GUIDELINES FOR ESTIMATING PERSONNEL REQUIREMENTS FOR STATE WATER QUALITY CONTROL AGENCIES

U. S. Environmental Protection Agency

December 1970

GUIDELINES FOR ESTIMATING PERSONNEL REQUIREMENTS FOR STATE WATER QUALITY CONTROL AGENCIES

by

WALTER R. HAGER
Program Grants Officer

Office of State Program Review & Assistance
Environmental Protection Agency
Washington, D.C. 20242

December 1970

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 35 cents (paper cover)

CONTENTS

Page

PREFACE 1

I. INTRODUCTION 3
Variations in Legislation, Administration, and Organization of Programs 4
Requirements for an Effective Water Quality Control Program 8
Need for Guidelines 9
Scope of This Study 10

II. TYPICAL STATE WATER QUALITY CONTROL PROGRAM 11
Authority 11
Program 17
Organization 22
Staffing 27

III. PROGRAM STAFFING GUIDELINES 31
Idealized Water Quality Management Program 31
Guidelines 35

ACKNOWLEDGEMENT 47

BIBLIOGRAPHY 47

TABLES

TABLE 1. Positions Authorized for the Staff of Texas Water Quality Board 28

2. Comparison of Public Administration Service Recommendations and Fiscal Year 1969 Man-Years Assigned to State Water Pollution Control Agencies 37

3. Texas Water Quality Board 1970 Workload 45

4. Estimates of Personnel Requirements for the Texas Water Quality Board Using Guidelines 46

FIGURES

Page

FIGURE 1. Organization—Federal Water Pollution Control Administration, January, 1970 6

2. Relationship of the Water Quality Board to Other State Agencies 14

3. Organization of Texas Water Quality Board 23

4. Field Operations of the Texas Water Quality Board—Districts and District Offices 26

5. Program Activities of Idealized State Water Quality Control Program 34

6. Idealized Organization State Water Quality Control Agency 36

7. Relationship of Inspection Frequency to Percent Urbanization 40

PREFACE

THIS work's purpose is to dispel the air of mystery surrounding staffing of Government agencies charged with regulating the quality of public waters. It was presented as a report to the faculty of the Graduate School of the University of Texas at Austin in partial fulfillment of the requirements for the Degree of Master of Arts in Public Administration in April 1970. While focusing on staffing needs for State water quality management agencies, the premise underlying the guidelines is that an agency's staffing is a function of the authority granted it and the workload resulting from the exercise of that authority. Since the bulk of expenditures by a State water quality management agency is for salaries and associated benefits, the numbers of personnel and the skills and experience needed to carry out the agency program also furnish a means for establishing an operating budget.

As State water quality management agencies are by and large staffed and directed by engineers and scientists, the guidelines, through use of an engineering methodology, may be readily useful to those agencies with only minor modifications for those functions not covered by the general model.

As presented, the guidelines provide only a method of approach founded upon the experience and observations of those using them. Used in this way, the methodology is responsive to varying conditions. However, the overall measure of their utility is the results of the water quality management program staffed using the guidelines, i.e., the quality and usefulness of the State's water stemming from the implementation of the authority assigned to the agency and exercised through its staff. The guidelines can provide direction in estimating total requirements for existing agencies, or for undertaking added functions, as well as serving as a tool for evaluating the effects on staffing and budget of reorganization and/or reassignment of functions.

The author's hope is that the guidelines provided in this report, by formalizing what program managers have been doing informally in various ways, will lead to the development of more effective water quality management programs.

W. R. HAGER

Washington, D.C.
NOVEMBER 1970.

INTRODUCTION

THE CASE for water quality management was well put by the Select Committee on National Water Resources of the U.S. Senate. It reported that by 1980 total requirements of water for all purposes, from surface and underground sources, will almost equal total developable supplies of 650 billion gallons per day and may by the year 2000 amount to almost double the available water. This magnitude of use is not necessarily a cause for alarm, as water can be used again and again as it flows to the sea.[1] Yet in the process of being used, these waters become polluted and may become unfit for some useful purposes. Hence, the growing demands for water in the face of limited supplies and increasing pollution necessitate an approach to water resources management founded on quality considerations as well as quantity.[2]

While the select committee's findings were published nearly 10 years ago, the general conclusion that future water needs will be met only by using the available supply over and over again, as is already occurring in some of the more heavily populated and industrialized areas of the country, has been increasingly validated with the years. To be used or reused, water must be of suitable quality. Use almost always results in degradation of the physical, chemical, biological, bacterial, and esthetic qualities of water, i.e., it is polluted.

Preventing and minimizing this pollution is the purpose of water quality management. Stated simply, water quality management means "providing the right quality of water in right quantities for the purposes to be served at the points where it is needed." [3] With the placing of increasing demands upon limited supplies, "more usable water can be provided to meet these needs by controlling pollution than by any other means." [4]

Water quality management has been correctly described as "both a concern and a responsibility of every segment of our society, and calls for the exercise of sound judgment and discerning statesmanship." [5] Satisfactory meeting of this responsibility, however, requires that much factual information regarding water availability, quality, use, and control, including the multitude of water pollutants and their effects, must be collected, analyzed, and disseminated, and also that sound technical,

---

[1] U.S., Congress, Select Committee on National Water Resources, U.S. Senate, *Water Resources Activities in the United States, Water Quality Management,* Committee Print No. 24 (Washington, D.C.: Government Printing Office, 1960), p. 1.

[2] *Ibid.,* p. 4.

[3] *Ibid.,* p. 2.

[4] *Ibid.*

[5] *Ibid.,* p. 3,

legal, and administrative procedures for the cooperative planning for multiple use of the available water resources be developed and applied.[6] These requirements, the basis of sound water quality management, are dependent upon the efforts of governmental water pollution control agencies.

Variations in Leglislation, Administration and Organization of Programs

The national Government and various States have followed similar paths in developing and implementing water pollution control legislation, resulting in continuing water quality management programs. Water pollution control legislation was first introduced by Senator Cockrell in the U.S. Congress on December 18, 1897.[7] Since that time, numerous bills have been considered in both the House and the Senate until at the present time, the Federal Water Pollution Control Act, as amended, (hereafter referred to as the act) guides the Federal Water Pollution Control Administration's activities.[8]

Even a cursory comparison of the legal, administrative, and organizational aspects of these programs reveals that no two are alike; but a broad generalized description can be given that all are expected to protect the quality of the waters of the States from degradation which makes them unsuitable for legitimate uses. The national water quality management legislation interlocks with the States' legislation and programs in purpose, administration and organization.

National Water Quality Control Program

The general interrelationship of the national program to the States' programs is setout in the declaration of policy of the act:

> (*a*) The purpose of this act is to enhance the quality and value of our water resources and to establish a national policy for the prevention, control, and abatement of water pollution. (*b*) In connection with the exercise of jurisdiction over the waterways of the Nation and in consequence of the benefits resulting to the public health and welfare by the prevention and control of water pollution, it is hereby declared to be the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of the States in preventing and controlling water pollution, to support and aid technical research relating to the prevention and control of water pollution, and to provide Federal technical services and financial aid to State and interstate agencies and to municipalities in connection with the prevention and control of water pollution. * * * (*c*) Nothing in this act shall be construed as impairing or in any manner affecting any right or jurisdiction of the States with respect to the waters (including boundary waters) of such States.[9]

---

[6] *Ibid.*

[7] U.S., Congress, House, Committee on Rivers and Harbors, *Pollution of Navigable Waters, Hearings* on H.R. 519, H.R. 387, and H.R. 4070, 79th Cong., 1st sess., 1945, p. 180.

[8] *Federal Water Pollution Control Act, U.S.C.*, vol. XXXIII, sec. 466 *et seq.*, (1969).

[9] *Ibid.*, sec. 466.

The control of water pollution is essentially a local function, with the State water pollution control agency responsible for coordinating local measures and works for preventing and controlling polluting conditions. The act does not alter this fundamental relationship. The national water quality management program places the primary responsibility for water pollution control on the State and interstate agencies with the Federal Government providing technical and fiscal support together with enforcement of national water quality standards on interstate and coastal waters.

National government interest in pollution began when regulation as carried out by the State agencies did not adequately control pollution in various waters, e.g., the Ohio River Basin. Through the years, the emphasis on control of water pollution at the national level has expanded from the protection of the public health (sanitary) aspects of water use to include protection of all legitimate uses through the addition of water conservation considerations. The passage of the Federal Water Pollution Control Act in 1956 [10] and its amendments [11] have provided for a program on a national scale which will serve the various purposes of water quality management.

The act created the Federal Water Pollution Control Administration (FWPCA) and provides for its staffing in general terms. In January, 1970, FWPCA was organized (as shown in fig. 1) under a commissioner and five assistant commissioners for Environmental and Program Planning, Administration, Operations, Research and Development, and Enforcement, respectively. The commissioner is in turn responsible to an Assistant Secretary of the Interior. The Administration's field operations are administered through nine regional offices. FWPCA during fiscal year 1969 had an authorized staff of approximately 2,200 positions and an operating budget of $73 million.[12] At the present time, there are more positions allotted to the national agency for regulation of water quality than by the combined 50 States to their water pollution control agencies.[13]

The key authorization in the act has the purpose of melding national and State programs through the preparation and development of comprehensive programs for water pollution control. The FWPCA is to develop such plans with the cooperation of other Federal agencies, the State water pollution control agencies and interstate agencies, and the municipalities and industries involved. The act requires further that in the survey for or planning of Federal agency reservoirs consideration

---

[10] U.S., Congress, *Federal Water Pollution Control Act,* Public Law 84–660, 84th Cong., 2d sess., 1956.

[11] U.S., Congress, *Federal Water Pollution Control Act Amendments of 1961,* Public Law 87–88, 87th Cong., 1st sess., 1961. U.S., Congress, *Water Quality Act of 1965,* Public Law 89–234, 89th Cong., 1st sess., 1965. U.S., Cong., *Clean Water Restoration Act of 1966,* Public Law 89–753, 89th Cong., 2d sess., 1966.

[12] U.S., Congress, *Public Works Appropriations for 1969 for Water Power Resources Development and the Atomic Energy Commission,* Public Law 90–147, 90th Cong., 2d sess., 1968.

[13] *State and Interstate Programs for Water Pollution Control, Digest of Fiscal Year 1969 State Program Plans* (Washington, D.C.: U.S., Department of the Interior, Federal Water Pollution Control Administration, State and Regional Program Grants Branch, 1969), sec. 2.

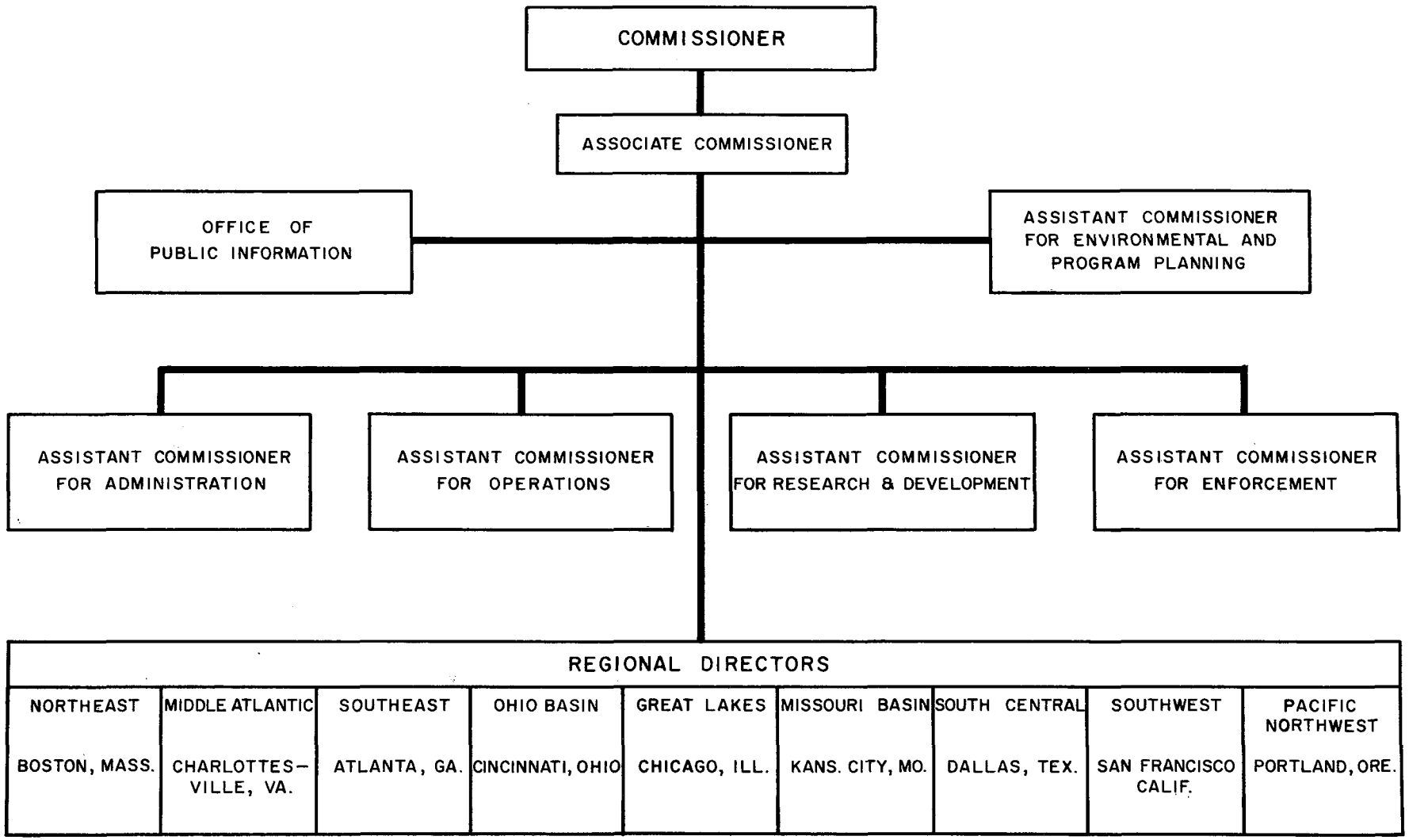


FIGURE 1.—*Organization—Federal Water Pollution Control Administration, January, 1970.*

be given to the inclusion of storage for regulation of stream flow for the purpose of water quality control. Also, with respect to water resources planning, the act authorizes grants to planning agencies for administrative expenses of developing effective water quality management plans for a basin.

The act directs that the Secretary of the Interior shall encourage "Interstate Cooperation and Uniform Laws" and gives the consent of the Congress for the negotiation of compacts between two or more States for water pollution control purposes. The act authorizes the Secretary to conduct in the Department of the Interior a "Research, Investigation, Training, and Information" program and to make "Grants for Construction" of necessary treatment works. A Water Pollution Control Advisory Board is established within the Department of the Interior consisting of the Secretary (or his designee) who shall serve as chairman and nine members appointed by the President, none of whom shall be Federal officers or employees. The act provides for the establishment of water quality standards for interstate waters under a procedure in which the States play the primary role. Standards and a plan for their implementation and enforcement adopted by a State become the standards applicable if, subsequent to their adoption, the Secretary determines them to be consistent with the purposes of the act. Enforcement measures against pollution of interstate and navigable waters by the Federal Government are also authorized. Cooperation to control pollution from Federal installations is likewise provided.[14]

At the outset, the act's "Declaration of Policy" recognizes the primary responsibilities and rights of the States in enhancing the quality and value of our water resources by prevention, control, and abatement of water pollution. Further, the act provides for technical assistance and financial aid to state and interstate agencies by the National Government. This policy is supported by the establishment of grants for water pollution control programs to assist the State and interstate agencies in meeting the costs of establishing and maintaining adequate water quality control programs.[15]

State Water Quality Control Activity

Though differing in the details of organization and other administrative aspects, the fifty states can be said to have similar water quality control legislation since all authorize the adoption of water quality criteria for interstate waters and a plan for the implementation and enforcement of those criteria. Further, the standards and implementation plans adopted by the States have been approved by the Department of the Interior.[16] Stemming from the similarities in legislation and approved plans, all State water pollution control programs are similar in function. All are designed for the purpose of protecting water quality. The Texas Water Quality Board is typical in authorizing legislation, administration, and organization for achieving that purpose. Having

---

[14] *Federal Water Pollution Control Act,* United States Code *op. cit, passim.*

[15] *Ibid.* passim.

[16] *Digest of Fiscal Year 1969 State Program Plans,* sec. 1.

much in common with the other 49, it will provide an empirical model for examining the workings of State water quality agencies.

The day-to-day control of water pollution is essentially a function of the local governmental entities together with the industries which dispose of wastes to the various watersheds. The State agency's relationship with this function is in regulating water quality. This regulating authority stems from a declared policy that the quality of the waters within the State is subject to control by the State government and that pollution of these waters constitutes a menace and shall be prevented, controlled, and abated.[17] Regulation of water quality through control of the actions of municipalities and industries which would result in quality degradation is the implementation of that policy.

The practical difficulties of dealing effectively with water quality problems are accentuated by the complexity of the pollutants and the fragmentation of control. While waste treatment and disposal is for practical purposes a local activity, it does not demand the duplication of facilities within limited areas as now exists. Resources in personnel, advice, training, finance, inspection, and enforcement are dissipated over an unnecessarily large number of sewage authorities, districts, and industries. Development and implementation of comprehensive programs for control of water pollution by the State water quality management agency is suggested by the national legislation as a remedy for this problem.[18]

Relations with industry present a problem when the industry is the main source of employment and prosperity in a locality. Some local authorities feel that too enthusiastic implementation of water quality activities by the State agency will drive the industry out and keep new industry from the area.[19]

Thus, the State water pollution control agency is faced with a complex balancing of values in protecting water quality through local pollution control entities under legislative and economic restraints which have developed over the years and continue to evolve.

Requirements for an Effective Water Quality Control Program

In a recent publication entitled *An Action Program for Clean Water,* a State water quality management program is described in five basic elements of effort: program administration, planning, facilities construction, technical services, and enforcement.[20] The basic elements

---

[17] U.S. Department of the Interior, Federal Water Pollution Control Administration, *Suggested State Water Pollution Control Act, Revised,* (Washington, D.C.: Federal Water Pollution Control Administration, 1966), p. 1.

[18] *Federal Water Pollution Control Act,* as amended.

[19] Thomas R. Jacobi, Richard A. Pavia, and E. F. Ricketts, "Staffing and Budgetary Guidelines for State Water Pollution Control Agencies," *Journal Water Pollution Control Federation,* vol. 37, No. 1 (January 1965), p. 10.

[20] Phillip L. Tate and James M. Hudgens, *An Action Program For Clean Water,* Joint Study and Proposals by South Carolina Pollution Control Authority and Federal Water Pollution Control Administration, Middle Atlantic Region (1969), p. 59.

in turn must be supported by suitable legislative authority, funding, and a plan of implementation to coordinate the five basic elements using the resources and personnel available.

Given all three of the essential supports—legal authority, funding, and an implementation plan to carry out the five basic elements—there remains a requirement for perhaps the most essential ingredient for an effective water quality control program: personnel. The essential supports are devised by men of various disciplines, and suitably trained personnel in adequate numbers are needed to carry out the plan of implementation. As surely as it is man and his endeavors which have affected water quality degradation, it is likewise man who must deal through his societal programs with this degradation by preventing and controlling it.

Need for Guidelines

Though much information and data have been provided to State legislatures and water pollution control agencies for guidance in setting up water quality control legislation, implementation plans, and funding, there has been little study of personnel requirements for effective State water quality management programs.[21] In January 1965, Jacobi, Pavia, and Ricketts presented "Staffing and Budgetary Guidelines for State Water Pollution Control Agencies." [22] The work for that report was done by Public Administration Service, Chicago, Ill. on a contract from the Division of Water Supply and Pollution Control, Public Health Service, U.S. Department of Health, Education, and Welfare. As such, it was oriented mainly toward public health program implementation and centered, in general, on service per unit of population. Since that time water quality management has broadened its emphasis from a public health orientation to involve other considerations noted but not used in the Public Administration Services study as foundations for criteria. For example, implementation of standards for interstate waters to enhance water quality and protect all legitimate uses was not a requirement of state water quality management agencies at the time of that sudy. Also, much weight was placed in the study upon needs to eliminate untreated discharges of sewage and industrial wastes. While this is still a consideration for some States, the bulk of the State agencies are now concerned with upgrading treatment of municipal and industrial waste to meet water quality standards in the streams.[23] Also, the number and complexity of water quality management considerations do not necessarily increase in concert with population and industrial growth. Guidelines for estimating personnel requirements could be made more useful through inclusion of consideration of diverse environmental conditions.

---

[21] The reader is directed to: U.S. Department of the Interior, Federal Water Pollution Control Administration, *Guidelines for Establishing Water Quality Standards for Interstate Waters,* Federal Water Pollution Control Administration, May 1966; *State Water Pollution Control Act, Revised,* supra; and U.S. Department of the Interior, Federal Water Pollution Control Administration, *The Cost of Clean Water,* Washington, D.C.: Government Printing Office, 1968.

[22] *Journal Water Pollution Control Federation,* supra.

[23] *Digest of Fiscal Year 1969 State Program Plans,* sec. 6.

Scope of the Study

This study proposes the development of general guidelines for estimating personnel requirements for state water quality control agencies based upon an examination of a typical program, that of the Texas Water Quality Board, and the projection of an idealized water quality control program.

TYPICAL STATE WATER QUALITY CONTROL PROGRAM

THE AUTHORITY to regulate water quality in Texas is vested in the Texas Water Quality Board. The Board was created by the legislature to administer the policy of the State on water quality, which is:

> to maintain the quality of the water of the state consistent with the public health and enjoyment, the propagation and protection of terrestrial and aquatic life, the operation of existing industries, and the economic development of the State; to encourage and promote the development and use of regional and area-wide waste collection, treatment, and disposal systems to serve the waste disposal needs of the citizens of the state; and to require the use of all reasonable methods to implement this policy.[1]

The program for carrying out this policy is developed by the Board and its staff.

The relationship between the program's requirements and the staff needed to carry out the requirements can be understood by examining the program which implements the State's water quality control policy and the organization which is evolving to operate the program effectively.

Authority

The Texas Water Quality Board was created by the Texas Water Quality Act of 1967.[2] This act was the culmination of legislative efforts to protect the quality of Texas waters which extend back at least to 1860.[3] Additional authority was given the Board by amendments passed during the 1969 session of the legislature.[4]

History

The first water pollution prohibition appeared in the Penal Code as the result of the acts of 1860 and prohibited the depositing of dead animals in Texas streams.[5] This prohibition underwent evolution and modification over the years and was repealed when the Texas Water Pollution Control Act was enacted in 1961.[6] The first civil statutes on

---

[1] Texas Legislative Service, S.G. 147 (61st Legislature, Reg. sess., 1969), sec. 1.02. Also Article 7621-d-1, *Vernon's Texas Civil Statutes.*

[2] Texas, S.B. 204 (60th Legislature, Reg. sess. 1967).

[3] Texas, acts 1860, p. 97.

[4] S.B. 147, supra.

[5] Texas, acts 1860.

[6] Texas, H.B. 24 (57th Legislature, Reg. sess., 1961), sec. 14.

water pollution were codified in 1913,[7] and underwent modification and change until repealed by the 1961 act.

Early water pollution control program activities in Texas were carried out primarily by the State Health Department, but protection of fish and wildlife was the responsibility of the Game and Fish Commission. The program was markedly informal, since the State was for the most part rural with its population spread thinly about the State area. Most early efforts were concentrated on regulating disposal of municipal sewage. The informality permitted considerable latitude and judgment by the law's administrators.[8]

As water pollution grew as a problem, the Texas Railroad Commission joined the health and fish and wildlife authorities, with responsibility for control of pollution from oilfield wastes.[9]

In 1953, the legislature created the Texas Water Pollution Advisory Council, composed of representatives of the Attorney General, the State Health Department, the Game and Fish Commission, the Board of Water Engineers, and the Railroad Commission and provided for a systematic exchange of views and information among the key State agencies although it had no real statutory authority, funds, or personnel as does the present Board.[10] The Water Quality Board has cited the Council's actions as the beginning of an effective program, with two significant steps. First, a program was undertaken to control pollution resulting from disposal of oil field wastes, principally brines. Second, a statewide water sampling network was established in order that the quality of the waters of the State would be monitored regularly to detect water quality degradation in advance of serious damage. This "Statewide Water Quality Monitoring Program" was a cooperative operation of the State Health Department and the Texas Parks and Wildlife Departments, i.e., game wardens collected water samples at strategic locations on the streams throughout the State, while the State Health Department laboratory analyzed the samples.[11] As with the other legislation which had evolved for the regulation of water pollution in Texas, the statute creating the Council was repealed by the State Water Pollution Control Act in 1961.[12]

The 1961 act authorized a six-man Water Pollution Control Board which was increased to seven by the 59th Legislature in an amendment adding as a member the chairman of the Texas Railroad Commission. The Board, under the 1961 act as amended in 1965, was closely aligned with the State Health Department by having the Director of the Water Pollution Control Division of that Department serving as Executive Secretary to the Board. The Board's technical, scientific, legal, and other services were performed by personnel of other State agencies. The execu-

---

[7] *Vernon's Annotated Revised Civil Statutes of the State of Texas* (Kansas City, Mo.: Vernon Law Book Company, 1969), art. 4444.

[8] Texas Water Quality Board, *Texas Water Quality,* A Summary of Water Pollution Control in the State of Texas, undated statement, p. 1.

[9] Ibid., p. 2.

[10] Texas, H.B. 448 (51st Legislature, Reg. sess., 1953).

[11] *Texas Water Quality,* op. cit., p. 2.

[12] H.B. 24 (57th Legislature, 1961), sec. 14.

tive secretary was designated the administrator of water pollution control activities for the Board.[13]

A new board with independent water quality management authority and its own staff was created by the Texas Water Quality Act of 1967.[14] The new Board also consisted of seven members: three appointed by the Governor and four from interested State agencies, Railroad Commission, Parks and Wildlife, Water Development and Health (see fig. 2). The Board's Executive Director, an employee of the Board, serves as chief administrative officer.

The Texas Water Quality Act of 1967 was the first general Texas statute dealing entirely with water quality control; other statutes concerning water pollution control either concern local jurisdiction or deal with regulation of specific segments of the economy, e.g., petroleum production or protection of fish and wildlife. The 1967 Texas act set out the State policy with regard to water quality control, created the Texas Water Quality Board, outlined a system of water quality control, provided for coordination of water quality control programs of various State agencies and local governments, and provided a basis for coordinating water quality control programs of the State with those of the National Government.

Specifically, the 1967 legislation delegated to the Board authority to:

(1) Administer the Act and to establish and control the quality of the waters of the State;

(2) Regulate, through a permit system, waste discharges into or adjacent to the waters in the State;

(3) Regulate, through area-wide orders, septic tank use to prevent pollution that may directly or indirectly injure the public health.

Further, the 1967 act imposed duties to:

(1) Encourage voluntary cooperation by various groups in preserving the greatest possible utility of the waters in the State;

(2) Encourage the formation and organization of cooperative groups of users of waters in the State for the purpose of providing a medium to discuss and formulate plans for the attainment of water quality control;

(3) Establish policies and procedures for securing close cooperation among State agencies concerned with water quality;

(4) Cooperate with governments of the United States and other States;

(5) Conduct studies and research on water quality criteria or control problems, disposal systems, and treatment systems for various wastes.

The 1967 Act granted the Board and its employees quasi-judicial powers to hold hearings and take testimony, quasi-legislative powers to make rules, and authority to institute legal proceedings to compel compliance with provisions of the legislation. In carrying out its duties and authorized function, the Board and its employees were granted the right of entry for investigating conditions relating to water quality in the State and to examine records pertaining to these matters. Authority was also granted to conduct investigations as the Board may deem advisable in discharging its duties, make contracts and agreements as necessary to the exercise of the Board's powers, and to perform such other functions as are necessary to carry on the Act.

Court review of Board decisions was provided for by this legislation.

---

[13] Ibid., sec. 3(g).

[14] *Vernon's Annotated Texas Civil Statutes,* op. cit., sec. 7621 d–1.

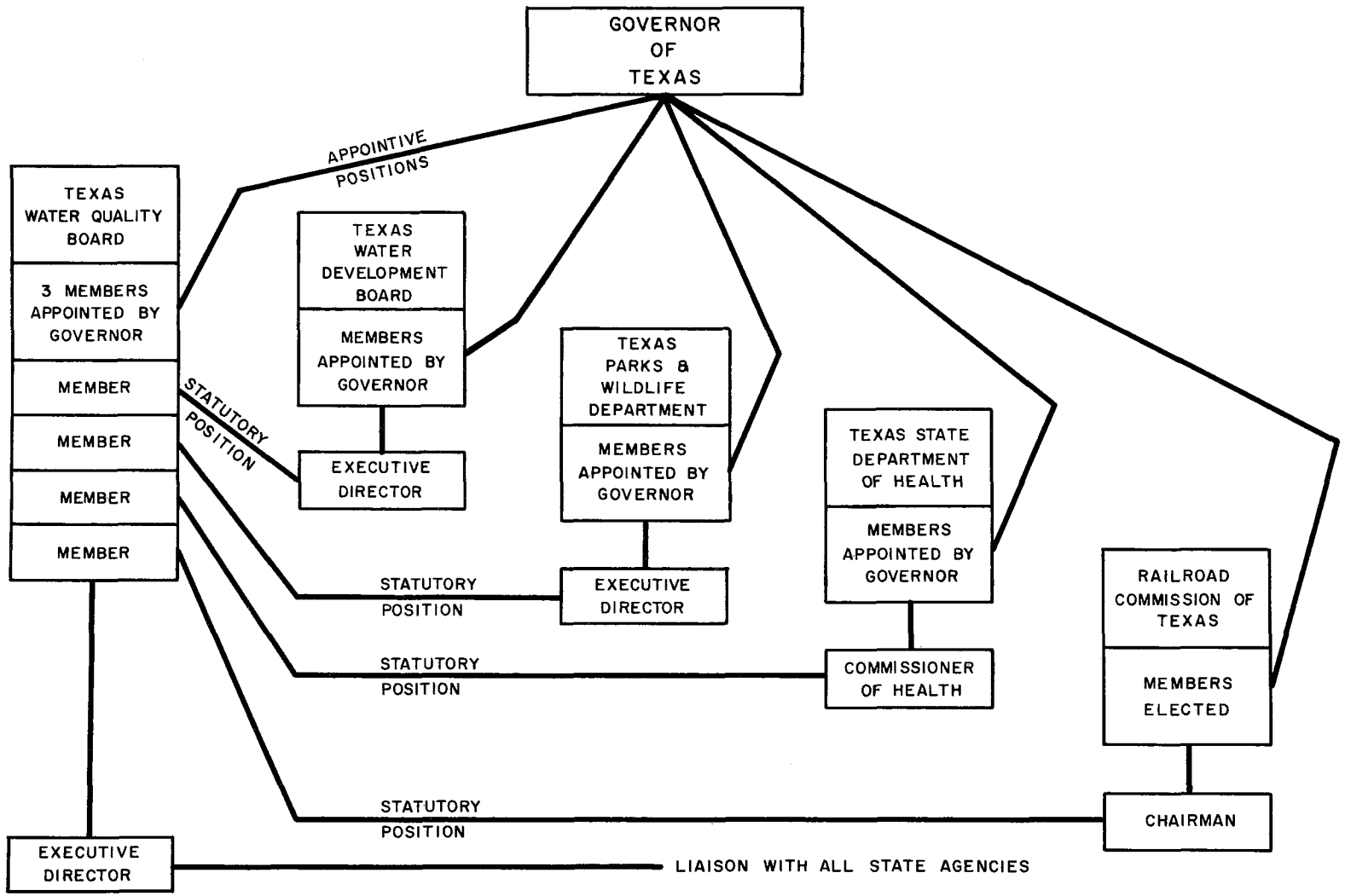


FIGURE 2.—*Relationship of the Water Quality Board to Other State Agencies.*
Source: Texas Water Quality Board.

A requirement that all persons proposing to construct or alter a sewer system or treatment system file preliminary plans and specifications 30 days prior to the start of construction was incorporated in the legislation as well. The Board was specifically granted power under the 1967 act to enter into agreements with Federal agencies and to accept funds from the Federal Government to aid in carrying out its program and duties, but imposed various restrictions, i.e., no grant shall be made for any project unless the project is approved by the Board and unless it is included in the State water quality program.

The 1967 law provided a general prohibition against pollution, set forth the enforcement procedures and penalties, the authority of local governments, exceptions, notice procedure, protection of common law remedies, protection of confidential information, validation of previous permits, orders, etc., repealed previous legislation, provided for severance of unconstitutional clauses, and set the effective date as September 1, 1967. These latter portions of the 1967 act supported and clarified the duties and authorities of the Board and its employees.

Texas Water Quality Act, as Amended

The legislature amended the Texas Water Quality Act of 1967 in 1969 by the enactment of a piece of legislation known simply as the Texas Water Quality Act (TWQ Act). This law amends, revises, and rearranges the 1967 act to improve its structure and provide for more effective control of water quality. The most recent legislation is broken into six sections covering the various authorities provided by the legislation.[15]

The 1969 Act designates the Board as the principal authority on all matters relating to water quality in Texas and responsible for establishing a statewide water quality sampling monitoring program. The 1969 legislation provides for prompt action when necessary to effectuate the policy and purposes of the law by authorizing the issuance of temporary orders relative to existing or impending waste discharges. The Board is specifically empowered to approve the construction or material alteration of all sewer systems, treatment facilities, etc. other than those reviewed by the State Health Department and the Water Rights Commission.

The 1969 Act includes a procedure for the Board to define the areas in which regional or area-wide waste collection, treatment and disposal systems should be used in place of a multiplicity of small plants and the Board can designate the system or systems to serve the area. The Board is granted authority to set rates which may be charged to the users of such a system.

With regard to accidental discharges and spills, the Board is given the power to adopt rules or issue orders establishing safety and preventive measures for activities which are potentially capable of causing or resulting in the spillage or accidental discharge of pollutional materials. The new law changed the enforcement provisions so that the discharge of certain defined types of waste is a violation unless the discharge is made pursuant to a permit, rule, or order of the Board, irrespective of

[15] Texas, S.B. 147 (61st Legislature, Reg. ses., 1969).

whether or not pollution results. In this way, a permit will serve as a device to regulate and control the quality of the discharges to Texas Waters.

In addition to these authorities, the legislature in 1969 placed the responsibility for regulating industrial solid waste disposal under the Solid Waste Disposal Act with the Board [16] and transferred the function of issuing subsurface waste disposal permits under the Injection Well Act from the Water Development Board to the Water Quality Board.[17]

Other Texas Statutes Affecting Water Quality Management

While the Board is under the Texas Water Quality Act vested with the largest portion of water pollution control authority, there does exist a substantial body of State and Federal law authorizing others to perform similar functions. The 1969 legislation is a synopsis of the cooperating agencies' functions. These duties and authorities are extensions of powers previously granted to the Water Well Drillers Board, the Water Development Board, Railroad Commission, Parks and Wildlife Department, State Department of Health, and local governments.[18]

The other statutes are:

(1) The Water Well Drillers Act establishes a licensing agency for persons engaged in the drilling of water wells and grants pollution control authority with respect to proper drilling and plugging of this type well.[19] The 1969 amendments transferred authority for regulation of injection wells for disposal of wastes to subsurface stratum from the Water Development Board to the Water Quality Board.[20]

(2) The duties and responsibilities of the Texas Water Development Board as specified by the TWQ Act are: "The Texas Water Development Board shall investigate all matters concerning the quality of ground water in the state and shall report its findings and recommendations to the board." The Texas Water Development Board is the state's chief water resource planning agency. The agency historically has been the state's groundwater investigation agency and has an extensive program for the protection of the quality of groundwaters and the investigation of possible pollution of these waters.[21]

(3) The Railroad Commission is vested with authority to control:

(*a*) pollution from wastes produced in connection with the production of oil and gas; [22]

(*b*) pollution which is likely to result from the plugging of abandoned oil, gas, injection or exploration wells; [23] and

(*c*) the business of transporting salt water from oil and gas wells for disposal elsewhere.[24]

(4) The Parks and Wildlife Department is charged with enforcement of the TWQ Act insofar as any violation occurs which affects fish and other aquatic life, birds, and animals.[25]

---

[16] Texas, S.B. 125 (61st Legislature, Reg. ses., 1969).

[17] Texas, S.B. 138 (61st Legislature, Reg. sess., 1969).

[18] *Texas Water Quality,* op. cit., p. 6.

[19] *Vernon's Annotated Texas Civil Statutes,* op. cit., art. 7621e.

[20] Texas, S.B. 138 (61st Legislature, Reg. Ses., 1969).

[21] Texas, S.B. 147 (61st, 1969), sec. 1.07.

[22] *Vernon's Annotated Texas Civil Statutes,* op. cit., arts. 60029 and 6005 (Oil and Gas Wastes).

[23] Ibid.

[24] Ibid., art. 6029b.

[25] *Vernon's Annotated Penal Code of the State of Texas* (Kansas City, Mo.: Vernon Law Book Co., 1952), art. 978f.

(5) The State Health Department's pollution control function is concerned essentially with protection of public drinking water systems and sewage disposal systems.[26]

(6) City governments are empowered to prohibit pollution of any stream which may constitute a source of water supply and to provide protection of a watershed using the concept of nuisance abatement and prohibition.[27]

(7) The General Land Office is vested with authority to control pollution resulting from all development (oil and gas production) of state owned (public) land.[28]

In addition, there are other statutes granting various degrees of authority to control water pollution to local governmental institutions such as river basin authorities, cities, and water districts. These together with certain interstate compacts providing for control of pollution of interstate waters complete the array of authorities augmenting the Water Quality Board's authority.

Program

The duties and authorities vested in the Water Quality Board by the legislature have resulted in a broad-based program for control of the quality of the waters of Texas consisting of six major program elements: Water Quality Standards, Permits, Enforcement, Planning, Construction Grants, and the Galveston Bay Study.

Water Quality Standards

Until very recently, the water quality in Texas streams and coastal waters was undefined. The program objective of the water pollution control agency was usually to prevent obvious pollution and to maintain the streams in such condition that pollution complaints were kept at a minimum. Also the quality was kept adequate to serve the various water supply functions that might be made of the State's waters.

In 1965, during the course of consideration of the water pollution problem in the Houston Ship Channel of Harris County, the Water Pollution Control Board began defining quality standards for the waters in that area. Following the enactment of the 1965 amendments to the Federal Water Pollution Control Act, the Board developed water quality standards for all Texas waters, both inter and intrastate. The standards and plan for their implementation were adopted by the Board in June 1967, and shortly thereafter were approved by the Secretary of the Interior. The standards are not uniform throughout the State but reflect natural differences occurring from stream to stream and varying quality requirements related to water use.

The Board administers a program for changing the standards as required by improved technical and economic evaluation techniques and changing quality needs in the various portions of Texas waters. This program also provides for monitoring the quality of the State's waters to ascertain whether the standards are being met and, if they are not, determining the cause of the departure from the set standards.[29]

---

[26] *Vernon's Annotated Texas Civil Statutes,* op. cit., art. 4477–1.

[27] Ibid., art. 1175(19).

[28] Ibid., arts. 5351 and 5366.

[29] *Texas Water Quality,* op. cit., p. 9.

Permits

As provided in the TWQ Act, waste discharges into the waters of the State shall be made only in accordance with the terms and conditions of a permit issued by the Board. At a minimum, each permit states: (1) The duration of the permit; (2) the maximum quantity of waste which may be discharged thereunder at any time and from time to time; and (3) the quality, purity, and character of waste which may be discharged in keeping with the permit requirements. Three types of permits are issued to regulate the quantity and quality of wastes discharged to State waters:

(*a*) A "statutory permit" (commonly called a grandfather clause permit) allows, under the 1961 law, waste discharges in existence at that time to continue;

(*b*) A "regular permit" is issued by the Board for new waste discharges; and

(*c*) An "amended permit" is a statutory or regular permit which has been altered at the direction of the Board following the carrying out of required quasi-judicial procedures.

The procedures to be followed in issuing permits require full investigation by the Board and its staff, full public disclosure of pertinent information, and notification of interested persons. The procedures provide for the protection of those subject to its regulation by notice, opportunity to be heard, and decision without bias. Independent review of Board action is available in the appropriate courts.

The Board requires the holding of a public hearing on each permit application following notice to the general public through newspapers and interested persons through direct mail advice. Persons wishing to support or deny the issuance of the permit are given an opportunity to be heard at the hearing, which is held as close to the area of the State where the waste discharge is to be made as possible. Hearings are held by a Hearing Examiner for the Board (usually an attorney) with the assistance of technical and scientific personnel. The examiner's report is reviewed and evaluated by the Board's staff and, after acceptance by the executive director of the Board, is considered by the Board. Majority approval of the Board is required for issuance of the permit. Similarly, majority opposition results in denial of a permit. The primary considerations in the Board's deliberations are: (1) the information obtained at the public hearing; (2) the technical staff's findings that in compliance with the Board's requirements the pollution control measures proposed are, as far as is reasonable and economical, the highest degree that can be obtained; and (3) the Water Quality Standards established for the State waters involved.[30]

The permit program element is closely allied with the water quality standards and enforcement program elements. The procedures and staff utilized in setting standards are a salient part of the permit program element. The water quality standards provide the bases for setting the effluent quantity and quality requirements contained in the waste discharge permits. The water quality monitoring portion of the standards. program element furnishes the data required to evaluate the effectiveness

[30] Ibid., pp. 10 and 21.

of the permit program, as well as information needed to allow for suitable revision of existing permits.

Enforcement

The enforcement program element is concerened with gathering the data and information needed to achieve compliance with the water quality standards and permits and initiation of suits against pollutors, i.e., those discharging without a valid permit or in violation of a valid permit. The TWQ Act provides that the Attorney General, at the direction of the Board, institute and conduct a suit for the State. In advance of the Attorney General's formal action, various informal and formal actions would be undertaken by the Board and its staff.[31]

Enforcement is based upon an inspection system, involving all permit holders, operated to assure that all significant waste discharges for which permits have been issued will be inspected at appropriate intervals. During the inspections, field analyses are performed and samples collected for laboratory analysis to confirm the quality of the waste water discharged.

When an inspection reveals that a waste discharge is not in compliance with the governing permit, the permittee receives a letter informing him of the violation and requesting remedal action. This letter does not specify a course of action. Should the violation continue, specific instructions for remedying the violation are provided through the following steps:

(1) Approximately two months following the initial notice of noncompliance, a followup inspection is carried out, and additional samples are collected.

(2) Should the followup indicate no substantial improvement, the permittee is notified that a detailed study will be made and specific recommendations submitted to the permittee. These recommendations are provided to the permittee in both informal and formal forms, i.e., verbally and in writing. Variations of this procedure are employed as circumstances dictate. However, in all instances, every conceivable step is taken to secure voluntary compliance to avoid institution of a suit by the Attorney General.

The Board refers to a policy of "enforced compliance" as denoting all those activities necessary to bring about compliance with water quality standards in cases where the agency is faced with recalcitrant or uncooperative attitudes on the part of pollutors. For violations originating within the State, the Board (or other agency having authority) can, acting through the State attorney general, initiate suit. In general, a public hearing, in advance of the suit, is held in the area of concern to gather pertinent evidence as to the causes and effects of the alleged violation. Should the facts warrant, the matter is then referred to the Attorney General's office with sufficient evidence to support a suit. Following referral, the Board continues to gather data and to attempt settlement of the matter through voluntary compliance.

---

[31] Ibid., p. 10.

When pollution originates outside of the State and adversely affects the quality of State waters, contact is initiated with the appropriate agency in the State involved to undertake the action which may be necessary to correct the difficulty through joint efforts.[32]

In a broad sense, the actions taken following the setting of water standards, the issuance of permits, and the followup inspection to assure compliance are all a part of the enforcement of the TWQ Act.

Planning

The planning program of the Board is setup to evaluate how the social and economic trends in the State will affect the Board's administration of a comprehensive water quality management program and how, in turn, the Board's programs, policies, and decisions will influence the social and economic growth of the State. The Board's program is coordinated with those of other State agencies. The Board's planning staff provides it with pertinent information on land use planning and economic considerations so that the Board will be able to properly evaluate the total effect of its decisions. The Board is represented on the 15 member Planning Agency Council for Texas (PACT). PACT is coordinated from the Governor's office and insures (1) that the results of planning efforts by one State agency are available to other State agencies; (2) that the impact of the plans of one State agency on the plans of another State agency are considered; and (3) that the total resources available to the State (universities, colleges, foundations, Federal Government, and industry) are applied to State planning for the solution of a problem and that the use of basic data by State agencies involved in planning is uniform.[33] The Board's planning activities, therefore, are conducted under the concept voiced by the legislature that the Governor is the Chief Planning Officer and that he is authorized to appoint Interagency Planning Councils in certain functional areas including natural resources and health. An example of this concerns area-wide sewage disposal planning.

The Texas legislature, at its Regular Session in 1967, appropriated $2 million to the Board to be used for "planning and feasibility studies, by contract, of area-wide sewage treatment facilities." [34] As a result, an ad hoc committee, consisting of representatives of the Office of the Governor—Division of Planning Coordination, the Texas State Department of Health, and the Board, has under preparation an "overview" of the State with respect to the need for area-wide sewage planning funds. The committee deduced that the extent of pollution problems is related to a significant degree to the population density of the area.[35]

It is the Board's responsibility to implement and administer the planning grant and loan program and to this end has setout policies and procedures for the use of these funds in the *Rules of the Texas Water*

---

[32] Texas Water Quality Board, *State Program Grant Application,* Water Pollution Control Program, FY 1970 [FWPCA–112 (Rev. 4–68)], pp. 25–27.

[33] *Vernon's Annotated Texas Civil Statutes,* op. cit., art. 4413 (32a).

[34] Texas, S.B. 15 (60th Legislature, Regular Sess., 1967).

[35] *Texas Water Quality,* op. cit., pp. 10–11.

Quality Board.[36] While the area-wide sewage disposal planning activities using the planning grant appropriations are the keystone of the Board's planning program, the Board's planning effort is not limited to administration of that appropriation.

River basin planning, for the most part, is carried out by river authorities in Texas. Several of the larger authorities have plans and most of the remainder are in the process of devising and/or initiating plans. The Board through its planning grants has funded or partially funded a large amount of planning in 8 of 14 basins.[37]

All of the long-range water quality management planning by the Board is keyed to State and Federal research efforts having to do with Texas waters. Constant attention is given to water quality management as the water resources of the State continue to be developed and used as the result of the growth of municipal and industrial water needs. A major effort toward developing area-wide waste disposal systems for the State's metropolitan areas and river basins is a large part of the water quality management plan. From these planning outputs come the necessary information to guide the Board in the issuance of permits and orders to promote logical orderly development of water quality control facilities.

In its general concept of planning the Board recognized the broad impact of its adoption and implementation of water quality standards for the surface waters of the state and that the effect of its decisions concerning permits for individual waste discharges is broader than the prevention of stream pollution. The planning program is the result of this realization, together with the need for interagency coordination and administration of planning grants.[38]

Construction Grants

Under section 8 of the Federal Water Pollution Control Act, as amended, the Board administers at the state level Federal grants for the construction of municipal sewage treatment works. Any municipality or similar public body created by or pursuant to State law and having jurisdiction over disposal of sewage, industrial wastes, or other wastes is eligible for a grant. The Board sets the priority of this eligibility as the requests for grants usually exceeds the funds available. Applications for funds are rated on the basis of financial need, condition of existing facilities, pollution aspects, nuisances, and readiness-to-go factors. This program is carried out in cooperation with the State Department of Health, which sets the design criteria for sewerage facilities under its public health authorities and reviews plans and specifications for proposed works to assure compliance with these criteria. (In addition, the Texas Water Rights Commission reviews and approves sewage disposal systems constructed by certain water districts.) During the construction of pollution control facilities under the Federal grant program, inspec-

[36] Texas Water Quality Board, *Rules of the Texas Water Quality Board,* adopted Nov. 28, 1967, pp. 46–55.

[37] *State Program Grant Application,* op. cit., p. 42.

[38] Ibid., pp. 51–52.

tions are made at the 25, 50, 75, and 100 percent stages of completion.[39]

The TWQ Act authorizes grants to supplement those of the Federal Government. However, no funds have been appropriated by the legislature to implement this program element.[40]

Galveston Bay Study

The Galveston Bay Study is a major program being conducted under the direction of the Board utilizing a wide variety of sources of finances and services. As planned, it is a 3-year, $3 million, multidisciplinary effort to determine the optimum management program for the Galveston Bay system waters. Expectations are that the managerial mechanism derived from the correlated findings of the study may result in the creation of a State agency patterned after the River Development Boards that have been successful in controlling water quality in the rivers of Germany. The study is being carried out by various State universities, agencies of the Federal Government, and consulting engineering firms under the management of a small Board staff to coordinate the contracts and inputs of the various agencies.[41]

Organization

The staff of the Texas Water Quality Board is organized into five divisions (see fig. 3) to carry out the program authorized and funded by the legislature. Each of these divisions is headed by a Director responsible to the Executive Director, and the Deputy Director, who assumes the duties of the Director in his absence. The five operating divisions are: Administrative Services, Field Operations, Central Operations, Hearings and Enforcement, and the Galveston Bay Study.

The Executive Director and his immediate staff direct and coordinate the activities of the five divisions and perform other required functions, such as coordinating the Board's activities with those of other agencies or institutions and reporting Board activities. These functions include public information, legislative liaison, interagency coordination, program and plans development and analysis.

Public information keeps the public informed of agency program activities, the effect these programs have on individual members of the public, and what can be done to gain maximum benefits from the programs. The information is as candid, nontechnical, and timely as possible. Similarly, this information in slightly more technical and detailed form is available to the legislature. Contacts with legislative committees are extremely important in making known to the legislature information on program progress, goals, and problems.

Interagency coordination provides the vehicle for the Board to interact with those State agencies affected by or having responsibilities in the

[39] Ibid., p. 34.
[40] Ibid., p. 33.
[41] *Texas Water Quality,* op. cit., pp. 13–14.

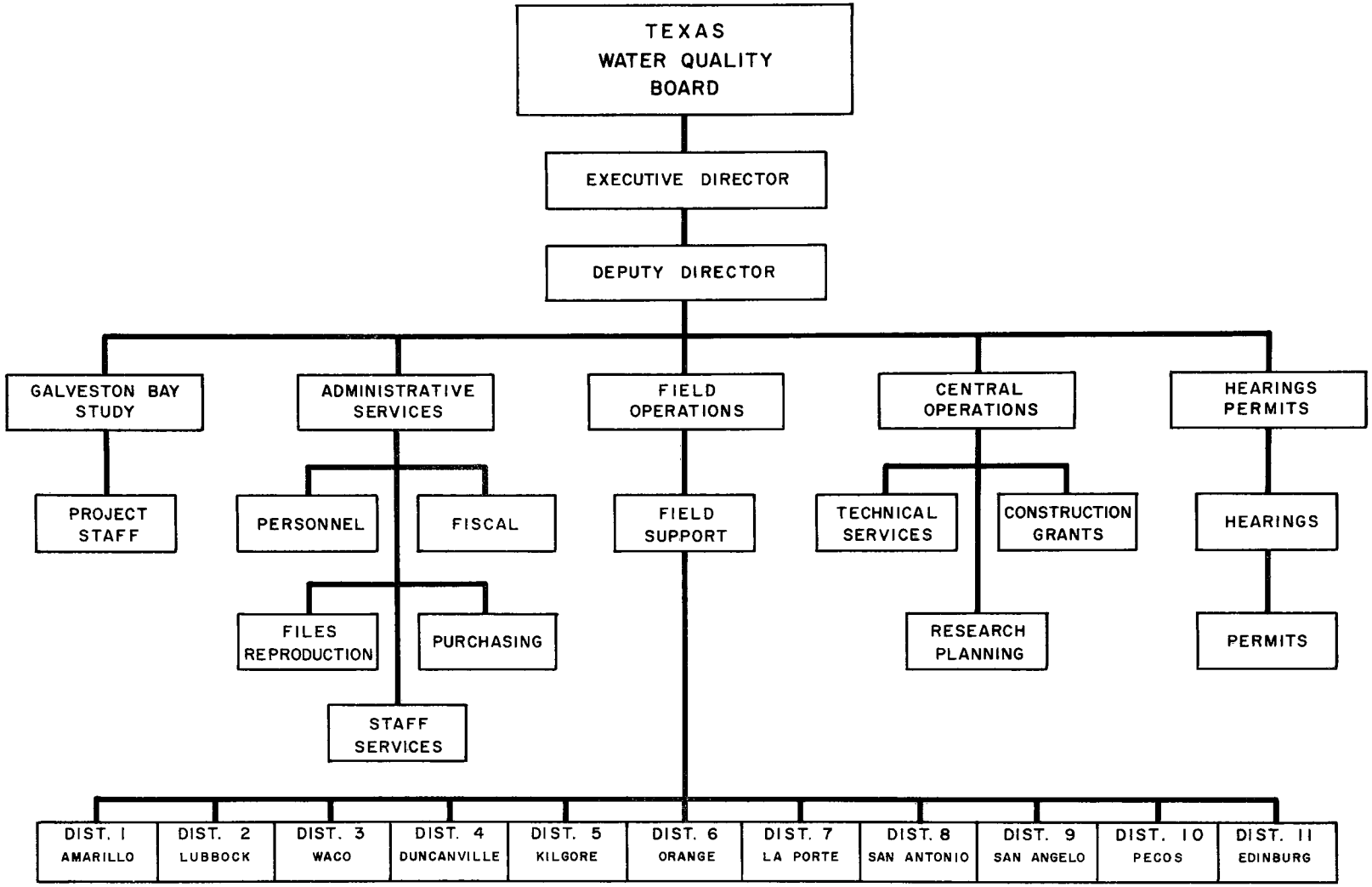


FIGURE 3.—*Organization of Texas Water Quality Board.*
Source: Texas Water Quality Board.

management of water quality, e.g., the Water Development Board, Parks and Wildlife Department, Railroad Commission, and the State Department of Health. The coordination is accomplished through informal contacts by agency staff and by membership on committees such as PACT and the water quality data committee chaired by the Board's representative, the Executive Director.

The analysis of on-going programs and their development along with new undertakings resulting from legislative actions is also handled by the executive staff. This is a continuing function for maximizing the value of objectives reached by the agency, considering the resources of manpower and money available to achieve those objectives. Based on these evaluations, changes in program management can be recommended to the Board, such as alteration of priorities or changes in goals. Programs and plans are developed to meet projected needs.[42]

The Executive Director has an Administrative Coordinator to aid in planning and coordinating agency activities and programs and a staff assistant with journalistic experience to carry on a public information program.[43]

Administrative Services Division

The Administrative Services Division has five sections: Personnel, Fiscal, Files and Reproduction, Purchasing, and Staff Services. This division provides functions without which the program activities of the Board staff would be severely hampered. Its clientele is the other divisions. Each section supplies a specialized service interrelated to the other sections of the Administrative Services Division and auxiliary to the operations of the other divisions.[44]

The Personnel Section is responsible to the Director of Administrative Services for carrying out personnel policies concerning recruiting and keeping qualified personnel and for the Board's continuing staff training and career development program.

A primary operation of the Fiscal section concerns budgeting, the allotting of funds to carry out the Board's functions. A second activity of this section is budgetary accounting, which is an integral part of the operating budget procedure. All disbursements made by the Board are conditioned on the Board's formal approval on recommendation from the Executive Director and certification from the Fiscal Section as to the availability of funds prior to the commitment of any funds. The accounting system is operated so that the Executive Director can know the fiscal position of the agency at any time.[45]

The Files and Reproduction Section maintains the Board's records and reproduces for distribution the documents which are a part of cooperation and coordination within the State government and intergovernmental organizations.

---

[42] Emory G. Long, Administrative Coordinator, Texas Water Quality Board, private interview, Jan. 21, 1970.

[43] *State Program Grant Application,* op. cit., p. 52.

[44] Emory G. Long, Administrative Coordinator, Texas Water Quality Board, private interview, Jan. 21, 1970.

[45] *State Program Grant Application,* op. cit., pp. 13–14.

The Purchasing Section handles the procurement of goods and services for the Board and its staff.

The Staff Services Section is responsible for dispersing office supplies, opening and distributing incoming mail, collection and posting of outgoing mail, clerical and secretarial assistance, office services and miscellaneous support to the agency staff. Originally, all secretarial and clerical staff was assigned to this section on pool basis.[46]

Field Operations Division

The Field Operations Division is organized to carry out routine technical operations and investigations in the field. For this purpose the State is divided into 11 districts with an office in each (as shown in fig. 4). The primary function of this division is determination of whether the municipal and industrial permit holders are operating in compliance with effluent requirements contained in their permits granted by the Board. This is accomplished through a routine permit surveillance procedure. In addition, the district personnel collect 15 quarterly and 145 monthly samples in the 109 zones of the inland river basins and 64 monthly profile samples in the 51 coastal water zones. These samples are collected and forwarded to the laboratory of the State Department of Health for analysis in order to monitor the State's inland and coastal waters with respect to the standards set for water quality. Field personnel conduct routine investigations to discover pollution discharges for which no permit has been issued; make inspections to determine qualifications and needs of communities applying for grants to construct sewage treatment facilities; instigate joint studies and surveys with other agencies of Government into causes, effects, and possible remedies of water pollution; and report their findings to the Board. The Field Support Section at the Board's headquarters in Austin provides technical backup for the field staff and augments them as needed for special situations which arise with regularity. In effect, this is a "trouble shooting" group.[47]

Central Operations Division

The Central Operations Division has three sections: Technical Services, Construction Grants, and Planning and Research.

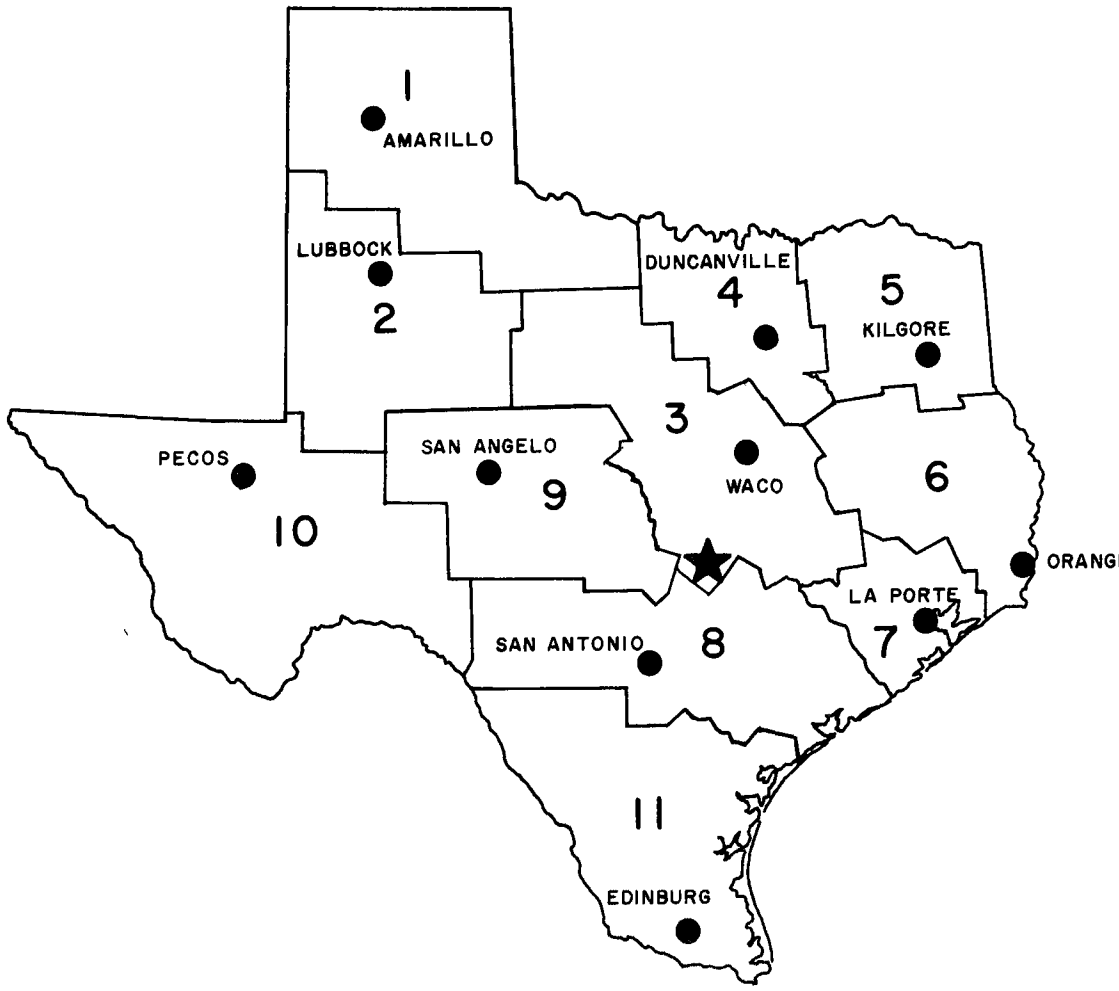
The Technical Services Section furnishes complete technical review of the treatment schemes proposed for various waste-producing operations which are submitted to the Board for permit approval, permit amendment, or for other actions. This section also develops the technical information required for evaluation of proposed or existing waste treatment facilities, the expected effluent quality, and the expected effect on receiving waters.[48]

The Construction Grants Section administers the program providing federal funds granted for construction of municipal treatment facilities. This section's staff processes applications for grants, determines priorities,

[46] Emory G. Long, Administrative Coordinator, Texas Water Quality Board, private interview, Jan. 21, 1970.

[47] Ibid.

[48] Ibid.



LEGEND:

2 DISTRICT NUMBER

★ CENTRAL OFFICE

● DISTRICT OFFICE

FIGURE 4.—*Field Operations of the Texas Water Quality Board—Districts and District Offices.*

Source: Texas Water Quality Board.

makes onsite inspections at 25, 50, 75, and 100 percent completion to ascertain construction progress and assure that all permit requirements are being carried out. Also, post-construction inspections insure that performance and maintenance are satisfactory and alert the district office personnel that followup is needed should operating problems be revealed.[49]

The Planning and Research Section administers funds appropriated by the legislature for the development of comprehensive water quality control and pollution abatement programs as well as handling the staff work involved in contracting for various research studies on the myriad

[49] Ibid.

of problems associated with water quality control. In developing recommendations for the Board's use in awarding planning grants or research contracts, priorities are established according to guidelines set by the section's staff. Applications are evaluated according to these guidelines. After the grant is awarded, this section follows the progress of the planning activity or research project.

In addition to the grants and contract activities, the section provides information and evaluation to the Board concerning planning and goals for its water quality management program.[50]

Hearings and Enforcement Division

The Hearings and Enforcement Division consists of the Hearings Section and the Permits Section.

The Hearings Section provides specific legal services for the scheduling and conduct of public hearings required by the TWQ Act for the modification of water quality standards and the granting or modifications of permits to discharge to State waters. Further, the section obtains legal information and technical data necessary to make recommendations to the Board regarding formal enforcement of Board orders.

The Permits Section issues waste discharge permits following favorable Board action and gathers and reviews all applicable data to insure adequacy of application content. This section also records all permit issuances and compiles statistical data pertinent to waste discharges.[51]

Galveston Bay Study

The Galveston Bay Study is a major effort to devise a program for optimum management of the waters of the Galveston Bay System. As such, it is an integral part of the overall water quality program of the State. As originally authorized the survey portion of the study was to be completed by 1971. However, due to the way the project funds were made available, it may be necessary to extend the study beyond the original completion date to accomplish the goals set in the study plan.[52]

Staffing

The program of the Board is carried out by a staff having a currently authorized strength of 135 positions as shown in Table 1. Approximately half of the positions are professional with the remainder being technical aides, secretarial, or clerical.

According to interviews with members of the Board's executive staff and the budget analyst for the Legislative Budget Board who is familiar with the Board's budget requests, the Board's staff is at a level which is below that required to administer the act effectively. However, while neither

[50] Ibid.
[51] Ibid.
[52] Ibid.

agency has devised parameters for determining adequacy, the staff is being developed on a phased basis.[53]

TABLE 1.—*Positions Authorized for the Staff of Texas Water Quality Board.*

ACTIVITY		POSITIONS
Executive:		
Executive Director	1	
Deputy Director	1	
Administrative Coordinator	1	
Staff Assistant	1	
Secretarial	4	
Sub Total		8
Administrative Services Division:		
Director	1	
Operating Staff	18	
Sub Total		19
Field Operations Division:		
Director	1	
District Offices Staff	41	
Central Office Staff	15	
Sub Total		57
Central Operations Division:		
Director	1	
Operating Staff	25	
Sub Total		26
Hearings and Enforcement Division:		
Director	1	
Operating Staff	20	
Sub Total		21
Galveston Bay Project:		
Director	1	
Staff	3	
Sub Total		4
Total		135

Source: Interview with Texas Water Quality Board personnel, Jan. 21, 1970.

Current evaluation of staffing is based on three principal considerations:

(1) Availability of the various disciplines and skills at the current State pay scales. Practically speaking, could the positions be filled with qualified personnel if the funds were appropriated? There has existed over the years a scarcity of qualified water pollution control engineers, technicians, and specialists, such as chemists and aquatic biologists

[53] Joe Teller, Deputy Director, and Emory Long, Administrative Coordinator, Texas Water Quality Board, private interviews, Oct. 1, 1969. Bill Wells, Budget Analyst, Texas Legislative Budget Board, private interview, Jan. 22, 1970.

willing to work at the pay scale established for State agencies. In this situation, the Board, knowing that the legislature is unwilling to appropriate funds which cannot be suitably expended, requests only the amount which it expects can be expended in the current technical skills market.

(2) The geographic and program distribution of staff within the organization, whether in the central office or in the field. This distribution of the existing staff and the disciplines represented on it is compared with the projected program needs. Staff assignments are correlated with the current and expected workload at each location and in each program. Current opinion is that the Board is understaffed, but it is not clear as to how much. Program goals are as yet not clearly defined enough to estimate total requirements for central and field operations.

(3) Recognition that administrative and auxiliary operations are functions of the size of the technical staff. For example, x number of engineers requires y secretaries or clerks for support. No firm parameters, such as amount of correspondence or filing operations, are used. As with the availability of technical skills, administrative personnel requirements are based primarily upon the judgment and experience of those planning, budgeting, and evaluating the personnel needs.

Requests for increases in auxiliary staff are evaluated upon expectations of increase in workload, including possible reallocation or reorganization of existing staff to handle the expected increase in activity. This type of evaluation is used for agencies which have existed long enough to be considered fully staffed to meet the administrative requirements of the laws under which they function. The Water Quality Board has not yet reached that point, as the legislature expanded its duties and responsibilities during both the 1967 and 1969 sessions.

The Legislative Budget Board's budget examiner keeps in close contact with the Board executive staff so as to be sensitive to the agency's conception of its effectiveness and budgetary problems, often offering advice as to potentially useful techniques and devices which have been used by other agencies within the State or in other States or governmental institutions.[54]

In summary, staffing requirements of the Texas Water Quality Board are determined through the judgment of the Board's executive staff in concert with that of the Legislative Budget Board considering mainly availability of competent recruits and expected workload. However, no workload criteria have been developed to date.

[54] Ibid.

PROGRAM STAFFING GUIDELINES

THIS REPORT proposes guidelines for the development of estimates of personnel needs of State water quality control agencies using the pollution control legislation suggested by the Federal Water Pollution Control Administration [1] as the authority for an "idealized (model) program."

Idealized Water Quality Management Program

The "ideal" water quality management program functions authorized in the suggested legislation prompts the derivation of an organization of general design to carry out these functions. This organization serves as a framework for the presentation of guidelines for the workload projections employed to estimate the number of personnel required for effectively implementing the authorized program. Thus, in this report the base for estimating the staff needed for program implementation is the suggested legislation.

Several current trends in State pollution control legislation should be noted. First, there has been recognition of the relationship between water quality control and solid waste disposal, with regulation of both based in the same agency, as in Texas.[2] Further, regulation of all forms of environmental pollution has been placed in one agency, i.e., control of air and water pollution as well as solid waste disposal, as in Arkansas.[3] While cognizance is taken of these apparent bellwether conditions, this report is limited to consideration of personnel requirements for State agencies concerned only with water quality control.

Ideal Program Authority

The model authority for the "ideal" program is the suggested act developed to aid in carrying out the requirement in section 4(a) of the Federal Water Pollution Control Act, as amended, "to encourage the enactment of improved and so far as practicable, uniform state laws. * * *" [4] The revised suggested act was issued in 1966 to include establishment of water quality standards throughout the United States and a "shifting emphasis from the mere abatement of existing pollution to the policy of preventing pollution in its incipiency." [5] The suggested act provides

[1] U.S., Department of the Interior, Federal Water Pollution Control Administration, *Suggested State Water Pollution Control Act, Revised,* (Washington, D.C.: Federal Water Pollution Control Administration, 1966), p. 10.

[2] Texas, S.B. 125 (61st Legislature, Reg. Sess., 1969), sec. 2.(7).

[3] *Arkansas Water and Air Pollution Control Act,* Act 472 of 1949 as amended by Act 183 of 1965, *Arkansas Statutes* sec. 81–1909 et seq. and sec. 19–2743.

[4] *Federal Water Pollution Control Act,* as amended, 33 U.S.C. 466 et seq.

[5] *Suggested State Water Pollution Control Act, Revised,* op. cit., p. viii.

the base for a model water quality control program. This program should be capable of responding to changes in: (*a*) pollution control technology, (*b*) water use and subsequent waste production, (*c*) population and industry size and location, and (*d*) water quality requirements to meet use shifts without requiring changes in the authority granted the regulatory agency by the legislature. Further, the program under this Act should be capable of responding to trends affecting water quality with resulting changes in the number and skills of the personnel required to carry out the program.

Cognizance is taken of the budgeting and appropriations procedures which describe the limits to which programs for water quality control can be implemented; however, it is assumed that the program for water quality control authorized in the suggested act is of key importance to the health and welfare of the State and, as such, enjoys the support of the people of the State and is granted adequate appropriations by the legislature. The suggested act sets no limit as to quality of the program authorized; so it is assumed that protection of the State's water resources is of considerable importance, thus requiring a program to meet the policy objectives of the suggested act.

In general, the legislation authorizing the program of the Texas Water Quality Board is congruent with the suggested act and the "ideal" program functions parallel those of the Board.

Ideal Program Functions and Organization

The ideal (or model) program and organization to carry it out is for study purposes. Perhaps the program and organization to be discussed and which will serve as the base for developing the personnel guidelines should have been designated "suggested" as was the act providing the model authority. However, it is not necessary for the purposes of this report to suggest a program and organization, only to devise them as a step to developing the guidelines. The specification of the program and organization as ideal should not be interpreted as representing it as best, for there is no general best program and organization for all state water pollution control agencies. The program and organization are nevertheless presented as ideal in the sense of being archetypal ideal (or prototype) for developing the personnel requirements guidelines under the authority described in the suggested Act. The various program elements and organization segments described below can be expected to exist in similar forms in those states using the water quality standards-permit type system for management of water quality, as in the typical program.

Under the suggested act the comprehensive program plan serves as the basis for management of the various program functions and activities such as planning, water quality standards, facilities construction, permits, and enforcement. All activities are dependent upon information and data describing water quality and the waste discharges affecting it. This information must be kept current to serve the planning and evaluation function which provides a means for assigning priorities to activities in terms of immediate, urgent, near future, and long-range needs to

assure compliance with existing standards or permit conditions and/or prevention of damages to water quality by the amendment of permits. Thus, the basic continuing program function is *surveillance* of the quality of the waters of the State and the waste discharges to them.

The information and data gathered by the surveillance activity in the field provide the bases for the planning, water quality standards, facilities construction, permits, and enforcement program activities. Each of the program activities requires different types of information and depth of detail in the information and data. The use of these data by each of the major program activities will illustrate the significant program functions and how each is coordinated with the others (as shown in Fig. 5).

Planning is carried on as a continuing program activity in two interrelated areas: water quality control program for the State's waters and the State's administration of that program.

Under the model program, the State's comprehensive water quality control program plan is assembled to meet present, near future (five years), and long range (25 and 50 years) needs of the State and as such will use the data furnished by surveillance activities to establish base data and trends in water quality, as in the typical program. The plan, as developed, serves as the foundation of the budgeting and appropriations process, since each year's needs would result from evaluation of progress in meeting the criteria set in the plan and development of conditions relating to them. The complexities of controlling water quality through the governmental process do not permit a piecemeal operation based upon solutions to problems after damage and degradation. Current practice recognizes the validity for prevention of pollution and, thus, the necessity of the continuing planning function. The development of the overall state plan for preserving water quality at a high level to serve a wide range of uses makes possible the development of a plan for the agency itself so that the required staff and leadership will be available when needed.

The data obtained from the stream (and coastal waters) surveillance activities can be evaluated to determine whether progress is being made toward meeting the standards, when a water quality improvement is required, or whether a degradation trend is developing requiring action to prevent pollution from violating the standards. The economic development of the state as projected in the state plan may from time to time require modification of standards. Information from surveillance activities is needed to determine whether such a modification is feasible and what its effect will be on water quality in downstream and upstream locations. Information developed by the water quality standards program activity provides inputs to the planning, permits, and enforcement activities.

The review and evaluation of data obtained from surveillance activity coupled with the water quality standards and state plan provides the basis for the permit function, i.e., issuance, denial, modification, or revocation. Permit program activities provide the foundations for the facilities construction activities.

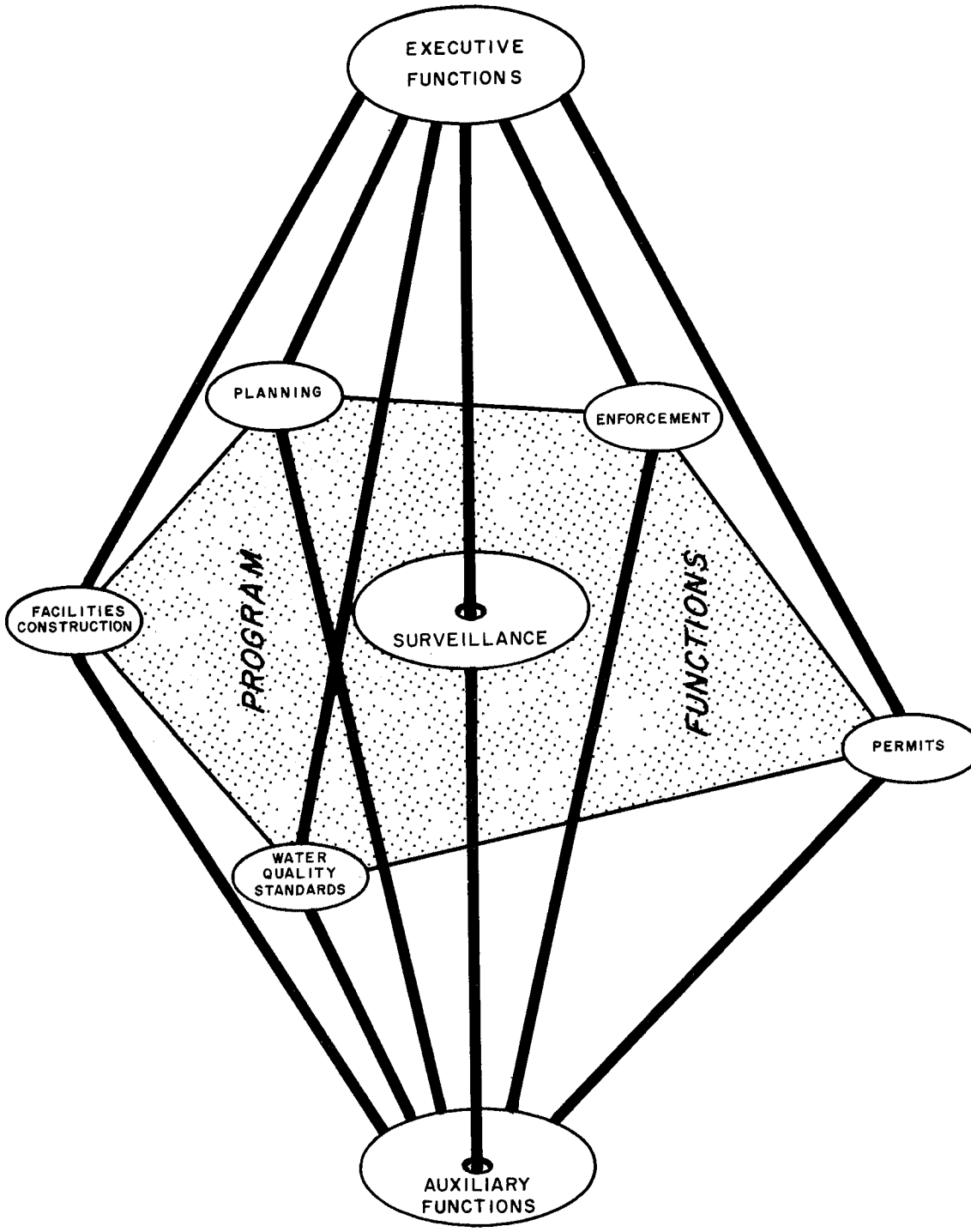


FIGURE 5.—*Program Activities of Idealized State Water Quality Control Program.*

The facilities construction program activity also utilizes data obtained from surveillance of treatment plant construction and operation to provide information to the other program activities and administers the state and federal grants to municipalities for construction of water pollution control works.

A significant adjunct activity to the facilities construction program element is operator training. The engineering works for treatment of wastes will prove to be of little value without suitably trained personnel to operate them. Certification of operators is a permit activity for regulating those who operate water pollution control works. The absence

of adequate water pollution control facilities or operation of existing works can result in formal enforcement action under the suggested act.

The results of surveillance activity are the bases for formal enforcement action, when combined with inputs from permits, water quality standards, and facilities construction. The enforcement activity prepares the technical and legal instruments required for action by the Board in turning a violation over to the Attorney General. Supporting all of the functions authorized by the suggested act are the auxiliary activities which must be provided to keep the administration of the program elements working smoothly.

Over all these program segments is the executive function stemming from the authority granted to the Board's executive director. This activity provides coordination and direction of the program activities within the Board's staff. Further, this activity furnishes the focus for interagency coordination with other state agencies and the agencies of other states, agencies of the federal government and interstate institutions, as well as providing information to the legislature and the public.

Government agencies are organized on the basis of either or both of two models. One is known as the staff and line model; the other is the functional model. However, most organizations are a composite of each rather than pure types. A major problem is the relationships between the functional headquarters and the individuals carrying out the program in the field.[6] There is, as with the idealized program, no one best organization, only those that perform effectively. As illustrated in Fig. 5, all program functions are equally important and interrelated, requiring full-time coordination by the executive. For purposes of description in this report in estimating staffing requirements, the idealized organization will be divided into five segments:

Executive
Headquarters Program
Field Program
Auxiliary
Legal Counsel

Figure 6 illustrates the idealized organization.

Guidelines

The purpose of the guidelines developed in this report is to provide a tool for estimating the workload of an effectively administered State water quality management program much in the manner of Taylor's "Scientific Management." [7] However, these guidelines are not considered

[6] John M. Pfiffner and Robert V. Presthus, *Public Administration,* 4th ed. (New York: The Ronald Press, 1960), p. 249.

[7] Frederick W. Taylor, *Scientific Management* (New York: Harper & Brothers Publishers, 1947), passim.

to be useful for setting work rates. Conversely, the work rates determine the program workload and the number of personnel.

A study by the Public Administration Service,[8] based upon data available for all of the 50 States, developed guidelines based on two types of staffing needs: general and facility service. Facility service staff are those personnel involved primarily in surveillance of existing water

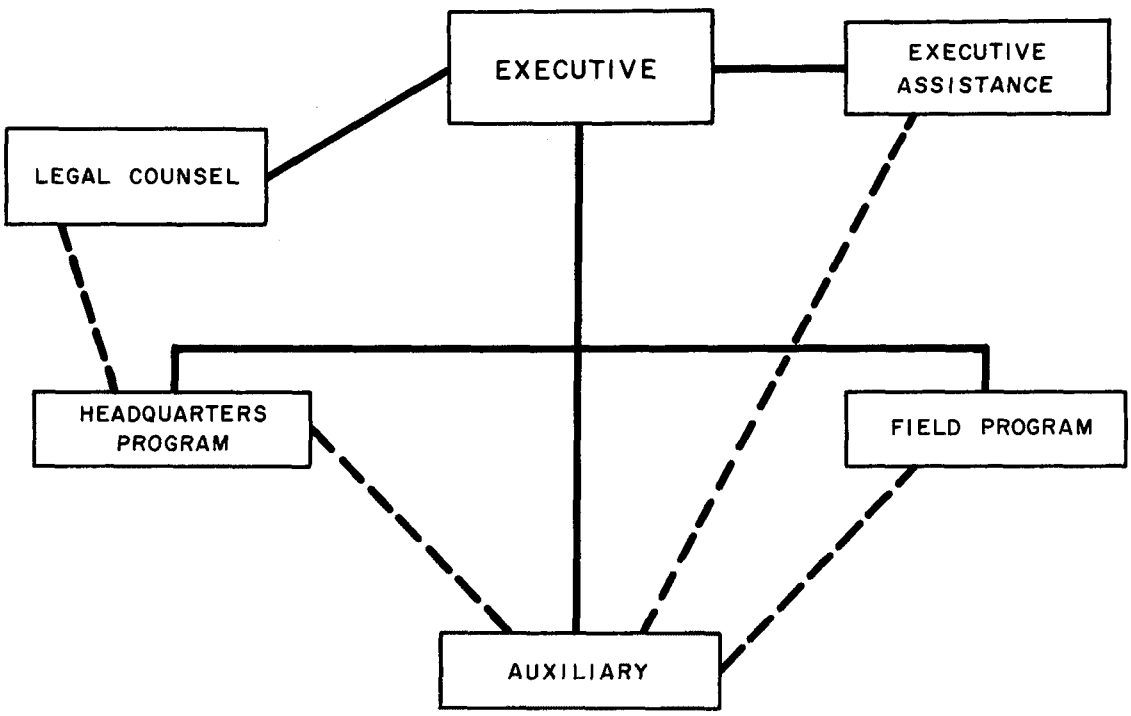


FIGURE 6.—*Idealized Organization State Water Quality Control Agency.*

pollution control facilities, including the training and licensing of treatment plant operators. Facility service staff requirements criteria were based upon absolute ratios of staff to number of treatment plants and water-using industries. The general staff needs included those personnel not included in facility service and were determined on a relative scale. State population, area, recreational use of water, and industrial work force, coupled with interviews with the water pollution control program administrators of 13 States were used to derive estimates of minimum and desirable general staff needs. That report indicated that staffing for special problems, such as acid mine drainage and oil-field brine pollution, would require additional staff.[9]

Table 2 compares the staffing for State water pollution control agencies recommended in 1964 by Public Administration Service with the number of man-years assigned to water quality management by the same State agencies during fiscal year 1969.

Criteria for Guidelines

The guidelines to be used in estimating personnel needs are based upon the primary function authorized by the suggested act, i.e., regula-

[8] Thomas R. Jacobi, Richard A. Pavia, and E. F. Ricketts, "Staffing and Budgetary Guidelines for State Water Pollution Control Agencies," *Journal Water Pollution Control Federation,* Vol. 37, No. 1 (January 1965).

[9] Ibid., p. 13.

TABLE 2.—*Comparison of Public Administration Service Recommendations and Fiscal Year 1969 Man Years Assigned to State Water Pollution Control Agencies.*

STATE	MAN-YEARS MIN.[1]	MAN-YEARS DES.[2]	FY 1969	STATE	MAN-YEARS MIN.[1]	MAN-YEARS DES.[2]	FY 1969
Ala.	33	59	15.20	Mont.	22	33	7.00
Alas.	15	25	11.80	Neb.	26	40	12.32
Ariz.	24	35	12.50	Nev.	15	26	8.15
Ark.	26	38	26.30	N.H.	21	30	16.50
Calif.	180	274	124.00	N.J.	86	133	80.30
Colo.	32	48	18.00	N.M.	16	24	12.70
Conn.	46	67	37.15	N.Y.	194	293	202.50
Del.	20	34	37.33	N.C.	56	99	51.50
Fla.	58	93	68.00	N.D.	11	17	8.90
Ga.	43	76	38.00	Ohio	137	209	46.00
Ha.	12	17	25.60	Okl.	35	53	19.50
Ida.	21	30	9.25	Ore.	35	53	40.25
Ill.	133	204	56.00	Pa.	155	236	159.51
Ind.	61	106	61.50	R.I.	31	46	27.65
Ia.	41	63	14.60	S.C.	32	47	27.75
Kans.	32	49	37.31	S.D.	16	25	11.70
Ky.	26	45	35.00	Tenn.	40	70	33.00
La.	34	61	24.56	Tex.	122	191	89.00
Ma.	32	46	18.17	Utah	28	41	12.30
Md.	38	68	24.70	Vt.	17	28	19.80
Mass.	76	117	59.00	Va.	41	74	55.60
Mich.	110	171	73.85	Wash.	39	70	66.30
Minn.	58	104	46.10	W. Va.	22	32	34.30
Miss.	26	38	19.00	Wisc.	71	126	68.00
Mo.	58	103	30.33	Wy.	17	28	2.60
				Total	2,410	3,995	2,036.43

[1] Minimum. [2] Desirable.

Sources: Minimum and Desirable from Thomas R. Jacobi, Richard A. Pavia, and E. F. Ricketts, "Staffing and Budgetary Guidelines for State Water Pollution Control Agencies," *Journal Water Pollution Control Federation,* Vol. 37, No. 1 (January 1965), p. 20. *State and Interstate Programs for Water Pollution Control, Digest of Fiscal Year 1969 State Program Plans* (Washington, D.C.: U.S. Department of the Interior, Federal Water Pollution Control Administration, State and Regional Program Grants Branch, 1969), Sec. 2.

tion of water quality, and should reflect changes in workload resulting from variations of water quality requirements, improvement in the technology of water quality control, and shifts in population and water uses affecting water quality. Alterations of these factors and/or the agency function will result in increases or decreases in staffing needs. The guidelines should be sensitive to these changes. Likewise, as for the guidelines developed by Public Administration Service, "they must be relatively

simple if only because there still are no foundations for a technically refined 'scientific' approach in detail." [10]

Since all of the States have adopted water quality standards and all but six require discharge permits,[11] guidelines based upon a water quality standards-permit type regulatory model administration are presented in this report. Further, the guidelines are applicable only to activities contained in the program as planned under the authority in the suggested act. Contingency planning for disasters, either natural or manmade, are not within the purview of this report although it is recognized that staff will be diverted to such highly necessary activities from time to time. Only state agencies of small proportions with respect to the manpower required to cope with the disaster are expected to be severely affected by such situations. However, even these, if adequately staffed, would possess the necessary degree of flexibility to handle emergencies without serious disruption of routine operations.

In keeping with the policy set out in the suggested act to prevent pollution, surveillance of stream quality and waste discharges is the fundamental activity of an idealized water quality control agency. Surveillance activity workload can be estimated by determining the number of discharges requiring inspection, the frequency of inspection, the number and type of water quality monitoring stations and the frequency of sample collection. As various program activities affect or are affected by the surveillance function (see Fig. 5), the other program activities can be estimated as a function of the surveillance workload.

Unit of Measure: Man-Year

The unit of measure for estimating staff requirements in this report is the man-year, which has available no more than 1,840 man-hours, 46 (40-hour) man-weeks, or 230 8-hour man-days. This unit was determined on the basis of a 2,040 man-hour (52 40-hour man-weeks or 260 8-hour man-days) year and the average employee having: 10 days of annual leave (80 hours); 10 days of holidays (80 hours), although most States have more official holidays; 5 days of annual sick leave (40 hours); and 5 days of annual training (40 hours) either on the job or at suitable institutions. Few employees will follow this outline exactly, but it is an indication of the considerations involved in estimating staffing needs. Adjustments can be easily made in this estimate to provide a more realistic appraisal of available working time per person.

Program Operations—Field

Program operations in the field consist essentially of:

(1) Inspections of municipal and industrial waste treatment plants to assure compliance with discharge permit conditions;

(2) Inspections of construction of water pollution control works to assure compliance with permit conditions and expected completion schedule;

---

[10] Ibid.

[11] *State and Interstate Programs for Water Pollution Control, Digest of Fiscal Year 1969 State Program Plans* (Washington, D.C.: U.S., Department of the Interior, Federal Water Pollution Control Administration, State and Regional Program Grants Branch, 1969), Sections 5 and 6.

(3) Monitoring of quality of the waters of the State;
(4) Participation in conferences and hearings on water quality standards and/or issuance, modification, or enforcement of waste discharge permits; and
(5) Preparation of reports concerning the above activities.

The inspections activities workload can be estimated on the basis of the number of locations to be inspected, the average frequency of inspection, and the average time required per inspection. The number of locations to be used in the estimate are a function of the agency's policy on regulating discharges. For example, many industries have multiple outlets, each with its own treatment system and all operating under a single permit from the agency. The same is true of many municipalities. In general, each treatment works or system rather than each permit holder should be considered a location for estimating purposes.

Frequency of inspection can be discussed in terms of complexity of treatment (secondary or tertiary), amount of waste handled (in million gallons daily), complexity of waste treated, downstream uses, etc. All have merit as considerations while not providing a basic measure of workload. To date, inspection programs of State pollution control agencies have been handled on the basis of devoting resources to inspections not needed for report compilation, special technical studies, and other "crash projects." The result has been that, while the agency insisted on construction of treatment works, no surveillance program is provided to assure that works are being operated effectively at all times.[12]

Frequency of inspection, on the whole, can serve the purposes of the pollution control program by being setup proportional to the uses protected and the potential for water quality degradation. Quality degradation, in turn, can be described as a function of concentration of industry and population as measured by urbanization, i.e., the more highly urbanized, the more frequent the inspection should be to assure compliance. This inspection program would be analogous to that carried on by the Department of Agriculture in the meatpacking industry or the Department of Defense among its contractors, where the packers or contractors are under surveillance in proportion to their size or significance.

For estimating purposes, Figure 7 displays the relationship between per cent urbanization as defined by the Bureau of the Census and average annual frequency of inspection. Not all discharges need be inspected this often while others need more frequent and detailed inspections. Also, the inspection program goals of the various state agencies are plotted against 1960 percent urbanization in this figure. Frequency of inspection goals are, in general, arbitrary under existing conditions, as staff is seldom available to meet them.

The average number of inspections needed per discharge are determined from figure 7. The manpower needs for this activity can be estimated by multiplying by the average time required per inspection and the number of locations requiring surveillance by the average frequency of inspections, i.e., $M_f = (I)(T)(L)$, where

[12] Ibid., sec. 8.

M_f = Manhours/year, field
I = Inspections/year (Figure 7)
T = Average manhours per operation
L = Number of locations.

In general, the construction inspections workload can be estimated on the basis of expected activity in issuing permits to municipalities and industries and grants for construction to municipalities. As with plant operation surveillance, inspections planned multiplied by the aver-

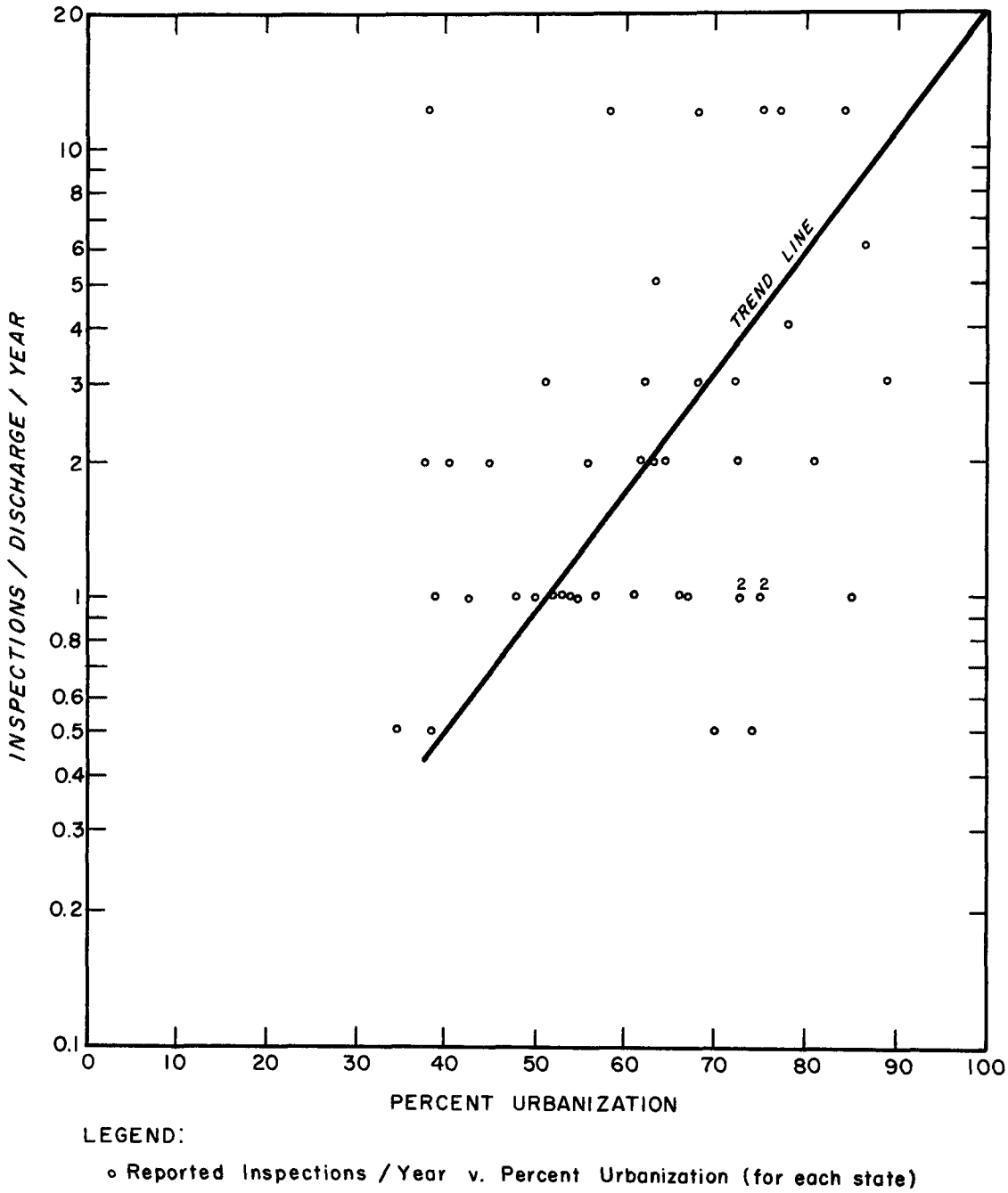


FIGURE 7.—*Relationship of Inspection Frequency to Percent Urbanization.*

Source: Percent urbanization—U.S. Department of Commerce, Bureau of the Census, 1960; inspections – *State and Interstate Programs for Water Pollution Control, Digest of Fiscal Year 1969 State Program Plans* (Washington, D.C.: U.S., Department of the Interior, Federal Water Pollution Control Administration, State and Regional Program Grants Branch, 1969), sec. 8.

age time required for each will determine the workload for this activity, i.e., $M'_f = (P)(T)(L)$, where P = number of inspections of plant construction.

The protocol in carrying out each inspection is important. The industrial plant manager (or responsible municipal official) is usually contacted prior to actually entering the plant for the construction or operations inspection. This brings the gravity of the need for compliance to the attention of a responsible official. The construction superintendent or plant operator is then interviewed to determine the current status of construction or operation. A tour of the plant ensues to verify the information shown in construction or operations reports. Samples are collected and analyzed for further verification of operating results. Usually a summary report of the inspection is prepared for the record. This may be as simple as filling in of blanks on a form, or it may be more involved.

Inspection time can be diverted to unscheduled investigations of fish-kills, unauthorized discharges, etc., as these activities properly are a part of the surveillance function.

Like inspection activities, stream sampling is another field operation which can be planned and its manpower requirements estimated. Most states have established the water quality monitoring station locations required to implement their standards program. In general, there are two classes of monitoring: (1) small streams and (2) large streams and coastal waters. Different sampling techniques are used in each class. Samples of small streams are easily obtained, whereas large streams and coastal waters usually must be "sectioned," using boats and special sampling equipment.[13] As with inspections, estimates can be based on number of locations, frequency and manpower per sample run (in man hours), i.e., $M''_f = (S)(T)(L) + (S')(T)(L)$, where

S = Samples collected/year from small streams

S' = Samples collected/year from larger streams and coastal waters

In general, participation in conferences and hearings can be estimated on the basis of anticipated activity. The field personnel have a feel for what is developing as the result of contacts during inspections and observations, much as a salesman "knows the territory," and can provide a base for estimation $M'''_f = (C)(T)$, where

C = number of conferences/year.

Preparation of reports on program field activities workload can be estimated as a function of the workload required by those activities, i.e., $M_{fr} = k\ (M_f + M_f' + M_f'' + M_f''')$. In this equation, k represents the ratio between the man-hours required for report preparation and the man-hours expended in the various field activities.

Other Field Activities

The field personnel estimates should also include manpower required by special problems, such as acid-mine drainage, oil-field brine, feed

[13] Emory Long, Administrative Coordinator and Joe Teller, Deputy Director, Texas Water Quality Board, interviews on Oct. 1, 1969 and Jan. 21, 1970.

lot run-off, or irrigation return flows, the control of which is a significant part of the field operations. However, each requires special estimates which would follow the pattern set in the general operations estimating procedure outlined above, i.e., number of operations per year, time per operation, and number of locations.

In general, a ratio of clerical-stenographic personnel to technical personnel should be established for field operations. This ratio may range from 1:3 to 1:7 depending upon the amount and detail of correspondence to be handled in the field.[14]

Program Operations—Headquarters

Program operations at agency headquarters consist of:

(1) Technical support including data evaluation, specialized services, and laboratory services;
(2) Construction grants activities;
(3) Enforcement (including hearings); and
(4) Planning.

The headquarters technical support activity serves not only the field by handling contacts and correspondence with industries and municipalities concerning compliance but provides technical service to other headquarters elements, such as construction grants and enforcement activities. This activity evaluates the data gathered by the surveillance operation in the field and assesses the need for actions to achieve compliance with water quality standards and permits.

Operator certification and training is a necessary adjunct to this activity, being directly related to treatment plant operation. Many states water quality management agencies require that those operating municipal and industrial waste treatment works be certified as a device to assure operating proficiency.

Operator training should be included as a program activity in the State water quality management agency. Often this activity is carried out by other groups, agencies or institutions, such as the State water pollution control association, State education agency, or colleges and universities. The operator training program, while taking a variety of forms, should be coordinated with the certification activity to assure communities and industries that an adequate number of suitably qualified operators are available and that those working operating personnel have an opportunity to keep abreast of new development and techniques in water quality management.

The number of technical support personnel required should be a function of the activity in the field, together with the activity level in enforcement operations, i.e., $M_q = k' (M_{ft}) + k'' (M_e)$, where

M_q = manhours/year, headquarters
M_{ft} = manhours total field activities
k', k'' = constants and
M_e = manhours/year, enforcement.

The manpower needed to staff the agency laboratory is a function of

[14] Data obtained on staffing of Texas Water Quality program during interviews with Emory Long and Joe Teller, Oct. 1, 1969 and Jan. 21, 1970.

the number of samples to be analyzed, the detail of analysis required, and the average time required per sample analysis, i.e., $M_l = (S)(T) + (S')(T) + (S''')(T)$, where $S''' =$ number of samples collected/year from water pollution control plants during inspections. Automation has had a significant impact on laboratory operations so that a high volume of work is required to operate efficiently. Agencies having less than the critical amount of work needed to operate a laboratory efficiently usually contract for their laboratory work, as is done in Texas. State health agencies usually have developed an efficient laboratory program which can accommodate the water quality agency's load until it has the workload required to operate its own laboratory.

The staff required to operate the construction grants activity is a function of the number of grants applications processed and the average time spent per application, i.e., $M_g = (N)(T)$, where $N =$ number of applications/year.

The enforcement activities staff in headquarters can be estimated on the basis of the expected number of hearings, compliance and enforcement actions relating to water quality standards, and permits and the average input required for completion of these actions, i.e., $M_e = (A)(T)$, where $A =$ actions/year.

The amount of field activity is a suitable guide to workload for the planning activity on the basis that planning will be affected by the findings of these activities, i.e., $M_p = K\ (M_{ft})$.

Headquarters program operations are concerned mainly with preparing correspondence and reports. Therefore, the ratio of clerical-stenographic personnel to technical-professional personnel can be based upon workload but should not exceed 1:4.[15]

Executive

The staff required to perform the executive functions can be based upon the complexities of the activities involved, such as interagency coordination, activities planning, public information, legal counsel, legislative liaison, and special projects. Estimates of the workload for interagency coordination can be founded upon the number of agencies having interrelated activities with the water quality control agency. As with the surveillance portion of the agency operations these contacts are more often than not relegated to being done "hit or miss" or more often when a crisis arises resulting in the lost motion of reestablishing rapport with the coordinating agency. Therefore, time should be planned to carry out this function, i.e. a set program of interaction varied according to the scope of the interrelationship. The workload can be estimated as $M_x = (n)(T)(B)$ where

$n =$ number of contacts per year
$B =$ number of agencies to be contacted.

Activities planning, public information, legal counsel, and legislative liaison are functions needed to carry out an effective program of water quality management though no bases for estimating the workload

[15] Ibid.

have been derived. Of the three, public information comes closest to being estimated on the basis of activity in the field and rapidity of program change, with needs being proportional to enforcement and compliance activities tempered by the change factor. The frequency of Board meetings also influences the public information function.

Auxiliary Operations

In general, the function of auxiliary operations, which include the personnel, fiscal, purchasing, filing and reproduction, automatic data processing, and other service activities designated as staff services in the typical agency, are related to all the activities of the agency and should be estimated on the basis of total agency program. Much consideration must be given to the experiences and staffing of other state agencies (such as Highway Department, Health Department, etc.) regarding these functions.[16] Often, since these functions are common to all agencies, standard practices are adopted which can be used to guide the personnel needs estimate, particularly those concerned with personnel, fiscal, and purchasing activities. Based upon these practices, a proportionality can be determined between agency activities expressed in man-years and auxiliary services, i.e., $M_a = K' (M_{ft} + M_{ht})$.

One auxiliary service runs counter to the proportionality expressed above. Automatic data processing (ADP) can be used to increase the agency's productivity by handling routine tabulation and computations. Increases in ADP personnel may be required in the absence of an increase (and perhaps a decrease) in the number of personnel in the other agency activities.

Program Coordination

The idealized program and organization are schematic only and do not provide specifically for program coordination through other than the program planning function in the Executive. Day-to-day coordination is recognized as necessary for effective program operations. An estimate of staffing needs therefore must include the supervisory staff required to accomplish this function. Just as there is no one best organization there is likewise no one best way of estimating staff needs for program coordination; however, a coordinator (supervisor) is needed for each operating unit, such as field offices, divisions and sections in headquarters, et cetera.

Occupational Distribution

In a manner similar to the Public Administration Service report, it is desirable to touch upon the aspect of staffing needs concerned with the major occupational categories. That report weighed heavily the judgment of the administrators of the 13 States visited during the course of that survey. It was found that practice and judgments varied considerably. The findings of that study concerning occupational distribution were that, in general, the States with the smallest staffs have the highest ratios of

[16] Bill Wells, Budget Analyst, Texas Legislative Budget Board, private interview, Jan. 22, 1970.

professional to nonprofessional personnel.[17] As shown in Table 2, few of the States have been able to meet even the minimum levels recommended in the Public Administration Service report. With the expectation that staffing will not be provided at minimum levels any more than water quality will be managed to meet minimum standards, it "seems highly probable that as such staffing objectives are approached increased opportunities will be available for more extensive use of support personnel (nonprofessionals including clerical employees, inspectors, engineering aides and technicians, and laboratory assistants)." [18] Based on the staffing of the typical water quality control agency, approximately 50 percent of the total may be nonprofessional in the model program founded upon regulation of quality through surveillance.[19]

Example of Use of Guidelines

In order to test the suitability of the broad guidelines presented, the idealized program and organization are combined with program operations of the typical program of the Texas Water Quality Board (TWQB). The TWQB program plan for fiscal year 1970 indicates the information pertinent to estimating staffing needs as shown in Table 3. Using these data and the guidelines, Table 4 illustrates the staffing needs for the idealized program.

The example does not consider staffing requirements for special projects, such as the Galveston Bay Study, nor special problems requiring continuing operations or project type research or technical assistance. These latter would concern control of acid-mine drainage, oil-field brine, feed lot run-off, wastes from water craft, oil and hazardous materials spills, etc. Staff for administration of these functions is authorized in the suggested act, but the workload for program elements of this type should be estimated separately and added to the staff needs for the basic water quality standards-permit type regulatory program.

[17] *Journal Water Pollution Control Federation,* op. cit., p. 20.

[18] Ibid., p. 21.

[19] Data obtained on staffing of Texas Water Quality Board program during interviews with Emory Long, Jan. 21, 1970.

TABLE 3.—*Texas Water Quality Board 1970 Workload.*

Surveillance	
Number of field offices	11
Discharges to be inspected	2,200
Construction sites to be inspected	300
Water Quality Monitoring	
Total-stations	224
Stream	160
Quarterly	15
Monthly	145
Coastal waters	64
Quarterly	64
Hearings and Compliance	
Actions on permits and standards	400
Conferences	300
Interagency Coordination	
State agencies	5
Interstate agencies	3
Federal agencies	5

Source: *Texas Water Quality Board, State Program Grant Application,* Water Pollution Control Program, Fiscal Year 1970 [FWPCA—112 (Rev. 4–68)], passim.

TABLE 4.—*Estimates of Personnel Requirements for the Texas Water Quality Board Using Guidelines.*

	MAN-HOURS	MAN-YEARS
Program operations—field:		
M_f = (I*)(T)(L) = (4)(8)(2200) =	70,400	38.3
M_f' = (P)(T)(L) = (4)(8)(300) =	9,600	5.2
M_f'' = (S)(T)(L) + (S′)(T)(L) = (4)(2)(15) + (12)(2)(145) + (4)(16)(64) =	7,696	4.2
M_f''' = (C)(T) = (300)(8)	2,400	1.3
	90,096	49.0
M_{fr} = k (M_f + M_f' + $_f''$ M_f''') = 0.25 (90,096) =	22,500	12.3
Supervision (11 offices)	20,200	11
Field subtotal (M_{ft})	132,796	72
Clerical-stenographic, 1:5		14
Field total		86
Program operations—headquarters:		
M_q = k′ (M_{ft}) + k″ (M_e) = 0.75 (72) + 0.5 (12)	110,400	60.0
M_g = (N)(T) = (300)(24)	7,200	3.9
M_e = (A)(T) = (400)(56)	22,400	12.2
M_p = K (M_{ft}) = 0.1 (72)	13,300	7.2
	153,300	83.3
Supervision	18,400	10
Headquarters Subtotal (M_{ht})	171,700	83
Clerical-Stenographic 1:4		20
Headquarters Total		103
Executive:		
Director, Deputy Director, activities planning, public information, etc.		3
Interagency Coordination M_x = (h)(T)(B) = (12)(8)(18)	1,728	0.9
Executive		4
Clerical-Stenographic 1:1		4
Executive total		8
Auxiliary Operations:		
M_a = K′(M_{ft} + M_{ht}) = 0.2 (72 + 83) =		31
Agency total — 86 + 103 + 8 + 31		228

* Based on 75 percent urbanization.

The guidelines presented in this report can (and should) be altered to reflect changes in program function and supporting technology. For example, the trend line in Figure 7 should be shifted when data become available on the impact of an effective surveillance program on plant operations. A study correlating number and quality of plant inspections with operating efficiency would greatly aid in better setting the slope and location of the trend line. Also, the user of the guidelines should be aware that the various constants (k and K) were estimated for the typical agency in the example and will vary from agency to agency. However, those used in the example provide a suitable "point of departure" for use in estimating program staffing needs. Likewise, the time factor (T) for each program activity must be derived from program experience, as travel and other conditions affecting this factor vary widely. In summary, the guidelines in this report provide a framework for estimating personnel needs for state water quality management agencies to be tempered in use with judgment and experience.

ACKNOWLEDGMENT

APPRECIATION is expressed to Dr. Emmette S. Redford, Ashbell Smith Professor of Government, The University of Texas at Austin, for the opportunity to develop this report under his guidance and to Lynn F. Anderson, Director, Institute of Public Affairs, for his advice, comments, and confidence regarding this report.

For their very good help in furnishing the information and data regarding the operations of the Texas Water Quality Board, the author is most grateful to Hugh Yantis, Executive Director of the Board, Joe Teller, Deputy Director, and Emory Long, Administrative Coordinator of the Board's staff. Likewise, the comments and suggestions of Bill Wells of the Texas Legislative Budget Board were most helpful. The encouragement and comments of Kenton Kirkpatrick of the Dallas Regional Office of the Federal Water Pollution Control Administration during the development of this report are gratefully acknowledged by the author. Also, the author is indebted to Mrs. Kay Estes for her skill in preparing the drawings for this report. Finally, the author wishes to acknowledge the contribution of the Federal Water Pollution Control Administration in providing the opportunity to study for 1 year at the University of Texas at Austin.

BIBLIOGRAPHY

Public Documents and Reports

Arkansas. *Arkansas Water and Air Pollution Control Act,* Act. 472 of 1949 as amended by Act 183 of 1965.

TATE, PHILLIP L., and HUDGENS, JAMES M., *An Action Program for Clean Water.* Joint Study and Proposals by South Carolina Pollution Control Authority and Federal Water Pollution Control Administration, Middle Atlantic Region, 1969

Texas. *Acts 1860.*
Texas Water Quality Board. *Rules of the Texas Water Quality Board,* Adopted November 28, 1967.
Texas Water Quality Board. *State Program Grant Application, Water Quality Board,* Fiscal Year 1970.
Texas Water Quality Board. *Texas Water Quality,* A Summary of Water Pollution Control in the State of Texas, undated statement.
U.S. *Federal Water Pollution Control Act, U.S. Code.* Vol. XXXIII, 1969.
U.S. Congress. *Clean Water Restoration Act of 1966.* Pub. L. 89–753, 89th Cong., 2d Sess., 1966.
U.S. Congress. *Federal Water Pollution Control Act Amendments of 1961.* Public Law 87–88, 87th Cong., 1st Sess., 1961.

Books

PFIFFNER, JOHN M., and PRESTHUS, ROBERT V. *Public Administration.* 4th ed. New York: The Ronald Press, 1960.
TAYLOR, FREDERICK W., *Scientific Management.* New York: Harper & Brothers Publishers, 1947.

Other Sources

Texas Legislative Budget Board. Private interview with Bill Wells. January 22, 1970.
Texas Water Quality Board. Private interviews with Emory Long, Administrative Coordinator. October 1, 1969 and January 21, 1970.
Texas Water Quality Board. Private interview with Joe Teller, Deputy Director, October 1, 1969 and January 21, 1970.
U.S. Department of the Interior, Federal Water Pollution Control Administration. *Suggested State Water Pollution Control Act, Revised.* Washington, D.C.: FWPCA, 1966.

Legal Citations

Texas. H.B. 24. 57th Legislature, Regular Session, 1961.
Texas. H.B. 448. 51st Legislature, Regular Session, 1953.
Texas. S.B. 15. 60th Legislature, Regular Session, 1967.
Texas. S.B. 125. 61st Legislature, Regular Session, 1969.
Texas, S.B. 138. 61st Legislature, Regular Session, 1969.
Texas. S.B. 147. 61st Legislature, Regular Session, 1969.
Texas. S.B. 204. 60th Legislature, Regular Session, 1967.
Vernon's Texas Civil Statutes.

Vernon's Texas Penal Code.

Articles

JACOBI, THOMAS R., PAVIA, RICHARD A., and RICKETTS, E. F., "Staffing and Budgetary Guidelines for State Water Pollution Control Agencies," *Journal Water Pollution Control Federation,* Vol. 37, No. 1 (January 1965), 5–24.
U.S. Congress. *Federal Water Pollution Control Act.* Public Law 84–660, 84th Cong., 2d Sess., 1966
U.S. Congress. *Public Works Appropriations for 1969 for Water Power Resources Development and the Atomic Energy Commission.* Public Law 90–147, 90th Cong., 2d Sess., 1968.
U.S. Congress. *Public Works for Water, Pollution Control, and Power Development and Atomic Energy Commission Appropriation Act, 1970.* Pub. L. 91–144, 91st Cong., 1st Sess., 1969.
U.S. Congress. *Water Quality Act of 1965.* Public Law 89–234, 89th Cong., 1st Sess., 1965.
U.S. Congress, House, Committee on Rivers and Harbors. *Pollution of Navigable Waters, Hearings* on H.R. 519, H.R. 387, and H.R. 4070, 79th Congress, 1st Sess., 1945.
U.S. Congress. Select Committee on National Water Resources, United States Senate. *Water Resources Activities in the United States, Water Quality Management.* Committee Print No. 24. Washington, D.C.: Government Printing Office, 1960.

U.S. Department of the Interior, Federal Water Pollution Control Administration. *The Cost of Clean Water*. Washington, D.C.: Government Printing Office, 1968.

U.S. Department of the Interior, Federal Water Pollution Control Administration. *Guidelines for Establishing Water Quality Standards for Interstate Waters*. FWPCA, May, 1966.

U.S. Department of the Interior, Federal Water Pollution Control Administration. *State and Interstate Programs for Water Pollution Control, Digest of Fiscal Year 1969 State Program Plans*. Washington, D.C.: State and Regional Program Grants Branch, 1969.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1971 O—411-020