WATER RESOURCE MANAGEMENT AS RELATED TO WATER POLLUTION CONTROL

By

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The subject of this paper, "Water Resources Management as Related to Water Pollution Control" represents a rather wide field. There are many ramifications involved in Water Resource Management and Water Pollution Control which make it difficult to confine a discussion to any single aspect. Because man-made impoundments, especially those built primarily for developing peaking electric power, are of great concern to those of us in Alabama responsible for water quality control, this paper will be devoted to this topic.

In Alabama, we have for the past fifty years or more been faced with problems caused by the impoundment of water. These problems involved mosquito control and it was not until recently that dammed up waters became of vital state-wide concern to the Alabama Water Improvement Commission from the standpoint of flow and quality control.

In one area of our state we have been faced with pollution problems due to low flows and sizeable discharges of municipal and industrial wastes. These problems were somewhat relieved by construction of a large hydro electric dam on the head waters of the river in this area which resulted in a substantial increase in low flows. Construction of another dam and reservoir above the area in question is nearing completion. The incorporation of power generation in this project resulting in drastic regulation of flows will present complex problems involving state, federal and local interest.

Since 1915 the Tombigbee and Warrior Rivers have been canalized from Jackson to Lock 17 near Birmingham. An all-year channel 9 feet deep, 200 feet wide and 400 miles long with 15 locks and dams was maintained until 1955. At this time the Corps of Engineers undertook an ambitious program of modernization. If the program had adhered to a plan outlined by the late Lt. Gen. Louis A. Pick, Chief of Army Engineers, in a talk at Tuscaloosa, Alabama, August 26, 1952, conditions caused by river developments would be less critical today.

In his talk General Pick identified replacement of the outdated locks and dams with modern structures as the most pressing need. When completed, these would cause the rivers to become almost a continuous reservoir. The primary purpose of the program would of course be for navigation with flood control and power generation representing additional benefits.

In planning these improvements it was recognized that the available supply of water for industrial and municipal uses was becoming increasingly critical in the upper reaches of the Warrior River which included water for the Birmingham area. Stream pollution problems, particularly in the Birmingham and Tuscaloosa areas, were considered along with the need to augment low flow for dilution purposes. General Pick stated that the Warrior-Tombigbee Rivers of that day had either too much or too little water, the Corps was operating obsolete structures for navigation, and the river systems for power production and provision of adequate water for waste dilution purposes had not been developed. He proposed that these problems be corrected and suggested a comprehensive plan for doing so.

Modernization of the Warrior River for flood and navigation purposes is practically complete. A reservoir, primarily for power purposes, was constructed by a private concern on the headwaters. Unfortunately, as often is the case, water supply and low flow augmentation were omitted from the overall water resource plan suggested by General Pick. The dams proposed specifically for flood control and low flow augmentation have not been constructed by the Corps of Engineers or by others. The headwater dam, originally proposed by the Corps and constructed by private interest, was designed for the production of power and flood control. All other benefits, including increased flow resulting in low flow augmentation on the lower reaches of the river, were incidental. Use of this reservoir, due to its design and financial structure, is extremely restricted.

With the completion of a lock and dam immediately above Tuscaloosa the situation with respect to water quality will again become critical. Power generation will be a part of this operation. As is the rule for all hydro-power operation, the project is designed for peaking power. During periods of low flow, water will be released over a period of approximately 2.5 hours each day; over a 5-day week. The remaining time no flow, other than lockage, will occur. Water-using industrial plants located below this lock and dam discharge effluents into the pool formed by a lower structure on the river. The absence of flow in the river for considerable periods of time will present problems of great magnitude despite treatment of effluents to the highest attainable degree. The situation is further complicated due to the high degree of development in the area in which the industries are located. Land for storage of effluent for discharge with river flow is at a premium.

The Warrior and Tombigbee Rivers as originally developed for navigation consisted of many low head dams over which considerable mixing and re-aeration occurred by flow. These are now replaced by six long deep lakes. Instead of 17 points for re-aeration there are now only six.

Two paper mills are presently located on the Tombigbee, thirty miles apart. Both mills are operating under Alabama Water Improvement Commission permits. When these applications were considered by the commission, re-

aeration occurred between the two mills. Calculations of treatment needs based on flows, stream recovery, effluent characteristics and other usual considerations indicated no serious waste assimilation problems.

Removal of the low head dams above and below the lower mill and construction of a new lock and dam below this mill has created unforeseen problems with respect to stream recovery.

I am sure that we were aware, sub-consciously at least, of results of changing flow characteristics on a river system. Perhaps we should have considered the possibility of such changes, but work loads and an inadequate staff do not always permit this kind of predicting. We learned an unforgettable lesson which has since been applied to other situations through changes that occurred on this reservoir: there is little oxygen recovery in waters moving through relatively deep sluggish reservoirs.

Following the Warrior-Tombigbee incident, another company proposed to construct a paper mill on one of our large streams which was unrestricted in flow. Plans to develop the river for navigation, however, were known at this time. Before approving the application to discharge waste, the Alabama Water Improvement Commission required that the company present data showing the effects of waste discharge on water quality under the condition of impoundment. This has since become an established policy.

The impoundment of all major rivers in Alabama to create deep sluggish pools is becoming a reality. The Warrior-Tombigbee is fully impounded from Mobile to Birmingham. The Alabama River is currently being developed throughout its length for navigation and power generation will be incorporated in two of the three locks and dams comprising the overall project. In all Alabama the Coosa River is fully developed for power purposes. With the development of the Alabama-Coosa River System and the Chattahoochee River which is now underway, all major river systems in our state will consist of deep sluggish pools throughout their lengths.

Recent developments on the Coosa, which were contructed primarily for power purposes by a private company, focused attention to problems resulting from severe regulation of river flow. Most hydro-plants must operate as peaking power units causing flows downstream to be interrupted in some instances for the greater part of the day. Dilution of treated effluents from municipalities and industry is a necessity if water of a reasonably good quality is to be maintained in the receiving stream. If flow is restricted, discharges must be restricted accordingly. If no flow occurs for various periods of time, effluents must be stored and the discharges from storage reservoirs adjusted to flow in the river. Existing industry located below power pools must adjust to meet these requirements if the approved hydro-electric project is to operate efficiently.

Private power developments are under the jurisdiction of the Federal Power Commission, and this agency in the past has not appeared to consider all downstream uses when studying applications for power development. All new industries must consider power operating schedules where applicable and must take into consideration low flows in other instances. In either case, storage and discharge is necessary if conditions demand.

The simplified discussions of problems that relate to and definitely affect waste discharges are in no way intended to be critical of any one or of any agency. The purpose is to point out additional reasons for over-all comprehensive planning in the development of river systems.

In Alabama I am afraid we are a little late in respect to some of these programs. The major portions of our river systems now consist of continuous impoundment, or will become so upon the completion of authorized projects. Over-all comprehensive river basin planning cannot be stressed too strongly.

Many questions arise: What agency will be responsible for this type of program? How will it be organized and discharge its duties with so many vested interests in water resources? How will it bring together in one solid package all interests? By what mechanism can decisions be made that will be final in nature? The answers to these questions are not within the context of this paper, but it is a problem which deserves the most serious attention of all of us engaged in the many activities of water resources.

I suspect that the deterring factor in developing comprehensive planning for workable water resources is the reluctance on the part of related water resource agencies to surrender any part of their activities to an overall water resource group. Leadership in bringing together agencies, particularly at state and interstate levels, interested in water use, conservation, and regulation to develop a workable comprehensive plan also seems to be lacking. There have been and there are now many agencies interested in water resource planning, but it appears that plans to place recommendations in action are inadequate. If sincere action programs could be worked out, individual interest would probably cooperate fully.

No matter what degree of treatment liquid wastes receive, they eventually end up in our streams or disposed of through the ground. If we are to continue to grow both industrially and urbanly, we must, through necessity, require that these wastes be treated to the highest degree practical. We must also manage our waters to accomplish the best and most beneficial use for all. Stream pollution control, therefore, is most important in overall water resource planning.

Adequate control of water quality requires that we be aware of conditions in our streams, lakes and reservoirs. Active streams have been

studied for years, and we have a fair knowledge of the ecology of free flowing water. We can predict rather accurately changes that will occur in water quality if a particular stream is called upon to receive and assimilate waste products.

Tests and procedures presently being used may not be adequate to draw conclusions as to behavior of reservoirs constructed on water courses for navigation, flood control and power generation. The need for additional study of reservoirs, particularly in the South, is apparent and urgent. It may be found that no two reservoirs will have the same characteristics. Recent surveys and investigations of the water quality of Lake Michigan are an example of the lack of knowledge we have of these type waters.

We in the South have given little attention to the overall study of reservoirs due mainly, I suppose, to other more pressing problems and to the fact that until recently such knowledge was not necessary. Increased impoundments, coupled with the necessity to use these waters for treated waste dilution, has made it imperative that we turn our attention to these studies. The studies should be designed to accurately identify conditions in each individual reservoir. Water quality should certainly be one of the parameters considered; but the effects of depth, nutrients, reservoir width, temperature and many other factors affecting water quality should be included.

A paper entitled "Eutrophication" presented at the 41st annual Convention of the Soap and Detergent Association, New York City, January 25, 1968, by Dr. Gerard A. Rohlich, Professor of Civil Engineering and Director of Water Resources Center, University of Wisconsin, is an example of the many unknowns involved in water quality control. The article definitely identifies the need for further study of this most important aspect of water pollution control.

Dr. Rohlich describes the magnitude of the problems and cites methods of prevention and control. According to the article it was estimated in the Lake Mendota drainage basin that the annual contribution from municipal and industrial waste water amounted to 47,000 pounds of nitrogen and 17,000 pounds of phosphorus. This is extremely high, but in addition rural run off contributed 52,000 pounds of soluble nitrogen with 45,000 pounds being derived from manure.

The problem of excessive aquatic growths caused by water enrichment is an old one, but only recently has it received national attention. Studies of algae blooms and aquatic growth have been largely confined, until recently, to highly advertised and developed recreation areas, to those waters taken for public water supply and to bodies of water subjected to mosquito (Anopheles quadrimaculatus)control. In the past, Tennessee Valley Reservoirs in Alabama have at one time or another been plagued with prolific microscopic growths and hard to control aquatic plants. So far as is known, waste products from municipalities or industries were and are not implicated.

Agencies charged with water pollution control can include in their programs the discharge of material from waste treatment plants that might affect aquatic growths including algae. These agencies can not be expected, however, to extend their activities to the control of run-off waters over the entire country side. It appears that control of run-off waters is rather limited at the present time. However, problems associated with waters of this classification are being recognized by many interested agencies, organizations and individuals.

Dr. John M. Lawrence, Fisheries Division, Department of Zoology, Entomology, Auburn University, has devoted many years to the study of aquatic plants, including their growth, herbicide treatment and effects on water quality. For the past two years he has been investigating certain water quality aspects of the Walter F. George Reservoir located on the Chattahoochee River. The project entitled "Relationships of Chemical and Physical Characteristics of Water to Aquatic Life in Walter F. George Reservoir" is sponsored by the Alabama Water Resources Research Institute, Auburn University, and has the following objectives:

1. To obtain monthly information on stratification and density currents in various regions of the reservoir during a three year period.

2. To obtain information on the distribution of oxygenated water (i.e.) those water regions suitable for occupancy by fish in various regions of the reservoir throughout each year.

3. To obtain information on the concentrations of plant nutrients, including minor elements and toxications, in various regions of the reservoir during various seasons of the year.

4. To obtain information on the concentration of suspended organic and inorganic materials present at various depths in various parts of the reservoir during different seasons of the year.

5. To obtain information on phytoplankton distribution, composition and production in waters at various depths and regions of the reservoir during various seasons of the year.

6. To determine rate of development and distribution of rooted aquatic plants at region samples in the reservoir.

7. To determine the condition of a variety of species of fish in various portions of the reservoir at different seasons of the year.

8. To correlate data to achieve the above objectives through computer data analyses and develop prediction techniques for use in future monitoring of waters, plants and fish life in the Walter F. George Reservoir.

The work that Dr. Lawrence has undertaken on this reservoir is most ambitious, and it is doubtful that all objectives can be explored within

the time limits of the project. In conducting this work Dr. Lawrence is evaluating most critically the data he collects. It is impractical to include a discussion of this data as it is too voluminous and presents too many unanswered questions. Dr. Lawrence has pointed out on many occasions that we have little knowledge of the behaviour of impoundments in southern waters. This exciting project is well underway and may be deemed successful if it does nothing more than identify problems and capture the attention of those responsible for water management and pollution control.

Developments on these reservoirs coupled with increased uses make it imperative that additional reservoir studies be accelerated to solve immediate problems.

As late as 1963 water pollution control agencies were considering waste discharges in relationship to the ability of the receiving stream to assimilate waste coupled to downstream usage and related factors. In other words the degree to which waste would be treated was based more or less on the ability of the stream to effectively handle the waste in question taking downstream use into consideration. This concept is expressed in the "Plan for Development of the Land and Water Resources of the Southeastern River Basins" prepared by the U. S. Study Commission, Southeastern River Basins dated 1963.

The report states: "The pollution abatement features are designed to provide satisfactory water quality in the face of large projected growth. All towns with 800 or more people would be served by systems of sanitary sewers and treatment plants designed to remove at least 35 per cent of the organic contamination before waste water is discharged to streams. A higher degree of pollution abatement is included in the plan for the larger, more concentrated municipal sources of pollution." Another section of the report states: "The estimate of water required for waste dilution in the years 1975 and 2000 has been developed from special studies and the utilization of data contained in prints of the Senate Select Committee on National Resources. The estimates are based on the volume of waste to be treated, as determined from municipal and industrial water use, the strength of the waste to be treated, and the maintenance of a minimum dissolved oxygen concentration of 4 parts per million in the receiving stream. It is also assumed that the degree of waste treatment by the year 1975 will afford a B.O.D. reduction of 70 per cent for municipal waste and 60 per cent for industrial waste. A higher degree is assumed by the year 2000 giving a B.O.D. reduction of 80 per cent for municipal waste and 70 per cent for industrial waste."

These statements were representative of the opinions of a majority of engineers and those engaged in administering stream pollution control programs in 1963 when the report was prepared. The Federal Water Pollution Control Act of 1965 required that each state adopt standards for all interstate waters within a certain period of time after which standards might be set by the Department of the Interior. Obviously, the previously successful policy of judging each discharge on an individual basis had to be replaced in favor of meeting certain established standards. Little would be

accomplished by a discussion at this time of standards and plans for implementation, both of which must be approved by the Secretary of the Interior.

All states have submitted plans to the Secretary of the Interior, but few have received unqualified approval. Material submitted by the states must meet certain requirements. For instance, primary treatment for new and increased pollution is not recognized unless the discharge is to the sea some specified distance from shore. All waste must, at the minimum, receive secondary treatment. In Alabama this is interpreted to mean 85% removal of B.O.D. from domestic waste and 75% removal of B.O.D. from industrial waste.

Waste treatment proposals have been escalated since the passage of the 1965 Federal Water Pollution Control Act. Requirements originally proposed for the year 2000 by the U. S. Study Commission, Southeastern River Basins, are now being applied in the year 1968.