# Manpower Planning
# for
# Wastewater Treatment Plants

Prepared for
Office of Water Programs,
Environmental Protection Agency

by

Olympus Research Corporation

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# Contents

# FOREWORD

The instructional material provided in this manual has been designed to offer guidance to those individuals engaged in manpower planning for certain segments of the water pollution control field. A preliminary version of this material was used in a series of three workshops sponsored by the Office of Water Programs (OWP). Representatives of federal, state, and local water pollution control agencies attended these workshops, as did representatives of federal and state offices of labor and of education. The reactions of the participants in these workshops to the preliminary material were solicited, as were their suggestions for improvement. Many of these suggestions have been included in the current version of this manpower planning manual.

This manual has been written because of the importance attached to manpower planning by OWP. The manpower development staff within OWP recognizes that manpower is a vital factor in the accomplishment of national water pollution control objectives. The effectiveness and economy with which wastewater treatment plants and collection systems are designed, constructed, and operated are dependent upon the availability of qualified personnel to the public and private organizations responsible for these functions. Because of the recognition of the importance of manpower, OWP has established a manpower planning program whose objective is to satisfy the basic objective of manpower planning and to ensure that the necessary trained manpower is available at the time and place required. The basic components of OWP's manpower planning program are the development of a forecasting process by which manpower needs can be determined and the development of action programs by which the projected needs may be satisfied. The forecasting process consists of the following elements: the development of planning tools, the determination of manpower and training requirements, the determination of manpower training supply, and the identification of imbalances between supply and demand. The basic function of the action programs of manpower planning is to develop programs aimed at recruiting, retaining, and utilizing manpower and to develop programs to provide adequate training for new and current employees in the water pollution control field. This manual represents an initial and important step in satisfying the objectives of the manpower planning program.

One of the objectives of the manpower planning program within OWP is the establishing of a manpower planning capability at the state level for all manpower issues related to water pollution control. This is not an immediate objective, however, and a less comprehensive manpower planning capability is being sought during the initial phases of OWP's program. For this reason the scope of this manual has been limited to a consideration of manpower planning for that segment of the water pollution control field whose manpower needs have been given first priority by OWP: municipal wastewater treatment plants.

To satisfy the various manpower objectives in water pollution control in general and for wastewater treatment plants in particular, local, state, and federal cooperation will be required. Recognizing the value of such cooperation, OWP has proceeded in its strategy of developing a manpower planning capability on the premise that the ultimate responsibility for obtaining the necessary manpower resides with that organization needing the manpower, whether it be a state or local entity. The federal government, however, can perform certain common and developmental-type functions more effectively and economically than can individual states and cities. Futhermore, it is felt that water pollution control manpower planning cannot be done independent of the many manpower programs sponsored by the federal government, which, of course, require the participation of other federal agencies. The development of this manual falls within one of those areas where it is felt that the resources of the federal government are most effectively and efficiently allocated.

Responsibility for overseeing the construction, operation, and maintenance of municipal wastewater treatment plants is usually a state function. The training and certification of the manpower employed in these municipal plants are also a state function most usually performed by the state water pollution control agencies. The primary focus in designing this manual has been directed therefore to that person in a state agency who has the responsibility for planning the manpower and training requirements of municipal wastewater treatment plants. This person may or may not be employed by the state water pollution control agency. For example, such a person may in fact work in a state or local manpower planning council, the state employment security office, or a state environmental protection agency.

Because of the possible diversity in the backgrounds of those engaged in manpower planning for municipal wastewater treatment plants, the instructional material in this manual has been prepared and organized to meet five general objectives:

(1) To review the general principles and practices of manpower planning

(2) To review the development of the nation's water pollution control program and the need for a systematic effort in water pollution control, particularly at the municipal level

(3) To examine the educational and manpower development resources that are available for use by the water pollution control field

(4) To provide instruction in manpower planning for use in planning manpower needs of municipal wastewater treatment plants

(5) To organize in a workbook format a series of steps that draws upon the above information and applies it directly to manpower planning for municipal wastewater treatment plants

The information presented in meeting the five objectives has been organized into five separate chapters. It should be noted that the instructional material will move from the general to the specific. This style was followed to permit use of this manual by persons employed both in and out of the water pollution field.

# CHAPTER ONE

# PRINCIPLES AND PRACTICES IN MANPOWER PLANNING

# ACKNOWLEDGMENTS

This manual has been prepared as a result of effective cooperation between two federal agencies, the U. S. Office of Education and the Environmental Protection Agency. A contract between Olympus Research Corporation and USOE, supplemented by additional funds from EPA, made it possible to glean the necessary talent from the environmental and educational spheres to review initial drafts of the document and to produce the final publication. Special thanks go to Dr. Howard Matthews, Director, Division of Manpower Development and Training, USOE, for providing the contractual support of the project.

Without the guidance and direction of Morton S. Ettelstein of the Manpower Development Staff, Office of Water Programs, EPA, this manual would not have its present thrust. The comments and constructive criticism of Thomas R. Hill of the Division of Manpower Development and Training, Bureau of Adult, Vocational and Technical Education, USOE, have aided greatly.

The manual was developed in what was essentially a three-step process. First, the draft of the manual was prepared by Olympus Research Corporation under the guidance and direction of the Environmental Protection Agency. Second, the draft was presented at a series of seminars held across the nation to more than 200 knowledgeable individuals who reviewed the material and offered suggestions for improvement. Those who reviewed the material included representatives from both national and regional staffs of EPA, from the Department of Health, Education and Welfare, from the Department of Labor, from various state environmental agencies, and from agencies of metropolitan government dealing with environmental and manpower problems. Finally, the manual was rewritten in its present form to reflect the suggestions obtained through the series of conferences.

The manual was written by J. Kenneth Davies, Lloyd L. Gallardo, Edward F. Mackin, Garth L. Mangum, Kenneth C. Olson, and Colin Wright, who had final editorial responsibility.

# CHAPTER ONE

# PRINCIPLES AND PRACTICES IN MANPOWER PLANNING

Though the primary user of this manual might be a specialist in planning to meet state and local needs for personnel in water quality activities, he will undoubtedly perform his functions more effectively as he becomes a part of a new and growing profession involved in a wide variety of activities but using a common set of tools toward accomplishing a similar set of objectives—the profession of manpower planner. In this chapter we identify the various levels and types of manpower planning and review those steps generally followed in what we refer to as specialized or micro-manpower planning—that form of manpower planning closest to the assignment of the state water pollution control manpower planner.

## *A. Typology and Experience in Manpower Planning*

No single concern has more generally permeated the full range of economic and social activites throughout the world over the past two decades than the concern for manpower as a human resource. There are many reasons for this concern. Government policies aimed at maintaining or achieving full employment have become a political imperative in every industrial democracy. In an industrial society the majority are dependent upon wage and salary income, while in a democratic society the majority will demand that the government meet those needs they cannot meet themselves. Job creation is high on the list of such needs. In addition, because inflation is a major obstacle to full employment, nations pursuing the goal of inflation control must train and upgrade their workers and improve their labor markets to reduce the inflationary impact of government employment policy. As advanced societies meet more and more of their basic needs for goods, the emphasis of consumer demand shifts toward the more labor-intensive services. In the capital-goods sector, the technology becomes more developed and requires more advanced human inputs from trained minds and hands. Warfare tends to demand and absorb the best technical manpower. With more and more people living closer and closer together, served by more and more technology, the complexities of life demand more human effort in planning, control, and remediation. Meantime, those countries in search of modernity must pursue the same excellence in human resources, leaping over those years when concern with the development of capital and natural resources was dominant.

To show the universality of national manpower planning, a discussion of a few international examples will be enlightening. The nature and objectives of the economic and political environments in which manpower planning occurs differ widely among countries, depending on national goals and priorities. The manpower policies that are developed in such countries will reflect those differences.

Manpower planning in Western and Northern Europe is similar to that in the United States in having as its major objective the social welfare of wage-earning families. Subsidiary, but important to this objective, is the reduction in inflationary pressure induced by a policy of maintaining full employment. The immediate goal of such planning is to provide a job for all who desire it–a goal made possible by the rise of the working class to political power. The need for adopting such a goal comes about in part because of maladjustments existing in the marketplace for which corrections must be made. The achieving of this goal is made easier by the small size, population homogeneity, ideological commitment, and low birthrate of the countries involved.

The objective of Soviet manpower planning is the efficient use of a scarce economic resource–manpower–and is an integral part of the national economic plan. The U.S.S.R. faces labor shortages because of the great population losses during World War II, yet its economic development plans require dispersal of population and manpower over a vast expanse of territory. Soviet policies provide incentives for workers to move to undesirable locations and to work at "productive" (goods-producing) rather than "unproductive" (service) jobs. Despite its reputation for arbitrariness, the Soviet Union seems to have given up most of the various forms of compulsion it once used and now relies primarily on monetary incentives, though compulsion remains as the ultimate tool of manpower policy and is used when needed.

Japanese manpower planning is dedicated to the maximum utilization of the labor force and is made necessary by the existence of rapid economic growth, a reduced birthrate (induced by a vigorous program of birth control), and a paternalistic employment system. Numerous policies and programs have been instituted to increase the labor force through increased participation of women, older workers, and rural residents.

In contrast to these activities in developed countries, the developing agrarian nations find themselves in the quandary of too few educated and trained workers and too many uneducated and untrained citizens. Their manpower plans usually contain programs for the development of rudimentary school systems designed to increase literacy and programs to either send their nationals abroad for certain education or training or to attract citizens from other countries to provide the needed initial cadre of entrepreneurs, managers, engineers, technicians, and teachers.

Three types and levels of manpower planning have emerged within the United States: (1) national macro-manpower planning to determine the levels of economic growth necessary to achieve employment targets or to fill the human resource needs for meeting national goals, (2) national manpower program planning for administration of programs designed to remedy the problems of special groups of persons, and (3) micro-manpower planning for the specialized needs of private business firms, employer associations, employee associations, and public agencies. Examples of each will better illustrate the role and techniques of the manpower planner in modern society.

### *B. National Macro-manpower Planning*

An oversimplified version of national macro-manpower planning would include: (1) forecasting the size of the labor force in the following year, (2) estimating the level of economic production (gross national product (GNP)) likely to occur without policy measure changes, (3) estimating the level of employment likely to be generated by that GNP, (4) deciding upon an employment target, and (5) devising policies, consistent with other economic and social goals, to reach that target.

To illustrate these five steps, we introduce a simple example. Let us assume that the size of the labor force (those employed plus those seeking employment) next year is to be 90.5 million persons. Let us now suppose that the estimate of the GNP next year is $1,100 billion and that this level of GNP will generate employment of 85.1 million persons which is 94 percent of the projected labor force. If it were now assumed that 96 percent employment of the labor force is the optimal employment level, meaning employment for 86.9 million, an unemployment gap of 1.4 million people would exist, and steps would then have to be taken to eliminate this gap. These steps might include government fiscal and/or monetary policies that involve the national government's power to tax, spend, and regulate the supply of money and credit. In instituting such policies, other national goals must be taken into consideration, such as price stability and personal freedom.

While the primary tools used in reaching the target of full employment are such items as expenditures, tax, and monetary variables, there is growing interest (though not as yet much skill) in using education, manpower training, and the various labor market measures as anti-inflation devices to assist in reaching macro-manpower planning goals. It is now generally conceded that the U.S. economy could attain any level of employment it wanted if it could just learn to do so without inflation.

While macro-manpower planning may seem removed from the operations of other manpower planners, the ease or difficulty with which other manpower planners are able to accomplish their work will be affected by macro-manpower successes or failures. It would seem, therefore, that other manpower planners must become familiar and conversant with what is taking place with manpower issues at the macro level. A start in providing material pursuant to this end is found in some of the remaining sections of this chapter and also in Chapter Three.

## *C. National Manpower Program Planning*

During the 1950s manpower policies and programs in the United States concentrated on producing a supply of highly educated scientists and engineers devoted to keeping ahead of the Soviet Union in the arms and space races. Persistently rising levels of unemployment during the late 1950s and the explosive race issues of then and the early 1960s turned attention to new issues. Alleviating the competitive handicaps of those persons in or entering into the labor market, who were unable to obtain adequate employment and earnings, became the dominant objective of manpower policies in the 1960s. In the 1970s, with the general level of unemployment rising, concern began to be expressed for other groups, such as unemployed aerospace workers and returning veterans.

### *1. Emergence of National Manpower Programs*

A long series of programs has emerged in an attempt to meet these needs. The Manpower Development and Training Act; the Economic Opportunity Act, with its Neighborhood Youth Corps, Job Corps, Operation Mainstream, and New Careers Program; JOBS; and the Work Incentive (WIN) program to rehabilitate welfare recipients and the Concentrated Employment Program (CEP) to bring together all manpower programs in a concentrated area comprise the more important ones. The most recent is the Emergency Employment Act (EEA) of 1971, also known as PEP (for public employment programs), which seeks to employ the unemployed in public sector service jobs during the current recession (1971-72).

This variety of categorical programs—all (except for the last mentioned) aimed at essentially the same disadvantaged target groups but having different administering agencies; funding procedures; eligibility requirements; levels of federal, state, and local authority; and mixes of services—was confusing and hard to administer. National policy making tended toward uniform program directives regardless of local situations. Categorical programs required enrollees to fit program requirements in order to receive available services, rather than having a package of services tailored to individual needs.

Policy makers were never able to make up their minds whether the basic obstacles to adequate employment and income for so many were the individual's lack of qualifications and motivation or institutionalized discrimination in the hiring process. For policy, the answer made all the difference. Some programs leaned one way and some the other. Most assumed that the individual, rather than the institutions had to change. But increasingly we are becoming aware that there are institutional barriers requiring institutional reform.

*2. Cooperative Area Manpower Planning System*

The Cooperative Area Manpower Planning System (CAMPS) was created in an attempt to coordinate all of the agencies and programs. Representatives of each agency involved in funding and administering manpower programs in a state or major metropolitan area met, explored state or local employment problems, identified target groups, and informed each other of their plans. This cooperation was, however, a case of equals working with equals with no one having authority to reallocate funds across program lines if one program should seem better adapted to the current or local situation than another.

In each state, the Employment Service (ES) was to provide the leadership but include all agencies involved in manpower programs. Each state was to draft a state plan for the delivery of manpower services. As the system expanded, OEO, the Departments of Commerce, Housing and Urban Development, Agriculture, and Defense along with the Civil Service Commission became signatories to the interagency guidelines setting up CAMPS in the spring of 1967. In 1971, EPA was added as a signatory.

The system was to include regional, state, and local CAMPS committees. The local committees were to draw up their plans, under federally issued guidelines, to be forwarded to the states and there consolidated in state plans to be forwarded for regional approval. Individual agencies maintained the power of final approval of their individual programs.

While CAMPS has been far from perfectly effective, it established a mechanism for communication among agencies providing manpower and manpower-related services, and it pointed to the need for more power through control of funding if it was to be an effective planning agency. The U.S. Department of Labor (DOL) has continued to be the primary advocate and user of CAMPS, with most of the other agencies providing varying degrees of resistance or acceptance.

Probably the most effective use of CAMPS as a planning device has been with Manpower Development and Training (MDT). Of the money allotted to MDT by Congress, Washington retains 20 percent to be used for national projects to meet critical national needs. The remaining 80 percent is made available to the states. Of that 80 percent, 20 percent has been available to be spent by the states in accordance with their approved CAMPS plans but without specific regional approval. The remaining 80 percent of state-allocated money can be spent only on project-by-project approval of the regional officials.

### *3. The Emergence of State and Area Manpower Planning Councils*

Frustrated by the details of administering programs under the restrictions of federal guidelines, a few governors and mayors began to play a stronger role. Some were irritated by the fact that federal manpower funds tended to bypass them in going directly to either autonomous state education and employment service agencies or to quasi-private community action agencies operating at the local level. Through legislation or executive order, a few governors and mayors began to intervene with their own staffs and organizations. Examples of such organizations are New York's Human Resources Administration, Utah's State Manpower Planning Council, and California's Department of Human Resource Development. Within whatever discretion was available under federal law, they wanted to shape manpower programs to fit local, political, and economic needs.

DOL has become increasingly aware of the objective need and political pressure to decentralize more manpower policy decision making to the regional, state, and local levels, and has declared its intent to go as far as present law allows toward decentralization and decategorization. A concomitant of this has been the decategorization of the manpower programs to give more flexibility in determining the mix of services. A variety of legislative proposals has been made to effect this flexibility; and there seems to be a strong likelihood of their eventual success. In general, the ultimate model will probably involve federal funding and guidelines; state, local, and regional annual or multiyear plans; federal (national and regional) plan approval; state and local administration; and federal (regional) monitoring and evaluation. The major issue is the exact degree of federal (regional), state, and local authority. Each level tends to be jealous of its prerogatives and decision-making authority. Each thinks of the others as being hungry for power.

In the meantime, states (and a limited number of local governments) have been given federal funds through CAMPS for manpower planning staffs. This contribution from CAMPS has placed personnel on the staffs of large city mayors and governors who have a personal interest in enlarging the roles of their principals—and therefore themselves—in manpower decisions, and constitutes a cadre of perhaps 1,000 nonfederal planners (financed by federal funds) engaged in manpower programs for the disadvantaged. EEA funds have probably increased the number of local and state manpower planners, though the total effect is yet unknown. This is in addition to the manpower administrators on state and local governments' payrolls. Most of these personnel have limited backgrounds and training in their new assignments. In addition, involvement of private industry through the National Alliance of Businessmen's Job Opportunities in the Business Sector (NAB-JOBS) has produced an uncertain number of manpower staff on private payrolls added to those already employed by private agencies administering Job Corps and Job Corps-type programs. At this point, federal manpower staffs are more numerous and more experienced, though most of them are better described as administrators rather than as planners.

President Nixon in 1971 and again in 1972 asked Congress for manpower revenue sharing in which blocs of manpower money would be made available to state and larger local units or consortia of governments with few strings attached. Such monies, coupled with the limited manpower monies appropriated by state and local governments, would enhance the ability of these units to do manpower planning. There is, however, much concern over the ability of such units to do effective planning and to do the type of planning that would meet the national goals of emphasizing assistance to the disadvantaged. This concern could probably be met, at least in part, by the development of professionally competent manpower planners at all levels of government. The future of revenue sharing, at least under the present administration and Congress, is at best uncertain.

*4. Interagency Cooperative Issuances No. 72-1 and No. 72-2*

Meanwhile in 1971, the National Manpower Coordinating Council (NMCC), faced with eventual decentralization and in a move toward revenue sharing, issued Interagency Cooperative Issuance No. 72-2 in recognition of the "lack of impact of CAMPS on funding decisions." The issuance called for both structural and functional revision of CAMPS, allowing for increased initiative by state and local officials in the planning and initiating of manpower programs. Former state CAMPS committees are known as State Planning Councils and local CAMPS committees as Manpower Area Planning Councils (MAPC). The primary tasks of these councils are:

(1) To advise elected officials, governors, and RMCCs of locally conceived area and state needs

(2) To assist local elected officials and governors in the development of plans to meet these needs, including priorities and recommendations for funding

These plans are to include all manpower and manpower-related programs, irrespective of funding source. In the case of programs funded by the Manpower Administration and agreed upon by the RMCCs, these plans will constitute action plans for funding to the maximum extent possible under existing laws. With respect to other agencies, they only constitute recommendations.

State and area councils will be supported by independent secretarial staffs. Area plans are submitted through the state manpower planning council with its comments to RMCC, and MAPC has the opportunity to comment to RMCC on the state plan.

Membership on the planning councils has been expanded to include:

(1) Representation from the broadest spectrum of interests

(2) Decision-making agency representation

(3) Client group representatives chosen by the clients

(4) Representation of the public, business, and organized labor

ICA No. 72-1 constitutes the policy guidelines for fiscal year 1972, with a separate section for each of the agencies signatory to the document, including OWP.

Five planning levels have been designated:

(1) The National Manpower Coordinating Committee (NMCC)

(2) Regional Manpower Coordinating Committees (RMCC)

(3) State Manpower Planning Councils (SMPC)

(4) Manpower Area Planning Councils (MAPC)

(5) Ancillary Manpower Planning Boards (AMPB)

The NMCC establishes the overall goals and guidelines, delegating to the RMCCs the responsibility and authority to administer these. These committees include representatives from the nine federal departments and agencies signatory to CAMPS. The SMPCs are the creation of the governors and constitute their overall manpower planning arm. MAPCs are the creations of mayors or other local officials of large cities, metropolitan areas, and other special areas such as Indian reservations. The AMPBs are planning arms of the SMPCs, in areas not designated as MAPCs.

The sequence of planning as stated in ICA No. 72-2 is as follows:

(1) SMPCs, MAPCs, and AMPBs are involved in preliminary planning and discussions and develop draft plans.

(2) Draft plans are exchanged, and an attempt is made to reach agreement.

(3) MAPCs and AMPBs submit plans to the governor. MAPC plans are also submitted to the RMCCs.

(4) SMPCs develop comprehensive state plans, forwarding to the RMCCs and to mayors.

(5) Mayors comment to RMCCs on state plans.

(6) RMCCs review plans and comments, resolve differences, and approve plans.

(7) RMCC agencies use plans to the extent possible in final actions.

These plans will:

(1) Identify the people needing services

(2) Identify employers needing workers

(3) Designate the provision of services needed to make people employable in the shortest and best way

(4) Include all manpower and manpower-related program plans regardless of funding source

If this CAMPS planning process is fully implemented, it will constitute a major change in the planning process, with the local areas and states playing the major roles in the development of plans. Implementation is contingent, however, on developing the manpower planning capabilities of the local and state planning councils and boards that will require trained planners—either full-time manpower planners or general planners with manpower planning capabilities. The experience gained should lead the way to considerable decentralization.

### *5. National Manpower Program Planning Steps and Principles*

In a profession so new that only two universities—the University of Utah and the University of Redlands, insofar as we know—explicitly give a master's degree in manpower planning and administration, there is as yet no common methodology for manpower planning. There is, however, a near consensus on the appropriate planning steps in national manpower program planning. Such planning steps are:

(1) Identifying critical manpower problems

(2) Establishing manpower program objectives

(3) Exploring alternative approaches to the accomplishment of objectives

   (a) Inventory of resources
   (b) Identification of alternate target groups
   (c) Establishment of priorities
   (d) Marshaling of available facts
   (e) Estimate of costs and benefits

(4) Choosing and implementing most cost-effective approach

(5) Involving inputs from other institutions related to manpower planning process: unions, schools, employment service, etc.

(6) Monitoring programs

(7) Evaluating program achievement

(8) Feeding back and modifying from lessons of experience

There is also emerging a set of principles for national manpower program planning which may have application to other manpower planning activities:

(1) There should be a regular and formal process of manpower planning at the state and local levels as well as at the regional and national levels.

(2) Planning, to be meaningful, must be a continuous effort unencumbered by the problems of day-to-day administration.

(3) Manpower planning, like planning in general, involves systematic steps, procedures, and actions to:

   (a) Identify the people to be served
   (b) Establish priorities

(c) Formulate a mix of services
(d) Organize a delivery system
(e) Feed back into the program the improvements and the results of monitoring and evaluation

(4) Planning of manpower services in the present environment requires that the planning body control the allocation of funds. If funding takes place independently of the formal planning process, the planning program will not have the support or the impact desired.

(5) Manpower planning requires that the people needing service be brought together with the institutional capacity to provide service. This means, in practical terms, that cities and states must jointly plan and program a common effort. Neither has the capacity to proceed independently of the other.

(6) Persons with nearly equal employment handicaps should have equal access to services. This concept requires a model for the formal allocation of resources on a geographical basis and on a program-content and -level basis.

(7) A manpower planning program should be structured so that it has the support and possibly the participation of client groups, appropriate elected officials, manpower agency professionals, and persons with the professional planning skills from economics, statistics, psychology, and related disciplines.

While the manpower planner, for whom this manual is primarily designed, will have little to do directly with most national manpower program planning, these programs do constitute potential sources for the manpower needed in his manpower programs. In addition, the increasing social and political pressures require that the micro-manpower planner take these programs and their clienteles into consideration in their manpower planning activities. Therefore, close acquaintance with programs and personnel in this area is essential.

*D. Micro-manpower Planning within the Private Sector*

The major purpose of this manual is to meet the needs of the state water pollution control manpower planner. In subsequent chapters material will be presented to give that individual perspective in the ramifications of his job. Such a perspective will be obtained by a discussion of the nature of environmental problems, the scope and structure of the water pollution control field, the organization of the education, training, and employment systems which develop this nation's manpower resources, and the principles, practices, and functions of the manpower planning profession. The remainder of this chapter, however, will be devoted to discussing the basic principles and steps of what has been referred to as micro-manpower planning—that type of manpower planning conducted to meet the manpower needs of a particular industry, company, or agency. It is from this general area of manpower planning that the specific steps in manpower planning for wastewater treatment plants will be derived.

Manpower planning in the business firm is a relatively new activity. In the past, most employees have needed only the most rudimentary training for their jobs, and such skills could be replaced with ease if new skills were needed. However, with unionization, seniority rules, benefit packages, and changes in business practices, there has developed a tendency toward the development of careers, reducing turnover and making for a greater interdependence between employers and employees. A higher proportion of employees are now skilled workers, technicians, engineers, scientists, and others with long training times in whom firms may have made major investments and which firms want to retain. Professional business management puts a premium on looking ahead to see that each supervisor, manager, and corporate officer is understudied and the right replacement is in the right place at the right time. Whereas once the primary personnel concern was human relations (to keep employees happy despite the necessity of discipline) or labor relations (keeping the peace), manpower planning with its career implications is now rising in importance relative to both.

The primary motivation for firms and employer associations to be involved in manpower planning is its ability to contribute to profits. Thus, if the costs of manpower planning and developments are less than the potential benefits, planning will be done once the relationship of costs to benefits is known. Increasingly, larger firms and employer associations include, as potential benefits, the public esteem that may come from demonstrating a social conscience in their manpower policies as well as the direct benefits that may be derived from cooperating with government in its attempt to achieve certain social goals, especially in the hiring of disadvantaged people. These inclusions enhance the prospects for manpower planning.

In its manpower planning, a firm or employer association must take four unique and important manpower characteristics into consideration:

(1) To reach maximum productivity in higher skills, an individual must prepare by way of education and training for a long period of time.

(2) The value of workers generally appreciates, rather than depreciates, from use for a substantial period of time.

(3) An investment in manpower becomes the possession of the individual who is free to leave the employment of a firm or agency almost at will, though he or she may well remain in the industry.

(4) Personal satisfaction plays a key role in a worker's productivity and stability.

The employer's manpower needs depend upon the product or service he sells, the technology used, and the profitability of the firm. The available manpower depends upon the population, the labor force participation rate (the percentage of the population in the labor force), the human resource development system, and the demands of other employers.

To project manpower needs, therefore, entails projecting economic conditions, product or service demand, market share, wage rates, costs, and prices. The sophistication required for such projections lies beyond the resources of all but the larger individual firms, though business or industrial associations or consultants may be of some value to small companies. The most effective manpower planning is found in rapidly growing companies in expanding industries, but is concentrated primarily with planning for the higher level or skill shortage positions.

This part of the manpower planning profession, though also new, has begun to develop its assorted professional practices. For instance, the usual steps to manpower planning in the firm or association consist of:

(1) A projection of manpower requirements in different firms, departments, divisions, occupations, and levels at various points in the future

(2) An inventory of the numbers, ages, skills, and performance of current personnel

(3) Implementation of a plan to develop current personnel appropriate to meet future needs and to supplement that personnel as required from outside sources

At a more detailed level, these steps require the manpower planner to:

(1) Examine the historical data to determine the relationships between the size and composition of the work force and sales, production, and inventories

(2) Examine the historical data to determine retirements, deaths, quitting and dismissal rates, promotions and transfers, and retraining periods and retrainability rates

(3) Determine the relationship of staff functions to line employees, sales volume, and production

(4) Examine the rate of product or service development and its impact on the work force

(5) Determine the rate of productivity increase in terms of the ratios of man-hours to output, capital equipment to output, and of man-hours productivity index to capital productivity index

Then, given forecasts regarding sales, capital outlays, and product development, the following steps are taken in defining the work to be done:

(1) Make forecasts of turnover, promotion and transfer, retrainability and productivity increases (both from ongoing methods of improvement, work simplification, etc., and from major installations of automation, electronic data-processing equipment, plant layout revisions, etc.).

(2) Construct a model to forecast future manpower needs based on forecasted variables.

(3) Use the model to make two-, five-, and ten-year projections.

(4) With these projections, the company can compare its projected manpower supply to its projected needs and make plans to do something about its potential quantitative deficit or surplus.

Once the quantitative requirements for the future have been forecast, the firm or employer association must answer such pertinent qualitative questions relating to its employment needs as the following:

(1) Can the voluntary separation rate be reduced, particularly among the most promising younger employees?

(2) Can the replacement problem be met by opening up positions in middle management for younger men? What changes would this mean in retirement policy?

(3) Do all management positions require the equivalent of a college education?

(4) Are there men among the hourly and weekly work force with managerial potential?

(5) What are the sources of manpower—untrained and trained?

(6) Can women be used for some of the supervisory jobs?

(7) Can jobs be identified which develop younger men at faster rates than other jobs?

(8) Can capable men be obtained by transfer from other units of the firm or industry?

(9) Should the firm begin to hire outsiders who will provide the talent and age requirements needed?

(10) What are the qualitative requirements of the various jobs?

(11) How might the qualitative requirements best be met?

(12) What training programs are needed to fill needs?

(13) What is the best situs for these training programs?

(14) Are there any departments with problems of greater or lesser severity than the overall firm?

(15) Does the firm really need, say, 15 percent of its labor force as engineers when a third of them are doing nonengineering work?

(16) Can men not considered to have promotion potential be developed into promotable candidates?

(17) Can incentive factors (salaries, fringe benefits, promotions, job status, etc.) be revised to achieve greater effort from available manpower?

(18) Is a high school diploma really necessary?

(19) Are there identifiable career ladders?

(20) What training programs are needed to make career ladders effective?

A firm with some foresight will have established criteria for either internal development and promotion or outside recruiting. Though internal development is usually preferred, there are times and jobs for which the firm has no current available talent or lacks the time to develop the skills, knowledge, and judgments of existing personnel. When this occurs, the manpower planner must take steps to assure that there are responsive external human resource development institutions available within the community. This requires a knowledge of and working relationship with such human resource institutions.

A primary conflict often exists between national manpower program planning and micro-manpower planning in the efforts of national manpower program planners to get the disadvantaged hired. Ever-increasing hiring standards stand in the way of employing the more poorly equipped workers. Employer reluctance to train, unless absolutely necessary, can be understood when it is realized that the trained worker is free to leave almost at will and may hire himself out to a competitor. However, effective manpower planning should result in a higher retention rate, minimizing the losses from this source; and internal training programs may reduce the length and cost of the orientation period. The federal NAB-JOBS and MDT-OJT programs help to bridge this gap, with the federal government financing the training of disadvantaged workers by private firms.

The location and authority of the manpower planner in the business firm is still unclear; but there seems to be a tendency to place the function, along with budgeting, under those having ultimate responsibility for generating and measuring performance of an operating plan. With techniques so new, the pitfalls are many. Errors in projections are common and widespread. The primary determinants of future employment are not generally clear. There are no generally accepted measures of competence, and personal judgments are less than objective. Department heads and other supervisors often attempt to "hoard" good people by "hiding them" from the planner. Internal and external labor markets touch only at certain ports of entry and exit, making it difficult to foresee future interactions between supply and demand for manpower.

### *E. Micro-manpower Planning within the Water Pollution Control Field*

Leadership for manpower planning within the water pollution control field is exercised by the Manpower Development

Staff (MDS) within OWP. The fact that this manual has been prepared indicates the value that OWP is placing upon the development of a capability to engage in manpower planning. Such planning is considered a vital factor in accomplishing the national water pollution control objectives. It has been recognized, however, that the formulation and evaluation of programs to provide adequate manpower to the water quality industry have been hampered by two problems: (1) a lack of information concerning what are the real requirements for and supply of water pollution control manpower, and (2) the lack of a systematic framework for doing manpower planning within the 50 states and territorial possessions.

The first problem is being rectified by the execution of a survey questionnaire completed on a sample of 3,500 municipal wastewater treatment plants and administered jointly by the Department of Labor and the Environmental Protection Agency in 1971 (hereafter called DOL/EPA survey). The preparation of this manual is an attempt to rectify some of the implications of the second problem.

Some of the major functions performed by MDS are:

(1) To establish manpower planning criteria

(2) To develop manpower factor guidelines

(3) To measure current employment in the water quality industry

(4) To project future manpower requirements in the water quality industry

(5) To develop programs to improve the recruitment, retention, and utilization of manpower

(6) To assist regional and state agencies in manpower planning

(7) To collect and disseminate manpower information

OWP believes that it can best serve the water quality industry by actively seeking to effect close coordination with other federal programs. In this way it will utilize the skills and resources of other agencies, particularly manpower agencies within DOL and the U.S. Office of Education (USOE). The 1970-71 survey of employment in municipal wastewater treatment plants is an example of interagency cooperation initiated by the Environmental Protection Agency (EPA) and OWP.

MDS, in cooperation with DOL's Manpower Administration, designed and conducted in 1971 an extensive survey of employment in municipal wastewater treatment plants. (A copy of the survey questionnaire appears as Appendix I.) State employment service personnel, water pollution control organizations, and many similar regional, state, and local groups participated in the administration of this survey. The results should provide the industry with very useful base-line data for measuring employment in one major segment of the industry. Similar cooperation is anticipated with the Department of Housing and Urban Development (HUD). In addition, some cooperative efforts are under way to improve the level of manpower planning in large metropolitan areas and in regional labor market areas. For example, the necessity of identification of manpower needs is now recognized by EPA and HUD in water quality programs that are planned jointly.

In addition to measuring current employment, MDS has been concerned about projections of future manpower requirements. Tasks associated with this function include: design of the methodologies and procedure for generating, processing, storing, and communicating the data and information, and establishment of the appropriate capabilities of manpower planning at all levels of government. To make periodic manpower projections, plans will be prepared and reported by each of the states and each of the regions, and this will be used as a basis for development of national projections and plans by OWP staff. Until state and city capabilities are developed, regional and national projections will be made on the basis of existing available data.

The objectives of establishing manpower planning criteria will be to produce, maintain, and disseminate criteria to facilitate the identification of the various types of personnel engaged in water pollution control activities and to make manpower requirement determinations. The criteria will need to be continuously updated to provide for changes in technology and in manpower utilization practices. It is intended that the criteria be made available to consulting engineers and government staffs for planning the staffing of new plants and evaluating the staffing of existing plants. The regional staffs will be called upon to make arrangements for criteria development studies, to handle the regional review of new criteria, and to assist others in the application of the criteria.

To ensure that appropriate manpower information is generated and manpower factors are considered in the design and demonstration of new equipment, MDS will develop, maintain, and disseminate a manual of guidelines. The manual will be made available to all EPA staff, contractors, equipment manufacturers, and others connected with the design and analysis of water pollution control systems at the state and local levels.

Various forms of assistance will be provided for designing work plans, preparing requests for proposals, selecting and negotiating with contractors, reviewing project progress, and determining acceptability of end products. Assistance will be provided to engineering and research firms and to equipment manufacturers in their activities related to the manpower factors associated with equipment and system design and demonstration. OWP is concerned with the solution of problems and improvement of practices related to manpower development and utilization. To this end, guidance materials will be generated and special analyses made on topics such as recruiting practices, certification of wastewater treatment plant operators, salary structures, career development opportunities, and organization and management practices.

It is anticipated that a manpower planning capability will be established in each region. The primary outputs of this effort will be projections of regional manpower needs and supply and action plans for training and overcoming manpower problems. In addition, regional offices will stand ready to assist state offices in their planning activities.

The extent to which the function of manpower planning is recognized as an essential activity by the senior administrator of a state agency will be an important measure of how well municipal wastewater treatment plants will be staffed, operated, and maintained. It is no accident that in those states with systematic manpower planning, program development, and training of plant operators, significant gains have been recorded in achieving water quality objectives. Progress in proper staffing at the municipal wastewater treatment level is often a reflection of how well a state agency's senior management perceives the manpower planning function. If it ranks in importance and is coordinated with facilities construction, surveillance, enforcement, and standard setting, it will directly influence the quality of those parts of these agency functions that depend upon an adequate supply of qualified manpower. If, on the other hand, it is relegated to a staff member as "one more hat to wear" in an understaffed state agency, state water pollution control authorities would do well to consider alternative methods for having this function performed.

For a state water pollution control agency to develop a satisfactory manpower plan, a number of factors must be available: (1) a person or persons who are knowledgeable and can articulate the mission, goals, and objectives of the industry; (2) the resources and technology available and required to achieve the desired objectives; (3) an accurate data base that can be collected and utilized and which can define the direction and boundaries or limits of the industry; and (4) at least one person who can identify, analyze, and describe the most significant issues or problems that relate to the industry's manpower needs. In short, the minimum manpower planning capability that must be available to a state water pollution control agency is the ability to at least identify, define, and assign priority to those manpower requirements absolutely essential to achieving the agency's objectives.

If manpower planning for water pollution control is not done within the state water quality agency or by a more comprehensive environmental management agency, two alternatives should be considered: planning by state agencies other than the water pollution control agency and planning by the local communities. At least three "outside" manpower planning resources are available to assist state authorites responsible for water pollution control: (1) the state department of employment security, (2) the state department of education, and (3) CAMPS, with its system of state and local manpower planning councils. The first two of these resources will be examined in Chapter Three, while the third has been treated in this chapter. All represent valuable expertise to assist water quality agencies in establishing manpower development and training programs.

There are many advantages in having the staff of a state water pollution control agency develop its own manpower planning capability. Other state agencies operate under different authority and pursue objectives that may sometimes be in conflict with the goals of water pollution control. An example of such conflicts is the possibility of a conflict between the maintaining of full employment and the achieving of some desired level of water quality. Manpower planners in general will have as one of their goals that of full employment. Such a goal, however, may have to go unsatisfied, temporarily at least, if a firm has to be closed down or have its production activities curtailed because its activities are causing water pollution which places in jeopardy the health and general welfare of the community. Nevertheless, a state water pollution control agency should be prepared to investigate and seriously consider close cooperation in manpower planning with officials from education, the employment service, and state manpower planning councils. After all, if the aim of the manpower planner is to develop programs that make the most effective use of personnel, minimizing duplication of effort at any level of government will reflect well on the state agency executive who successfully makes full use of the expertise and resources of other state agencies that he believes are equipped to assist in manpower planning.

For the most part, few local communities have the resources to carry out comprehensive manpower planning to meet their needs in the water pollution control field. However, large cities and a growing number of other urban population centers have initiated modest efforts to carry out metropolitan regional planning, and this recent development in the national strategy for improved water quality management offers the state water pollution control agency an excellent opportunity to participate with other local organizations as a member of a metropolitan manpower planning council. Such membership will put the state water agency into direct communication not only with training and manpower development agencies, but also with those who offer funding and technical assistance that can be used in planning programs to upgrade workers now on the job or to train new workers for future job openings. Local communities will probably continue to look to state agencies for programs for the training and upgrading of workers now employed in local plants.

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# CHAPTER TWO

## WATER POLLUTION AND THE DEVELOPMENT OF THE WATER POLLUTION CONTROL PROGRAM

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## CHAPTER TWO

## WATER POLLUTION AND THE DEVELOPMENT OF THE WATER POLLUTION CONTROL PROGRAM

### *A. Introduction*

Pollution is a pervasive and persistent problem. We have all seen chimneys belching smoke, refuse strewn along our highways, automobile graveyards, and once-clean waters turned foul by human and industrial waste. Pollution does not discriminate among individuals and communities by affecting some and not others, though some may experience pollution more than others. Pollution has no public advocates, though individuals may differ in their recommendations for its proper reduction. Pollution, we all agree, is bad and must be significantly reduced.

In his message transmitting to Congress the first annual report of the Council on Environmental Quality, President Nixon said:

> Our environmental problems are very serious, indeed urgent, but they do not justify either panic or hysteria. The problems are highly complex, and their resolution will require rational systematic approaches, hard work, and patience. There must be a *national* commitment and a *rational* commitment.[1]

That such commitments are being made in the area of water pollution control we hope to illustrate in this chapter.

The contents of this chapter have also been designed to provide a common understanding of water pollution problems and pollution control programs for the manpower planner in the water pollution control field, regardless of in which state office such planning may occur. We shall discuss water as a

[1] Council on Environmental Quality, *Environmental Quality* (Washington, D.C.: U.S. Government Printing Office, 1970), p. xiv. (Emphasis in the original.)

national resource, threats to the quality of this resource, and the development of legislation and governmental programs to preserve it.

*B. Water as a Resource*

Two observations which, though simple, provide a key to understanding the problem of water quality are: (1) The supply of water from nature remains basically constant from year to year, and (2) conflicting demands are made upon the use of water.

While the supply of water has remained constant, the demand for water has increased. This is not to imply, as some prophets of doom have suggested, that we are or will shortly be out of water, though water shortages are of great concern in certain regions. Rather, it implies that the public's attitude toward the use of water must be changed if the supply of water of a desired quality is to be maintained and distributed equitably.

There are two essentially conflicting demands imposed upon our water supply. One type of demand arises from the fact that water is necessary to maintain and to preserve all forms of life. For such demands certain standards of cleanliness are required. The second type of demand arises from the usefulness of water in certain human and industrial activities. For such uses high standards of cleanliness are not required.

Quite clearly these two opposing demands for water cause almost certain conflict—a conflict arising out of the commonality of the water resource. They also create a conflict because individuals and firms, though generally falling into both classifications of demand, are not always aware of the effects their actions have upon themselves and upon others. These circumstances also arise because some of the economic and political institutions in the United States have not been designed to reflect the fact that water is generally a scarce and valuable resource that is used to satisfy a variety of functions. In former times a smaller and more dispersed population, along with a lower level economic activity, did not place a great deal of strain upon the ability of water to dilute and assimilate waste. As a consequence of this lower scale of activity, the inherent conflicts in the different demands placed upon water remained dormant. As the level of population and economic activity changed and as water uses changed, the condition of water quality changed also.

### *C. Threats to Water Quality*

Documentation, in the sense of providing precise figures, of the amount and type of pollutants emitted into receiving waters is difficult if not impossible. Government agencies have not inventoried all sources of pollution; nor do the resources exist for them to accomplish this task in the foreseeable future. However, samples of water quality at different points in time and space, recurrent testing of water quality at stationary testing stations, and extrapolations to the universe from these samples (based upon reasonable analytical techniques and professional judgments of those skilled in water quality management) are available.

#### *1. Types of Pollutants*

There are eight major categories of water pollutants[2]: (1) oxygen-demanding wastes, (2) disease-causing agents, (3) plant nutrients, (4) synthetic organic chemicals, (5) inorganic chemicals and mineral substances, (6) sediments, (7) radioactive substances, and (8) heat.

#### *2. Amounts of Pollution*

Though we have noted that a precise documentation of the magnitude of water pollution is not possible at this time, nevertheless some idea of the magnitude of certain aspects of the problem, particularly as it may change over time, is possible. In this section we consider, by way of illustration and example only, the projected changes in three factors related to water pollution. The three factors that we have chosen are BOD, phosphorus, and thermal pollution. Although thermal pollution is not directly related to the pollution activities of wastewater treatment plants, nevertheless the available data depicting the possible growth of thermal pollution will give us some indication of the possible growth of pollution in general.

*a. Growth of BOD.* The primary measurement of the strength of organic waste is the amount of oxygen used in a

[2] For further details, see U.S. Department of Interior, *A Primer on Wastewater Treatment* (Washington, D.C.: U.S. Government Printing Office, 1969), pp. 10-13.

fixed period of time and at a fixed temperature by the biological processes involved in the stabilization of organic matter. This action is called the biochemical oxygen demand (BOD). The presence of organisms in water allows bacteria to decompose waste material. If, however, the concentration of organic waste is high, the available oxygen is insufficient to allow the bacteria to decompose the waste, and water pollution results.

Table 2-1 shows the estimated increase in the gross production of BOD for 1957, 1964, and 1968. The average annual growth rate in BOD production is approximately 6 percent. The important insights to be obtained from this table are that: (a) the production of BOD is related to many industrial activities

**TABLE 2-1**

**Estimated Increase in Gross Production of BOD (1957, 1964, 1968)**

| Waste Source | *Millions of Pounds of BOD per Year* 1957 | | 1964 | | 1968 |
|---|---|---|---|---|---|
| Food processing | 3,400 | | 4,300 | | 4,600 |
| Textile mill products | 660 | | 890 | | 1,100 |
| Paper and allied products | 4,300 | | 5,900 | | 7,800 |
| Chemical and allied products | 5,500 | | 9,700 | | 14,200 |
| Petroleum and coal | 410 | | 500 | | 550 |
| Rubber and plastics | 20 | | 40 | | 60 |
| Primary metals | 350 | | 480 | | 550 |
| Machinery | 100 | | 130 | | 180 |
| Transportation equipment | 50 | | 120 | | 160 |
| All other | 300 | | 390 | | 470 |
| Manufacturing TOTAL | 15,090 | | 22,460 | | 29,670 |
| Sewered population | 5,700 | | 7,600 | | 8,500 |
| TOTAL | 20,790 | | 30,060 | | 38,170 |
| Annual rate of increase | | 5.4% | | 6.2% | |

Source: Environmental Protection Agency, Water Quality Office, *Cost of Clean Water*, vol. II of *Cost Effectiveness and Clean Water* (Washington, D.C.: U.S. Government Printing Office, March 1971).

and since these activities increase over time, so will the production of BOD; and (b) approximately one-third of the produced BOD comes from sewage, and as the population increases, BOD will increase also. Clearly, the implication of these observations is that increasing economic activity and population will require increasing amounts of treatment to maintain given water quality standards.

*b. Growth of phosphorus.* Natural bodies of water contain mineral and organic elements that are essential for biological growth. Sometimes, as the result of pollution, however, an overabundance of one or more of these elements occurs. Table 2-2 shows the magnitude of increase of one such element—phosphorus. Increases of such a magnitude have had a dele-

**TABLE 2-2**

**Estimated Increase in Phosphorus Discharged as Municipal Sewage (1957, 1964, 1968)**

| | *1957* | *1964* | *1968* |
|---|---|---|---|
| Sewered population (millions of persons) | 98.4 | 119.6 | 139.7 |
| Per capita phosphorus production, pounds | | | |
| (a) From metabolic process | 1.0 | 1.0 | 1.0 |
| (b) From consumption of detergents | 2.0 | 3.0 | 3.3 |
| TOTAL sewered phosphorus (million lbs per year) | 295.2 | 478.4 | 600.7 |
| Less phosphorus incorporated in sewage sludge: | | | |
| (a) Primary treatment—0.5 lb per capita (million lbs per year) | (12.9) | (20.4) | (21.8) |
| (b) Secondary treatment—1.31 lbs per capita (million lbs per year) | (63.6) | (81.3) | (111.8) |
| TOTAL discharged phosphorus (million lbs per year) | 218.7 | 376.7 | 467.1 |

Source: Environmental Protection Agency, Water Quality Office, *Cost of Clean Water*, vol. II of *Cost Effectiveness and Clean Water* (Washington, D.C.: U.S. Government Printing Office, March 1971).

terious effect upon water ecology and have caused abnormal growth in certain aquatic organisms. The amount of available phosphorus has increased in recent years because of the substitution of phosphorus detergents for soap, not only by households but also by industry. In addition, because of the increased demand for phosphorus, the production of phosphorus detergents has increased, thus resulting in an increase in the amount of phosphorus entering receiving waters, not only as a residual from cleansing processes but also as a waste in the production of the detergent itself.

The estimated increases in phosphorus discharges from municipal sewage for 1957, 1964, and 1968 are shown in Table 2-2. The average annual growth rate in estimated phosphorus production was approximately 7 percent between 1957 and 1968. Clearly, the same conclusions may be obtained concerning the growth of phosphorus as were obtained for BOD.

*c. Growth of thermal pollution.* The primary source of thermal pollution is the electric power industry which requires tremendous quantities of water for cooling. Insofar as the use of electricity will increase in the future, the possible magnitude of thermal pollution will also increase. Table 2-3 shows the past and estimated future use of electricity from 1912 to 1985.

**TABLE 2-3**

**U.S. Electric Power—Past Use and Future Estimates**

| Year | Billion Kilowatt-hours |
|---|---|
| 1912 | 12 |
| 1960 | 753 |
| 1965 | 1,060 |
| 1970 | 1,503 |
| 1975 | 2,022 |
| 1980 | 2,754 |
| 1985 | 3,639 |

Source: Federal Water Control Administration, "Industrial Waste Guide on Thermal Pollution" (Washington, D.C.: U.S. Government Printing Office, September 1968).

From 1970 to 1985 the average annual increase in the use of electricity is approximately 6 percent.

*D. Factors Affecting Water Quality*

The factors that affect water quality may be divided into four categories: (1) increases in population, (2) changes in technology, (3) the lack of economic incentives or penalties, and (4) the existence of a "frontier psychology."

We shall not be concerned as to whether this is an exhaustive listing or whether a shorter list could be as encompassing, nor shall we attempt to list these factors in order of the seriousness of their effect; but rather, we present this classification because it provides a convenient framework for summarizing the principal causes of water pollution.

*1. Increases in Population*

The sheer increase in the number of people places considerable pressure upon facilities designed to treat waste water. More people simply implies more waste. If waste water is not adequately treated and is allowed to find its way into the water system, as has occurred in recent years, more water pollution results. The effects of increases in the population are further intensified by the tendency of the population to congregate in large urban areas. The resulting increases in population density place great strain upon existing treatment facilities and do so, it appears, in greater proportion than the simple increase in population density.

The increases in waste resulting from increases in population are not limited to human waste. As more people are absorbed into the economy, more products are demanded and produced, whether they be industrial or agricultural. Thus economic activity has increased with a resulting increase not only of final products but also of waste material.

*2. Changes in Technology*

With the advance of science, new products and new methods have evolved. Our life-styles have been changed. We drive more and bigger automobiles, buy drinks in "disposable" containers, and use new chemicals in our homes and factories. Though such changes may have had significant beneficial effects upon our lives, they have not been without some detrimental side effects. In moving to new ways of producing electricity (for example, by harnessing atomic power), we have experienced, as a detrimental side effect, the consequences of emitting heated water (thermal pollution) into our estuaries. Advances in biological and chemical branches of science have increased the efficiency by which we produce food, but they have done so with the consequence that our water resources are becoming saturated with harmful pesticides and phosphates.

### *3. Lack of Economic Incentives or Penalties*

Although many of our activities are affected by economic forces, we have usually considered the bounties of nature to be unlimited. Because of the conflicting demands placed upon our water resource and the relative scarcity of such resources, this provision of nature cannot be considered a free good, especially if we desire certain standards of water quality while still demanding certain material things.

If we allow the indiscriminate emission of pollutants into our waterways, we pay all of the costs inherent in low water quality—fewer places to swim, higher costs of supplying drinking water, and increased possibility of disease. Yet if we eliminate pollutants completely, we face the prospect of high control costs for individuals and for firms, with the resulting decreases in individuals' incomes to spend on other goods and services. We must reduce pollution in an effective and equitable manner.

We have seen significant changes in technology and leisure time without the required changes in economic incentives to control their adverse effects. For example, individuals buy disposable containers but are not confronted directly with the cost of disposing of them. Consequently, more products are produced in disposable containers than would be the case if the price of the product reflected its true cost. Furthermore, firms emit such things as chemicals and refuse into receiving waters without paying the added purification costs of providing potable water or without indemnifying those directly affected by the resulting dirty water. As a consequence of these conditions, such firms are able to charge a price for their products that is lower than if they were confronted with the true costs of their operations. This situation would be alleviated if firms were confronted with the true cost of their activities. This could be accomplished by imposing taxes upon certain goods, the proceeds of which would pay for their disposal, and by imposing effluent fees, the presence of which would give industry the incentive to decrease the emission of pollutants. In the absence of such economic incentives, water quality will continue to be less than what is desirable or attainable. The recognition of these facts has found expression in the most recent report of the President's Council of Economic Advisors; and recently Russell Train, Chairman of the Council of Environmental Quality, said:

> We think that significant reductions in waste discharges might be more quickly and inexpensively effected if, in addition to regulatory restrictions, changes were made in the costs of facing individual polluters. For example, a system of effluent or emission charges requiring payment for the amount of specific pollutants added to the environment would, it seems to me, help harness the normal competitive forces of our economy to work with us rather than against us in achieving our pollution abatement goals.[3]

### *4. Frontier Psychology*

In summarizing the relationship between the American society and its natural resources, Alexis de Tocqueville said, "Their ancestry gave them love of equality and of freedom; but God Himself gave them the means of remaining equal and free by placing them upon a boundless continent." This abundance has, however, caused us to be careless. This carelessness has been referred to as "a reflection of our frontier psychology."

Man has traditionally been a developer, for he alone among all living things is capable of changing his environment. It has been asserted that man, particularly Western man, has pursued development with a frontier mentality—a mentality that causes him to believe that his resources are unlimited. As a consequence of this error in thinking and this selfishness of attitude, developmental decisions have been made without an awareness of their consequences for water quality. Cities have

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[3] Address delivered at the Atlantic Council, Battelle Memorial Institute Conference, Department of State, Washington, D.C., June 15, 1971 (processed) as quoted in Charles L. Schultze *et al.* (eds.), *Setting National Priorities in the 1972 Budget* (Washington, D.C.: The Brookings Institution), p. 239.

grown with no more thought to sewage treatment than the requisite pipes to direct the effluent to some receiving waters, and firms have expanded their facilities with equally reckless abandon.

*E. Governmental and Private Responses for Water Quality*

Pollution control has become a major issue of public policy. In this section we shall review some of the major landmarks in the development of government response to problems of water pollution control. Though our review is brief, it is sufficient to indicate that in recent years the rate at which government control has been extended and monetary appropriations made has risen quite rapidly.

*1. Role of State and Local Governments*

Prior to 1948 most of the responsibility for controlling water pollution resided with state and local governments. Even in colonial times cities had regulations governing the disposal of sewage. Baltimore, for example, banned the use of cesspools in 1889, in 1857 Philadelphia began the construction of a sewer system, and also in 1857 Brooklyn installed sewers for the transportation of sewage. As cities grew, regulations governing the emission of foreign material into waterways were adopted by both state and local authorities. However, such regulations were adopted primarily to minimize the disruption of water navigation. Late in the 19th century as scientists began to establish the relationship between contagious diseases and water pollution, state and local governments created public health boards that were charged with pollution control as a way of maintaining health standards.

State and local governments have traditionally played an innovative role in environmental protections and continue to do so even with the increased involvement of the federal government, an involvement we shall document in the next section. The state and local governments perform creative and essential functions in planning, managing, and enforcing the various means that have been adopted to restore and maintain water quality. Though the variety in and the number of state and local governmental efforts prohibit a detailed examination of their activities, a few general observations can be made by referring to two tables recently released by EPA.

Table 2-4 shows the amount of funding and the amount of manpower for state and federal water quality agencies as funded in 1970 and budgeted for 1971. As indicated in the table, there has occurred an increase of approximately 21 percent in the amount of money devoted to water quality programs and an increase of approximately 8 percent in the number of man-years devoted to work in such programs.

Though state and local governments have enjoyed considerable success in their efforts in water pollution control, their work has become increasingly difficult as pollution has increased and as the size and number of municipalities have increased. Since pollution is no respecter of political boundaries, it was difficult for one locality, or even a state, to clean up its water when other communities were not so inclined. Furthermore, even those communities dedicated to improving water quality have experienced increasing difficulty in financing their projects as financial squeezes began to affect state and local governments. In addition, there arose competition among municipalities for new business, some of which polluted; and in many areas pollution control was afforded low priority by those cities competing for new industry and fearful that stringent controls would put them at a competitive disadvantage. Such problems, along with the experiences of the New Deal (e.g., increased federal control and aid to state and local governments), eventually began to encourage federal authorities to take increasingly more initiative.

### 2. *Role of the Federal Government*

Prior to 1948 the only federal legislation in the area of water pollution control was an 1899 law prohibiting the dumping of debris into navigable waters—to prevent impediments to navigation rather than to fight pollution—and a 1924 act prohibiting oil pollution from ocean-going vessels. Since 1948 a series of federal acts has been passed, beginning with the Water Pollution Control Act of 1948. The contents of this Act were based upon the opinion that the control of water pollution was a state and local responsibility but that the federal government should aid the financing of such facilities by providing capital in the form of loans to state and local governments. In 1956 the Water Pollution Control Act was amended to change what was a temporary authority into a permanent authority and to change

# TABLE 2-4

## Funding and Manpower for State Water Quality Agencies (1970-71)

| State | *Fiscal Year 1970 Funding* | | | *Fiscal Year 1971 Budgeted* | | | Fiscal Year 1970 Man-Years | Fiscal Year 1971 Man-Years |
|---|---|---|---|---|---|---|---|---|
| | Federal | State | Total | Federal | State | Total | | |
| Alabama | 185,012 | 58,068 | 243,080 | 190,500 | 158,750 | 349,250 | 21.90 | 22.20 |
| Alaska | 20,100 | 56,280 | 76,380 | 20,000 | 114,700 | 134,700 | 8.20 | 15.00 |
| Arizona | 69,377 | 59,003 | 128,380 | 75,500 | 88,117 | 163,617 | 12.75 | 11.00 |
| Arkansas | 118,169 | 182,401 | 300,570 | 115,700 | 275,000 | 390,700 | 27.30 | 35.00 |
| California | 662,460 | 2,314,066 | 2,976,526 | 661,100 | 2,801,270 | 3,462,370 | 239.00 | 192.30 |
| Colorado | 84,970 | 141,463 | 226,433 | 88,000 | 220,485 | 308,485 | 20.00 | 21.00 |
| Connecticut | 169,811 | 324,787 | 494,598 | 167,400 | 503,905 | 671,305 | 50.80 | 64.00 |
| Delaware | 86,267 | 217,312 | 303,579 | 85,900 | 202,200 | 288,100 | 36.33 | 33.20 |
| District of Columbia | 89,055 | 271,515 | 360,570 | 87,800 | 579,744 | 667,544 | 51.70 | 63.80 |
| Florida | 267,440 | 462,300 | 729,740 | 266,300 | 658,519 | 924,819 | 68.50 | 72.00 |
| Georgia | 223,337 | 412,894 | 636,231 | 218,700 | 535,544 | 754,244 | 38.00 | 50.00 |
| Hawaii | 65,100 | 114,781 | 179,881 | 71,100 | 184,900 | 256,000 | 24.20 | 31.00 |
| Idaho | 42,957 | 173,467 | 216,424 | 44,100 | 214,000 | 258,100 | 9.75 | 20.30 |
| Illinois | 379,097 | 645,359 | 1,024,456 | 428,000 | 2,327,340 | 2,755,340 | 95.00 | 188.00 |
| Indiana | 229,696 | 346,732 | 576,428 | 230,000 | 484,358 | 714,358 | 66.03 | 56.80 |
| Iowa | 123,699 | 121,309 | 245,008 | 121,200 | 124,580 | 245,780 | 15.25 | 22.75 |
| Kansas | 98,724 | 321,285 | 420,009 | 97,600 | 426,400 | 524,000 | 37.75 | 49.61 |
| Kentucky | 171,210 | 218,059 | 389,269 | 165,000 | 327,546 | 492,546 | 33.00 | 45.80 |
| Louisiana | 187,743 | 266,887 | 454,630 | 184,100 | 331,502 | 515,602 | 40.00 | 49.00 |
| Maine | 64,122 | 371,023 | 435,145 | 63,000 | 397,093 | 460,093 | 24.00 | 29.00 |
| Maryland | 183,480 | 1,135,869 | 1,319,349 | 181,300 | 1,369,830 | 1,551,130 | 69.20 | 82.60 |
| Massachusetts | 224,604 | 413,490 | 638,094 | 264,600 | 457,598 | 722,198 | 58.00 | 58.00 |
| Michigan | 358,803 | 659,392 | 1,018,195 | 357,800 | 992,200 | 1,350,000 | 91.00 | 95.50 |
| Minnesota | 156,651 | 561,030 | 717,681 | 155,400 | 661,955 | 817,355 | 60.40 | 60.00 |
| Mississippi | 149,000 | 123,235 | 272,235 | 145,100 | 72,550 | 217,650 | 25.75 | 25.00 |
| Missouri | 199,368 | 224,456 | 423,824 | 196,700 | 230,534 | 427,234 | 31.50 | 31.50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Montana | 39,896 | 69,117 | 109,013 | 39,000 | 68,664 | 107,664 | 7.00 | 7.00 |
| Nebraska | 66,404 | 77,909 | 144,313 | 66,400 | 117,021 | 183,421 | 12.20 | 11.90 |
| Nevada | 21,485 | 32,682 | 54,167 | 23,787 | 34,213 | 58,000 | 5.50 | 5.71 |
| New Hampshire | 63,488 | 300,544 | 364,032 | 63,500 | 517,326 | 580,826 | 55.00 | 66.00 |
| New Jersey | 313,742 | 856,408 | 1,170,150 | 311,900 | 726,204 | 1,038,104 | 77.90 | 88.90 |
| New Mexico | 52,875 | 34,943 | 87,818 | 52,300 | 113,000 | 165,300 | 11.30 | 14.60 |
| New York | 671,175 | 4,349,545 | 5,020,720 | 650,400 | 4,564,632 | 5,215,032 | 328.00 | 300.00 |
| North Carolina | 269,764 | 438,219 | 707,983 | 264,600 | 509,930 | 774,530 | 58.50 | 57.00 |
| North Dakota | 34,398 | 30,454 | 64,852 | 37,200 | 27,700 | 64,900 | 6.00 | 5.85 |
| Ohio | 445,000 | 495,549 | 940,549 | 447,300 | 819,875 | 1,267,175 | 51.10 | 60.00 |
| Oklahoma | 119,156 | 138,437 | 257,593 | 117,600 | 181,098 | 298,698 | 19.00 | 31.90 |
| Oregon | 97,121 | 497,780 | 594,901 | 96,900 | 468,835 | 565,735 | 38.50 | 41.80 |
| Pennsylvania | 496,504 | 1,779,523 | 2,276,027 | 488,300 | 2,085,978 | 2,574,278 | 206.00 | 170.81 |
| Rhode Island | 110,443 | 163,827 | 274,270 | 111,000 | 187,200 | 298,200 | 29.65 | 32.60 |
| South Carolina | 159,749 | 200,631 | 360,380 | 157,400 | 365,474 | 522,874 | 36.50 | 43.00 |
| South Dakota | 41,165 | 58,683 | 99,848 | 38,500 | 66,500 | 105,000 | 11.70 | 8.70 |
| Tennessee | 212,537 | 188,780 | 401,317 | 208,200 | 329,320 | 537,520 | 31.50 | 37.50 |
| Texas | 436,951 | 1,796,201 | 2,233,152 | 427,000 | 1,771,339 | 2,198,339 | 133.00 | 145.00 |
| Utah | 54,592 | 62,455 | 117,047 | 55,400 | 92,052 | 147,452 | 11.15 | 12.67 |
| Vermont | 43,999 | 216,078 | 260,077 | 43,700 | 239,820 | 283,520 | 21.60 | 23.00 |
| Virginia | 212,858 | 625,220 | 838,078 | 210,500 | 1,065,740 | 1,276,240 | 78.50 | 100.00 |
| Washington | 131,037 | 997,205 | 1,128,242 | 131,037 | 1,025,803 | 1,156,840 | 73.50 | 73.50 |
| West Virginia | 111,682 | 173,790 | 285,472 | 111,682 | 233,870 | 345,552 | 28.50 | 28.50 |
| Wisconsin | 196,393 | 959,602 | 1,155,995 | 193,000 | 1,402,000 | 1,595,000 | 75.00 | 83.00 |
| Wyoming | 23,786 | 31,302 | 55,088 | 23,600 | 39,400 | 63,000 | 2.50 | 3.00 |
| Guam | 46,719 | 43,105 | 89,824 | 75,000 | 39,469 | 114,469 | 7.80 | 10.60 |
| Puerto Rico | 198,900 | 106,234 | 305,134 | 195,000 | 182,813 | 377,813 | 26.50 | 36.95 |
| Virgin Islands | 52,725 | 35,325 | 88,050 | 70,300 | 35,150 | 105,450 | 10.40 | 10.90 |
| TOTAL | 9,334,796 | 24,956,011 | 34,290,807 | 9,392,406 | 32,051,045 | 41,443,451[a] | 2,709.11 | 2,934.75[b] |

Note. Data represents activities of water quality agencies, not expenditures for pollution control facilities. Fiscal year refers to the federal July-June fiscal year.

[a] 20.86 percent increase over 1970 expenditures

[b] 8.3 percent increase over 1970 level

Source: Environmental Protection Agency, Office of Water Programs.

what had been a system of loans to a system of grants. The annual authorization under the amended Act was $50 million.

In the early 1960s Congress appeared to be dissatisfied with the progress of pollution control and eventually adopted the Water Quality Act in 1965. This Act increased the authorized level of funding, increased support to research and development activities, created the Federal Water Pollution Control Administration (FWPCA), and strengthened the role to be played by the federal government in the enforcement of water pollution control and the establishment of water quality criteria. In 1966 the Clean Water Restoration Act was passed, which further increased authorized funding—reaching a high of $1.25 billion by 1971—and increased research and development activities into advanced water treatment methods. Also at this time (1966) the FWPCA was transferred from Health, Education and Welfare (HEW) to the Department of the Interior.

Between 1967 and 1970 water pollution control legislation concentrated upon specific pollution problems. Bills were passed which dealt with problems of oil pollution, acid mine drainage, eutrophication, and thermal pollution. Such acts were primarily designed to strengthen the weaknesses of former acts or to cover aspects of pollution control that had been overlooked in previous acts. In addition, the FWPCA was changed to the Federal Water Quality Administration (FWQA).

In 1970, realizing the fragmentation of responsibility, not only in water pollution control but the entire area of environmental control, President Nixon by a Presidential Act established EPA. This agency represented an addition to the President's cabinet and thereby emphasized the importance the federal government was now assigning to problems of environmental deterioration. In addition to EPA the President established the Council on Environmental Quality—a committee created to report directly to the President in an advisory and recommendatory capacity on environmental issues.

Three terms frequently used to describe the government funding process include authorization, appropriation, and expenditures. Each term has a specific meaning. When a legislature enacts a new law that requires funding for implementation, the legislature will authorize a ceiling or upper limit in dollar amounts. The actual monies Congress or a state legislature appropriates for any piece of legislation are the result of a subsequent and an entirely different appropriation process. Appropriations are often below authorization amounts. Expenditures of a government depend upon an agency of the executive branch of government. While a government agency can usually find ways to encumber all funds it has received through an appropriation, it is possible for a variety of reasons for expenditures to fall below the level of appropriations. It is not unusual for a legislature to increase both appropriation and authorization levels from time to time on any piece of legislation, thus permitting an agency to expand its staff and services. In Table 2-5 a summary of federal appropriations for water pollution control is shown. As can be seen, both appropriations and expenditures have increased, though expenditures have been substantially below those amounts appropriated.

**TABLE 2-5**

**Federal Appropriations and Expenditures for Water Pollution Control (Millions of dollars)**

| | *Actual* | | | *Estimated* | *Proposed* |
|---|---|---|---|---|---|
| | 1965 | 1969 | 1970 | 1971 | 1972 |
| Grant program for construction of waste treatment facilities: | | | | | |
| Appropriations | $ 93 | $214 | $800 | $1,000 | $2,000 |
| Expenditures | 70 | 135 | 176 | 422 | 1,000 |
| Administration, research, development, miscellaneous grants, enforcement: | | | | | |
| Appropriations | 35 | 87 | 87 | 120 | 143 |
| Expenditures | 31 | 79 | 86 | 113 | 131 |
| TOTAL: | | | | | |
| Appropriations | 128 | 301 | 887 | 1,120 | 2,143 |
| Expenditures | $101 | $214 | $262 | $ 535 | $1,131 |

Sources: *The Budget of the United States Government . . . Appendix*, for fiscal years 1967, 1971, 1972, pp. 494 and 496, 625 and 803, 805, respectively; *The Budget of the United States Government, Fiscal Year 1972* (Washington, D.C.: U.S. Government Printing Office), p. 113.

### 3. *Role of the Private Sector*

The private sector has also become involved in the control of water pollution. Most obviously, the private sector has been affected by governmental regulations and, in many cases, has had to reorganize its production processes to meet the requirements of the new legislation. If some aspects of the currently proposed legislation are enacted, the private sector will have to reorganize its production processes even more.

Some indication of what has been occurring in the private sector in the area of water pollution control can be obtained by examining the appropriations for research and development in this area as well as the amount of money actually invested in pollution control equipment. Table 2-6 shows the amount appropriated to research and development in 1970 by broad industrial classifications and the planned expenditure for 1971. Table 2-7 gives actual and planned investments in both air and water pollution control. Though these figures are not as accurate as we should like, they do perhaps give some indication of the monies involved and the increased commitment of the private sector to pollution control. These monies fall short of those that it has been estimated will be required by industry to satisfy federal guidelines such that further increases can reasonably be expected.

President Nixon has called for the establishing of a national industrial pollution control council. Such a council would work closely with the Council on Environmental Quality, the Secretary of Commerce, and other federal agencies involved in pollution control. The purpose of such a council would be to help develop effective policies for curbing pollution, to enlist increased support from business and industry to reduce pollution, and to provide a mechanism through which government officials could work with industrial leaders to establish voluntary programs for accomplishing desired pollution control goals.

## F. *National Water Pollution Control Program*

In response to expressions of public concern over existing levels of water pollution (as reflected in part in the passing of certain legislation), a national water pollution control program was developed. In this section we review the significant aspects of this program. In our review we shall, as in previous sections, concentrate upon the role of municipal wastewater treatment facilities and upon those aspects of the national program that would seem to be of importance to the manpower planner.

**TABLE 2-6**

**Industry Research and Development Expenditures for Pollution Control, 1970-71 (Millions of dollars)**

| Industry | Actual 1970 | Planned 1971 | Percent change 1970-71 |
|---|---|---|---|
| Iron and Steel | $ 1.7 | $ 0.8 | –53 |
| Nonferrous metals | 10.1 | 13.5 | 34 |
| Machinery | 177.6 | 186.5 | 5 |
| Electrical machinery and communications | 48.1 | 63.7 | 32 |
| Aerospace | 181.3 | 222.0 | 22 |
| Autos, trucks, and parts | 60.1 | 74.6 | 24 |
| Other transportation equipment | 2.2 | 2.1 | –5 |
| Fabricated metals and ordnance | 7.0 | 11.0 | 57 |
| Professional and scientific instruments | 31.6 | 32.9 | 4 |
| Lumber | 0.4 | 1.2 | 200 |
| Furniture | 0.4 | 1.1 | 175 |
| Chemicals | 53.1 | 36.1 | -32 |
| Paper | 8.2 | 8.3 | 1 |
| Rubber | 3.2 | 3.1 | -3 |
| Stone, clay, and glass | 15.4 | 19.1 | 24 |
| Petroleum products | 34.4 | 43.2 | 26 |
| Food and kindred products | 5.6 | 7.3 | 30 |
| Textile mill products | 5.0 | 4.3 | –14 |
| Apparel | $<.5$ | $<.5$ | NA |
| Other manufacturing | 15.7 | 12.4 | –21 |
| All manufacturing | 661.1 | 743.2 | 12 |
| Nonmanufacturing | 80.4 | 182.6 | 127 |
| All industry | $741.5 | $925.8 | 25 |

Source: McGraw-Hill Book Company.

## TABLE 2-7

### Industry Investment for Air and Water Pollution Control, 1969-71 (Millions of dollars)

| Industry | Actual 1969 | Actual 1970 | Planned 1971 | Percent change 1969-70 | Planned percent change 1970-71 |
|---|---|---|---|---|---|
| Iron and steel | $ 179 | $ 206 | $ 212 | 15 | 3 |
| Nonferrous metals | 41 | 100 | 152 | 144 | 52 |
| Electrical machinery | 32 | 52 | 58 | 63 | 12 |
| Machinery | 51 | 121 | 169 | 137 | 40 |
| Autos, trucks, and parts | 55 | 67 | 118 | 22 | 76 |
| Aerospace | 22 | 15 | 18 | —32 | 20 |
| Other transportation equipment | 15 | 15 | 6 | 0 | —60 |
| Fabricated metals | 44 | 53 | 70 | 20 | 32 |
| Instruments | 25 | 25 | 28 | 0 | 12 |
| Stone, clay, and glass | 63 | 64 | 104 | 2 | 62 |
| Other durables | 103 | 135 | 175 | 31 | 30 |
| TOTAL durables | 630 | 853 | 1,110 | 35 | 30 |
| Chemicals | 140 | 169 | 263 | 21 | 56 |
| Paper | 143 | 153 | 321 | 7 | 110 |
| Rubber | 9 | 50 | 42 | 456 | −16 |
| Petroleum | 260 | 337 | 507 | 30 | 50 |
| Food and kindred products | 58 | 84 | 151 | 45 | 80 |
| Textiles | 10 | 13 | 25 | 30 | 92 |
| Other nondurables | 31 | 60 | 37 | 94 | —38 |
| TOTAL nondurables | 651 | 866 | 1,346 | 33 | 55 |
| All manufacturing | 1,281 | 1,719 | 2,456 | 34 | 43 |
| Mining | 105 | 115 | 135 | 10 | 17 |
| Railroads | NA | 28 | 28 | NA | 0 |
| Airlines | NA | 21 | 27 | NA | 29 |
| Other transportation | 0 | 4 | 10 | | 150 |
| Communications | 0 | a | a | NA | NA |
| Electric utilities | 155 | 405 | 679 | 161 | 68 |
| Gas utilities | 130 | 110 | 148 | —15 | 35 |
| Commercial[b] | 0 | 100 | 158 | | 58 |
| All business | $1,671 | $2,502 | $3,641 | 50 | 46 |

NA = not available

[a] Less than 0.5

[b] Based on large chain, mail order, and department stores; insurance companies; banks; and other commercial business

Source: McGraw-Hill Book Company.

### *1. Mission, Objectives, and Goals of the Office of Water Programs*

Within the framework of the federal-state-municipal partnership, a national strategy has been suggested that, if followed, will contribute significantly to achieving adequate standards of water quality throughout the country. This plan includes a statement of the mission, objectives, and goals of the national program for water pollution control and an established order of priorities among a variety of possible activities.

The central mission of the national program is:

(1) To prevent further pollution of the nation's water resources by preserving existing high-quality waters for future generations and maintaining achieved level of water quality for presently defined uses

(2) To reverse the present degradations of the nation's waters and to enhance the value of water and related resources by abating pollution and by managing waste-bearing waters for beneficial reuse

(3) To contribute to a coordinated and long-range national program for the preservation of a balanced environment

A principal objective of the national program for the five-year period ending in 1976 is to establish water quality standards and obtain compliance with such standards. The objective to be attained by 1980 is to manage and control all sources of water pollution and to develop the technology and institutions for the complete recycling of waste and the reuse of renovated waste waters.

To achieve the objective of reaching established water quality standards, several intermediate goals have been established. The following is a sample of such goals:

(1) To have an information system and the management capability to direct resources toward high-priority goals (by 1971)

(2) To establish effluent requirements as an element in establishing water quality criteria (by 1972)

(3) To complete programs of heat and radiation control from power plants (by 1972)

(4) To complete required implementable water basin plans to be certified by the states and river basin commissions and to be accepted by OWP (by 1973)

(5) To achieve compliance with effluent requirements for municipal wastes and maintain this level of compliance on an ongoing basis through surveillance, enforcement, and public utility long-term financing arrangements (by 1974)

*2. Program Strategy*

The goals of the national water pollution control program have been structured into an order of priorities which in turn determines a water program strategy. Within this program strategy the most important item is the establishing of water quality standards. Such standards, when properly used, identify water uses and water quality criteria along with a timetable for corrective measures and a mechanism for implementation and enforcement of the standards. The second item in the program strategy is the development of river basin pollution abatement and prevention plans. Water quality standards provide the basis for control and abatement activities to be implemented in each basin plan, while the basin plan provides the means for focusing upon the appropriate combination of technology, facility construction, enforcement, and the management of resources in the most cost-effective manner for obtaining the desired water quality.

Some significant elements of the program strategy are:

(1) To take those actions that will assure the adoption of federally approved water quality standards by all of the states

(2) To take those actions that will encourage the state to develop implementable plans to achieve the federally approved water standards. This will be done by:

(a) Increasing federal and state emphasis upon good planning for river basins and regional-metropolitan areas

(b) Requiring that federally subsidized construction projects conform with approved water quality plans

(c) Assuring that the priorities established in state program plans (i.e., the one- and five-year lists to be explained subsequently) are consistent with the schedules contained in approved basin or regional-metropolitan water quality plans

(3) Annual, qualified, objective analysis of each state program to identify strengths and weaknesses, activeness of legislative base, inactivity of funding, and successes as measured by programs in attaining water pollution control goals

*3. Priorities in National Problem Areas*

In assessing the impediments to achieving the stated objectives of water quality, we have identified several national problem areas. These problem areas are: (1) municipal-sewered wastes, (2) industrial and power plant wastes, (3) agricultural wastes, (4) other urban wastes, (5) oil and hazardous materials spills, (6) mining and wells, and (7) other wastes.

To order this list of problem areas in terms of priorities, two indices were compiled by EPA/OWP. One, the "impact index " attempted to relate the proportion of waste discharged by a given problem area to total wastes discharged in the basin and to the population adversely affected by this discharge. A large relative discharge affecting a large proportion of the basin's population results in a high index. The other was the "action effectiveness index" which combines the relative costs of control, effectiveness toward meeting standards, availability of technology to meet the need, and willingness and ability to proceed with the desired activity. This factor modifies the impact index to indicate the most effective area in which to make initial investments.

Municipal-sewered discharges ranked first among the problem areas regardless of which index was used. This factor indicates that attention to this particular problem area has been assigned first priority.

*4. Municipal Wastewater Treatment Plants*

Municipal wastewater treatment plants, ranging from very minor holding tanks to highly complex operations that permit water to be eventually recycled into the community's potable water supply, are designed to perform specific functions. The EPA data collection and reporting system, known as STORET, uses "type of treatment" as the key term in the identification of a municipal wastewater treatment plant. Approximately 16 separate types of treatment can be identified. This number is increased, however, when it is realized that a particular plant may engage in several types of treatment. Terms such as "primary" and "secondary" are used to describe the general type of treatment a plant engages in and, as such, will contain specific types of treatment.

To establish more precisely the place of employment for detailed manpower planning, identifying the plant by two additional means of subclassification is necessary: plant size and specific processes available for treating waste. Plant size is measured by the volume of waste water treated or the average daily flow expressed in million gallons per day (mgd). Determining the specific process in the use is a little more complex; but it is the combination of processes that most accurately represents the technology used in the plant. As an example, a secondary treatment plant is formed by a configuration of a number of specific processes extended beyond the primary process.

Advanced or tertiary-type treatment plants, while few in number,[4] are significant because they represent the most modern technology available in the municipal water quality field and, as such, signal to the manpower planner many of the job tasks that must be performed in the future.

For the present (and the immediate future), the manpower planner in a state agency is required to devote much of

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[4]Only 10 tertiary plants were reported in Federal Water Quality Administration, "Inventory of Municipal Waste Facilities," *Statistical Summary, 1968* (Washington, D.C.: U.S. Government Printing Office, June 1970).

his time to calculating the need and developing training programs for persons increasingly employed in plants having the secondary treatment process. Table 2-8 gives data that are suggestive of the direction technological change has taken during the past few years. As can be seen, in 1940 the number of secondary and primary plants was about the same, while by 1968 the number of secondary plants was approximately four times that of primary plants. Furthermore, the total number of plants more than doubled within the 28-year period. Similar growth in the future is not unlikely.

In future years the concern for higher water quality standards, increasing population, and changes in technology will bring about the following changes in wastewater facilities: (1) replacement of obsolete plants, (2) expansion of existing plants by increasing flow capacity, (3) improvement of or upgrading the treatment process in existing plants, (4) combination of (2) and (3), and (5) new plant design and construction.

### *5. Construction of Plants*

Clearly the construction of municipal wastewater treatment plants will play an important role in the national plan and strategy for water quality. For this reason, as well as for reasons

**TABLE 2-8**

**Number of Primary and Secondary Municipal Wastewater Treatment Plants in the United States (Selected years, 1940-68)**

| Type of Treatment | 1940 | 1945 | 1948 | 1949 | 1957 | 1962 | 1968 |
|---|---|---|---|---|---|---|---|
| Primary | 2,938 | 2,889 | 3,035 | 3,073 | 2,771 | 2,709 | 2,431 |
| Secondary | 2,630 | 2,897 | 3,023 | 3,157 | 4,747 | 6,669 | 10,126 |
| TOTAL | 5,580 | 5,786 | 6,058 | 6,230 | 7,518 | 9,378 | 12,565 |

Source: Federal Water Quality Administration, "Inventory of Municipal Waste Facilities," *Statistical Summary, 1968* (Washington, D.C.: U.S. Government Printing Office, June 1970).

that will become more apparent in subsequent chapters of this manual, it will be profitable for us to trace those steps that are most commonly followed in bringing a wastewater treatment plant into being.

Following a period of determining desired water uses (current and future) and establishing water quality criteria at the various sources that are necessary to effect those uses, state agencies identify and record the specific sources of pollution to determine which sources need to be reduced. When a municipality is found to be discharging waste that causes the receiving water to be below water quality standards, the state water pollution control agency notifies by letter the appropriate local authority. Since this letter is recognized in many states as a legal citation fully enforceable by the state courts, its receipt by the local governmental authorities signifies the commencement of the community's attempt to do its part in meeting water quality standards either by building new or by expanding and upgrading existing wastewater treatment plants.

Through authorization given by the various water pollution control acts discussed in the previous section, the federal government stands ready to offer financial assistance to local governments wishing to build, expand, or upgrade wastewater treatment plants. To qualify for such assistance, certain procedures must be followed: When the type and size of facility has been determined, designed, and approved by the state water pollution control agency, the local community, through the state, formally applies for a federal sewage treatment works grant. If the application is approved, the grant is awarded, and shortly thereafter the final plans and specifications of the plant are submitted and approved. With this approval, bids for the construction of the plant may be taken and, upon acceptance, construction initiated. Immediately prior to the construction of the facility, the engineer responsible for designing the wastewater treatment plant must submit for approval an "operating manual" which includes staffing requirements. Upon the completion of construction, the plant is inspected and commences operation thereafter.

One year after the facility has been in operation, regional operations and maintenance personnel inspect the facility. Current rules and regulations for federal grants also require that the state assure that it will conduct annual inspections for three years after construction to determine whether such facilities are operated and maintained in an efficient, economic, and effective manner and to ensure that approved operative and maintenance practices are followed. Although all states do not have annual or seasonal inspection programs, it is intended that such a capability be established in the near future.

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# CHAPTER THREE

## HUMAN RESOURCE DEVELOPMENT AND WATER POLLUTION CONTROL

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# CHAPTER THREE

## HUMAN RESOURCE DEVELOPMENT AND WATER POLLUTION CONTROL

Solving the problems of water pollution control will require a major manpower effort. This is a commonplace fact of the age in which we live—the age of manpower, of education, of human resources. Whatever the current issue, be it law and order, community health, national defense, reduction of poverty, or the protection of our environment, the critical resource is trained manpower: physical and social scientists, engineers and technicians, and those workers with social as well as manipulative skills.

The results of a recent study conducted by the National Planning Association (NPA) illustrates the challenge of acquiring the necessary manpower to achieve certain goals. Considering a series of national goals identified in 1960 by a national commission established by President Eisenhower, NPA asked, "If we seriously set out to achieve these goals, would we have enough manpower to do them all?" The answer was an unqualified "No!" If we want rising living standards—including both private and public goods and services; national defense; better health care; improved education; adequate recreational facilities; cultural amenities; resource conservation and development; housing; a clean, attractive, and healthy environment; and all the rest—we cannot have them all at once. We must, therefore, establish priorities among these goals and organize our resources efficiently to achieve as many of them as possible. To this end we must plan the development of human resources to enable them to make the greatest possible contribution to the achievement of these national goals.

### *A. Role of the Manpower Planner in Human Resource Development*

The manpower planner is charged with the primary responsibility of satisfying the manpower needs of the organization within which he operates. In meeting this responsibility, the manpower planner must first identify the number and kind of workers that are needed and at which particular time and place they will be needed. The methodology used in identifying such needs will be developed subsequently. The manpower planner must then plan to meet these identified needs through the development of human resources. Developing the needed human resources will require that the manpower planner: (1) be familiar with the existing human resource development institutions, (2) determine the extent to which these institutions can provide the needed manpower, and (3) work with these institutions to maximize their contributions to human resource development. Any deficiency in the ability of existing institutions to meet human resource needs will require that the manpower planner become involved either in the adjustment of existing institutions or in the creation of new institutions. It is with the human resource development institutional framework of the United States that we shall be concerned in this chapter.

While the manpower planner's primary function is to engage in those activities that will ensure that his organization's manpower needs be satisfied, the psychology of today's labor force and the human-oriented training of the professional manpower planner require that his activities go beyond merely meeting the identifiable institutional needs. Today's worker demands the opportunity to develop to the maximum of his potential as a human being. This means the opportunity: (1) to become educated to the extent capable, desired, and needed to compete in a modern world; (2) to become trained with an occupational skill needed by the society within which he lives; and (3) to have the opportunity to put that knowledge and skill to effective use and in so doing, provide for his personal needs. The manpower planner must understand and accept these personal, people-oriented needs and seek a mutual accommodation with the needs of his industry. The exciting concept about manpower planning is that personal human needs can usually be met at the same time that the institutional needs are satisfied. The extent to which the manpower planner is successful in accommodating these needs will determine his ultimate success as a professional.

If these needs are to be met, it is required that, in addition to a vigorous and growing economy which will be providing job opportunities:

(1) An education system providing sufficient education and vocational training exist to enable all citizens to develop their human potentials to the maximum, thus enabling them to compete in the labor market

(2) An employment system provide the educated and trained labor force with the opportunity to take advantage of employment opportunities which will best utilize their talents

*B. The Education System*

*1. Its Evolution*

The American education system began early in the history of the United States. The Founding Fathers saw the need for the encouragement of the educational process. Under the Land Ordinance of 1785, 1/36 of the land in new territories was set aside for support of educational activities, with most states adding a like amount for a total of 1/18 of the land to benefit the common schools. This Act was followed by the Morrill Act of 1862, which granted land as an endowment for state colleges dedicated to education in the agricultural and mechanical arts. Most of these schools later added education in business and industry and played a key role through their extension services in the development of the most productive agricultural system in the world.

By the turn of the century, a major schism had developed in the ranks of education. One group, the generalists, maintained that the major purpose of high school was to prepare students for college and that college was to emphasize a liberal education in culture and theory. Little or no attention was given to preparing people for a "job." On the other hand, the "vocationalists" looked upon people as human economic resources and maintained the need to prepare them throughout the educational process with skills needed in the labor market. John Dewey, who saw the benefits to be derived from the preparation of worker-citizens and the danger of a bifurcated education system, tried but could not heal the breach. The generalists prevailed to the neglect of vocational education.

To aid in meeting the demands for skilled manpower in World War I, Congress passed the Smith-Hughes Act of 1917 which provided federal grants on a matching basis to states for vocational education. Throughout the following years, the federal government remained the prime sponsor of vocational education. The original list of vocational programs allowed under Smith-Hughes—agricultural, trade, industry, and home economics—was later expanded to include distributive education and secretarial training. On the state level, however, the generalists prevailed, with the resulting neglect by the state and local school districts of vocational education. While traditional high schools and state colleges secured new buildings and the best students, vocational education inherited the castoffs, both in terms of buildings, students, and all too frequently, teachers. It became too often the neglected stepchild.

In 1963, following many years of intensive debate in response to the Manpower Revolution of that decade, the Vocational Education Act was passed (amended in 1968), constituting one of the most significant developments in the evolution of a system for human resource development. The restrictions of the old vocational education legislation were removed. For the first time, vocational education was to be people (human) rather than program oriented. The Act emphasized assistance to the individual in preparing for employment and keeping up-to-date with the knowledge and skills needed by the job market. Programs could cut across all occupations except those requiring at least a bachelor's degree. They could involve people of all ages and preparation levels. Research and experimentation were provided. Area vocational schools were also encouraged. And most importantly, the federal funds available were increased from $55 million in 1964 to $225 million in 1968, with state and local funds increasing in the same period from $278 million to $715 million. The result has been more attractive physical plants, younger and more competent staffs, and, consequently, a range of student quality from the least able to the most able. The physically, socially, and economically handicapped or disadvantaged are singled out for special attention. Vocational education has become a full-fledged and fully accepted part of the academic community, cutting across the wide range of community interests.

Perhaps a return to John Dewey's philosophy of education calling for worker-citizens is becoming possible. An educational system which concentrates on developing the manipulative as well as the intellectual skills, which gives to all students the real option to select and prepare for a career which may emphasize one or the other, might better meet our needs. To give our students that real choice, training for manipulative skills should be as honored and supported as training in intellectual skills. Manipulative training should contain sufficient content to provide the opportunity for change to the other approach. By the same token, the student who selects the more intellectual approach should have as a real option the transfer to a manipulative-oriented program. To make such transfers possible requires the removal of psychological and other barriers now existing.

One of the most promising developments within the education establishment in making effective Dewey's concept of worker-citizens is what is called "career education." Promoted by USOE, the concept is relatively simple. The education establishment is being nudged in the direction of educating students for careers rather than educating them for college or for a job. To accomplish such an education requires that students obtain a wide acquaintance with the "world of work." Such an acquaintance should be developed throughout a student's school life and should permeate the whole curriculum. At the secondary level, a student will make a tentative selection of a career area, each career area encompassing all levels of skill and conceptualization. This selection is followed by the development of the skill needed in that career field, enabling the student to secure a job upon exit from school, whether by dropout or graduation. Whichever the form of exit, the system would encourage reentry for the development of additional skills and concepts as needed for continued career development. This concept envisions education as a means to an end—a career—rather than solely as an end in itself.

*2. General School System*

Historically, the American education system has begun with the five- or six-year-olds, either in kindergarten or the first grade. Increasingly, however, educational opportunities are being given to three- and four-year-old preschoolers in private or quasi-private nursery schools. The federal Headstart program provides funds for preschool programs, primarily for children from disadvantaged homes. Grades 1 through 8 concentrate their attention on developing reading, writing, speaking and computational skills as well as an understanding of the world in which we live. However, manipulative skills are generally neglected after kindergarten. While the emphasis in grades 9 through 12 is usually on the same order as the earlier grades, some schools include vocational courses which begin to develop manipulative vocational skills as well as some appreciation of vocational opportunities after high school. These programs still suffer somewhat from the traditional view that only the troublemakers and less capable students find their way into such programs, though there is some evidence that this attitude may be breaking down. One of the major problems facing the manpower planner is that individuals just finishing high school, or those who have dropped out, are seldom prepared for much more than laborer kinds of entry-level jobs. The dropout, because of his frequent lack of abilities obtained from a general education (e.g., reading, writing, speaking, computation, and general understanding), is frequently limited in his ability to be promoted without additional education. The high school graduate, who has taken full advantage of the educational program, usually has the general skills needed to make advancements on the job. However, he frequently lacks practical knowledge and manipulative skills, which many entry-level jobs require. The high school diploma and the graduation equivalency diploma (G.E.D.), generally speaking, can be assumed to give a student sufficient basic education to handle lower level entry jobs.

The continued development of the "career education" concept should eventually merge the academic or traditional education with vocational education, both being important in developing and maintaining a career.

*3. Vocational Schools*

An important arm of the education system is vocational schools, public and private, that accept individuals regardless of educational credentials and train them in a particular vocation. These schools pay little attention to so-called general education—humanities, the arts, the sciences, the social sciences. The training, though generally narrow, provides students with the skills to obtain employment in narrow occupational fields such as barbering, secretarial, plumbing, heating, electrical, computer technology, etc. Theoretical underpinnings are often neglected in favor of the practical. From the viewpoint of the individual, the chief disadvantage of such schools is that a particular skill may become obsolete, of little or no economic value; and unless the individual has continued with his "education," he may be at a disadvantage in a changing labor market. This disadvantage is overcome by looking at the training in the vocational school not as something that is final, but only as a step in "career education." From the viewpoint of manpower planning, such graduates can be used in operator- or craftsman-type jobs; but without additional, more generalized education, they are usually limited, or at least thought to be limited, in their abilities to advance.

### 4. *Two-Year Colleges*

Sometimes identified as the most rapidly growing sector of the American education system, the two-year college helps to bridge the gap created by the nature of the development of most four-year colleges. There are generally three kinds of two-year colleges: technical, community, and junior. The technical colleges concentrate primarily on programs to train people in vocational and manipulative skills, but with an increasing amount of general and theoretical background. They grant certificates for completion of certain short-term courses and frequently grant associate degrees for the completion of two-year programs. Operators, technicians, and skilled workers are often products of these schools.

Community colleges emphasize educational service to the whole community and are frequently much like technical colleges in what they emphasize and in the programs they offer. Increasingly, these colleges are "open schools" admitting all applicants and then helping them move from their present educational levels to wherever they wish to move. Much impetus has been given to this trend by the inclusion of MDTA skill centers at community colleges.

Junior colleges may have much the same characteristics as the technical and community colleges. The more traditional junior colleges do, however, constitute a stepping stone to the four-year college and university—either for those who wish to improve upon their high school preparation or for those who wish a less expensive first two years in their post-high school educational program. Associate degrees are usually granted by junior colleges, and sometimes there are limited vocational programs available.

*5. Four-Year Colleges*

The more traditional post-high school college has been the four-year college or university offering bachelors' degrees. Such institutions are usually characterized as providing what is called a "liberal education," though some schools also offer vocational programs. A person may major in the humanities, fine arts, sciences, or social sciences. These students are seldom prepared for a job as such, though their more general and theoretical training may prepare them for learning one of a wide variety of primarily white-collar occupations. Many employers look to these graduates as potential managers requiring a more generalized background than is provided in technical and vocational schools. The graduates of the science programs can often assume, with a minimum amount of additional training, a technology-type job. A substantial number of college students continue on to graduate school.

*6. Post-graduate Universities*

Long considered the ultimate in education are the post-graduate universities which include the programs and philosophies of the four-year colleges but in addition offer graduate programs with masters' and doctorate degrees. They frequently include such professional programs as law, engineering, dentistry, business, medicine, etc. The graduates of these schools are usually classified as professionals and scientists—at the top of the educational spectrum.

*7. Continuing Education*

High schools, two-year colleges, four-year colleges, and universities frequently have continuing or adult education programs and short courses designed for adults who are not enrolled as full-time students and frequently do not intend to get a degree but merely want to continue their educations as circumstances permit. Such programs offer real opportunities for upgrading the abilities of full-time employees. They are usually quite flexible in the courses they offer, and there are seldom any entrance requirements. They are generally held at night, though vocational and technical schools and community colleges also cater to this type of student in daytime offerings. Adult basic education is often available, financed by federal funds, enabling adults with deficiencies in English, mathematics, and other basic education to learn or relearn these subjects. It is frequently possible to obtain a G.E.D. which is generally acceptable as the equivalent of a high school diploma. Such education frequently establishes a base, permitting people previously condemned to dead-end, low-paying jobs to develop the skills needed for occupational and economic upgrading.

*8. Cooperative Education*

While most daytime education programs have little or no on-the-job training components, some schools have developed cooperative education programs which build into the education process the opportunity to work for remuneration under educational direction and often for credit. These programs enable students to earn while they learn, and for some, provide a superior form of motivation for the learning process.

*9. Employer Education and Training Programs*

Many of the larger employers offer education and training programs for their employees. These are of two primary types: external and internal. Some employers pay for the tuition and books and grant free time or any combination of these for employees to enroll in courses and programs, usually directly related to their present jobs or in preparation for advancement. Large firms frequently have internal training programs in which they either bring in instructors under employer auspices or develop their own cadre of instructors for the purpose of upgrading and updating their staffs. Internal programs have the advantage of giving the employer greater control over what the employees learn, and the training can be tied directly to their unique operations. There is less transferability of knowledge and greater direct benefits. One of the problems may be employee receptivity.

Correspondence courses are often available to employees, with employers sometimes financing these courses if they are closely enough related to the employees' work. Somewhat related to the traditional correspondence course is the self-instruction or programmed learning course. Such a course may be tailor-made to a particular employer's operation, with a minimum amount of instructor activity and a maximum amount of self-teaching. Such programs are especially helpful for orientation and at lower levels of competence, though of less value at the more sophisticated levels. The same kinds of programs are also available in more general types of learning such as accounting, simple mathematics, grammar, etc.

From the social point of view employer education and training programs have the deficiency of being generally limited to those of demonstrated superiority. The NAB-JOBS program helps to bridge this gap through federal financing of training for disadvantaged people.

*10. Apprenticeship Programs*

In some of the more highly skilled trades, formal apprenticeship programs are available. Usually under the joint sponsorship of management and the labor union with relevant jurisdiction (a carefully structured and controlled program of mostly on-the-job training), an apprentice, working with an experienced journeyman, is trained carefully in each phase of the trade or skill. These programs last usually from two to five years, at the end of which time the apprentice becomes a journeyman. There is sometimes conflict between labor unions which promote these programs and vocational schools which attempt to shorten the period of training required for a skilled craftsman through formal classroom and on-the-job training. From the social point of view, these programs have in the past worked to the disadvantage of racial minority groups that have been systematically excluded from such programs. Equal employment laws and regulations enforced on management and unions alike should in time eliminate this form of discrimination, especially where federal funds are used.

*11. State and Local Roles in Education*

At the state level, the highest authority in education is usually vested in a single board which provides policy direction to specialized segments of the education system. The state board, for elementary and secondary education, will usually provide for the establishment of local administrative units called school districts. One of the unique characteristics of American education is the extent to which schools are administered by local authorities operating independently under local boards.

The theory supporting this practice argues that local control will permit education to reflect and be responsive to the will of the local electorate and taxpayer. In very few cases will local school districts be concerned with manpower planning as an ongoing activity. Most school districts will look to the state department of education for guidance in this area. The few exceptions to this general procedure are the large metropolitan school districts or specialized regional vocational education districts.

Within most state education systems there is (either as a separate board or under the general board) an authority to administer the state's higher education, post-secondary system. There is also a vocational education office charged with the responsibility for promoting vocational education through the school system of the state. There is sometimes conflict over the location of responsibility for the administration of post-secondary vocational education. Many vocational educators and their promoters do not feel comfortable (in fact, feel discriminated against) when controlled by university- and college-oriented boards and have moved in the direction of separate boards.

*12. Federal Role in Education*

While historically education has been considered as primarily the function of local and state government, with the private sector fundamentally concerned with colleges and universities, the federal government has come to play a significant role. USOE has been given prime responsibility for aiding in the development of an education system which will promote national goals as formulated by Congress, the Supreme Court, the President, and the federal educational bureaucracy. USOE has established and staffed regional offices which work closely with state and local agencies as well as monitor the progress of federal contracts and grants to various education and research agencies. In addition, USOE, assisted by its regional offices, collects, analyzes, and disseminates data needed within the education establishment.

Within USOE is the Bureau of Adult, Vocational, and Library Programs directing its primary efforts toward two groups: (1) the high school dropout and the high school graduates, both of whom are in need of specialized training for immediate employment, and (2) people in the labor force who need retraining to keep up with technological change. Funds are provided to states on a fifty-fifty matching basis. Within the Bureau, the Division of Manpower Development and Training was created in response to the Manpower Development and Training Act of 1962. This Division has been given the responsibility for the management and operation of HEW's responsibilities under MDTA, with the primary purpose of providing "education and training to help unemployed and underemployed persons fully participate in productive employment." The Division also has the responsibility to help establish programs to alleviate skill shortages. Both the Bureau and the Division have representatives in the regional offices of USOE which are a part of the regional offices of HEW.

*13. Purpose of Education and Training*

The purpose of education differs, depending upon the frame of reference. From the point of view of the individual, it is a means of providing for his needs—physical, mental, psychological, social, political, and spiritual. From the point of view of society, it is to develop an enlightened citizen capable of self-government and self-support. From the point of view of the employer, it is to prepare productive workers. Examining this latter function in greater detail, we find that general education should prepare a person to make adjustment to entry-level jobs in the minimum amount of time and with the minimum amount of expense to the employer. The employer does not want to have to teach new employees how to read, write, and speak English, or how to do simple arithmetic. Career education recognizes that, in addition, manipulative skills and positive work attitudes are also an important part of the education process. The employer usually expects to provide orientation training. Training for upgrading of existing employees is designed to give them the opportunity for higher level jobs, providing them with upward mobility for those who desire it, and for morale building. Training for updating enables the employer to take advantage of the latest technology in the field, either to remain competitive or to become more efficient if in a noncompetitive position. It is generally felt that both upgrading and updating, to be most effective from the employer's point of view, must be under his considerable control and directed toward meeting his needs.

Under the career education concept, there is no longer the traditional dichotomy between education and training, both concepts being merged into the single term "career education." However, there may still be conflict between the traditional advocates. Increasingly, educators are accepting the idea that the proof of a "good" educational experience is employment. Schools are more and more concerning themselves with what happens to their graduates, some even accepting the responsibility to help graduates find jobs. The resulting close contact with the world of work should play a key role in developing worker-citizens.

### *C. The Employment Service System and the U.S. Department of Labor*

It would be a mistake to assume that the preparation of an individual through the education system automatically assures that he will be a part of the labor force. The next step in entering the labor force after obtaining an education, while usually not as time-consuming, nevertheless is not automatic, nor even easy. An individual must convince an employer that there is a need for his service. With the development of the public employment service (ES) system, we have the second major element of a human resource development establishment.

#### *1. Its Evolution*

Until the 1930s, job hunting and placement were haphazard. Most people were hired off the streets or through friends, though some firms had developed fairly sophisticated personnel departments to screen job applicants. Private employment offices existed for certain kinds of jobs but were frequently characterized by exploitation of the job seekers. During World War I, a nationwide public employment service was organized to meet the labor demands of that period. However, during the 1920s it was allowed to atrophy almost to a point of extinction. Under the authority of the Wagner-Peyser Act of 1933, the beginnings of a new national employment system were laid, with state employment services to be financed on a matching basis from general funds. In 1935, the Social Security Act was passed, establishing the basic system of today. States had the opportunity of establishing employment services to be financed 100 percent out of federal funds coming from a federal unemployment compensation tax on employers. All states eventually took advantage of the opportunity and established state employment service agencies.

During the remainder of the prewar years, these state services were mainly concerned with screening welfare and work-relief participants through the application of "ready, willing, and able-to-work" tests. The system was federalized shortly after the outbreak of World War II, being placed under the War Manpower Commission and given the responsibility to allocate scarce manpower. Following the war, the Employment Act of 1946 was passed, declaring that:

> It is the continuing policy and responsibility of the federal government to use all practicable means consistent with its need and obligations and other essential considerations of national policy with the assistance and cooperation of industry, agriculture, labor, and state and local governments, to coordinate and utilize all its plans, functions and resources for the purpose of creating and maintaining, in a manner calculated to foster and promote free competitive enterprise and the general welfare, conditions under which there will be afforded useful employment opportunities, including self-employment, for those able, willing, and seeking to work, and to promote maximim employment, production, and purchasing power.

Despite this legislative injunction, the service was allowed to atrophy again, its primary function being an "unemployment agency" responsible for handling unemployment compensation claims and matching a few job orders with the available workers.

In 1958, Secretary of Labor James P. Mitchell gave a speech in which he criticized the service for failing to act adequately as a placement agency. This criticism released several forces which began to develop the service into what is designated by some authorities as a "community manpower service center," with its major function "human resource development." In some states, it has virtually become such, while in others, it remains as the "unemployment office."

### *2. Organization and Functional Operations of the Employment Service*

Beginning in 1962, in response to the "manpower revolution" of that decade, ES began to take on expanded responsibility as a manpower agency concerned with all aspects of manpower. Each employment center was to become a community manpower center, operating within a state- and nationwide network. To achieve its goal of a more efficient labor market involved not only in the employer's interest but also in that of the clients, ES was required to become associated with employers, unions, schools, and community development efforts. With the plethora of manpower programs of the 1960s, its involvement would have to expand to include the myriad of federal manpower programs as well as programs providing ancillary services. No longer was ES to merely wait for jobs to be listed with it. It was to seek new job orders and to place clients.

To accomplish its goals, ES has had the traditional tools of testing, counseling, referrals, and payment of unemployment compensation. Beginning with the "war on poverty," it has been expected to assist clients not meeting employer standards by working with vocational educators to establish training courses in fields where there is "reasonable expectation of employment." In addition, ES is to recruit and screen unemployed and underemployed persons for those training programs. Training is then to be followed by placement efforts.

Another tool is "relocation." ES has had limited funds to use in assisting clients to relocate, moving from areas of high unemployment to areas of manpower shortages or low unemployment. When coupled with education and training, it has the potential power to improve the functioning of the labor market. Unfortunately, ES funds have been too limited to contribute significantly to the solution of unemployment.

For a time, ES was so concerned with its antipoverty client orientation that it ran the danger of losing the confidence of the employers who became wary of ES referrals. Recently, however, the service has moved to a more balanced position, that of providing the best possible service to all elements of the community, and employers are increasingly using ES services.

Federal agencies and contractors are required by law to list job openings with ES.

Some of the activities of the Office of Economic Opportunity (OEO), especially the Community Action Agencies (CAA), in setting up competitive service centers which reached out to the youth and the poor, induced ES to add to its services Youth Opportunity Centers (near central city ghettos) as well as other "outreach" activities, seeking out potential clients hesitant to come into ES centers. Minority consultants were added to whom racial minorities could better relate.

In 1968, ES was given responsibility to provide manpower services to Concentrated Employment Programs (CEP), to train and place welfare recipients in the Work Incentive (WIN) program, to recruit disadvantaged people for JOB Opportunities in the Business Sector (JOBS), and to lead in the establishment of CAMPS.

Considerable internal turmoil was involved in these changes and additions, resulting in the elimination of the Bureau of Employment Service and the creation of the U.S. Training and Employment Service of the Manpower Administration. State employment services were to relate to the federal government through the regional manpower administrators and thence to the Manpower Administration.

For the unemployment offices to become community manpower service centers, considerable changing of funding and philosophy was required. The transition has been made more difficult, though not impossible, by the fact that state offices operated under both state and federal laws. Although federal financing tends to give federal authorities some power over state activities, the fact that the system must operate under state civil service and state legislatures often makes it more difficult for federal officials to implement their ideas. The conflict is not only between state and federal officials, however, for in the past several years sharp disagreements have occurred at the federal level between "old line" ES personnel and those who are pressing the community manpower service concept. The involvement of ES activities within the line authority of the Manpower Administration of DOL may be onerous to some, but it enhances the role of state ES agencies as manpower service agencies.

DOL has decentralized its activities to a great extent, and the regional manpower administrator is being given the major responsibility for promoting and monitoring manpower programs within his region. A large proportion of DOL and OEO manpower money is apportioned to the regional offices. The regional manpower administrator will, in turn, apportion it to state and local manpower planning councils.

The national Manpower Administration is advised, in part, by the National Manpower Advisory Committee (NMAC). While the NMAC has no administrative power, it can and does make its influence felt on policy questions. This advisory body also advises, though less effectively, the secretary of HEW on his manpower responsibilities. The regional manpower administrator also has an advisory committee which advises him on the application of policy to the region. This regional committee also serves in an advisory capacity to the regional director of HEW. Its chairman also serves as an associate member of NMAC, giving a regional input to NMAC.

While on the state level, ES has served as the primary agent for planning DOL's manpower programs, this function is in the process of being changed with the development of the state and local manpower planning councils that serve as the manpower planning arm of the governor and local elected public officials. However, whatever the outcome, ES will still play a very powerful role. In local areas it will probably continue as a prime deliverer of programs for human resource development because of its presence throughout community-based employment offices.

*D. National Manpower Programs*

In addition to the manpower revolution of the 1960s and its demands for changes in the human resource development system, a third dimension was added which was to make its mark upon the other elements—education and the employment service. Until the 1960s those two elements constituted the whole. But in the minds of some, they were not responsive enough to the needs of this new era of rapid change which had left behind about a fifth of the population, the poor of the nation. The result was the creation of national manpower programs with the purpose of optimizing the manpower contributions of the nation's population. Because of past neglect, special attention was focused on those sectors of the population experiencing the greatest difficulty in becoming an effective part of the labor force.

### *1. Manpower Development and Training*

The first really significant element of this new dimension of the human resource development system was MDT, created by the Manpower Development and Training Act of 1962 (MDTA).

Human Resource Development (HRD) requires a linking of ES with the education establishment. A key mechanism for accomplishing this has been the enactment and administration of MDTA. Conceived as a temporary program to train persons unemployed as a result of technological change and later adapted as a part of the "war on poverty," MDT has shown its staying power and flexibility by assuming a leadership role in HRD. While it has responsibility for vocational-type training for the adult population in general, its major emphasis is on the disadvantaged portions of the population.

Under MDTA, administrative responsibility is shared by the secretary of HEW and the Secretary of Labor. DOL, acting through the state employment service, establishes the need for training by identifying people eligible for and requiring training and the occupations in which there is reasonable expectation of employment. Within HEW, the division of MDT of USOE is responsible for administering manpower institutional training programs to meet the objectives under Title II of the Act. Specifically, each state employment service has designated an MDTA coordinator and each state school office an MDTA supervisor, usually within a division of vocational and technical education. These two coordinate MDT for the state. MDTA has made possible a variety of major innovations in the HRD system which are of interest to the manpower planner. These innovations are:

(1) Innovative techniques and material for those lacking adequate communicative and computative skills

(2) Use of adult basic education to upgrade the general educational level of trainees

(3) Bilingual basic education and skills training for those who must learn English as a second language

(4) On-site testing to determine education areas which need strengthening as well as to determine occupational abilities and interests

(5) On-site counseling to assist students to meet successfully their new challenges, and especially to help in making occupational choices

(6) Open admissions, admitting all persons referred by agencies, regardless of educational background

(7) Open-entry/open-exit institutional training using modular units, admitting students at any point in the course and allowing them to exit at any time

(8) Development of occupational clusters, permitting greater flexibility on the part of the trainees in the selection of an occupation

(9) Association of skill centers with colleges encouraging MDTA students to enroll in allowable courses with regular college students. The acquisition of a G.E.D. has become possible, and some MDTA students are encouraged to continue for a college degree.

Perhaps one of the most important contributions to the range of institutions available to the HRD system has been the MDTA skill center and its emphasis of institutional training for disadvantaged persons. MDTA has provided a basis for funding a variety of environmental manpower training programs and will continue to be a resource of considerable value to the manpower planner.

In addition to the institutional programs and courses located at various education institutions and at independent skill centers, MDT has established on-the-job training (MDT-OJT) programs with employers in which employers are reimbursed for training costs through the state ES. During slack labor market periods, employer response has been less than enthusiastic. However, during tight labor markets, employer enthusiasm increases considerably. Overall, OJT constitutes roughly one-half of the MDTA enrollment. In addition to MDT (institutional) and MDT-OJT, there is an individual referral program. Where institutional training is needed but there is insufficient demand to warrant the establishment of special classes at an institution, individuals can be referred for training to existing programs. MDT is expensive primarily because it involves living stipends in addition to covering direct educational costs, but such arrangements do assist those who could not afford additional training without such help.

*2. Vocational Rehabilitation*

An additional resource which is of some importance to the manpower planner is the Vocational Rehabilitation Program, not only in its preparation of people for employment but also in the example of success it provides in human rehabilitation. This program is an employment-oriented activity whose goal is employability. Although it offers both skill development and job creation, its special significance is the process by which access to employability services and employment is achieved.

The vocational rehabilitation program each year places in competitive employment a large number of disadvantaged persons, making it one of a small number of effective programs. The high success rate is built in because the process begins with careful evaluation of the potential employability of the client. When employability is determined, the Rehabilitation Services Administration has, within a single program, the authority to fund nearly any activity related to employment for any eligible client. Essentially any service that contributes to achieving the individual's employment objective is acceptable, including: (1) comprehensive evaluation, both psychological and medical; (2) medical, surgical, and hospital care and related therapy to remove or reduce disabilities; (3) prosthetic devices; (4) counseling and guidance for vocation adjustment; (5) training; (6) service in comprehensive or specialized rehabilitation facilities; (7) maintenance and transportation; (8) tools, equipment, and licenses needed for work or in establishing a small business; and (9) placement and follow-up. Eligibility, too, is broad, having expanded from the physically handicapped to the mentally handicapped, and more recently to behavioral disorders characterized by deviant social behavior or impaired ability to carry out normal relationships with family and community which may result from vocational, educational, cultural, social, environmental, or other factors.

The key element of the program is a personal relationship between a client and a trained counselor, equipped, as it were, with a blank check to purchase whatever medical, educational, or other services are needed to successfully place the client in satisfactory employment. After evaluation to ascertain potential employability and to determine handicaps and strengths, the counselor and client jointly work out an employment plan merging the client's interests and realistic possibilities for employment. The program is usually locally administered by a state social services department, education department, or as a separate entity. A few states have created departments of human resources which encompass the rehabilitation function.

It is of considerable importance for the manpower planner to establish close ties with the Vocational Rehabilitation Agency.

*3. Public Employment Programs*

Long advocated by manpower experts, an important and growing part of national manpower programming are programs offering the unemployed and disadvantaged jobs with local and state governments, either temporary or permanent, to be financed by federal funds.

Public Service Careers (PSC) is aimed at opening entry-level public jobs to the disadvantaged by revising the nature of tasks performed to eliminate unnecessary barriers to employment. Additionally, efforts are made to eliminate arbitrary merit or civil service system requirements which effectively bar the disadvantaged from public service. Funds are provided for training of program enrollees and some supportive services. Stipends or subsidy to the employing unit are not included.

The Emergency Employment Act of 1971 (PEP) provides a new and probably permanent addition to the arsenal of manpower resources. Public service employment funds are allocated to cities, counties, and states to pay up to 90 percent of the wages and benefits for new public service jobs in areas of critical public concern. Persons hired with these funds must be unemployed for at least 30 days (in the case of rehires) and seven days (in the case of new hires). Special requirements exist for underemployed persons. Special preference is given to unemployed Viet Nam veterans, graduates of manpower programs, and high-technology and professional manpower. Unfortunately, minimal funds are provided for training purposes under this Act. The program requires that individuals be moved eventually to permanent-type jobs. Since pollution control is one of the most critical public service needs, the PEP program, by making federally financed public employment slots possible in the area of environmental management (including water quality), may have a major impact in adding to the flexibility of environmental manpower planning. Such inclusion, however, is not automatic but must be sought.

*4. Other National Manpower Programs*

There are a number of other categorical manpower programs which constitute less important resources to the environmental manpower planner within the HRD system. Nevertheless, they should be understood. Those programs authorized under the Economic Opportunity Act, such as Neighborhood Youth Corps, Job Corps, Operation Mainstream, and Special Impact, may be of some use to the manpower planner concerned with environmental careers.

The Work Incentive Program authorized by 1968 amendments to the Social Security Act, which is aimed at moving welfare recipients into productive employment, may be difficult to adapt to environmental careers under existing conditions; however, the resourceful planner may find it of some value.

*5. Need for Coordination in Manpower Programs*

This seemingly endless expansion of manpower and manpower-related programs produced considerable confusion and conflict. A myriad of agencies and programs with varying requirements and benefits were competing for the same clientele. Local agencies were faced with an increasing variety of programs and funding sources. In the closing month of fiscal year 1966, the announcement of cooperative state manpower planning was made, the result of leadership by the Manpower Administration of DOL but in cooperation with HEW. This planning effort was to become CAMPS which was described in Chapter One.

### *E. Manpower Development and Training in the Water Pollution Control Field*

The education system usually provides the general education required for persons entering the water pollution control field at the lower level-entry positions. A number of post-high school institutions might possibly provide the training in water pollution control needed by the professional and technical workers, either entry or upgrading, without any federal encouragement. However, in an industry as uncertain as water pollution control, because of its dependence upon relatively unpredictable legislative and executive decisions, training for specific occupations in the industry would be highly speculative and risky. It has therefore been necessary for an agency of government to help assume the financial risks inherent in such training programs. This function OWP has assumed, helping to direct national resources into their areas through its training programs, both in-house and out-of-house. The training activities of MDS fall into three basic categories: training grants, direct training, and interagency training programs.

#### *1. OWP Training Grants*

It will be helpful to summarize the internal education and training programs now being offered by OWP in order to indicate the directions in which MDS is moving to support water pollution control activities. This staff is developing a fully integrated training approach which incorporates remedial education programs as well as beginning, intermediate, and advanced programs in training water pollution control personnel. For applications or information write to: Chief, Academic Training Branch, Manpower Development Staff, Office of Water Programs, Environmental Protection Agency, Washington, D.C. 20460.

*a. Graduate programs.* Within the general category of training grants, there are several subprograms. The first is graduate training programs in water pollution control and water quality management. These training activities, authorized by the Federal Water Pollution Control Act of 1956, as amended, provide that EPA/OWP will maintain a grant-in-aid program aimed at assisting public and private institutions in establishing, expanding, or improving training opportunities for persons interested in careers or research, teaching, administration, and general service in water pollution control. Individual support is provided through such training programs in the form of stipends and allowances for individuals obtaining professional degrees leading to careers in the field of water pollution control or the management of water quality. The basic program requires the possession of a bachelor's degree, normal eligibility for admission to graduate school, and appointment on a full-time basis.

The graduate training program is basically aimed at producing professional personnel in four general careers in water pollution control: (1) environmental engineers; (2) aquatic biologists, water chemists, and chemical engineers; (3) administrators and planners; and (4) economists and other social scientists. In addition to stipend support of trainees, grants may also be made to institutions which offer the training program for the purpose of improving the staff and facilities. Under the grant-in-aid program, a variety of special areas is covered, including: sanitary or agricultural engineering, limnology, aquatic-ecology, wildlife biology, zoology, and oceanography.

In addition to the full-time graduate training, short-term programs are offered which provide upgrading and skill improvement capacity to working professionals. Furthermore, attempts are being made to service those engineers from such fields as aerospace and electronics who, for a variety of reasons, have found difficulty obtaining employment in recent months and hope to find employment in the water pollution control field.

*b. Research training fellowships.* In addition to graduate training programs, the Federal Water Pollution Control Act of 1956 provides that OWP may maintain a grant-in-aid program to increase the number and competence of trained specialists engaged in research and other activities related to the control of water pollution and the maintenance of water quality. As a result, OWP has made available a limited number of research training fellowships for study in the fields of engineering, physical science, biological science, and some socioeconomic disciplines. The applicant must have a bachelor's degree, must have completed 30 hours of graduate study at a recognized institution of higher education, and be accepted for admission in an appropriate institution. These fellowships are generally awarded for a 12-month period, and the research fellow is expected to pursue a program on a full-time basis. Support for longer periods is available. Post-doctoral fellowships are also available for those with doctoral degrees.

*c. Undergraduate training grants.* Enactment of the Water Quality Improvement Act of 1970 specifically provided for undergraduate training grants to institutions of higher education which agreed to provide training to individuals planning to enter an occupation which involves the design, operation, or maintenance of wasterwater treatment works. Training grants may be awarded to two-year, post-high school institutions for demonstration programs in the operation, maintenance, and management of treatment plants. Demonstration programs at the baccalaureate level to train individuals in the design of treatment works are also fundable. Individual scholarships for undergraduate study are authorized under the law and will be provided by the granting institutions.

*d. Operator/technician training grants.* Improvement Section 5(g)(1) of the Water Quality Act of 1970 makes possible the support of:

(1) State training grants to upgrade plant personnel

(2) Advanced waste treatment training

(3) Instructor training

The basic objective of Section 5(g)(1) is to plan, devise, implement, and fund training programs that will assure an adequate supply of skilled subprofessional manpower to operate and monitor wastewater treatment collection and distribution systems. Specific programs that are included in this program are:

(1) Coupled OJT training programs utilizing both classroom instruction and on-the-job training

(2) Variations of classroom training with in-service, hands-on training

(3) Correspondence or extension courses followed by "over-the-shoulder"-type instruction

(4) Highly specialized technical training for high levels of plant personnel, such as phosphorous removal techniques and instrumentation training

(5) Decision-maker seminars to acquaint civic officials with training efforts

(6) Combinations of the above, including short-term refresher courses

Pilot grants will be developed in approximately 30 states for training 1,500 persons.

Additional funds will be allocated for programs that are national in scope. These programs are initiated by members of the state and local training branch headquarters staff to fill the voids left in the overall training effort needed to attain MDS requirements. These efforts are coordinated with the regions in order to develop sites to carry on the training. Programs to be researched and funded under this portion of the commitment are:

(1) Advanced waste treatment programs for professional and other interested persons

(2) Training courses for instructors at all levels of our training programs

(3) National decision-maker conference

(4) Field-study course to provide training for operators unable to attend regular training sessions

(5) Training courses for operators employed by federal agencies as a joint effort

(6) Extended aeration courses for operators of small package plants throughout the country

*e. Other technical training grants.* MDS has also undertaken a few innovative technical grants aimed at furthering the capacity of the Division to perform its function. These activities include the development of curriculum guides and teacher training systems, the development of programmed instructional materials, and the promotion of a correspondence course for treatment plant operators developed by Sacramento State College.

*2. Direct Training*

MDS conducts certain programs on a direct basis at selected institutions in support of water pollution control at five locations in Ohio, Oklahoma, Georgia, Oregon, and New Jersey. Additional training courses can be held in other areas. The objective of the direct training branch is to provide specialized training in specific causes, prevention, and control methodologies related to water pollution. Training offered under the Direct Training Branch is usually not offered or readily available elsewhere in these specialized subjects.

Specific training is provided in the planning, development, and management of wastewater treatment facilities. Training programs are aimed at improving the operation and maintenance of wastewater treatment facilities and support and supplementary state and local programs of operator training. Direct training programs typically focus upon those individuals in supervisory, managerial, or training levels who are in a position to transmit their knowledge to others whom they supervise or with whom they work.

It is expected that this training will lead to rapid application of new research findings, increase skills of technical and professional personnel, and train new employees recruited from other professional or technical areas in the special skills required in water pollution control. Scientists, engineers, and recognized authorities from other EPA programs, other government agencies, universities, and industry supplement the training staff by serving as guest lecturers and special consultants.

Most training is conducted in the form of highly technical, short-term courses of one or two week's duration. The scope and level of these courses is designed to meet specific practical features of wastewater treatment plant design and operation, water quality evaluation in field and laboratory, and technical and administrative aspects of water quality management and water pollution control.

*3. Training Programs under Interagency Agreements*

MDS, through its state and local manpower development branch, has undertaken a variety of initiatives aimed at meeting the critical shortage of trained operators in wastewater treatment plants at the state and local levels. It has participated actively in the CAMPS program, developing four programs funded cooperatively with DOL, HEW, and OEO.

*a. Coupled classroom and on-the-job training programs.* MDS along with MDTA has developed a combination of classroom and on-the-job training programs under subcontracts with states, municipalities, councils of governments, colleges, universities, and special wastewater districts. This program currently trains approximately 1,000 operators annually—70 percent of whom are undergoing upgrading training while 30 percent are new entries. These training programs vary from 22 to 44 weeks in length, depending upon local assessment of conditions and needs. All provide essentially the same basic instruction and training in subjects such as mathematics, science, communications, plant operations, laboratory techniques, and maintenance practices. Through cooperative arrangements between the training institutions and publicly owned local wastewater treatment facilities, trainees receive part of their training at these latter facilities. Certificates of proficiency are issued in the program, and in most cases those operators who take upgrading training have received salary increases. The program is administered on the basis of subcontracts with states, major municipalities, or councils of the government and with direct grants to universities and special wastewater districts. Coupled classroom and on-the-job programs are now being carried out in about half of the states in the nation.

*b. Regional institutional training programs.* In addition to the state and local levels' coupled programs, OWP has initiated a series of regional full-time training programs based at community colleges or vocational schools in critically situated areas of the country. Regional centers in New Jersey, Maryland, Florida, Ohio, Colorado, Missouri, Iowa, and Louisiana offer short-term courses approximately 22 weeks in duration. Enrollment in the regional centers is generally limited to approximately 40 trainees per session. Each trainee receives approximately 440 hours of formal classroom instruction and 440 hours of related hands-on training in a cooperating wastewater treatment plant. Subsistence allowances are paid to the trainees by DOL through MDTA.

*c. Transition training programs.* An additional experimental program has been developed which is aimed at servicemen returning to civilian life. This program, operated in cooperation with the Department of Defense, has linked nine regional military installations to nine local educational institutions offering courses in wastewater treatment plant operation in Maryland, North Carolina, South Carolina, Hawaii, Washington, Ohio, and California. Two additional programs are being developed overseas in Korea and Germany. Sewage plants located near the training institutions and military bases are utilized during the course. The course is open to servicemen during their last six months of duty.

*d. Public service careers programs.* Using the Public Service Careers Program in 1971-72, MDS has been engaged in the training of approximately 400 new wastewater treatment plant operators for existing job vacancies and upgrading the skills of 500 employed persons in Alaska, South Carolina, Texas, Virginia, Wisconsin, and the Virgin Islands.

*4. Related Environmental Training Programs*

Related environmental training programs are offered by the Environmental Control Administration, Radiological Health Training Branch, Solid Wastes Management Office, Air Pollution Control Office, and all of EPA. In addition, related programs are offered by the National Institute of Occupational Safety and Health, the Food and Drug Administration, and the Center for Disease Control of the Department of Health, Education and Welfare.

*5. Involvement with CAMPS*

OWP, the first office within EPA to become involved in the CAMPS planning, participated in the issuance of ICA No. 72-1; and EPA personnel, largely out of OWP, have been appointed to serve with regional CAMPS committees.

In its CAMPS planning document, OWP states that the Manpower Development Staff program is:

(1) To encourage and assist agencies, institutions, and individuals in conducting courses dealing with environmental pollution

(2) To increase the number and proficiency of persons employed as treatment operators

(3) To schedule courses of EPA facilities for professionals and subprofessionals

(4) To provide grants to schools or individuals for subprofessional training

To assure inclusion in CAMPS planning on the state level, the state environmental authorities must seek representation on the state CAMPS committee or manpower planning councils. Because of the emphasis of MDTA and a member of other manpower programs on serving the "disadvantaged," environmental authorities should give serious consideration to developing recruitment and training plans, enabling people in this category to become environmental control personnel. This may require some restructuring of job content and added flexibility in training programs.

*F. A Model for Cooperative Human Resource Development Planning*

An important function of the manpower planner is that of providing a bridge between the area he represents and other professional fields. When employed by a state agency or in a particular industry, be it health care, transportation, or improving environment quality, the manpower planner has a dual responsibility. On the one hand he must understand the technical operations and needs of his own industry in order to adequately interpret his industry to other agencies and professions. He must also become familiar with the human resource agencies his organization might use in meeting its manpower requirements. The more expert the manpower planner can be in assessing his industry's manpower needs, the greater will be the opportunity for precision and confidence in his translation of these needs into terms and concepts useful to educational administrators, curriculum developers, and training institutions. As a bridge builder, the manpower planner can provide an administrative paradigm for human resource development through cooperative planning.

Cooperative planning has already begun in the water pollution control field in both the national and the regional offices of EPA. It is suggested that further cooperation between regional manpower representatives, from the appropriate federal agencies, be encouraged by fostering a "team approach" to planning at the regional and state levels. The three federal agencies most concerned with developing trained manpower for water quality and environmental management include the Manpower Administration officers in DOL, the USOE, and, of course, the OWP.

This team approach can also be fostered by regional representatives at the state and local levels by setting up situations which bring appropriate state and local representatives together to jointly plan development of the needed human resources. The state agency representatives would include the state supervisor for manpower programs in the state employment office, the manpower specialist for vocational education in the state office of education, and the state water pollution control agency person most concerned with the proper staffing of wastewater treatment facilities and similar areas of manpower need. It will also be to the advantage of the water quality manpower planner to be involved in the manpower planning and coordinating activities of the state and area manpower planning councils or CAMPS committees. The simple model illustrated in Figure 3.1 shows the relationship of those agencies that should be involved in manpower planning for the water pollution control field.

The chief advantage to be derived from this "team approach" to planning can be seen in the potential for each agency to profit from the experience and information pool of the other two agencies. DOL and the state employment services possess considerable expertise in measuring demand in the labor market and making job and salary evaluation, while the vocational education staff is familiar with the resources and capability of regional, state, and local training institutions. The manpower planner representing an environmental agency is in an ideal position to facilitate communication and program planning between his own agency and the two federal and state units most concerned with employment and training, and the manpower planning councils can help relate water quality manpower planning to the overall manpower planning and activities of the state and local areas.

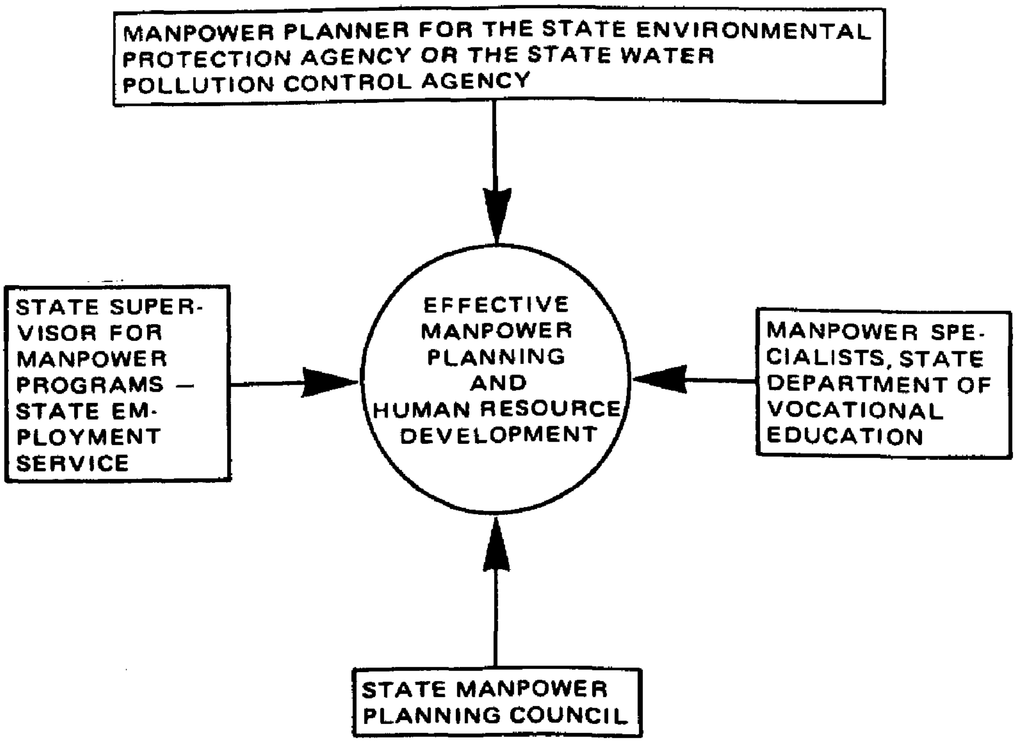


**Figure 3-1. A Model for Cooperative Human Resource Development Planning**

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# CHAPTER FOUR

## MANPOWER PLANNING FOR MUNICIPAL WASTEWATER TREATMENT PLANTS

A. Introduction

B. Manpower Planning Process—An Overview

C. Seven Steps for Manpower Planning in Municipal Wastewater Treatment Plants

1. Describe that segment of the water pollution control field for which manpower training is being performed.

2. Determine the relationship between the objectives of the state water pollution control agency and the objectives of manpower planning.

3. Determine selected characteristics of current and expected employment.

4. Analyze manpower problems.

5. Develop training plans and action steps in response to current and expected manpower training needs and manpower problems.

6. Develop and maintain a data system.

7. Monitor and evaluate all of the manpower planning process.

# CHAPTER FOUR

# MANPOWER PLANNING FOR MUNICIPAL WASTEWATER TREATMENT PLANTS

## *A. Introduction*

In this chapter the focus is narrowed to manpower planning for a specific source of employment in water pollution control. Because of the limited resources available to the manpower planner in a state water pollution control agency and the initiatory aspects of this planning effort, our approach will not be as detailed as we might like. Furthermore, the development of the manpower planning techniques will be made within the institutional framework already established, or in the process of being established, by OWP and the conceptual framework implied by the methodology employed in the recent DOL/EPA survey of employment in wastewater treatment plants.

Though the exposition in this chapter is primarily in terms of a single occupation, that of wastewater treatment plant operator, the analysis can be applied to most, if not all, occupations found in a wastewater treatment plant.

## *B. The Manpower Planning Process—An Overview*

The objective of manpower planning for wastewater treatment plants is to ensure that the right number and the right kind of people are in the right place at the right time. The primary function of the manpower planner is to develop manpower information and training plans to ensure that this objective is continuously satisfied.

To assess whether the planning objective is being satisfied, the planner must first define, or have defined for him, what the "right number" and the "right kind" of people are. The definition of what constitutes the right number of people is related to what has been called the level of "recommended employment," while the definition of the right type of people is related to the qualifications workers should have when occupying positions within wastewater treatment plants. Determining the right place and time for employment requires the optimal placement of workers both spatially and temporally. This aspect of the manpower objective recognizes that elements of change impinge upon those processes that affect manpower conditions and should be taken into account by the manpower planner.

The major aspects of change that affect manpower conditions in wastewater treatment plants are the growth in the number and size of the plants, the change in technology of wastewater treatment, and the various elements of transformation that occur within a given level of employment. Over time both the number and size of wastewater treatment plants have increased. As such changes continue, they will generate an ongoing need for additional manpower. In addition to this source of growth in the level of employment, more manpower will be required to fill positions vacated by individuals who, for a variety of reasons, terminate their employment. As changes in the technology of wastewater treatment occur and as changes in water quality standards call for more reliability in the performance of wastewater treatment plants, not only will additional manpower be needed, but the qualifications of many of those currently employed will have to be updated. All of these changes will require imaginative additions to existing training programs.

When the manpower planner has assured himself that he is familiar with the definitional and descriptive aspects of employment in wastewater treatment plants, he must then determine in a quantitative sense whether the objective is currently being achieved and whether or not it will be achieved in the future. This will require that the manpower planner not only measure and assess characteristics of current employment, but also project future employment characteristics.

If the manpower objective is currently being satisfied, the planner must determine whether existing and expected future manpower programs, as tempered by his expectations of future manpower conditions, are sufficient to guarantee that the objective will be continuously satisfied. If the objective is not being satisfied, or if existing programs are judged inadequate to ameliorate projected future problems, the manpower planner must determine the nature and possible cause for such failure. Having made such a determination, he must develop, or assist in the development of, those programs that will eliminate, or at least reduce, current and anticipated future manpower problems.

To measure and project selected characteristics of employment in wastewater treatment plants, the manpower planner must collect and draw conclusions from certain data. These tasks require that the planner establish a system for collecting, storing, retrieving, and analyzing data. The collection of data for inclusion in such a data system implies that there is a body of data deemed important to collect and that an analytical framework exists, whether stated explicitly or residing implicitly in the actions of the planner, that serves as a guide in determining which data are relevant.

The analytical framework used in this manual is dual but interrelated. We are concerned with recommended employment while also being concerned with budgeted and actual employment. In the DOL/EPA survey of employment in wastewater treatment plants, the three types of employment are identified and measured. Recommended employment is that which, if currently used, would maximize the establishment's efficient operation. Budgeted employment is that level budgeted by the government, a unit responsible for the operation of the wastewater facility. Actual employment is simply the number of individuals employed by the facility at the time the survey questionnaire was completed.

Historically there have been differences in the numbers associated with these alternative measures of employment. Recommended employment is based upon engineering and other technological considerations, while budgeted and actual employment is determined by the various economic forces that impinge upon the demand and supply for positions in wastewater treatment plants. The number of people actually employed in a given occupation will be determined by the juxtaposition of demand and supply forces, where those various forces subserve under the demand for workers are affected, in varying degrees, by the technological considerations that determine the level of recommended employment. The level of actual employment for a given occupation within wastewater treatment plants will be related to such variables as: (1) the budget for the plants, (2) wages paid within the occupation, (3) wages paid in occupations requiring similar skills and education, (4) the effluent (in mgds) of the plant, (5) water quality standards, (6) certification requirements for operators, (7) nature of labor market for that area in which the plant is located and from which it is expected to draw its labor supply, and (8) general nature of working conditions.

Wastewater treatment plants are operated by personnel employed by local municipalities, the officials of which also determine the operating budget for the facility. It is from this budget that money is made available to employ individuals to operate the plant. For given values of other variables that affect the employment of a particular type of labor, it is reasonable to expect that the larger the budget allocated to the plant, the more employment there will be. Because of this, the size of the budget is among the more significant variables that determine the amount of employment within a plant. It is, for example, one of the important variables which determine how close actual employment is to recommended employment. Within a given budget, however, other variables will have an important effect on the level of actual employment.

Wages paid to operators, especially in relation to wages paid to individuals of similar skill and educational attainment working in other occupations, will be a significant determining factor in both the number of people who are sought by the managers of the wastewater facility and the number of people wishing to work there. Working conditions, which contain a variety of possible configurations, will be an important factor in determining the desirability of work within a wastewater treatment plant and will, therefore, affect the level of employment that can be achieved with a given wage rate.

The effluent of a wastewater treatment plant, both in its quantity and quality, is an index of the number of gallons of water treated and the type of treatment used. In Chapter Two, we documented the growth in the quantity of pollutants being produced and the growth of the wastewater treatment plants to treat these pollutants. Each of these factors implies that the number of gallons treated will increase over time. Furthermore, the type of treatment has changed over time; one of the most recent examples of which are new methods for phosphorus removal. It is reasonable to assume a positive relationship between the amount of water treated in both of its dimensions and the quantity of operators demanded; thus as treatment increases, and no changes in technology occur, we should expect an increase in the level of recommended employment.

Enforcing certain laws and regulations to increase water quality will have two separate effects upon employment. As water quality standards are enforced, the amount of water treated and the degree of treatment will increase with the resulting increase in actual employment. In addition, there are existing regulations which when enforced, give many states the power to require that budgeted employment be equal to recommended employment. When such laws are enforced and there occurs an increase in budgeted employment, actual employment may also increase.

The quantity of labor available for employment within a wastewater treatment plant will, in the aggregate, be determined by the number of people between certain ages since only such people are considered to be potential members of the labor force. The specific educational and skill requirements for certain jobs delimit the available number for such jobs as does the spatial distribution of places of residence and places of work. There are limitations upon how far people can and will travel to and from work; thus the labor market for a particular plant will have a spatial limitation. In time, however, all of these constraints might be relaxed as individuals respond to certain stimuli. Thus the size of the available labor force might increase as people migrate into a given area or as transportation facilities improve, or the number of people having a given educational background might increase as the size and number of various training programs are increased.

Within the general type of restriction just outlined, the quantity of labor available to a wastewater treatment plant will also be a function of the wages paid. In general, the higher the wage in one occupation (relative to another requiring similar skills and education and having similar working conditions), the greater will be the quantity of labor made available for employment. This increase in the quantity may come about because of the added inducement for certain people to travel farther to and from work or even to change their places of residence to be closer to the source of higher wages. Higher wages may induce people to obtain the requisite training for a particular job, though this will not affect the available quantity immediately because of the necessary time lags in completing the training. Higher wages may also affect the size of the labor force by inducing students to leave school earlier than normal and inducing those not in the labor force, such as housewives and discouraged workers, to enter it either on a full- or part-time basis.

Within the preceding analytical framework, the manpower planner must determine the number of additional workers who must be recruited to a particular occupation and the type of training they should be given. He should also determine what additional training might be provided for current and future employees. Training, whether for new or existing employees, may be of short or long duration and may be for the purpose of skill improvement or for entry-level jobs. Upon obtaining estimates of the number of people receiving the various types of training, the manpower planner should work in cooperation with training specialists in devising an efficient program for meeting training needs.

### *C. Seven Steps for Manpower Planning in Municipal Wastewater Treatment Plants*

To accomplish the basic objectives of manpower planning requires that certain activities be performed. The performance of these activities may be viewed as occurring in a sequential fashion, the order of which, though differing in minor ways among different planners, would be dictated by a logic shared by many individuals engaged in manpower planning. Though the sequence may be divided into few or many steps, we have chosen to delineate the following seven discrete steps as descriptive of the planning process:

(1) Describe that segment of the water pollution control field for which manpower planning is being performed.

(2) Determine the relationship between the objectives of the state water pollution control agency and the objectives of manpower planning.

(3) Determine selected characteristics of current and expected employment.

(4) Analyze manpower problems.

(5) Develop training plans and action steps in response to current and expected manpower training needs and problems.

(6) Develop and maintain a data system.

(7) Monitor and evaluate all of the manpower planning process.

The details of how one applies each step may differ slightly among the various types of manpower, and some planners may prefer to increase or decrease this number of steps to allow for more or less detail. Nevertheless, the seven steps provide a useful framework for initiating a manpower planning process in the water pollution control field.

*1. First Step: Describe that segment of the water pollution control field for which manpower planning is being performed.*

The purpose of executing this step is to have the manpower planner become familiar with that segment of the water pollution control field for which he is conducting manpower planning. The technological aspects of wastewater treatment will have important effects upon manpower issues. The manpower planner must, consequently, become familiar with some of the general technological aspects of water pollution control. He should also become familiar with existing job classifications and requirements.

One of the first things that the manpower planner should note is that wastewater treatment plants differ by the type of treatment they perform and the amount of waste water they treat per day. We shall refer to these two characteristics as the "type and size" of the wastewater treatment plant. The type of treatment may be identified by its code number obtained from a coding system used, but now in the process of being redeveloped, by OWP. A list of the codes in recent use follows.

| *Code* | *Name* |
|---|---|
| 20 | Primary—settling tanks with no detail |
| 21 | septic tanks |
| 22 | Imhoff tanks |
| 23 | mechanically cleaned tanks |
| 24 | plain, hopper bottom tanks |
| 29 | Primary—others and unknown |
| 30 | Chemical |
| 41 | Secondary—activated sludge |
| 42 | extended aeration |
| 43 | biological filters, fixed nozzle |
| 44 | biological filters, rotary |
| 45 | intermittent sand filter |
| 46 | land disposal |
| 47 | lagoons |
| 48 | biological |
| 49 | Secondary—others and unknown |

The size of a wastewater treatment plant is usually identified on the basis of the plant's "average day capacity," measured in mgds. In the DOL/EPA survey, six classifications of size were recognized: unknown, 0.001–0.999, 1.000–4.999, 5.000 –24.999, 25.000–99.999, and 100.000 plus.

Within a wastewater treatment plant several occupations are found. In the DOL/EPA survey 21 specific occupational categories were identified and a summary of the job descriptions provided. (In Appendix II, we provide a list and summary job description of these 21 occupations.) In many states the number of occupations found within a typical wastewater treatment plant, and the relevant job description, will differ from those used in the DOL/EPA survey. For example, the DOL/EPA survey listed two classifications of operators—Operator I and Operator II—while in some states four or five grades or classifications of operators exist, all with differing job descriptions. That such differences exist is not surprising, given the local autonomy that has existed and still exists in the operation of wastewater treatment facilities.

OWP is aware of the diversity in both the number and description of occupations and is now supporting research aimed at improving our understanding concerning the appropriate number of occupations to designate for wastewater treatment plants, the number of workers that should be assigned to each occupation, the appropriate job descriptions for each occupation, and the general education and skill requirements for each occupation. Such research is not being undertaken merely to try to standardize job numbers and descriptions, but rather to provide assistance to local communities in the efficient staffing of their wastewater treatment facilities. One of the first results of this research are the "staffing guides" that now exist in preliminary form.

The engineer who designs a wastewater treatment plant provides a schedule detailing the number and type of workers to be employed in each job classification within the plant, if the plant is to be operated at its design efficiency. (The level of employment that would occur if these recommendations were followed is the recommended employment mentioned previously.) The engineer will have at his disposal the staffing guides which OWP will shortly make available throughout the nation. These staffing guides are not intended to represent static organizational tables, but rather are intended to be flexible guidelines for staffing complements to be adapted to specific local situations. These guides also contain an occupational list for wastewater treatment plants along with a description of the type of work performed and the skills required to perform such work for each occupation. The occupational descriptions should also be considered flexible guidelines to be adjusted according to what local conditions dictate. A preliminary sample of a staffing guide appears as Table 5-1:D in Chapter Five.

Knowing that wastewater treatment plants differ by type and size, that there has been some attempt to standardize the job descriptions and occupational structure in such plants, and that the staffing complement varies according to plant type and size, the manpower planner should inventory his own state with respect to the type of facilities currently in operation and determine whether the occupational titles and descriptions displayed in Appendix II compare with those currently in use within his state.

Not only should the manpower planner become familiar with the different employment requirements and the suggested qualifications of the various personnel within a wastewater treatment plant, he should also determine what training programs are currently available and what additional training programs it would be desirable to institute. Aside from the "qualitative" aspect of training, the manpower planner should also determine some of the "quantitative" aspects of training programs. He should obtain knowledge about the financial resources available for training programs, the capability of existing training institutions to increase their training loads, the availability of additional or alternative institutions to conduct training, and the methods by which recruits for the various training programs are obtained.

Some of the specific problems a manpower planner may identify in recruiting candidates for a training program may actually have their roots within the occupation, or in the interrelated network of various occupations for which the training is being offered. For example, if the occupation is one lacking in opportunity for personal advancement, it will be exceedingly difficult to recruit and retain employees. If, however, the occupation or series of occupations can be structured to provide a "career ladder," then the recruiting, training, and job stability may be greatly enhanced.

2. *Second Step: Determine the relationship between the objectives of the state water pollution control agency and the objectives of manpower planning.*

The purpose in executing this step is to have the manpower planner become familiar with the specific objectives of the state water pollution control agency that might affect the fulfillment of the manpower planning objective. The presence of this step acknowledges that the manpower planner must view himself as an important member of the state water pollution control team. Certain policies and priorities established by the state agency affect the specific direction that manpower planning will take, as may the limitations of those individuals or agencies that support the manpower planner in the performance of his duties.

The objectives and goals of manpower planning should be understood within the broader objectives and goals of a state's water pollution control program. As discussed in Chapter Three the federal water pollution control program identifies the state water pollution control agencies as playing a central role in improving water quality. Because of the central role of the state agency and the effort of the federal and state agencies to work together, it will often be the case, aside from minor differences in emphasis, that the objectives of the state program will, wherever applicable, be the same as those of the federal program. The manpower planner should become familiar with his state's programs, particularly as they apply to the improvement, expansion, and operation of existing wastewater treatment plants and the construction of new plants.

The manpower planner may wish to begin this aspect of the planning process by collecting and becoming familiar with the contents of such items as the state's various water pollution control planning documents, the water quality standards implementation plans, the legislation authorizing the construction of wastewater treatment plants in the state, the policy statements and directives being issued on the state's water pollution by the state agency, and whatever information is available concerning past and projected future values of the financial support for water pollution control programs. This information will provide the manpower planner with a broad outline of the state's water pollution control objectives.

In addition to this kind of information, it will also be useful for the manpower planner to obtain copies of what are referred to in many states as the "one-year" and "five-year needs." These documents list a state water pollution control agency's priorities for building new wastewater treatment plants throughout the state. Such information is based upon the priorities established by the various basin plans that may exist within the state and the water quality standards implementation plans.

One further piece of information that the manpower planner should obtain relates to the water pollution control agency's position regarding the staffing of wastewater treatment plants. Since the number of people to be recruited and trained should be based upon actual employment rather than recommended employment, it will be necessary for the planner to determine whether, in his state, an attempt will be made to induce the municipalities that budget for wastewater treatment plants to bring employment, or at least the number of budgeted positions, in line with the level of recommended employment.

He should also be familiar with his state's program for the certification of operators. He should determine the current effects such a program has upon desirable training programs and the possible future effects that changes in the program might have.

*3. Third Step: Determine selected characteristics of current and expected employment.*

The purpose of completing this step is for the manpower planner to gain knowledge of the various dimensions of current and expected future employment within wastewater treatment plants. This knowledge is needed to determine current and expected future manpower and training needs. An important aspect of this step is the development and use of an instrument to collect the data by which to measure the various dimensions of current and expected future employment. The DOL/EPA survey is an example of such an instrument and represents the initial attempt to collect manpower data for wastewater treatment plants.

We shall divide this step into three subsections. In the first we shall deal primarily with current employment characteristics, in the second with projecting future employment characteristics, and in the third with calculating additional manpower requirements.

*a. Current employment characteristics.* When the survey instrument is completed, the first task is to determine the value of the three alternative measures of employment—recommended, budgeted, and actual. Since both full- and part-time work exists as a part of actual employment and may exist as a part of recommended employment, an attempt should be made to distinguish between total employment (whether it be recommended, budgeted, or actual) and total full-time employment. If resources permit, data should also be obtained on "full-time equivalent" employment. For example, if the total number of workers is 120 and the total full-time workers is 100 with the 20 people working half-time, then there would be 110 full-time equivalent workers.

The differences among the three alternative measures of employment should be computed. The difference between recommended and budgeted employment will be referred to as the "budget shortfall," the difference between budgeted employment and actual employment as "vacancies," and the total of these two, or what is the difference between recommended and actual employment, as the "employment shortfall." These shortfalls and vacancies should also be expressed in ratio form, with actual employment being the denominator, in order to eliminate scale effects and to facilitate certain types of projections to be discussed below.

In addition to measuring employment totals, the manpower planner should obtain other characteristics of employment. In particular, "terminations" and "accessions" should be measured. Terminations are the number of employees that leave a particular occupation within the year, while accessions are the number of people that enter a particular occupation within the year. (On some occasions such changes are referred to as "turnovers.") Terminations determine the number of workers that have to be attracted to the occupation if employment is to remain unchanged within the relevant time period, while accessions measure the number of workers attracted to the position.

Terminations consist of several components. Individuals leave a particular occupation for several reasons—they die, retire, quit, are discharged, are promoted within the plant or to some other plant, or are transferred or request a transfer to some other plant. Accession, which measures the sources from which new employees were recruited, also has several components. An individual may come to a particular job from what we shall refer to as "external labor sources." Workers coming from this source will usually have no direct experience in wastewater treatment plants and may exhibit considerable variance in their education and skills. Another component of accession is that related to those workers who are already employed in a wastewater treatment plant but who transfer into the occupation in question. Such transfers may be in the form of a promotion, or an upgrade, insofar as the transfer is to an occupation requiring greater expertise than the position vacated. Such transfers may occur from within the same plant or from some other plant within the state. Transfers may also be "horizontal transfers," those individuals who transferred from one wastewater treatment plant to another while keeping the same occupational title. Although the same occupational title is used, different skills may be required. The determining factor in this matter would seem to be the difference in the type and size of plant between which the employee transferred.

In Figure 4.1, we illustrate schematically the preceding process. We also introduce in this diagram some alternative nomenclature. We shall divide terminations into two major components—separations and transfers out—where "separations" include such items as "quits" and "discharges" while "transfers out" refers to those workers that left their employment in the occupation in question but did not leave the state's wastewater treatment system. We shall also divide accessions into two major components—new hires and transfers into—where "new hires" are those workers that come from external labor supply sources and "transfers into" includes accessions due to upgrade within or between plants and horizontal transfers between plants. We also illustrate in Figure 4.1 the fact that workers may enter a particular occupation with or without training though, of course, the former is to be preferred.

One additional piece of information that should be obtained when this step is executed is a detailed education and work profile of each employee in the wastewater treatment plants. This information may be difficult for many manpower planners to obtain because of budgetary restrictions, and less ambitious undertakings should be followed. At a minimum, information should be collected that attempts to assure whether current employees are qualified for their positions. If certification requirements exist, such information will be important not only for determining the number of current employees that should have some type of training but also the needed capacity of any program designed to bring all those employees so required into certification.

*b. Future employment characteristics.* The manpower planner should project the value of all the employment characteristics measured in the preceding substep. A reasonable period of time over which to make projections of future employment characteristics is five years because other segments of the water pollution control field engage in five-year projections. Because of the time necessary to project the value of future employment and the lead time necessary to respond to whatever problems may exist, a period of one or two years is too short a time. This

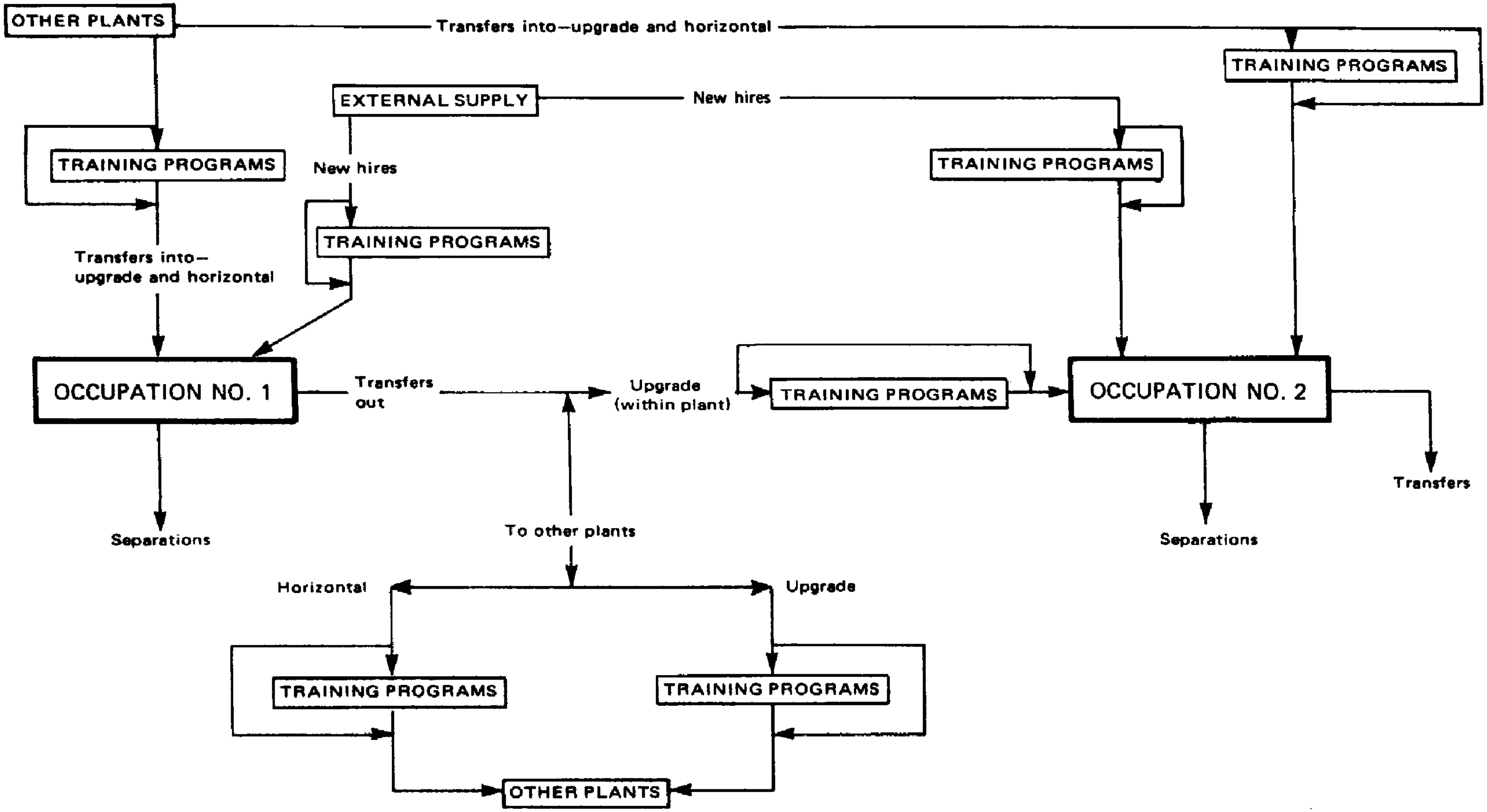


**Figure 4.1. Termination and Accession Processes**

is especially true when it is recognized that most of the available data are annual. Furthermore, the tradition of post-secondary school programs and the postponement of career choice until early adulthood appear to dictate a planning horizon of from three to five years.

The projection of future manpower requirements and employment can be accomplished by relying upon data obtained from the survey instrument used to measure current employment and from certain documents that are related to what we have referred to in Chapter Two as the construction grants process.

From among the many activities that occur in the construction grants process, five can be singled out as having particular significance to the manpower planner. They are significant either because certain important information is available at that time or because it would be desirable to have certain information at that time. These five activity points are: the basin plan, the construction grant application, the approval of plans and specifications, the final inspection, and the operation and maintenance annual inspection. Though certain manpower information is already available from existing forms, it is the intent of EPA/OWP to expand the available data base by adding to these forms questions that are designed to obtain additional manpower information.

To illustrate the type of information that is normally available at these five data points, we shall trace the process by which a typical wastewater treatment plant comes into existence. Initially the need for a wastewater treatment plant, either a new one or an expansion of an old one, is identified in the basin plan—the first data point. The plant is often identified by the type and size needed and, as such, will appear on the state's list of priorities where a date is sometimes given for completion of such a facility. The use of this information, and the information contained in the staffing guides, will enable the manpower planner to make some preliminary projections for the additional manpower that will be required to operate this plant. Such a projection would be of recommended employment.

The second source of information is the engineering report accompanying the construction grants application form.

New federal guidelines require that manpower data be made available in the engineering report. Such information, when available, can be obtained from those offices in the state dealing either with operations and maintenance or construction grants. Should such manpower data not be made available, the manpower planner can once again use the available information on the type and size, the staffing guide, and the estimated date of completion to make preliminary projections of recommended employment.

The third data point in the construction grants process is when the plans for the construction of the wastewater treatment plant and the specifications of the plant are approved. At this point an operations and maintenance manual is usually available, as is a detailed staffing plan. Upon completion of the plant, a final inspection is conducted at which time we have the occurrence of the fourth data point. Up to this point in the process, only the level of recommended employment has been available because actual budgetary data have not been available, and there has been an absence of an employment history from which to obtain data such as terminations and accessions. When the final inspection occurs, however, data on budgeted employment will be available since by the time this inspection is held, the plant is complete and ready for operation.

After the final inspection, another inspection is performed approximately one year after the plant has been in operation and represents the fifth data point. This inspection is normally executed jointly by federal and state personnel from the operations and maintenance division. It is the intention of OWP to establish at least an annual inspection of wastewater treatment plants by state personnel from operations and maintenance. Though this inspection was originally designed and planned on the basis of gathering data on the technological aspects of the plant's operation, it is the intent of both the federal operations and maintenance and the manpower development staff in OWP to expand this annual inspection form to collect the data which are pertinent to manpower planning.

Because the new federal guidelines pertaining to the operation and maintenance of wastewater treatment plants require that manpower data be made available at the data points listed above, the manpower planner's task of obtaining data of projected increases in recommended employment resulting from new and expanded plants is made more simple. In principle, he should be able to visit those people in his state agency concerned with construction grants, as well as operations and maintenance, to obtain data on recommended employment for each year for approximately the next five years. Because of these new guidelines, the manpower planner should therefore make every effort to become acquainted with those individuals working in the offices responsible for collecting these data, and should continuously urge them to supply him with, and possibly cooperate in the format for displaying such data.

We illustrate in Figure 4.2 the time phasing of the manpower data collection system. The amount of information on manpower aspects of wastewater treatment plants increases as the plant draws closer to completion, as does the certainty attached to the data.

Much of the projected employment data obtained from the construction grants process will be for recommended employment. One of the tasks that the manpower planner must do, which we shall discuss shortly, is to determine additional manpower and training needs. But such determinations should be based upon actual rather than recommended employment. Insofar as actual employment is expected to differ from recommended employment, the manpower planner must make separate estimates of the future values of actual employment.

Given the limited resources available to most manpower planners, detailed projections will not be feasible and, given the probable magnitude of the manpower problems of the state, unnecessary. Until additional resources are made available or experience suggests that more complex methods are required, the manpower planner should make his projections of future actual employment in the following manner: from the annual survey of wastewater treatment plants, the manpower planner can calculate the factor proportionality between recommended and actual employment which we shall note as "P." Actually, several *P*s might be estimated, not only for different occupations but also for different types and sizes of plants so that, in principle, a matrix of *P*s would be computed.

When future actual employment is projected, these *P*s may be used by simply multiplying the projected recommended

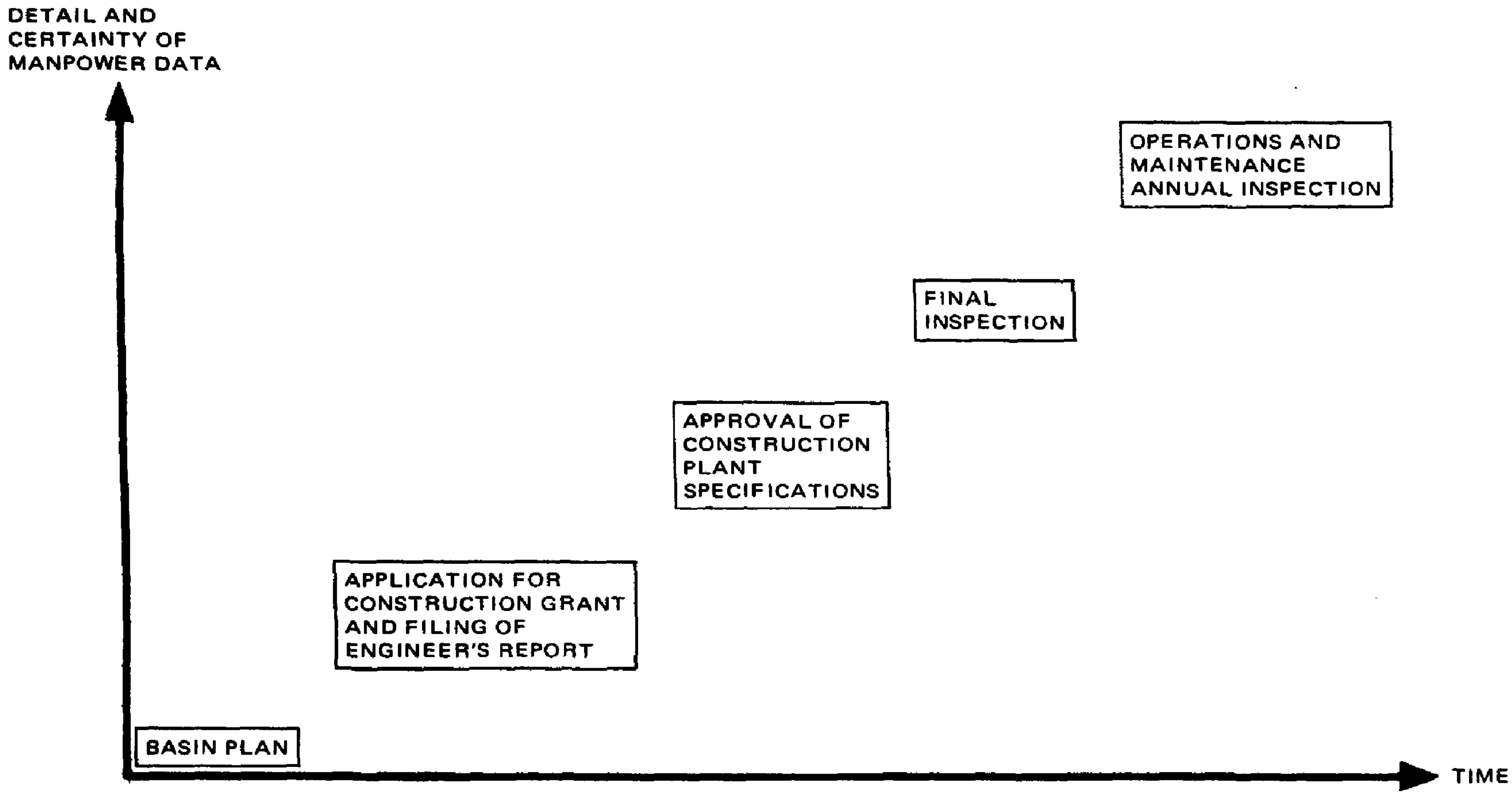


**Figure 4.2. The Time Phasing of Manpower Data**

employment by them. This would imply that the ratio of actual to recommended employment which exists today is assumed to exist each year in the future. Should there be reason to believe that future conditions will change so as to affect the size of *P*, then the value of *P* used in this process should be adjusted accordingly. For example, if the relevant *P* for a given projection has been estimated to be 0.80 in the current period, but it is expected that in the near future actual employment will be closer to recommended employment, because of a concerted effort to enforce existing regulations, then over the next five years the value of *P* used might increase as in the following sequence 0.82, 0.84, 0.86, 0.88, and 0.90. This would imply that over the length of the five-year planning horizon, it is being assumed that actual employment in wastewater treatment plants will increase from 80 to 90 percent of recommended employment.

*c. Additional manpower requirements.* A further task in this step, which applies to both current and future time periods, is the determination of additional manpower requirements. Such a determination has both a quantitative and qualitative aspect. It will require that the manpower planner calculate the number of additional workers that will be required in each occupation for each year in the planning horizon, the type of training they may require, and the type of training that may be required of current employees.

To determine the number of additional workers that will be needed, the manpower planner must determine what growth in actual employment will occur within the year and how many workers will terminate employment within the year. There are several aspects to consider under the rubric of growth, all of which, however, will be captured in the value assigned to *P*, the factor of proportionality between actual and recommended employment. Growth in actual employment may occur because of the addition of new or the expansion of existing plants, or because of a decrease in the employment shortfall in new and existing plants.

By examining the accession rate and its various components, the manpower planner will be able to obtain estimates of the most likely sources for the additional manpower. On the basis of the various accession rates, the manpower planner may then provide estimates to those individuals working in the training division of labor supply when they, in consultation with the manpower planner, may devise the appropriate training programs.

The final task in the execution of this step is the revision of various aspects of the estimating procedure. Over time, changes in termination and accession rates may occur and should be used in the projection process. Adjustments over time may also be required in the value assigned to $P$. If, for example, current federal guidelines are followed, the value of $P$ will very shortly be equal to unity, indicating an equivalence between actual and recommended employment.

*4. Fourth Step: Analyze Manpower Problems.*

The purpose of analyzing manpower problems is to have the manpower planner become familiar with a variety of possible manpower issues—their causes and possible solutions. Although there are many problems with which a manpower planner may be confronted in successfully fulfilling his objectives, we shall consider only a portion of them and shall consider only those that relate directly to the recruitment, retention, and utilization of the wastewater treatment plant personnel.

There can, quite legitimately, be some disagreement about what constitutes a manpower problem, the evidence that a given problem exists, and the cause of that problem. This occurs, in part, because of the infinite regress which may occur in determining the "basic" cause of a problem. Hence, differences among individuals concerning differences between cause and effect relationships will, to some extent, depend upon how far in the infinite regress pattern a particular problem is traced. One possible way of viewing a sequence of manpower problems is illustrated in Figure 4.3. The sequence has been extended to just beyond that point where it seems reasonable to expect the actions of the manpower planner to have some noticeable effect. In the first block, the specific problem confronting the water quality industry with which manpower will be intimately related is the improper operation and maintenance of a wastewater treatment plant. The "cause" of this problem, to some, might be identified as "inadequate staffing," in both its quanti-

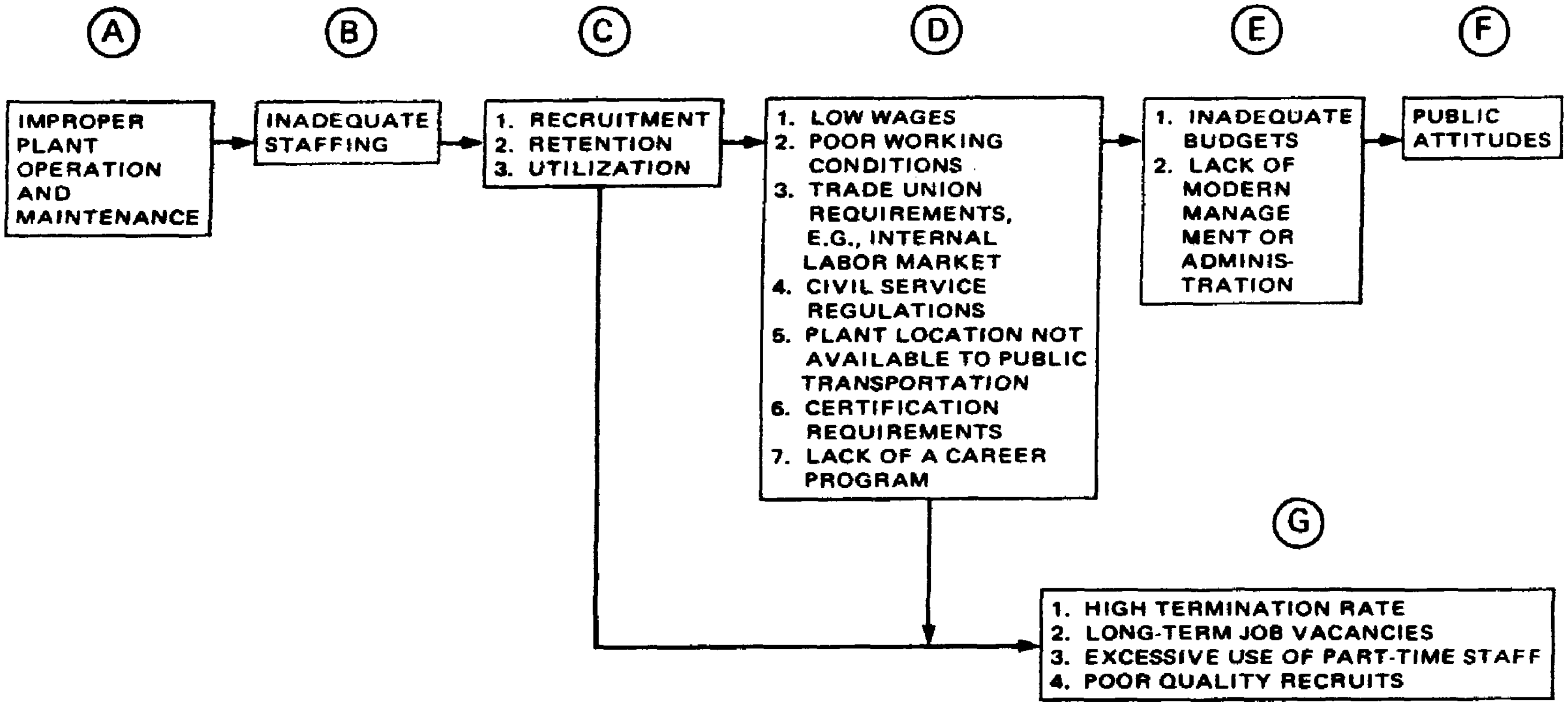


**Figure 4.3. The Sequence of Manpower Problems**

tative and qualitative aspects, while to others inadequate staffing will simply be identified as another problem. The "cause" of inadequate staffing may be identified as being related to recruitment, retention, and use of manpower, which may be caused by low wages or poor working conditions, which in turn are identified by others to be "problems." Two other steps illustrating the problem of inadequate budgeting, poor plant management, and public attitudes are included in the figure. Block G, which is not in the chain of possible problems but is connected to blocks C and D, may be taken as factors which may be problems in themselves but also evidence of other problems. Thus the existence of a high termination rate is indicative of a problem in manpower retention or evidence of poor working conditions, etc.

A question the manpower planner must answer is, "At which level should I attempt to enter the chain of problems depicted in the preceding figure?" The principle of division of labor would seem to suggest that those individuals working in operations and maintenance be concerned with blocks A and B, while the manpower planner would direct most of his energies to solving those problems listed in blocks C and D.

The inability to recruit new and retain current employees may be related to similar variables. Difficulties in recruiting new individuals into a particular occupation may be related to the existence of physically poor working conditions, lack of assumed prestige in the occupation, or low wages. The presence of any one of these variables, with the absence of compensating offsets in other variables, would be sufficient to cause recruitment and retention problems. Alternatively, however, the presence of one or two of these variables may be completely offset by significantly high values for the remaining values. For example, high wages may offset the effects of poor working conditions and occupational prestige.

To determine whether recruitment and retention are existing problems within wastewater treatment plants, we find that some of the variables already computed may be of assistance. If retention is a problem, for example, it would be expected that separation rates, particularly quit rates, would be higher than for other occupations within the state that require similar skills and education. If recruitment is a problem, it would be expected that the vacancy rate would be higher than the state average for similar occupations. Problems of recruitment and retention may also be reflected in more qualitative as compared to quantitative aspects of employment. The presence of workers with qualifications less than those that are reasonably desirable would be evidence of recruitment and retention problems. The willingness of those supervising the operation of wastewater treatment plants to accept poor work habits would also be evidence of recruitment and retention problems.

The appropriate use of workers, though most appropriately related to the technological operations of the plant, may result in certain types of problems with which the manpower planner must concern himself. Hiring or promoting workers to positions for which they are not qualified would be one form of poor utilization that might place undue pressures upon some workers, thus causing them to quit and thereby contributing to manpower problems. Considerable disparity between recommended and actual employment might be taken as prima facie evidence of poor worker utilization. Such conditions may result in increased work loads on existing workers and thereby eventually lead to the other problems of recruitment and retention.

Determining whether recruitment and retention of workers are indeed a problem for a state's wastewater treatment plants would require that quit and vacancy rates be compared with such rates for other occupations. Comparisons among occupations within wastewater treatment plants should also be made to determine whether internal differences exist. To determine which of several possible factors are contributing to the existence of any manpower problem will be a difficult task, given the resources available to most state manpower planners; nevertheless, some attempt should be made to determine the cause of specific problems.

5. *Fifth Step: Develop training plans and action steps in response to current and expected manpower training needs and manpower problems.*

The purpose of executing this step is to have the manpower planner develop plans for recruiting, to a particular occupation, that number of workers his calculations imply will be needed, to ensure that such recruits receive the training necessary to properly qualify for the occupation, and to take certain steps designed to eliminate those manpower problems already identified. Much of the program development and activities called for in executing this step will require that the manpower planner develop a close working relationship with individuals in a variety of departments both within and outside the state water pollution control agency. Furthermore, the manpower planner must develop a sense of priorities in his work of implementing certain programs. Problems that affect the present operation and maintenance of wastewater treatment plants will require an immediate response, even though initially pretested solutions are not available, while the planning for and implementation of programs that have bearing more upon the solution to future problems should be afforded somewhat lower priority. This is not to imply that the planning and development of manpower programs to solve expected future problems should not be initiated in the current period, but only that their urgency should be recognized as being less than the solution to current problems.

The development of additional training programs will require time not only to develop the content of the programs but also to recruit students, organize and offer the planned training, and evaluate the results. In setting up training programs, the planner should ask and have answered the following kinds of questions:

(1) Who will be trained? What is their level of education? Their age? Are they inside or outside the industry?

(2) Are they being trained for entry-level positions with career opportunities and mobility, or for positions that offer little opportunity for advancement?

(3) What prerequisite skills should be expected of trainees recruited to the program under consideration?

(4) What task will the graduates be expected to perform once they are on the job?

(5) Do existing training programs have the ability to satisfy current and projected training needs?

The answers to some of these questions will be obtained from the data generated in executing previous steps. For example, data collected on accessions to a given occupation will give the manpower planner information on the sources of additional manpower. If data are also collected on the educational background of such individuals, then, in consultation with individuals working in federal training programs, the appropriate kind of training can be identified and planned.

The manpower planner will find assistance in meeting his training needs from the following sources:

(1) A training officer in his own agency

(2) The state director of vocational education in the state department of education

(3) The manpower development officer in the state employment service

(4) A community college dean of occupational studies or a person in a similar position in another post-secondary institution offering technical programs

(5) The manpower development and training committee of the state or regional federation or association concerned with water pollution control

(6) Federal OWP

(7) Consulting engineers

(8) Equipment manufacturers

(9) The various unions concerned with the various occupations within wastewater treatment facilities

The person contacted in any of these organizations should be familiar with funding sources to expand or initiate new training programs. He will also be anxious to learn of any opportunity that promises to offer a "reasonable expectation of employment" to the graduates of his training programs.

In the development of a training program, the manpower planner and the training specialists may jointly develop programs based on the following steps:

(1) Establish performance objectives expected of the program graduates once employed on the job.

(2) Design an evaluation procedure to measure the level of performance of the graduates on the job.

(3) Design the instructional and training format of the presentation form (e.g., "hands-on" experience, lecture/note taking, experimentation/discovery, programmed self-instruction, and combinations of these).

(4) Select instructional media (e.g., case materials, specialized equipment, films, tapes, etc.).

(5) Develop instructional components (e.g., modular forms, concepts, units).

(6) Test and revise instructional components on pilot groups.

(7) Produce instructional components.

(8) Test and revise instructional components.

(9) Implement training program.

(10) Test and revise instructional system as a result, measuring graduate performance on the job.

Once a given program has been developed, it should, insofar as it is successfully fulfilling its objectives, be maintained. The goal of program maintenance is creation of an interactive network of parties who have a direct interest in the water quality and manpower fields. The purpose of this network is the maintenance of programs and activities that minimize manpower problems. A manpower planner, working in cooperation with training specialists (both inside and outside the industry) and representative of employer groups, trade unions, professional organizations, state and local employment services, and educational institutions, should promote the flow of information concerning manpower problems. In addition, he should work toward the development of an organization for monitoring the progress of recently developed manpower programs, identifying new manpower problems as they occur and projecting potential manpower problem areas at some time in the future.

The manpower planner's active membership on state, regional, or area manpower planning councils is a good place to begin to build an interactive network of interested groups. There is no formula that outlines in step-by-step fashion how to create a program to maintain the success of earlier efforts. But a manpower planner who gets himself situated to participate in the feedback of ongoing operations and at the front end of new developments in the industry will soon learn how to meet the manpower needs of his industry.

There may be some reservations as to how much a state manpower planner in the state water pollution control agency may act toward solving certain types of manpower problems that could confront a municipal wastewater treatment plant. The most likely candidates for such manpower problems are poor working conditions and low relative wages. Insofar as the manpower planner can document such problems and the magnitude of the actions necessary to solve them, he can then, either singly or as part of a team effort, try to convince those people who have more direct control over such matters that these problems are of serious proportion and should be eliminated.

At this point in the manpower planning process the manpower planner should report the results from completing the first five steps to those individuals that will provide the assistance necessary to satisfy the manpower planning objectives. Thus, he should report his estimates of training needs to the staff concerned with training in this agency, his analysis of manpower problems to the various agencies that may assist him in eliminating whatever problems exist (the agency so chosen will, of course, depend upon the manpower problems that have been discovered), and his estimate of future manpower needs to individuals not only within his own agency but also to CAMPS. Such reports should describe the situation under discussion, and tables should accompany such a report whenever necessary.

The manpower planner should contact the executive director and/or the chairman of the state manpower planning council to request an opportunity to present his report at a regularly scheduled meeting. Sufficient copies of written reports should be furnished to the secretariat of the state CAMPS organization to provide each member with a copy. Verbal presentations to the council should focus upon identifiable action steps to be taken by the council collectively as well as by individual members who represent service-delivery agencies. Training needs requiring allocation of resources should be a matter of principal importance.

Where appropriate, similar presentations should be made to area manpower planning councils with appropriate attention paid to area-specific problems and action steps.

*6. Sixth Step: Develop and maintain a data system.*

In executing the preceding steps, certain employment data were collected and analyzed. These data were used as the basis for such activities as projecting the future values of certain employment characteristics, documenting the possible existence of manpower problems, and determining the number of additional workers needed each year within the planning horizon. Clearly, the existence of manpower data is important for the manpower planning process, and every effort should be made to increase the amount and availability of useful data.

To accomplish such a task not only requires that annual surveys of wastewater treatment plants be conducted and the progress of new plants monitored, but also that the resulting data be stored in such a manner as to be easily retrievable for future use and analysis. In time, the manpower planner may have direct access to computer facilities and programming expertise; but until such time comes, he will do well to devise simple tables that summarize for each year the data collected in the annual survey and the various calculations and projections made on the basis of those data. By faithfully recording the annual data and calculations made with such data, the manpower planner will be contributing to the important task of developing time series data for manpower in the wastewater treatment plant segment of water pollution control.

Because of the importance of alternative measures of employment, these should be recorded each year, as should terminations and accessions. Since the various rates—vacancy, terminations, etc. —are used in analyzing manpower problems and projecting the future value of certain employment characteristics, they should be recorded in such a way as to facilitate the manpower planner in detecting any significant changes in their respective values.

Because of the uncertainty attached to the projections made by the manpower planner, he should be aware of the possibility of projection errors and be ready to measure and adjust for such errors in his future work. It is through the maintenance of a data system on a continuing basis that the manpower planner will have the data necessary to compare his projections and analysis with the data measured in the annual survey and adjust his projections and analytical techniques accordingly.

The manpower planner should become knowledgeable of other information and data systems within state and federal water pollution control offices and, wherever meaningful, integrate his system with other systems. In obtaining such knowledge, he will undoubtedly discover alternative sources of data. Though it will always be necessary for him to initiate some data collection, nevertheless the amount he has to personally collect could be minimized by successfully integrating his data system with others.

*7. Seventh Step: Monitor and evaluate the manpower planning process.*

Throughout this manual, particularly in the first part of this chapter, the general principles of manpower planning have been outlined in a manner that seems most reasonable for their application to manpower planning in the water pollution control field. Because of the peculiarities of the various states, other slight adjustments to these principles may have to be made on a state level by the state manpower planner. To accomplish this, the manpower planner must continually seek to improve his performance by making the necessary adjustments in his various activities. It should be apparent, therefore, that the job of manpower planning will not be complete until the manpower planner has determined how effective his manpower plan, in both its design and execution, has been. For this reason it is important that the evaluation of the manpower planning process be considered as a separate step in this process. Although listed as a separate step, the evaluation of the planning process, more than any other of the preceding steps, is best understood as a continuous process and one fully integrated with all of the preceding steps. Information obtained from monitoring and evaluating the planning process should be fed back into each step of the planning process in an attempt to improve the precision and reliability of the process. Such practices of using information in this way are often referred to as "feedback" systems.

In order that the various components of the manpower planning process be correctly evaluated, the manpower planner must establish performance criteria. Some difficulty may be experienced in doing this during the initial phases of establishing a manpower planning capability within a state. Thus, for example, it may be difficult, initially, to determine whether or not an error of 15 percent in projecting actual employment next year is tolerable. In time, when the state manpower planner has accumulated experience within his state and with information provided to him by OWP from experiences in other states, some basis for establishing quantifiable performance criteria will have been developed. With such criteria the state manpower planner may then be able to measure his own performance and take the appropriate steps to improve it. The areas in which he will most easily be able to grade his performance will be those such as the accuracy of his projections of future actual employment, his calculation of future manpower needs, the ratio of the number of people trained to the number of people that should be trained, and the adequacy of alternative techniques in projecting the value of selected employment characteristics and in reducing the problem areas of manpower within his state.

An important aspect of the evaluation process is the useful inputs that it provides within the framework of a feedback system. By the evaluation of past performance, insight will be obtained on how to improve upon currently practiced procedures. These weaknesses can be corrected with a resulting increase in the efficiency of the manpower planning process. Such a process of continually evaluating performance and making the necessary corrections by feeding the relevant information back into the planning systems is made more effective, in general, when all of the feedback information is used with little delay and with the greater specificity of the feedback information.

# CHAPTER FIVE

## APPLIED MANPOWER PLANNING FOR MUNICIPAL WASTEWATER TREATMENT PLANTS

Applied Step 1: Describe that segment of the water pollution control field for which manpower planning is being performed.

A. Inventory of Existing Plants

B. Types of Occupations

C. Existing Training Opportunities

D. Career Ladders

Applied Step 2: Determine the relationship between objectives of the state water pollution control agency and the objectives of manpower planning.

A. Legislative Authority

B. Water Quality Uses and Criteria

C. Budgetary History

Applied Step 3: Determine selected characteristics of current and expected employment.

A. Measuring Current Employment Characteristics

B. Projecting Future Employment Characteristics

C. Additional Manpower Needs

Applied Step 4: Analyze manpower problems.

A. Recruitment

B. Retention

C. Utilization

Applied Step 5: Develop training plans and action steps in response to current and expected manpower training needs.

Applied Step 6: Develop and maintain a data system.

Applied Step 7: Monitor and Evaluate the Manpower Planning Process.

# CHAPTER FIVE

## APPLIED MANPOWER PLANNING FOR MUNICIPAL WASTEWATER TREATMENT PLANTS

The purpose of this chapter, which we shall refer to as the workbook section of the manual, is to provide for the application of those planning procedures outlined in the previous chapter. It is the intent of this workbook to provide the manpower planner with an outline of the forms (and a description of the detailed steps for completing such forms) that can be used in carrying out the various manpower planning activities. *In the process of completing this workbook, the manpower* planner would have executed all the planning steps developed in the previous chapter and would thereby have completed the first cycle in conducting manpower planning for a segment of the water pollution control field.

As mentioned in the previous chapter, our exposition will be primarily in terms of the single occupation of wastewater treatment plant operator. Our planning methods are, however, applicable, with only minor changes, to the remaining occupations within a wastewater treatment plant. Our practice of considering only the occupation of operator will imply that when an entire table is to be devoted to the characteristics of a single occupation, the operator classification will be used; and when a table is relevant for all occupations, we shall highlight only the operator classification—it being understood that the remaining occupations are treated in an identical manner.

This workbook has been developed in such a manner that each element in the manpower planning process is spelled out in considerable detail. Some persons will no doubt find the work program outlined here difficult, and others will likely question the necessity to be as thorough and careful as this workbook requires. The workbook should be a helpful guide, however, and is not intended that it be a straightjacket requiring unnecessary precision and detail. Each planner can adapt the material provided here to meet the needs of his organization. It is essential, however, that the manpower planning process outlined in this document be thoroughly understood. Once a broad and general understanding is achieved, and after some experience, changes or modifications may be readily incorporated into a state's manpower planning process.

*Applied Step 1:* Describe that segment of the water pollution control field for which manpower planning is being performed.

## *A. Inventory of Existing Plants*

The manpower planner may obtain information from the staff concerned with monitoring the operation and maintenance of wastewater treatment plants that would enable him to prepare an inventory of the wastewater treatment plants within his state. Initially, this information can be accumulated in a master table having the format as illustrated in Table 5-1:A. In such a

TABLE 5-1:A

**Inventory of the State's Wastewater Treatment Plants**

| PLANT NUMBER | LOCATION | CODES | | | SIZE IN MGD | TREATMENT | |
|---|---|---|---|---|---|---|---|
| | | COUNTY | SMSA | BASIN | | CODE | NAME |
| | | | | | | | |

table the manpower planner would have displayed all the relevant information concerned with the physical aspects of his state's wastewater treatment plant system. This information may, for certain purposes, be rearranged and displayed in a format such as that illustrated in Table 5-1:B. This table uses the treatment codes currently used by STORET (but currently under revision) and a division of plants by size as used in the DOL/EPA survey of employment in wastewater treatment plants. Note that a table such as Table 5-1:B provides a summary of plants by type and size. Some of this same information could be displayed in an alternative and simpler format. We illustrate such a format in Table 5-1:C.

## TABLE 5-1:B

### Inventory of the State's Existing Plants by Type and Size

| TYPE OF TREATMENT | SIZE OF PLANT BY AVERAGE DAY CAPACITY MGD | | | | | | |
|---|---|---|---|---|---|---|---|
| | UNKNOWN | 0.001-0.999 | 1.000-4.999 | 5.000-24.999 | 25.000-99.999 | 100.000+ | TOTAL FOR GIVEN TYPE |
| 20 PRIMARY–SETTLING TANKS | | | | | | | |
| 21 PRIMARY–SEPTIC TANKS | | | | | | | |
| 22 PRIMARY–IMHOFF TANKS | | | | | | | |
| 23 PRIMARY–MECHANICALLY CLEANED | | | | | | | |
| 24 PRIMARY–PLAIN, HOPPER BOTTOM | | | | | | | |
| 29 PRIMARY–OTHERS AND UNKNOWN | | | | | | | |
| 30 CHEMICAL | | | | | | | |
| 41 SECONDARY–ACTIVATED SLUDGE | | | | | | | |
| 42 SECONDARY–EXTENDED AERATION | | | | | | | |
| 43 SECONDARY–BIOLOGICAL | | | | | | | |
| 44 SECONDARY–BIOLOGICAL | | | | | | | |
| 45 SECONDARY–SAND FILTER | | | | | | | |
| 46 SECONDARY–LAND DISPOSAL | | | | | | | |
| 47 SECONDARY–LAGOONS | | | | | | | |
| 48 SECONDARY–BIOLOGICAL | | | | | | | |
| 49 SECONDARY–OTHERS AND UNKNOWN | | | | | | | |
| TOTAL PLANTS FOR GIVEN SIZE | | | | | | | |

## TABLE 5-1:C

### Inventory of the State's Existing Plants by General Type of Treatment and by Size

| TYPE OF TREATMENT | SIZE OF PLANT BY AVERAGE DAY CAPACITY IN MGD | | | | | | |
|---|---|---|---|---|---|---|---|
| | UNKNOWN | 0.001–0.999 | 1.000–4.999 | 5.000–24.999 | 25.000–99.999 | 100.000+ | TOTAL PLANTS FOR GIVEN TYPE |
| PRIMARY | | | | | | | |
| SECONDARY | | | | | | | |
| TERTIARY | | | | | | | |
| TOTAL PLANTS FOR GIVEN SIZE | | | | | | | |

## B. *Types of Occupations*

In the DOL/EPA survey, a total of 21 specified occupations were used. A list of these occupations appears as the first column in the example of a staffing guide displayed as Table 5-1:D, and a list of the job descriptions appears as Appendix II.

**TABLE 5-1:D**

**Staff Complements to Wastewater Treatment Plants**

**Example No. 1[a]**

| *Occupation Title* | *Plant Average Day Capacity in mgd* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *1* | *3* | *5* | *10* | *20* | *35* | *50* | *65* | *80* | *100* |
| | *Estimated Number of Personnel* | | | | | | | | | |
| Superintendent | | | 0.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Assistant superintendent | | | | | | 1 | 1 | 1 | 1 | 1 |
| Clerk typist | | | | 1 | 1 | 1 | 1.5 | 2 | 2 | 2 |
| Operations supervisor | | | | | | | | | | 1 |
| Shift foreman | | | | | | | | 1 | 1 | 1 |
| Operator II | 1 | 1 | 1 | 1 | 2 | 3 | 6 | 6 | 7 | 8 |
| Operator I | 3 | 4 | 5 | 4 | 4 | 5 | 6 | 6 | 8 | 8 |
| Auto. equipment operator | | | | | | 1 | 1 | 1 | 2 | 2 |
| Maintenance supervisor | | | | | | | | | | 1 |
| Mech. maintenance foreman | | | | | | | | 1 | 1 | 1 |
| Maintenance mechanic II | | | | 0.5 | 1 | 1 | 1 | 2 | 2 | 2 |
| Maintenance mechanic I | | | | | 1 | 1 | 1 | 1 | 2 | 2 |
| Electrician II | | | | | 0.5 | 1 | 1 | 1 | 1 | 1 |
| Electrician I | | | | | | | 0.5 | 0.5 | 1 | 1 |
| Maintenance helper | | | | 1 | 1 | 1 | 2 | 2 | 3 | 4 |
| Laborer | | 0.5 | 1 | 1 | 2 | 4 | 4 | 5 | 5 | 7 |
| Painter | | | | | | | | | | 0.5 |
| Storekeeper | | | | | | | | 1 | 1 | 1 |
| Custodian | | | | | | | 1 | 1 | 1 | 1 |
| Chemist | | | | | | | | | 0.5 | 0.5 |
| Laboratory technician | | | | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| TOTAL staff complement | 4 | 5.5 | 7.5 | 9.5 | 14.5 | 22 | 29 | 34.5 | 41.5 | 48 |

[a] Plant components included in this example are:

| *Liquid Treatment* | *Sludge Treatment* | *Other Plant Components* |
|---|---|---|
| Raw wastewater pumping | Primary sludge pumping | Yardwork |
| Preliminary treatment | Sludge digestion | Laboratory |
| Primary sedimentation | Sludge drying beds (b) (1, 3 and 5 mgd plants) | Administration and general |
| Chlorination | Sludge lagoons (c) (10 mgd and larger plants) | |

[b] Sludge removed from plant site by plant personnel.
[c] Sludge removed from plant site under contract.

In some states the occupations will differ from those exhibited in the staffing guide. When such differences arise, the manpower planner should note them and decide whether to recommend that job restructuring be attempted in order to align the list of occupations in his state with those suggested by OWP. Valuable information used in making such decisions would be obtained by comparing the OWP job descriptions with those in his state. It is probably the case, for example, that the job descriptions for Operators I and II cover whatever number of operators appear in most states, but the division of responsibilities (i.e., the job structure) among operators is different.

In addition to being familiar with the job descriptions for the various occupations within his state's wastewater treatment plant system, the manpower planner should become familiar with other aspects of the occupation. Such aspects would include the qualification profile, the entry sources for the occupation, and those occupations into which a worker may transfer from the occupation in question. These additional characteristics of the occupation, along with the job description, constitute what is called the occupation description. An example of an occupation description for Operator I is:

OCCUPATION DESCRIPTION

Title: OPERATOR I, WASTEWATER TREATMENT PLANT

*JOB DESCRIPTION*

Assists Operator II in performance of any combination of following tasks pertinent to controlling operation of plant or performs various tasks as directed: Operates treatment facilities to control flow and processing of wastewater, sludge, and effluent. Monitors gages, meters, and control panels. Observes variations in operating conditions and interprets meter and gage readings and test results to determine processing requirements. Operates valves and gates either manually or by remote control; starts and stops pumps, engines, and generators to control and adjust flow and treatment processes. Maintains shift log and records meter and gage readings. Extracts samples and performs routine laboratory tests and analyses. Performs routine maintenance functions and custodial duties. Operates and maintains power generating equipment and incinerators. Classified by title such as Pumping Station Operator I or Digester Operator I when performing specialized activities only.

*QUALIFICATIONS PROFILE*

1. Formal Education
   High school graduate or equivalent training and experience.

2. General Requirements

   a. Ability to learn operation of plant processes and equipment.

   b. Ability to maintain and evaluate simple records.

   c. Ability to maintain working relationship with other shift workers.

3. General Educational Development

   a. Reasoning
   Apply common sense understanding to carry out written, oral, or diagrammatic instructions. Deal with problems involving concrete variables in or from standardized situations.

   b. Mathematical
   Perform ordinary arithmetical calculations.

   c. Language
   Ability to comprehend oral and written instructions, record information, and request supplies and work materials orally or in writing.

4. Specific Vocational Preparation
   On-the-job training from date of employment. Completion of an operator training course highly desirable. Previous experience as laborer or equipment operator in wastewater treatment plant also desirable.

5. Aptitudes—Relative to General Working Population

| | |
|---|---|
| a. Intelligence | ) |
| b. Verbal | ) |
| c. Numerical | ) |
| d. Spatial | ) Lowest third excluding |
| e. Form Perception | ) bottom 10 percent |
| f. Clerical Perception | ) |
| g. Motor Coordination | ) |
| h. Finger Dexterity | ) |
| i. Manual Dexterity | ) Middle third |
| j. Eye-Hand-Foot Coordination | ) Lowest third excluding bottom 10 percent |
| k. Color Discrimination | ) Middle third |

6. Interests
   Preference for activities of a routine, concrete, organized nature; dealing with things and objects.

7. Temperament
   Worker must adjust to situations involving a variety of duties and evaluation of information against measurable criteria.

8. Physical Demands
   Medium work; involving climbing, balancing, stooping, kneeling, crouching, reaching, handling, fingering, talking, hearing, visual acuity, depth perception, and color vision.

9. Working Conditions
   Both inside and outside. Exposed to weather, fumes, odors, and dust. May be exposed to toxic conditions. Definite risk of bodily injury.

ENTRY SOURCES: Graduates of operator training courses, treatment plant laborers or equipment operators, general public.

PROGRESSION TO: Operator II.[5]

## *C. Existing Training Opportunities*

Though many aspects of a state's training programs will be considered in Applied Step 5, an appropriate description of that segment of the water pollution control field for which manpower planning is being performed should contain data that describe some of the quantitative aspects of existing training opportunities. It will be important, for example, for the manpower planner to know something about the dimensions of the state's capacity to train individuals for positions within wastewater treatment plants. By completing a table such as Table 5-1:E, the manpower planner will gain information on what the

**TABLE 5-1:E**

**Summary of Training Programs for 1971**

| OCCUPATION | NAME AND LOCATION OF TRAINING PROGRAM | LENGTH OF COURSE | COURSE CAPACITY | NUMBER TRAINED | NUMBER FINDING EMPLOYMENT IN AREA OF TRAINING | TRAINING EXPENDITURE | |
|---|---|---|---|---|---|---|---|
| | | | | | | TOTAL | PER TRAINEE |
| | | | | | | | |

[5]Manpower Development Staff, "Manpower Requirements," mimeographed (Washington, D.C.: Office of Water Programs, Environmental Protection Agency, 1972), pp. 197, 198.

state's current capacity to train is and the relevant training costs per trainee. This information will be helpful in projecting the costs of increasing this capacity if, for example, projections of future training needs should differ significantly from current training capacity.

## *D. Career Ladders*

A career ladder within a wastewater treatment plant provides an opportunity for advancement and defines the path that such advancement is most likely to follow. Whether or not career ladders exist will play an important part in satisfying the objectives of manpower planning, for their presence will tend to attract and keep workers while their absence will tend to repel and discourage workers. The manpower planner should document the existence of career ladders in his state and help in the development and introduction of them should they be weak or absent. Figure 5.1 (a modification of an internal document of

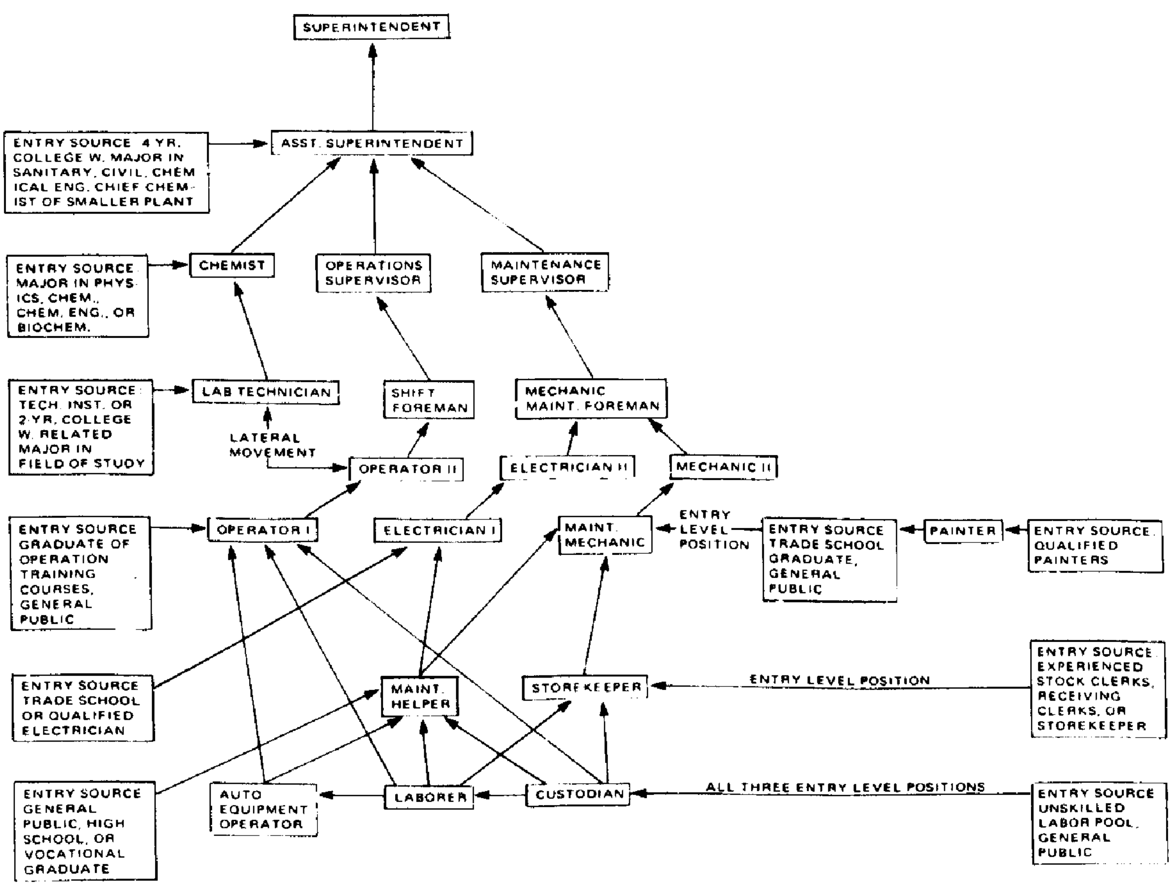


**Figure 5.1. Career Ladder for a 50 to 100 mgd Wastewater Treatment Plant**

MDS) shows a schematic of a career ladder. The manpower planner should construct the relevant figure for his state. More quantitative aspects of career ladders will be considered in Applied Step 5.

*Applied Step 2:* Determine the relationship between objectives of the state water pollution control agency and the objectives of manpower planning.

The purpose of this operation is to provide the manpower planner with a simple set of guidelines to assess the progress his agency has made in achieving its objectives of water pollution control. As a unit of government, the state water pollution control agency will be responsive to and its success dependent upon: (1) legislative authority, (2) program activities, and (3) available resources. A familiarity with these important elements will permit the manpower planner to make judgments concerning the direction of his agency and the progress it is making in pursuit of specified objectives.

*A. Legislative Authority*

The manpower planner should do the following tasks:

(1) Cite and describe the state and federal legislative authority that defines the missions of water pollution control in his state. Cite the title of the law or laws, or report on the progress of any legislation currently under consideration by the state legislature that will modify in any substantial way the goals or objectives of the state water pollution control agency.

(2) Comment upon any relevant policy directives that have significant manpower implications.

*B. Water Quality Uses and Criteria*

(1) Because water quality standards represent specific benchmarks for evaluating a state's progress in bringing water pollution under control, briefly describe the progress made by the state in establishing water quality standards on both interstate and intrastate waterways.

(2) What is the status of the water uses inventory?

(3) What is the status of the establishing of water quality criteria?

(4) What is the status of the state's implementation plans for municipalities only?

*C. Budgetary History*

The manpower planner should describe the agency's budgetary history for the past few years and estimate the fiscal resources the agency can anticipate to meet future needs. This task may be accomplished by completing a table such as Table 5-2:A.

**TABLE 5-2:A**

**State Budgetary History and a Tentative Forecast for Construction and Grants to Municipalities for Wastewater Treatment Plants 1969-1976 (Millions of dollars)**

| | 1969 | 1970 | 1971 | 1972 | 1976 |
|---|---|---|---|---|---|
| FEDERAL SHARE | | | | | |
| STATE SHARE | | | | | |
| LOCAL SHARE | | | | | |
| TOTAL | | | | | |

*Applied Step 3:* Determine selected characteristics of current and expected employment.

The DOL/EPA survey of wastewater treatment plants was done on a sample basis, and the resulting data inflated so as to apply to the universe of plants. In the future, information on the universe of plants should be obtained. The most probable source of acquiring the needed information is through the inspections currently managed (and currently being expanded) by the staff concerned with the operation and maintenance of wastewater treatment plants. Should this opportunity not be available in the manpower planner's state, he should consider circulating a form such as the instrument shown as Table 5-3:A.

We shall refer to this instrument simply as the "data form" throughout this chapter.

**TABLE 5-3: A**

**Wastewater Treatment Plant Data Form**

| | | | | | |
|---|---|---|---|---|---|
| 1. ESTABLISHMENT NO. | 2. STATE CODE | 3. STATE NAME | 4. COUNTY CODE | 5. SMSA CODE | 6. BASIN CODE |
| 7. TYPE OF TREATMENT CODE | 8. TYPE OF TREATMENT NAME | | 9. POPULATION GROUP SERVED | 10. MILLION GALLONS PER DAY | |
| 11. NAME AND ADDRESS OF ESTABLISHMENT | | | | | |

| OCCUPATION | LINE NUMBER | RECOMMENDED | RECOMMENDED FULL-TIME | RECOMMENDED FULL-TIME EQUIVALENTS | BUDGETED TOTAL | BUDGETED FULL-TIME | BUDGETED FULL-TIME EQUIVALENTS | ACTUAL EMPLOYMENT | ACTUAL FULL-TIME | ACTUAL FULL-TIME EQUIVALENTS | ACTUAL EMPLOYMENT YEAR AGO | ACTUAL FULL-TIME EMPLOYMENT YEAR AGO | ACTUAL FULL-TIME EMPLOYMENT EQUIVALENT YEAR AGO | TERMINATIONS | | | | | | ACCESSIONS | | | | | MINIMUM WAGE | MAXIMUM WAGE | AVERAGE WAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | SEPARATIONS | | | | | | | TRANSFERS INTO | | | | | |
| | | | | | | | | | | | | | | TOTAL | TOTAL | QUITS | DISCHARGES | DEATH/ RETIREMENT | TRANSFERS OUT | TOTAL | NEW HIRES | TOTAL | UPGRADE | HORIZONTAL | | | |
| | | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w | x | y | z |
| TOTAL (ALL OCCUPATIONS) | 01 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUPERINTENDENT | 02 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ASSISTANT SUPERINTENDENT | 03 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OPERATIONS SUPERVISOR | 04 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SHIFT FOREMAN | 05 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OPERATOR II | 06 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OPERATOR I | 07 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAINTENANCE SUPERVISOR | 08 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MECHANICAL MAINTENANCE FOREMAN | 09 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MECHANIC II | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MECHANIC I | 11 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAINTENANCE HELPER | 12 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ELECTRICIAN II | 13 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ELECTRICIAN I | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CHEMIST | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LABORATORY TECHNICIAN | 16 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| STOREKEEPER | 17 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CLERK TYPIST | 18 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AUTOMOTIVE EQUIPMENT OPERATOR | 19 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CUSTODIAN | 20 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PAINTER | 21 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LABORER | 22 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OTHER | 23 | | | | | | | | | | | | | | | | | | | | | | | | | | |

NARRATIVE SECTION (Check one)

1. Is the treatment facility meeting the discharge requirements established at the time of design? . . . . . . ( ) Yes ( ) No
2. Is the treatment facility meeting current discharge requirements? . . . . . . ( ) Yes ( ) No
   If "No," check the item that identifies the most important reason ( ) Hydraulic overload ( ) Organic overload ( ) Inadequate O&M budget ( ) Inadequate staffing ( ) Inadequately trained staff ( ) Other
3. Do the treatment facility personnel also operate and maintain a wastewater collection system? . . . . . . ( ) Yes ( ) No

Once the data form has been completed, the manpower planner should make certain calculations. We shall illustrate the relevant tables in which to record these calculations but shall do so only for the occupation noted as Operator I—it being already understood that similar calculations should be made for the remaining occupations. Occasionally in following discussions, we shall use a table that contains all of the occupations, and we do this at those times when it seems appropriate to remind the manpower planner that master tables should occasionally be made which summarize the results of several calculations.

It is quite possible that a data collection system for each wastewater treatment plant in the state will be unnecessary if measures can be adopted by which existing manpower data can be simply updated on a continuing basis. Perhaps the simplest way to accomplish this would be to have the manpower planner return a previously completed copy of the data form to the person in charge of the wastewater treatment plant to make the necessary changes. Because the manpower planner must depend upon the plant manager for the correctness of his data, the more demands the planner places upon the manager's own data system, the less accurate are the data received most likely to be. This observation implies that the manpower planner should ask only for "raw data" and not request that the plant manager make certain calculations.

*A. Measuring Current Employment Characteristics*

From the preceding data form (Table 5-3:A) and from the DOL/EPA survey in Appendix I, information to complete Table 5-3:B may be obtained. Columns 2 through 4 in this table are obtained by summing, for each occupation, columns *e*, *c*, and *a* in questionnaire A of the DOL/EPA survey. (This information is also available directly from Table 1 compiled from the DOL/EPA survey that should have been compiled in completing the DOL/EPA survey.) From the data form for wastewater treatment plants, when completed, the relevant totals are obtained from columns *a*, *d*, and *g*, respectively.

**TABLE 5-3:B**

**Alternative Measures of Employment by Occupation**

| (1) OCCUPATION | (2) RECOMMENDED EMPLOYMENT | (3) BUDGETED EMPLOYMENT | (4) ACTUAL EMPLOYMENT |
|---|---|---|---|
| | | | |
| OPERATOR I | | | |
| | | | |

Table 5-3:C may be completed from information in Table 5-3:B in the following manner: column 2 is obtained by sub-

tracting column 3 from column 2 in Table 5-3:B; column 3 by subtracting column 4 from column 3; and column 4 by either adding columns 2 and 3 in Table 5-3:C or subtracting column 4 from column 2 in Table 5-3:B.

**TABLE 5-3:C**

**Shortfalls and Vacancies by Occupation**

| (1) OCCUPATION | (2) BUDGET SHORTFALL | (3) VACANCY | (4) EMPLOYMENT SHORTFALL |
|---|---|---|---|
| | | | |
| OPERATOR *I* | | | |

Table 5-3:D is completed by dividing columns 2, 3, and 4 in Table 5-3:C by column 4 of Table 5-3:B. The data in Table 5-3:D are free of scale effects, so that meaningful intraoccupational comparisons can be made. (Such comparisons will be made in Applied Step 4.)

**TABLE 5-3:D**

**Shortfall and Vacancy Rates by Occupation**

| (1) OCCUPATION | (2) BUDGET SHORTFALL RATE | (3) VACANCY RATE | (4) EMPLOYMENT SHORTFALL RATE |
|---|---|---|---|
| | | | |
| OPERATOR *I* | | | |

In Table 5-3:E data on terminations and accessions are displayed. From the data form the total number of terminations *is the sum of column m, while separations are the sum of* column *n*. The components of separations are, in order, the sums of columns *o* through *q*. The total number of transfers out is the sum of column *r*. From the DOL/EPA survey the total number of terminations is the sums of columns *m* and *n* as appropriately inflated. Separations are the sum of column *n*, with quits being the sum of column *o*, and transfers out are the sum of column *m*. Additional detail on the components of separation is not available from the DOL/EPA survey.

**TABLE 5-3: E**

**Terminations and Accessions by Occupation**

<table>
<tr><th rowspan="3">OCCUPATION</th><th colspan="6">TERMINATIONS</th><th colspan="5">ACCESSIONS</th></tr>
<tr><th rowspan="2">TOTAL</th><th colspan="4">SEPARATIONS</th><th rowspan="2">TRANSFERS OUT</th><th rowspan="2">TOTAL</th><th rowspan="2">NEW HIRES</th><th colspan="3">TRANSFERS INTO</th></tr>
<tr><th>TOTAL</th><th>QUITS</th><th>DISCHARGES</th><th>DEATH/ RETIREMENT</th><th>TOTAL</th><th>UPGRADE</th><th>HORIZONTAL</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>OPERATOR I</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

For accessions we have from the data form the total number as the sum of column *s*. For the components we have new hires from column *t*; and for transfers into and its components, we have columns *u*, *v*, and *w*. Total accessions from the DOL/EPA survey are obtained from column *i*, with new hires from column *j*, and transfers into from column *l*. Further detail is not easily or accurately available from the DOL/EPA survey.

Total termination and accession rates are most appropriately computed by using current actual employment as the denominator or base. Their major components—separations and transfers out; new hires and transfers into—could be expressed in two alternative forms: The first form would use current actual employment as a base, while the second would use the number of terminations and accessions, respectively, as the bases. The remaining components such as quits, discharges, upgrades, etc., could be expressed by using the previously mentioned bases but may also be used for a base, as applicable: separations, transfers out, new hires, or transfers into. Which of these alternative bases is eventually chosen will depend upon the uses to which the resulting rates are to be put. Since the most frequently used rate would be that using actual employment as a base, it is such a rate that is entered into Table 5-3:F. Other tables could be displayed using the alternative bases and could, for convenience, be listed as Tables 5-3:Fi, Fii, etc.

### TABLE 5-3:F

**Termination and Accession Rates by Occupation**

| OCCUPATION | TERMINATION RATES | | | | | | ACCESSION RATES | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOTAL | SEPARATIONS | | | | TRANSFERS OUT | TOTAL | NEW HIRES | TRANSFERS INTO | | |
| | | TOTAL | QUITS | DISCHARGES | DEATH/ RETIREMENT | | | | TOTAL | UPGRADE | HORIZONTAL |
| | | | | | | | | | | | |

All of the preceding tables were concerned with data that were relevant to the state as a whole. The manpower planner should now complete similar tables but for data according to size of plant, type of treatment, and plant location. To do this, he must decide upon the division of his state's plants according to type, size, and location. In the tables that follow in the sequel, we shall assume a division by type and size similar to that used in the DOL/EPA survey of four types of treatment (i.e., two primary and two secondary) and five size classifications. Since a manpower planner in a particular state—as dictated by the specific characteristics of his state's wastewater plant system—may wish to use a different classifying of plants, we shall refer to type of treatment by the codes *A*, *B*, *C*, and *D*, and size of plant by the codes 1, 2, 3, 4, and 5.

We shall not display the tables that would be the counterparts to Tables 5-3:B through F, for they would be repetitive and used more in the nature of worksheets for those tables which we shall illustrate immediately below. In Tables 5-3:G through J, certain information is listed according to type and size of plant. This information will be useful in noting differences among plants according to type and size and will be the basis for some of the analyses introduced in Applied Step 4.

To complete Table 5-3:G, the manpower planner should enter the level of recommended, budgeted, and actual employment, in that order, in subcells *a*, *b*, and *c*.

**TABLE 5-3:G**

**Comparison of Alternative Employment Concepts by Type and Size of Wastewater Treatment Plant for Operator I**

| Type of Treatment | Size of Plant | | | | | Av. for Given Type |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| A | a.<br>b.<br>c. | | | | | |
| B | a.<br>b.<br>c. | | | | | |
| C | a.<br>b.<br>c. | | | | | |
| D | a.<br>b.<br>c. | | | | | |
| Av. for Given Size | | | | | | |

In Table 5-3:H, the shortfall and vacancy rates should be displayed. Listed in order, these will be: budget shortfall rate, vacancy rate, and employment shortfall rate. These will be entered in subcells *a*, *b*, and *c*.

In Table 5-3:I, termination rates by type and size of plant are displayed. The three numbers are, in order: termination rate, separation rate, and transfer out rate. These will be entered in subcells *a*, *b*, and *c*.

In Table 5-3:J, the components of the separation rate are displayed. They are, in order: quit rate, discharge rate, and death and retirement rate. These will be entered in subcells *a*, *b*, and *c*.

## TABLE 5-3:H

**Comparison of Shortfall Vacancy Rates by Type and Size of Wastewater Treatment Plant for Operator I**

| Type of Treatment | Size of Plant | | | | | Av. for Given Type |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| A | a.<br>b.<br>c. | | | | | |
| B | a.<br>b.<br>c. | | | | | |
| C | a.<br>b.<br>c. | | | | | |
| D | a.<br>b.<br>c. | | | | | |
| Av. for Given Size | | | | | | |

## TABLE 5-3:I

**Comparison of Termination Rates by Type and Size of Waste-water Treatment Plant for Operator I**

| Type of Treatment | Size of Plant | | | | | Av. for Given Type |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| A | a.<br>b.<br>c. | | | | | |
| B | a.<br>b.<br>c. | | | | | |
| C | a.<br>b.<br>c. | | | | | |
| D | a.<br>b.<br>c. | | | | | |
| Av. for Given Size | | | | | | |

TABLE 5-3:J

**Comparison of Separation Rates by Type and Size of Wastewater Treatment Plant for Operator I**

| Type of Treatment | Size of Plant | | | | | Av. for Given Type |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| A | a.<br>b.<br>c. | | | | | |
| B | a.<br>b.<br>c. | | | | | |
| C | a.<br>b.<br>c. | | | | | |
| D | a.<br>b.<br>c. | | | | | |
| Av. for Given Size | | | | | | |

*B. Projecting Future Employment Characteristics*

It was stated in Chapter Four that projections of actual employment would be based upon the projections of recommended employment. The projections of recommended employment could, in principle, be obtained in two alternative ways:

(1) From the manpower information system to be implemented for manpower planning for wastewater treatment plants

(2) From estimates based upon the construction grants process

(a) Either directly from the staff concerned with municipal wastewater facilities or

(b) Indirectly on the basis of information concerning new and expanded plants within the state and upon information contained in the staffing guides

None of these methods is completely satisfactory and the merits of each should probably be combined.

The projections obtained from the manpower information system for wastewater treatment plants could be obtained in the same way as such estimates were obtained in the DOL/EPA survey. In that survey plant managers were asked to use whatever means were at their disposal to project future recommended employment in their particular plants, while various municipal officials were surveyed to determine the completion dates of new plants, and estimates of expected future employment were then made with regard to such plants.

The second alternative would be to obtain from the staff concerned with the operation and maintenance of wastewater treatment plants the manpower data required in the various forms used in the construction grants process, and then add to this the estimates of any changes in recommended employment in existing plants. If manpower data are not available directly from the operations and maintenance staff, the manpower planner must generate his own estimates.

With the manpower information system currently being developed by OWP, coupled with the incentive that most states would have in maintaining a good data base on which to make projections of construction and financial needs in the area of water pollution control, it would seem reasonable to expect that the manpower planner could obtain estimates of additions to recommended employment directly from the staff concerned with the operation and maintenance of wastewater treatment plants. Many states have for several years collected the data that are necessary to complete the first three columns of Table 5-3:K, and with the advent of new federal reporting procedures, the data necessary to complete the remaining columns will be available.

Should projections of additions to recommended employment from new plants not be available directly from the municipal facilities office, it will then be necessary for the manpower planner to rely upon the information he obtains from conducting his employment survey or by making his own projections. He can make such projections by obtaining information such as that contained in the first three columns of Table 5-3:K and

TABLE 5-3: K

**New Plants and Their Recommended Employment Listed in Order of Projected Construction Completion Dates**

| TYPE | SIZE | COMPLETION DATE | RECOMMENDED EMPLOYMENT |
|---|---|---|---|
| | | | OPERATOR I |
| | | | |

combining it with information readily available from the staffing guides. Hence if the manpower planner knows that a plant of a given type and given size is to come on line in six months, he can then obtain from the staffing guide relevant to such a plant a tolerable approximation to the additions to recommended employment by occupation sufficient to complete Table 5-3: K.

The recommended employment listed in Table 5-3: K should be added for each year in the planning horizon and entered into a table such as Table 5-3: L.

TABLE 5-3: L

**Additions to Recommended Employment from New Plants by Year**

| OCCUPATION | YEAR | | | | |
|---|---|---|---|---|---|
| | 1972 | 1973 | 1974 | 1975 | 1976 |
| | | | | | |
| OPERATOR I | | | | | |
| | | | | | |

From the staff concerned with municipal facilities or from the annual updating of the data form, the manpower planner will obtain estimates of changes in recommended employment for existing plants that are being modified in some way. Such information may be entered in a table such as Table 5-3:M.

**TABLE 5-3:M**

**Additions to Recommended Employment from Existing Plants by Year**

| OCCUPATION | YEAR | | | | |
|---|---|---|---|---|---|
| | 1972 | 1973 | 1974 | 1975 | 1976 |
| | | | | | |
| OPERATOR I | | | | | |

To determine the projected level of employment for next year, the manpower planner adds to recommended employment for this year the total of additions to recommended employment from new plants and the changes in recommended employment from the modification of existing plants. The manpower planner may accumulate this total for each year in the planning horizon and may complete a table such as Table 5-3:N.

**TABLE 5-3:N**

**Recommended Employment by Year and by Occupation**

| OCCUPATION | RECOMMENDED EMPLOYMENT | | | | | |
|---|---|---|---|---|---|---|
| | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
| | | | | | | |
| OPERATOR I | | | | | | |

Before estimates of actual employment can be obtained, it is necessary to determine the value of $P$, the factor of proportionality between actual and recommended employment, for the state as a whole and the various occupations separately. This can be done quite simply by dividing actual by recommended employment. We show the format for displaying such calculations as Table 5-3:O.

**TABLE 5-3:O**

**Factors of Proportionality between Actual and Recommended Employment by Occupation**

| OCCUPATION | RECOMMENDED EMPLOYMENT | ACTUAL EMPLOYMENT | $\frac{\text{ACTUAL}}{\text{RECOMMENDED}} = B$ |
|---|---|---|---|
| | | | |
| OPERATOR I | | | |
| | | | |

The factors of proportionality displayed in the previous table are most applicable for the first year in the planning horizon. If it is anticipated, for whatever reason, that actual employment will change relative to recommended employment throughout the planning horizon, such changes should then be incorporated into the value of the *P*s that are used in future time periods. To record the changes, if any, in the expected value of the factors of proportionality, the manpower planner should construct a table such as Table 5-3:P. This table will also provide the manpower planner with a record by which at some future date he may check the accuracy of his projections concerning the relationships between actual and recommended employment.

**TABLE 5-3:P**

**Factors of Proportionality by Occupation and Year**

| OCCUPATION | YEAR | | | | | |
|---|---|---|---|---|---|---|
| | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
| | | | | | | |
| OPERATOR I | | | | | | |
| | | | | | | |

To obtain estimates of actual employment, the manpower planner should multiply the estimates of recommended employment in Table 5-3:N by the factors of proportionality in Table 5-3:P with the results entered into a table such as Table 5-3:Q.

**TABLE 5-3:Q**

**Estimates of Actual Employment by Year and Occupation**

| OCCUPATION | ACTUAL EMPLOYMENT | | | | | |
|---|---|---|---|---|---|---|
| | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
| | | | | | | |
| OPERATOR I | | | | | | |

## C. *Additional Manpower Needs*

By additional manpower needs, we mean the additional workers required in order that the effective demand for workers be satisfied. Such needs arise because people terminate employment and also because growth occurs in employment. Estimates of the additional workers that will be needed because of termination may be obtained by multiplying the estimate of actual employment by the termination rate. If $E_i$ denotes actual employment in the $i$th year and $t_i$ the termination rate, then the additional manpower needed in 1972 due to terminations would equal $t_{71}E_{71}$. Actually, since employment changes throughout the year, a better estimate would be to compute the average employment for 1971 and 1972 and multiply it by the termination rate for 1971. Since employment and termination rates are available by occupation, this calculation can be done for each occupation.

Additional needs due to growth may be computed simply by subtracting actual employment of one year from actual employment of a succeeding year. Hence, for 1972 the additional needs due to growth would simply be $E_{72} - E_{71}$.

Needs arising from the growth of employment may be further separated according to whether the growth comes from new and expanded plants or from certain changes in the employment practices within wastewater treatment plants. Those changes that we specifically have in mind are the possible decreases in the employment shortfall. Insofar as changes in the factor of proportionality were assumed in estimating future actual employment, then implicit in such estimates was the assumption that changes in the employment shortfall would occur. Insofar as the manpower planner feels it beneficial to separate the effects of growth into these two components, he may do so by estimating future actual employment on the assumtpion that the factor of proportionality does not change—which, upon subtracting succeeding estimates, gives additional manpower needs due to new and expanded plants only—and then multiplying actual employment by additions to the factor of proportionality to obtain increased manpower needs from changes in employment practices.

The above calculations should be made for each occupation and entered into a table such as Table 5-3:R. The totals from such tables can then be shown in a format such as Table 5-3:S. These two tables are shown in their entirety.

**TABLE 5-3:R**

**Additional Manpower Needed by Source for Operator I from 1972 to 1976**

| REASONS FOR ADDITIONAL MANPOWER | YEAR | | | | |
|---|---|---|---|---|---|
| | 1972 | 1973 | 1974 | 1975 | 1976 |
| 1. TERMINATIONS IN CURRENT EMPLOYMENT | | | | | |
| 2. GROWTH IN CURRENT EMPLOYMENT | | | | | |
| a. NEW AND EXPANDED PLANTS | | | | | |
| b. DECREASE IN EMPLOYMENT SHORTFALL | | | | | |
| TOTAL | | | | | |

Needs arising from the growth of employment may be further separated according to whether the growth comes from new and expanded plants or from certain changes in the employment practices within wastewater treatment plants. Those changes that we specifically have in mind are the possible decreases in the employment shortfall. Insofar as changes in the factor of proportionality were assumed in estimating future actual employment, then implicit in such estimates was the assumption that changes in the employment shortfall would occur. Insofar as the manpower planner feels it beneficial to separate the effects of growth into these two components, he may do so by estimating future actual employment on the assumtpion that the factor of proportionality does not change—which, upon subtracting succeeding estimates, gives additional manpower needs due to new and expanded plants only—and then multiplying actual employment by additions to the factor of proportionality to obtain increased manpower needs from changes in employment practices.

The above calculations should be made for each occupation and entered into a table such as Table 5-3:R. The totals from such tables can then be shown in a format such as Table 5-3:S. These two tables are shown in their entirety.

TABLE 5-3:R

**Additional Manpower Needed by Source for Operator I from 1972 to 1976**

| REASONS FOR ADDITIONAL MANPOWER | YEAR | | | | |
|---|---|---|---|---|---|
| | 1972 | 1973 | 1974 | 1975 | 1976 |
| 1. TERMINATIONS IN CURRENT EMPLOYMENT | | | | | |
| 2. GROWTH IN CURRENT EMPLOYMENT | | | | | |
| a. NEW AND EXPANDED PLANTS | | | | | |
| b. DECREASE IN EMPLOYMENT SHORTFALL | | | | | |
| TOTAL | | | | | |

# TABLE 5-3:S

## Additional Manpower Needed by Occupation from 1972 to 1976

| OCCUPATION | YEAR | | | | |
|---|---|---|---|---|---|
| | 1972 | 1973 | 1974 | 1975 | 1976 |
| TOTAL (ALL OCCUPATIONS) | | | | | |
| SUPERINTENDENT | | | | | |
| ASSISTANT SUPERINTENDENT | | | | | |
| OPERATIONS SUPERVISOR | | | | | |
| SHIFT FOREMAN | | | | | |
| OPERATOR II | | | | | |
| OPERATOR I | | | | | |
| MAINTENANCE SUPERVISOR | | | | | |
| MECHANICAL MAINTENANCE FOREMAN | | | | | |
| MECHANIC II | | | | | |
| MECHANIC I | | | | | |
| MAINTENANCE HELPER | | | | | |
| ELECTRICIAN II | | | | | |
| ELECTRICIAN I | | | | | |
| CHEMIST | | | | | |
| LABORATORY TECHNICIAN | | | | | |
| STOREKEEPER | | | | | |
| CLERK TYPIST | | | | | |
| AUTOMOTIVE EQUIPMENT OPERATOR | | | | | |
| CUSTODIAN | | | | | |
| PAINTER | | | | | |
| LABORER | | | | | |
| OTHER | | | | | |

The final task in executing Applied Step 3 is to estimate the sources from which the additional manpower needs are most likely to be obtained. To accomplish this, we turn to the various components of the accession rate. For purposes of exposition, note that the major components of accessions are "new hires" and "transfers into." If these rates were, for example, 1/3 and 2/3, expressed as a percentage of total accession, and an additional 12 workers were needed within the coming year, then on the basis of past experience, and in the absence of additional information, it would be reasonable to estimate that three would come from new hires and nine from transfers into the occupation.

Care should be exercised in this matter, however, to assure that this estimating procedure be adjusted if additional evidence exists. If, for example, it had been discovered that, on the average, 50 percent of new Operator IIs came from the ranks of Operator Is and that, due to some change in the plant operation, additional Operator IIs were needed to such an extent that 50 percent of the increase would be greater than all employees in the Operator I category, then the preceding technique would have to be adjusted.

In a table such as Table 5-3:T the estimates of additional manpower needed in a specific year should be entered, and then, on the basis of existing data concerning the various components of accessions, estimates should be made on the most likely source of such manpower. Such information will be invaluable in designing training programs since the presumed background of the new workers may have significant effects upon the contents of the training program.

**TABLE 5-3:T**

**Sources of Additional Manpower by Occupation**

| OCCUPATIONS | ADDITIONAL MANPOWER NEEDED | SOURCE OF ADDITIONAL MANPOWER | | |
|---|---|---|---|---|
| | | NEW HIRES | TRANSFERS INTO | |
| | | | UPGRADE | HORIZONTAL |
| | | | | |
| OPERATOR I | | | | |
| | | | | |

*Applied Step 4:* Analyze manpower problems.

The basic problems that the manpower planner will wish to investigate in this section are related to the recruitment, retention, and utilization of personnel. It is first required that he determine whether such problems exist. When such a determination is made, it should be noted that certain types of evidence may be related to more than one problem area. Thus, for example, high vacancy rates may be indicative of both recruitment and retention problems. This observation is simply a way of noting that the three manpower problems under investigation are themselves interrelated. Having called such interrelationships to the attention of the manpower planner, we shall, nevertheless, consider each of the three problems separately for each has certain unique characteristics.

*A. Recruitment*

Evidence that recruitment is a problem would be indicated by:

(1) High vacancy rates

(2) Excessive use of part-time personnel

(3) Poor quality of recruits

Judgmental decisions will be required in determining what is "high," "excessive," and "poor." Such decisions may be aided, however, by collecting and comparing certain data. To determine whether vacancy rates are "high," the manpower planner should:

(1) Compare vacancy rates for occupations within wastewater treatment plants to determine whether there is significant variation among occupations

(2) Compare the vacancy rate for each occupation with the vacancy rate, wherever possible, for occupations requiring similar skill and educational background

A comparison of vacancy rates for occupations within wastewater treatment plants will be facilitated by listing occupations, in decreasing order, according to their vacancy rates. This would be accomplished by completing Table 5-4:A.

TABLE 5-4:A

**Rank Order of Occupations by Vacancy Rate**

| OCCUPATIONS RANKED ACCORDING TO DECREASING VACANCY RATE (1) | VACANCY RATE (2) |
|---|---|
| | |
| | |
| | |

With the help of individuals located in the state employment service, the manpower planner could complete a table such as Table 5-4:B. Column 1 lists occupations for wastewater treatment plants and column 2, the vacancy rate for each

TABLE 5-4:B

**Comparison of Vacancy Rates in WWTPs with Occupations Requiring Similar Skills and/or Education**

| OCCUPATION (1) | VACANCY RATE (2) | VACANCY RATES FOR OTHER OCCUPATIONS | | |
|---|---|---|---|---|
| | | HIGH (3) | LOW (4) | (UNWEIGHTED) AVERAGE (5) |
| | | | | |
| | | | | |
| | | | | |

occupation. Columns 3 and 4 display the high, low, and average vacancy rates for occupations having similar skill or educational requirements.

Evidence that there was an excessive use of part-time personnel would be obtained from a comparison of actual part-time to recommended part-time employment. To facilitate the comparison, Table 5-4:C should be completed.

TABLE 5-4:C

**Comparison of Actual Part-time with Recommended Part-time Workers**

| OCCUPATIONS (1) | NUMBER OF PART-TIME WORKERS | | PART-TIME RATES | | ACTUAL PART-TIME RATE / RECOMMENDED PART-TIME RATE |
|---|---|---|---|---|---|
| | RECOM-MENDED (2) | ACTUAL (3) | RECOM-MENDED (4) | ACTUAL (5) | (6) |
| | | | | | |
| | | | | | |
| | | | | | |

In Table 5-4:C both the numbers and rates of part-time workers are shown. The rates are displayed to eliminate possible scale effects. It may be possible, however, to have a difference between recommended and actual part-time workers yet have equality in the part-time rates. This would reflect a problem not so much of incorrect use of part-time workers but rather one of having differences between recommended and actual employment. Column 6 lists the ratio of the part-time ratios. A value of unity indicates that recommended and actual part-time rates are equal, a value less than unity indicates that the actual part-time rate is less than the recommended part-time rate, and a value greater than unity indicates a higher part-time rate for actual employment than for recommended employment.

Evidence to discriminate among the quality of possible recruits will be quite difficult to obtain for most manpower planners, given the resources at their disposal. A table could be constructed from data that the manpower planner may obtain from those individuals working in the training office and from Tables F-5 through F-11 in the *Manpower Report of the President* (MRP) by which a comparison of the quality of recruits could be made. In Table 5-4:D we display a format that would facilitate such a comparison.

If it is possible to complete all or part of Table 5-4:B, those occupations in wastewater treatment plants having higher vacancy rates than the average of other occupations would be candidates for further study. If Table 5-4:B cannot be completed, those occupations ranked at the top of Table 5-4:A should be considered further. How far down the rank ordering

## TABLE 5-4:D

**Comparison of New Recruits for the Positions of Operators I and II with Enrollees in Various Training Programs**

| CLASSIFICATION | PERCENTAGE HAVING YEARS OF SCHOOL COMPLETED | | | | |
|---|---|---|---|---|---|
| | UNDER 8 YEARS | 8 YEARS | 9-11 YEARS | 12 YEARS | OVER 12 YEARS |
| OPERATOR I | | | | | |
| INSTITUTIONAL TRAINING PROGRAMS UNDER MDTA (MRP, Table F-5) | | | | | |
| OJT TRAINING PROGRAMS UNDER MDTA (MRP, Table F-7) | | | | | |
| OPERATION MAINSTREAM PROJECT (MRP, Table F-10) | | | | | |
| NEW CAREERS PROJECT (MRP, Table F-10) | | | | | |
| CIVILIAN LABOR FORCE 25 YEARS AND OLDER (MRP, Table E-10) | | | | | |
| OTHER OCCUPATIONS OF SIMILAR SKILL REQUIREMENTS | | | | | |

of occupations the manpower planner will go will depend upon the resources at his disposal and his judgmental decision as to what constitutes high or "intolerable" vacancy rates.

Similar procedures should be followed in determining whether "excessive" use of part-time personnel is occurring. Those occupations for which the ratio

$$\frac{\text{actual part-time rate}}{\text{recommended part-time rate}}$$

is other than unity should be investigated further. Greatest concern would appear to be warranted when the ratio is greater than unity. Should those occupations so characterized also be those ranked high according to vacancy rates, additional cause exists to investigate such occupations further.

The manner in which additional investigations should be made will be discussed after we consider the problems of retention and utilization.

### *B. Retention*

Evidence that retention is a problem could be obtained by analyzing the various components of the termination rate. Those components that would be the most relevant to investigate would be quits and discharges. High quit rates would be evidence of voluntary separation from the plant, for a variety of possible reasons, while discharges would be indicative of involuntary separations. Again, however, benchmarks to determine normality are not easily available, and judgmental decisions will have to be made. To facilitate these decisions, an ordering of occupations according to quit and discharge rates ought to be made. This would require the completion of a table such as Table 5-4:E.

**TABLE 5-4:E**

**Rank Order of Occupations According to Quit and Discharge Rates**

| QUIT RATE | RANK ORDER OF OCCUPATION | RANK ORDER OF OCCUPATION | DIS-CHARGE RATE |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

### *C. Utilization*

The utilization of personnel is an issue most appropriately investigated by the staff concerned with the operation and management of wastewater treatment plants. Nevertheless, there is one way of displaying certain data already computed that would, from the manpower planner's perspective, indicate those occupations where some problems with utilization might exist. Insofar as shortfalls may indicate the presence of utilization problems, a rank ordering of occupations according to shortfall rates would at least indicate, in a simple manner, those occupations where utilization may be a problem. This procedure would require the completion of Table 5-4:F. In this table we have allowed for a ranking as the basis of budget shortfall and employment shortfalls.

**TABLE 5-4:F**

**Rank Order of Occupations By Shortfall Rates**

| BUDGET SHORTFALL RATE | OCCUPATION | OCCUPATION | EMPLOYMENT SHORTFALL RATE |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

In summarizing all of the preceding work in this step and in preparing for the analysis of the possible determination of manpower problems, the manpower planner should complete a table such as Table 5-4:G. Using the value of 1 to denote the occupation having the highest rate for a particular variable, we could rank all occupations according to the various problem areas. From such a table those occupations appearing to rank high in all or many areas should be the first ones considered for further study.

To help determine which occupations are primary candidates for further study, the manpower planner should compute the average rank. This would require the summing of all the points for each occupation in Table 5-4:G, dividing by 5, and then ranking the occupations from low value to high value as in Table 5-4:H. The occupations having the lowest average value are those that would seem to be experiencing the more serious problems.

Upon determining whether certain problems exist or, alternatively, after determining whether the value of some

## TABLE 5-4:G

### Rank Ordering of Occupations According to Several Possible Problem Areas

| OCCUPATION TITLE (1) | OCCUPATION RANK ACCORDING TO | | | | |
|---|---|---|---|---|---|
| | VACANCY RATE (2) | PART TIME RATE (3) | QUIT RATE (4) | DISCHARGE RATE (5) | EMPLOYMENT SHORTFALL RATE (6) |
| SUPERINTENDENT | | | | | |
| ASSISTANT SUPERINTENDENT | | | | | |
| OPERATIONS SUPERVISOR | | | | | |
| SHIFT FOREMAN | | | | | |
| OPERATOR II | | | | | |
| OPERATOR I | | | | | |
| MAINTENANCE SUPERVISOR | | | | | |
| MECHANICAL MAINTENANCE FOREMAN | | | | | |
| MECHANIC II | | | | | |
| MECHANIC I | | | | | |
| MAINTENANCE HELPER | | | | | |
| ELECTRICIAN II | | | | | |
| ELECTRICIAN I | | | | | |
| CHEMIST | | | | | |
| LABORATORY TECHNICIAN | | | | | |
| STOREKEEPER | | | | | |
| CLERK TYPIST | | | | | |
| AUTOMOTIVE EQUIPMENT OPERATOR | | | | | |
| CUSTODIAN | | | | | |
| PAINTER | | | | | |
| LABORER | | | | | |

variable constitutes a problem, the manpower planner should attempt to determine the cause of the problem. This is an area of analysis that many state agencies may find difficult to complete because of inadequate resources. Nevertheless, the manpower planner should attempt to ascertain the principal causes of the problem. Primary candidates for the causes of many

**TABLE 5-4:H**

**Rank Order of Occupations According to the Average Value of Several Possible Problem Areas**

| OCCUPATION | AVERAGE VALUE OF RANK ORDER |
|---|---|
| | |
| | |
| | |

problems are low wages, poor working conditions, lack of career ladders, etc. Though it will be difficult to quantify many of these variables, some attempt should be made to do so.

The types of analyses with respect to determining the possible cause of certain problems that we shall consider in this section are simple and straightforward. We shall suggest that certain scatter diagrams be computed and, on the basis of certain simple tests, will determine whether certain cause and effect relationships exist. When the type of analysis that we are about to suggest is conducted, it is necessary that certain computations be made which involve the obtaining of average values for certain variables and the difference between the average and individual values. For example, if we denote that the wage rate for a particular computation in the $i$th plant within the state was $W_i$, then the average wage rate will be noted as $\overline{W}$. The difference between the average wage and the individual wage will be noted as $(\overline{W} - W_i)$. The proportional difference as $(\overline{W} - W_i)/\overline{W}$. Hereinafter, the proportional difference in wages will be noted as $w^*$.

We may do similar computations for other variables such that we would have the following set of definitions:

$v^*$ = proportional difference in vacancy rates
$p^*$ = proportional difference in part-time rates
$s^*$ = proportional difference in employment shortfall rates
$q^*$ = proportional difference in quit rates
$d^*$ = proportional difference in discharge rates

When these computations are completed, they can be entered onto a scatter diagram such as the one shown in Figure 5.2.

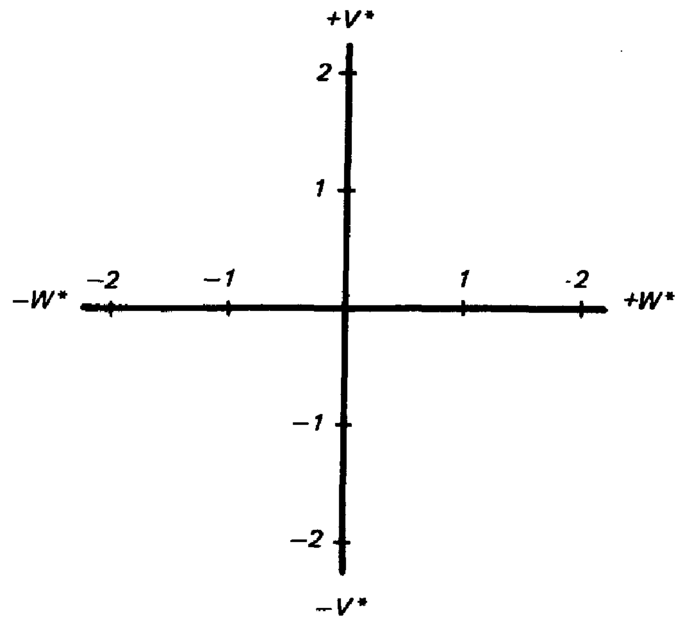


**Figure 5.2. Relationship between Vacancy Rate and Wage Rate**

In a diagram such as Figure 5.2 we would expect that as wages in a particular plant went above the average wage, the vacancy rate would tend to go below the average vacancy rate. Hence if there were a cause and effect relationship between wages and vacancy rates, we would expect to see a negative trend in the scatter diagram, as indicated by Figure 5.3.

A positive relationship would not be expected, and the scatter diagram depicting no definite trend, as in Figure 5.4, would be taken as partial evidence that, in the particular case at hand, there is no strong relationship between wages and vacancies.

Similar analyses could be followed for the other variables listed above. Should the scatter diagrams indicate the trends that are expected if cause and effect relationships exist, this would be a signal to the manpower planner to eliminate the problem by working on eliminating the cause of the problem. Thus, if vacancies are judged to be an important manpower

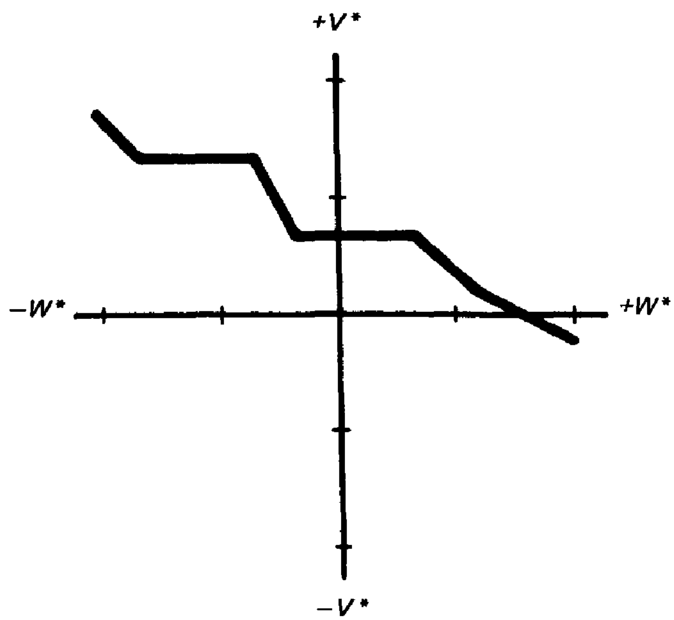


Figure 5.3. One Possible Negative Relationship
between Vacancies and Wage Rates

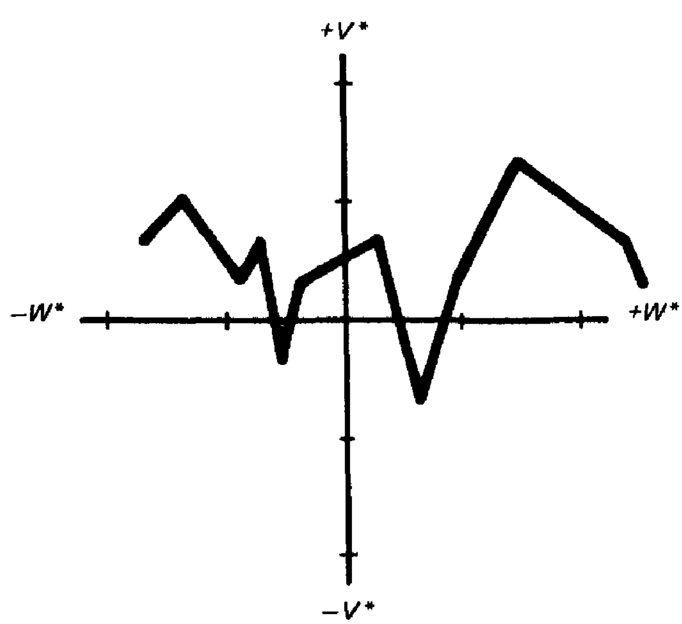


Figure 5.4. One Possible Neutral Relationship
between Vacancies and Wage Rates

problem and it is indicated that wages and vacancies are related as expected, the manpower planner should then pursue those measures aimed at increasing the wages in those plants that are below average and in raising the wages for all workers in that occupation throughout the state.

It is intended by OWP that in the near future certain types of manpower analyses will be computerized. Thus the type of analyses that we have just reviewed will be done more rigorously by using sophisticated statistical techniques and the facilities of the STORET system. Until such time as these analyses are available, however, it will be helpful to the manpower planner to perform the types of analyses we have suggested.

*Applied Step 5:* Develop training plans and action steps in response to current and expected manpower training needs.

In the execution of this step, the manpower planner seeks to compile data and develop plans concerning the kind of training that is to be provided in the state, the location within the state for this training, and the number of people who should participate. Training programs may in general be classified as training for: (1) entry-level positions or (2) skill improvement. Training programs for skill improvement may be further differentiated according to whether the training is: (1) to upgrade the skills of workers who are currently employed but who are, for example, transferring from one occupation to another, or (2) to update certain skills that may have become obsolete because of technological change within an occupation. Training programs for occupations within wastewater treatment plants should also be differentiated according to the type and size of plant in which the trainee is to be employed. In consultation with the staff concerned with training and with the staff concerned with the operation and maintenance of wastewater treatment plants, the manpower planner may group the plants within his state by type and size according to the similarity of their training needs.

The quantitative dimensions of the required training capacity for these general types of training may be determined by data obtained in the execution of the state's training needs for a given occupation, plant classification, and year and may be displayed in a table such as Table 5-5:A. Within each general classi-

## TABLE 5-5:A

**Total Training Needs for Operator I[a] for 1972**

| TYPE OF TRAINING (1) | NUMBER TO BE TRAINED (2) | NUMBER TRAINED LAST YEAR (3) | TRAINING COSTS LAST YEAR (4) | CHANGE IN NUMBER TO BE TRAINED [(2) – (3)] (5) | ESTIMATED TRAINING COSTS THIS YEAR (6) | CHANGE IN TRAINING COSTS [(5) - (6)] (7) |
|---|---|---|---|---|---|---|
| ENTRY LEVEL | | | | | | |
| UPGRADE | | | | | | |
| UPDATE | | | | | | |
| TOTAL | | | | | | |

[a]Although this table is generalized, the manpower planner may wish to construct a similar table for each plant classification that has common training requirements.

fication of training, the manpower planner should determine the number that should be trained, the number trained last year, and the difference between these numbers. If the numbers entered in column 2 are those that have been measured in the various substeps of Applied Step 3, the data displayed in column 4 will be a measure of the required increase in the state's training capacity. The remaining columns give some insight into the dimensions of the budgetary aspect of satisfying the estimated training needs of the state.

Each of the aggregate training statistics can be broken down into finer detail for each of the general classifications of training. In Table 5-5:B we illustrate the format for such data

## TABLE 5-5:B

**Training Needs for Entry-Level Training for Operator I[a] for 1972**

| TRAINING PROGRAM CODE (1) | TYPE OF TRAINING (OJT, INSTITUTIONAL COUPLED, ETC.) (2) | SUGGESTED LOCATION FOR TRAINING (3) | NUMBER TO BE TRAINED (4) | NUMBER TRAINED LAST YEAR (5) | CHANGE IN TRAINING NEEDS (6) | ESTIMATED TRAINING COSTS (7) | ESTIMATED TRAINING COSTS PER TRAINEE (8) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

[a]Althouth this table is generalized, the manpower planner may wish to construct a similar table for each plant classification that has common training requirements.

for entry-level training. (Similar data should be obtained and displayed for upgrade and update training.) It will, of course, be important for the manpower planner to determine and then record the manner in which training will be given—Will it be

OJT, institutional, or coupled training? This information, along with information concerning the geographical distribution of the required training, will help in determining the location for such training. The remaining columns follow the pattern of Table 5-5:A by seeking to illustrate the magnitude of the changes in training needs and the relevant budgetary requirements of satisfying such changes.

On occasion there may be some difficulties in determining where the manpower planning process ends and the role of manpower training begins. This is not a distinction to belabor, though the fact that it may exist indicates the nature of other types of information that must be provided in order that adequate training programs can be developed. Before individuals have been recruited into a training program, the content of such a program should be determined by the type of work that the trainee will be expected to perform. For this reason the manpower planner should provide the staff of the training office of his state agency (should such an office be separate from the manpower planner's office) with the relevant occupation descriptions for his state. Such descriptions will list the general educational, specific vocation educational, and skill requirements for various occupations. These descriptions will, in turn, help to determine the contents of the training programs. Furthermore, the occupation description should refer to the specific categories of training within the state. This should be done in that section of the occupation description which delineates specific vocational training.

To help those concerned with training to adjust their curriculum to the characteristics of the labor force that is recruited to the positions, the manpower planner should prepare a table such as that displayed in Table 5-5:C. Such information gives those working in the training office an estimate of the raw material with which they will work.

In a number of states certification programs for positions within wastewater treatment plants have been or may shortly be introduced. Such programs often call for a training response. To display the important data relevant to training needs for certification, the manpower planner should complete a table such as Table 5-5:D. In addition to such data the manpower planner should provide a verbal description of the nature of the certifi-

## TABLE 5-5:C

**Characteristics of Individuals Participating in Training Programs for Operator I for 1971**

| CLASSIFICATION OF TRAINING | DISTRIBUTION OF YEARS OF SCHOOL COMPLETED | | | | | AVERAGE NUMBER OF YEARS COMPLETED | AVERAGE AGE | PERCENT HAVING PREVIOUS TRAINING |
|---|---|---|---|---|---|---|---|---|
| | LESS THEN 8 YRS | 8 YRS | 9-11 YRS | 12 YRS | OVER 12 YRS | | | |
| ENTRY | | | | | | | | |
| UPGRADE | | | | | | | | |
| UPDATE | | | | | | | | |

## TABLE 5-5:D

**Characteristics of Certification Program by Occupation for 1972**

| OCCUPATION | NUMBER EMPLOYED | NUMBER THAT REQUIRE CERTIFICATION | PERCENT OF THOSE WHO NEED CERTIFICATION | NUMBER CERTIFIED LAST YEAR | CERTIFICATION CLASSIFICATION |
|---|---|---|---|---|---|
| | | | | | |
| OPERATOR I | | | | | |
| | | | | | |

cation program which would include a description of those skills that a worker will be required to have. Such a description will be similar to the occupation description, as adjusted for the peculiarities of his state, displayed in Applied Step 3.

A final task that the manpower planner should perform relates to the nature of career ladders within his state's wastewater treatment plant system. Career ladders provide an opportunity for advancement within the occupational structure of a wastewater treatment plant. The typical routes for such advancement within the manpower planner's state system should be documented. This can be done verbally, diagramatically, or by the use of a table. We have illustrated in Figure 5.1 in this chapter one possible system of career ladders. From the figure the outlines of a table such as Table 5-5:E can be constructed such that when the relevant data have been entered into the tables, some quantification of the extent of career ladders within the state is available, though such quantification may vary according to plant size. From Table 5-5:E we may conclude, for

TABLE 5-5:E

**Quantitative Description of Career Ladder for Operator I for 1971**

| OCCUPATIONS FROM WHICH WORKERS HAVE TRANSFERED INTO OPERATOR I CLASSIFICATION (1) | NUMBER OF ACCESSIONS INTO OPERATOR I (2) | PERCENT OF ACCESSIONS FROM THIS SOURCE (3) |
|---|---|---|
| LABORER | | |
| AUTO EQUIPMENT OPERATOR | | |
| CUSTODIAN | | |
| TOTAL | | |

example, that the higher the percentage in each row of column 3, the more the occupation in question is a source of advancement to Operator I classification, and the more important is such an occupation in the career ladder structure of the wastewater treatment plant. In Table 5-5:Ei we have a table illustrat-

TABLE 5-5:Ei

| OCCUPATIONS TO WHICH WORKERS HAVE TRANSFERED FROM OPERATOR I CLASSIFICATION | NUMBER OF TRANSFERS FROM OPERATOR I | PERCENT OF TRANSFERRED FROM OPERATOR I |
|---|---|---|
| OPERATOR II | | |
| FOREMAN | | |
| OPERATIONS SUPERVISOR | | |
| TOTAL | | |

ing transfers out of Operator I with similar conclusions to be drawn from this table as from Table 5-5:E.

Much of the information that is necessary in the execution of this planning step will have to be obtained from sources not previously mentioned. It should be possible, for example, for some of the training data to be obtained from the staff concerned with training wastewater treatment personnel within the state. Other information, such as the educational profile, is most appropriately obtained by distributing a questionnaire to each employee in the state's wastewater treatment plant system. In Appendix III we display a questionnaire recently circulated by Michigan's Department of Public Health. The Michigan Information Form collects such data on the employee as his educational and training background, his employment record, and his certification status. From such data it will be possible to generate estimates of the educational profile of the work force for a particular occupation within the state's wastewater treatment plants. It should also be possible to determine certain aspects of training needs.

*Applied Step 6:* Develop and maintain a data system.

At this point in the development of a manpower planning capability in state water pollution control agencies, it would be an improvement on existing practices if the manpower planner executed the previous five steps and did so with care and conviction. In the sixth step it is suggested that the manpower planner record the output of all the previous steps, which can be conveniently accomplished by completing a table such as Table 5-6:A. Over time this table can be extended to cover more years than illustrated in this table.

It should be recalled that as a part of Applied Step 3, a data form was introduced for each wastewater treatment plant. One task that should be an important aspect of Applied Step 6 is the maintenance and expansion of this data form. Because it was unreasonable to ask those people in charge of managing a wastewater treatment plant to make certain calculations pertaining to employment within their particular plant, the data included in the data form are not as complete as the manpower planner's data system should be. It is suggested that a "summary data matrix," such as the one displayed as Table 5-6:A,

# TABLE 5-6:A
## Summary Data Matrix of Employment Characteristics for Operator I

| CHARACTERISTICS | YEAR | | | | | |
|---|---|---|---|---|---|---|
| | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
| RECOMMENDED TOTAL | | | | | | |
| RECOMMENDED FULL-TIME | | | | | | |
| RECOMMENDED FULL-TIME EQUIVALENTS | | | | | | |
| BUDGETED TOTAL | | | | | | |
| BUDGETED FULL-TIME | | | | | | |
| BUDGETED FULL-TIME EQUIVALENTS | | | | | | |
| ACTUAL EMPLOYMENT | | | | | | |
| ACTUAL FULL-TIME | | | | | | |
| ACTUAL FULL-TIME EQUIVALENTS | | | | | | |
| ACTUAL FULL-TIME EMPLOYMENT EQUIVALENTS | | | | | | |
| ACTUAL/RECOMMENDED EMPLOYMENT | | | | | | |
| BUDGET SHORTFALL | | | | | | |
| BUDGET SHORTFALL RATE | | | | | | |
| VACANCY | | | | | | |
| VACANCY RATE | | | | | | |
| EMPLOYMENT SHORTFALL | | | | | | |
| EMPLOYMENT SHORTFALL RATE | | | | | | |
| TOTAL TERMINATIONS | | | | | | |
| SEPARATIONS | | | | | | |
| QUITS | | | | | | |
| DISCHARGES | | | | | | |
| DEATH AND RETIREMENT | | | | | | |
| TRANSFERS OUT | | | | | | |
| ACCESSIONS | | | | | | |
| NEW HIRES | | | | | | |
| TRANSFERS INTO | | | | | | |
| UPGRADE | | | | | | |
| HORIZONTAL | | | | | | |
| TERMINATION RATE | | | | | | |
| SEPARATION RATE | | | | | | |
| QUIT RATE | | | | | | |
| DISCHARGE RATE | | | | | | |
| DEATH/RETIREMENT RATE | | | | | | |
| TRANSFER OUT RATE | | | | | | |
| ACCESSION RATE | | | | | | |
| NEW HIRE RATE | | | | | | |
| TRANSFERS INTO RATE | | | | | | |
| UPGRADE RATE | | | | | | |
| HORIZONTAL RATE | | | | | | |
| NUMBER TRAINED | | | | | | |
| NUMBER THAT REQUIRE TRAINING | | | | | | |
| TOTAL NUMBER CERTIFIED | | | | | | |
| NUMBER CERTIFIED THIS YEAR | | | | | | |

for this reason be maintained for each plant within the state's wastewater treatment system. Such a form is not as formidable to maintain as it may first appear to be because for many plants, the entries will not change significantly from year to year. Furthermore, the information needed to update and maintain such a form, especially for the smaller plants within the state's system, could be obtained by a simple telephone call. A plant manager could have been provided with a copy of the data form for the preceding year and asked merely to report the changes in employment that may have occurred.

*Applied Step 7:* Monitor and Evaluate the Manpower Planning Process

This action step provides the planner with the means for measuring his effectiveness and, of equal importance, a procedure for improving the planning process. By definition, the process of planning requires both preview and review of the task to be performed. This suggests that the planner view his function as a continuous process of iteration and reiteration. The results should be a refinement of both data inputs and judgments. Evaluation, therefore, is not the final step in the planning process; it represents a milestone the planner can use to signal a return and critical review of each of the previous steps.

The initial part of the execution of this step is intended to provide the planner with a set of basic questions he will want to consider and a means for measuring the progress achieved relative to each applied step. The more frequent his review and the more specific his response, the higher the quality of the feedback into the planning process.

The manpower planner should complete Table 5-7:A, checking that statement which best describes the status of his various activities.

An important aspect of the monitoring and evaluation of the manpower planning process is the investigation of the accuracy with which the values of future manpower variables are projected. To facilitate such an investigation, the manpower planner should complete a table such as Table 5-7:B. If the numbers in column 4 are negative, the projected values are

## TABLE 5-7:A

### Evaluation Check-Off

| Applied Step 1 | Applied Step 2 | Applied Step 3 | Applied Step 4 | Applied Step 5 | Applied Step 6 | Applied Step 7 |
|---|---|---|---|---|---|---|
| Determination has not begun or has been delayed. | Study of objectives has not begun. | Design of survey has not begun. | Analysis of problems has not begun. | Action on training needs has not begun. | Data requirements are not known. | Evaluation procedure has not begun. |
| Study of field has begun. | Agency objectives have not begun. | Survey instrument has been developed, field tested, and data collected. | The identification of problem areas has been completed. | Contact has been established with training authorities. | Data requirements have been specified. | Evaluation procedure is being developed. |
| Determination of field is in progress. | Agency objectives have been analyzed. | Analysis of data under way and employment levels have been determined. | Isolation of problems is well under way. | Training requirements specified, needs established, and program elements identified. | Data requirements are being collected. | Evaluation procedures have been identified and being set up. |
| Determination of field is well under way. | Tentative manpower objectives have been formulated. | Identification of employment characteristics has been completed. | Analysis of specific problems has been completed. | Funding commitments made, facilities made available, and staff assigned. | Data requirements have been collected and organized. | Evaluation procedures have been established and under way. |
| Comprehensive and in-depth study has been completed. | Manpower objectives have been derived from agency objectives in detail. | Future estimates of employment requirements have been determined. | Rank order of importance has been assigned to problems. | Arrangements completed to provide training as required on a regular basis. | Information system has been installed and is operating. | Evaluation procedure has been accomplished. |

TABLE 5-7:B

Comparison of Projected and Actual Values
of Manpower Variables for Operator I for 1972

| MANPOWER VARIABLE | PROJECTED VALUE | ACTUAL VALUE | PERCENTAGE DIFFERENCE $\left[\frac{(3)-(2)}{(3)}\right]$ |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| RECOMMENDED EMPLOYMENT | | | |
| BUDGETED EMPLOYMENT | | | |
| ACTUAL EMPLOYMENT | | | |
| ADDITIONAL MANPOWER NEEDS | | | |

greater than the actual values, and if positive, the projected values are smaller than the actual values. From such information the manpower planner must try to determine the cause of the projection error and make the judgmental decision of what constitutes a significant error. In executing the planning process during the next time period, he should adjust his projection techniques in accordance with the errors displayed in Table 5-7:B. Errors displayed in this table should provide input into the next cycle of manpower planning activities by indicating to the manpower planner those areas of his plan that are in need of the greatest adjustment.

# APPENDIX I

DOL/EPA Survey

# DOL/EPA Survey

U.S. DEPARTMENT OF LABOR
Manpower Administration

## DATA ON EMPLOYMENT IN MUNICIPAL WASTE TREATMENT PLANTS

QUESTIONNAIRE A

*TYPE OR PRINT IN BLACK INK*

| 1. ESTABLISHMENT NO. | 2. STATE CODE | 3. STATE NAME | 4. COUNTY CODE | 5. SMSA CODE | 6. BASIN CODE | 7. TYPE OF TREATMENT CODE |
|---|---|---|---|---|---|---|
| | | | | | | |

| 8. TYPE OF TREATMENT NAME | 9. POPULATION GROUP SERVED | 10. MILLION GALLONS PER DAY |
|---|---|---|
| | | |

| 11. NAME AND ADDRESS OF ESTABLISHMENT | 12. STATE INFLATION FACTOR | 13. SMSA INFLATION FACTOR |
|---|---|---|
| | | |

| SELECTED WASTEWATER TREATMENT PLANT OCCUPATIONS | LINE NUMBER | EMPLOYMENT | | | | | | | | LABOR TURNOVER-PRECEDING YEAR | | | | | | | JOB VACANCIES | | | WAGES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Accessions | | | Internal Transfers | | Separations | | | | | |
| | | Current Total | Current Full-Time | Authorized Total | Authorized Full-Time | Recommended Total | Recommended Full-Time | Year Ago Total | Year Ago Full-Time | Total | New Hires Total | New Hires From Other Plants Only | To Occupation | Out Of Occupation | Total | Quits | Current Total | Reason For Vacancies 1/ | Open One Month Or More | Average Annual Salary |
| | | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s |
| Total (All Occupations) | 01 | | | | | | | | | | | | | | | | | | | |
| Superintendent | 02 | | | | | | | | | | | | | | | | | | | |
| Ass't. Superintendent | 03 | | | | | | | | | | | | | | | | | | | |
| Operations Supervisor | 04 | | | | | | | | | | | | | | | | | | | |
| Shift Foreman | 05 | | | | | | | | | | | | | | | | | | | |
| Operator II | 06 | | | | | | | | | | | | | | | | | | | |
| Operator I | 07 | | | | | | | | | | | | | | | | | | | |
| Maintenance Supervisor | 08 | | | | | | | | | | | | | | | | | | | |
| Mech. Maint. Foreman | 09 | | | | | | | | | | | | | | | | | | | |
| Mechanic II | 10 | | | | | | | | | | | | | | | | | | | |
| Mechanic I | 11 | | | | | | | | | | | | | | | | | | | |
| Maintenance Helper | 12 | | | | | | | | | | | | | | | | | | | |
| Electrician II | 13 | | | | | | | | | | | | | | | | | | | |
| Electrician I | 14 | | | | | | | | | | | | | | | | | | | |
| Chemist | 15 | | | | | | | | | | | | | | | | | | | |
| Laboratory Technician | 16 | | | | | | | | | | | | | | | | | | | |
| Storekeeper | 17 | | | | | | | | | | | | | | | | | | | |
| Clerk Typist | 18 | | | | | | | | | | | | | | | | | | | |
| Auto. Equipment Operator | 19 | | | | | | | | | | | | | | | | | | | |
| Custodian | 20 | | | | | | | | | | | | | | | | | | | |
| Painter | 21 | | | | | | | | | | | | | | | | | | | |
| Laborer | 22 | | | | | | | | | | | | | | | | | | | |
| Other | 23 | | | | | | | | | | | | | | | | | | | |

### NARRATIVE SECTION

*(Check one)*

1. Is the treatment facility meeting the discharge requirements established at the time of design? . . . . . . . . . . . . . . . . ☐ Yes ☐ No
2. Is the treatment facility meeting current discharge requirements? . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ☐ Yes ☐ No

   If "No," check the item that identifies the most important reason ☐ Hydraulic overload ☐ Organic overload
   ☐ Inadequate O&M budget ☐ Inadequate staffing ☐ Inadequately trained staff ☐ Other
3. Do the treatment facility personnel also operate and maintain a wastewater collection system? . . . . . . . . . . . . . . . ☐ Yes ☐ No

*1/ Enter letter that identifies the most significant reason for vacancies: A—qualified personnel not available; B—pay not adequate to attract qualified workers; C—inadequate transportation to or from plant; D—other*

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| EMPLOYMENT PROJECTIONS FOR EXISTING MUNICIPAL WASTE TREATMENT PLANTS QUESTIONNAIRE B | | | | | | | |
|---|---|---|---|---|---|---|---|
| NAME AND ADDRESS OF ESTABLISHMENT | | | | | | | |
| SELECTED WASTEWATER TREATMENT PLANT OCCUPATIONS | LINE NO. | AVERAGE EMPLOYMENT FOR OCTOBER | | | | | |
| | | ACTUAL | PROJECTED | | | | |
| | | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
| | | a | b | c | d | e | f |
| Total (All Occupations) | 01 | | | | | | |
| Superintendent | 02 | | | | | | |
| Ass't. Superintendent | 03 | | | | | | |
| Operations Supervisor | 04 | | | | | | |
| Shift Foreman | 05 | | | | | | |
| Operator II | 06 | | | | | | |
| Operator I | 07 | | | | | | |
| Maintenance Supervisor | 08 | | | | | | |
| Mech. Maint. Foreman | 09 | | | | | | |
| Mechanic II | 10 | | | | | | |
| Mechanic I | 11 | | | | | | |
| Maintenance Helper | 12 | | | | | | |
| Electrician II | 13 | | | | | | |
| Electrician I | 14 | | | | | | |
| Chemist | 15 | | | | | | |
| Laboratory Technician | 16 | | | | | | |
| Storekeeper | 17 | | | | | | |
| Clerk Typist | 18 | | | | | | |
| Auto. Equip. Operator | 19 | | | | | | |
| Custodian | 20 | | | | | | |
| Painter | 21 | | | | | | |
| Laborer | 22 | | | | | | |
| Other | 23 | | | | | | |

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## EMPLOYMENT PROJECTIONS FOR NEW MUNICIPAL WASTE TREATMENT PLANTS
QUESTIONNAIRE C

NAME AND ADDRESS OF ESTABLISHMENT

| SELECTED WASTEWATER TREATMENT PLANT OCCUPATIONS | LINE NO. | AVERAGE EMPLOYMENT FOR OCTOBER | | | | | |
|---|---|---|---|---|---|---|---|
| | | ACTUAL | PROJECTED | | | | |
| | | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
| | | a | b | c | d | e | f |
| Total (All Occupations) | 01 | | | | | | |
| Superintendent | 02 | | | | | | |
| Ass't. Superintendent | 03 | | | | | | |
| Operations Supervisor | 04 | | | | | | |
| Shift Foreman | 05 | | | | | | |
| Operator II | 06 | | | | | | |
| Operator I | 07 | | | | | | |
| Maintenance Supervisor | 08 | | | | | | |
| Mech. Maint. Foreman | 09 | | | | | | |
| Mechanic II | 10 | | | | | | |
| Mechanic I | 11 | | | | | | |
| Maintenance Helper | 12 | | | | | | |
| Electrician II | 13 | | | | | | |
| Electrician I | 14 | | | | | | |
| Chemist | 15 | | | | | | |
| Laboratory Technician | 16 | | | | | | |
| Storekeeper | 17 | | | | | | |
| Clerk Typist | 18 | | | | | | |
| Auto. Equip. Operator | 19 | | | | | | |
| Custodian | 20 | | | | | | |
| Painter | 21 | | | | | | |
| Laborer | 22 | | | | | | |
| Other | 23 | | | | | | |

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Apr. 1971

# APPENDIX II

Appendix II

# MANPOWER ADMINISTRATION – ENVIRONMENTAL PROTECTION AGENCY: JOINT SURVEY OF MUNICIPAL WASTE TREATMENT PLANTS JOB DESCRIPTIONS OF OCCUPATION CATEGORIES

## SUPERINTENDENT:

Responsible for administration, operation, and maintenance of entire plant. Exercises direct authority over all plant functions and personnel, in accordance with approved policies and procedures. Inspects plant regularly. Analyzes and evaluates operation and maintenance functions; initiates or recommends new or improved practices. Develops plans and procedures to ensure efficient operation of present plant and provide for projected future requirements. Recommends plant improvements and additions. Co-ordinates data and prepares or reviews and approves operation reports and budget requests. Controls expenditure of budgeted funds and requests approval for major expenditures, if required. Recommends specifications for major equipment and material purchases. Organizes and directs activities of plant personnel. Maintains effective communications and working relationships with employees, government officials, and general public. Designated as Superintendent I or II, depending upon size and complexity of plant.

## ASSISTANT SUPERINTENDENT:

Assists in administrative engineering and supervisory duties, under general direction of superintendent. Serves as superintendent in his absence. Aids in analyzing and evaluating operating and maintenance procedures, and in developing new or improved practices. Participates in maintenance of operating records, compilation of data, and report preparation. Assists in employee training. Inspects plant. Assists in planning special maintenance work and minor plant alterations. Designated Assistant Superintendent I or II, depending upon size and complexity of plant.

## CLERK TYPIST:

Performs any combination of following tasks and/or other clerical duties. Operates typewriter and other standard office machines and equipment; including adding machine, calculator, and duplicating machine. Serves as secretary to superintendent. Acts as receptionist. Responsible for personal work determination in accordance with established precedent or policy. Sets up simple office routines and filing systems. Minor supervisory responsibilities. Composes routine correspondence. Answers telephone and handles routine inquiries from public. Typing includes tables, reports, requisitions, forms, and other material from copy, draft, or dictating machines; frequently involving judgment regarding format or information to be included. Clerical duties include maintaining financial records not requiring technical bookkeeping skills. Duties ordinarily include posting, filing/sorting, and other routine clerical functions.

## OPERATIONS SUPERVISOR:

Supervises and co-ordinates activities of plant operators, laborers, custodians, and/or laboratory personnel. Prepares work schedules, subject to approval of superintendent or assistant. Analyzes recording instrument readings and laboratory test results, adjusts various plant processes accordingly. Prepares reports and maintains records. Inspects plant to determine efficiency of operation, cleanliness, and maintenance requirements. Instructs and directs operators. Determines remedial action in emergencies. Conducts training program. Requisitions chemicals and supplies. Performs duties of assistant superintendent in his absence.

## SHIFT FOREMAN:

Supervises operation of plant, under general direction of superiors. Performs duties of maintenance supervisor or foreman in their absence. Supervises, instructs, and assigns specific duties to shift workers. Reviews and evaluates work performance. Participates in training programs. Inspects plant equipment and processes regularly. Analyzes instrument readings and laboratory test results. Determines site and causes of any malfunctions.

Orders, supervises, or participates in required adjustments or repairs. Maintains and evaluates operating records. Replaces operator or maintenance worker during emergency situations. Communicates with other shift foremen regarding plant conditions.

OPERATOR II:

Performs any combination of following tasks pertinent to controlling operation of plant. Operates wastewater treatment, sludge processing, and disposal equipment to control flow and processing of wastewater, sludge, and effluent. Monitors gauges, meters and control panels. Observes variations in operating conditions and interprets meter and gauge readings and test results to determine processing requirements. Operates valves and gates either manually or by remote control; starts and stops pumps, engines and generators to control and adjust flow and treatment processes. Maintains shift log and records meter and gauge readings. Extracts samples and performs routine laboratory tests and analyses. Performs routine maintenance functions and custodial duties. Operates and maintains power generating equipment and incinerators. Classified by titles such as Pump Station Operator or Digestor Operator when performing specialized activities only.

OPERATOR I:

Assists Operator II in performance of any combination of following tasks pertinent to controlling operation of plant or performs various tasks as directed. Operates wastewater treatment, sludge processing, and disposal equipment to control flow and processing of wastewater, sludge, and effluent. Monitors gauges, meters, and control panels. Observes variations in operating conditions and interprets meter and gauge readings and test results to determine processing requirements. Operates valves and gates either manually or by remote control; starts and stops pumps, engines, and generators to control and adjust flow and treatment processes as required. Maintains shift log and records meter and gauge readings. Extracts samples and performs routine laboratory tests and analyses. Performs routine maintenance functions and custodial duties. Operates and maintains power generating equipment and incinerators. Classified by title such as Pump Station Operator I, or Digester Operator I when performing specialized activities only.

## MAINTENANCE SUPERVISOR:

Supervises all preventive and corrective maintenance on plant and equipment. Plans, schedules, and directs maintenance of wide variety of specialized mechanical and electrical equipment plus buildings, structures, and grounds. Inspects plant frequently to ensure proper maintenance procedures. Determines necessity for and establishes long-range maintenance programs. Decides remedial action in emergency situations. Assigns work to Mechanical Maintenance Foreman and Electricians. Supervises installation and testing of new or rebuilt equipment. Supervises and instructs maintenance personnel. Supervises inspection of subcontracted maintenance work. Submits maintenance budget requests. Supervises maintenance records. Performs related work as required.

## MECHANICAL MAINTENANCE FOREMAN:

Supervises mechanical maintenance crew in performance of wide variety of maintenance and repair tasks on machinery, equipment, buildings, structures, and grounds. Duties include any combination of tasks such as the following: Assigns tasks to maintenance crew. Directs and/or participates in maintenance and repair tasks as required. Supervises and instructs maintenance personnel on routine and emergency tasks. Consults superiors regarding preventive maintenance program. Establishes and operates preventive program. Inspects plant and mechanical equipment for malfunctions and needed repairs. Determines repair methods. Consults with superior and/or manufacturer's representatives on difficult or complicated repairs. Keeps maintenance records. Works with subcontractors.

## MAINTENANCE MECHANIC II:

Performs preventive maintenance and repairs on mechanical and electro-mechanical machinery and equipment, under general direction of superior. Maintains buildings, structures, and grounds. Duties include any combination of tasks such as following: Lubricates equipment and checks for malfunctions. Replaces packing in pumps or valves. Replaces bearings in motors, pumps, and other equipment. Adjusts and cleans bar screens, comminutors, and weir plates. Cleans out pipes and performs other plumbing and pipefitting tasks as required. Uses gas and/or arc welding equipment to heat, cut, braze, or weld. Performs duties of electrician and/or painter in their absence. Relines incinerator with firebrick. Installs and sets up new equipment. Assists in keeping maintenance records. Supervises, instructs, and inspects work of Mechanic I, Operator-Mechanic, Maintenance Worker, or Laborer to ensure proper performance of maintenance work or repairs. Performs general maintenance and repair tasks on buildings, structures, and grounds.

MAINTENANCE MECHANIC I:

Performs or assists in performance of preventive maintenance and repairs on mechnical and electro-mechanical machinery and equipment, under direction of Mechanic II, Foreman, or Supervisor. Maintains buildings, structures, and grounds. Duties include any combination of tasks such as following: Lubricates motors and equipment and checks for malfunction. Replaces packing in pumps and valves. Replaces bearings in motors, pumps, and other equipment. Adjusts and cleans bar screens, comminutors, and weir plates. Installs and sets up new equipment. Cleans out pipes and performs other plumbing and pipefitting tasks as required. Uses gas and/or arc welding equipment to heat, cut, braze, or weld. Performs duties of electrician and/or painter in their absence. Assists Mechanic II and/or Foreman on difficult or highly complicated maintenance or repair tasks. Performs general maintenance and repair tasks on buildings, structures and grounds; including limited laboring and custodial tasks. Assists in keeping maintenance records.

MAINTENANCE HELPER:

Assists maintenance mechanics in maintaining and repairing equipment, machinery, buildings, and grounds. Duties include any combination of tasks such as following: Cleans and lubricates pumps, motors, and related equipment. Assists in removing, repairing, and replacing equipment as directed. Performs routine building maintenance work. Performs simple repairs and adjustments to equipment. Keeps simple records. Carries or holds materials, supplies, or tools to assist mechanics, electricians, or painters. Performs laborer tasks as required.

ELECTRICIAN II:

Inspects, repairs, and maintains electrical and/or electronic operating and control systems, equipment, and fixtures; including instrumentation and heating and cooling systems. Exercises independent judgment in solving normal work problems under general supervision of maintenance supervisor or assistant superintendent, uses standard and special electrical tools and equipment, such as voltmeters, ammeters, and synchroscopes. Duties include any combination of tasks such as following: Inspects, maintains and repairs wiring and lighting systems, electrical control equipment, meters, outlets, and panels. Installs new equipment. Interprets oral and written instructions, specifications, wiring diagrams and codes. Supervises Electrician I, Maintenance Helper, and /or Laborer. Establishes and operates scheduled maintenance program for plant equipment. Repairs electrical and electronic instruments. Keeps maintenance records. Prepares labor and material estimates.

ELECTRICIAN I:

Participates in installation, maintenance, and repair of electrical systems, equipment, and fixtures. Assists Electrician II in particularly difficult or complicated tasks. Work frequently performed independently, subject to inspection by superiors. Follows oral and written instructions including specifications, wiring diagrams, and codes. Duties include any combination of tasks such as following: Inspects, maintains, and repairs wiring and lighting systems, electrical control equipment, meters, outlets, and panels. Installs new equipment. Supervises maintenance helper and/or laborer. Repairs electrical instruments. Keeps maintenance records.

CHEMIST:

Supervises and performs specialized and complex chemical, bacteriological and physical tests and analyses of raw, partially treated, and treated wastewater and by-products to determine efficiency of plant processes and ensure that plant effluent meets local, state, and federal requirements. Conducts or supervises less complex routine tests. Supervises collection of laboratory samples. When laboratory technician is present, supervises technician and provides routine procedures to be followed. Evaluates and interprets test results, establishes test priorities, prepares reports, and supervises laboratory technicians. Assembles data, maintains records, and prepares periodic reports. Sets up pilot processes when conducting research on improved procedures. Provides direct or indirect instructions to operating personnel regarding chemical requirements and adjustments, changes, or additions to various treatment processes. Classified as Chief Chemist, Chemist I or Chemist II, or Research Chemist according to function performed.

LABORATORY TECHNICIAN:

Performs any combination of the following routine laboratory tasks as instructed by chemist. Collects samples of plant influent, partially treated wastewater, sludge, effluent, and other by-products. Assembles instruments and equipment for analytical or research work. Prepares chemical and bacteriological media, stains, reagents, and test solutions routinely used in laboratory. Operates equipment and conducts tests as directed. Maintains test result records, prepares data sheets. Prepares or assists in preparation of reports. Cleans, maintains and stores instruments and equipment. Maintains inventory and order supplies. Performs custodial duties in laboratory. Operates laboratory in small primary treatment or trickling filter plant in absence of chemist.

STOREKEEPER:

Requisitions, receives, stores, and issues supplies, tools, and equipment. Maintains inventory records and controls. Duties include any combination of tasks such as following: Inspects incoming stock to verify quantity, quality, and adherence to specifications. Identifies and stores material. Fills orders and issues supplies from stock. Prepares periodic or perpetual inventory. Requisitions replacement quantities of stock items as necessary. Compiles records and reports of material used, spoilage or other loss, inventory adjustments, and refusal of shipments. Recommends changes in established procedures. Determines methods of storage, identification, and location of stock. Divides stock quantities into portions to fill orders.

AUTOMOTIVE EQUIPMENT OPERATOR:

Operates automotive equipment such as dump truck, tank truck, fork lift, or tractor to perform any combination of tasks such as following: Loads or assists in loading grit, sludge, or other disposable material. Hauls material from plant to disposal area. Unloads material at destination. Operates tractor to cut grass or weeds, bulldoze soil, or remove snow. Performs maintenance on vehicles.

## CUSTODIAN:

Cleans all or designated portions of wastewater treatment plant and grounds. Performs any combination of tasks such as following in accordance with established procedures, subject to inspection for adherence to required standards of cleanliness and compliance with instructions. Sweeps, mops, waxes, and polishes floors; washes walls and woodwork; dusts furniture, piping, valves, etc. Washes and polishes windows and metal surfaces. Cleans restrooms and maintains supplies. Empties wastecans and ashtrays. Polices and performs general custodial duties on grounds, including picking up litter and sweeping walks. May shovel snow and cut grass. Adjusts heat and air conditioning controls. Reports any repairs or adjustments required. Acts as watchman. Washes and polishes cars and trucks.

## PAINTER:

Performs all types of painting work, including any combination of tasks such as following: Under general supervision of Maintenance Foreman or Shift Foreman. Prepares various surfaces for painting by washing, scraping, burning, sanding, sand-blasting or other means as necessary. Mixes, matches, and blends various paints, enamels, lacquers, varnishes, stains and special protective coatings to achieve desired color, consistency, and drying properties. Caulks, putties, cements, or plasters holes and cracks. Cuts and replaces glass in windows and doors. Erects and uses ladders, scaffolding, and swinging stage equipment as required. Paints buildings, structures, equipment, and furniture using brush, roller, spray gun or other applicator. Prepares wall and hangs paper or other wall-covering material. Performs simple sign-painting, using stencils. Requisitions material and equipment. Cleans and stores tools and equipment. Cleans up work site or arranges for laborer to clean up.

## LABORER:

Performs any combination of following: Tasks in Wastewater Treatment Plant. Cleans equipment such as bar screens, comminutors, and weirs. Lubricates machinery, loads and unloads trucks; spreads sand, gravel, and dirt. Drives truck. Paints (rough) and performs other minor maintenance. Digs and refills ditches. Cleans drains, ditches, and culverts. Cuts grass, weeds, and brush; trims trees and bushes; rakes grass, leaves, and trash; seeds and cares for lawn and ornamental plantings. Removes snow and ice from walkways, driveways, and equipment. Collects and disposes of trash and garbage. Washes and cleans vehicles, tools, and equipment. Carries or holds material, supplies, or tools to assist maintenance personnel.

# APPENDIX III

WWTP – 1

# WASTEWATER TREATMENT PLANT OPERATORS
## INFORMATION FORM

| | | | | |
|---|---|---|---|---|
| SOCIAL SECURITY NUMBER: | NAME *(Last, First, Middle Init.)* | | | |
| HOME MAILING ADDRESS: | | POST OFFICE: | STATE | |
| ZIP CODE: | HOME PHONE NO: *(Include Area Code)* | BIRTHDATE: | SEX: 1. ☐ MALE 2. ☐ FEMALE | EMPLOYMENT STATUS: 1. ☐ ACTIVE 2. ☐ INACTIVE 3. ☐ RETIRED |

**PRESENT EMPLOYMENT (Fill in below):**

NAME OF PLANT:

PLANT MAILING ADDRESS:

| | |
|---|---|
| POSITION TITLE: | STATUS: 1. ☐ FULL TIME 2. ☐ PART TIME 3. ☐ SEASONAL |

**WASTEWATER TREATMENT PLANT CERTIFICATE (Fill in below):**

| | | | | |
|---|---|---|---|---|
| 1. ☐ CLASS A | 2. ☐ CLASS B | 3. ☐ CLASS C | 4. ☐ CLASS D | 5. ☐ NOT CERTIFIED |
| Year: ______ | Year: ______ | Year: ______ | Year: ______ | |
| Number: ______ | Number: ______ | Number: ______ | Number: ______ | |

**WATER TREATMENT CERTIFICATES (Fill in below):**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. ☐ F 1 | 2. ☐ F 2 | 3. ☐ F 3 | 4. ☐ D 1 | 5. ☐ D 2 | 6. ☐ M | 7. ☐ T |

**PROFESSIONAL STATUS (Fill in below):**

| | | |
|---|---|---|
| 1. ☐ ENGINEER | 2. ☐ SANITARIAN | 3. ☐ OTHER: ______ |
| REGISTERED: 1. ☐ YES 2. ☐ NO | REGISTERED: 1. ☐ YES 2. ☐ NO | REGISTERED: 1. ☐ YES 2. ☐ NO |
| REGISTRATION NO: ______ | REGISTRATION NO: ______ | REGISTRATION NO: ______ |

**MILITARY STATUS:**

VETERAN: 1. ☐ YES 2. ☐ NO DRAFT CLASS: ______

I hereby certify that the information contained herein is accurate and complete.

______________________
*Signature*

______________________
*Date*

**EDUCATION AND TRAINING – DIVISION I** WWTP – II

GRAMMAR SCHOOL *(Circle highest grade you completed in Grammar School):* 1 2 3 4 5 6 7 8

| HIGHER EDUCATION HIGH SCHOOL | COURSE OF STUDY | CIRCLE HIGHEST GRADE COMPLETED | Date From Mo. – Yr. | Date To Mo. – Yr. | DID YOU GRADUATE? |
|---|---|---|---|---|---|
| NAME: LOCATION: | | 9 10 11 12 | | | 1. ☐ YES 2. ☐ NO |
| NAME: LOCATION: | | 9 10 11 12 | | | 1. ☐ YES 2. ☐ NO |

IF YOU DID NOT GRADUATE FROM HIGH SCHOOL, HAVE YOU OBTAINED A STANDARD HIGH SCHOOL EQUIVALENCY G.E.D. CERTIFICATE? 1. ☐ YES 2. ☐ NO IF YES - DATE EARNED (Mo.-Yr.) ______

JUNIOR COLLEGES, COLLEGES YOU HAVE ATTENDED *(List below):*

| | | DATES ATTENDED | | |
|---|---|---|---|---|
| NAME: | MAJOR: | From (Mo.-Yr.): | To (Mo.-Yr.): | NAME OF DEGREE: |
| LOCATION: | MINOR: | | | YEAR OF DEGREE: |
| NAME: | MAJOR: | From (Mo.-Yr.): | To (Mo.-Yr.): | NAME OF DEGREE: |
| LOCATION: | MINOR: | | | YEAR OF DEGREE: |
| NAME: | MAJOR: | From (Mo.-Yr.): | To (Mo.-Yr.): | NAME OF DEGREE: |
| LOCATION: | MINOR: | | | YEAR OF DEGREE: |

HOW MANY HOURS CREDIT HAVE YOU OBTAINED FROM AN ACCREDITED COLLEGE *(Fill in below):*
*NOTE:* Term credits are obtained in a school offering 3 twelve-week periods from September to June. Semester credits are obtained in a school offering 2 or 3 sixteen-week periods annually. If you attended more than three colleges, use additional sheets of paper and attach.

| UNDERGRADUATE | GRADUATE | UNDERGRADUATE | GRADUATE |
|---|---|---|---|
| SEMESTER CREDITS: ______ | SEMESTER CREDITS: ______ | TERM CREDITS: ______ | TERM CREDITS: ______ |

WHAT BUSINESS, TRADE, OR OTHER SCHOOLS HAVE YOU ATTENDED *(Including courses while in military service):*
*NOTE:* Include any extention or correspondence courses you have completed. List in sequence from earliest date to present. Give name of school, or sponsoring agency, location, course title or subject material, beginning and ending dates of attendance, and hours in class per week. For correspondence courses, check proper box. Include such courses as 'Gull Lake Laboratory Course', but do not include short duration activities such as, 'Wastewater Plant Operator Fall Training Session.'

| | | DATES ATTENDED | | |
|---|---|---|---|---|
| NAME: | COURSE TITLE OR SUBJECT: | From (Mo.-Yr.) | To (Mo.-Yr.) | HOURS IN CLASS PER WK. |
| LOCATION: | CORRESPONDENCE COURSE: ☐ YES | | | |
| NAME: | COURSE TITLE OR SUBJECT: | From (Mo.-Yr.) | To (Mo.-Yr.) | HOURS IN CLASS PER WK. |
| LOCATION: | CORRESPONDENCE COURSE: ☐ YES | | | |
| NAME | COURSE TITLE OR SUBJECT: | From (Mo.-Yr.) | To (Mo.-Yr.) | HOURS IN CLASS PER WK. |
| LOCATION: | CORRESPONDENCE COURSE: ☐ YES | | | |
| NAME | COURSE TITLE OR SUBJECT: | From (Mo.-Yr.) | To (Mo.-Yr.) | HOURS IN CLASS PER WK. |
| LOCATION: | CORRESPONDENCE COURSE: ☐ YES | | | |
| NAME | COURSE TITLE OR SUBJECT: | From (Mo.-Yr.) | To (Mo.-Yr.) | HOURS IN CLASS PER WK. |
| LOCATION: | CORRESPONDENCE COURSE: ☐ YES | | | |
| NAME | COURSE TITLE OR SUBJECT: | From (Mo.-Yr.) | To (Mo.-Yr.) | HOURS IN CLASS PER WK. |
| LOCATION: | CORRESPONDENCE COURSE: ☐ YES | | | |

IF YOU HAVE ATTENDED MORE THAN SIX SPECIAL STUDIES COURSES, USE ADDITIONAL SHEETS OF PAPER AND ATTACH.

WWTP – III

## EXPERIENCE – DIVISION II

| | |
|---|---|
| YEAR ENTERED WORK IN WASTEWATER TREATMENT PLANT: ________ | AREAS IN WHICH YOU ARE MOST KNOWLEDGEABLE: |
| NUMBER OF YEARS OF EXPERIENCE IN: | 1. ☐ PRIMARY TREATMENT W/ DIGESTERS |
| 1. PRIMARY TREATMENT ________ | 2. ☐ ACTIVATED SLUDGE |
| 2. ACTIVATED SLUDGE ________ | 3. ☐ TRICKLING FILTER |
| 3. TRICKLING FILTER ________ | 4. ☐ LABORATORY |
| 4. LABORATORY ________ | 5. ☐ MECHANICAL WORK |
| 5. DIGESTERS ________ | 6. ☐ ELECTRICAL WORK |
| 6. VACUUM FILTERS ________ | 7. ☐ VACUUM FILTERS |
| 7. INCINERATOR ________ | 8. ☐ INCINERATOR |
| 8. RAPID SAND FILTER ________ | 9. ☐ OTHER: ________ |

**EMPLOYMENT RECORD (Fill in below):**

*NOTE:* Beginning with your present or last employment and continuing in reverse time order, list and describe in detail in the spaces provided, and on additional sheets if necessary, every position which you have filled since the beginning of your wastewater treatment plant work experience including that while in the military service. If you have held two or more positions for the same plant or different levels of responsibility or with different duties, list and describe them separately the same as though this had been for separate employers.

| | | | |
|---|---|---|---|
| PLANT LOCATION: | | | POSITION TITLE: 1. ☐ SUPERINTENDENT 2. ☐ ASST. SUPERINTENDENT 3. ☐ SHIFT SUPERVISOR 4. ☐ OPERATOR 5. ☐ CHIEF CHEMIST 6. ☐ LAB. TECHNICIAN 7. ☐ MECHANIC 8. ☐ ELECTRICIAN 9. OTHER: ________ |
| DATE From (Mo.-Yr.) | DATE To (Mo.-Yr.) | No. Employees Supervised by you: ________ | |

DESCRIPTION OF DUTIES *(Be Specific):*

| | | | |
|---|---|---|---|
| PLANT LOCATION: | | | POSITION TITLE: 1. ☐ SUPERINTENDENT 2. ☐ ASST. SUPERINTENDENT 3. ☐ SHIFT SUPERVISOR 4. ☐ OPERATOR 5. ☐ CHIEF CHEMIST 6. ☐ LAB. TECHNICIAN 7. ☐ MECHANIC 8. ☐ ELECTRICIAN 9. OTHER: ________ |
| DATE From (Mo.-Yr.) | DATE To (Mo.-Yr.) | No. Employees Supervised by you: ________ | |

DESCRIPTION OF DUTIES *(Be Specific):*

| | | | |
|---|---|---|---|
| PLANT LOCATION: | | | POSITION TITLE: 1. ☐ SUPERINTENDENT 2. ☐ ASST. SUPERINTENDENT 3. ☐ SHIFT SUPERVISOR 4. ☐ OPERATOR 5. ☐ CHIEF CHEMIST 6. ☐ LAB. TECHNICIAN 7. ☐ MECHANIC 8. ☐ ELECTRICIAN 9. OTHER: ________ |
| DATE From (Mo.-Yr.) | DATE To (Mo.-Yr.) | No. Employees Supervised by you: ________ | |

DESCRIPTION OF DUTIES *(Be Specific):*

| | | | |
|---|---|---|---|
| PLANT LOCATION: | | | POSITION TITLE: 1. ☐ SUPERINTENDENT 2. ☐ ASST. SUPERINTENDENT 3. ☐ SHIFT SUPERVISOR 4. ☐ OPERATOR 5. ☐ CHIEF CHEMIST 6. ☐ LAB. TECHNICIAN 7. ☐ MECHANIC 8. ☐ ELECTRICIAN 9. ☐ OTHER: ________ |
| DATE From (Mo.-Yr.) | DATE To (Mo.-Yr.) | No. Employees Supervised by you: ________ | |

DESCRIPTION OF DUTIES *(Be Specific)*

WWTP – IV

## EXPERIENCE – DIVISION II

PLANT LOCATION:

DATE From (Mo.-Yr.) | DATE To (Mo.-Yr.) | No. Employees Supervised by you: ______

POSITION TITLE:
1. [ ] SUPERINTENDENT
2. [ ] ASST. SUPERINTENDENT
3. [ ] SHIFT SUPERVISOR
4. [ ] OPERATOR
5. [ ] CHIEF CHEMIST
6. [ ] LAB. TECHNICIAN
7. [ ] MECHANIC
8. [ ] ELECTRICIAN
9. [ ] OTHER: ______

DESCRIPTION OF DUTIES (*Be Specific*):

PLANT LOCATION:

DATE From (Mo.-Yr.) | DATE To (Mo.-Yr.) | No. Employees Supervised by you: ______

POSITION TITLE:
1. [ ] SUPERINTENDENT
2. [ ] ASST. SUPERINTENDENT
3. [ ] SHIFT SUPERVISOR
4. [ ] OPERATOR
5. [ ] CHIEF CHEMIST
6. [ ] LAB. TECHNICIAN
7. [ ] MECHANIC
8. [ ] ELECTRICIAN
9. [ ] OTHER: ______

DESCRIPTION OF DUTIES (*Be Specific*):

## GENERAL EXPERIENCE (Fill in below):

List and describe in detail in the spaces provided, and on additional sheets if necessary, your work experience other than in a wastewater treatment plant, but which provides a background of experience which has contributed significantly to your work in the wastewater treatment field. List in reverse time order.

EMPLOYER: | ADDRESS:

DATE From (Mo.-Yr.) | DATE To (Mo.-Yr.) | No. Employees Supervised by you: ______ | POSITION TITLE:

RESPONSIBILITY AND DESCRIPTION OF DUTIES (*Be Specific*):

EMPLOYER: | ADDRESS:

DATE From (Mo.-Yr.) | DATE To (Mo.-Yr.) | No. Employees Supervised by you: ______ | POSITION:

RESPONSIBILITY AND DESCRIPTION OF DUTIES (*Be Specific*):

EMPLOYER: | ADDRESS:

DATE From (Mo.-Yr.) | DATE To (Mo.-Yr.) | No. Employees Supervised by you: ______ | POSITION:

RESPONSIBILITY AND DESCRIPTION OF DUTIES (*Be Specific*):

MACHINES OR MECHANICAL EQUIPMENT WHICH YOU CAN OPERATE SKILLFULLY (*Fill in below*):

| | |
|---|---|
| 1. | 2. |
| 3. | 4. |

# GLOSSARY

Accessions

Additions to establishment's employment roll within the preceding year

Accession rate

Total accessions divided by current full-time employment

Horizontal—number of people who transferred into the occupation from a similar occupation in a wastewater treatment plant

Horizontal rate — total number of horizontal transfers divided by total number of transfers

New hires — number of people hired within the past year who were obtained from external labor supply sources

New hire rate—number of new hires divided by number of accessions

Transfers into — number of people entering a particular occupation who were transferred from some other occupation either within the same wastewater treatment plant or from some other plant in the state

Transfer into rate — number of people transferring into the occupation divided by accession rate

Upgrade—that number of people who transferred into the occupation from some other occupation requiring fewer skills and less educational background

Upgrade rate—total number of upgrade transfers divided by the total number of transfers

Associate degree

An educational degree usually signifying completion of two years of prescribed college or university level coursework

Bachelor's degree

An educational degree usually signifying completion of four years of prescribed college or university work

Basic education

The education essential to take care of one's self, usually including basic language, mathematics, and other communication skills

Basic plan

A plan for achieving water quality standards within an area drained by a river and its tributaries

Bilingual

Communication in two languages

Biochemical oxygen demand

The quantity of oxygen used in the biochemical oxidation of organic matter in a specified time, at a specified temperature, and under specified conditions. This term also refers to a standard test used in assessing wastewater strength.

Career education

A concept of education which brings together both general and vocational education in mutual support to assist the individual in the development and maintenance of a career throughout a working life

Career ladder

The various skill or developmental steps, arranged from the lowest level to the highest, in a career area

Categorical programs

Government programs to meet a specific need

Certification

The granting of a certificate which states that an individual has successfully completed a given course or a series of related courses and indicating that the individual is qualified to perform a given function

Client

An individual making use of the services of an agency

Community Action Agency (CAA)

A local agency formed and funded by the Office of Economic Opportunity for the purpose of representing the poor and providing certain programs of assistance with a high degree of client control. Sometimes referred to as the Community Action Programs (CAP).

Community college

A two-year educational institution with minimal entrance requirements, established to serve the post-secondary and remedial educational needs of a community

Concentrated Employment Program (CEP)

A federally funded program to bring together all needed manpower services within a limited target area to provide concentrated services to the disadvantaged

Cooperative Area Manpower Planning System (CAMPS)

A system established by federal agencies engaged in manpower development activities for the coordination of such activities at the local, state, regional, and national levels

Cooperative education

A work-study program at the college level enabling a student to work about half time while pursuing a college program, under the supervision and control of the educational institution

Cost-effective approach

The use of an approach to the attaining of certain objectives which has the least cost for the greatest effectiveness

Coupled classroom

A program bringing work and classroom experience together, each reinforcing the other through a coordinated curriculum of activities

Decategorization

The elimination of categories

Decentralization

The delegation of authority and responsibility to subsidiary units

Direct training
The training developed and offered by an agency

Disadvantages
Those meeting federal standards
(1) Poverty level incomes and
(2) Unemployed or underemployed and
(a) Under 23 or
(b) Over 45 or
(c) Minority or
(d) Handicapped or
(e) High school dropout

Doctorate degree
A professional degree offered by universities and colleges following successful completion of several years of work beyond the bachelor's degree signifying that the recipient is a scholar in a given field of learning

Dropout
One who leaves school before completion of a given program

Economic Opportunity Act
The federal act of 1964 setting up the Office of Economic Opportunity with the avowed purpose of eliminating poverty by opening to everyone the opportunity for "education, training, work, decency, and dignity"

Education
The process of developing knowledge, skill, mind, and character

Effluent
Wastewater or other liquid, partially or completely treated, or in its natural state, flowing out of a treatment plant

Elementary education
The education from kindergarten through 6th grade

Employment
Actual employment—number of people employed at the time the survey was taken

Actual full-time employment—number of people employed at the time the survey was taken who worked at least 36 hours a week

Actual full-time equivalents—total number of hours worked by all people employed divided by 40

Actual part-time employment—number of people employed at the time the survey was taken who worked less than 36 hours a week

Authorized employment – number of people allowed in the budget for the wastewater treatment plant

Authorized full-time employment—the number of people allowed in the budget for the wastewater treatment plant who worked at least 36 hours a week

Authorized full-time equivalents—number of hours worked by all people authorized for employment divided by 40

Authorized part-time employment—the number of people allowed in the budget for the wastewater treatment plant who worked less than 36 hours a week

Recommended employment—the number of people who if currently employed would maximize the plant's effective operations

Recommended full-time employment—the number of people who if currently employed would maximize the plant's effective operation who would work at least 36 hours a week

Recommended full-time equivalents—total number of recommended hours of work divided by 40

Recommended part-time employment—the number of people who if currently employed would maximize the plant's effective operation who would work less than 36 hours a week

Evaluate

To determine the degree to which the objectives of a program are met

External labor market

That labor market lying outside the industry

Feedback

Making available to a program the results of monitoring and evaluation so that the program can be continuously improved

Fringe benefits
Those nonmonetary rewards or benefits provided by an employer

Full employment
The employment of all persons willing and able to work. Statistically this is about 95–96 percent of the labor force

General education development diploma (G.E.D.)
A program designed for school dropouts to give them the development equivalent to that received from securing a high school diploma, and generally accepted in lieu of that diploma

Graduate training
Education and training beyond the bachelor's degree

Gross national product (GNP)
The market value of all goods and services produced by a nation for the marketplace

Hands-on
Experience using actual equipment

Higher education
Education beyond high school

Human resource development
The development of human beings into producers through education, training, and employment services

Inflation
The general or overall upward movement of prices or the price level

Interagency agreement
An agreement between two or more government agencies

Internal labor market
That labor market within an industry

Institutional program
A training program in an educational institution as differentiated from an apprenticeship or on-the-job training

Job Corps
A program of education and training for disadvantaged

high school dropouts to build them into self-respecting, productive citizens

Job evaluation

The process of dividing a job into its major components to enable analysis for the purpose of establishing rates of pay and training

Journeyman

A craftsman qualified to function in a trade without supervision

Junior college

Two-year, post-secondary colleges with the main purpose of preparing people to go on to a four-year college program

Labor market

The geographical area within which most workers are secured. For some occupations, this may be a given community, while for others, it may be nationwide.

Labor unions

Organizations of workers for the purpose of representing them in bargaining with private employers or government

Liberal education

Education in the arts—literature, philosophy, languages, history—as compared with professional or technical subjects

Macro-manpower planning

That manpower planning associated with macro-economic planning, which generally involves full employment of human resources of manpower

Manpower

Productive human beings

Manpower Administration

The agency within the Department of Labor with the primary responsibility for administering manpower programs

Manpower advisory committees

Federal committees at the regional and national levels created to advise Department of Labor and Department of Health, Education and Welfare officials on manpower problems and programs

Manpower coordinating councils
Federal councils of federal officials from various agencies at the national and regional levels to coordinate federal manpower programs

Manpower Development and Training Act (MDTA)
The federal legislation of 1962, first designed to retrain persons with obsolete skills, redirected to include youth and then to emphasize training for the disadvantaged

Manpower planning
Planning for the optimal development and use of manpower

Manpower planning councils
Councils at local and state levels, representing a cross section of the community, including elected and appointed officials, clients, business and labor representatives, to plan manpower activities for optimum effectiveness

Manpower revolution
The period of the 1960s in which technological changes and problems became apparent, producing a series of corrective manpower programs

Master's degree
A collegiate degree usually requiring one to two years of work beyond the bachelor's degree

Micro-manpower planning
That manpower planning involved in meeting the manpower needs of a particular company, agency or industry

Minorities
Refers to those ethnic groups in a minority who experience special problems of assimilation into the dominant culture

Monitor
The day-to-day evaluation of a program's movement toward achieving certain goals

National Alliance of Businessmen—Job Opportunities in the Business Sector (NAB-JOBS)
An organization of businessmen with the purpose of giving jobs to disadvantaged people, the extra training costs involved being reimbursable from the federal government

National manpower program planning
That manpower planning involved in meeting specific national needs, i.e., pollution, disadvantaged, shortage of science skills, etc.

Neighborhood Youth Corps (NYC)
A federally funded program to give jobs to youth 16 to 22, enabling them to stay in school or return after dropping out

Occupational cluster
A grouping of closely related skills or occupations having a common core of skills and/or learning

On-the-job training (OJT)
The usually informal training that is a part of learning a job as compared with classroom and apprenticeship programs

Open entry
The admission of students regardless of educational background taking them as far as they are capable and desire

Operation Mainstream
A federal OEO work-relief program for older, near unemployable workers

Operator
One who operates equipment in the workplace

Outreach
Reaching out into the community, offering services to clients rather than waiting for clients to come into an office

Placement
The placing of a person on a job by an educational or employment agency

Pollution
A condition created by the presence of harmful or objectionable material in water

Port of entry
The place where a person enters

Productivity
The output per unit of input, usually per person or per man-hour

Professional
One who works in any profession such as law, medicine, engineering, teaching, etc., implying training at the four year college level

Programmed learning
A planned system program for learning a subject usually of the self-instruction variety

Projections
Using current statistics, determining future statistics from the trends they establish

Promotion
The movement up an occupational ladder

Public employment
Employment with a government agency

Public Employment Program (PEP)
The temporary program established by the Emergency Employment Act of 1971 to subsidize jobs in the public sector of the local and state levels of unemployed and underemployed persons

Public service careers
A permanent federal program to finance the preparation of disadvantaged persons for careers in the public service

Referrals
Those persons referred to an agency or employer for service or employment

Regional
Generally refers to the geographical area covered by several states

Relocation
The process of moving, usually from an area of labor surplus to an area of labor shortage

Revenue sharing
The granting of a block of money for generalized purposes and with few guidelines

Salary
Payment by the week, month, or year

Secondary education
Education in the 7th through 12th grades

Skilled worker-craftsman
A worker who has learned a craft or trade

Skills Center
Centers set up under MDTA to give disadvantaged people the opportunity to develop a skill and basic education

Special impact
Areas especially hard hit by military bases from which large numbers of students enter the school system, but the residents pay no property tax to support the schools

Subprofessionals—paraprofessionals
Persons trained to perform work to assist professionals but requiring less than baccalaureate education and training

Technical college
A post-high school educational institution which prepares technicians in relatively narrow occupational areas

Technician
A person trained to perform complex or technical jobs requiring less than bachelor's degree work or its equivalent

Technology
The method of performing a series of operations

Terminations – number of people who discontinue their employment within the preceding year for a particular occupation
Death and retirement rate—total number who died or retired divided by total number of separations
Death and retirements—total number of people within a wastewater treatment plant terminated because of death or retirement
Discharge—number of people released from employment because of unsatisfactory performance
Discharge rate—the number of discharges divided by number of terminations
Quit rate—total number of quits divided by total number of separations
Quits—number of people who voluntarily terminated their employment within the wastewater treatment plant
Separation rate—total number of separations divided by the total number of terminations
Separations—number of people who discontinued their employment within a state's system of wastewater treatment plant
Termination rate—total terminations divided by full-time employment
Transfers out—number of people who terminated their employment within a given occupation in a wastewater treatment plant in order to obtain employment either in some other occupation within the same or alternative waste facility
Transfer out rate—total number of transfers out divided by total number of terminations

Tight labor market
A condition in the labor market in which there is a shortage of workers to meet existing demand, creating good job opportunities and rising wage levels

Training
The development of vocational skills

Training grant
The awarding of money by a government agency to establish a training program

Transfer
The lateral movement of a person from department to department or plant to plant

Turnover
The change of personnel

Typology
The differentiation of various types of activity

Undergraduate training or education
The training or education in college up to and including a bachelor's degree

Unemployment
Being without a job but in the process of looking for one

Unemployment compensation
Compensation paid to workers by the government during periods of unemployment

Updating
Bringing skills up to date with the latest technology

Upgrading
The improvement of job skills

Vocational education
The preparation of an individual for a vocation, usually requiring manual skills

Vocational rehabilitation
Making people employable through the reduction or elimination of physical, mental or social problems

Wages
Payment by the hour

Water quality
The chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

The same water may be of good quality for one use and bad for another, depending upon its characteristics and the requirements for the particular use.

Water standards
Definitions of water quality established as a basis for control for various water-use classifications

Water use
A system of classifying utilization of waters in natural watercourses for such purposes as potable water supply, recreation and bathing, fish culture, industrial water, waste assimilation, transportation, and power production

White-collar occupations
Those occupations requiring a substantial amount of communicative skill and involving substantial mental activity

Work Incentive (WIN)
A federally financed program for welfare recipients who are able to work in which extra compensation is provided them as an incentive to register for employment and educational/training programs.

Youth opportunity centers
Centers established specifically to aid youth in the development of job skills and the acquisition of job opportunities