ALASKA'S WATER RESOURCES PROBLEMS AND RESEARCH NEEDS

Institute of Water Resources

Five-Year Research Plan

June 1980

Introduction

The Water Resources Research Act of 1964 authorized the establishment of a water resources research institute in every state. The objectives of the University of Alaska's Institute of Water Resources are to respond to priority needs identified by state and local government agencies, to make a significant contribution to regional and national water resources problems, and to conduct basic and applied water resources research. The Water Research and Development Act of 1978 urges state institutes to develop a program in close consultation and collaboration with leading water resources officials within each state to promote research, training, information dissemination, and other works meeting the needs of the state (PL 95-467, Section 101(b)(3)).

The purpose of this report is to summarize Alaskan water resources problems which have been identified through several cooperative efforts, to describe those problems that require research answers as opposed to administrative solutions or expansion of data collection programs, and to develop the Institute's plan for water resources research during the next five years. The plan will be updated annually for presentation to the U.S. Department of Interior's Office of Water Research and Technology (OWRT), which was established to administer and fund research programs for the state water resources research institutes.

Problem Identification Process

In Alaska, several organizations have been established to identify water resources problems and research needs. The most comprehensive effort has been undertaken by the Alaska Water Study Committee, which has published a number of reports. Important contributions have been made by other organizations, including the Inter-Agency Hydrology Committee for Alaska, the Water Resources Board, and Alaska chapters of national organizations including the American Water Resources Association, the National Water Well Association, and the Water Pollution Control Federation. Citizens groups, special interest groups, and municipal organizations have also participated. A description of the cooperative efforts undertaken by several groups is presented as a background to problem identification.

Institute of Water Resources - In October 1972 the Institute of Water Resources sponsored a seminar, Alaska Water Resources Needs for the '70s. The objectives of the seminar were to identify the water resources problems peculiar to Alaska, to delineate the state of the art, and to establish directions for future research (Carlson and Butler, 1973). Problem areas discussed by different panels included water quality, water resources control, resources development, and resources administration. Problem areas identified by the participants and by the advisory board included water resources management in cold climates, fisheries management, recreational lakes management, reservoir management, flood control, and urban water resource management.

The Institute has continued its efforts to identify problem areas and solicit input in the identification process. For the past five years, the Institute has published a quarterly newsletter and an annual report. Questionnaires have been circulated with the newsletter to obtain input. Identified problem areas include flood prediction and design, frozen soils, water supply in urban and village areas, waste disposal and management, toxic trace element management, aquatic resource management, and coastal zone management.

The Institute of Water Resources annually submits identified problems and research needs to the Office of Water Research and Technology. In the past, water quantity problems have included management of excess water, supply availability, and water allocation. Water quality problems include groundwater quality protection, upland watershed quality degradation, lake and reservoir quality degradation, estuary quality, and urban water. Problems with planning and management operations were also identified. More recently, broad priority problems that are similar to those of other states in the Pacific-Northwest include: instream flow requirements; conservation of water; conflicts between power, irrigation, and fisheries; and Native American water rights.

The Institute initiated the problem identification process for the five-year plan at the 30th AAAS Alaska Science Conference in September 1979. Topics discussed were aquatic life/freshwater systems and hydraulic engineering/facilities design and construction. Following group discussion, an assessment of water resources problems included data gaps, a lack of basic understanding of processes, lack of ability to predict base conditions or disturbances with quantitative accuracy, and the brush fire approach to problem solving used by many state agencies. Identification of research needs included data design, the need for studies and techniques to evaluate processes, and improved techniques for locating water. Recommendations for research priorities included more basic research to form a better foundation for applied research. Participants are listed in Appendix I.

Alaska Water Study Committee - The 1975 National Water Assessment, sponsored by the U.S. Water Resources Council, was a three-year study with the objective of identifying and describing: (1) existing and emerging water and related land problems from both a national and

regional perspective, and (2) the effects of not solving them. The assessment was undertaken as a cooperative effort among government agencies, public and private groups, and the general public. Special attention was given to the economic, social, and environmental impacts of not resolving the nation's water resources problems as they exist now (1975-1985) and as they might develop in the future (1985-2000).

The Alaska Water Study Committee works under the guidance of the Water Resources Council. This ad hoc committee is composed of representatives from state and federal agencies, the Alaska Federation of Natives, and the Alaska Municipal League. The Alaska Water Study Committee sponsored the Specific Problem Analysis portion of the 1975 National Water Assessment in Alaska. This task was called the Alaska Water Assessment. The general purpose of the Alaska Water Assessment was to present the state perspective on water and related land problems and sufficient information for the Water Resources Council to establish national priorities on water problems. The Committee appointed and directed a study team to prepare the Alaska Water Assessment.

The assessment was divided into four steps or activities. The first activity was an identification of present and future water problems (Alaska Water Study Committee, 1975a). Problems identified included those associated with Alaska's cold climate, its unique fish and wildlife resources, community water supplies and sewage treatment facilities, Alaskan institutional needs, and present and anticipated growth in the Alaskan population and economy.

The second activity involved compilation of information and assumptions on future levels of resource use, income, employment, population, and estimates of future water requirements. Using these data, the study team screened and, in some cases, redefined the initial problem list. Several geographic problem areas and statewide problem issues that appeared sufficiently complex and important to warrant more detailed analysis were selected. Some of the statewide problems dealt with remote village water, lack of data, instream water use, institutional practices, energy, and water availability (Alaska Water Study Committee, 1976a).

The third activity provided more detailed information for these problem areas and issues. It focused on problem effects and the probable social, economic, and environmental implications of not solving the problems. It also addressed the types of planning efforts which may be merited for the problem areas and the issues (Alaska Water Study Committee, 1976b).

The Alaska Water Study Committee (1977) has published a summary report as the last step of the Alaska Water Assessment, which summarizes previous steps in the assessment and sets out views of the Alaska region on relative importance and priorities for addressing water problems, together with conclusions and recommendations for solving Alaska's water and related land resource problems. This information was used by the

U.S. Water Resources Council (1978a,b) in preparing regional assessment summaries which are now being finalized and printed for distribution. The Alaska region is one of 21 regions nationwide. A chart and map showing problem issues for 16 areas in Alaska are attached.

Southcentral Alaska Water Resources Study (Level B) - The Alaska Water Study Committee (1975b) proposed a more detailed (Level B) study of the water and related land resources of Southcentral Alaska. The goal of the study is to reach agreement among local, state, and federal governments, private interests, and the public on a recommended strategy involving policies, programs, and projects for guiding future conservation, management, development, and preservation of water and related land resources.

The study is designed to address problems and issues of regional significance based primarily upon existing information, to prioritize these problems and issues, to understand and evaluate the interrelationships of water and resource allocation and land use, and to seek an agreement on recommended strategies (Alaska Water Study Committee, 1978). The focus will be on key long-term issues which can be adequately reviewed within the constraints of the study schedule and budget. A report and an environmental impact statement will be prepared. The report will set forth recommendations and relative priorities for follow-up actions by local, state, and federal governments.

Phase I involved a detailed assessment of present and future needs of six water and related land resource functional categories. A needs assessment has been prepared for each of the following categories: electric power, fish and wildlife, land use management, recreation, water quality, and water supply. Each assessment contains an inventory for the category, a projection of future needs and demands, and a discussion of laws, policies, and administration.

During Phase II, alternative single-purpose solutions that could satisfy projected needs identified in Phase I were developed. Together, the Phase I and II efforts will serve as building blocks for comprehensive planning. Areas and resources identified as being in conflict due to competing demands from different functional uses (e.g., electric power vs. fish and wildlife) will be analyzed, and alternative resource management strategies that are responsive to national and state objectives of economic development and environmental quality will be prepared.

The study is being coordinated with other ongoing planning efforts of the local government units in the study area, the Alaska Coastal Management Program, the various land use planning efforts related to the Alaska Native Claims Settlement Act, ongoing Level C studies such as the Metropolitan Anchorage Urban Study (MAUS) recently completed by the U.S. Army Corps of Engineers, and basin plans prepared under Section 303(e) and Section 208 of the Federal Water Pollution Control Act Amendments of 1972.

Alaska Department of Environmental Conservation - In 1977, the Alaska Department of Environmental Conservation published a water quality status report. In an overview of water pollution in Alaska, problems cited include: infrequent but potentially large oil spills; small, localized problems attributable to construction activities and resource exploitation; and compliance with water quality standards at selected stream segments. The Department published Issues and Choices in Alaska's Environment in 1978. The report defines land, air, and water quality problems and recommends a variety of actions. Water pollution control issues include placer mining, petrochemicals, chronic oil pollution, timber harvesting, salvage logs, and Beaufort Sea development. Water planning consideration issues include data for land use planning and water supply appropriation, rural village sanitation, water and sewer systems grants, water wastage, rainwater use, and water allocation for North Slope petroleum development.

The Alaska Department of Environmental Conservation's Division of Water Programs (1978) identified the need for explicit and detailed information on the physical, chemical, and biological characteristics of Alaskan waters and the ways in which water quality characteristics are altered by pollution in order to identify water quality problems and measure the progress of solutions. A capacity for rapid storage manipulation, display, and updating of data is essential to cost-effective water quality management. There is a lack of adequate water quality data for point and nonpoint source discharges from placer and load mines. Little information is available on water quality problems resulting from logging. Information on nonpoint sources, including urban and agricultural runoff and waste oil, needs to be compiled and put in a format that can be used to evaluate management needs. A method to correlate information from diverse sources into a map-base storage system needs to be developed.

The Alaska Department of Environmental Conservation (1979a,b) and the U.S. Environmental Protection Agency agreed that the initial phase of the Alaska Water Quality Management Planning Program would concentrate on nonpoint source pollution control, as authorized by Section 208 of PL 92-500 (the 1972 Amendments to the Federal Water Pollution Control Act). Five areas of study have been village sanitation, waste oil, timber harvesting, transportation corridors, and placer mining. Each study focused on identifying the problem, developing best management practices that could avoid or mitigate adverse water quality impacts from the activities, and recommending institutional and legal measures to implement the best management practices.

Although the five study topics were statewide in focus, nonpoint source pollution control was also examined in the Municipality of Anchorage (Anchorage, Municipality, 1979). The study focused on urban runoff in developed and developing areas, soil erosion and sediment control from construction sites, runoff and percolation from snow disposal sites, and failures of onsite wastewater disposal systems. The U.S. Army Corps of

Engineers (1979a-i) conducted a concurrent study to plan for water resources development in the Anchorage bowl. Studies included water supply, estuarine water quality, and a wastewater facility plan. In Anchorage, the major water resource needs are: adequate and dependable water supply sources for a growing population, improved and expanded wastewater collection and treatment facilities, effective systems to manage urban runoff, and determining the need to protect the water quality of Cook Inlet.

Research Problems and Priorities

The Institute of Water Resources prepared a summary of water resources problems and needs from available summaries in February 1980. Copies were distributed to ninety organizations (Appendix II), which were requested to designate a staff member to review the draft and provide input on the Institute's five-year plan. Designees to date are listed in Appendix III. Several groups also provided written comments, which expressed concurrence with identified problems and needs or clarified priority areas. Availability of the review draft was announced in the Institute's newsletter. A presentation on the development of the five-year plan and the problem identification process was made to the Water Resources Board in March 1980.

The Institute reviewed publications and written comments to determine which problems might be solved by research. Research problems are listed in seven categories. General problem statements with citations are followed by specific concerns of agencies that commented on the review draft (see Appendix III).

Hydraulic and Hydrologic Processes - Alaska suffers major flooding somewhere in the state nearly every year. The design of appropriate stream crossings for roads and pipelines that will withstand flooding and related erosion of foundations is another problem. Both flood prediction and design research must be directed toward techniques and methods suitable for Alaskan circumstances. Alaska has many problems caused by permafrost. A comprehensive resource program must address frozen soil hydrology as well as roadway embankment and building foundation design and protection (Alaska, University, Institute of Water Resources, 1975).

The Alaska Water Study Committee's Water Supply Work Plan Committee (1979) inventoried available surface water and groundwater and identified community water systems, availability of water, and problems in southcentral Alaska. Many streams and rivers have very little potable water due to extreme siltation. Problems are encountered with winter freeze-up of water supply streams in some villages. Groundwater aquifers in Anchorage and the North Kenai area have experienced some localized fluctuations in water levels, possibly due to excessive depletion. In other areas where groundwater yields are lower and quality is poorer, problems occasionally occur, often associated with cold temperatures.

The Alaska Department of Environmental Conservation (1979b) found that erosion of materials from roads, railroads, and pipeline corridors causes sediment deposition in Alaska's surface waters. The impacts of the sediment on water quality and fish habitat are similar to those described for timber harvesting. Excessive and continuing sedimentation can result from inadequate consideration of potential water quality impacts during the planning, design, construction, and maintenance phases of transportation facility development. Presently known and developing technology needs to be applied to transportation facilities in Alaska. Criteria and standards for controlling erosion for unique Alaskan situations need to be developed. These conditions include continuing and intermittent permafrost, unstable stream channels, extreme temperature changes, and glaciering.

Specific problems identified by agency review include:

1. Sediment transport on the North Slope - Alaska Department of Fish and Game (ADF&G)
2. Prediction and control of aufeis - Alaska Division of Emergency Services (DES)
3. Erosion control criteria and standards - DES, Tanana Chiefs
4. Flood prediction and design - Alaska Department of Natural Resources (DNR), Tanana Chiefs
5. Ice-jam flood prediction with LANDSAT - DES
6. Reservoir construction on permafrost - DNR
7. Dam construction standards - DNR
8. Behavior of braided rivers in the subarctic environment - U.S. Army Corps of Engineers (USACE)
9. Water supply prediction - Municipality of Anchorage

Geochemistry of Alaskan Waters - In many areas of Alaska, geologic activity has resulted in a very active geohydrologic subsurface regime, thus causing problems with surface leachate and toxic substances in groundwater supplies. Because of Alaska's mineralized, mountainous terrain, there is a need for studies directed toward the effect of geochemical phenomena on water (Alaska, University, Institute of Water Resources, 1975).

The Alaska Department of Environmental Conservation (1979b) found that surface mining operations frequently produce substantial discharges of water pollutants including sediments, organics, heavy metals, and other toxic substances. At present, there are few proven guidelines to control nonpoint source pollution generated by placer mining operations resulting primarily from the removal, relocation, and management of overburdened materials and tailings. Research is needed to determine tolerances and thresholds of indigenous arctic and subarctic aquatic species to changes in a variety of water quality parameters including dissolved oxygen, temperature, pH, ammonia, heavy metals, suspended solids, and turbidity. Information is also needed to improve the water quality standards, i.e., to classify waters more realistically for the protection of actual present and future uses rather than for all possible uses.

Specific problems identified by agency review include:

1. Effects of placer and lode mining - Tanana Chiefs

Aquatic and Terrestrial Ecology - The Alaska Water Study Committee's Fish and Wildlife Work Plan Committee (1979) determined that limiting factors for fishery and wildlife resources utilization include lack of a data base on which to adequately assess supply and demand, and lack of an adequate research data base for formulating comprehensive management programs for the resource.

Specific problems identified by agency review include:

1. Aquatic species criteria - U.S. Fish and Wildlife Service (USFWS)
2. Aquaculture research - Tanana Chiefs
3. Permafrost and nonpermafrost wetlands - USFWS

Aquatic Ecosystem Impacts and Management Strategies - Intensive lake and aquatic resource management in Alaska is only just beginning. Interest in using lakes for aquaculture and using lakes, rivers, and coastal areas for fish hatcheries is increasing. Studies are needed at all levels of research and management. With the current emphasis on outer continental shelf development, most of the water environment of the coastal zone needs to be examined through a series of comprehensive studies. Research is needed to determine the current and emerging role of various enforcement agencies as well as the adequacy of existing legislation for management of the coastal zone (Alaska, University, Institute of Water Resources, 1975).

The Alaska Water Study Committee's Recreation Work Plan Committee (1979) found large data gaps and a general lack of up-to-date information on recreation, due partially to several factors, such as deficiencies in research, personnel, and funds.

Specific problems identified by agency review include:

1. Evaluation and application of alternative instream flow methodologies - ADF&G, DNR, USFWS
2. Legal policies, private ownership of water - Sealaska
3. Relationship between groundwater withdrawal for irrigation and streamflow - Tanana Chiefs
4. Floodplain management research and policy - DES

Pollution Control Technology - An ever-recurring problem in village and urban areas is inadequate water supply. The extremely long, cold winter creates deficiencies in most Alaskan communities. The rapidly expanding resources base has caused a number of problems with groundwater distribution and recharge in urban areas. All these factors are complicated by: Alaska's sparse population; great transportation, construction, and operation costs; and poor understanding about many aspects of arctic hydrology. There is a need for developing operational water supply

systems for small communities, as well as better techniques of groundwater management in urban areas (Alaska, University, Institute of Water Resources, 1975).

Waste management and disposal are plagued by conflicting regulations and a lack of standard, environmentally suited designs adopted to Alaskan needs. Effective enforcement of credible environmental regulations that fit Alaska's peculiar circumstances must include development of appropriate land use controls in urban areas in order to solve groundwater pollution problems. Design, construction, maintenance, and operator training techniques are required for urban and remote communities (Alaska, University, Institute of Water Resources, 1975).

The Alaska Water Study Committee's Water Quality Work Plan Committee (1979) determined that areas needing most attention are: operation and maintenance of wastewater treatment plants; fertilizer and pesticide application control; logging on private lands; development of a framework to evaluate water quality conditions in harbors to accommodate the expanding fisheries industry; improved procedures for the U.S. Army Corps of Engineers' permits and for certifying federal licenses and permits under Section 401 of the Clean Water Act; and development of an efficient information retrieval system for monitoring the NPDES permit program.

The Alaska Water Study Committee's Water Supply Work Plan Committee (1979) found that there are few community water supply systems, and inadequate construction and maintenance of individual and community supply systems have resulted in quick deterioration and failures. In the Kodiak area, the need to utilize surface sources almost exclusively for potable water supply has resulted in the mandatory construction of expensive water systems and storage structures in areas of small populations. Inadequate construction and maintenance have occurred frequently, as witnessed by dam failure and quick deterioration of village water systems.

The Alaska Department of Environmental Conservation (1979b) concurred that the lack of satisfactory waste disposal facilities in rural Alaskan villages results in unsafe water supplies, localized pollution of surface and groundwater sources, and a high incidence of waterborne disease. Adverse physical conditions frequently make conventional disposal systems impractical. Most villages do not have funds or an administrative structure sufficient to construct, operate, or manage water or wastewater treatment and disposal systems. State and federal agencies assisting in providing facilities do not always coordinate activities with each other.

The Alaska Department of Environmental Conservation (1979b) also found that although timber harvesting practices on public lands have been managed by federal and state agencies, such control has not been practiced on private lands. Various aspects of timber harvesting, primarily

road construction and logging, have been responsible for severe, adverse impacts on water quality. A program to permit appropriate utilization of the state's resources, while protecting related resource values (such as water quality from degradation), needs to be developed for private lands in order to ensure the long-term productivity of timber, water, fisheries, and related resources.

Specific concerns identified by agency review include:

1. Water uses and wastewater treatment in seafood processing - DNR
2. Rural water supply and treatment system alternatives - DNR, Bristol Bay Borough, Tanana Chiefs
3. Onsite waste disposal - Municipality of Anchorage
4. Pollution control technology and environmental effects related to mining - Tanana Chiefs

Alternative Energy Technology - The Alaska Water Study Committee's Electric Power Work Plan Committee (1979) identified basic problems associated with energy and power development in Southcentral Alaska. The range of available power supply options will be significantly reduced because of proposed wilderness, park, refuge, and wild and scenic river designations. Coal may not be an available alternative because of air quality regulations. Each alternative for power supply and transmission has a variety of environmental considerations.

Specific concerns identified by agency review include:

1. Feasibility of groundwater heat pumps - DNR, Water Resources Board
2. Utilization of geothermal resources - DNR
3. Alternative energy for rural areas - Tanana Chiefs

Information Dissemination and Training - The Alaska Water Study Committee's Water Supply Work Plan Committee (1979) identified lack of data as the number one problem. No agency or collection of agencies has currently comprehensively collected water resources information. The apparent lack of concern about water availability by developers and agencies is identified as one factor hampering better water resources information gathering.

Specific concerns identified by agency review include:

1. Water resources training - DNR, USFWS
2. Data base management strategies - Alaska Department of Transportation and Public Facilities (DOTPF), USFWS, Water Resources Board

Current Research Summary

An overview of current research is presented to identify problem areas that are receiving attention, and to place the Institute's research role in perspective.

The Institute maintains an information office in Anchorage at the University's Arctic Environmental Information and Data Center (AEIDC). AEIDC monitors current research in Alaska and annually updates its data base. The data base covering the last three years probably represents about ninety-five percent of the research being conducted in the state. Before presenting statistics on water resources research, the following qualifications should be noted: research projects are listed as presented by the investigators; thus, one individual may define many elements of a program as separate research projects, whereas, another individual may call an entire program one project. The figures listed in Appendix IV should be used as a guide.

The data base for calendar year 1979, which includes many projects continuing into 1980, was searched on the topics glaciology, snow, permafrost, hydrology, limnology, fish, and water supply and utility systems. A list of the 277 projects was produced for the Water Resources Board and is on file at DNR's Water Management Section in Anchorage and the Institute of Water Resources in Fairbanks.

There are many other research areas that relate to water resources. These include the atmosphere, geology and geomorphology, forestry, soils, and land use planning. Approximately one-quarter of all of the research being conducted in Alaska has relevance to water resources.

Hydraulic and Hydrologic Processes, Geochemistry of Alaska Waters - Research for these two areas is listed under glaciology, snow, permafrost, and hydrology. In the field of glaciology, about fifteen research projects were conducted each year, with most of the research being carried out by universities and the remainder by federal agencies, notably the U.S. Geological Survey (USGS). Research is focusing on the stability of Columbia Glacier, glacier surging, glacial depositional processes, and effects of climatic changes on glacier formation. Ten research projects on snow were conducted in 1977, mostly by federal agencies; while only six were carried out in 1978 and 1979, half of the research was done by the state. Snow research is limited to avalanche, snow depth, and ice thickness forecasting and development of collection techniques for engineering and water supply uses. However, the cooperative snow survey program includes the effects of many agencies. In the area of permafrost, about twenty-five research projects were conducted each year, mostly by universities and the U.S. Army's Cold Regions Research and Engineering Laboratory (CRREL). Permafrost research includes assessment of geotechnical hazards in developed and developing areas, control of permafrost under highways, effects of construction on permafrost, properties of frozen soils, and engineering properties of subsea permafrost. Over sixty projects were conducted annually on hydrology in 1977 and 1978. Three-quarters of this research was done by federal agencies--about half of that by USGS. There was some participation by the state university and the private sector. In 1979, forty projects on hydrology were underway, of which one-quarter were USGS, one-quarter were other federal, and one-quarter were university.

Hydrology projects include a number of data collection programs and reconnaissance studies. Research is being conducted on aufeis formation and control, flood analysis techniques, hydrologic models, and arsenic in groundwater.

Aquatic and Terrestrial Ecology, Aquatic Ecosystem Impacts and Management Strategies - Research for these two areas is listed under limnology and fish. Most of the limnological research has been conducted by Alaskan and out-of-state universities, but has decreased from forty projects in 1977 to twenty projects in 1979. Limnological research includes a number of studies on nutrient dynamics, effects of oil spills and road construction on arctic lakes, studies related to salmon spawning success, and baseline water quality and benthos investigations at the Delta agricultural demonstration project. Almost three-quarters of the fisheries research is conducted by the Alaska Department of Fish and Game, but the number of projects has decreased from about one-hundred-twenty in 1977 and 1978 to seventy-five in 1979. Many of these projects are data collection programs for management purposes. Other projects are directed at obtaining information on life history and habitat requirements of certain species.

Pollution Control Technology, Alternative Energy Technology - Research for these two areas is listed under water supply and utilities. During 1977 and 1978, many of the forty-five projects were carried out by the private sector, in most cases, under contract to the Alaska Department of Environmental Conservation. The increase of projects in 1979 to seventy-six reflects large and small hydropower reconnaissance and feasibility studies being conducted by the private sector, the Alaska Power Authority, and the U.S. Army Corps of Engineers.

Institute of Water Resources Research Role

Current and proposed activities of the Institute of Water Resources are listed for the seven problem area categories.

Hydraulic and Hydrologic Processes - The Institute's objective is to study hydraulic and hydrologic processes unique to the north and to develop management and prediction schemes for surface water and groundwater resources through field studies, modeling, engineering, and technology. Emphasis during the last year was directed towards developing an understanding of the hydrologic behavior of seasonally frozen soils. Results from this study will be useful for not only predicting surface runoff generated from these areas, but also appraising the potential for groundwater recharge and the transport of pollutants. A proposal has been submitted to the National Science Foundation to continue this field effort for three more years. The continuation of the program will allow for an examination of a wider range of conditions. The end product will be a model to predict runoff based on the soil conditions and input from snowmelt and precipitation.

The development of adequate and reliable groundwater supplies is a persistent problem throughout Alaska, especially in metamorphic and igneous terranes where substantial residential development is taking

place. The problem is especially acute in the highland terranes surrounding the two largest metropolitan areas, Anchorage and Fairbanks. The Institute will assess the usefulness of fracture-trace and lineament mapping for groundwater prospecting in terranes typical to Alaska. If proved useful, this too will greatly enhance water well location and offer large potential savings to the public.

A chronic problem of construction in Alaska is engineering structures on streams that will not impede fish passage. IWR will seek funding to address this immediate need.

Geochemistry of Alaskan Waters - The Institute plans to study the geochemistry of Alaskan waters (with emphasis on the source, content, and transport of major and trace constituents) and the application of various minerals to areas of water treatment and alternative modes of energy production. Researchers are examining the geomicrobiology of arsenopyrites in interior Alaska. Results show that bacterial activity is definitely associated with arsenopyrite deposits and may be a significant factor contributing to arsenic release to groundwaters. A broad spectrum of studies have been completed on arsenic contamination of groundwaters. These studies not only provide major new insight into arsenic contamination of groundwaters in the Fairbanks area, but they also provide valuable information to gold miners of the area. Two projects on hydrogeochemical exploration for uranium are awaiting analysis of samples by the Los Alamos Laboratory.

Aquatic and Terrestrial Ecology - The Institute is promoting an understanding of aquatic and terrestrial ecology (particularly related to development of renewable resources, mining technology, agriculture and forestry, and preservation of natural environments) through basic and applied research. Research funded by the National Science Foundation has examined the phosphate-limited growth kinetics of algae. The primary objective of this project was to use laboratory continuous cultures to evaluate the effect of changing macronutrient ratios on the microbial species composition of lake ecosystems. With the ability to measure both extracellular and intracellular nutrient concentrations, it is possible to predict not only ranges of species coexistence or exclusion, but also the exact biomass of the system. The implications of such results become apparent with the finding that the total biomass of a phosphorus-limited aquatic environment can be reduced by adding the correct macronutrient.

An application of algae nutrition for an assessment of higher plant nutrition in agriculture is part of a research proposal pending with the Environmental Protection Agency. Another proposal to this agency to study the microbial ecology of streams affected by placer mining will be submitted soon.

Aquatic Ecosystem Impacts and Management Strategies - The Institute's objective is to develop an understanding of subarctic and arctic aquatic ecosystems to assess adverse environmental impacts due to human activity,

and to provide both basic and management contributions to northern limnology. A review of the research conducted on oil spills in northern freshwater environments was performed for the U.S. Environmental Protection Agency. As a result of this work, recommendations were sent to the Alaska Department of Environmental Conservation on water quality criteria for hydrocarbons.

Studies on productivity of Clearwater Creek are continuing to provide insight into the environmental effects of large-scale agricultural development in the Delta area. A major effort will be required to understand productivity in Clearwater Creek. This research was begun under funding provided by the State of Alaska in the baseline environmental impact studies of the Delta Agricultural Demonstration Project. These funds were not adequate but did initiate the work. No funds were available for FY80. Currently, a proposal has been made to the U.S. Environmental Protection Agency for the funds to continue and expand these studies.

In a study of the local climate back into geologic time, two long cores were successfully taken from Harding Lake, Alaska, by a team of Japanese and Alaskan scientists. Analysis of the Harding Lake cores has not been initiated because of funding limitations. The Japanses Ministry of Education funded the first phase of analysis at a low level, perhaps because the cores were shorter than anticipated. Now that preliminary analysis has shown these to be as old as expected, funding agencies should become more generous. A proposal will be written to NSF for funds to analyze the chlorophyll degradation products of these cores.

Pollution Control Technology - The Institute intends to develop pollution control technology appropriate for developing both renewable and nonrenewable resources, and to generate methods for evaluating pollution transport in Alaskan air and water environments. A two-year study funded through the Alaska Sea Grant Program on wastewater treatment in seafood processing will end in November 1980. This study has concentrated on physical separation of solids from the liquid effluent. Laboratory tests have been performed in Fairbanks and a pilot plant built in Kodiak. A new proposal is being submitted to Sea Grant to extend this project to study the use of coagulants. It is desired in the future to apply some of this same solid-liquid separation technology to treatment of placer-mining waters, enhanced gold recovery, the physical cleaning of coal, and small-scale residential water and wastewater treatment systems.

A three-year project on oxygen transfer in salmon spawning media is nearly completed. This study has involved the measurement of hydraulic characteristics of flow through porous media and an analysis of these results to delineate their relevance to oxygen transport. The results should provide a basis for the development of scaling laws for hatcheries.

Alternative Energy Technology - The Institute will investigate alternative (especially solar) energy technologies suitable for the Alaskan environment and communicate these technologies to the Alaskan public. The Institute is publishing a "Builder's Guide to Water and Energy," a manual designated to aid all property owners and developers in assessing the water, waste disposal, and energy options for their sites. A report was recently completed for the Alaska Legislative Subcommittee on Power Alternatives entitled "Solar Energy--A Component of the Power Alternatives Study." A design for a passive solar rural school will soon be completed through the support of the Alaska Department of Transportation and Public Facilities and the U.S. Department of Energy. This design should markedly decrease the oil heating requirements of rural schools, which is presently a severe problem.

Information Dissemination and Training - The Institute's objective is to provide training for undergraduate and graduate students, continuing education for specialists, and public service by responding to specific inquiries and disseminating information developed at the Institute through newsletters, reports, and journal articles.

Student Training - Nine graduate students are working towards advanced degrees through IWR, including three who are pursuing doctoral programs. These students are associated with the Environmental Quality Science and Engineering Programs, the Oceanography and Ocean Engineering Program, and the Land Resources Management Program. Two undergraduate student helpers have worked part time during the school year and are working full time this summer. Most IWR faculty have joint appointments with academic units and, in this capacity, taught about three dozen graduate and undergraduate courses. In addition, IWR's microbiologist taught two courses at the Juneau campus.

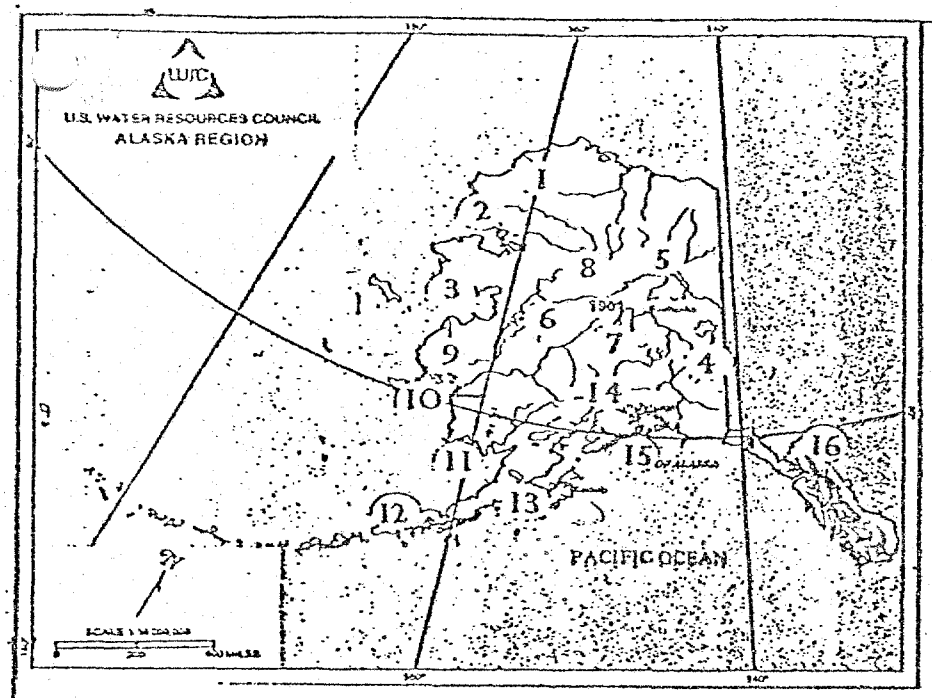
Continuing Education - Two short courses on statistical applications for specialists were offered, and a workshop on environmental effects of placer mining is being planned. A two-day seminar on solar heating systems was recently held for professionals in Anchorage. Two IWR investigators organized this seminar through sponsorship of the Department of Mechanical Engineering. IWR provided the keynote speaker to the First Alaska Alternative Energy Conference in Anchorage and the recent Solar Collector Workshop in Fairbanks. IWR personnel have taught short courses on solar energy in Fairbanks, Adak, and Unalaska.

Inquiries - IWR responded to approximately 2,000 requests for water resource information from government, industry, and the public. About 900 people received information and assistance on alternative energy in the past year.

FIGURE V-57
OCCURRENCE OF PROBLEM ISSUES BY AGGREGATED SUBREGION AND PROBLEM AREAS — ALASKA

Problem Issues	1901	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Water Quantity																	
Fresh Surface	0	X	X	X			X	X	X	X	X	X		X	X	X	X
Ground	0			X		X	X	X	X	X	X	X		X	X	X	
Marine & Estuarine			X									X					
Surface/Depth		X										X					X
Water Quality																	
Fresh Surface	0	X	X	X			X	X	X	X	X	X		X	X	X	X
Ground	0		X	X			X	X	X	X	X	X		X		X	
Marine & Estuarine			X	X							X	X		X	X	X	X
Surface/Depth																	
Related Lands																	
Flooding	0	X	X	X		X	X	X		X	X			X	X	X	X
Drainage															X		X
Erosion/Sediment		X	X	X	X	X	X	X	X	X				X	X	X	X
Dredge & Fill, Subsidence								X			X			X	X	X	
Water Related Use Conflicts		X		X		X	X	X	X			X		X	X	X	X
Other	0	X				X	X	X		X	X			X	X	X	

O Problem issues identified by Federal Agency Representatives
X Problem issues identified by State-Regional Representatives



ALASKA REGION

PROBLEM AREAS

1. Arctic
2. Kotzebue Sound
3. Norton Sound
4. Upper Yukon – Canada
5. Upper Yukon
6. Central Yukon
7. Tanana
8. Koyukuk
9. Lower Yukon
10. Kuskokwim Bay
11. Bristol Bay
12. Aleutian
13. Kodiak-Shelikof
14. Cook Inlet
15. Gulf of Alaska
16. Southeast

FIGURE V-56

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APPENDIX I

SCIENCE FOR ALASKA: 30TH ALASKA SCIENCE CONFERENCE

September 19-21, 1979

WORKSHOP: Alaska Water Resources Research Needs

Name	Affiliation
Robert Carlson, Chairman	Institute of Water Resources, University of Alaska
Linda Perry Dwight, Chairman	Institute of Water Resources, University of Alaska
Bill Barnwell	U.S. Geological Survey
Steve Bredthauer	U.S. Army Corps of Engineers
Quentin L. Florey	U.S. Office of Water Research and Technology
Carla Helfferich	Geophysical Institute, University of Alaska
Steve Kailing	Environmental Services Ltd.
Jeff P. Koenings	Alaska Department of Fish and Game
Jacqueline D. LaPerriere	Institute of Water Resources, University of Alaska
Bob Madison	U.S. Geological Survey
George McCoy	U.S. Geological Survey
Giles N. McDonald	Consultant
R. S. Samuelson	International Engineering Company
Richard Seifert	Institute of Water Resources, University of Alaska
Jack Van Hyning	Aquabionics Inc.
Church Vowell	City of Unalaska
Ming-ko Woo	Ma Master University

APPENDIX II

DRAFT FIVE-YEAR PLAN DISTRIBUTION

State

Alaska Department of Commerce and Economic Development
- Alaska Power Authority
- Division of Economic Enterprize, Planning Section
- Division of Energy and Power Development

Alaska Department of Community and Regional Affairs
- Division of Community Planning

Alaska Department of Environmental Conservation
- Commissioner

Alaska Department of Fish and Game
- Commissioner

Alaska Department of Health and Social Services
- Division of Public Health

Alaska Department of Law

Alaska Department of Military Affairs
- Division of Emergency Services

Alaska Department of Natural Resources
- Commissioner
- Water Management Section

Alaska Department of Public Safety
- Division of Fish and Wildlife Protection

Alaska Department of Transportation and Public Facilities
- Deputy Commissioner, Planning and Research

Alaska Office of the Governor
- Alaska Council on Science and Technology
- Commercial Fisheries Entry Commission
- Division of Policy Development and Planning
- Office of Coastal Management
- Oil and Gas Conservation Commission

Appendix II (continued)

Federal

Army
- Cold Regions Research and Engineering Laboratory
- Corps of Engineers, Chief

Bureau of Land Management, State Director

Bureau of Mines

Coast Guard

Department of Agriculture, Representative of the Secretary

Department of Commerce, North Pacific Fisheries Management Council

Department of Energy
- Alaska Field Office
- Alaska Power Administration

Department of Interior
- Alaska Pipeline Office
- Level B Study

Environmental Protection Agency, Alaska Operations

Federal Aviation Administration, Planning Staff

Federal Housing Authority

Fish and Wildlife Service
- Area Director
- Biological Services

Forest Service, Alaska Planning Team

Geological Survey, Representative of the Director

Heritage Conservation and Recreation Service

National Marine Fisheries Service, Auke Bay Laboratory

National Park Service, Alaska Area Office

National Weather Service, River Forecast Office

Public Health Service, Office of Environmental Health

Soil Conservation Service
- State Conservationist
- Snow Service Supervisor

Appendix II (continued)

Local

Municipality of Anchorage
Health and Environmental Protection, Environmental Health Division
Planning, Physical Planning Division
Public Works, Engineering Division
Water and Sewer Utilities

Bristol Bay Borough, Manager

Fairbanks Northstar Borough, Environmental Services

Haines Borough, Chairman

City and Borough of Juneau, Planner

Kenai Peninsula Borough, Borough Chairman

Ketchikan Gateway Borough

Kodiak Island Borough

Matanuska-Susitna Borough, Chairman

North Slope Borough, Manager

City and Borough of Sitka

Special Interest Groups

Alaska Oil and Gas Association

Cordova District Fishermen's Union

Prince William Sound Aquaculture Corporation

Tanana Chiefs Conference

Trustees for Alaska

Western Alaska Cooperative Marketing Association

Regional Native Corporations (12)

Pacific Northwest Oceana Region Water Institutes (5)

Water Resources Board (7)

Alaska Council on Science and Technology (7)

APPENDIX III

COMMENTS RECEIVED	NOMINEE
State	
Alaska Department of Environmental Conservation	
Ernst Mueller, Commissioner (none)	Dave Sturdevant
Alaska Department of Fish and Game, Habitat Protection Section	
Richard Logan	Bruce Wright
Alaska Department of Military Affairs, Division of Emergency Services	
Christie Miller	--
Alaska Department of Natural Resources, Division of Forest, Land, and Water Management, Water Management Section	
Brent Petrie	Steve Mack
Alaska Department of Transportation and Public Facilities, Design and Construction	
R. D. Shumway, Deputy Commissioner	Jon Scribner
Federal	
U.S. Army Corps of Engineers	
Colonel Lee Nunn (none)	(Tom Munsey)*
Department of Energy, Alaska Power Administration	
Donald Shira	Jim Cheatham

*Not able to participate in development of five-year plan, provided contact for information.

Appendix III (continued)

COMMENTS RECEIVED	NOMINEE
Federal (cont.)	
Department of Interior, Level B	
Richard Dworsky	--
Fish and Wildlife Service, Ecological Services	
Mel Monson	Gary Stackhouse
Fish and Wildlife Service, Biological Services	
John Morrison (none)	Norval Netsch
Fish and Wildlife Service, Biological Services	
Norval Netsch	--
Other	
Municipality of Anchorage	
Bruce Phelps	(Bruce Phelps)*
Bristol Bay Borough	
Flore Lekanof	--
Tanana Chiefs	
Rich Cormack	Rich Cormack
Sealaska Corporation	
Robert Loescher	--

*Not able to participate in development of five-year plan, provided contact for information.

APPENDIX IV

CURRENT RESEARCH CONDUCTED IN ALASKA

1977 (1550 Total Projects)

	Federal	State	University	Other	Total
Glaciology	5	–	10	–	15
Snow	7	2	1	–	10
Permafrost	8	3	8	2	21
Hydrology	38	7	13	6	64
Limnology	7	5	29	2	43
Fish	27	115	23	9	174
Water Supply & Utility Systems	10	10	5	18	43
					370

1978 (1700 Total Projects)

	Federal	State	University	Other	Total
Glaciology	5	–	7	1	13
Snow	3	3	–	–	6
Permafrost	8	4	12	3	27
Hydrology	40	6	7	4	57
Limnology	4	5	25	2	36
Fish	35	127	25	12	189
Water Supply & Utility Systems	16	13	2	17	48
					376

1979

	Federal	State	University	Other	Total
Glaciology	4	–	6	3	13
Snow	4	2	–	–	6
Permafrost	8	4	5	4	21
Hydrology	24	2	11	4	41
Limnology	1	1	18	2	22
Fish	12	75	4	4	95
Water Supply & Utility Systems	9	18	6	43	76
					277