is to provide a catalyst necessary to stimulate development of viable research and educational activities on urgent water problems related to the development and management of water resources in North Dakota, the region, and the Nation.

The program of the water institute encourages competent research of a basic and applied nature as related to water resources development, management, and use. These activities are fostered in an effort to provide the best quality of life for the citizens of North Dakota with maximum benefit to the region and the Nation. The policy of the water institute is to develop an interdisciplinary program of research and education.

The passage of Public Law 88–379 made possible rapid expansion in volume and scope of water research in North Dakota. When the water institute was organized, there was a relatively small number of professional man-years involved in research directed at water problems. During the period of 1965–1971, 46 different scientists at NDSU and UND served as principal investigators of projects funded through the water resources research institute. During this period, the water institute funded 31 projects through the annual allotment program, and eight projects through the matching grant program.

A point of special significance has been the stimulation this pro-

gram has generated to new disciplines becoming interested in the critical problems in the water research field. For example, law, home economics, sociology, psychology, and political science have only recently become actively involved in research on water problems. Although progress is being made, more involvement is necessary from the social and behavioral sciences. Such increased involvement is possible only with increased availability of funds.

Another important aspect of the program developed through Public Law 88–379 funding relates to water as an organizing commodity. As such, water provides a natural environment to stimulate interdisciplinary research on increasingly complex problems. Interdisciplinary teams are becoming more and more common to the solution of water problems in North Dakota. This is happening also throughout the country.

The institute cooperates and works closely with local, State, and Federal agencies involved in developing and managing the State's water resources. The institute director is a member of advisory committees to several State and Federal water-related agencies. In addition, the institute director served during the past year as chairman of the Citizen's Educational Affairs Committee of the Souris-Red-Rainy River Basin Commission.

Involvement in these committee activities provides opportunities to explain the importance of an imaginative forward-looking research program which provides vital development and planning information for the formulation of sound decisions for developing and implementing effective water use programs.

The general public is becoming increasingly concerned about problems relating to the development, management, and use of our natural resources in general, and in water resources in particular. This concern is evidenced by increasing demands placed upon the director's office for published and unpublished information, speaking engagements, and miscellaneous requests.

The director presented about six talks per month last year to State groups, civic organizations, sport clubs, and other interested groups. Three years ago there were probably two requests a year directed to the director's office for this type of activity. This type of activity is increasing very rapidly. However, we were unable to fulfill all our requests during the past year due to a shortage of funds. Passage of S. 2428 will permit us to further extend our educational commitment throughout the State.

The institute was called upon by the North Dakota Irrigation Districts Association to study the North Dakota laws relating to irrigation districts. The institute provided assistance in conducting the research and drafting a bill which was introduced and passed in the 1971 session of the State legislature. The director was called upon to present both oral and written testimony before House and Senate committees during 1971 sessions of the North Dakota State Legislature.

In addition, the director served on other special committees preparing information for use by the State legislature. The institute was involved in planning and preparing portions of a video tape series dealing with environmental quality of the Lake Agassiz region.

The training of graduate students is vitally important in providing highly trained and interested graduates for important water-related

jobs in the future. The program of the water resources research institute has supported either partially or totally 104 students working toward advanced degrees. However, we see this activity leveling off. By June 30, 1971, these students had produced more than 20 M.S. and Ph. D. theses. Most of these graduates have taken jobs with State and Federal agencies or private firms involved in water development, management, and use.

In addition, projects funded by the water institute have provided financial support to employ approximately 75 undergraduate students. The annual reports of the Office of Water Resources Research show a substantial increase in graduate students supported by the title I program between fiscal year 1966 and fiscal year 1968. However, since fiscal year 1968, the number of students has remained nearly constant.

The number of graduate students supported by the program reached a maximum of 35 students in fiscal year 1969. This number dropped to 27 in fiscal year 1970, and 21 in fiscal year 1971. This reduction has not resulted from a lack of qualified candidates, but rather the result of continued inflation. This reduction in students occurs at a time when it appears that immediate action should be taken to increase the supply of manpower with water resources training if national goals are going to be achieved. For example, a study conducted by Dr. James E. Lewis, Louisiana Water Resources Research Institute, concludes that by 1975 there will be a deficit in water resources manpower of over 50,000, and by 1980 this deficit will increase to well over 100,000. This conclusion points out the urgency of passing S. 2428 at the earliest moment to alleviate this projected manpower shortage.

The additional funds which would be authorized by S. 2428 would compensate for losses due to inflation over the last seven years, accelerate work now underway, support needed new research, and provide the means for initiating a much needed program for the interpretation and dissemination of research results.

Inflation has greatly reduced the purchasing power of a dollar during the past 7 years. In 1964, the purchasing power of a dollar, based on the 1957–59 price index, was 92 cents. By 1971, the purchasing power of this same dollar has decreased to 70 cents. These figures represent an overall index of purchasing power. The purchasing power has decreased much more on some items. For example, salaries and equipment prices have increased much more rapidly. The average salary of the professional staff at North Dakota State University has increased more than 50 percent since 1964. The cost of many items of equipment necessary for the conduct of research has increased as much as 60 to 75 percent.

Therefore, the current purchasing power of the $100,000 allotment approved in 1964 is in the neighborhood of $50,000. Therefore, the proposed increase in the allotment program to $250,000 per year is not a 150-percent increase from the original allotment, but closer to a 50-percent increase. That is, the $250,000 annual allotment proposed in S. 2428 represents only a 50-percent increase in the research capacity of the program as intended in 1964.

The North Dakota Water Resources Research Institute has provided a catalyst to initiate and carry out a considerable amount of much needed research on problems relative to water development, conservation, and management in North Dakota. Interest has grown to the point

that this institute received proposals totaling $379,000 for funding through the annual allotment program in fiscal year 1972. Since there were only $100,000 to allocate for research, it was necessary to fund some projects at less than optimum levels in order to provide some input to problems requiring research attention. This obviously prolongs the duration of obtaining answers to urgent problems. At the same time, many excellent projects had to be rejected because of a severe shortage of funds.

Continued rejection of projects suggests to the researcher that other problem areas are more urgent and, consequently, many confident researchers shift their efforts to other areas. As a result, we lose the research capability of the scientist involved as well as the training of much needed manpower for future water-related jobs.

Another important element in the difficulty of accomplishing research is that nearly all the easy solutions have been obtained, and the problems that remain to be solved are much more difficult and complex. This means that a larger input of financial support and scientific man years will be necessary to make the progress toward the solution of problems in the future consistent with that which has been obtained in the past.

As we look to the future, some of the things that are going to be particularly important are what I call effective communications. I believe this will be one of the most essential characteristics of a viable water resources program for the 1970's.

One major area of concern is the communication of ideas relating to the existence of water-related problems and the presentation of possible alternate solutions to these problems to the general public. I found in my various speaking engagements that people are not aware of the problems that exist even in their local areas with regard to water development and use and even more astonishing is their lack of understanding that there are solutions to this problem, that we do not have to live with the continuing degredation of our water quality in our environment. I think we have not fulfilled our obligation in carrying this message to them.

Continuing education programs are extremely important as a vehicle to expedite the acceptance of proposed programs to solve water problems. The acceptance of action programs by the public is largely determined by the extent to which the public (1) is aware that a problem exists, (2) believes that the problems present a threat to the community or the well-being of the community, and (3) believes that corrective action is possible and practical.

One major purpose of research is to develop a body of knowledge adequate to answer the above questions. Only when the research results are communicated in a manner to satisfactorily answer the above questions will the final payoff of the research expenditure be realized.

Emphasis, therefore, must be placed on the development of continuing education programs with the general public and to provide effective use of the research results for which the public has been willing to spend money for their solutions. Current continuing education programs are being conducted in areas where funds are available to carry out work. A catalyst is necessary to place increased emphasis or higher priority on continuing education programs designed to disseminate results of the water resources research program.

The research programs of the agricultural experiment stations were not fully effective until the Cooperative Extension Service was created to serve the dissemination function to that program. We have the organization structure through various extension divisions within our university systems.

Additional financial support to influence a redirection of priorities in present programs or provide additional manpower will make possible a rounding out of the research programs initiated through Public Law 88–379.

The North Dakota Water Resources Research Institute is in the process of completing a new long-range research program. Preliminary results of this study show that (1) the university's water resources research program should be reoriented to focus more effectively upon the critical problems of the State and the Nation, (2) that a broader range of scientific disciplines should be involved in research, particularly from the behavioral sciences, and (3) research findings and results should be more effectively disseminated for the purpose of fostering better private and public decisionmaking.

The program of the North Dakota Water Resources Research Institute, with the aid of additional money, will expand as follows:

First, in terms of research, we would broaden and intensify our efforts to (1) more attention will be directed to North Dakota's ecological and environmental complex with particular emphasis on the impact of man and his facilities upon the State's natural amenities—I think this is one area we have neglected in the past, the idea of directing our attention toward man and his use of the environment, the conservation and development of it for generations in the future—(2) continued research effort will be given to the efficiency and productivity of agriculture, but with new emphasis upon its interrelationships to North Dakota's total environment and economy, (3) more of the research focus will be oriented to municipal and industrial water problems—we have probably neglected that more than any other aspect of water development in North Dakota—(4) studies with respect to economic and financial considerations of water use and management will be intensified, and (5) more research will be directed toward the human, behavioral, and institutional aspects of water development, management, and use.

It has been pointed out this morning, and North Dakota is no different, we have a mass of institutional organizations which are involved in the management and use of the water resources in the State. In some cases, four or five jurisdictions will have overlapping jurisdiction.

In addition to the increased emphasis upon research, funds provided in the proposed legislation would enable the North Dakota Water Resources Research Institute to systematically develop a program designed to inform and educate the citizens of North Dakota concerning water resources needs and problems. An expanded program is sorely needed to fill communication gaps in this area.

If the money authorized in this proposed legislation were forthcoming, the water institute would propose to undertake the following:

One, initiate a publication program designed to interpret research findings and to relevant and comprehensive form for the citizens-laymen.

Two, cooperate with major associations and groups representing various segments of North Dakota's population in producing informational conferences courses, and educational materials appropriate for the respective audiences.

Three, work through the university's informational media and with nonuniversity media to develop information programs on significant public issues.

Four, adapt some of the educational techniques of the Cooperative Extension Service for rural populations for the transmission of water resources knowledge to urban populations.

I think it is fair to point out at this point that North Dakota, like many States in the Great Plains, has experienced a rapid decline in population as well as employment opportunities in the last 10 years. As we think of development opportunities in the future, water is the key to economic growth.

Water is the key to resource development and economic growth in North Dakota. The economy of the State depends mainly on income generated by the agricultural sector. Whatever is done to develop the resources of North Dakota in an effort to expand employment opportunities and general economic activity, whether through industry, recreation, agriculture, or other, it will be built on land and depend on water.

In order to make certain that an adequate supply of high-quality water is available for future use, a long-range program of research and continuing education in the use, development, and management of water are necessary. An increase in the authorization of funds to the annual allotment program as proposed in S. 2428 would greatly facilitate the accomplishment of this goal in North Dakota.

The North Dakota Water Resources Research Institute urges favorable action on this legislation.

Mr. Chairman and members of the committee, I thank you for your attention and your interest in this program and the opportunity to appear before you today, and present this testimony on behalf of North Dakota and the water institute.

Senator Moss. Thank you, Dr. Anderson, that was a fine statement, and you gave us a good review and analysis of what you have been doing in North Dakota, and what you would hope to do with additional funding.

I was interested in your discussion of the interdisciplinary teams that have been put together in some of this research. We were having a little colloquy about that with the last witnesses that were on, and it seems we all were thinking along the same line. Of course, there are many disciplines that would apply in this field of water utilization and research about its preservation and use, and how it shall be distributed and so on. So, I am glad of that.

I think you pointed up very clearly for us the real need there is for additional funding. If you will just look at inflation alone, or increasing costs, personnel costs as well as material costs, it certainly would require more funding.

Is it your opinion that the amount of $250,000 for each State is superior to the $200,000? The bills we have before us have two figures, you know.

Dr. ANDERSON. Certainly the $250,000, I believe, is the minimum to develop the programs we are talking about, both in terms of even catching up with what we lost in terms of inflation on our research program. There are many areas in which we have to become more actively involved, and then the dissemination function, which really—in terms of our involvement in North Dakota, I received a little funding from the universities extension division which allowed me to carry on some of the educational programs and conferences in our State. There haven't been any funds utilized to this end.

Dr. Allee and others mentioned this morning, I think through my experience in the cooperative extension program in North Dakota, certainly to get a program going that is going to be useful and effective, $50,000 is a minimum in terms of the technology transfer aspect of our program, not only in terms of the generating of the educational material to get the job done, but then the taking of the educational materials out and holding meetings and conferences and so forth to make the people aware of what is happening and what they can do to make this environment in which they live more acceptable.

Senator Moss. So, you strongly recommend the $250,000 figure?

Dr. ANDERSON. Yes; that is a minimum amount that I think we can look for as really being the level of funding where we can get the greatest payoff for the dollars invested.

Senator Moss. Thank you very much, Dr. Anderson. We appreciate it.

Dr. John Clark, from New Mexico State University.

Dr. Clark, we are glad to have you before the committee, and we look forward to hearing your testimony.

STATEMENT OF DR. JOHN W. CLARK, DIRECTOR, NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE

Dr. CLARK. Thank you, Mr. Chairman, Senator Jordan.

I am John W. Clark, director of the New Mexico Water Resources Research Institute, and also representing Dr. Gerald W. Thomas, president of New Mexico State University.

I would like to point out here that the New Mexico Water Resources Research Institute operated under a written cooperative agreement with the three major universities in our State, and that we are funding a research grant at a fourth university, and we are opening negotiations for cooperation with a fifth university. So, we truly represent major universities in the State of New Mexico through our institute.

I have a prepared statement I wish to have included in the record, and I would read it at this point.

Senator Moss. Yes, that will be included in the record in full as is the order on all of these prepared statements, and you may emphasize whatever part you wish.

Dr. CLARK. My two main points are these:

One, the Water Resources Research Act of 1964 has made and is making valuable contributions to the quality of life in New Mexico.

Two, funding at the $250,000 level is necessary to meet the reasonable needs of our program.

As a direct result of the 1964 Water Resources Research Act, the State of New Mexico has significantly increased its funding and activity in water resources research.

The 1970 legislature appropriated $104,000 for research in our State. The 1971 appropriation is $108,000. We are asking at this point in time for next year, $150,000 from our State for research.

In addition to that, the State has constructed with State funds a substantial building to house our institute and is operating and maintaining that building.

So, these are the substantial contributions from our State, and we expect these contributions to increase in the future.

Now, the increase in annual allotments from the present $100,000 is needed for several reasons.

One that has been stressed here, but I would like to stress it again, we need more adequate information dissemination program at the State level. I think it is absolutely necessary that we bring together the principal investors on a research project and the water users. The research professor will benefit from his close association with the application of this work and the water user will get a clearer picture of what the researcher had in mind and will be able to gain from the close association. I think this needs to be formally incorporated within our State program so we actually go out and disseminate our information among the potential users, and not just publish them in the scientific journals, and we develop a sort of mandarin-type language in society where we talk to ourselves, but are not talking to the people that need our work.

Also, I am particularly interested in the comments made by Senator Allott on the need to go into the study of the institutional mechanisms by which we administer our water resources. This is particularly important in the West. Many of these old institutional mechanisms are quite old, they do not recognize the multiuse of water.

We are not being as efficient in our administration as we should be, and I think research toward these institutional mechanisms, both better understanding the present mechanisms and possibly designing or changing these mechanisms could lend much to water management.

We need increased funding to keep up, or keep abreast of the current problems, because planning requires information at the present point in time in order to take care of future problems, and while science and technology are enlarging the range of possible alternatives in water management, the changes in our society are creating new demands and I think we have only scratched the surface with regard to water research needs.

It is going to be a continuing and enlarging need, just because of our complexities of life in order to satisfy those needs.

Thank you, gentlemen.

Senator Moss. Thank you very much, Dr. Clark, and we are pleased to have your testimony and to know the use that you have made of the funding in your State and the need for additional Federal contributions.

I suspect New Mexico's water problems are a lot like Utah's. We don't have enough water and at the same time we are being pressed constantly on the water quality problems, and therefore we have to consider reuse and all of these various things on which we need research.

As you point out, what we need to do is to be in communication with the water user so he understands the real problems that have to be

settled by research, and scientific consideration of all these factors that impinge upon supply and quality and distribution of water.

I appreciate this paper, and I am glad to know you are doing as much as you are in New Mexico, and can do more if you can get adequate funding.

Senator Jordan?

Senator JORDAN. No questions.

Senator Moss. Thank you, sir.

(The statement referred to follows:)

STATEMENT OF DR. GERALD W. THOMAS, PRESIDENT, NEW MEXICO STATE UNIVERSITY

Prepared statement of Dr. Gerald W. Thomas, President of New Mexico State University and Professor John W. Clark, Director of the New Mexico Water Resources Research Institute. (Hearing on S. 2428 to Amend the Water Resources Research Act of 1964 before the Committee on Interior and Insular Affairs, Senate, Washington, D.C., October 13, 1971).

I am John W. Clark, Director of the New Mexico Water Resources Research Institute, and also representing Dr. Gerald W. Thomas, President of New Mexico State University.

In rather brief testimony, we would like to develop and support two basic points. They are these:

1. The Water Resources Research Act of 1964 has made and is making valuable contributions to the quality of life in New Mexico.

2. Funding at the $250,000 level is necessary to meet the reasonable needs of our program.

Perhaps the greatest challenge facing New Mexico in the next decade is to provide an acceptable balance of economic and social well-being within a quality environment. We can achieve this through adequate comprehensive planning Such planning assumes a fundamental knowledge of biological, physical, and social knowhow necessary to a political solution.

While science and technology are enlarging the range of possible alternatives in water management, momentous changes in society are creating new demands. The seriousness of this problem is noted by a recent study of the general Accounting Office[1] which found that in every river basin studied the quality of water has deteriorated in recent years. This situation is symptomatic of the fact that we have not achieved a sufficient understanding of the basic causes and dimensions of the problem. Much has been accomplished, much more remains to be accomplished.

Water is the most limiting resource in New Mexico and the water that we have is the State's greatest asset. Surface and subsurface water is used to supply growing municipal and industrial demands and to irrigate the land. According to the Senate Select Committee Report of 1961 and the Water Resources Council Report of 1968, a major part of the State is facing the most critical shortage of water in relation to projected demands of any other area of the Nation.

As a direct result of the 1964 Water Resources Research Act, the State of New Mexico has increased its contributions for water research. These are:

1. The 1970 New Mexico State Legislature appropriated $104,000 as a line item to the Water Resources Research Institute for research and $108,000 in 1971, $150,000 is being requested for 1972.

2. A substantial building, built with State funds, was completed in March 1970 to house the Water Resources Research Institute and this facility is operated and maintained by the State.

3. During the period, 1965 to 1971, 71 research projects have been administered through the Institute. These projects are conducted by investigators at the University of New Mexico, New Mexico Institute of Mining and Technology, Eastern New Mexico University, and New Mexico State University.

The increase in the Annual Allotments authorization from the present $100,000 per state under P.L. 88-379 to $250,000 per state as provided in S. 2428, is needed for the following reasons.

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[1] "Examination into the Effectiveness of the Construction Grant Program for Abating, Controlling and Preventing Water Pollution," Report of the Comptroller General of the United States (1969).

1. There is an increasing concern with micro-chemical and micro-physical substances entering our raw-water supplies. We are, at present, poorly prepared to evaluate the hazards of many of these substances in the water phase of the environment.

2. Additional funds are needed to implement a more adequate "information dissemination" program at the State level so that research results can be effectively applied and used in decision making.

3. More efforts to be directed towards the social sciences where institutional mechanisms need to be analyzed and possibly changed to allow water to seek its economic level in a period of changing priorities.

4. Increased funding is necessary for research to keep abreast of current problems and to provide for planning and policy for the future.

Raw water sources have generally decreased in quality because of increased water use and this trend is expected to continue into the future. This has placed a difficult burden on the water-supply industry, which is caught between two strong trends in water quality. Water users are demanding improved quality and uniformity in the water product, while, at the same time, raw water sources are deteriorating. An increased research effort is necessary to provide the technology to assist with this difficult task.

Senator Moss. We will now hear from Mr. David Howells, director of the Water Resources Research Institute of the University of North Carolina.

We are glad to have you, Mr. Howells.

STATEMENT OF DAVID H. HOWELLS, DIRECTOR, WATER RESOURCES RESEARCH CENTER, UNIVERSITY OF NORTH CAROLINA

Mr. HOWELLS. Thank you, Senator Moss and Senator Jordan.

I am David H. Howells, director, Water Resources Research Institute of the University of North Carolina, located on the campus of North Carolina State University at Raleigh.

I might mention here that five different institutions of higher education in North Carolina are presently participating in our program. I have only a very brief statement at this time.

In view of my previous testimony before this subcommittee on July 20, 1970, in support of similar legislation, I will restrict my present comments to the principal differences between the bills now under consideration. In doing this, however, I would like to underscore the continued applicability and relevancy of my earlier statements at the 1970 hearing.

I will address my remarks to the differences in appropriation authorizations and language concerning the deevlopment of institute research programs in cooperation with State water agencies.

First, the matter of appropriation authorization. It was my original position that annual allotments of $250,000 are needed to fulfill the expectations of the original act and proposed new programing in the area of dissemination of research findings. The realities of inflation subsequent to the 1964 act and new environmental pressures are well known to the subcommittee.

Despite substantial matching by the participating universities—in North Carolina last year, estimated non-Federal contributions in facilities and indirect program support totaled $13,328—the purchasing power of the $100,000 annual Federal allotment authorized by the act is too small to get a really meaningful program underway. In the past year, for example, we were able to reach only the first 10 of 22

worthwhile projects, and the budgets of these had to be pruned to the bone to include them at all.

The annual allotment program authorized by the Water Resources Research Act provides the only mechanism and funding for associating a State's university research capability with its water resource planning and management efforts. It is here that a State can focus its research on State and regional problems in support of its own programs. Without this kind of support, there is little hope of upgrading State activities to the levels necessary to make them full partners in water resource planning and management.

A vital part of this effort authorized by the proposed legislation will be a new programing to facilitate the flow and utilization of new information from research by State and local water agencies. I think here the added language is essential and we simply need the undergirdance in undertaking this new activity, the reassurance that comes from that language.

This new work will not be a simple task, since it must take into account a variety of user groups with different technical capabilities and the fact that special efforts must be made to break through the barriers arising from agency personnel being too busy to reflect on the need for new understanding, techniques, and methodologies to deal with new and emerging problems.

Additional funds will be needed for this important new activity. An authorization less than $250,000 will not provide for this without further eroding an already inadequate research base. I strongly urge the subcommittee to accept this amount as the authorized annual allotment under new legislation.

The second point I wish to discuss is the language in S. 2428 which requires that annual programs submitted by the State institutes to the Secretary of the Interior for approval shall include assurance satisfactory to the Secretary that such programs were developed in close consultation and collaboration with leading water resource officials within the State. This is a reasonable and logical requirement which I heartily endorse to the extent of developing institute programs in close consultation with State agencies.

If collaboration is interpreted as a high degree of consultation, I would endorse the language in its present form. If, however, collaboration means sharing the final approval function, I would have to oppose the inclusion of this word.

There are a number of areas associated with State water resource planning and management which need thorough investigation and review which might not be encouraged by State agencies. They should have no veto in these cases.

Another important consideration is that authority for the final research programs put together by the State institutes should not be divided if the responsibility is borne entirely by the institutes. The wholly desirable intent of the language is close cooperation and I suggest that the final language stop here, striking the words "and collaboration."

I strongly urge the approval and early enactment of this important legislation. If the subcommittee has any questions, I would be pleased to respond.

Thank you for the opportunity to appear before you today.

Senator Moss. Well, thank you very much, Director Howells. Your suggestion on language is appreciated, and I would think, for myself, of course I cannot speak for the committee, we have not discussed this, but that collaboration ought to be clearly spelled out by legislative history as to what it means. I agree with you that there should not be really a veto power. It is really a consultation process. Everybody has had his chance to talk about it and make his input to be considered, but eventually the authority to go ahead on the project rests with the institute that is responsible.

It certainly would not contribute to good administration if some outside State agency or some other State agency could simply put in a veto, so we will consider that very carefully. The word "collaboration" appears in the House bill, and we will look at it very carefully and see whether we would want to strike it or to refine it by legislative history so it is clear what that word means.

You also strongly urge that we use this $250,000 figure. By way of explanation, that is where it started last year, and by amendment we had to put it back—we thought we did, anyway. But then the House didn't act, so we didn't get a bill last year.

We are starting over anew, and this $250,000 figure does seem to be supported by everyone who has come before us that has had any experience with the program at all and knows what we are trying to accomplish.

So, I think your testimony added to the others gives very strong weight to that. The fact that you were only able to fund 10 of 22 proposed projects is a pretty good indication of the limitation of funds lessening your effectiveness in this field that might be felt otherwise.

I appreciate your testimony.

Senator Jordan, do you have anything?

Senator JORDAN. No.

Senator Moss. Senator Jordan doesn't have any questions, and we are very aware of your testimony before us last year, and that is in the minds of the committee as we consider this bill.

Mr. HOWELLS. Thank you, Mr. Chairman.

Senator Moss. Thank you.

This completes the list of witnesses we had for this morning, unless there is someone that we overlooked in some way? Apparently not.

The hearing will be adjourned, and on the basis of the record we will proceed to mark up the bill at an early date.

(Whereupon, at 12:05, the hearing was concluded.)

APPENDIX

(Under authority previously granted, the following statements and communications were ordered printed:)

STATEMENT OF HON. HOWARD M. ROBISON, A U.S. REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW YORK

Mr. Chairman, I am pleased to return to your Subcommittee, again this year, to speak in support of the "Water Resources Research Act Amendments" bill as recently passed in the House. I do so, fully recognizing that it was this Subcommittee which undertook the important preliminary work on this subject during the last Congress, and that it was largely because of your efforts that we in the House were prompted to act this year.

Because of the presence in my own Congressional District of the Water Resources and Marine Sciences Center at Cornell University, I know full well of the contribution which the land-grant Water Research Institutes have made to the development of clean and adequate water resources. By working to develop environmental planning and management techniques for the water resources of their own areas, they have provided much of the research inventory to fuel present and future water-pollution control programs. It was with considerable confidence in the abilities of the Institutes to further expand the dimensions of their work that I proposed, last year, along with Representative John Saylor of Pennsylvania, that the authorized funding for these Institutes be increased to $250,000 and they be given the further responsibility of disseminating the results of their studies in an organized fashion.

This year's hearings by Representative Harold T. Johnson's House Subcommittee on Irrigation and Reclamation produced a strong set of amendments which increase funding to $250,000 per Institute and add reporting and coordination requirements commensurate with these funding increases. I was privileged to work closely with Representative Johnson's Subcommittee during the drafting of these amendments, and to cosponsor the final Committee bill which, as you know, passed the House on October 4th. During every step of the process, I received the cooperation and endorsement of the Universities' Council on Water Resources. As you have no doubt already noted, there are some small qualifications to that endorsement, which I am sure have been explained in detail by members of the Water Resources Council, but I personally feel that the reporting and coordinating requirements contained within H.R. 10203, the House Bill, should be included with the increase in authorized funding, as a measure of the increased responsibility and growth in stature attributed to the Research Institutes.

I know that S. 219, Senator Moss's bill, which has provided the focal point of your discussion, allows for a funding increase to $200,000 per Water Research Institute, a figure which was strongly considered during hearings in the House. However, I hope I can argue as forcefully in this body, as I attempted to do in my own, for the $250,000 funding level. As I suggested during House hearings on the Water Research Amendments, the authorization figure offers a ceiling under which my colleagues on the House Appropriations Committee will work. Should the Research Institutes continue to be as productive and dynamic as they have already proven, I would expect that the Appropriations Committees of both bodies would be pushing a $200,000 ceiling sooner than they would care to. Certainly, the present funding level has proven singularly inadequate to continue a topflight research effort; and in so many areas—but particularly in research related activities—inflation continues to take a heavy toll.

It is further worth recalling that even the most knowledgeable scientist in 1964 did not fully anticipate the multitude of emerging problems associated with our rapidly changing environment. So, I would urge, strongly, that you consider a

$250,000 ceiling to give the Research Institutes a cushion against the kind of inflation that has made such serious inroads into their past authorization, and thus to allow them to build significantly upon the accomplishments of their last six years.

I realize it is not necessary for me to speak at length about Section 2 of S. 219, since it is identical to Section 2 of H.R. 10203. By providing for the improved communication of research results, Section 2 would considerably improve communication between the research users and the researchers. Closing the information gap is a two way process which involves both the generator of the information and the receiver. Each must be actively engaged, and the Water Research Institutes are particularly suited to cooperate in this process because their work brings them into constant contact with interested parties in local and State government, and with planning agencies, consulting engineers and surrounding public utilities. What the Institutes lack is legislative authorization for the appropriations and related activities necessary to publicly interpret and disseminate water-research findings. An already effective program can best be made more responsive by granting this authority.

The Water Resources Research Act has generated a modest program by the standards of most other environmental control efforts; yet, the seed money which has previously been authorized the Water Research Institutes has often precipitated a considerable multiplier effect, as successful Water Research Act grants attract as many as 100 times their cost in outside public and private supplemental support. Your favorable consideration of the Amendments contained in H.R. 10203 will give the 51 Water Research Institutes—and, hopefully, newly-established Institutes in the District of Columbia, the Virgin Islands and Guam—a deserved vote of confidence, together with a sufficient funding mandate to apply themselves even more vigorously to the huge task of assuring clean and plentiful water resources for the future.

TERRITORY OF GUAM, U.S.A.,
OFFICE OF GUAM'S REPRESENTATIVE IN WASHINGTON,
Washington, D.C., October 12, 1971.

Hon. CLINTON P. ANDERSON,
Chairman, Subcommittee on Water and Power Resources,
New Senate Office Building,
Washington, D.C.

DEAR MR. CHAIRMAN: On behalf of the 100,000 Americans of Guam, I am writing to express my full support of H.R. 10203, one of three bills amending the Water Resources Act that are now before your Senate Subcommitee on Water and Power Resources.

As you know, H.R. 10203, sponsored by Congressman Harold Johnson, Chairman of the House Subcommittee on Irrigation and Reclamation, was passed by the House of Representatives early this month. The bill authorizes an increase in funding for the Water Resources Act from $100,000 to $250,000, and gives Guam a graduated level of funding in the bill, ranging from $125,000 for FY 1973, to $200,000 for FY 1974, and finally the maximum of $250,000 in FY 1975.

The other bills awaiting consideration by your Subcommittee, S. 219, introduced by Senator Moss, and S. 2428, sponsored by Senator Hansen, are both fine measures, and if enacted, will go far to assist the States and Territories in eliminating the problem of fresh water pollution. However, as originally drafted, S. 219 only increases the level of funding for the Water Resources Act from $100,000 to $200,000, an amount that I personally feel is too limited in these days of rampant inflation. S. 2428 would provide a higher authorization level, but authorizes the territories to receive only $50,000 in FY 1973, $100,000 in FY 1974, and $150,000 for FY 1975 and thereafter.

The precedent of graduated levels of funding during the initial years of the program's inception was successfully established in Section 100 of the 1964 Water Resources Research Act. However, the Department of Interior's rationale for requesting Congress to increase the amount allocated in the Act, and at the same time suggesting that the territories be funded at a level considerably below that of the original Act, escapes me.

The inclusion of Guam within the Act at this time would be a farsighted and meaningful action. Most of Guam's water supply comes from the numerous wells dug throughout the Island, and present statistics seem to indicate that sufficient fresh water exists to meet our immediate needs. However, several problems are

beginning to appear on the horizon that call for action now in meeting our future needs.

First is the anticipated rise in the rate of tourism on the Island. Last year 75,000 persons visited Guam. By 1980 that figure is expected to reach 400,000. In addition, the present civilian population of 85,000 is expected to double within the coming decade. In addition, we are establishing light industries and business enterprises. Obviously, additional sources of fresh water will have to be located in order to meet the inevitable demand.

The initiation on Guam of a concentrated program of research will certainly require substantial sums of money. The University of Guam, with 3,000 students currently enrolled, is a full-fledged institution of higher learning. Our school has a fine academic reputation and is fully qualified to handle research of this nature. Accordingly, with all due respect for the excellent bills introduced by Senators Moss and Hansen, I hereby request that your Subcommittee give every consideration to H.R. 10203. Acceptance of this legislation by the Subcommittee and the Senate will eliminate the necessity of a House/Senate conference, and therefore permit the Federal Government and the University of Guam to proceed with plans for a fresh water research center as soon as possible.

Thank you for your attention to this matter. Should you or members of your staff require further assistance or information with respect to the territory of Guam, I shall be pleased to be of service.

With best wishes,

Sincerely yours,

A. B. WON PAT.

MONTANA STATE UNIVERSITY,
Boseman, Mont., September 29, 1971.

Hon. MIKE MANSFIELD,
Office of the Majority Leader, U.S. Senate,
Washington, D.C.

DEAR SENATOR MANSFIELD: It is my understanding that the Senate Subcommittee on Water and Power Resources will be considering S. 121, S. 219, and S. 2428 on October 13, 1971. These bills are concerned with amendments to the Water Resources Research Act. It is my understanding, also, that S. 2428 is the same legislation as that coming to the Senate from the House of Representatives. A major feature of the legislation is the increase of state allotments to water resources research centers and institutes from $100,000 per state to $250,000. This increase in research funds is needed and justified on the basis of inflation in research costs as well as growth in the number and scope of water problems requiring research since the original Water Resources Research Act of 1964 provided $100,000 per state.

I urge your support of S. 2428. I am writing this as a former Director of the Montana University Joint Water Resources Center (1965–1969) and as a member of the Committee on Water Resources of the National Association of State Universities and Land-Grant Colleges. The current Director of the Montana University Joint Water Resources Research Center, Dr. Helmer Holje, is administratively responsible to me here at Montana State University but the water resourecs research program includes projects at the University of Montana and Montana Tech, as well as at Montana State University.

Sincerely yours,

ROY E. HUFFMAN,
Vice President for Research.

THE UNIVERSITY OF WYOMING,
WATER RESOURCES RESEARCH INSTITUTE,
Laramie, Wyo., October 15, 1971.

Senator CLIFFORD P. HANSEN,
Senate Office Building,
Washington, D.C.

DEAR CLIFF: The University of Wyoming would like to go on record as whole heartedly supporting the Bills now being considered by the Senate Interior Committee, S–121, S–219, S–2428, to amend the Water Resources Research Act of 1964.

The Water Resources Research Institute at the University of Wyoming has increased the interest and competency of water resources research on the campus

at Laramie, Wyoming. While the research being funded under the Water Resources Research Act of 1964 is not a major part of the total amount of water resources research being conducted at the University, the OWRR program has had a significant impact on the quality of all water-related research. The emphasis of the WRRI program has been to foster interdisciplinary interest and consideration with the result that more individuals have become interested and competent to accomplish water resources research.

The Water Resources Research Institute needs additional funding for several reasons. The first and most obvious one is the increasing cost of doing business. The $100,000 Annual Allotment is supporting much less research now than it did in 1968, when that level of funding was reached. At today's level, it probably takes $150,000 to accomplish the same amount of work as the $100,000 would have accomplished in the early days of the Act. A second reason is that the competencies of the research workers through our Institutes have increased significantly and there are enough problems requiring new insights, that it would be irresponsible not to take advantage of this new competency and fresh approach.

In addition to the need for more support to accomplish necessary research, there is a growing need to interpret and disseminate the results of the research already accomplished. The rules and regulations of OWRR specify that annual allotment and matching grant funds cannot be applied to "formal instructional activities, adult or public education, extension, or like activities. . . ." We believe it would be advantageous to have the Act amended to permit this type of activity and, of course, to accomplish such work would require additional appropriations.

Therefore, we believe that the Water Resources Research Institutes could make high quality use of the total appropriation of $250,000 per year, and we would encourage favorable consideration of this full amount.

In reviewing the proposed amendments to the basic Act, we note that there is a provision to require ". . . assurance satisfactory to the Secretary that such programs were developed in close consultation and collaboration with leading water resources officials within the State to promote research training and other work meeting the needs of the State." Because of the close cooperation and coordination we have always had with our State water resources officials, this provision is of no major concern to us. However we can envision some problems that could arise should the State water resources officials attempt to dictate or have veto power over the research to be conducted within an Institute. We would encourage that the Committee report make clear that it is not the intent of the legislation to provide the veto power to the State agencies. The necessity for coordination and cooperation, we believe, is valid and, in fact, we are practicing this procedure.

We appreciate this opportunity to comment concerning the proposed Bills and strongly encourage their enactment.

Sincerely yours,

PAUL A. RECHARD, *Director.*

U.S. SENATE,
COMMITTEE ON FINANCE,
Washington, D.C., October 21, 1971.

Hon. CLINTON P. ANDERSON,
Chairman, Subcommittee on Water and Power Resources, Senate Interior Committee, New Senate Office Building, Washington, D.C.

DEAR MR. CHAIRMAN: I would like to express my support for S. 2428, the bill to strengthen the Water Resources Research Act of 1964.

It is especially important that funds be increased for the Water Resources Centers, which are doing such vital work. Your committee's careful and expeditious consideration of this key legislation is most appreciated, and I am taking the liberty of forwarding to you a copy of a letter from Dr. Gerard Rohlich, Director of the Water Resources Center at the University of Wisconsin, which explains the Center's needs and progress, and states Dr. Rohlich's strong support of this legislation.

If possible, I would appreciate this and Dr. Rohlich's letter being printed in the hearing record on S. 2428.

Sincerely,

GAYLORD NELSON, *U.S. Senator.*

THE UNIVERSITY OF WISCONSIN,
WATER RESOURCES CENTER,
Madison, Wis., October 8, 1971.

Hon. GAYLORD M. NELSON,
The U.S. Senate,
Washington, D.C.

DEAR SENATOR NELSON: We were pleased to learn that the Subcommittee on Water and Power of the Senate Committee on Interior and Insular Affairs has scheduled a hearing on Wednesday, October 13, to consider bills S. 121, S. 219, and S. 2428, to amend the Water Resources Research Act of 1964.

The statement presented by our Center for the hearing on S. 3553 (91st Congress, 2nd Session), held on July 20 of last year, and printed on pages 183 and 184 in the published hearing, generally covers the concern we have toward the amendments under consideration. In addition, the Wisconsin Center presented a statement before the hearings of the House Committee on Interior and Insular Affairs this summer on June 29, on amendments to the Act (H.R. 10203).

The changes embodied in S. 2428 will make a significant impact on the water resources research and information program underway at the existing 51 state institutes. The increase in funds to the level of $250,000 per year will permit the Wisconsin program to take advantage of the momentum that has been developed during the past seven years. In addition to the increase in funds, S. 2428 offers a number of amendments to the present law which will strengthen the effective administration of the program.

During the last few years, the allotment program has been weakened because the fixed budget of $100,000 per year has allowed fewer investigators to participate in the program because of the gradual decrease in purchasing power caused by inflation. In recent years, most of the allotment funds have been directed toward the support of faculty and student salaries, and for services. For the continued success of the program, additional funds are needed to purchase research equipment to insure a balanced research program.

In keeping with the objectives of the Water Resources Act, the Center has maintained a viable program which encourages faculty and students throughout Wisconsin to direct their talents and efforts toward solving water resources problems. As a result, the Center has identified several potential investigators interested in water problems, especially as they relate to environmental quality. The activities in this phase of the Center's program has been complemented by the recent public awareness of environmental issues.

Faced with the continuing increased cost of living, an increased pool of expert talent available to study water problems, and the pressing needs for water research aimed at making improvements a practical reality in the decades ahead, an increase in the allotment grant program is necessary, if the program is to meet the challenge of the Act under which these funds are authorized. To maintain the focus and leadership which the water institutes have developed over the last seven years, increased funds are necessary to undertake and strengthen the research activities, and additional funds are required to provide for the effective dissemination of useful scientific and engineering information generated by the activities of this program, and other related activities.

As currently structured in Wisconsin, the allotment grant program provides "seed" money for the development of significant research projects relevant to the needs of the state, region, and nation; and supports research projects to be accomplished by researchers who are not widely known, especially those at the smaller universities in the state.

The allotment funds have permitted Wisconsin, as well as the other state institutes, to participate with federal agencies in developing research activities tailored to the particular needs of a region. In Wisconsin, the principal focus has been given to research that would lead to scientific and applied information and strategies for the enhancement of water quality. Without the increased support for the allotment program, it is likely that the program focus will become less effective than it has proved to be in the past years. Also, the increased support will permit us at Wisconsin, along with the other state institutes, to make positive contributions to the national needs in water resources research.

We have had an opportunity to review the changes recommended in each of the bills under consideration. We wish to stress our recommendation that S. 2428 be given favorable consideration by the Senate, and that our endorsement be included in the record.

Sincerely yours,

GERARD A. ROHLICH, *Director.*

THE SCHOOL OF ENGINEERING,
HOWARD UNIVERSITY,
Washington, D.C., October 12, 1971.

Senator HENRY JACKSON,
Senate Interior Committee,
Senate Office Building,
Washington, D.C.

DEAR SENATOR JACKSON: This letter is in reference to the proposal before your committee to establish a water resources research institute in the District of Columbia.

I strongly endorse proposals to (a) increase the authorization for the water resources research institutes of $250,000.00 per year, (b) establish institutes in the District of Columbia, Guam, and the Virgin Islands, and (c) give full, first year funding to the newly established institutes. Others have made a particularly strong case for the first two proposals. I would like to expand on the third proposal in light of our capabilities here at Howard.

If an institute is authorized for the District, it would be established at a Land Grant institution or some other institution designated by the District Government. Some have argued that the District's Land Grant institutions, Federal City College and the Washington Technical Institute, could not adequately use full initial funding and for this reason initial funding should be limited. This argument does not take into account the fact that there are other institutions in the District which can cooperate with the designated institution to fully utilize the full funding immediately. In particular, our School of Engineering has the following ongoing programs in water resources which are in need of support:

A study of small urban watersheds to better understand the effects of urbanization on surface runoff. This proposal is being considered by the Department of Interior (See Attachment I).

A study of water pollution with emphasis on bio-degradable pollutants. See Attachment II for a description of our Bio-Environmental Engineering Program of which water and waste water engineering is a part.

A study of systems engineering applications to the design of water and waste water facilities. In this study we expect to review the planning and design of various projects around the country in order to discover those benefits resulting from the systems engineering approach.

These are three major research projects which we have initiated, all of which require substantial support. In addition, we plan to start a Ph.D. program in September 1972 in Civil Engineering with a strong emphasis on water and other environmental concerns.

It is clear that the problems of water resources and quality in the District demand immediate attention. It is also clear that the educational institutions in the District are capable of immediately utilizing the $250,000.00 funding and more. Therefore, it would be unfortunate if an institute was established in the District without the full funding necessary to deal with this problem.

Sincerely yours,

PERCY A. PIERRE, *Dean.*

Enclosures.

ATTACHMENT I

SUMMARY

This proposal presents a three-year research program to study the effects of urbanization on surface runoff, with particular emphasis on a few selected small watersheds in Washington, D.C. Metropolitan Area. It has been well recognized that man's activities in urban areas result in changes in watershed and storm parameters which have great bearing on surface runoff processes. These activities differ greatly from one area to another and are continuously changing with time. To take into account the spatial and temporal variations of these parameters, the dispersed system approach is more suitable than the lumped system approach in attacking the problem.

Computation of surface runoff, by numerical solution of equations of continuity and momentum, for the simple case of overland flow has been demonstrated to be feasible and accurate. However, considerable amount of computer time is required for this type of computation because even the simplest type of watershed poses complications. Approximation techniques based upon sound physi-

cal concepts are urgently needed for developing economic and satisfactory methods for prediction of runoff from urban watersheds under varying conditions.

The following three-year research program is, therefore, proposed:

1st year.—The sensitivity of surface runoff to spatial variations of watershed parameters will be studied, and the major factors influencing the surface runoff under various conditions will be identified.

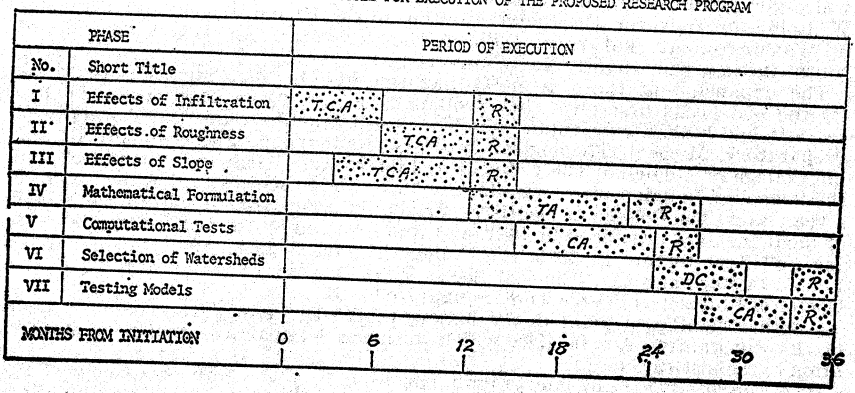
2nd year.—Based on concepts outlined in this proposal and the results of sensitivity studies obtained in the first year's program, approximate method (or methods) for prediction of surface runoff will be developed.

3rd year.—Based on the results of the first and second year's study, a few small watersheds will be selected in the Washington, D.C. Metropolitan Area and data will be collected and analyzed. The collected data will be used to measure the success of the approximation method(s).

A preliminary schedule for execution of the three-year research program is shown on the next page. The estimated budget is $27,000 for the first year, $27,000 for the second year, and $28,000 for the third year.

We believe that this program, if carried out, will provide a physically sound and computationally economic approximation for prediction of surface runoff for small watersheds having various degree of urbanization.

CHART I PRELIMINARY SCHEDULE FOR EXECUTION OF THE PROPOSED RESEARCH PROGRAM



TCA = Theoretical and Computational Analysis

TA = Theoretical Analysis

CA = Computational Analysis

R = Report

DC = Data Collection

Attachment II—Study and Research Program in Bio-Environmental Engineering and Sciences

Department of Civil Engineering, Howard University, Washington, D.C., 1971

History of the University

Howard University was founded by an Act of Congress on March 2, 1867 and approved by President Andrew Johnson on the same day, as a "University for the education of youth in the liberal arts and sciences, under the name, style, and title of 'the Howard University'." The Act, known also as the Charter, provided for normal, collegiate, theological, law, medicine, and agriculture "departments" and such other departments as the board of trustees might establish.

More than 30 members of the First Congregational Society first discussed the idea of an institution for recently emancipated freedmen. They were white men, wanting to provide the most appropriate educational service for former

slaves. A logical choice for this religiously motivated group was a theological seminary for freedmen.

At a meeting a day or two later, November 20, 1866, 10 members of the original group took the first formal action to establish this theological seminary. They selected the first 12 trustees of the institution and discussed the possibility of a site for it. General Otis Howard, one of the original group and head of the Freedmen's Bureau, offered to erect a building if a site could be acquired.

At another meeting, December 4, 1866, United States Senator Samuel C. Pomery of Kansas suggested that a normal school would improve the chance to get Congressional approval. The trustees adopted the new name, the Howard Normal and Theological Institute for the Education of Teachers and Preachers." Their plan also envisioned an institution of learning of "the higher grade" in the National Capital "for the colored man."

Planning continued at meetings in December and January. A committee was appointed to get a charter, the board of trustees was increased to 15, and the name of the institution again changed, this time to Howard University. The possibility of adding a medical department was discussed at a meeting in January 14, 1867.

United States Senator Henry Wilson of Massachusetts introduced a bill on January 23, 1867 to incorporate "the Howard University."

The Normal Department opened in early May 1867. The first students were white girls, children of two of the founders. Danforth B. Nichols and Ebenezer W. Robinson. However, the racial situation in the United States, and especially in Washington at that time, changed the institution for the "education of youth" into a predominantly Negro university.

The expansion of the University has reflected its determination to serve. By the end of its first term the enrollment had grown to 94 students. In five years it had built a curriculum which included nine departments: Normal and Preparatory, Musical, Theological, Military, Industrial, Law, Commercial, and the College of Medicine. The Colleges of Liberal Arts, Medicine, Pharmacy, and the School of Religion were organized in 1868. The School of Law was organized a year later. The College of Dentistry, originally a department within the School of Medicine, was organized in 1881, and was followed by the School of Engineering and Architecture in 1910, the College of Fine Arts in 1914, the Graduate School in 1934, and the School of Social Work in 1945. Programs leading to the Doctor of Philosophy degree were inaugurated in 1955.

Another significant point in the history of the University was the enactment of the Substantive Act in 1928 which authorized an annual federal appropriation to the institution.

The University's academic growth has been paralleled by expansion of its physical facilities. What was originally a "campus" of a single frame building is now a 50-acre campus of buildings and equipment valued at more than $50 million.

Howard University is also people—some 1,200 teachers, twice as many non-teaching employees, and over 12,400 students. Traditionally, Howard has had the largest gathering of Negro scholars in the world, contributing not just to the University community, but to national and international areas as well. Among its notable graduates are such people as Kelly Miller, Ernest Everett Just, Charles Houston, Dr. Charles Drew, Percy Julian, Judge William H. Hastie, Alain Locke, E. Franklin Frazier, John Hope Franklin, and Ralph J. Bunche.

Howard University has produced more than one-half of the nation's Negro physicians, lawyers, dentists, pharmacists, engineers, and architects, and its graduates are in positions of leadership and responsibility throughout the United States and in many foreign countries.

Howard University is dedicated to high standards of professional training, and to the education of scholars and researchers. It has also traditionally been committed to community service. President James Cheek expressed this increasing responsibility in his Formal Opening Address, September 1969:

"Our work in this University this year and in the years to come will be devoted to national problems in an effort to provide national leadership for both our people and our country.

"The total resources of this University will be mobilized to engage the entire spectrum of social problems which have emerged as crises in our national life.

"Here we shall seek and find creative and imaginative ways to bring solutions to the problems of the cities, the problems of human relations, the problems of educational disadvantage, the problems of economic insufficiency, the problems of inadequate health care, and to the problems related to overcoming

the lack of knowledge, understanding and appreciation of black Americans and black people throughout the world."

One way the University tries to solve problems is by creating new programs to deal with them. In recent years the United States has been faced with environmental pollution problems that stagger the imagination. Yet at the same time human and natural resources have never been so available. In this Age of Opportunity, when to hundreds of thousands of Americans education and work are nevertheless *out of reach*, Howard University has launched a major effort to prepare leaders for the crucial War on Ignorance, Ugliness, and Economic Injustice. The new interdisciplinary Graduate Program of Bio-Environmental Engineering and Sciences was established in the same spirit that gave birth to Howard University. In the belief that the problems which so violently face our nation and the world cannot be solved piecemeal, the University has launched a comprehensive educational program encompassing all branches of knowledge in a concerted effort to improve our environment.

BIO-ENVIRONMENTAL ENGINEERING AND SCIENCES GENERAL

Today man lives with one foot on the moon and the other on the earth; however, the planet Earth, inhabited by man, is deeply polluted. Man's earth environment has deteriorated to an alarming degree, in many respects because of man's ever increasing desire for convenient living and an expanding economy. In recent years it has become clear to the public sector that a reversal of the trend toward environmental degradation must be accomplished. This support is welcomed by environmental engineers who have been well aware of this situation for many years. During this time environmental engineers have worked diligently for practical solutions for environmental improvement and many times have been lonely in this struggle. Now, with the public's awareness of the problems, the opportunities for enthusiastic support of engineering solutions to environmental matters are unlimited.

Howard University has recognized this opportunity to train qualified graduate engineers to help fill the great need for specialists in the environmental field. The Bio-Environmental Engineering graduate program at Howard University covers instructions and research in a wide spectrum of areas. Within the framework of this education, students specialize in one of the several areas, including water chemistry, water and waste water treatment, and radiological health.

PROGRAM AT HOWARD UNIVERITY

As part of its many graduate offerings, the School of Engineering offers through the Civil Engineering Department a flexible program in Bio-Environmental Engineering and Sciences, leading to a Master's degree. Based on the varied backgrounds and interests of the students and the faculty members concerned, a desirable balance is maintained between theory and practice, and every effort is made to tailor a program of study to the background, potential and interests of each student. This multifaceted approach provides excellent academic preparation either for (a) a career in consulting or design and development, or (b) pursuit of the Ph.D. degree.

SUPPORTING PROGRAMS

To provide an interdisciplinary and a broad spectrum of education, graduate students can take advance courses in other allied departments at Howard University. Students are encouraged to take courses in chemistry, biology and mathematics.

ADMISSION

Admission to the Graduate School with full status in Bio-Environmental Engineering and Sciences (BEES) is granted to graduates of institutions whose requirements for the Bachelor's degree are approximately equivalent to those of Howard University, provided the applicant's scholastic average is high. The rules of admission and other requirements are described in detail in the Graduate School Catalog.

Students with a Baccalaureate degree in Chemistry, Biological Sciences, and various disciplines in engineering may be admitted to the program without extensive prerequisites.

Application forms and other information may be obtained by writing to the Director of Admissions, Howard University, Washington, D.C. 20001.

LABORATORIES

The BEES laboratories are equipped with modern instrumentation for instruction and research in chemical, physical and biological aspects of various fundamental problems in pollution abatement. Space is also available for large scale pilot plant work. The biological pilot treatment plant of the D.C. Sanitary Engineering Department is also available for applied and basic research.

The Fluid Mechanics laboratory contains basic facilities such as fixed-bed flume, tilting flume, pump and piping system that are suitable for research on water-related problems.

Modern instruments and space are available for special projects. Wind-tunnel facility is also available for simulating water flow.

FACILITIES

The library of the School of Engineering contains thousands of engineering and scientific volumes, and subscribes to periodicals relating to various fields of engineering, mathematics and the sciences.

Besides a IBM 360/50 digital computer which is operated as a separate entity by the University and is available to the whole University community, the Department of Civil Engineering operates an IBM 1130 digital computer, and a TR 48 analog computer. The latter two are available on an "open shop" basis, thus allowing the student direct and instant control over modification and completion of his computer programs.

Other supporting physical facilities include X-ray diffraction equipment in the Physics Department and an electron microscope in the College of Medicine.

UNIVERSITY SEMINARS AND COLLOQUIA

Howard University continually reaps the benefits of its ideal geographical location. In addition to its planned academic year, the BEES lecture series brings outstanding engineers and scientists to the campus. Students and faculty are able to attend lectures given by specialists who are either visiting consultants to or employees of federal government agencies in the Washington metropolitan area.

REQUIREMENTS

Howard University's graduate program in Bio-Environmental Engineering and Sciences leads to the Master's degree. For completion of the degree, 30 semester hours of credit are required; this includes a thesis which must demonstrate the student's ability to conduct individual research. Of the total, 20 hours comprise the major area of study, and 10 hours the minor area. After the completion of the research and/or course work, a final examination, written and/or oral, is given.

FINANCIAL ASSISTANCE

Various types of financial fellowships are available. Details of such financial aid awards may be obtained by writing to the Program Director, Dr. M. M. Varma, Department of Civil Engineering, School of Engineering, Howard University, Washington, D.C. 20001.

MAJOR COURSE DESCRIPTIONS

A wide variety of courses are available in the Civil Engineering Department and other departments of the University. BEES course offerings are:

C.E. 501 *Water treatment and water resources* 2–3–3 [1].—Water resources systems planning is studied in relation to demographics, chemicals, and biological factors. Treatment units are designed. Modern advances in the treatment processes will also be discussed.

C.E. 502 *Waste water treatment* 2–3–3.—Water quality control standards are established, adjustments required for changes in waste water are analyzed, treatment units are designed and the specifications prescribed.

C.E. 511 *Chemistry of water and waste water* 2–3–3.—Physical and chemical properties of water and waste water. Kinetics equilibria in water and sewage, organic and inorganic constituents of water and its effect on man's environment.

C.E. 512 *Sanitary microbiology and biochemistry* 3–0–3.—General properties of bacteria and the growth of bacteria. The mechanism of biochemical reaction. Carbohydrates, proteins, enzymes, energy balance, metabolism, and respiration. Anaerobic and aerobic digestion dynamics. The discussions are directed toward the application in Environmental Engineering.

[1] Lecture, laboratory, total.

C.E. 521 *Communicable diseases in man* 2–0–2.—Respiratory diseases, water and food borne diseases, insect and rodent borne diseases, disease control, control of the mode of transmission, and introduction to Human Physiology. The principle of epidemiological investigations is presented together with mathematical tools.

C.E. 531 *Environmental health engineering* 3–0–3.—A detailed study of the emerging problems surrounding the water and waste water in man's environment. Solid waste refuse collection and disposal, housing problems, laws and rules involved in environmental sanitation, ventilation and air conditioning, occupational health hazards, and environmental planning.

C.E. 541 *Radiological and environmental safety* 2–3–3.—Fundamentals of radiation, monitoring procedures, radiation detection, low level assay of water, waste disposal, and regulation of radiation sources. Concept of maximal permissible concentration dose, radiation biology and effect of other environmental pollutants affecting man. Introduction to theory and techniques of collection and analysis of air pollutants.

C.E. 542 *Radioisotope engineering I* 2–3–3.—Detailed properties of nuclear radiation, production availability and purification of radioisotopes, statistical consideration in radioactivity measurements, tracer selections, and calculation for a tracer in a biochemical process.

C.E. 543 *Radioisotope engineering II* 2–3–3.—Tracer in chemical application. Neutrons, introduction to quantum mechanics. Nuclear force and nuclear technology as related to public health.

C.E. 550 *Water quality management* 2–3–3.—Mechanics and kinetics of stream and estuary pollution. Effects of natural processes and pollution by man. Types of Pollutants: temperature, inorganic salts, oxygen demanding contaminants, sediments, organic compounds, and nuclear wastes. Self-purification.

C.E. 551 *Graduate seminar.*—Required (no credit).

C.E. 552 *Graduate seminar.*

C.E. 561 *Master's thesis.*—Credit varies (4–6).

C.E. 601 *Industrial waste water management* 3–0–3.—Waste disposal problems of various industries, causing pollution of natural bodies of water, method of treatment, and administrative and regulatory aspects are discussed, with emphasis on biochemical treatment processes.

C.E. 602 *Engineering analysis of physiological systems* 3–0–3.—Fundamentals of human physiology in a quantitative manner, including application of mathematical modeling to the study of physiological principles and approach that an engineer shall use in working with living system.

CURRENT RESEARCH INTEREST

The following list of subjects includes topics of current interest to the faculty.

Kinetics of biochemical oxygen demand.
Settling characteristics of biological solids.
Reaction rate coefficients of enzymatic detergents.
Oxygen uptake by dead algae.
Models of dispersions of pollution in turbulent and non-turbulent flows.
Measurement of sediment pollution.
Resistance in channel flows.
Reaction rate coefficient of biological slimes under varying conditions.
Inactivation of polio virus using various oxidents.

UNIVERSITY OF IDAHO,
October 8, 1971.

Hon. SENATOR FRANK CHURCH,
U.S. Senate Office Building,
Washington, D.C.

DEAR FRANK: At this time it has come to our attention that the Senate's Subcommittee on Water and Power Resources of the Senate Interior and Insular Affairs Committee is considering amendments to the Water Resources Research Act in the form of S. 219, S. 2428 and H.R. 10203. Our institute made a presentation at the hearings of the House of Representatives on this same subject.

We understand the Senate passed similar legislation during the past session of Congress and therefore sentiment is in favor of passage of some legislation in this regard.

Our desire now is to join with other state institutes in supporting H.R. 10203 which sets funding level at $250,000. We feel this funding level is necessary to

keep a viable program at our university. The press of many problems, such as the issue of Hells Canyon—Middle Snake River, enhancement and protection of the wildlife and fishery of the state, the economic well-being of rural areas where irrigated agriculture is the sustaining support, and concern for urban water supply in the scattered communities of our state are critical problems.

At the Idaho Water Resource Board meeting of September 24–25, Professor Warnick appeared and discussed with the board eight major research topics that have urgency and need for study now. These are repeated here to indicate the extensive nature of the problems.

1. State Scenic Rivers evaluation.
2. Post audit of major project.
3. Geothermal Power.
4. Upper Snake water use.
5. Economic analysis of Jefferson County to ascertain capability to pay for rehabilitation.
6. Methodology for computing the future depletion at the Brownlee Reservoir by upstream irrigation and multiple use development.
7. Minimum flows for satisfying use downstream of Hells Canyon.
8. Recharge of Snake River Plain.
   (*a*) Effect quantitatively.
   (*b*) Effect qualitatively.
   (*c*) Legal considerations.

Idaho has difficulty supporting all these research areas because of its small population and industrial base. Travel costs are inordinately high because the state is large and travel distances great.

We believe our past performance has demonstrated an efficient and responsive program. With regard to Section 3 subsection 100(b) of the H.R. 10203 we believe collaboration with leading water resource officials is desirable and only last week Dr. Lee of the Idaho Water Resource Board spent an afternoon on the campus discussing ways of cooperating with the institute. This week a representative of the Idaho Fish and Game Department will be on campus to discuss problems.

We solicit support for H.R. 10203 for increased funding of the Water Resources Institution by you and other members of the Senate Interior and Insular Affairs Committee. Professor Warnick is ready to answer any other questions and informs me that you do not feel it necessary for him to appear in person at the hearing on October 13.

Thanks for your continued support of our institute program.

Sincerely yours,

ERNEST W. HARTUNG, *President.*

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