

INFORMATION CIRCULAR NO. 7a



**PROCEEDINGS
OF
CONFERENCE
ON
WATER RESOURCES
RESEARCH NEEDS
IN
IDAHO**

Boise, Idaho
October 16, 1970

**Water Resources Research Institute
University of Idaho
Moscow, Idaho
83843**

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This conference was called by the Water Resources Research Institute of the University of Idaho to discuss research needs in water resources as it particularly applies to the academic community and those working in the field of research.

The objective of the conference was to expose areas of inquiry that appear to offer the greatest potential worth and need for research in water resources related to Idaho. Twenty-one representatives from Universities and Colleges located in the State were assembled to listen to the deliberations.

Representatives from the private sector of Idaho's economy presented ideas for research, along with representatives from both state and federal agencies concerned with water resources within the State. A list of attendees and participants appears at the end of the Proceedings.

Director of the Institute, C. C. Warnick, welcomed the group and appraised those in attendance of the designated role of the Institute as now functioning under the Water Resources Research Act of 1965, P. L. 379-88, as ammended. The function of the allotment program under Title 1 of the act was explained as the basic funding to provide seed money to initiate research within the University system of the State. This is now operating at the statutory limitation of \$100,000 per year. The matching grant program under Title 1 of the Act was explained and it was explained that non-federal funding has been very limited to date for proceeding with specific research.

The Title II program of research grants for specific research was explained and it was pointed out that anyone can apply direct to the Office of Water Resources Research for support. These grants are for rather definitely defined national needs. Professor Warnick expressed hope that those applying for grants in Idaho would advise him of such action so a coordinated effort can be achieved.

The conference was held primarily to provide researchers with information on the needs that are pressing many operating companies and agencies. This is an attempt in the part of the Institute to meet its obligation as presented under the Water Resources Research Act and hopefully serves the people of the State and region as a whole.

Professor Warnick made special mention of the representatives of Universities and Colleges other than the University of Idaho and asked Mrs. Donna Parsons to comment on the Regional Studies Program being undertaken by the College of Idaho on a grant from the Hill Family Foundation of Minnesota.

It is now the aim of the Institute to encourage further dialogue between research investigators and the people practicing in the real world. Hopefully earlier response will be made to the suggestions in the form of formal research proposals. It is hoped that a real cooperative program will develop that uses the ideas proposed and the combined knowledge of the practioners and the professors.

The listing of ideas follows.

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WATER AND WATERSHED RESEARCH NEEDS - Bureau of Land Management,
Idaho State Office, 334 Federal Building, Boise, Idaho 83702 -
By William L. Mathews, State Director.

Following is a summary of our understanding of the Bureau's water and watershed research needs in Idaho:

Watershed Conservation and Development

1. A better understanding of the erosion processes on the arid and semi-arid lands.
2. The effects of the erosion processes on water quality and yield.
3. Improved watershed rehabilitation techniques.
4. The effects of various rehabilitation techniques under varying conditions on water quality and yield.
5. Improved timber harvesting practices.

Water Resources

1. Identification of problem situations in water quality influenced by public land management.
2. Quantification of the "present situation" regarding water quality and water yield from the public land watersheds.
3. A better understanding of ground water supplies in areas where desert land development or other development is likely.
4. Projection, by various time frames, of the demands for desert land development as a result of improved pumping technology and economic factors.

WATER RELATED RESEARCH NEEDS - U. S. Atomic Energy Commission, Idaho
Operations Office, P. O. Box 2108, Idaho Falls, Idaho - By
Dr. Charles D. Pelletier

These suggestions come from Mr. Bruce Schmalz as well as Jack Barraclough of the U. S. Geological Survey stationed at the National Reactor Test Site:

1. Determining the effect of radio-active material on ground water.

2. The problem of the NRTS area being classified in a higher danger zone of earthquakes needs study because hydrologic data tends indicate a detachment of geologic features.
3. General ground water studies and hydrologic models. The existence of 900 wells in the 900 square miles offers a research source in its own right.
4. Prediction of renewed volcanism.
5. Effects of geology and microbial action on water in the station area.
6. The Ida-hole, a deep exploratory drill hole in the Snake River plain, to help define the hydrologic circulation.
7. Dispersion properties of water in the Snake River Plain.
8. The irrigated and non-irrigated areas of the Snake River Plain present a unique opportunity to investigate the inferred contamination of ground water by agriculture, industry and municipal land use.

SUGGESTIONS FOR RESEARCH PROJECTS - U. S. Corps of Engineers,
Walla Walla District, City-County Airport, Walla Walla, Washington -
By Frank Parsons.

Following is a list of research needs relating to the Corps of Engineers' activities in water resource planning and management. No priority has been established, although each would have immediate application.

1. Determine the effects of stream fluctuations resulting from project operation for power peaking. Factors to be considered should include, but not be limited to rate of change in river stage; duration of high and low flows; time of year; magnitude of change in flow; water temperature; and water quality. All probable effects including the intangible such as safety, and social consequences should be identified.
2. (a) Gather and evaluate water quality data on existing reservoirs and correlate with inflow quality, soil, vegetation, and other factors affecting water quality. The objective would be to identify the contributing and limiting factors in order to

predict water quality in reservoirs and to improve quality where problems exist.

(b) As a further study the limitations on uses resulting from poor water quality, such as fishing, municipal and industrial water supply, irrigation and recreation could be evaluated.

3. Develop criteria for evaluating environmental factors of water resources. This study should identify all factors affected by water resource management and establish methods for evaluation in the planning processes.
4. Investigate the effect of irrigation return flows on water quality. Identify sources and devise means for control.
5. Develop economical methods of channel stabilization that will not be detrimental to the stream ecology. This should include investigation of materials, construction methods, channel design, bedload movement and downstream effects.
6. Devise methods of rapid groundwater recharge, using flood flows.
7. Investigate possibilities of water quality improvement by artificial means, such as in-stream aeration.
8. Devise techniques to improve reliability forecasting snowmelt yield, based on snowpack and ground conditions.
9. Disregarding present practices and institutional constraints, evaluate the advantages and disadvantages of:
 - (a) Zoning flood plains for various purposes and uses.
 - (b) Establishing minimum & optimum streamflows.
 - (c) Limiting water diversions by requiring efficient use.
10. Define ecologic impact of changing from free flowing stream to reservoir.
11. Identify social and well-being factors related to water resources and devise methodology for consideration in the planning process.

COMMENTS ON RESEARCH NEEDS - U. S. Department of Agriculture,
Soil Conservation Service, Room 345, 304 N. 8th Street, Boise,
Idaho - By Lee T. Morgan, State Conservationist - Presented
by Homer C. Moore

Some of the problems that need attention in the field of soil and water in the state are given below:

A. Soil-water-plant relationships.

1. As influenced by quantities of materials as well as chemistry of materials in waste effluent. Also, the effect of effluent on plants, moisture intake of soils, and the adaptation of plants.
2. Soil moisture regimes

There is need for an improved formula for computing soil moisture regimes (water balance) from existing climatological data. The improved formula should be national in application to replace the Thornthwaite, Penman, Blaney-Criddle, and other formulas used in various sections of the country. The improved formula should be based on radiant energy and be adaptable for use both under natural rainfall and irrigation.

B. Erosion Control

1. The use of the water erosion equation is urgently needed. It should be modified as necessary to make its use as applicable here as it now is in the Corn Belt. The equation is needed for measuring the erosion control value of the various land uses and practices on each of the important soils. It can then be used in specifying effective combinations of practices.

The development of a formula for determining the value of the K (soil erodibility) factor from information in soil series descriptions, makes this part of the required information readily available. The climatic factor is the item which requires additional work.

C. Irrigation

1. Water requirements and consumptive use of water by agricultural crops.

Consumptive use information is needed for use in designing and operating irrigation systems. Data are required on the variation of the water requirements of different crops under irrigated conditions,

as related to stage of growth and climatological factors in order to accurately estimate consumptive use rates in other localities from empirical formulas. Information on the specific effects of high relative humidity in coastal areas is an item of special importance.

Much work has been done on the solar radiation method of estimating crop consumptive use requirements. These studies should be continued and expanded to provide the basis for preparation of a manual of operational procedure for field use.

D. Drainage

1. Develop a method and procedure for spacing parallel interception type drains on sloping land. This will involve a consideration of: soil permeability; land slope; water table gradient; desired drawdown for proper root zone depth; and the drainage coefficient - rate of ground water removal. The procedure should be applicable to irrigated lands and also drylands (non-irrigated) by making proper adjustment to the drainage coefficient used.
2. Surface run-off knowledge is needed to provide more effective ways of establishment and maintaining grassed waterways. This research should be accompanied with cost-returns.
3. Small lined channels to control small long duration flows should be studied.

E. Water Pollution Control

1. Treatment of saline drain effluent - Leaching and drainage of saline soils is essential to irrigation agriculture in the arid and semi-arid regions of the Western States. The removal and disposal of saline water from these lands presents a problem, as the outlet for drains is in natural streams, lakes, etc., and this increases the salinity of these waters. Pollution Control Boards are currently setting upper limits for waters that can be discharged into natural waters and in many instances these will be less than the salt content of drain discharges. Research is needed to explore means and methods to remove or reduce the salt content of drain waters so that the water quality will meet the standards established by Pollution Control authorities.
2. Determine if thermal pollution of streams, lakes, etc. from irrigation, drainage and surface return flow from agricultural lands is a factor, and to what extent.

3. The extent of water pollution from insecticides, herbicides and fertilizers in irrigation waste water and drainage water.

The needs do not include those currently listed by the Research Committee of the Idaho Association of Soil Conservation Districts.

It is hopeful cooperation will continue between the ARS, Idaho Experiment Station, Water Resource's Research Institute, and private sources to expedite these urgently needed research projects. The Service will continue to cooperate with the Water Resources Research Institute and fully endorses its role in research.

NEEDED SPECIFIC RESEARCH- U. S. Department of the Interior, Geological Survey, Room 365, Federal Building, Boise, Idaho - By
W. L. Burnham, District Chief

In the area of needed specific research, I feel the Institute could well consider the following:

1. A re-determination of consumptive use by crops common to Idaho agriculture categorized according to geographic location, cropping practices, water application methods, and growing-season climatic character.
2. Hydrologic effects on the total ground and surface water system of the Snake River below Bliss caused by pumping from the river and application on naturally arid, newly cultivated land south of the river.
3. A renewal effort to develop a usable relationship between geophysical measuring techniques and the stratigraphy and thickness of the Snake River Plain basalt-sediment sequence.
4. A systems analysis of the Snake River drainage basin between King Hill and Parma to relate existing and proposed pumping withdrawals from the River for agriculture to the time interval and flow systems involved in temporary ground water storage of the unconsumed pumped water that will go into storage beneath areas of application. A mathematical model approach may be the most valuable.

COMMENTS ON RESEARCH NEEDS - U. S. Department of Agriculture,
Agricultural Research Service, Soil and Water Conservation Research
Division, Snake River Conservation Research Center, Route #1,
Box 186, Kimberly, Idaho 83341 - By Dr. M. E. Jensen, Presented
By Professor C. E. Brockway

These statements consider problems that might be more appropriately studied in an academic environment such as at the Institute.

1. Economics:

Many diverse gravity irrigation systems are used in Idaho. In addition to these, pressure sprinkler systems of many different types are not only being marketed but are in use throughout the State. Idahoans continue to develop new lands and make additional improvements in old lands. Much engineering and soils data are now available, but the land manager also requires access to economic analysis so as to make the best possible decision. An economic analysis of irrigation systems would be valuable.

2. Water Laws:

Idaho needs to look at water law to see what can be done to encourage users of excess water to lessen or reduce diversions. Can this released water be transferred to other users having the same appropriation date? Could the user sell the water right to a new user who might have a later appropriation date attached to the water right?

3. Canal Company Institutions:

Idaho has 264 mutual companies with 4 to 9 users, 206 with 10 to 29 users, and 93 with 30 to 99 users (1959 Census). The consolidation of companies could result in a better managed system and a more efficient use of diverted water. These people, however, need aid including educational, financial, and institutional to effectively compete, and at the same time utilize water more efficiently. Some water might be released for use on other lands. The canal company statistics shown above are similar for Oregon, Washington, Utah, Wyoming, and Montana.

4. Crop Yield Versus Water Availability:

A good statistical summary correlating water availability with crop yield for the Northwest would be helpful in educating water users and would also be of assistance in defining areas of research needs.

5. Undercooling and Freezing Studies:

One important basic problem which is not understood is that of the undercooling of water and its resistance to turn to ice at tempera-

tures less than 0° C under some conditions. This is, of course, involved in the freezing of plants and soil and all of the associated problems in this area.

6. Precipitation and Air Pollution:

As monitoring of our environment for pollutants increases, it will be more and more important to have some baseline upon which to express the changes in concentration of these various constituents. Many pollutants are washed out of the atmosphere by both rain and snow. It would be helpful to know what pollutants are presently coming into Idaho by this source and their concentrations. Such information would be helpful in later determining changes of these same constituents as influenced by our environment and any changes which may be imposing upon it.

WATER RESOURCE NEEDS - U.S. Department of the Interior, Bureau of Reclamation, Regional Office, Region 1, Box 8008, Boise, Idaho 83707 - by H. T. Nelson

The following is a summary of our ideas on this matter:

We have become concerned in recent months with the attitudes on the part of some people that past water resources developments in Idaho are, in reality, detrimental to society. The problem has to do with the effect of developments on the environment, particularly, in the Upper Snake River Basin. While all must agree that any development on a stream will have direct effect on water quantity and quality, particularly if irrigation is involved, one cannot readily conclude that the net effect on the over-all environment for man is necessarily detrimental. This is particularly true in an arid or semi-arid climate like that which naturally exists in southern Idaho.

We believe that an impartial comprehensive study should be made of typical water and associated land resources developments in southern Idaho to determine the impact over the years. We are thinking, perhaps, of the Boise River Basin or the Upper Snake River Basin areas. To insure credibility, such a study should be supervised by an impartial entity like the University, with all interests cooperating. We believe that for such a study to be as meaningful and broad as possible, it should be based on the four objectives being promulgated by the National Water Resources Council. They are the

objectives of national economic development, regional development, environmental quality, and quality of life. The water resource development agencies are now awaiting instructions on how to implement these four objectives.

Environmental quality and quality of life will be of particular importance in such a study. No doubt, additional research is needed in these specific fields to become more knowledgeable of just how water resource developments affect them. It would be of value in the general field of water and associated land resources development to have definitive investigations of these relationships regardless of undertaking a specific study such as that for the Boise River Basin or the Upper Snake River Basin, as referred to above. Such investigations could be oriented to reflect examples from a cross section of existing developments; or for that matter, tied directly to a single existing project.

It would also be important to acquire additional knowledge concerning benefits, other than increases in farm income, resulting from water resource developments. This could be on a local, state, or regional basis. This study could take a form of an input, output, or economic impact analysis. This suggestion is based on the premise "that we know by observation that there are more benefits than the increased farm income to the individual operators." A study of this type should measure the multiplier effect of farm input purchases in an economic unit or area. In other words, to what extent do farm input purchases reverberate to other industries in the agri-business sector? How many dollars are generated by farm purchases in addition to the initial amount expended by the farmer? On the output side, there is a need to update information on the profits and increased incomes of local processors, retailers and wholesalers, and benefits accruing to others as a result of the increase in agricultural commodities and other benefits stemming from multiple-purpose water resource projects. In some cases, even new intensive industries come into an area. For instance, the increase in food processing in Idaho within the last 5 - 10 years contributes more dollars to local economies than if the products were sold unprocessed and processing was done out of state.

Other beneficial effects of such projects correlate with objectives stated by the President and other HEW programs concerning rural development, population dispersion, and stabilization of local economies. These need study and evaluation.

There are a number of other research needs in connection with water and associated land resources development. These are listed below.

It would be desirable to have more information on water application to crops by the drip method, or underground soakers.

We need to know more concerning the costs and benefits of pipeline irrigation systems as contrasted with canal systems.

Information should be obtained on the use of commercial fertilizers as contrasted with natural organic fertilizers and their effects on water quality.

We need to have considerable additional information concerning the effect of irrigation on water quality. Actually, the Federal Water Quality Administration is working with the Bureau of Reclamation to set up test areas for monitoring the effect of irrigation return flows on the quality of the receiving waters. One of the parameters is dissolved oxygen content. In this regard, apparently little work has been done to determine the aeration characteristics of standard drop structures, energy dissipators, etc. In areas where return flows are low in dissolved oxygen, properly designed structures might offer a means of aeration.

We also should be better informed on the effect of storage on quality of water in reservoirs and on downstream flows.

We would like to know more concerning the friction factors of new types of pipe, such as plastic, epoxy-fiberglass, etc.

There has been considerable discussion recently concerning the effect of reservoir spills in relation to nitrogen in the water and its adverse effect on fish. Research is needed in this field.

We need to know more concerning the amount and source of ground-water flow through the Rathdrum Prairie area and its relationship to the surrounding lakes and the Spokane River.

It would be beneficial to have a determination of benefits attributable to irrigation in the high rainfall areas of northern Idaho, changes in cropping patterns that would result with irrigation, and benefits resulting from related supporting industries.

A comprehensive study is needed to derive up-to-date man and tractor hours required for field operations involved in producing important crops grown in Idaho. Such a study would need to show the effect of such things as soil texture, shape and size of fields, and topographic conditions for both dryland and irrigated crops.

It would be beneficial if a determination of the incremental costs and production associated with incremental amounts of irrigation water applied during the 10- and 20-day peak water use periods could be derived. The basic question to be answered by such a study is at what point is the increased crop production offset by the additional costs of the conveyance and distribution system and other incremental costs. We recognize that the answer to this question will probably vary, depending on the types of crops grown.

Another item receiving more and more attention is the possible use of thermal power plant cooling water for agricultural purposes. While some practical research is going on in this field, considerably more information most likely will be required.

Studies should be made concerning future municipal water supply needs and sources of water for the city of Boise and other rapidly expanding areas in the State of Idaho.

Research is also needed to further develop information concerning the development of wildlife areas in conjunction with the irrigation aspects of water resource projects. We have in mind here, for instance, the development of wildlife areas in conjunction with the Mountain Home Division of the Southwest Idaho Water Development Project.

We also need additional information on the evaluation of the impact on wildlife, particularly upland game, of irrigation of croplands and drainage of croplands.

Continuing research is needed on the efficiency of various materials for canal lining which have been in operation for sometime. This would involve the consideration of concrete, asphalt, soil, various types of membranes, etc.

Many of the older Federal reservoirs were constructed with little or no consideration being given to water-associated recreation. There is a need for the evaluation of water-based recreation at older Federal reservoirs where little or no cost allocation has been allowed for recreation benefits.

These are some thoughts that we have concerning research in the water resources and associated land development field. They are being presented in this letter only as ideas. It would appear that if any of them were to be seriously considered by the University, additional clarification and discussion would be beneficial.

WATER AND WATERSHED RESEARCH NEEDS - U.S. Department of Agriculture,
U.S. Forest Service, Regional Office, Federal Building, Ogden, Utah - presented
by E. L. Noble. - by Vern Hamre

1. Methodology for determining values of water in Idaho for recreation and fishery purposes.

Although the use of water for recreational and fishery purposes is not classed as a beneficial use in Idaho, current concern for the environment and competition for water dictates that on-site and off-site values of water for recreation and fishery be equated with values of water for power production, irrigation, and industrial use. Alternative value studies made for other areas do not seem appropriate for Idaho's unique waters nor do such studies appear to reflect the national significance being given to the recreation and fishery values of Idaho's waters. Some recreation and fishery value ranges may result, for wild and scenic rivers, from the wild river methodology study, but a methodology or procedure needs to be developed for determining such values for other waters also.

2. Procedure for determining "tolerable" levels of sediment in streams.

Considerable information is available in regard to water quality standards for tolerable limits of chemical and biological pollutants. However, except for turbidity, there are no parameters available on which to characterize degradation of water quality from sedimentation - suspended and/or bedload. It would be most helpful to land managers and aquatic biologists if a method of procedure could be developed for determining, in advance, the tolerable amount of sediment a stream reach can accommodate before degradation of the aquatic environment begins.

3. Development of an acceptable water quality monitoring network for waters of the State of Idaho and development of a computerized storage and retrieval system of baseline information and water quality data.

Many Federal and State agencies are concerned with water quality information. Several are collecting and analyzing water quality samples. Some sampling stations are established to obtain baseline information. Others involve continuous surveillance for monitoring purposes. Because no State-wide organized network for water quality monitoring is available, considerable duplication of agency effort is possible. Some gaps in the network may exist. Also, with no data bank being available, there is no organized system of determining what water quality information is already on record for any particular reach of a stream or river.

4. Development of a remote sensing device to measure snow depth and water content of snow.

Further development of water resources and continued encroachment of improvements on flood plains require more real-time snow survey information for water supply and flood forecasting. Radio telemetered and manually measured snow courses require maintenance and/or travel which is expensive and oftentimes dangerous to personnel. Difficulties of travel to remotely located snow courses preclude the establishment of

enough courses for a satisfactory network or prevent silting in areas hazardous to travel. In addition, Wilderness regulations generally prevent installation of mechanical devices to measure snow and prohibit use of motorized vehicles to service them. As a result, there are wide gaps and delays in snow-course information needed for water supply and flood forecasting. A great savings in time and money could be realized if an airborne sonar or radar type device could be developed for measuring snow and water content.

ADDITIONAL COMMENTS - United States Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, 507 25th Street, Ogden, Utah 84401 - by Otis L. Copeland

1. Devise and implement a system for collecting and storing available water resource data that facilitates retrieval.
2. Augment the present system of collecting streamflow and water quality data from "small" water sheds in Idaho.
3. Determine, under more nearly realistic natural conditions, the effects of sediment and other water quality parameters on the survival and growth of fish.
4. Conduct research on the eutrophication of streams and lakes and its seriousness in Idaho in relation to present practices.
5. Explore feasibility and limitations on use of industrial effluents for irrigation or cooling liquids.

SUGGESTIONS FROM REPRESENTATIVES OF PRIVATE SECTORS
OF STATE OF IDAHO

NEEDS IN WATER RESOURCE RESEARCH - Anderson & Kelly, Consultants
in Engineering and Geology, 6700 Emerald Street, Boise,
Idaho 83704 - By Keith E. Anderson

Idaho's colleges and universities can contribute significantly in the field of water resource research.

From the standpoint of the consulting engineer there is a definite need for basic data collection, evaluation, and interpretation which -- though not "glamorous" research -- can provide better raw material for the consultant to use in the design and operation of facilities and in water resource management.

Examples of such studies would include:

1. Small watershed hydrology: precipitation, runoff, infiltration, base flow, evapotranspiration, and net water yield.
2. Small watershed flood studies, useful in design of channels and structures.
3. Analysis of precipitation and runoff for runoff coefficients applicable to storm drains under varying urban and rural conditions in Idaho.
4. In-depth water quality studies: chemical, physical and biological parameters.
5. Pumping plant cost analyses, particularly relating to maintenance and replacement.
6. Flood frequency and flows versus stage on controlled streams.
7. Irrigation project cost analyses.
8. Statistical analysis of basic data (climatic, runoff, etc.)

STATEMENT CONCERNING WATER QUALITY RESEARCH NEEDS - Boise Cascade
General Office, P. O. Box 200, Boise, Idaho 83701 -
By H. Tom Davis

- I Definition of the relative importance of the various aspects of a logging operation to the total increase in sediment yield due to logging.
- II Quantification of the erosion, sediment yield to streams and eventual deposition of sediment from a logging operation.
- III Further definition and categorization of the factors involved in erosion and stream sedimentation as they relate to logging (for field evaluation of sedimentation risk).
- IV The development of land-use allocation models that can realistically evaluate all the variables in land use planning, present a range of alternative allocations with their consequences and be readily adaptable to new information and concepts.
- V The development of ecologic impact and linear programming models to evaluate the environmental aspects of a proposed logging operation. Such aspects might include sediment yield, erosion and wildlife.
- VI The development of environmental survey and community design methods for a community size land unit (100 to 50,000 acres) that includes the natural factors and intrinsic qualities of the land and water.
- VII The development of low cost methods and equipment for monitoring the water quality and quantity in a water course. Simplicity, mobility, rapid installation and infrequent servicing should be emphasized.
- VIII Methodology for simulating the potential eutrophication of a proposed reservoir or existing water body with various land use alternatives.
- IX Methods of evaluating the potential chemical and biological changes in a surface water body based on chemical characteristics of the aquifers involved, geohydrologic flow system and surface inputs (i.e., septic tanks).
- X The synergistic relationships and effects of the important chemical water pollutants.
- XI Further definition of the relative importance of the various nutrients, sunlight and temperature on the eutrophication of a water body.
- XII Collection, collation and distribution of information concerning environmental control equipment, environmental effects and environmental relationships. Such information might include:
 - A. Hydromulching and hydroseeding equipment and materials.
 - B. Package treatment plants.
 - C. Waste treatment methods and costs (tertiary).
 - D. Watershed modeling techniques and methodology.

- E. Pollution-effect relationships in the aquatic environment.
- F. Summarization and development of criteria for evaluating potential land development.
- G. Hydrologic and environmental monitoring equipment.

STATEMENT ON RESEARCH NEEDS - Bunker Hill Company, Kellogg, Idaho
and ENVIRONMENTAL QUALITY CONTROL COMMITTEE FOR
ASSOCIATED INDUSTRIES OF IDAHO - By G. M. Baker

My name is Gene Baker. I am Manager of Plant Engineering for The Bunker Hill Company and Chairman of the Environmental Quality Control Committee for Associated Industries of Idaho.

We in Industry are grateful for the opportunity of presenting our views and opinions on areas of research needed most to help protect the water resources of the State. We in the mining industry have already benefited from the results of studies initiated under your program with regard to the South Fork of the Coeur d'Alene River.

The process of mining almost always involves the handling and use of water. Briefly this is why:

1. A mine with large work areas, at low levels, usually becomes a natural well; and, therefore, accumulates ground waters which must be pumped to the surface and discharged. These waters have been exposed to mineralized areas, and therefore, will be carrying some minerals and possibly have some associated effects. The volume of this water will vary from area to area. In the case of the Bunker Hill Mine, it averages about 2,000 gpm.
2. Waste rock is generated while excavating for tunnels, shafts and obtaining general access to mineralized ores. This waste rock must be removed from the mine and disposed of. In many cases, it contains a small amount of mineralization; and when exposed to the environmental elements, some of these minerals will be transferred into the water courses.

3. The ore removed from the mine must be concentrated before it can be processed through refinement to metals. This concentrating process is a wet process involving the addition of water and subsequent grinding to very fine material. The ground material (almost like powder) is then passed through floatation cells where chemicals are added and the valuable minerals are selectively floated to the surface and removed. The waste material is then discharged to large impounding areas where the solid material settles to the bottom of the pond and the clarified solution overflows to discharge. Various new processes have been incorporated to minimize the effect of this operation on the adjacent water courses, and I present it here only to acquaint you with the general system.

With the above required operation, there is little doubt that the mineral content of water courses adjacent to these operations will be increased. The amount of increase depends on many things, most of which cannot be eliminated entirely. In most cases the effects can only be minimized.

Mining areas are usually highly concentrated; and, therefore, affect only a very small part of the total state waters. For example, The Coeur d'Alene Mining District embraces an area only 23 miles long and 9 miles wide, a total of 207 square miles as against 83,000 miles in the state. On a percentage basis, this represents about 1/4 of 1% of the total state land area. If this mining district did not exist, the state would lose 4% of its total assessed valuation, 4% of its income tax and building fund revenue, and nearly 5% of the total wages paid in the state. The nation would lose 47% of its silver production, 11% of its lead production, and more than 8% of its zinc production. This area, in early 1967, had over 250 mining properties registered, although there are currently only 6 major mines in production (Bunker Hill, Crescent, Sunshine, Lucky Friday, Star and Galena). These mines are all subsurface.

As you drive through this area on Interstate 90, the only mining facilities in evidence are the surface plants used to first separate the waste material from the minerals, and secondly, to refine these minerals into actual metals. The plants in general are quite old and have been

in operation for many years, as in the case of the Bunker Hill Lead Smelter, which was brought on stream in 1917. There has been a considerable amount of investment in plants in recent years; however, in general, the existing plants and equipment are far from modern. Increasing labor costs, costs of materials and supplies, etc., have forced modernization in some areas; however, the task of modernizing these old plants, which essentially means complete rebuilding in most cases, is extremely costly and in recent years the companies have not been able to generate adequate profits to supply the needed investment dollars. With the exception of silver, metal prices have been fairly stable; and, if anything, have decreased slightly over recent years while all operating costs have increased considerably. In fact, in 1956, 14 years ago, the price of lead was 16¢/lb. and zinc was 14 1/2¢/lb. as compared to today's price of lead at 14¢/lb. and zinc at 15¢/lb.

In reviewing the needs of the mining industry for research on water pollution problems we find an open field. Generally there is very little known about the economical removal of heavy metals such as zinc, lead, copper, cobalt and cadmium from waste water from mining operations. Primary treatment utilizing large impounding areas for settling is about the only type of treatment used, and this is really only effective on suspended solids. I understand a research contract has now been awarded to the University of Idaho to investigate the tailing ponds treatment effectiveness in some detail; however, the results of this study will not be available for some time. I mention it here because it is an example of the very basic lack of research data in this field, and I believe this lack extends all the way down to a lack of knowledge on basic natural water background levels. I believe the entire field needs a good review to determine really where to start. I have listed three possible areas which could be developed into specific projects and would provide valuable data to both the mining industry and State control agencies. I believe their completion would represent a good basic start on the problem.

1. Develop assay data on natural backgrounds of heavy metals in state water courses located in mineralized areas and correlate these assays to area hydrology. Until data on natural background is available, there is no way of determining what effluent control is needed

or what use the water can serve. This data is needed now by the State in their efforts to establish water standards on state waters and once these standards are set, Industry will need the information to design treatment facilities.

2. A technology search is needed to bring together all existing data that can be applied to treatment of mine waste waters. For the long range, the treatment processes must meet the following requirements:
 - a. Reasonable economics regarded both initial cost and operating cost. The mining companies must be able to afford the system.
 - b. Produce a product amenable to metals recovery by being of the proper physical and metallurgical state.
 - c. Meet restricted space requirement. Areas for large tailings ponds are not available in many locations and this will become a more critical factor in future years.
3. Part of the problem of controlling effluents to the degree now contemplated is that of analyzing for concentrations in the ranges under 100 parts per billion. Standard procedures are needed for sampling and analysis. We believe the procedure should give both ionic metal concentration as well as chemical complexes and be sensitive down to 5 micrograms per liter or lower. Ultimately the procedure will have to be accepted by both the Idaho Board of Health and the FWQA and must be fast and reliable.

I assure you the mining industry is very anxious to see research accomplished in this field of water pollution control and we will cooperate in every way possible. Thank you again for giving us the opportunity to participate today.

STATEMENT ON RESEARCH NEEDS - Idaho Power Company, 1220 Idaho Street, Boise, Idaho 83701 - By Don Barclay

The Idaho Power Company was pleased to be asked to be here today to present to you our thoughts relative to water resource research that might be carried on to the benefit of the citizens of our state.

First of all before we make suggestions as to what might be studied it is important to realize that business and industry need that kind of research carried on that will produce tangible knowledge that can be put to practical use. This kind of knowledge generally works to the benefit of the customers served by Idaho Power Company and thereby indirectly benefits the Company. It is the Company's hope that regardless of the ultimate fields that are chosen for research that this general approach will be taken in determining which areas to investigate.

The Company has three suggestions for the group to consider:

1. That research be undertaken on the relative economics of gravity and sprinkler irrigation particularly as applied to the Mountain Home desert area. As you may or may not know, the Company has offered a proposal for a joint venture, between the State of Idaho and the Company, for the development of the reach of the Snake River between Guffey dam site and C J Strike dam. The State could use the benefit acquired from this venture to install sprinkler irrigation in the Mountain Home desert for well over 150,000 acres. A study of the conservation of water by use of sprinklers as well as the relative economic aspects of gravity versus sprinkler irrigation could aid the State of Idaho, and particularly the Idaho Water Resource Board in their deliberation of the company's proposal.
2. The Company would urge this group to give full attention to the water resource aspects of the Public Land Law Review Commission's report. This national commission issued their report in June 1970, which pertains to the use, retention and disposal of the public lands and the things thereon. Because the public lands lie in the western

states the impact of this commission's findings is important to them and especially to Idaho. We presume there will be legislation, as a result of this report, in the national Congress. Idaho has to do her homework now by completely digesting this report and determine its effect on Idaho's future development so that we may establish positions on key matters such as the Desert Land Act. For quite a number of years the Desert Land Act has made it possible to convert about 18,000 acres of desert lands per year into irrigated farms in the State of Idaho. If Congress acts on the commission's recommendations and abolishes the Desert Land Act, a definite economic impact on Idaho will be felt. The effect of the impact of this action or the suggested alternative is a question that needs to be analyzed. This is but one facet of the commission's report and I do not propose to enumerate them all here.

3. A third suggestion the Company has for the group is to study the benefits of the development of the great Snake River through creation of dams and reservoirs. The particular benefits that need investigation are those of recreation and pleasure use. Is it better, for instance, to leave a river as it now is or would it be better to develop it for the additional use through the creation of a dam and reservoir. We have in mind specifically the Middle Snake, which is that stretch of the river from Hells Canyon dam to the mouth of the Salmon River. Power benefits are readily measured. Recreational and aesthetic benefits are illusive.

In any of the foregoing recommendations or whatever the group chooses to study, again it is the Company's hope that the research will be done in such a way that practical use can be made of the facts developed.

COMMENTS MAILED TO INSTITUTE - Crookham Seed Company - By
George L. Crookham, Jr.

1. Problems of animal wastes along stream channels
caused by quartering livestock on streambanks.
2. Economics of correcting the above situation.

SUGGESTIONS FROM REPRESENTATIVES OF
STATE GOVERNMENT AGENCIES

WATER RESOURCES RESEARCH NEEDS IN IDAHO - Idaho Water Resource Board
Statehouse, Boise, Idaho - By Dr. Robert R. Lee, Director

This Water Resources Research Conference, sponsored by the Water Resources Research Institute at the University of Idaho, is a most welcome event. I am hopeful that it will lead to a better definition of our water resources research needs and a better definition of personnel and sources of funding to carry out the research. Without such a conference, it is entirely possible that research would be carried on that would not meet pressing needs or that some sources of research funding would be overburdened, while other sources would be ignored.

The Water Resource Board is interested in having the universities carry on research that cannot be done by private firms or state agencies. The list of research topics that we will suggest has this in mind. In the past, the Water Resource Board has provided considerable funding to the universities to assist in helping define water needs for the State of Idaho. With the conclusion of this water needs study effort, we foresee very little funding from the Board to the universities for research. We are hopeful, however, that other sources of funding will be relied upon in order to maintain the research capability at the universities that we have helped establish. We would also like to suggest that in order to make the results of university research usable by state and federal agencies, there should be close liaison with those agencies most affected and there should be periodic agency review of this research effort. Following is a list of potential research topics. More detailed information on what we have in mind can be presented during the discussion.

1. An environmental Base Study for Idaho - 1850. This study would be aimed at trying to describe Idaho's environment prior to the impact of the white man. River flows, climate, game populations, forest resources, Indian population, and other environmental factors would be defined.
2. An analysis of the organization, size, and objectives of water-related interest groups in Idaho.
3. An analysis of the sociological and economic benefits from living in rural Idaho versus the impact of out-migration to urban areas.
4. An analysis of the impact of irrigation return flow on water quality in the Snake River and its tributaries.

5. An analysis of optimum minimum flows for aquatic life in Idaho streams.
6. A post audit of Idaho's wild rivers as a guide to future planning and decision making.
7. An analysis of steelhead and anadromous fish runs in Idaho, past and future.
8. An analysis of the feasibility of reestablishing steelhead and salmon runs above Brownlee Reservoir.
9. An analysis of the impact of the Public Land Law Review Commission's recommendations, if implemented by Congress, on Idaho's water and related lands.
10. A post audit of a water resources project. The Idaho Water Resource Board has made an application for research funds to the Office of Water Resources Research to make a post audit of the Boise Project.
11. Development of mathematical water quality models adaptable to computers to assist in the planning and development programs of the Board.
12. The role of water resource development in establishing new towns in Idaho and the West. Research in this area should be closely coordinated with the Bureau of Reclamation and the Idaho Water Resource Board as part of the Southwest Idaho Water Development Project Studies.
13. Investigation of alternative means for financing state water resource development.
14. The impact of new land development in Idaho on farm prices and economic growth in Idaho.
15. The relationship of new land development in Idaho to crop surpluses and federal acreage retirement programs.
16. The preparation of a layman's geological history of this State. This would lead to a better understanding of the history of the formation of our rivers, mountains, land areas, etc., and would provide planning officials and local interests some insight into problem areas associated with man-made influence on the natural processes.
17. The development of hydrologic simulation models on river systems in the State and the refinement of synthetic hydrology techniques in order to better forecast future flows of water resources planning and development.
18. An analysis of the feasibility of using waste water from thermal electric plants to enhance agricultural development in Idaho.

19. Detailed research on the characteristics of the Snake Plain Aquifer so as to better define the impact of development and recharge on the aquifer. The State Department of Water Administration is cooperating with the U.S. Geological Survey and the Bureau of Reclamation to gain more information on the aquifer. This research effort should continue beyond the current program.
20. Definition of environmental quality and procedures for quantifying and evaluating the environmental quality objective. This is being done in part by the University of Idaho Wild Rivers Methodology Study, but research should continue.

We hope that among this list of research topics there are some that have appeal to members of the audience and others who are interested in conducting research in the water resources field. I will be pleased to try to answer any questions you may have about these suggested topics.

WATER RESOURCES RESEARCH NEEDS IN IDAHO - Department of Water
Administration, Statehouse Annex 2, Boise, Idaho - By
R. K. Higginson, Director

Listed below are research topics for consideration as requested. Each of these matters relates to a problem which this department has in connection with its responsibilities for investigations of the extent, nature, and location of the state's water resources and administration of the use of water under established water rights. Information which might be gained from research on any of these topics would aid this office as well as add to the store of information on the state's water resources. The department has a budget for water resources data collection and investigations; however, only a limited amount of these funds may be available as input to research of the listed subjects. We would be happy to discuss any of these matters with you in more detail if you should desire.

1. Development of an inexpensive, easily maintained, durable, accurate in-line flow meter. Regulation of the use of water through enclosed systems requires that there be some means of determining the rate of flow and the total volume used

per season or year. Presently available commercial measuring devices appear to be expensive and difficult to maintain. Development of an inexpensive device which could be installed on every pump or enclosed water system in the state would assist the water user by providing information needed for efficient use of the water.

2. Development of a more detailed Isohyetal map of Idaho and method of more accurate determination of basin water budgets. Presently available procedures allow for too much room for error when making estimates of precipitation, evapo-transpiration, and other major factors not easily determined. For example, over a period of several years three studies of the water yield of Raft River Basin produced results of 183,000, 320,000, and 140,000 acre-feet per year. Each result is based upon estimates of precipitation and other factors in the basin. A ten percent error in estimates of basinwide precipitation results in differences of 128,000 acre-feet in estimated annual water yield. This is important, particularly in view of the state law which requires regulation of ground water pumping on the basis of "reasonably anticipated average rate of future natural recharge."
3. Relationship between reduction in the amount of water applied to crops and crop yield. A recent report, Bulletin No. 516 of the Agricultural Experiment Station, entitled "Consumptive Irrigation Requirements for Crops in Idaho," gave percentile data for irrigation of crops at various locations throughout the state. In order for this information to be meaningful as a means of regulating the amount of water diverted and applied to beneficial use, studies need to be made to determine the tolerance levels of water shortages of various crops. Such studies should also include a determination of the season or period of the year when such shortages can be tolerated.

4. Determination of the most efficient design configuration and water requirements of fish rearing ponds and raceways. Numerous applications have recently been made for the construction of commercial fish hatcheries. Many of these filings are in conflict with one another. Part of the protests received to the granting of the applications for the water permits relate to claims that the individual is applying for more water than is reasonably required for the size of pond or the hatchery facility proposed. Questions have also been raised concerning the effect of one hatchery upon the quality of the water available for a downstream hatchery or other use. Research aimed at resolving these differences of opinion and establishing design criteria would be of benefit.
5. Determination of the cost of pumping ground water and the ability of the water user to pay for water. Previous studies have been made of various subjects relating to this topic. However, there are still many unresolved questions. Additional information needs to be gathered for our aid in the determination of reasonable pumping levels from an economic standpoint. Such determination is dependent upon the financial ability of each water user to pay for his water supply. The reasonable draw-down which might be tolerated under an "ideal" well situation should be given some study.
6. The effect of individual residential sewage disposal systems upon regional ground water quality. Additional research needs to be made of problems related to disposal of domestic sewage. This is becoming a problem particularly in areas outside of community collector systems. The rates of dispersion of pollutants and distance of travel of various bacteria, etc. should be investigated so that adequate steps may be taken to protect ground waters of the state against pollution.
7. Investigation of the feasibility of developing storage for water which occurs in dry-washes as a result of flash

floods. In many areas of the state the washes are normally dry throughout the year. However, on occasion they contain high flows as a result of thunder showers or snow melt. It is normally impractical to construct reservoirs on such washes to catch these high flows. The feasibility and methodology of diverting these flows and building off-stream storage to catch and hold water for later use by livestock or for other purposes should be investigated.

WATER QUALITY RESEARCH NEEDS - Idaho Department of Health, Water
Pollution Control Section, Environmental Improvement Division,
- By Dr. Lee W. Stokes, Chief Aquatic Biologist.

1. Inventory of irrigation water disposal wells.

It would be desirable to expand the previous inventory of sewage injection wells in southern Idaho to include a study of irrigation water disposal wells. Data is also required on the quality of water being discharged to underground aquifers in this manner.

2. Determination of water quality in deep aquifers.

A comprehensive study of water quality in the Snake River aquifer should be initiated. Attention should be paid to nutrient levels and radioactivity.

3. Tertiary treatment methods.

Methods for removal of nutrient materials from municipal and industrial effluents following secondary treatment should be developed for use in Idaho. Economical methods for phosphorus and nitrogen removal are required.

4. Disinfection of sewage lagoon effluents.

The management of lagoon systems should be studied with reference to disinfection of effluents without resorting to chlorination.

Bacterial reduction during winter operation is most critical.

5. Herbicides for lagoon weed control.

The effectiveness of various herbicides in the control of rooted and floating weeds in lagoon systems should be evaluated. A particular problem is the control of duckweed in sewage stabilization ponds.

6. Waste recycling; feeding studies; land disposal.

The general concept of returning organic wastes to the soil needs further study. More studies of the feasibility of irrigating with wastewaters and feeding waste materials to livestock would be desirable.

7. Off-river storage of irrigation water.

The feasibility of diverting water to off-river sites for irrigation storage as a substitute for dam construction should be studied.

8. Fish hatchery wastes.

The pollutional effects of wastes from fish hatcheries needs investigation.

9. Eutrophication studies.

General eutrophication studies should be carried out on all lakes in Idaho where there is current or potential recreational use.

10. Bioassays.

Information is needed on the effects of heavy metals and other toxic materials on the survival and reproduction of game fish and other aquatic organisms in Idaho's streams.

RESEARCH EFFORTS AND NEEDS IN WATER RESOURCES - Idaho Bureau of
Mines and Geology, Mines Building, Moscow, Idaho 83843 -
By Dale Ralston

The principal aim of the Idaho Bureau of Mines and Geology is to conduct research and engage in mineral and water resource studies leading toward the orderly development and utilization of these commodities. The present and past research efforts in water resources by the Bureau

include five major fields. Studies of the ground water resources of several specific areas have been performed including the Moscow basin and the Twin Falls area. Research has been conducted on ground water flow systems and the origin of evaporite minerals. A flow system under an irrigated field is also being examined. Studies are being performed on the reuse of wastewater including a study of surface irrigation with a factory waste effluent in a particular hydrogeologic environment. An investigation is in progress of the water quality and hydrogeology related to refuse disposal in a sanitary land-fill. Hydrogeologic criteria for the selection of safe refuse disposal sites have been published. The water quality problems associated with operations of the mining industry in Idaho is an important subject of present research. Ongoing investigations include analysis of heavy metals and their sources in the Coeur d'Alene River and means of treating mining effluent. The effect of settling ponds on the water resource system is being evaluated. A portion of related work on the effect of heavy metals on the biota of Coeur d'Alene Lake is also being supported.

The research needs of the Idaho Bureau of Mines and Geology in the water resource field relate very closely to the Bureau's ongoing projects:

1. Research toward understanding and correcting water quality problems related to the mining industry in Idaho is very important. Answers are needed to questions on the effect of various aspects of mine effluent processing, mine construction, and mine layout and design as related to the water resource system.
2. Research is needed toward understanding the effect of man on his water environment. Problems of flow systems near waste and sewage disposal sites need to be further investigated.
3. Possibilities of reuse of wastewater needs additional research. This technique appears to offer promise in Idaho for the elimination of some of our pollution problems.
4. Applied research is needed in many phases of the occurrence and movement of ground water so that ground water supplies can be better understood and evaluated.

5. Research in the occurrence, movement and quality of water as it relates to a particular geologic environment is also important. These are often the major factors controlling the selection of well sites.

COMMUNITY WATER SUPPLY RESEARCH NEEDS - State Planning and Community Affairs Agency, Statehouse, Boise, Idaho. - By Herb Derrick, Director.

Topics which should be given consideration are as follows:

1. Potable waters: 92% of this water is from underground sources in Idaho. Need to determine new sources of potable waters and the adequacy of present sources. There is lack of research on supply.
2. Recharge of underground waters: What is the stability of underground waters in most aquifers of the state?
3. Study the system of charging for drinking water: The usual case is the more used the cheaper the rates. Discrimination works against the family supply situation. Study pricing structure for water supply of municipal system.

WATER RESEARCH NEEDS FOR FISH AND WILDLIFE RESOURCES - Idaho Fish and Game Department, 600 South Walnut Street, Boise, Idaho - By James F. Keating, Fishery Research Supervisor

1. Possibly the most pressing need for statewide water research is that for a comprehensive water plan similar to the one now being prepared by the State Water Board. In addition to inventories of existing water and uses and projections of water development uses and needs, we feel the plan will bring to light a number of areas in which we need additional inventory, increased monitoring and studies to answer many unknowns. Without this detailed plan (which we feel will establish priorities) the following are presented without priority standing.

2. We need to develop a standardized simple method of determining acceptable minimum flows and optimum flows below water projects.
3. We need to compare the production of upland game birds in ditch irrigated versus sprinkler irrigated areas and predict the best possible methods of optimizing upland game bird production in both new and old irrigation project areas.
4. We need to develop methods for forecasting water quality of new reservoirs based on fertility of the watershed and stream conditions.
5. We need to develop methods of predicting changes in stream temperatures if water flows are altered by diversion or dams.
6. We need to develop better methods of evaluating the monetary loss to the State caused by accidents or pollutions which damage fisheries or other water oriented areas.
7. We need a study to determine the effects of fire retardants on streams or mountain lakes.
8. We need to develop methods of assessing the value of wildlife, fisheries and recreation benefits in proposed water development projects.
9. We need studies to develop water treatment systems that will minimize pollution (should include evaluations of the use of irrigation runoff and waste water from various processing plants as irrigation water).
10. There are certain areas of Douglas Gordon's economic studies which should be expanded to determine the values of specific fisheries.
11. We need a realistic appraisal of the relative cost of zoning flood plains to prevent the construction of permanent structures versus the typical flood channel project subscribed by the Corps of Engineers and other agencies. This determination possibly should have a high priority value because of the extremely valuable production of a wide variety of birds, wildlife, and fish within the flood plain zones of many of our rivers. Accelerating land development projects will possibly seal the doom of many of these areas within the near future without rapid action.
12. We need to develop methods of controlling and releasing storage water to maximize recreation, wildlife and fisheries benefits. Included in this program could be postaudits of existing water development projects.

13. We need to develop better methods of passing game animals over water canals in irrigation areas.
14. We would also like to second Dr. Robert Lee's recommendations for studies of the impact of irrigation return flows; low flow requirements; a postaudit of Idaho's wild rivers; analysis of Idaho's salmon and steelhead resources past and future; analysis of the potential for reintroduction of steelhead and salmon above Brownlee Dam; postaudits of water projects.
15. We need to develop better analysis of the true cost to the public of subsidized development of new irrigation lands.
16. A study of use of waste water from nuclear plants for agricultural use would be worthwhile and is receiving some attention by the Fish and Wildlife Service.
17. We feel that Tom Davis' recommendation of the development of low cost methods and equipment to monitor water quality is well taken, as is his need for methods for predicting effects of housing developments on lakes.
18. We support the need for studies of the effects of waste discharges from fish hatcheries as well as from processing plants, feed lots, and other operations affecting water quality.
19. We also recommend the need for modeling studies to predict the waste absorption capacity of the various rivers and reservoirs considering the variability and flows, water temperatures, volumes by season, and input of water of various quality.

There were quite a number of suggestions at the meeting that had merit and I assume these will be listed in your resume. We share with you the hope that the development of this list of water research needs will result in stimulating the creation of a blue ribbon panel to select priority needs so that some of the more urgent studies can be undertaken as funds from all sources become available.

WATER RESOURCES RESEARCH INSTITUTE

ATTENDANCE LIST FOR RESEARCH NEEDS CONFERENCE, BOISE, IDAHO, 16 October 1970

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