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WATER QUALITY MANAGEMENT RESEARCH NEEDS FOR ALASKA

FEDERAL WATER QUALITY ADMINISTRATION
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by

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A Working Paper presents results of investigations which are to some extent limited or incomplete. Therefore, conclusions or recommendations--expressed or implied--are tentative.

WATER QUALITY MANAGEMENT RESEARCH NEEDS FOR ALASKA

By Sidney E. Clark

Alaska is a large state, as large as Texas, California and Montana together. Alaska has great wealth in natural resources, of which water is very important. With nearly 34,000 miles of coastline and approximately 40 percent of America's fresh water resources, Alaska has a lot to be proud of, as well as a huge responsibility.

The Arctic and Subarctic climates impose severe stresses on ecosystems without man's influence. Man's influence must be carefully managed to minimize detrimental effects. There are three major elements in water quality management that must be clearly understood before consistent predictable results are available. They are:

1. Appropriate social and government structuring to take immediate advantage of known planning and management knowledge and resources.
2. Design criteria for waste water treatment in cold regions, including various types of industrial wastes that are presently being discharged or may be anticipated, for the future.
3. Appropriate water quality criteria for all areas of the State.

The three elements are of equal importance; one cannot be separated from the others. Unlike the other states, there has not been a large volume of baseline data collected, therefore, the present water quality standards, based on the best information available, do have weaknesses that will require strengthening as the baseline conditions become better defined.

Research must provide input toward accomplishing a better understanding in the three stated areas.

Social and Government Structuring

Most engineers in the utilities business will argue that the most frustrating part of their job is their inability to put to use all that they know will work to optimize public benefits--a sociological element. Some of the most potent tools of community planning are water, sewers, hospitals, and schools. As we all know ever so vividly, these tools are not effectively utilized. Two very serious road blocks cause difficulties in optimizing the benefits of long range planning and utility installation; namely, financing and governmental structuring. We in Alaska have the unique opportunity to minimize both of the above problems and get on with the business of developing planned communities.

The financial and governmental restrictions may be minimized if the State of Alaska will develop a semi-private corporation having the power to draw upon state-wide resources as backing for revenue bonds, and with capabilities to develop systems having "trunk" capacity for future development. By making it possible for communities to provide public utilities at lower interest rates and allow systems to be constructed before they can be justified on a density basis, better planning will result. Existing systems may be incorporated into new systems with appropriate consideration to the citizens of any given community.

The areas of important research needs are: (1) Determination of sociological impacts on waste water treatment utilities, including methods of financing and ownership should be evaluated. Large capital investments are required in an industry having dramatic changes and improvements occurring. (2) Investigation of alternatives to local ownership and operation should be pursued including the possibility of a semi-private corporation or corporations backed by the State (possibly similar to the Tennessee Valley Electric Authority) that could provide area-wide services for water supply, sewage collection and treatment, and solid waste collection and disposal.

Waste Treatment

Effective waste treatment can be provided at the present time in Alaska. The requirements for research are to develop more economical methods of treatment, minimize environmental (weather) protection, and determine the influences of extreme temperature changes, low temperatures, etc., on process efficiencies and equipment reliability. New approaches and fresh thinking are necessary for solution of waste treatment and disposal problems at remote locations. Industry, on one hand, can afford to obtain and maintain sophisticated equipment while, on the other hand, small, remote villages do not have the investment capital or the operating funds for sophisticated equipment. Examples of other research needs are:

Investigation of low temperature disinfection; effectiveness and new methods.

Development of simplified equipment that may be operated with minimal environmental (weather) protection.

Establishment of temperature corrections for the design of biological systems, including prediction models to predict minimum water temperatures within systems, based on the type of sewer system, service area size and location within the State.

Development of improved or new methods for positive control of mixed liquor solids concentrations in activated sludge.

Determination of more economical but feasible methods for organic sludge stabilization and disposal, particularly methods that utilize Alaska weather extremes.

Development of design criteria for low-cost construction approaches, including materials and construction techniques.

Development of low-cost reliable physical-chemical tertiary treatment systems for remote site application.

Determination of sewage lagoon performance (seasonal and long term) under Alaska conditions.

Development of reliable systems for collection and treatment of sewage in remote Alaska villages.

Establishment of feasibility for waste recovery through by-product development and marketing for the fisheries industry.

Development of tertiary treatment systems for ballast water treatment.

Water Quality

Waste treatment is a means to an "end". That "end" must be effective water quality management or the costs of waste treatment are an unnecessary drain on community resources. The basic characteristics of any system determine the system's function and usefulness. Man, until recent geologic times, has not been part of the wilderness ecology. Therefore, wherever man goes and takes his life support systems, changes are inevitable. The key to man's success in fitting himself into the ecological balance of any given area lies with his ability to become a symbiotic part of the ecosystem he is entering. Establishing a favorable symbiotic relationship between modern man and water resources is what water quality management is all about. After all if we were not creatures of habit, we would not be utilizing water for transporting wastes just as the ancients thousands of years before us did, but instead would, by now, have figured out new ways. Until we accept the fact that our wastes must be utilized as basic resources to be reused in a useful manner, they must be viewed as potential resource pollution. The technology, although not economically usable under present value systems, is available to provide complete treatment of waste water, thus returning the waters to their original or better condition. The waste concentrate or brine then becomes a potential pollutant for air or land resources. Management, then, must be a decision making process that involves decisions relative to the most favorable trade-offs of water-land-air changes or deviations from wilderness conditions. Sludge removed from water in the purification process must be disposed of through burial (land resource pollution) or incineration (air pollution) unless it is utilized as a resource; thus the impact of decisions to protect one resource must be weighed against potential problems created in other areas.

Alaska has an Alaska State Plan, including Water Quality Standards, adopted in its original form back in the 1950's but undergoing a major revision in 1967 to comply with Federal requirements. The water quality standards were formulated utilizing the best information available. The people most closely involved with the Water Quality Standards are the first to admit that improvements will become necessary as baseline information is collected in various parts of Alaska to provide a more accurate picture of true conditions including those unique to a given area.

Some people hate to allow the collection and interpretation of basic data for definition of baseline conditions to be called research, but researchers are ill-advised to go forward without it. The first order of business, then, must be the collection and interpretation of basic data to establish what baseline conditions really are in various parts of Alaska.

The basic water quality parameters such as dissolved oxygen, bacterial contamination indicators, pH, turbidity, biochemical oxygen demand (BOD), etc., need to be tested for validity under various Alaska conditions and appropriate tolerable limits established accordingly. For instance, the standard BOD test is conducted at 20°C with 5-day incubation. It would be a rare occasion when a river or lake in Alaska ever reached 20°C water temperature. Therefore, of what value is the standard BOD test except as a yardstick? Faster and cheaper "yardsticks" are available. Possibly Alaska needs to consider the use of COD combined with biodegradability studies. The biodegradability studies should be conducted utilizing the subject waste or treatment plant effluent as a substrate at temperatures equivalent to stream temperatures, including provision to follow the annual cycle of stream temperatures.

Minimum acceptable levels of dissolved oxygen have been established, but in many cases levels far below the minimum have been recorded (less than 1.0 to 3.5 mg/l) in streams where man's influence is not a factor.

Lowering the State's minimum standards to winter low DO levels is obviously not an appropriate solution and utilizing a percentage of naturally occurring DO levels is not an answer either. Present evidence, although extremely limited, seems to indicate that winter DO conditions are one of the major limiting factors in stream and lake productivity under Alaska's wilderness conditions.

Basic research to establish the impact of low dissolved oxygen on Arctic and Subarctic freshwater benthic organisms and fish is necessary.

Unless an effluent is completely sterilized, pathogenic microorganisms are going to be added to the receiving waters. Since Alaska's rivers and lakes have near freezing water temperatures for a major portion of the annual cycle, allowable numbers of indicator microorganisms for various intended water uses, appropriate for temperate climate situations, should be seriously questioned if not significantly modified when applied to Alaska water quality management. The old Public Health correlation factors for pathogens to indicators also are open to serious question when applied to cold waters.

As we all know from personal observation, many of Alaska's major rivers are laden with glacial silt for significant periods of time during the summer. Obviously the silt does not disrupt the annual spawning activities of the various fisheries. However, man's activities that lead to the addition of turbidity through gravel removal may not follow the same cyclic pattern as nature and may also add turbidity to streams that would otherwise be clear. The impacts of increasing concentrations of turbidity, extending periods of turbidity, changing annua cyclic patterns on fish migration and spawning, and bottom siltation and clarification definitely need to be determined.

Whenever any material is handled, some is bound to be spilled, even under the best of control and best intentions. Intuitively, we become scared when oil, in any quantity, gets on water and particularly so if the spill is a large one; rightly so. Although oil seeps have been occurring for thousands of years, they do not normally occur in the same locations where man may lose control of oil he is transporting. Once the crude oil has reached Alaska's water systems, its fate needs to be understood. Biodegradation will take place; the question is how fast. Interaction of silt of silt-laden rivers and estuaries with oil will take place; the questions then become one of where does the oily silt deposit, what effects does it have on the benthic community and what rates of bottom degradation may be expected. Arbitrary controls of spills other than physical cleanup should not be attempted without more knowledge of the fate and effect of oil on the aquatic environments involved. Any chemicals added to control (sweep the oil under the rug) may well have more detrimental effect on Alaska's water resources than allowing nature to handle that portion of the spill that cannot be physically cleaned up. It should be obvious that a state rich in oil resources should be obtaining detailed knowledge of the interaction of oil and its land and water resources so that cleanup and control of spills may be systematic and effective--not panic and tragedy.

Remote sensing equipment that is effective in pipeline leak detection is necessary as there are undoubtedly going to be thousands of miles of pipeline in Alaska in the future.

One of Alaska's most important industries for some time to come is going to be forest utilization. Logging practices can have tremendous influence on the water resources, particularly small streams in the logging areas and estuaries utilized for log storage in log rafts. The influences of bark on estuary benthic communities where logs are or will be stored needs to be determined so that positive approaches to minimize the damage may be implemented.